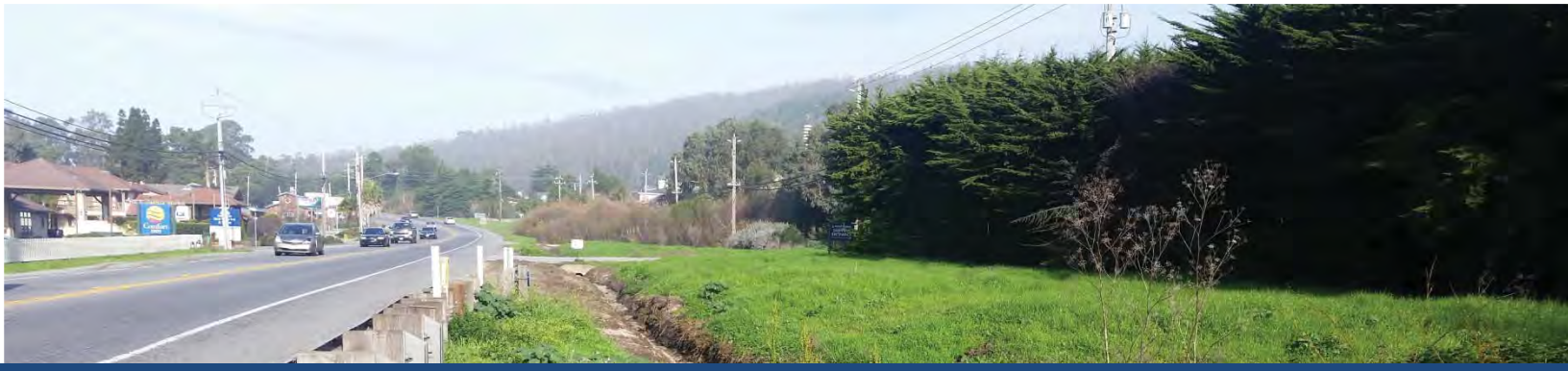
Half Moon Bay
Storm Drain Master Plan Update

August 2016



Department of Public Works

FINAL

Prepared by

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

Half Moon Bay
Storm Drain Master Plan

Half Moon Bay, California

August 2016

Prepared for:

City of Half Moon Bay
Department of Public Works

Designers Attest:

The following report has been prepared under the supervision of the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California.

Prepared by:

8/30/16

EMILY D. STRALEY, RCE No. 75282 (Date)

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

Table of Contents

Table of Tables

Table of Figures

List of Appendices

Executive Summary

ES.1 Study Objectives

A significant planning effort has been undertaken to help guide the City of Half Moon Bay to establish an approach to creating a prioritized Capital Improvement Program to mitigate the impacts of stormwater runoff in Half Moon Bay. This document identifies the steps taken to inventory and analyze the existing storm drain system, and provides recommendations for Phase II which will identify the capital improvement projects needed to provide an acceptable level of service throughout Half Moon Bay.

The main objective of this Storm Drain Master Plan Phase I document is to provide an inventory of the existing storm drain system, an analysis of capacity restrictions within the storm drain networks of Half Moon Bay, and recommendations for the approach of Phase II.

The following list presents a summary of steps taken:

1. A Geographical information system (GIS) based storm drain system database was created. Features include:
    - Storm drain pipes with diameter and material included as attributes;
    - Storm drain nodes including manholes, inlets, and connections with rim and invert elevations included as attributes;
    - Storm drain channels with approximate cross section and channel roughness included as attributes;
    - Roads that convey a significant amount of flow with approximate cross section and roughness included as attributes;
    - Drainage catchments with percent impervious, curve number, and total area included as attributes;
2. The physical condition of the drainage system is summarized;
3. Storm drainage analysis methodologies and criterion were established;
4. A hydrologic and hydraulic analysis of the existing storm drain facilities throughout Half Moon Bay was performed for the 2-. 10-, 25-, and 100-year storm events. System deficiencies are categorized in terms of the risk to private property and public safety.

ES.2 Sources of Flooding

Runoff generated within the study boundary is conveyed through storm drain systems that outfall to creeks and/or ditches, and ultimately the Pacific Ocean. Capacity deficiencies within the storm drainage network can contribute to flooding within Half Moon Bay. For the purposes of this report, flooding is defined as the surcharge of water above ground surface at a drainage inlet or manhole, above curb elevation in a roadway, and above bank elevation in a channel. The primary objective of the Storm Drain Master Plan Phase I is to identify locations subject to flooding and determine the cause. Flooding caused by creek spills, tidal action, or other such events have not been addressed in this report.

ES.3 Work Products

This master plan is intended to function at several levels. City planners and engineers responsible for the capital improvement program should find that this document contains sufficient background information and data to serve as a basis for the developing the approach to the Phase II analysis. For those City staff and other parties

interested in a more in-depth examination of storm drain facilities within Half Moon Bay, the companion GIS-based input and output from the MikeURBAN hydraulic model is available. MikeURBAN, developed by DHI, uses the MOUSE engine to model hydrology and hydraulics of urban drainage and sewer systems. As discussed in supporting reports and documents, the following information is available via the GIS database:

1. **Inventory of Drainage Facilities.** Information pertaining to each system component including drainage pipes, nodes, channels, and relevant roads may be accessed graphically or through database spreadsheets which have been provided electronically.
2. **Tributary Drainage Areas.** Information pertaining to land areas that contribute stormwater runoff, including factors related to land use and soil conditions and other basin morphology, is available graphically or through database spreadsheets which catalog tributary areas.
3. **Storm Drain Capacities Evaluation.** For each drainage system component, peak discharge and maximum hydraulic grade line are documented for each storm event. Based on hydraulic grade calculations, the degree of surcharge and depth (based on theoretical HGL) of water above ground are also determined.
4. **Drainage System Profiles.** Those interested in viewing drainage system profiles may do so graphically using software features specifically designed for this purpose. Real-time animations of water surface profiles and corresponding surface ponding depths for design storm events are also available.

ES.4 Capacity Analysis

Half Moon Bay's storm drain system is broken into nine drainage sub-areas as shown in Figure ES-1. Each collection system has been analyzed for the existing and future land use conditions to determine its performance during the 2-, 10-, 25-, and 100-year storm events. Areas of significant flooding within each system are recognized and identified for improvement.

ES.5 Phase II Recs.

Phase II of the Half Moon Bay Storm Drain Master Plan outlines the deficiencies in the storm drain system identified in Phase I and then recommends approaches that prioritizes and mitigates these deficiencies. Recommendations include the development of a Capital Improvement Program (CIP), identifying regulatory issues that may need to be addressed during implementation of CIPs, identifying water quality and conservation opportunities that may be implemented along with CIPs, and developing drainage design standards.

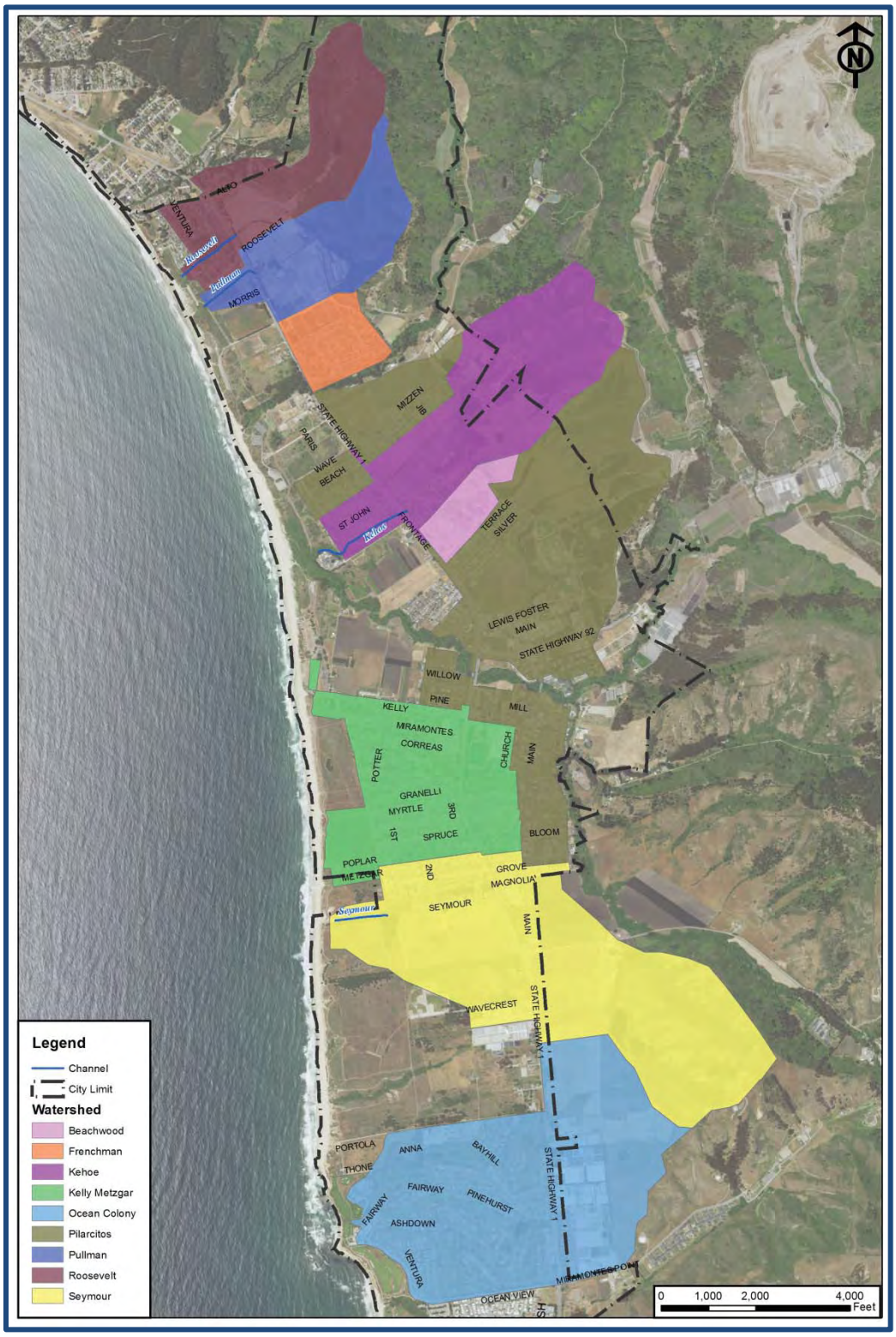


Figure ES-1: Half Moon Bay Drainage Areas

Chapter 1. Introduction

1.1 Overview

This City of Half Moon Bay Storm Drain Master Plan Phase I provides a discussion of the storm drain system inventory, a summary of the system condition, a discussion of hydrologic and hydraulic methodologies, an analysis of the existing system capacity, and a list of areas subject to flooding. This chapter provides a general discussion of the Half Moon Bay area setting, storm drain network, and history of flooding. This chapter also gives a brief description of the master plan process.

1.2 Setting

The Half Moon Bay capacity analysis study area covers the area that flows to the storm drainage system owned and maintained by the City. The study area is bounded by Miramar Drive to the north, Unconsolidated San Mateo County to the east, Miramontes Point Road to the south, and the Pacific Ocean to the west as shown in Figure 1-1. The majority of the Half Moon Bay study area is relatively flat with some mountainous terrain east of the City limits. Elevations range from 0 feet North Geodetic Vertical Datum (NGVD), to about 700 feet NAVD88.

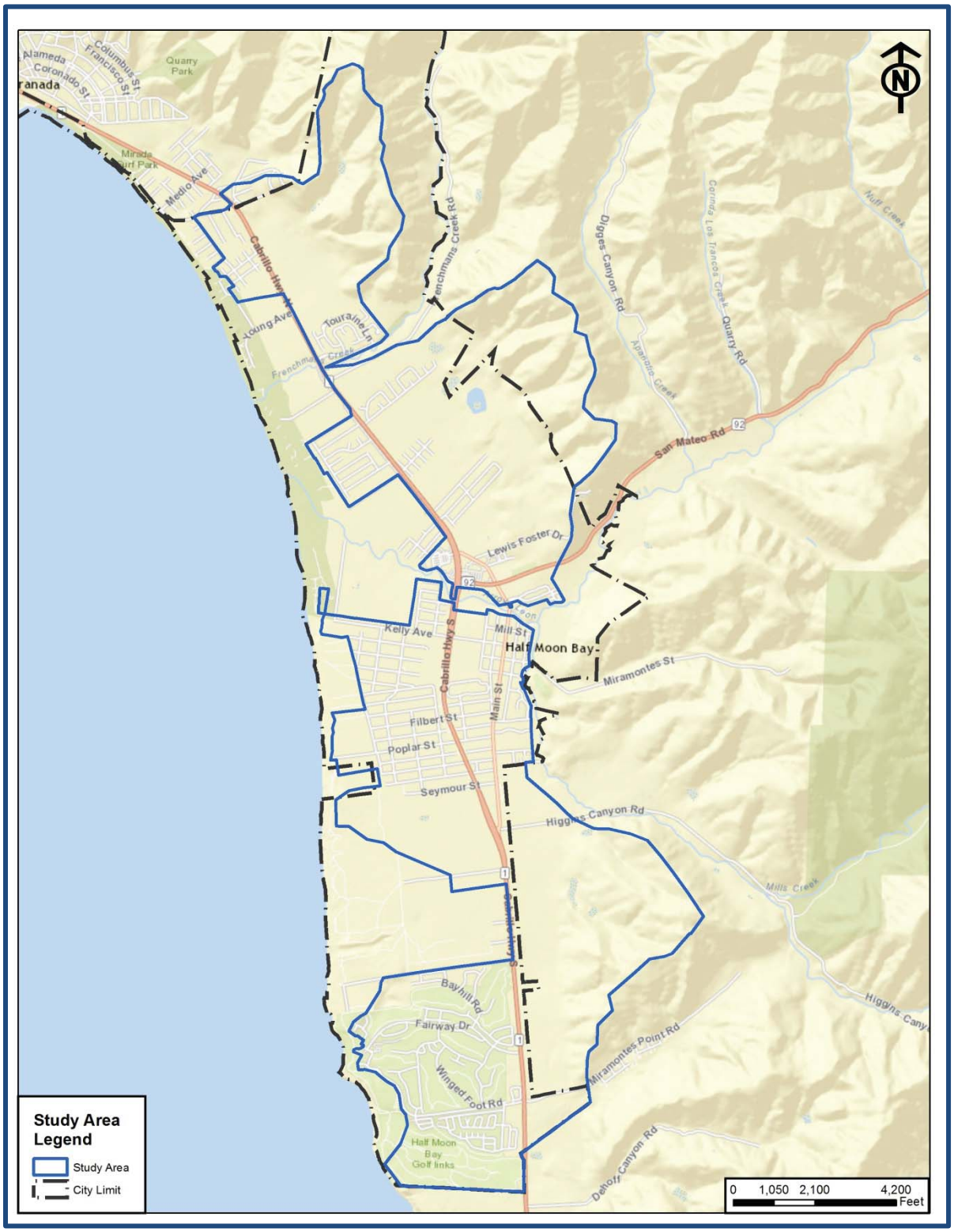


Figure 1-1: Location of Half Moon Bay Master Plan Capacity Analysis Study Area

1.3 Soils

The Natural Resources Conservation Service (NRCS) has classified soils into four hydrologic soil groups (A, B, C, and D) according to their infiltration rates. Group A soils have low runoff potential when thoroughly wet and typically consist of sand or gravel type soils. Group B soils are moderately well draining when thoroughly wet and consist of loamy sand or sandy loam textures. Group C soils have moderately high runoff potential when thoroughly wet and consist of loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have high runoff potential when thoroughly wet and consist of clayey textures. All soils with a water table within 24-inches of the surface are in Group D. The area that drains to the existing Half Moon Bay storm drain system consists of 37.4% Group B soils, 17.2% Group C soils, and 45.4% Group D soils.

1.4 Climate

Half Moon Bay's climate is marine-influenced with an average annual high temperature of 62.3°F and average annual low temperature of 46.1°F. Average summertime temperatures range from 66°F to 49°F. Average winter temperatures range from 59°F to 42°F. Mean annual precipitation is 28 inches, with the majority of that precipitation falling from November through March. Precipitation occurs entirely as rainfall. Snowmelt is not a hydrologic process that significantly affects runoff in the City.

1.5 Flood Protection Facilities

Precipitation that falls within the city of Half Moon Bay generates stormwater runoff. A portion of this runoff is conveyed through the storm drain networks and discharged to the creeks, ditches, or the Pacific Ocean through gravity outfalls. The City has a total area of 6.4 square miles (4,096 acres), 3.3 square miles (2,128 acres) of which flows to the City's storm drainage system. The remaining area flows overland and directly discharges to a regional creek or the Pacific Ocean. 1.2 square miles (793 acres) of Unincorporated San Mateo County flows to the City's storm drainage system, bringing to total system drainage area to 4.6 square miles (2,921). Regional facilities that provide flood protection to Half Moon Bay but are not included in this study include Frenchman's Creek, Pilarcitos Creek, Arroyo de en Medio, and Arroyo Canada Verde.

The system drainage area is divided into eight watersheds as shown in Figure 1-2. The watershed areas and system lengths are listed in Table 1-1.

Table 1-1: Watershed Areas and Length of Modeled Storm Drain Pipe

Watershed	Area (acres)	Pipe (miles)
Roosevelt	224	.18
Pullman	171	.17
Frenchman	69	.66
Pilarcitos	660	5.86
Kehoe	330	.57
Beachwood	45	.62
Kelly Metzgar	288	2.38
Seymour	577	.47
Ocean Colony	557	2.28
TOTAL	**2,921**	**13.19**

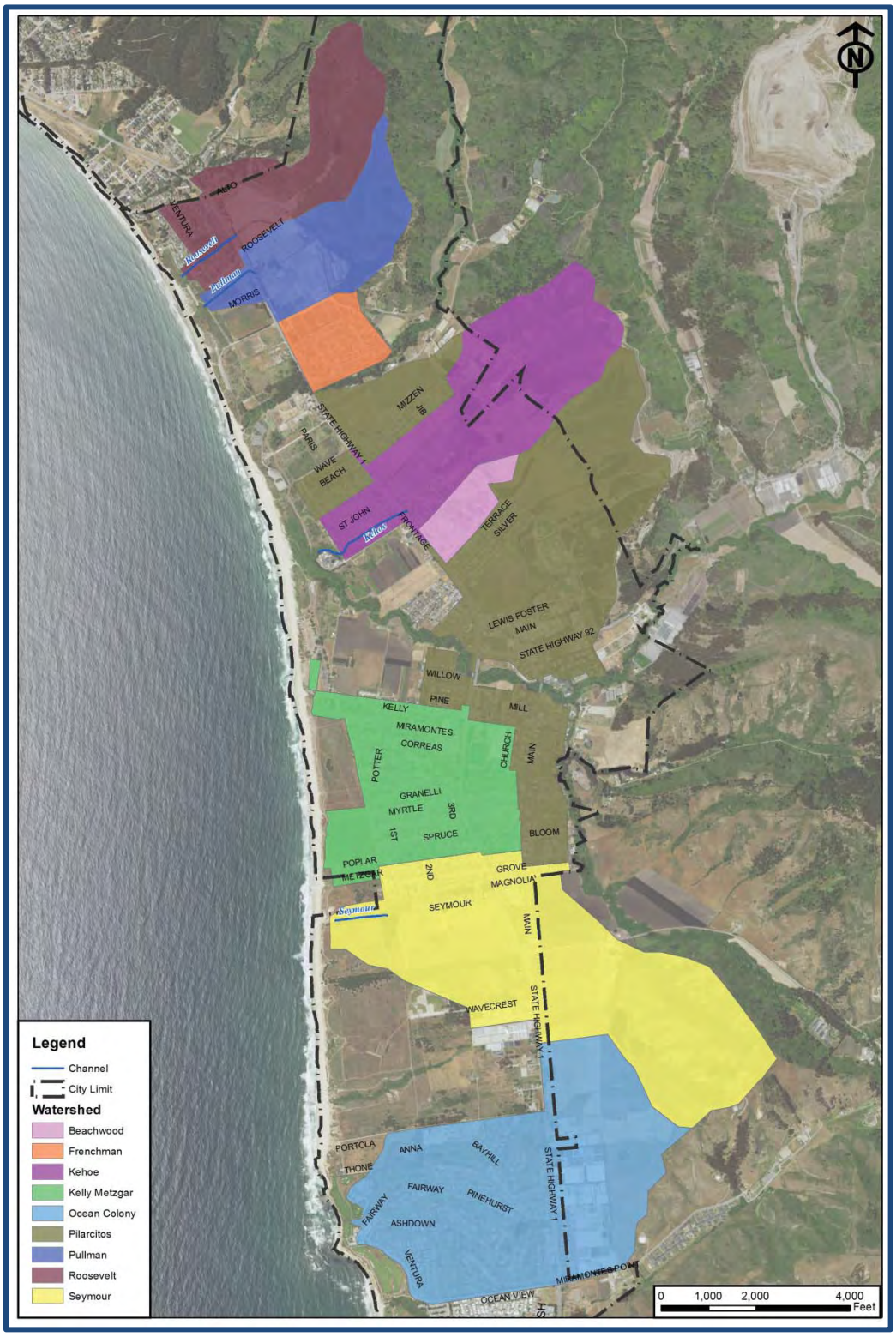


Figure 1-2: Half Moon Bay Drainage Areas

1.6 References

Various documents were referenced during the preparation of this master plan:

- Master Storm Drainage Report. Municipal Consulting Services, Half Moon Bay, California. (January 1978).
- Zoning Map. City of Half Moon Bay and Modified by M-Group, California. (June 2015).
- General Construction Permit. State Water Resources Control Board: Division of Water Quality. (Order 2009-0009-DWQ as amended by 2010-0014-DWQ and 2012-0006-DWQ). (2010).
- Municipal Regional Stormwater NPDES Permit No. CAS612008. California Regional Water Quality Control Board: San Francisco Bay Region. (Order R2-2009-0074). (2009).
- Santa Clara County Drainage Manual. Santa Clara County Department of Planning and Development Services. Prepared by: Schaaf & Wheeler Consulting Civil Engineers. (2007).
- Half Moon Bay Comprehensive Plan. City of Half Moon Bay Land Use and Development. (2007).
- Santa Mateo County Flood Insurance Study. Federal Emergency Management Agency (2015).
- Smith Field Drainage Report. BKF and Callander Associates, Half Moon Bay, California. (June 2014).
- Various Technical Documents and Electronic Data. County of San Mateo. Web 2016. < http://www.smcgov.org/ >

Chapter 2. Data

2.1 Overview

Schaaf & Wheeler reviewed and utilized readily available land use, topographic, geographical, and storm drain system data within the Half Moon Bay Storm Drain Master Plan Area (study area). Efforts were made to add to the collective data. Where necessary, assumptions and engineering judgment were used to complete remaining data gaps. This chapter summarizes the findings and data acquired as part of the Half Moon Bay Storm Drain Master Plan (SDMP). Data limitations, assumptions, and impacts are also summarized.

2.2 Data Sources

All project data and results are in vertical datum NAVD88 (feet) and State Plane (California Zone III) coordinate system. Santa Mateo County's 2005 1-foot contour LiDAR topography data (NAVD) with half foot accuracy (plus or minus 0.5 foot) is utilized for ground surface information. The ground surface information was supplemented by a topographic survey of Roosevelt Ditch, Pullman Ditch, and Seymour Ditch. The high resolution digital aerial imagery provided by ESRI was also used.

Topography and Aerial Imagery

Storm Drain System Data

The City did not have storm drain system information stored in electronic format at the start of this study. The network is mapped on drawings titled "City of Half Moon Bay Aerial Storm Facility Plan" created by Psomas and dated October 25, 2005. Pipes, manholes, and inlets are shown. Pipes are labeled with size and material. Manhole and inlet inverts are not labeled.

The steps taken to complete the data set to a master planning level of accuracy are detailed in the Data Quality and Data Assumptions sections of this chapter.

Historical Data and As-Builts

As-Built improvement plans were obtained for key locations from the City and Caltrans and reviewed to verify data and fill in data gaps. As-Built plans were assumed to be accurate and up-to-date.

Field Measurements

Schaaf & Wheeler spent approximately two weeks in the field gathering system data. Pipe diameter and system layout was verified and invert depths were measured. Unlike sanitary sewer modeling, storm water systems are designed to surcharge (pressure flow). Invert elevations become less critical than pipe diameter because the system's hydraulic grade lines (HGLs) are not governed by open channel flow dynamics.

FEMA and San Mateo County Data

San Mateo County's GIS data, which includes creek centerlines, watershed delineations, 1-foot contour topography, and land use was referenced for this study. FEMA reports were researched, but no creeks in Half Moon Bay have been the subject of a detailed study. FEMA GIS data was referenced to obtain flood zone information.

Land Use Data and Runoff Characteristics

The existing land use and future land use scenario was analyzed for the SDMP. The existing and future land use in Half Moon Bay is primarily open space and single family residential, interspersed with educational facilities, commercial, floriculture, and light industrial. The various land use descriptions are summarized in Table 2-1. Existing land use is shown in Figure 2-1 and future land use is shown in Figure 2-2.

The majority of developed land in Half Moon Bay is single family residential. Parcel size of the single family homes varies widely in Half Moon Bay, from 5,000 square feet to 10,000 square feet. Due to the range of areas within this category, assigning one impervious value would not be representative. Therefore, the single family residential category was broken up into four tiers based on parcel size with each tier being assigned

a unique percent impervious value.

In general, for the future land use condition, it is expected that single family residential, mobile home park, commercial, and exclusive floriculture land use area will increase with open space area decreasing. It is estimated single family residential (10,000 sq ft lot +) area will increase the most, with a 2.5% increase as compared to the existing land use. All other land use area is expected to remain unchanged in the future land use scenario.

Table 2-2: Land Use Descriptions and Percentages in Study Area

Description	Existing		Future	
	Area (acres)	Percent of area	Area (acres)	Percent of Area
Commercial	146.6	2.9%	171.1	3.5%
Exclusive Floriculture	209.3	4.2%	213.9	4.3%
Facilities	25.8	0.5%	25.8	0.5%
Highway	80.5	1.6%	80.5	1.6%
Industrial	62.6	1.2%	59.9	1.2%
Mobile Home Park	58.6	1.1%	58.6	1.2%
Multiple Family Residential	34.8	0.7%	34.8	0.7%
Open Space	3,352.5	68.1%	3,352.4	65.8%
Public Service	109.1	2.2%	109.1	2.2%
Single Family Residential (5,000 sq ft lot)	117.9	2.4%	119.8	2.4%
Single Family Residential (6,000 sq ft lot)	124.7	2.5%	124.7	2.5%
Single Family Residential (7,500 sq ft lot)	335.0	7.2%	380.3	7.7%
Single Family Residential (10,000 sq ft lot +)	181.6	3.7%	251.5	5.1%
Two Family Residential	64.2	1.3%	64.3	1.3%
TOTAL:	**4,950**	**100%**	**4,950**	**100%**

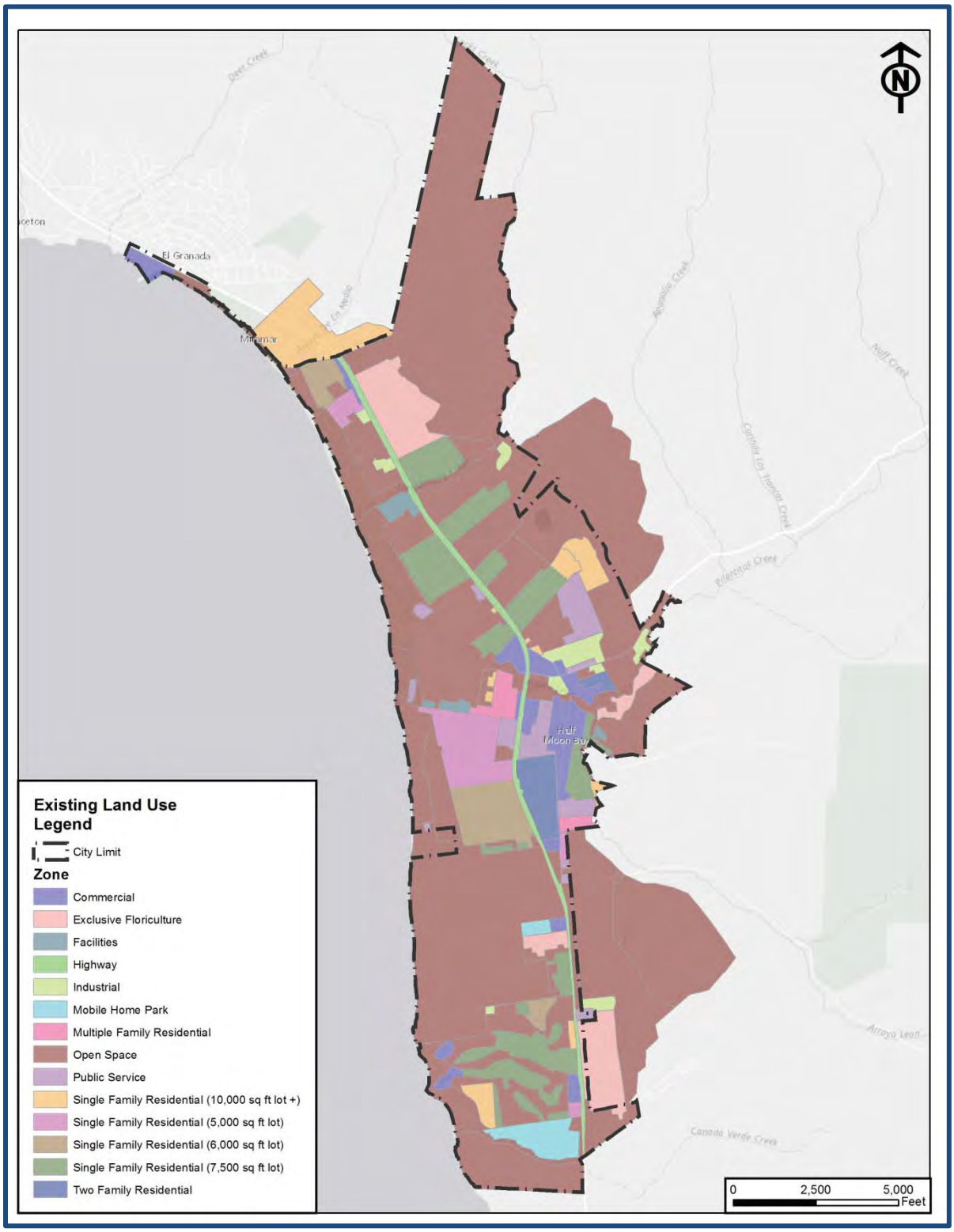


Figure 2-1: Existing Land Use of Half Moon Bay

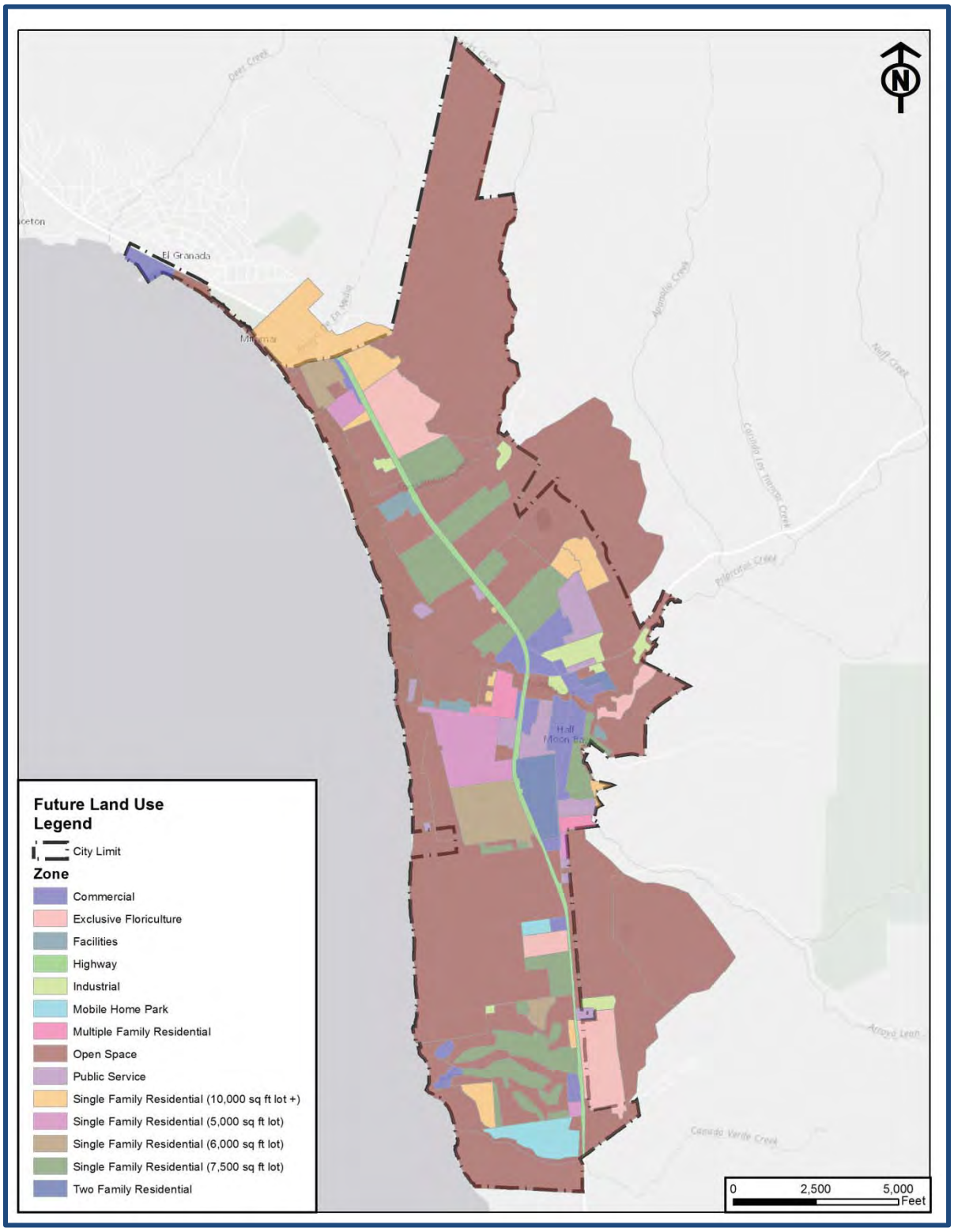


Figure 2-2: Future Land Use of Half Moon Bay

Rainfall runoff is determined by soil classification, land use, and percentage of impervious surface. Soils classification is based on Hydraulic Soil Group (A, B, C, or D); this data is produced by the National Resource Conservation Service (NRCS), and its use in the master plan analysis is described in detail in Chapter 3 - Methodology. The soil groups in Half Moon Bay are shown in Figure 2-3. The Curve Number methodology, also described in Chapter 3, is used for surface runoff calculations. NRCS runoff Curve Numbers (CN) were assigned to the City land use designations based on hydraulic soil group using values published in Santa Clara County Drainage Manual. The percent impervious for each land use type is based on values published in the County Drainage Manual and validated using the high-resolution aerial photography. These values are presented in Table 2-2.

Table 2-2: Soil Groups and Imperviousness

Description	Percent Impervious	Curve Number (AMC II)			
		Group A Soil	Group B Soil	Group C Soil	Group D Soil
Commercial	80	44	58	71	74
Exclusive Floriculture	80	44	58	71	74
Facilities	80	44	58	71	74
Highway	80	98	98	98	98
Industrial	80	44	58	71	74
Mobile Home Park	80	44	58	71	74
Multiple Family Residential	78	44	58	71	74
Open Space	10	44	58	71	74
Public Service	45	44	58	71	74
Single Family Residential (10,000 sq ft lot)	25	44	58	71	74
Single Family Residential (5,000 sq ft lot)	60	44	58	71	74
Single Family Residential (6,000 sq ft lot)	50	44	58	71	74
Single Family Residential (7,500 sq ft lot)	50	44	58	71	74
Two Family Residential	70	44	58	71	74

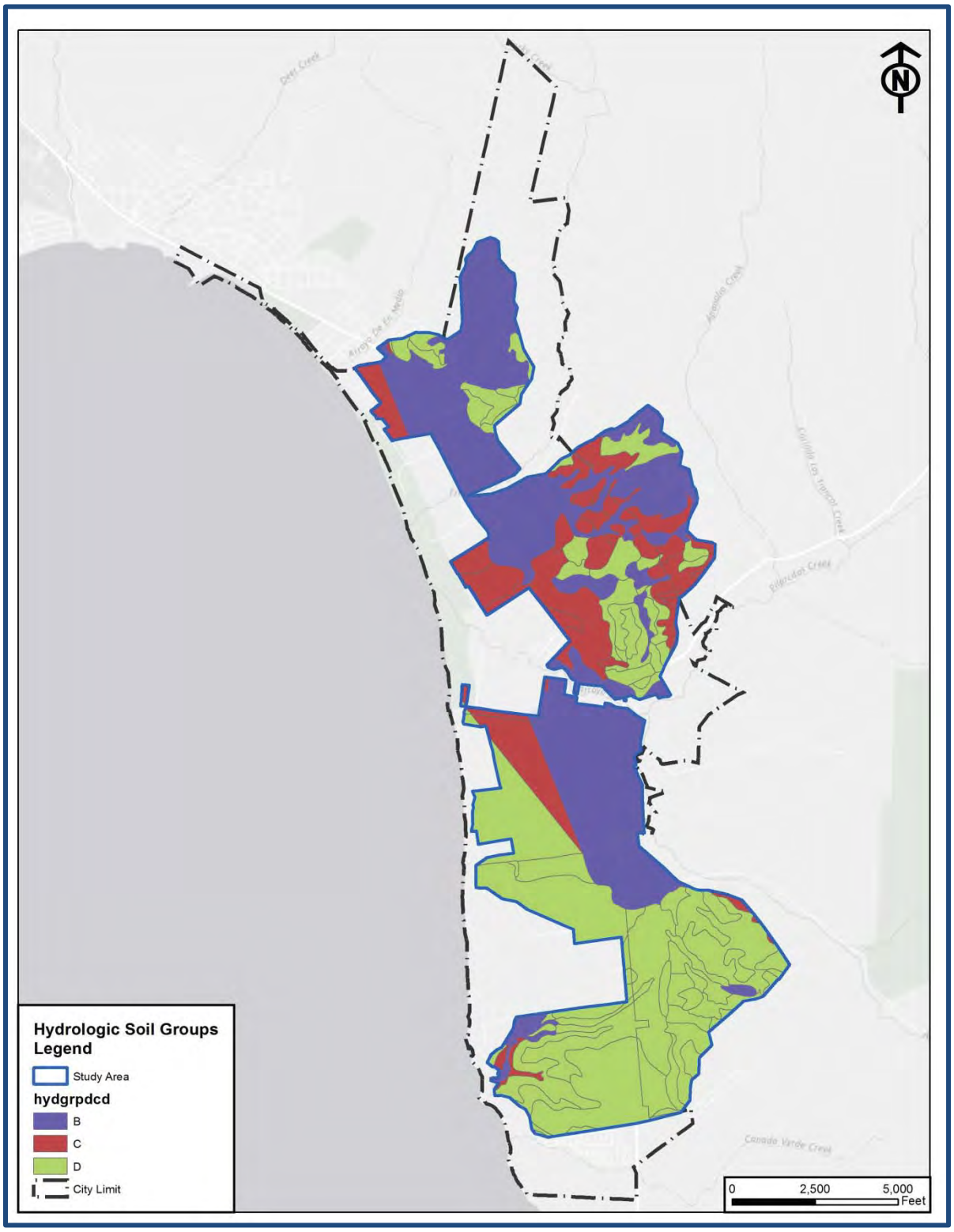


Figure 2-3: Hydrologic Soil Groups in Half Moon Bay

2.3 Modeled Data Assumptions

For this study Schaaf & Wheeler created GIS shapefiles of the storm drain system using the information detailed in the maps created by Psomas. The next step included field research to collect and verify pipe sizes and material, system layouts, and to measure invert depths. When field measurements were not feasible (due to either pipe location or depth), record drawings provided by the City or Caltrans were referenced if available. Any remaining unknown pipe diameters were assigned based on the diameter of surrounding pipes.

Rim elevations of manholes and inlets were globally assigned based on the County's LiDAR. Invert elevations were assigned based on either applying the field measured depth, or interpolating between up and downstream nodes. The method of assigning elevation data is preserved in the "Description" field of the final GIS database utilized by the model.

Chapter 3. Methodologies

3.1 Overview

The criteria used to evaluate storm drain system performance must be technically sound yet simple to understand and apply. Ideally, the same methodology used to analyze system performance for this report will also continue to be used for future infrastructure design. Schaaf & Wheeler is applying the County of Santa Clara's urban hydrology methods, as described in the Santa Clara County Drainage Manual (Schaaf & Wheeler, 2007), to estimate storm runoff from the existing land use for the Half Moon Bay Storm Drain Master Plan. The County's method is being used along with DHI's MIKE URBAN storm drain modeling software to determine system performance. Physical parameters used in the model are based on the information detailed in Chapter 2 - Data. Storm drain evaluation criteria described in the following section have been discussed with and agreed upon by the City of Half Moon Bay.

3.2 Evaluation Methodology

The methodology described in the Santa Clara County Drainage Manual (County Drainage Manual) was used to estimate storm runoff in Half Moon Bay. The County Drainage Manual was developed in 2007 to provide consistent design and evaluation criteria for storm drainage throughout Santa Clara County. San Mateo County does not have a drainage manual, and the Santa Clara County Drainage Manual methodology has been used to analyze other areas in San Mateo County. The unit hydrograph method (as describe in Chapter 4 of County Drainage Manual) was used because it allows for the development of a flood hydrograph using a design storm, an appropriate infiltration technique, varying antecedent moisture conditions, storage within the watershed, and a synthetic unit hydrograph.

The standard storm duration used in County Drainage Manual for rainfall simulation is 24-hours. The storm pattern is based upon the three-day December 1955 rainfall event, considered to be the storm of record for northern California. The precipitation pattern has been adjusted to preserve the local rainfall statistics in Santa Clara County, and can be found in Appendix D of the County Drainage Manual. This master plan effort includes modeling the hydrology for the 2-, 10-, 25-, and 100-year storm events.

3.3 GIS Based Modeling

The DHI's MIKE URBAN (MU) model with MOUSE engine was selected to model the Half Moon Bay storm drain system because it is tested and reliable software with a GIS interface. The MU model works with GIS data and can simulate runoff, open channel flow, pipe flow, and water quality. This program is ideal for the project because of its capabilities with overland flow and storage areas and the overall stability of the model.

The Half Moon Bay storm drain system is divided into nine independent sub-areas based on outlet points and major drainage channels for each area. These sub-areas are: Roosevelt, Pullman, Frenchman's, Pilarcitos, Kehoe, Kehoe High Flow, Pacific Ocean, Seymour, and Golf Course as described in Table 3-1. Each drainage system model is composed of a conveyance network (pipes, nodes, channels, roads, etc.) and the urban catchments contributing runoff to the pipe network.

Table 3-1: Half Moon Bay model drainage areas based on existing conditions

Sub-area	Description	Percent of area	Miles of pipe
Part 1: Roosevelt	This watershed is bounded by Miramar St to the North, the Corral de Tierra mountain ridge to the East, and Washington Boulevard to the South. Flow drains west through the Roosevelt Channel into the Pacific Ocean.	7.67%	0.18
Part 2: Pullman	This watershed is generally bounded by Washington Boulevard to the North, the Corral de Tierra mountain ridge to the East, and Rocket Farms to the South. Flow drains west through Pullman Channel into the Pacific Ocean.	5.85%	0.17
Part 3: Frenchman's	This watershed is generally bounded Rocket Farms to the North and the extents of the neighborhood in the watershed to the East and West and bounded by Frenchman's Creek to the South. Flow drains west through Frenchman's Creek into the Pacific Ocean.	2.36%	0.66
Part 4: Pilarcitos	This watershed is bounded by Frenchman Creek Rd. to the North, the Corral de Tierra mountain ridge to the East, and Arnold Way to the South. Flow drains west through Pilarcitos Creek into the Pacific Ocean.	22.60%	5.86
Part 5: Kehoe	This watershed is bounded by Spindrift Way to the North, the Corral de Tierra mountain ridge to the East, and Grandview Boulevard to the South. Flow drains west through Kehoe Channel into the Pacific Ocean.	11.30%	0.57
Part 6: Beachwood	This watershed is bounded by Grandview Boulevard to the North, by the Kehoe and Pilarcitos Watersheds to the East, and Terrace Ave to the South. Flow drains west through Kehoe Channel into the Pacific Ocean during a larger storms.	1.54%	0.62
Part 7: Kelly-Metzgar	This watershed is bounded by Kelly Ave to the North, downtown Half Moon Bay to the East, and Poplar Street to the South. Flow drains west through storm drain system and surface channels into the Pacific Ocean.	9.86%	2.38

Part 8: Seymour	This watershed is bounded by Poplar Ave to the North, a mountain ridge to the East, and Wavecrest Road to the South. Flow drains west through Seymour Channel into the Pacific Ocean.	19.75%	0.47
Part 9: Ocean Colony	This watershed is bounded by Redondo Beach Rd. to the north, a mountain ridge to the east, and Miramontes Point Rd. to the south. Flow drains west through storm drain system and surface channels into the Pacific Ocean	19.07%	2.28

Operation

Two separate calculations are performed by MU for the Half Moon Bay models: a runoff calculation estimating the amount of water entering the storm drain system during a design rainfall event; and the network flow calculation which replicates how the storm drain system will convey flows to outlet locations. Flows resulting from the runoff calculation are used as inflows for the subsequent network flow calculation. The MU runoff model offers a choice of five runoff routing descriptions: Time-Area routing, Kinematic wave/Non-linear reservoir, Linear Reservoir Method (in two sub-variants: Dutch runoff model and French runoff model), and the Unit Hydrograph Method (UHM). The Half Moon Bay storm drain models uses the UHM model with the NRCS dimensionless hydrograph and NRCS Curve Number loss method to calculate surface runoff. This method is in keeping with the County Drainage Manual prescribed methodology. A simulation can be started at any point during the chosen design storm to assess surface runoff for any period of the design storm, with computations made based on a user-specified time step.

The MU network flow model offers a choice of three flow description approximations: Dynamic Wave, Diffusive Wave, and Kinematic Wave; distinguished by the set of forces each takes into account. The Half Moon Bay storm drain models use the most comprehensive flow description, Dynamic Wave, which incorporates the effects of gravitational, friction, pressure gradient and inertial forces. Because it accounts for all major forces affecting flow conditions, this equation allows the model to accurately simulate fast transients and backwater profiles. The simulation of flooding at a node is accommodated by the insertion of an artificial "basin" above the node which will store water when the water level rises above the ground level. The surface area of the "basin" gradually increases (up to a maximum of 1000 times the node surface area) with rising water levels at the node, replicating the effects of flooding.

Water stored in the "basin" begins to reenter the system when the outflow from the node becomes greater than the inflow. The pipe flow simulation can be executed using either a constant or variable time step, and can be run for any portion of the time interval specified by the input rainfall time series and corresponding calculated runoff hydrograph.

Input and Output

MU surface runoff calculations require two types of input data: boundary data and urban catchment data. Boundary data for the run-off computation consists of an input rainfall time series representing the design storm event for the model. Urban catchment data includes the boundaries of each drainage catchment, along with relevant physical and hydrologic parameters including surface area and parameters used to calculate basin lag time. Drainage catchments for the nine sub-areas are shown in Figures 3-1 through 3-5.

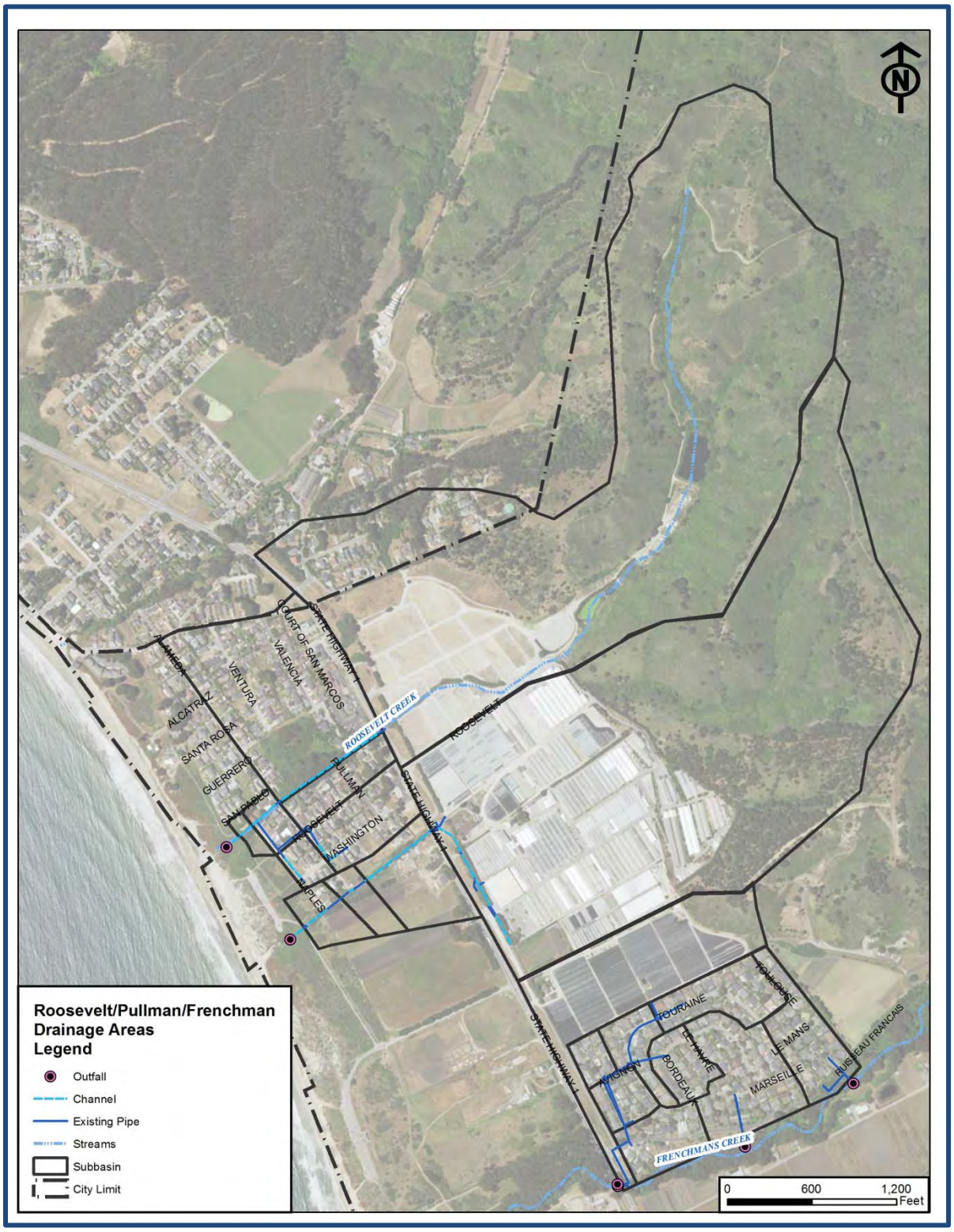


Figure 3-1: Roosevelt/Pullman/Frenchman Drainage Area Catchments

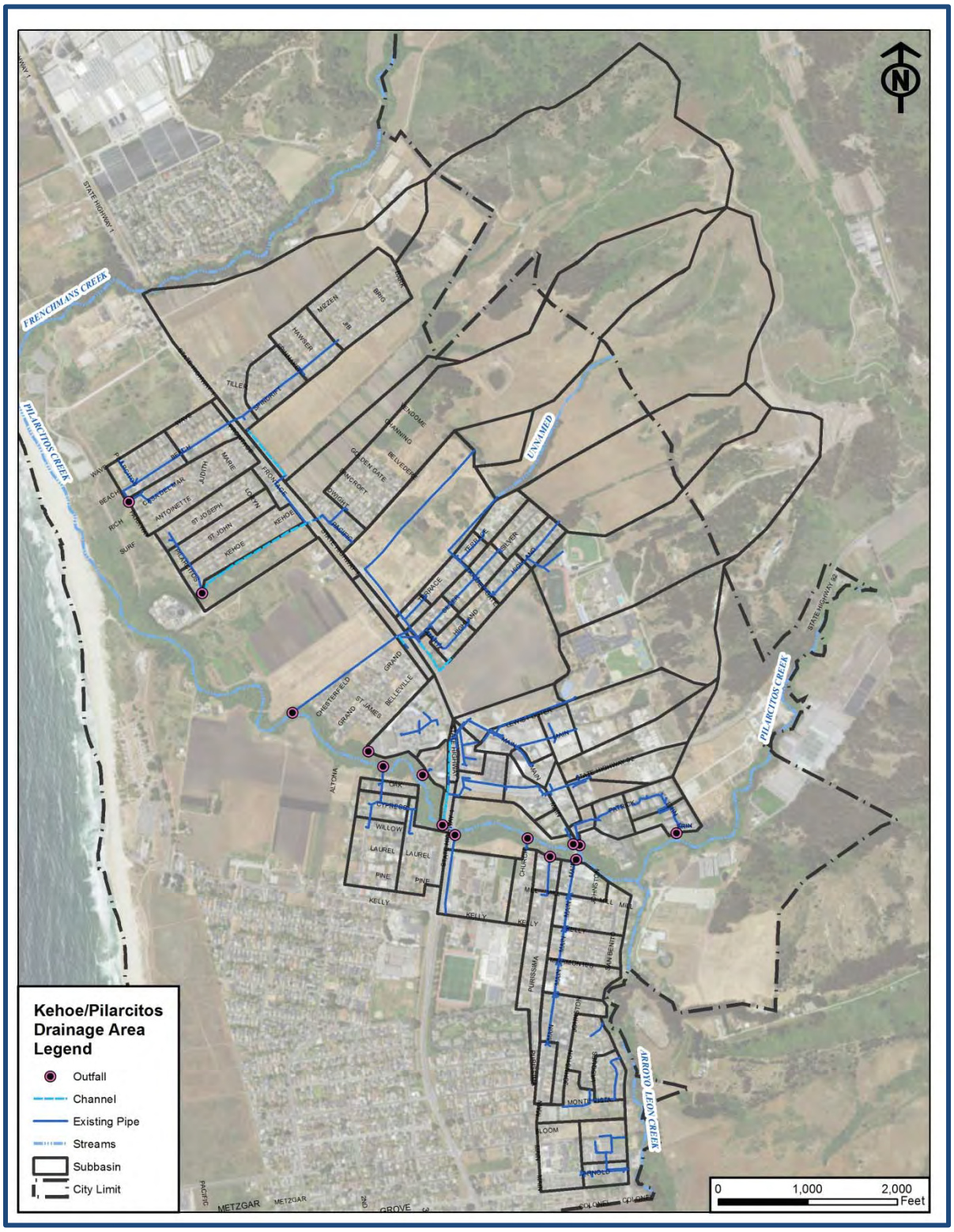


Figure 3-2: Kehoe/Pilarcitos Drainage Area Catchments

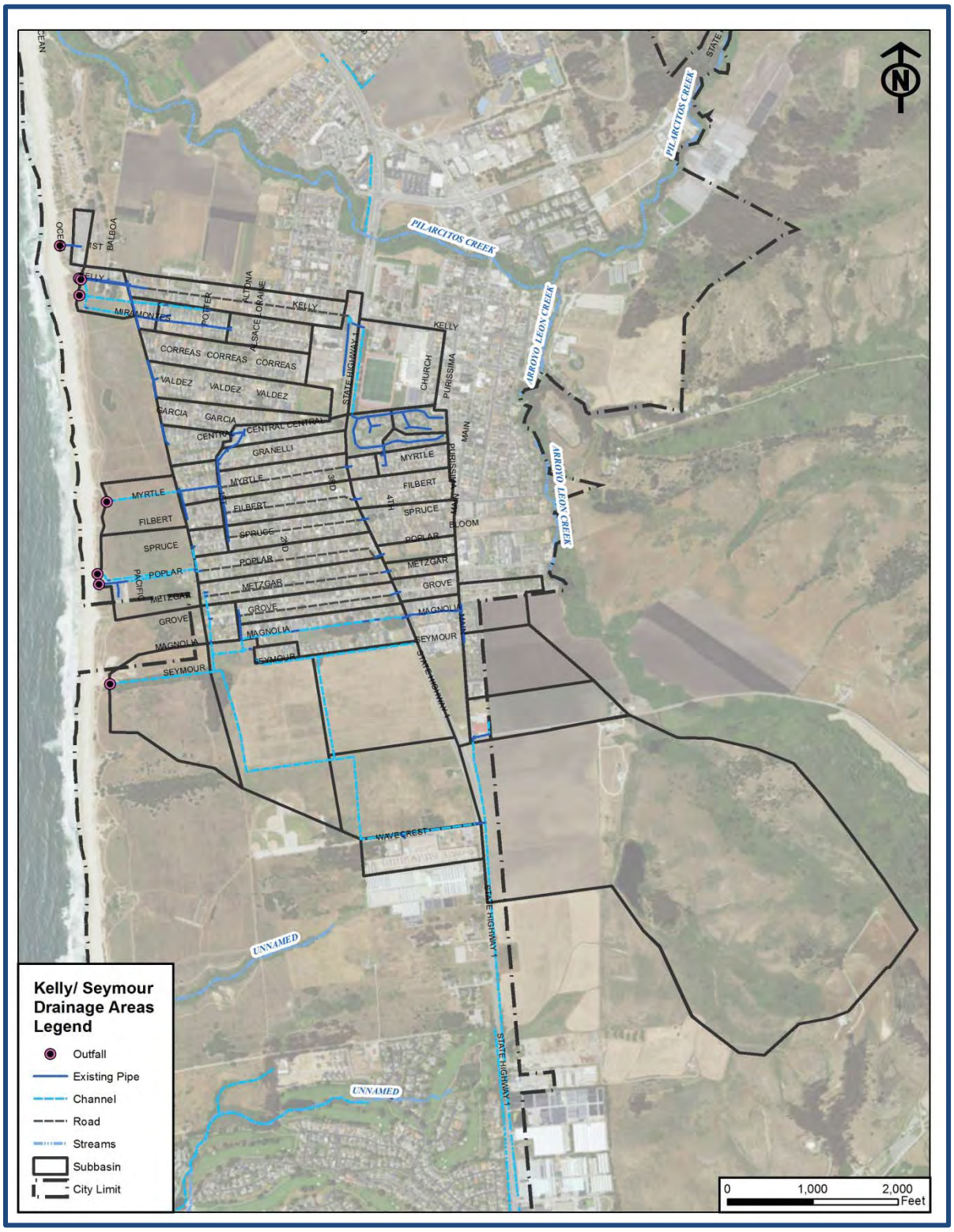


Figure 3-3: Pacific Ocean/Seymour Drainage Area Catchments

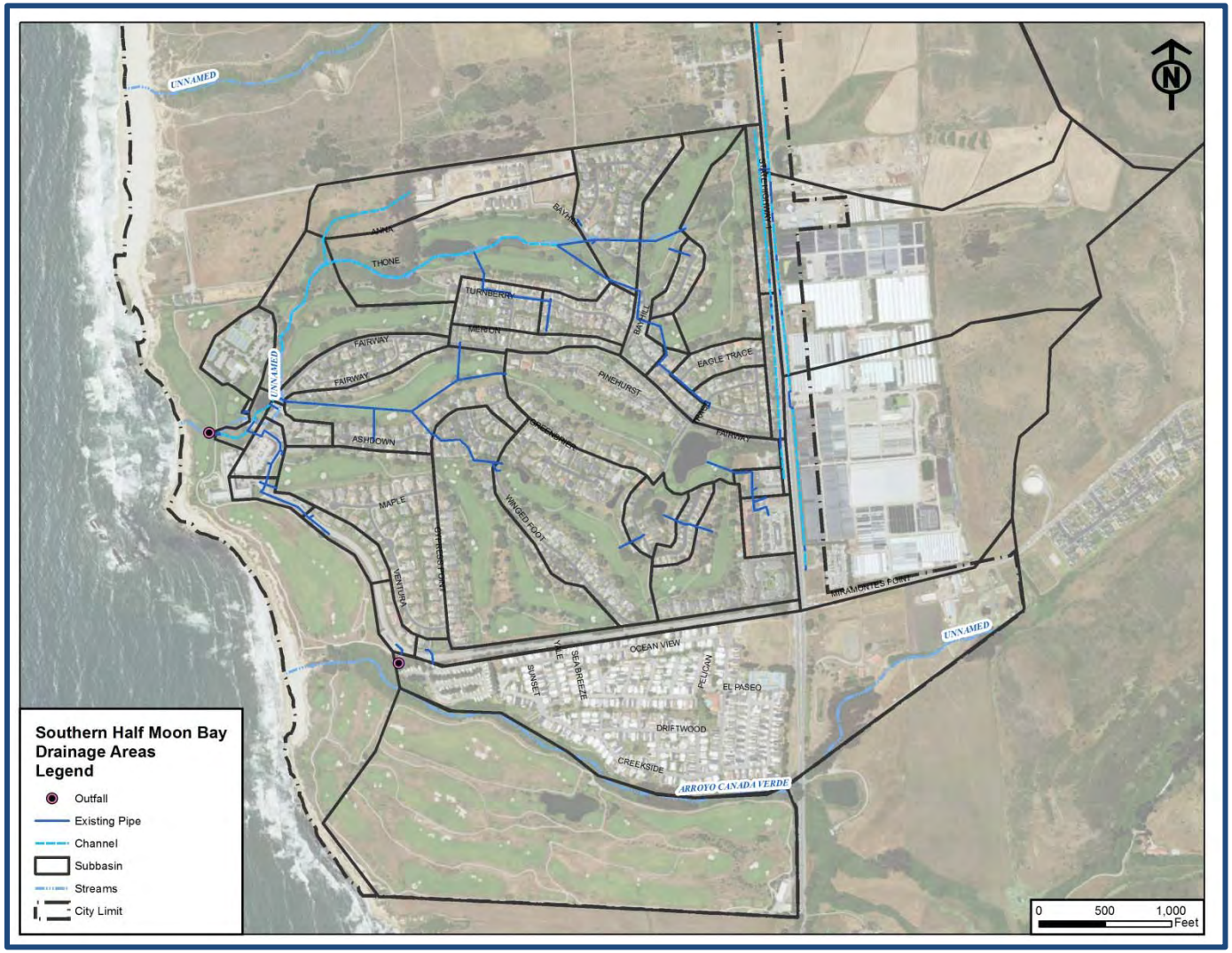


Figure 3-4: Golf Course Drainage Area Catchments

MU pipe flow calculations require network data, operational data, and boundary data as input. Network data consists of the pipe network elements including nodes (manholes, inlets, and outfalls) and links (pipes, culverts, and open channels). Parameters required to describe nodes include x and y coordinates of the node, a unique name, node type, depth and invert levels, and water levels at outlets. Parameters required to describe links include the name of upstream and downstream nodes, shape and dimensions, material or roughness, and upstream and downstream inverts. Network data also includes structural system elements, such as gates, pumps, and weirs, which are modeled as functional relationships connecting two nodes in the system, or associated with one node in the case of free flow out of the system.

Operational data consists of parameters which describe how these elements function in the network. Boundary data for the pipe flow computation can include any external loading, inflow discharges, water levels at interaction points with receiving waters, pump performance curves, as well as the results of a run-off calculation.

Output from the pipe flow computation includes the calculated water level at each node, pump discharges, weir discharges, water level in network branches, discharge in network branches, water velocity in network branches, water volume in the system, and time step data. Output is viewed using GIS, MU, or the MIKE-VIEW program. Results may be displayed in plan view or as a profile for a selected network section, and may be viewed as a temporal animation or at maximum or minimum values. Additional outputs which can be derived from MU pipe flow results using GIS and include: water depth, flooding level, pressure in closed conduits, percentage pipe filling, and the flow calculated for each link.

3.4 Surface Runoff Calculations

As described above, the first step of the MU model is to complete a stormwater runoff calculation that determines the amount of water entering the storm drain system from a specific rainfall event. Boundary and catchment data must be input to the model to complete this calculation.

Boundary Data

Methods used in this master plan to estimate peak storm water flow rates and volumes require the input of precipitation data. Since it is impossible to anticipate the impact of every conceivable storm, precipitation frequency analyses are often used to design facilities that control storm runoff. A common practice is to construct a design storm, which is a rainfall pattern used in hydrologic models to estimate surface runoff. A design storm is used in lieu of a single historic storm event to ensure that local rainfall statistics (i.e. depth, duration and frequency) are preserved. When combined with regional specific data for land use and loss rates, the model should produce runoff estimates that are consistent with frequency analyses of gauged stream-flow in the Santa Clara County area. In other words, the ten-year design storm pattern used for MU modeling creates results consistent with a ten-year storm runoff event.

Precipitation frequency analyses are based on concepts of probability and statistics. Engineers generally assume that frequency (probability) of a rainfall event is coincident with frequency of direct storm water runoff, although runoff is determined by a number of factors (particularly land use conditions in the basin) in addition to the precipitation event. Because the County's 24-hour storm pattern has been adjusted to preserve local statistics, there is increased confidence in this correspondence between the frequency of the rainfall and the frequency of the runoff.

Rainfall

The rainfall distribution pattern for the Half Moon Bay Storm Drain Master Plan was

obtained from the County Drainage Manual. The County's rainfall pattern is distributed in 5-minute time increments with a fraction of the total rainfall apportioned to each 5-minute increment as shown in Table 3-2. The resulting 24-hour rainfall pattern with 5-minute time steps is then prorated based on the Mean Annual Precipitation (MAP).

Table 3-2. Fractions of Total Rainfall for 24-Hour, 5-Minute Pattern for Map 28"

Time Starting	Fraction of Total Rainfall (%)	5-min pattern
0:00	0.154	1.851
1:00	0.141	1.698
2:00	0.300	3.601
3:00	0.616	7.389
4:00	0.549	6.585
5:00	0.531	6.375
6:00	3.448	41.376
6:10	1.031	12.372
6:30	0.944	11.323
7:00	0.526	6.307
8:00	0.330	3.960
9:00	0.246	2.951
10:00	0.344	4.131
11:00	0.406	4.869
12:00	0.307	3.689
13:00	0.320	3.837
14:00	0.232	2.778
15:00	0.257	3.086
16:00	0.232	2.778
17:00	0.129	1.543
18:00	0.167	2.006
19:00	0.180	2.160
20:00	0.154	1.851
21:00	0.373	4.475
22:00	0.296	3.549
23:00	0.154	1.851

The County Drainage Manual provides the total rainfall depth for each MAP and storm frequency using the following equation:

$$x_{T,D} = A_{T,D} + (B_{T,D}\ MAP)$$

Where: $x_{T,D}$ = precipitation depth for a specific return period and storm duration (inches), T = return period (years), D = storm duration (hours), $A_{T,D}$, $B_{T,D}$ = dimensionless coefficients from Tables B-1 and B-2, MAP = Mean Annual Precipitation (inches).

The precipitation intensity, $i_{T,D}$ is given by:

$$i_{T,D} = \frac{x_{TD}}{D}$$

The Mean Annual Precipitation (MAP) within Half Moon Bay is 28-inches based on the MAP figure in the County Drainage Manual. The rainfall totals for a 24-hour storm of the frequencies analyzed are shown in Table 3-3. The 10-year storm intensity graph for a MAP of 28-inches is shown in Figure 3-. The distribution of rainfall is based on balancing the storm to shorter rainfall statistics (10-minute, 1-hour, etc).

Table 3-3. 24-hour Rainfall Totals

Storm Frequency (yr)	Rainfall Total (in)
2	3.01
10	5.11
25	6.15
100	7.63

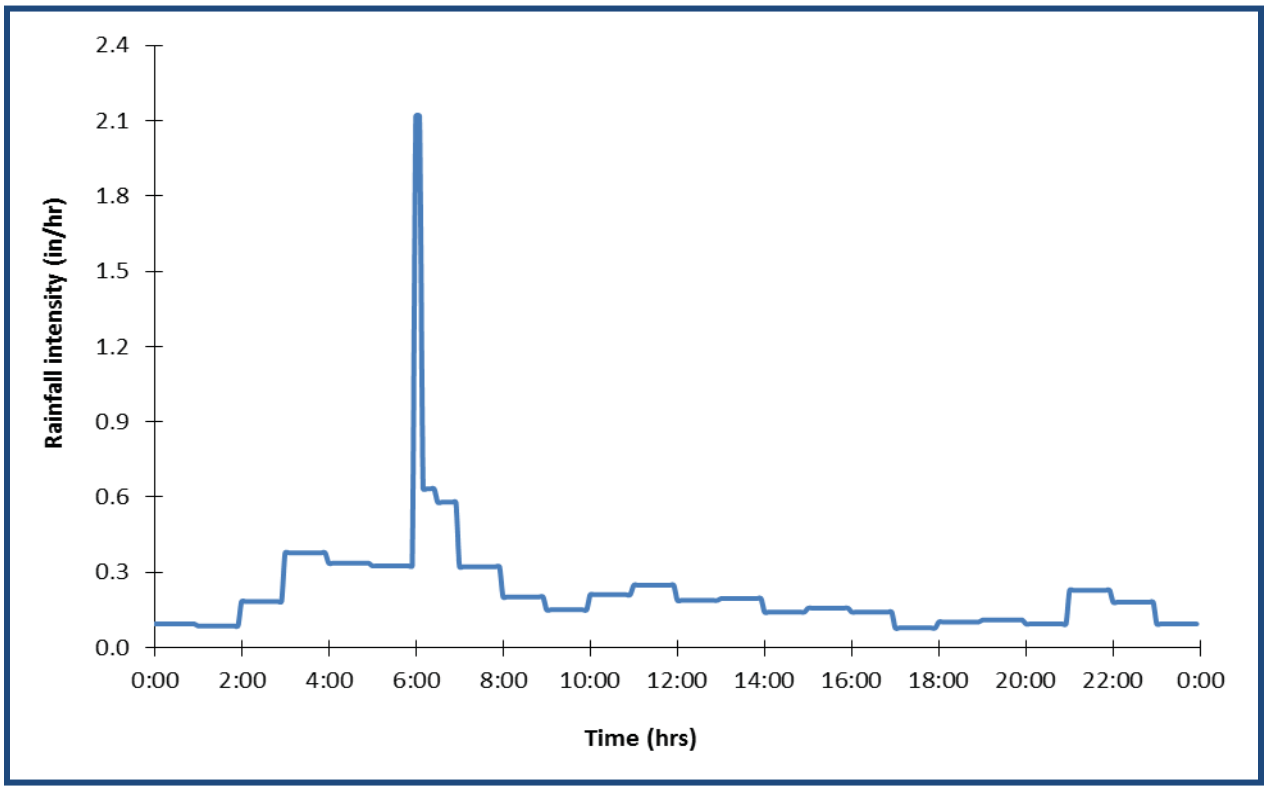


Figure 3-5: Half Moon Bay 10-Year Storm Intensity Graph (MAP 28")

Catchment

Urban catchment data includes the boundaries of each drainage catchment, along with relevant physical and hydrologic parameters including surface area, land use

Data

characteristics, and parameters used to calculate basin lag times. Half Moon Bay is divided into drainage areas, called catchments. Because the developed area is relatively flat, use of automated delineation routines in MU was not appropriate. The delineations completed by Schaaf & Wheeler rely heavily on engineering judgment and on experience in using contours, lot lines, storm drainage system layout, and aerial imagery.

A unit hydrograph is a numerical representation of the time response of catchment runoff caused by one inch of excess rainfall applied uniformly over a unit of time. Many different techniques are available to estimate unit hydrographs. The NRCS-dimensionless unit hydrograph is used in the Half Moon Bay storm drain models to be consistent with the County Drainage Manual. Direct runoff is calculated by subtracting losses, such as soil infiltration, from the rate of rainfall. The Curve Number (CN) method reflects these potential losses for a given soil type and land use.

Half Moon Bay is mainly single family residential with a centralized commercial area. The majority of the developed parcels have impervious surfaces that include buildings, roads, parking lots and sidewalks. Schaaf & Wheeler used imperviousness tables from the County Drainage Manual and validated them with aerial imagery. There is a degree of uncertainty in applying standard values to all similar land uses; however, this is adequate at a master planning level. The impervious percentages for each land use category are discussed in detail in Chapter 2, Data.

NRCS Curve Number

As mentioned previously, the NRCS Curve Number (CN) methodology was used to determine basin runoff. This methodology relies on the use of curve numbers to characterize basin infiltration and runoff potential. Curve numbers are based on a combination of land use, soil characteristics, and antecedent moisture condition. The NRCS has mapped soil types throughout the United States and has categorized each soil into Hydrologic Group (A, B, C, D). The portion of this map that covers the project area was obtained for this analysis. Type-A soils are well draining while Type-D soils are poor draining.

Antecedent moisture condition (AMC) is defined as the moisture content of a soil prior to any precipitation event. AMC is characterized by the SCS as:

AMC I	soils are dry
AMC II	average conditions
AMC III	heavy rainfall, saturated soil

The County Drainage Manual specifies a calibrated AMC value to properly convert the rainfall event's frequency of occurrence into the equivalent frequency of the runoff event. The AMC was calibrated for each storm frequency as described in Appendix B.

Curve numbers vary from 0 to 100, with 0 equating to no runoff from a basin and 100 indicating that all precipitation will run off. The County Drainage Manual was used to determine curve numbers for various land uses depending on soil type and AMC, as shown in Table 2-2. Curve Numbers were calculated for the pervious area within each catchment in Half Moon Bay using GIS techniques. Land use and soil hydrologic conditions were intersected and the appropriate CN was applied to each area. The pervious area of each catchment was then assigned a CN based on the area-weighted mean. The CN for each catchment's impervious area was set to 100.

Table 3-4. Calibrated AMC Values

Storm Frequency (yr)	AMC
2	2.25
10	2.25
25	2.1
100	2

Model Calibration, Basin Lag

The County Drainage Manual recommends the US Army Corps of Engineers lag equation. This equation uses basin length, shape, slope and land use to estimate lag. Schaaf & Wheeler used the County's 2005 LiDAR data to estimate basin flow paths and slopes. GIS routines were used to determine basin centroids and centroid lengths. The lag times computed with the equation described in the County Drainage Manual were short, with a negative lag time for some basins.

While the hydrologic model is statistically calibrated by using the calibrated AMC value as discussed in the previous section, the model was further calibrated by adjusting the basin lag equation. The peak runoff for basins of various sizes was first calculated using the unit hydrograph method and basin lag time calculated using the County Drainage Manual equation. The peak runoff for the basins was then calculated using the rational method as described in Chapter 3 of the County Drainage Manual. The peaks were compared and the basin lag equation was adjusted until the peak runoff from the two methods roughly matched. The basin lag equation was adjusted by removing the D/2 term, where D equals the unit hydrograph duration, and adding 5 minutes (0.083 hour) to produce the following lag equation:

where:

tlag SCS basin lag (hours)

N watershed roughness

L longest flow path from catchment divide to outlet (miles)

Lc length along flow path from a point perpendicular with the basin centroid to its outlet (miles)

S effective slope along main watercourse (feet/mile)

3.5 Pipe Flow Calculations

Detailed analyses of peak stormwater discharge are performed by the MU program, which also determines the flow condition in each drainage system element. The MU technical manual should be referenced for a more detailed description.

Closed Conduits

Pipes are modeled as one-dimensional closed conduit links which connect two nodes in the models. The conduit link is described by a constant cross-section along its length, constant bottom slope, and straight alignment. Unsteady flow in closed conduits is calculated using conservation of continuity and momentum equations, distinguishing between pipes flowing partially full (free surface flow), and those flowing full (pressurized flow). Most pipes within the Half Moon Bay model are modeled as reinforced concrete pipe (RCP) with a Manning's '*n*' of 0.013.

Junction Losses

Hydraulic losses at junctions (manholes, inlets, intersections) can be significant in pressurized drainage systems. Losses can vary due to construction methods, condition, and shape. Schaaf & Wheeler performed a sensitivity analysis of the loss coefficients used in MU to determine the most realistic model parameters. The MU Weighted Inlet Energy Method is used for this study. This method closely matches manhole losses prescribed in the County Drainage Manual as well as observed losses during flow monitoring.

Outlet Boundary Conditions

Pipe network outlets can be modeled with either a free outfall or a water surface elevation (fixed or variable with time) which captures backwater effects due to receiving water levels. In areas that outlet to a channel the water surface elevation is set at the top of bank elevation which assumes the channel is running full. The model was run with both a free outfall and downstream water surface elevation condition in order to determine whether flooding is occurring due to insufficient system capacity or backwater from the receiving water.

Channel Analysis

Roosevelt Ditch, Pullman Ditch, Kehoe Ditch, and Seymour Ditch were modeled using the U.S. Army Corps of Engineers' HEC-RAS 4.1 hydraulic model (USACE, 2010) using steady flow analysis for each storm event. Survey data that was collected by Schaaf & Wheeler was used to develop the cross sections for the hydraulic models, and were supplemented with LiDAR data. The roughness factors for the model are estimated based on field assessment.

Chapter 4. Storm Drain Collection Systems

4.1 Overview

The performance analysis of Half Moon Bay's storm drain collection system forms the essential core of this master plan. This chapter describes major storm drain facilities, and the known drainage issues. Areas that should be considered for improvement during Phase II are identified and prioritized.

4.2 Evaluation of the Storm Drain Capacity Criteria

Each collection system has been analyzed for the existing and future land use conditions to determine its performance during the 2-, 10-, 25-, and 100-year storm events. For purposes of readability, the existing and future land use condition 10-year storm results are shown in this chapter; results for all other storms can be found in Appendix F.

Areas of significant flooding are recognized herein. To determine the depth of flooding at any particular node in the MU model, the maximum hydraulic grade line (HGL) and ground elevation were utilized, as shown in the following equation:

Depth of flooding = Max HGL – Ground Elevation

For example, if the ground elevation is 7.5 ft at a node and MU computes a max hydraulic grade of 8.3 ft, the depth at flooding at this node would be 0.8 ft. Water is allowed to pond at the node until there is there capacity in pipe system to accommodate the flow. The depth and duration of flooding are considered during the prioritization process.

Categorizing Deficiencies

Half Moon Bay's storm drain system is broken into nine drainage sub-areas as previously discussed. The basins are organized around natural topographic boundaries and drainage facility boundaries or watersheds. It should be noted that neither private drainage systems nor site-specific drainage characteristics (i.e. individual parcels) have been analyzed as that level of detail is unnecessary at the master planning level. These models can be refined in the future to more precisely account for these site-specific drainage characteristics during the development of detailed drainage studies.

Storm drain deficiencies are described in the following sub-area discussions. In some locations, the hydraulic grade line (HGL) predicted by the one-dimensional (1D) model at individual nodes in the system may be greater than actual water surface elevation during a storm event. This is due to limitations and assumptions inherent in the 1D modeling software. For example, the top of drainage system where water from a catchment is added to the model, but in reality water enters that point through pipes smaller than 12-inches. In order to 'ground truth' predictive model results, Schaaf & Wheeler discussed model results with City staff and observed a storm event. Locations recommended for improvement consideration are based on the results of this complete process, not solely on model results. As such, some locations predicted to have flooding surcharge based on model results alone are not recommended for improvement consideration.

Deficiencies are categorized into three groups based on flood history, depth, and duration as described in Table 4-1.

Table 4-1. Deficiency Category Description

Deficiency Category	Description
High	Projects under this category have a large area of flooding where the 10-year maximum flood depth is greater than 12-inches, and are typically locations with the deepest and longest flooding situations. Areas of significant historical flooding fall into this category.
Moderate	This category has conditions similar to high priority, but has a smaller area affected by flooding. The depth and duration of flooding is less than that of a high deficiency category.
Low	Low priority deficiencies are generally considered nuisance flooding. The depth and duration of flooding is much less than that of moderate and high deficiency categories.

Condition Assessment

Schaaf & Wheeler noted the condition of storm drain facilities that were observed during field data collection. Overall, the system appears to be in good condition. The majority of the system is reinforced concrete pipe (RCP) with minimal signs of corrosion. The corrugated metal pipe (CMP) located during field condition is generally in poor condition and should be considered for improvement during Phase II of the master planning process. CMP pipe field identified by Schaaf & Wheeler is shown in Figure 4-1.

Figure 4-1: Location of CMP

4.4 Half Moon Bay Systems

Roosevelt/Pullman/Frenchman's

Overview

The Roosevelt drainage area is approximately 224 acres, the Pullman drainage area is approximately 171 acres, and the Frenchman's drainage area is approximately 69 acres. The three drainage areas have a combined total of 5,333 linear feet (1.01 miles) of modeled storm drain pipe equal to or greater than 12-inches in diameter. The Roosevelt drainage area flows west to Roosevelt Ditch which outfalls to the Pacific Ocean. The Pullman drainage area flows west to Pullman Ditch which outfalls to the Pacific ocean. The Frenchman's drainage area flows generally south to Frenchman's Creek which flows west to the Pacific Ocean

Identified Deficiencies

MU analysis of the Roosevelt, Pullman, and Frenchman's systems for the 10-year storm event existing land use condition shows flooding (HGL above the rim elevation of the node) occurring at 1 node when modeled with free outfalls. Flooding occurs at 6 nodes when boundary conditions are applied at the outfalls. A map of the 10-year flooding depths predicted by the MU analyses of the existing storm sewer system with free outfalls is presented in Figure 4-2. Flood depths predicted with boundary conditions applied are shown in Figure 4-3.

HEC-RAS analysis of Roosevelt Ditch shows that the ditch has 25-year capacity, and overtops during 100-year flow at one location. The profile of Roosevelt Ditch with water surface profiles is shown in Figure 4-6. HEC-RAS analysis of Pullman Ditch shows that the ditch does not have 2-year capacity. The culvert under Hwy 101 overtops at 10-year flow. The profile of Pullman Ditch with water surface profiles is shown in Figure 4-8. Frenchman's Creek was not analyzed as part of this study.

The future land use condition does not substantially affect flooding during the 10-year storm event, with similar flooding expected as in the existing land use condition as discussed above. A map of the 10-year flooding depths predicted by the MU analyses of the future land use with free outfalls is presented in Figure 4-4. Flood depths predicted with boundary conditions applied are shown in Figure 4-5.

Improvement Consideration

Pullman Ditch should be considered a high priority deficiency due to the depth of flooding. It should be improved or bypassed in order to prevent flooding of surrounding areas.

Roosevelt Ditch should be maintained periodically in order to maintain current capacity.

Since, the future land use condition in the Roosevelt, Pullman, and Frechman system does not substantially affect flooding as compared to the existing land use condition, no additional improvements are necessary for the future land use condition in this area.

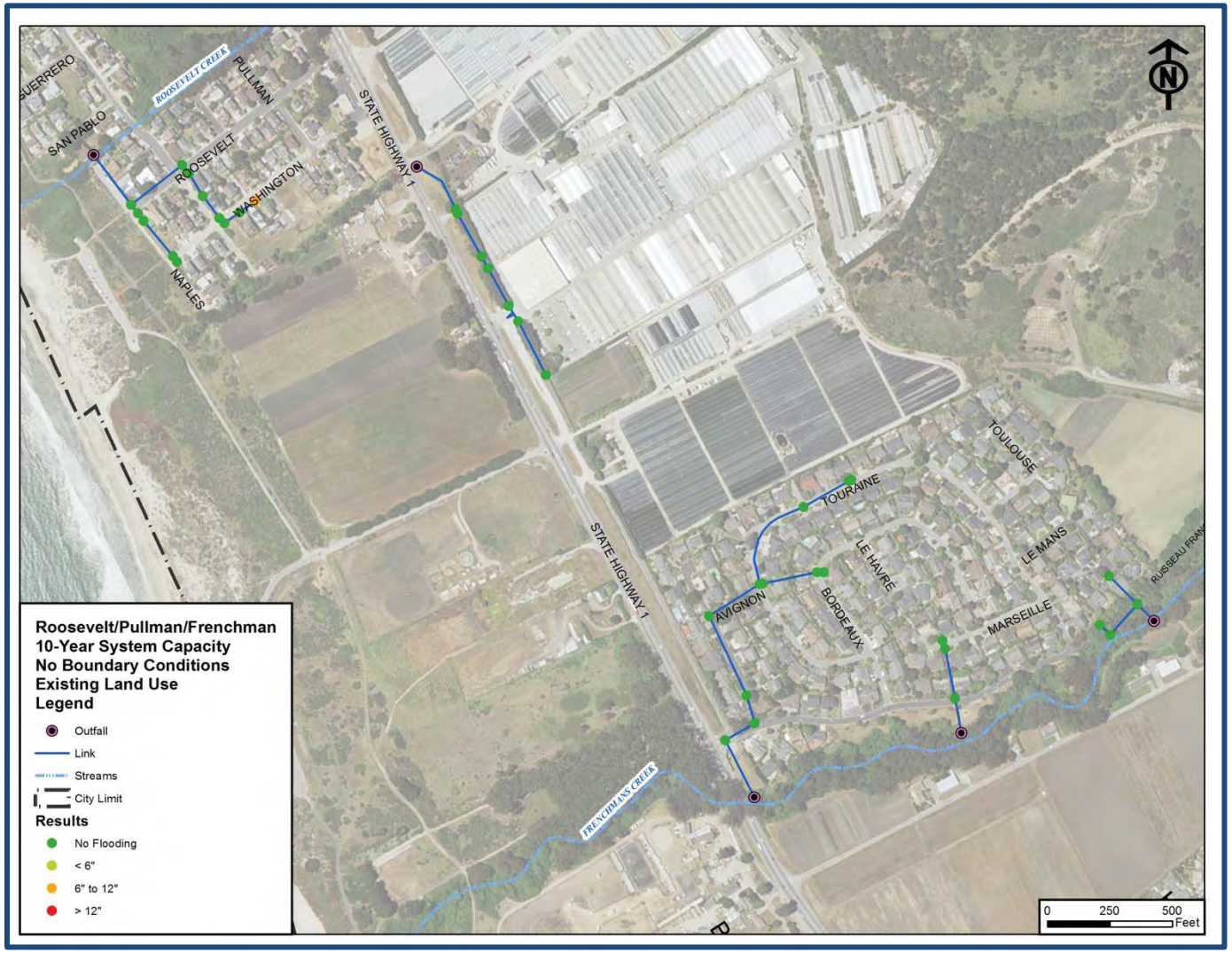


Figure 4-2: Roosevelt/Pullman/Frenchman 10-Year System Capacity with No Boundary Conditions and Existing Land Use

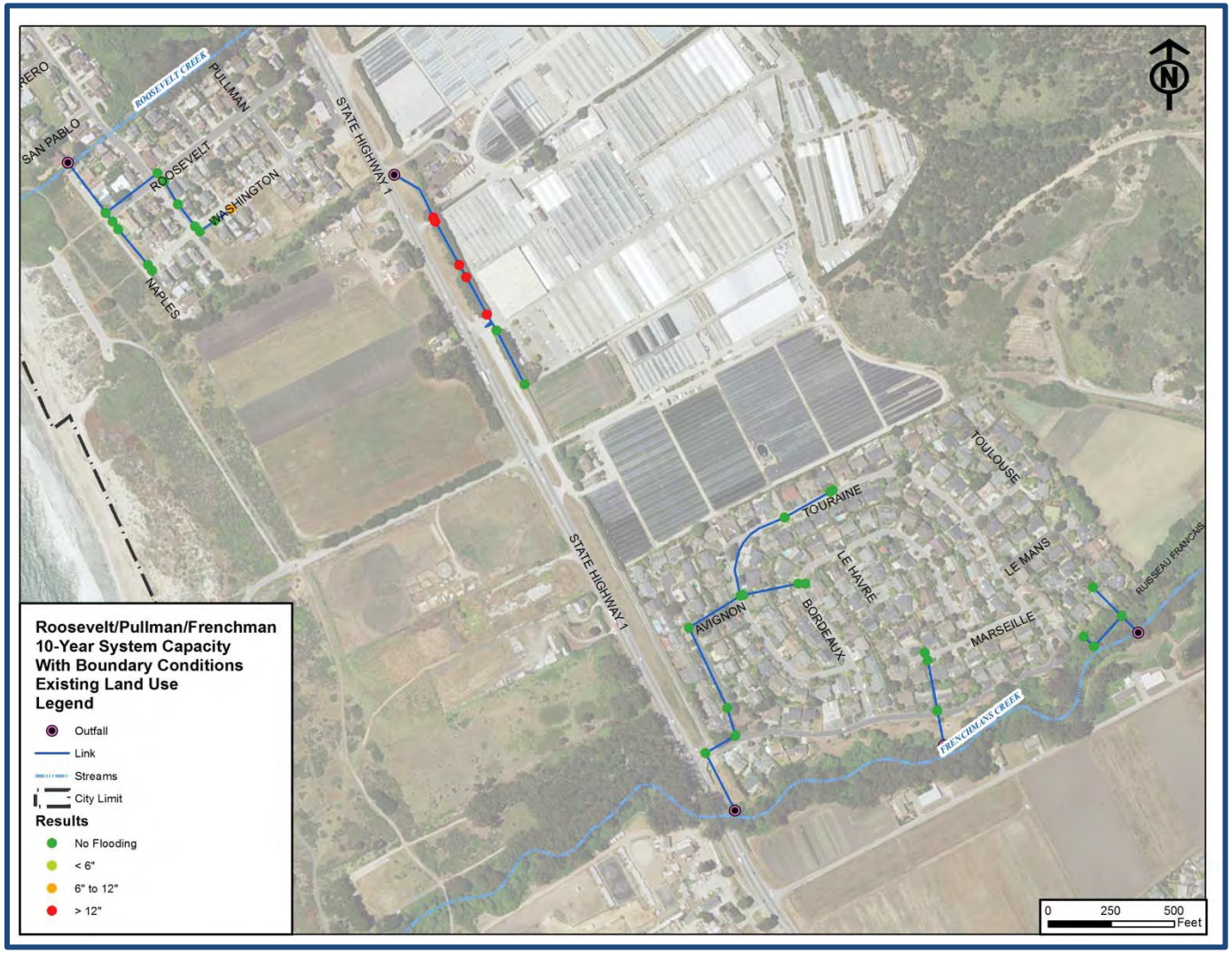


Figure 4-3: Roosevelt/Pullman/Frenchman 10-Year System Capacity with Boundary Conditions and Existing Land Use

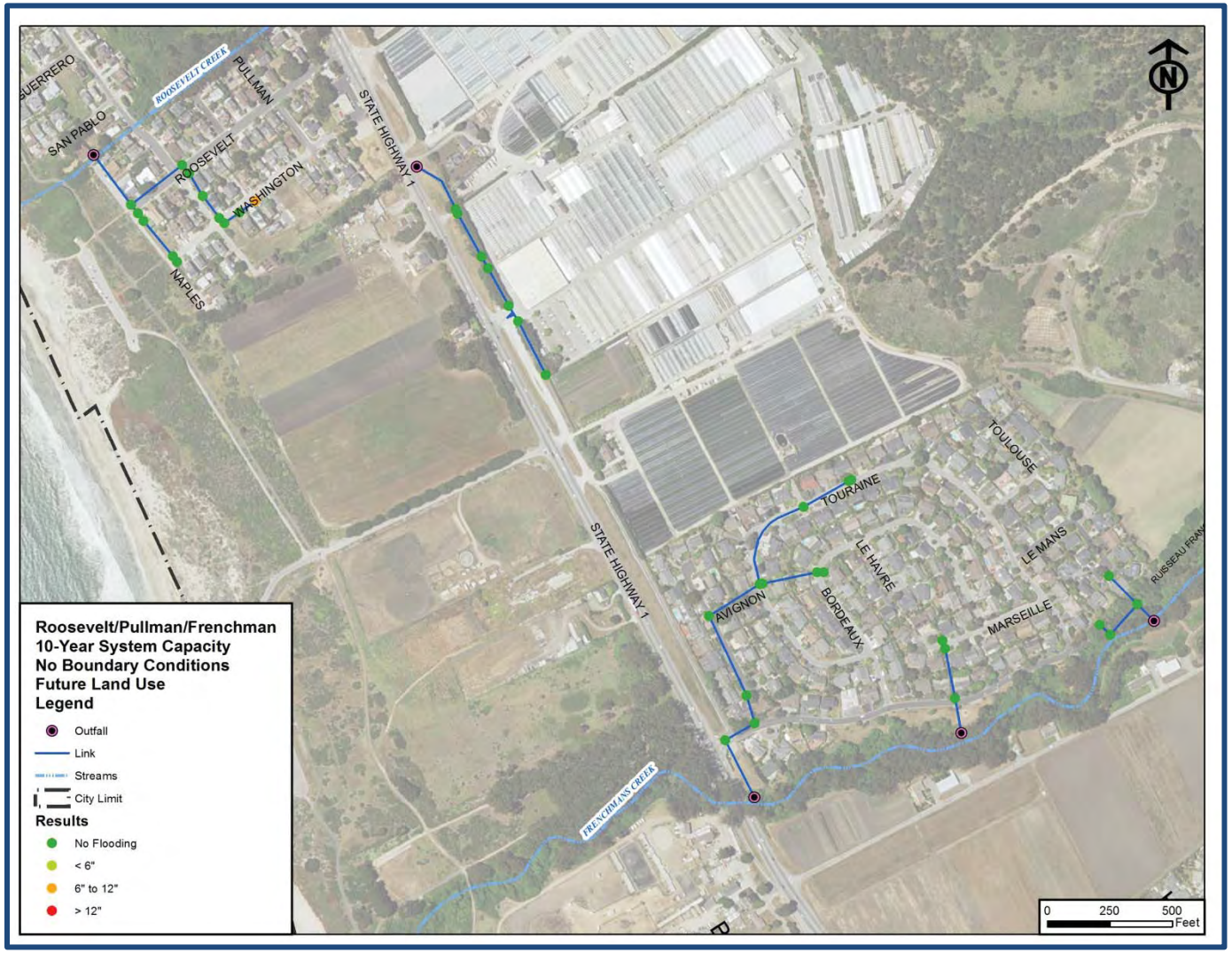


Figure 4-4: Roosevelt/Pullman/Frenchman 10-Year System Capacity with no Boundary Conditions and Future Land Use

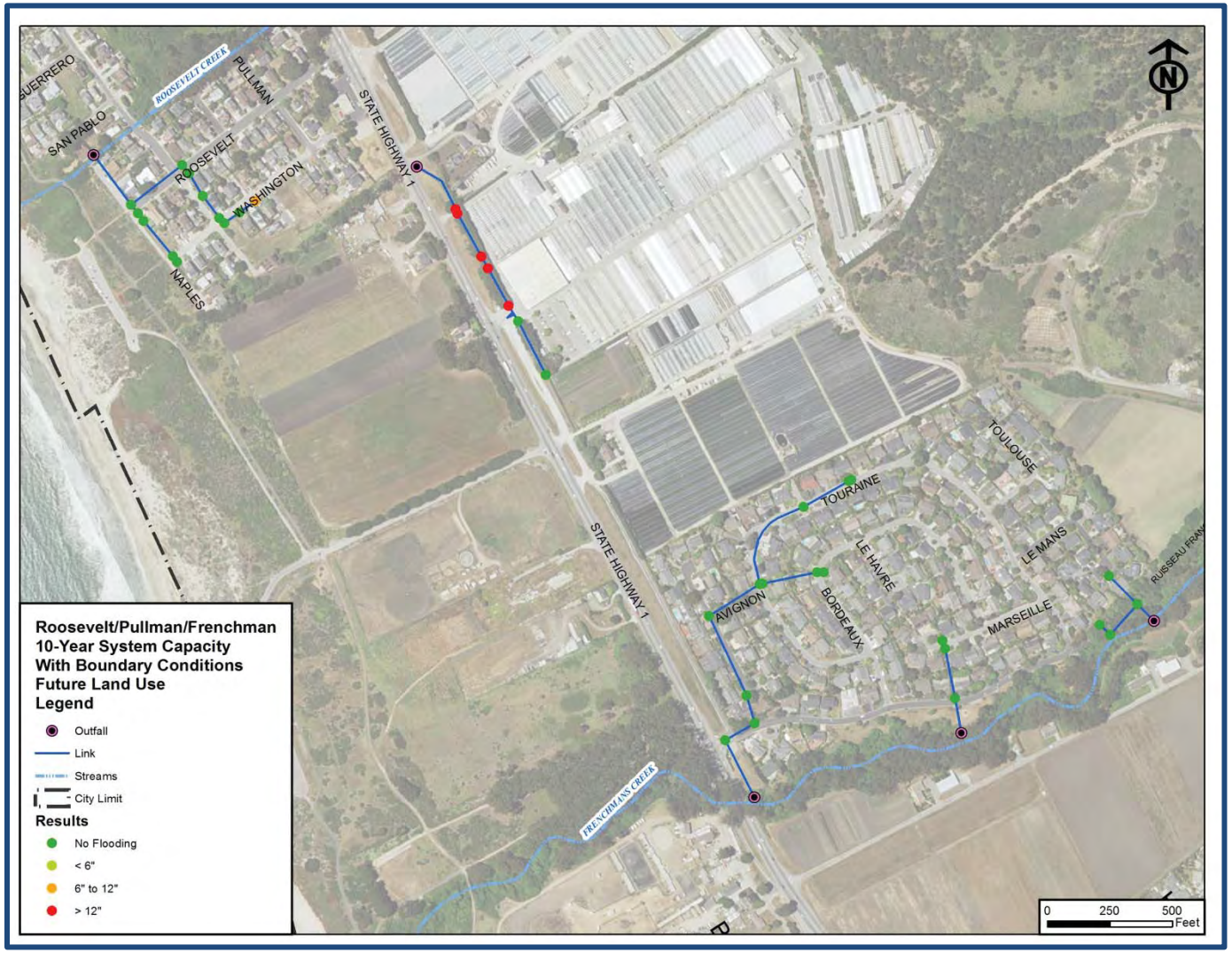


Figure 4-5: Roosevelt/Pullman/Frenchman 10-Year System Capacity with Boundary Conditions and Future Land Use

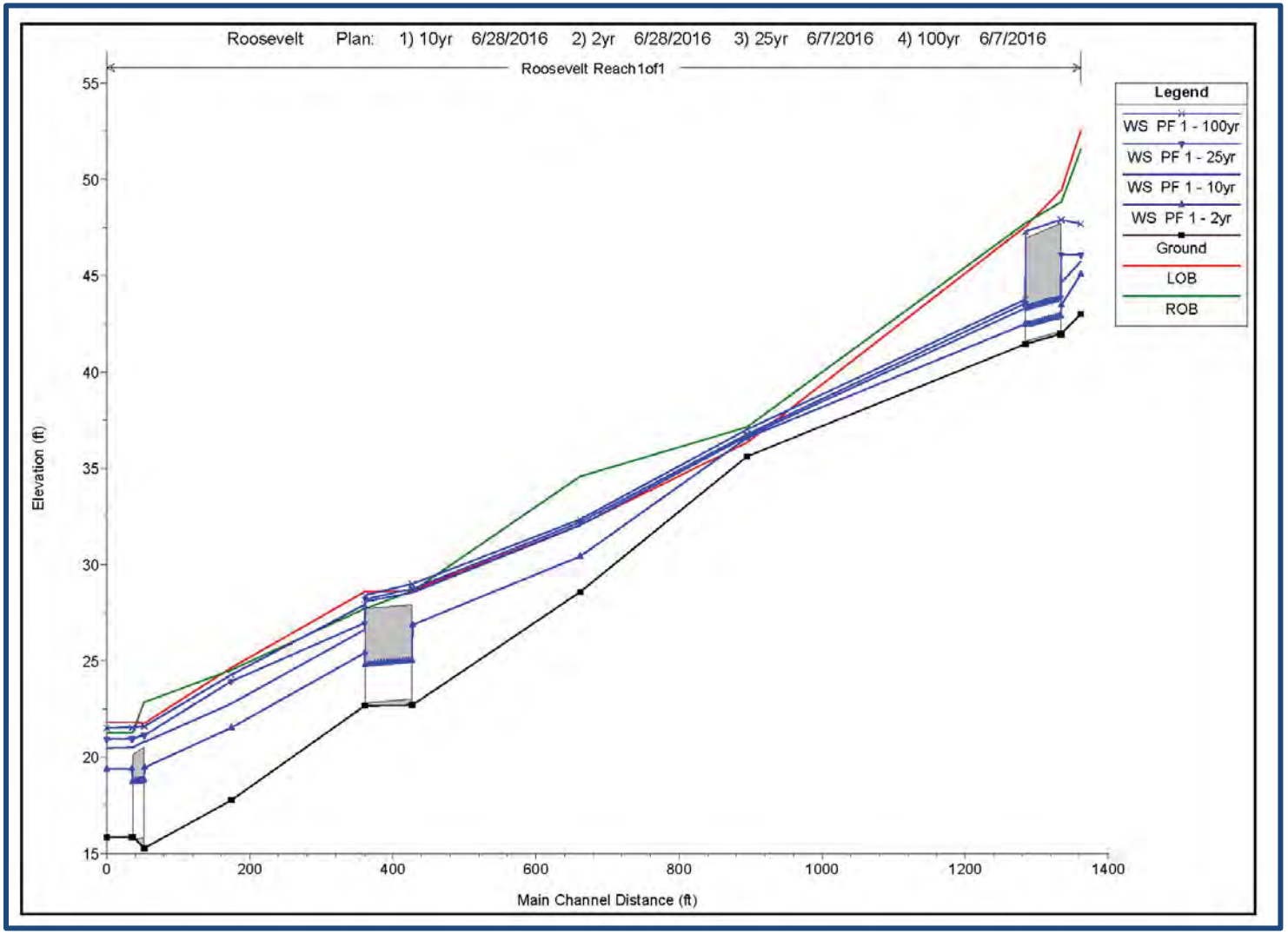


Figure 4-6: Roosevelt Ditch HEC-RAS Profile with Existing Land Use

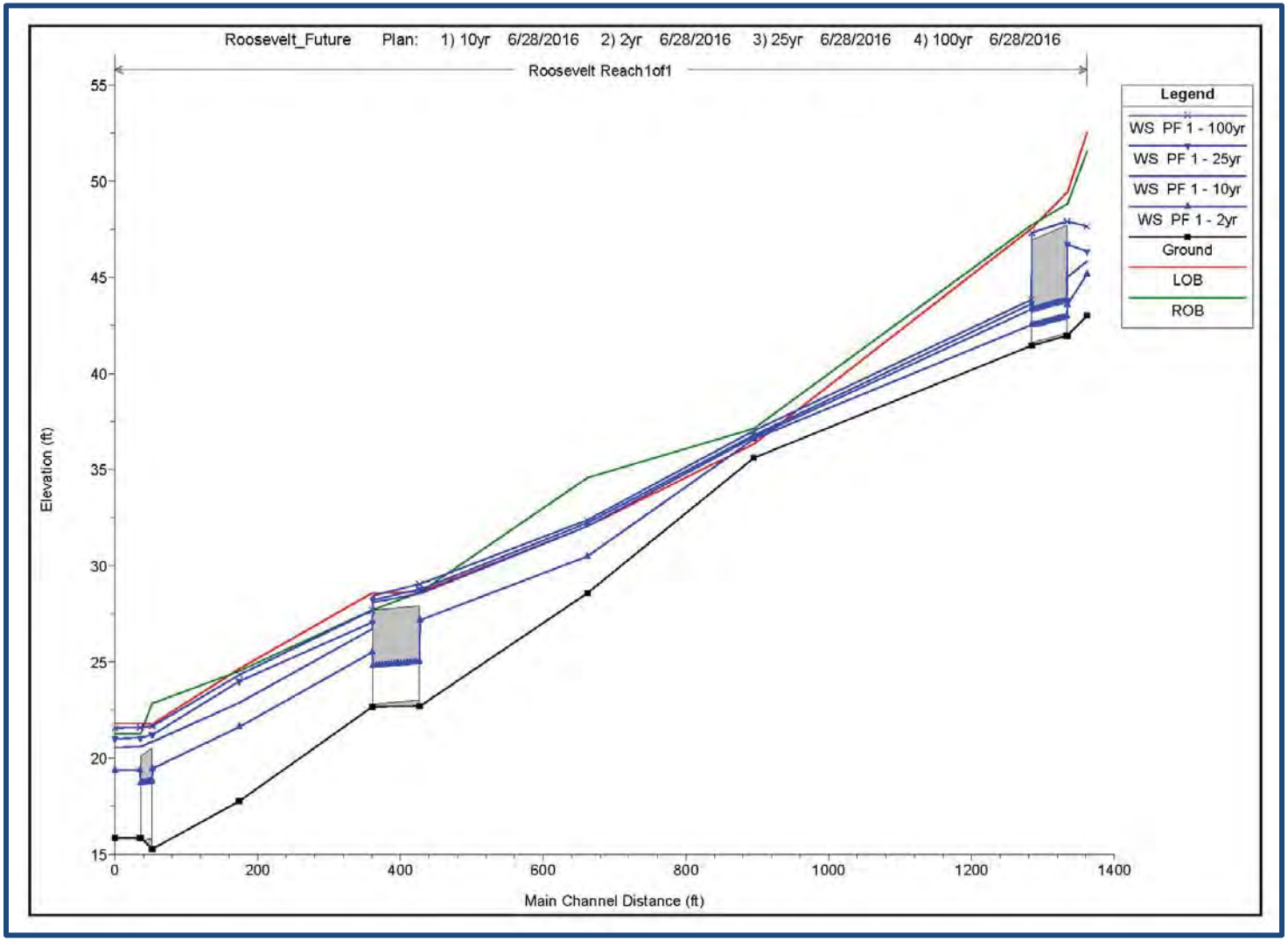


Figure 4-7: Roosevelt Ditch HEC-RAS Profile with Future Land Use

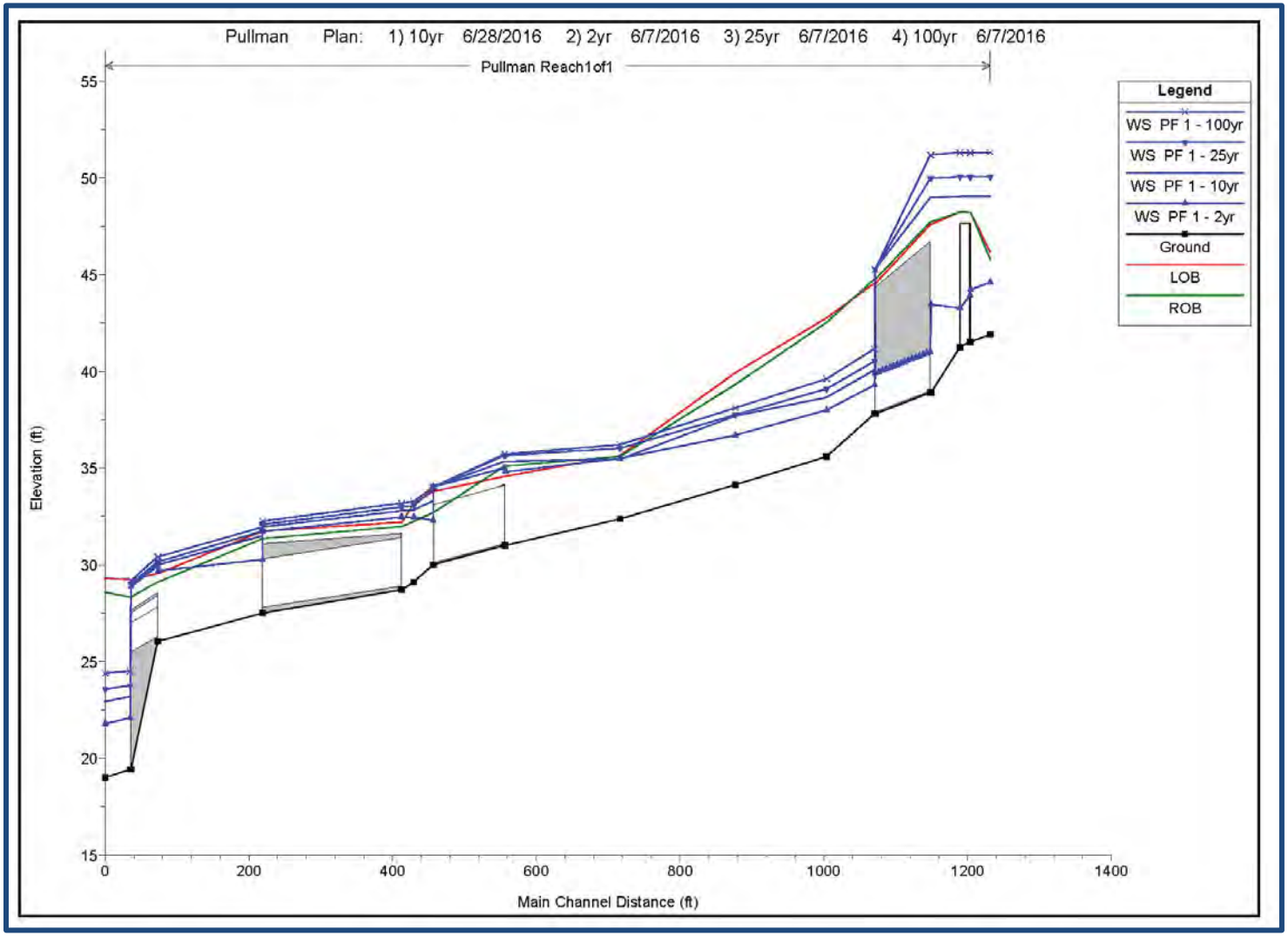


Figure 4-8: Pullman Ditch HEC-RAS Profile with Existing Land Use

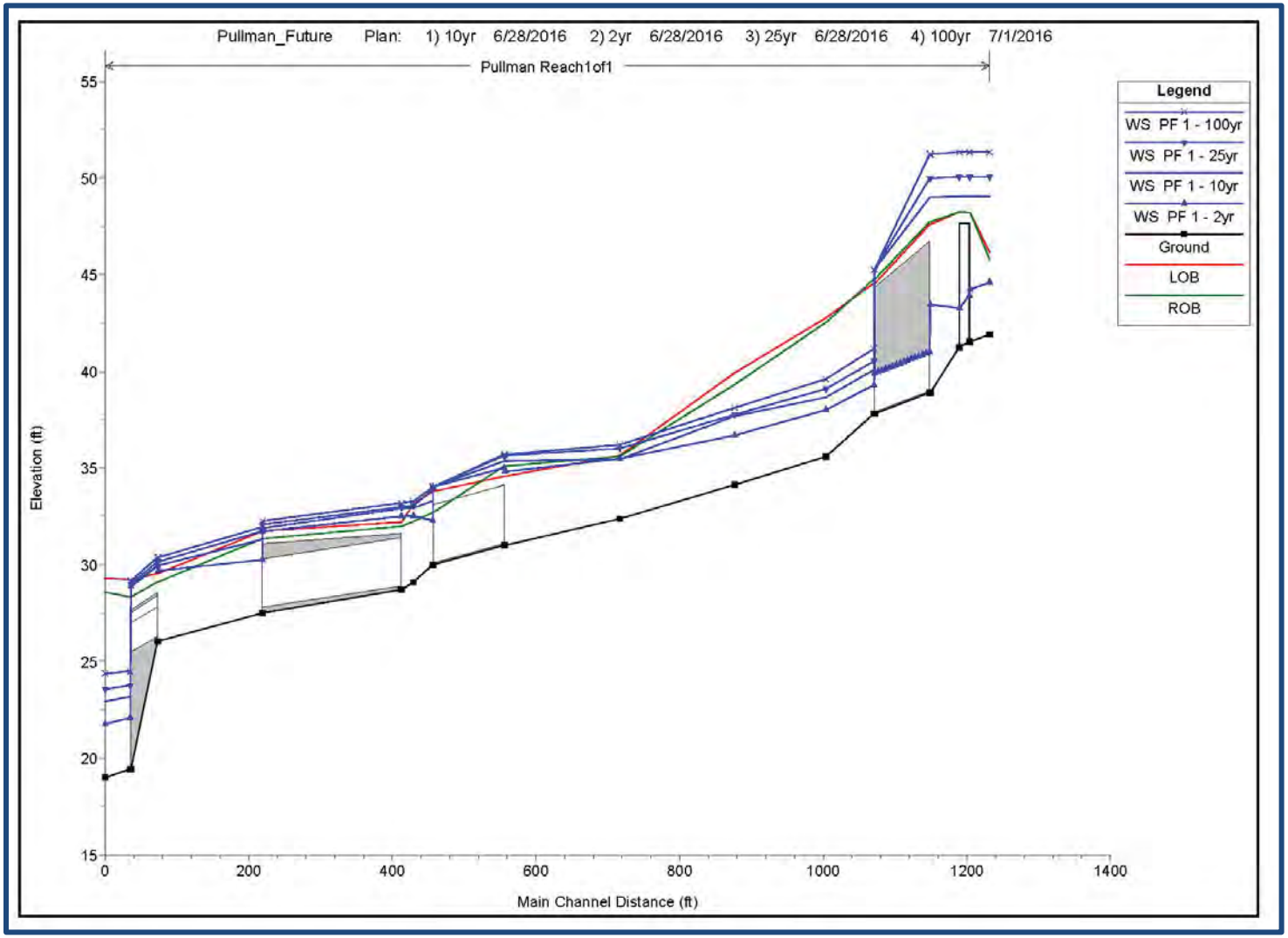


Figure 4-9: Pullman Ditch HEC-RAS Profile with Future Land Use

Pilarcitos/Kehoe

Overview

The Pilarcitos drainage area is approximately 660 acres and the Kehoe drainage area is approximately 330 acres. The two drainage areas have a combined total of 33,950 linear feet (6.43 miles) of modeled storm drain pipe equal to or greater than 12-inches in diameter. The Pilarcitos drainage area flows to Pilarcitos Creek which outfalls to the Pacific Ocean. The Kehoe drainage area flows west to Kehoe Ditch which outfalls to Pilarcitos Creek.

Identified Deficiencies

MU analysis of the Pilarcitos and Kehoe systems for the 10-year storm event existing land use condition shows flooding (HGL above the rim elevation of the node) occurring at 36 nodes when modeled with free outfalls. Flooding occurs at 44 nodes when boundary conditions are applied at the outfalls. A map of the 10-year flooding depths predicted by the MU analyses of the existing storm sewer system with free outfalls is presented in Figure 4-10. Flood depths predicted with boundary conditions applied are shown in Figure 4-11.

HEC-RAS analysis of Kehoe Ditch shows that the ditch has 100-year capacity. The profile of Kehoe Ditch with water surface profiles is shown in Figure 4-8. Kehoe Ditch was studied in depth during preparation of the "Kehoe Ditch Hydrology and Hydraulics Study" (Schaaf & Wheeler, December 2015).

The future land use condition does not substantially affect flooding during the 10-year storm event, with similar flooding expected as in the existing land use condition as discussed above. A map of the 10-year flooding depths predicted by the MU analyses of the future land use with free outfalls is presented in Figure 4-12. Flood depths predicted with boundary conditions applied are shown in Figure 4-13.

Improvement Consideration

The flooding occurring on Spindrift Way should be considered a high priority deficiency due to the depth and duration of flooding. The pipes that serve this area may require upsizing. Flooding occurring on Hwy 92 near the intersection of Main Street should also be considered a high priority deficiency due to the depth and duration of flooding. The pipes that serve this area may require upsizing.

Lower priority deficiencies occur on Jenna Lane near Laurel Ave. and Purissima St. near Mill St. Improvements to mitigate flooding in these areas should be considered.

Kehoe Ditch should be maintained to preserve existing capacity.

Since, the future land use condition in the Pilarcitos and Kehoe system does not substantially affect flooding as compared to the existing land use condition, no additional improvements are necessary for the future land use condition in this area.

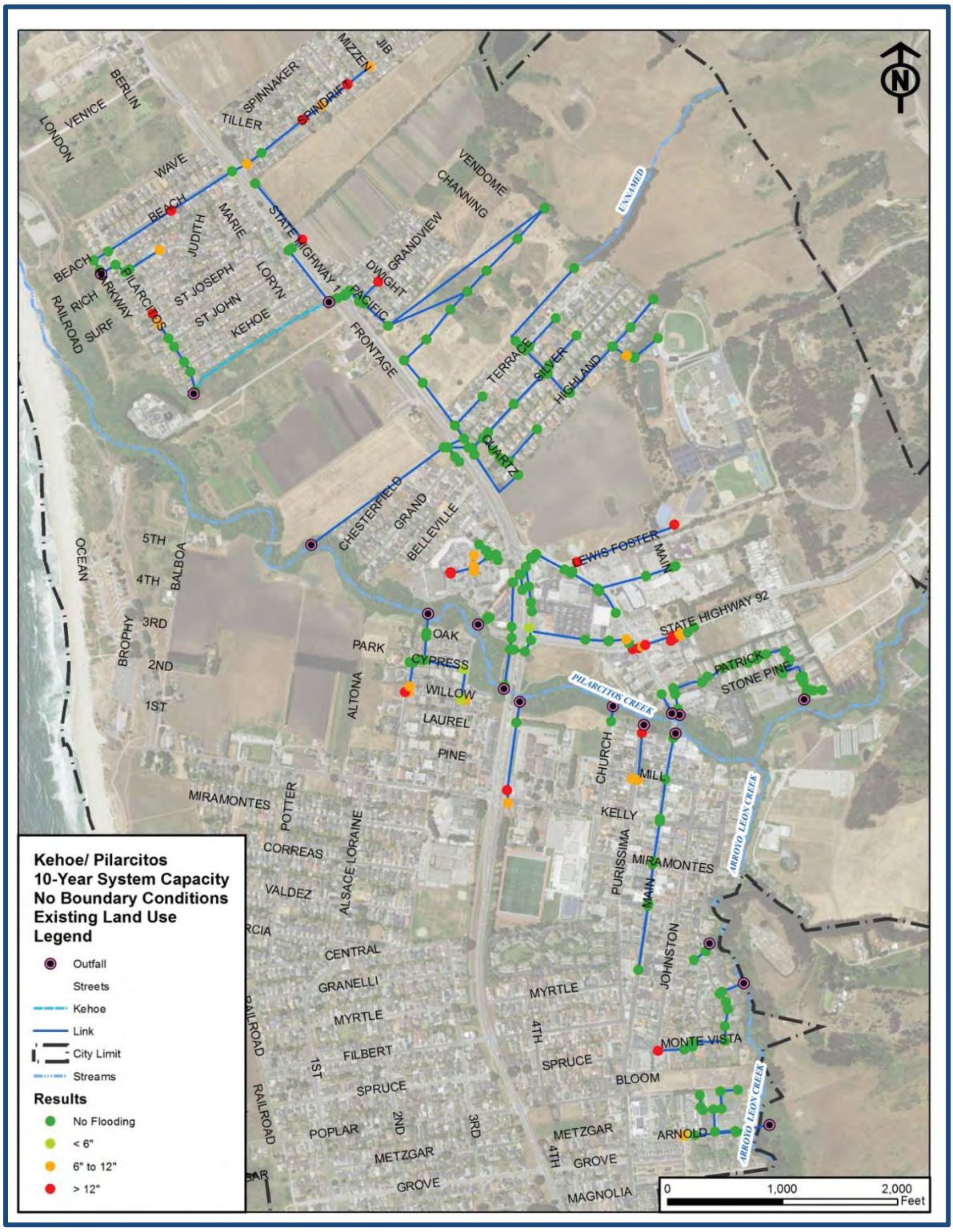


Figure 4-10: Kehoe/Pilarcitos 10-Year System Capacity with No Boundary Conditions and Existing Land Use

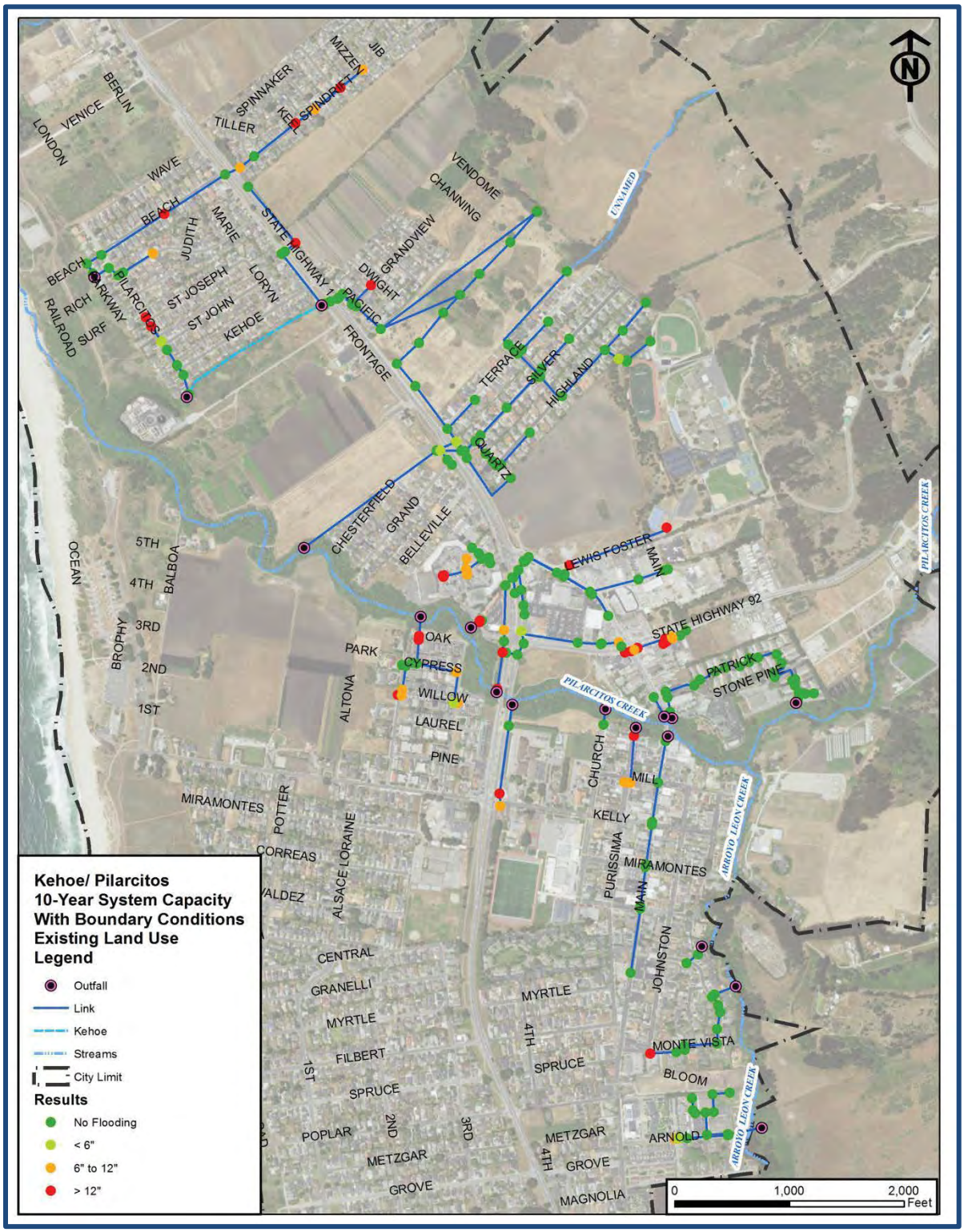


Figure 4-11: Kehoe/Pilarcitos Area 10-Year System Capacity with Boundary Conditions and Existing Land Use

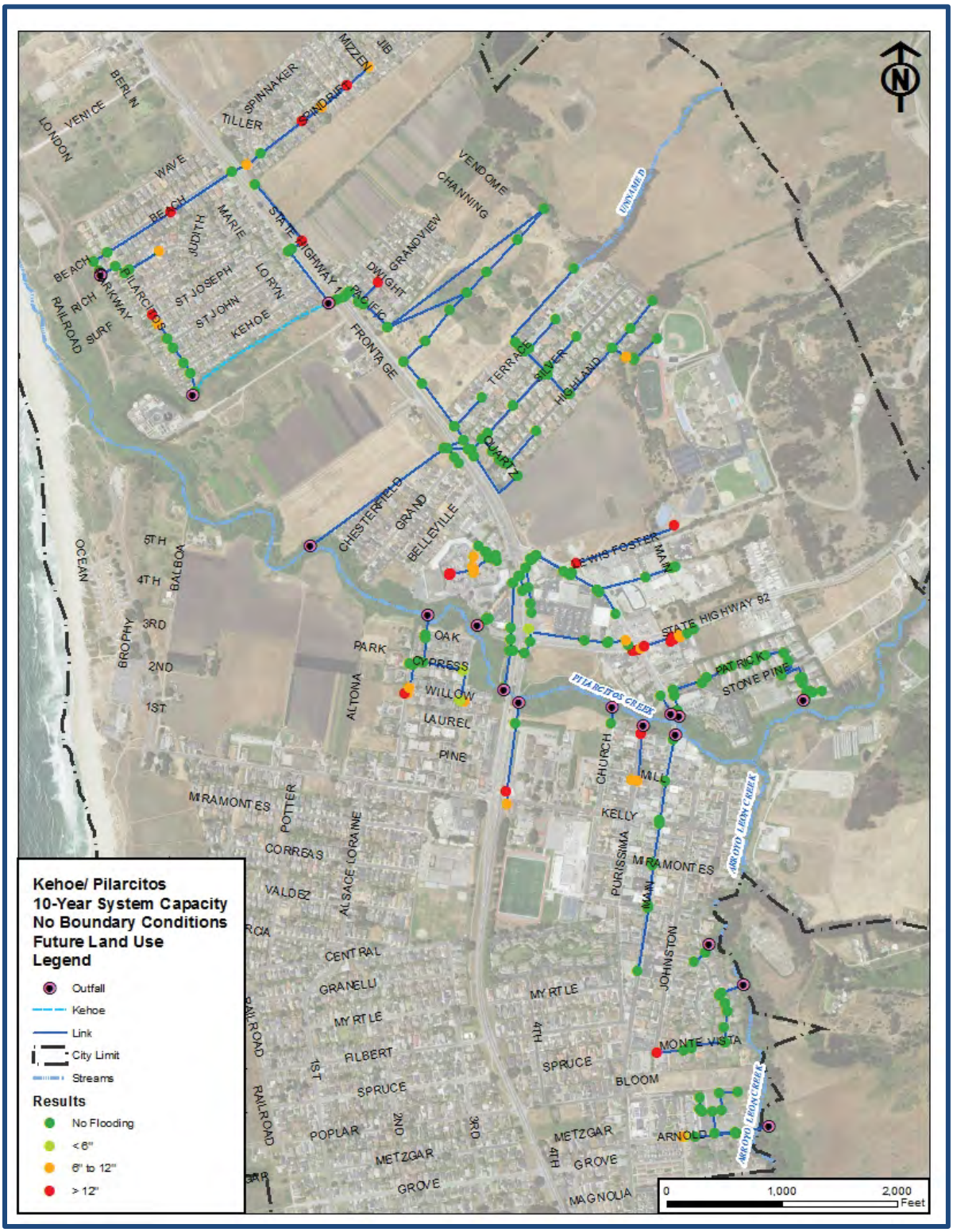


Figure 4-12: Kehoe/Pilarcitos 10-Year System Capacity with No Boundary Conditions and Future Land Use

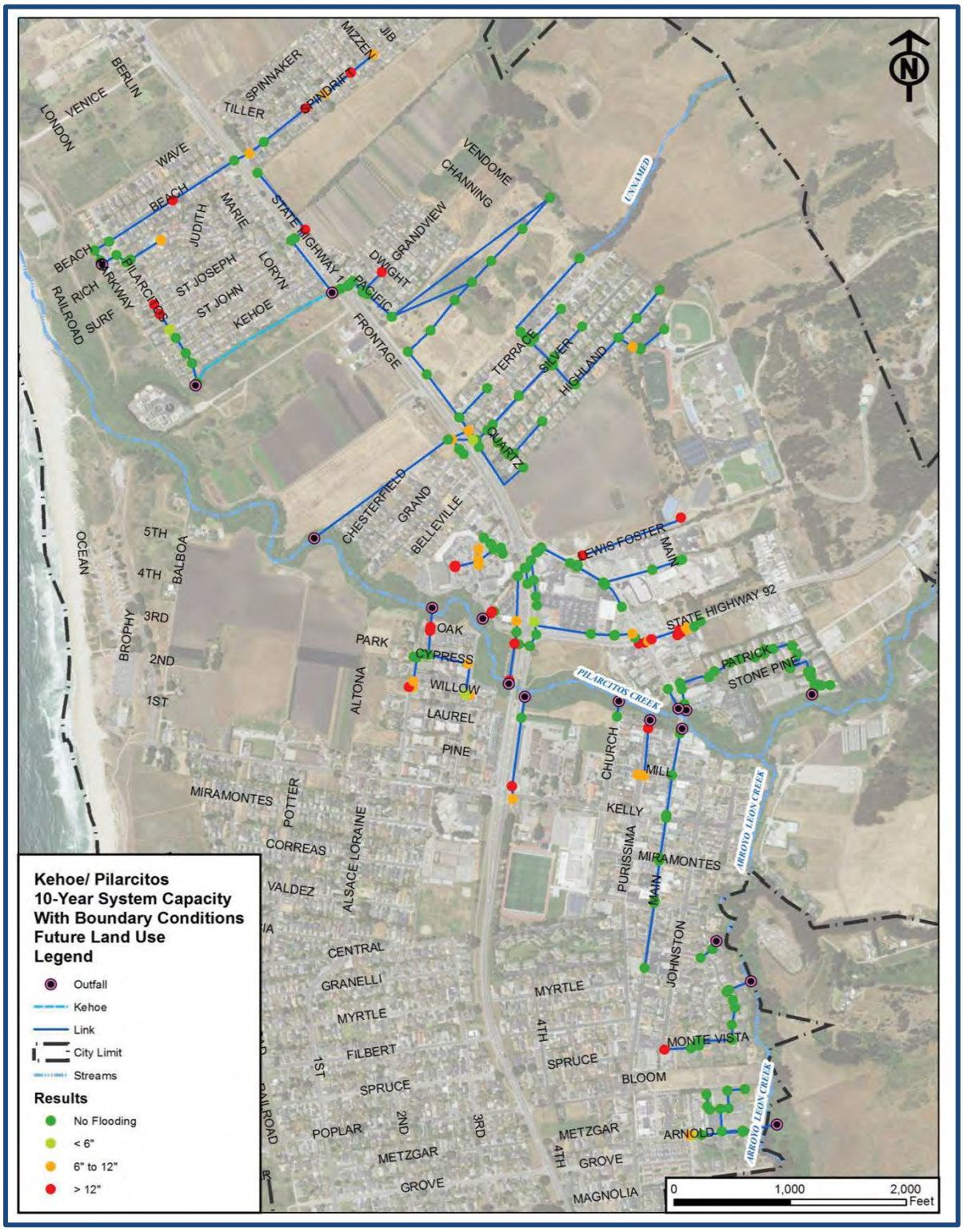


Figure 4-13: Kehoe/Pilarcitos 10-Year System Capacity with Boundary Conditions and Future Land Use

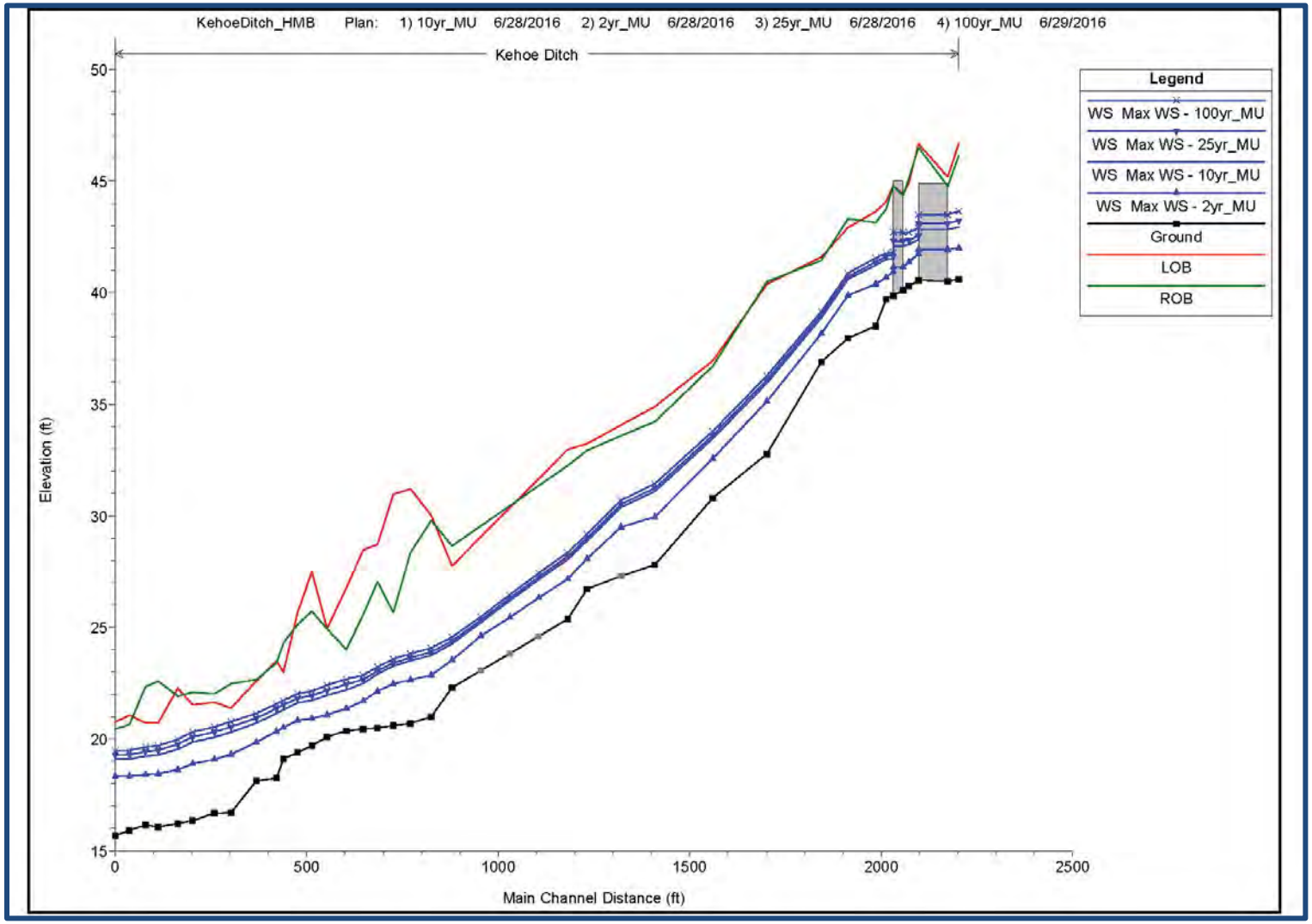


Figure 4-14: Kehoe HEC-RAS Profile with Existing Land Use

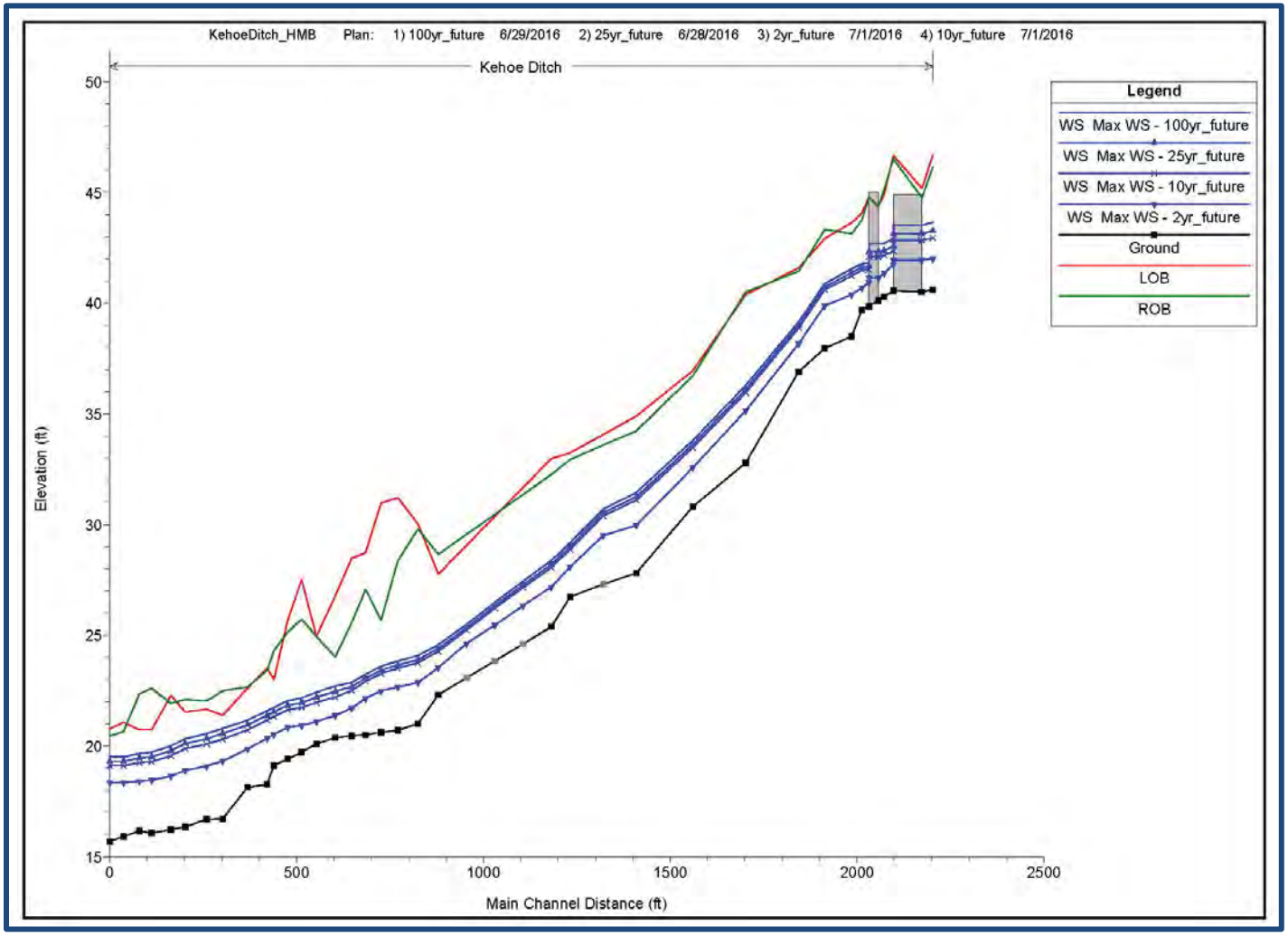


Figure 4-15: Kehoe HEC-RAS Profile with Future Land Use

Pacific Ocean/ Seymour

Overview

The Pacific Ocean drainage area is approximately 288 acres and the Seymour drainage area is approximately 577 acres. The two drainage areas have a combined total of 15,048 linear feet (2.85 miles) of modeled storm drain pipe equal to or greater than 12-inches in diameter. The Pacific Ocean drainage area flows generally west to the Pacific Ocean. The Seymour drainage area flows west to Seymour Ditch which outfalls to the Pacific Ocean.

Identified Deficiencies

MU analysis of the Pacific Ocean and Seymour systems for the 10-year storm event existing land use condition shows flooding (HGL above the rim elevation of the node) occurring at 46 node when modeled with free outfalls. Flooding occurs at 49 nodes when boundary conditions are applied at the outfalls. A map of the 10-year flooding depths predicted by the MU analyses of the existing storm sewer system with free outfalls is presented in Figure 4-16. Flood depths predicted with boundary conditions applied are shown in Figure 4-17.

HEC-RAS analysis of Seymour Ditch shows that the ditch has 2-year capacity, and overtops two locations with 10-year flow. It does not have greater than 10-year capacity. The profile of Seymour Ditch with water surface profiles is shown in Figure 4-20.

The future land use condition does not substantially affect flooding during the 10-year storm event, with similar flooding expected as in the existing land use condition as discussed above. A map of the 10-year flooding depths predicted by the MU analyses of the future land use with free outfalls is presented in Figure 4-18. Flood depths predicted with boundary conditions applied are shown in Figure 4-19.

Improvement Consideration

Flooding along Kelly Ave. should be considered a high priority deficiency. The culvert under Hwy 1 just south of Kelly Ave. discharges to an unimproved area to the east of Cabrillo Unified School District. Water then flows through undefined ditches often reinforced with sandbags to Kelly Ave. where it flows overland for approximately half a mile before re-entering the storm drain system. Several properties at the west end of Kelly Ave. are subject to stormwater intrusion multiple times a year. Improvements should be made that mitigate this flooding.

Seymour Ditch should be considered a high priority deficiency. The ditch should be improved or bypassed in order to provide an acceptable level of service to areas that discharge to the ditch.

Since, the future land use condition in the Pacific Ocean and Seymour systems does not substantially affect flooding as compared to the existing land use condition, no additional improvements are necessary for the future land use condition in this area.

Storm observation on the south west corner of Kelly Ave. and Hwy 1.

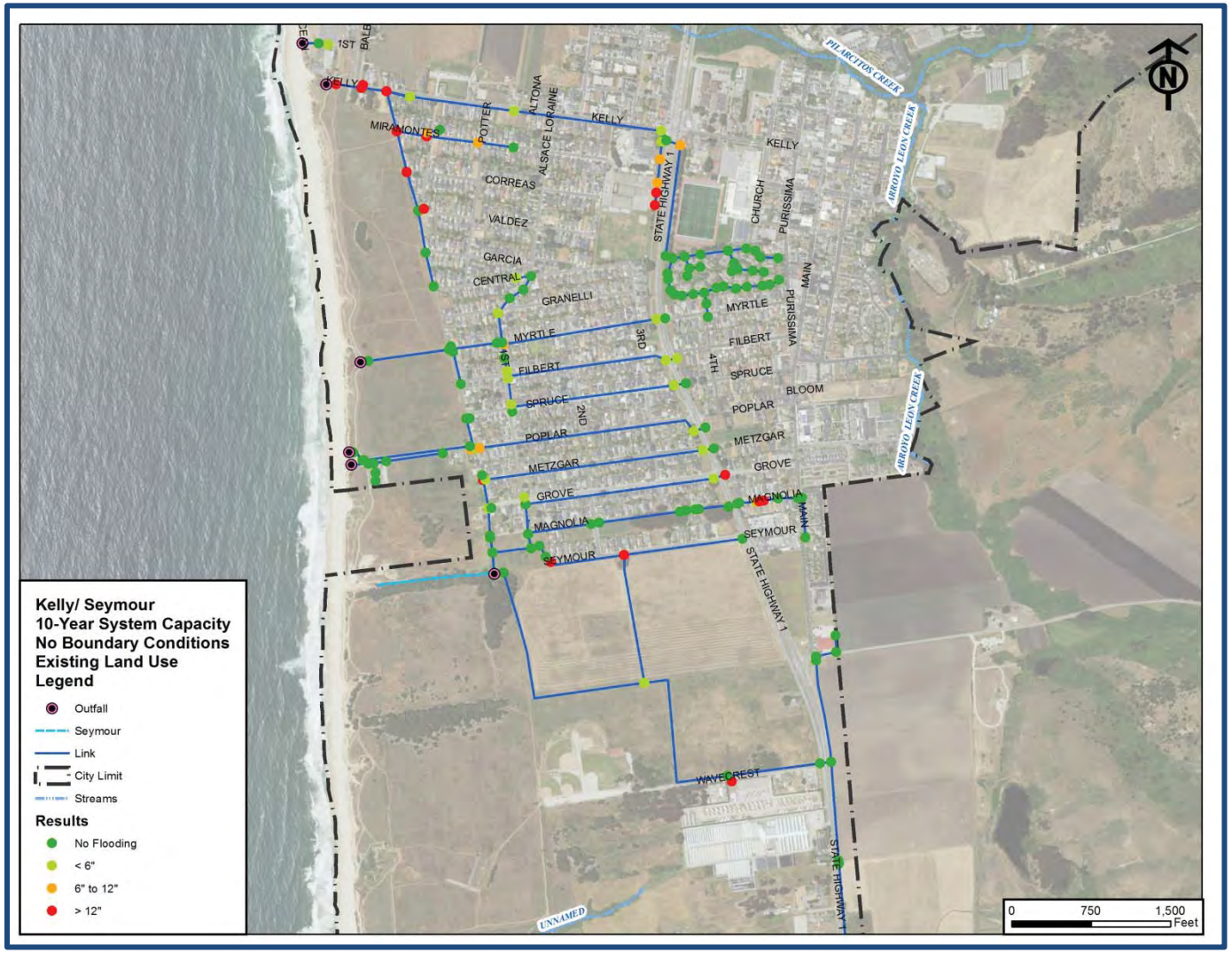


Figure 4-16: Pacific Ocean/Seymour 10-Year System Capacity with No Boundary Conditions and Existing Land Use

Figure 4-17: Pacific Ocean/ Seymour 10-Year System Capacity with Boundary Conditions and Existing Land Use

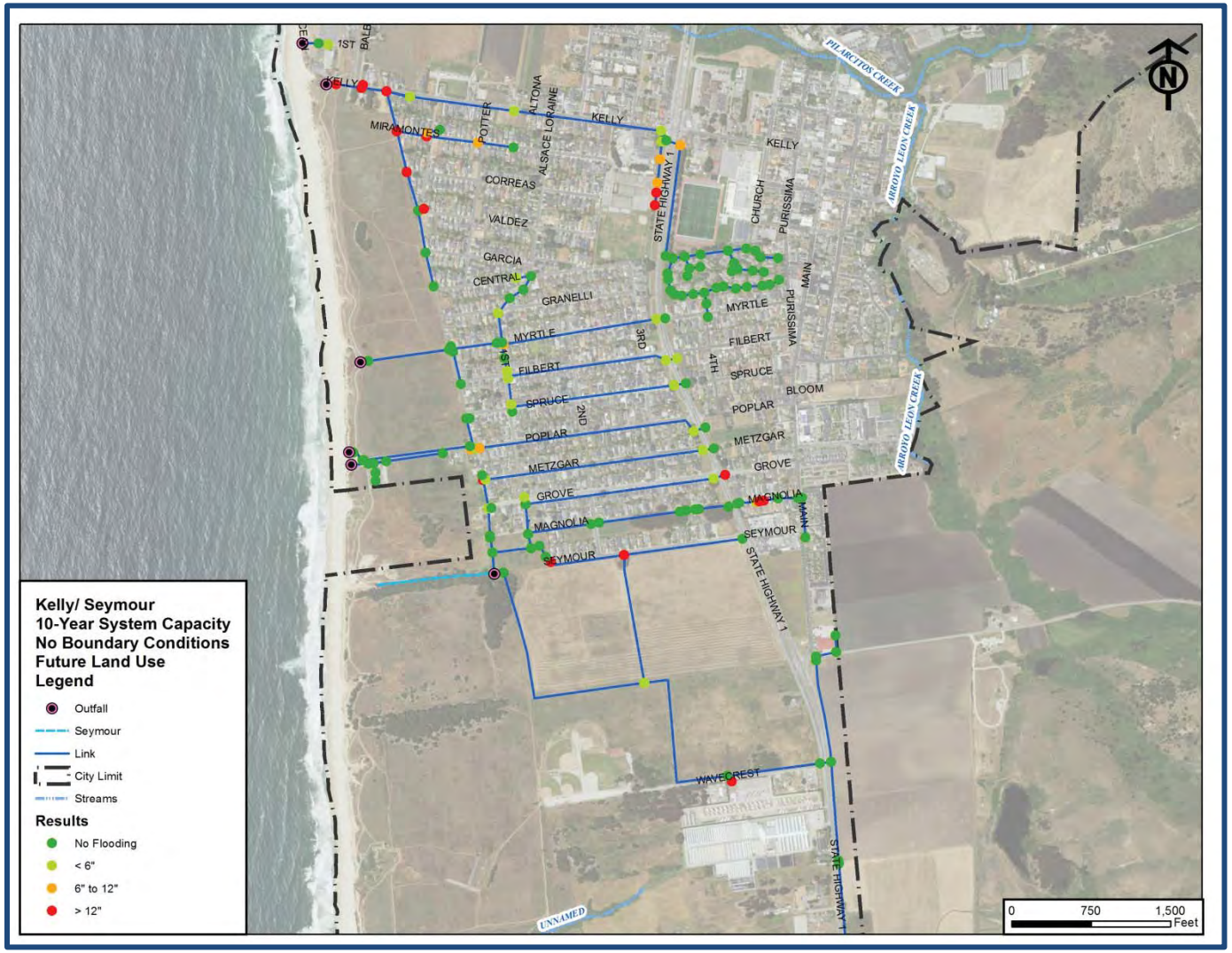


Figure 4-18: Pacific Ocean/ Seymour 10-Year System Capacity with No Boundary Conditions and Future Land Use

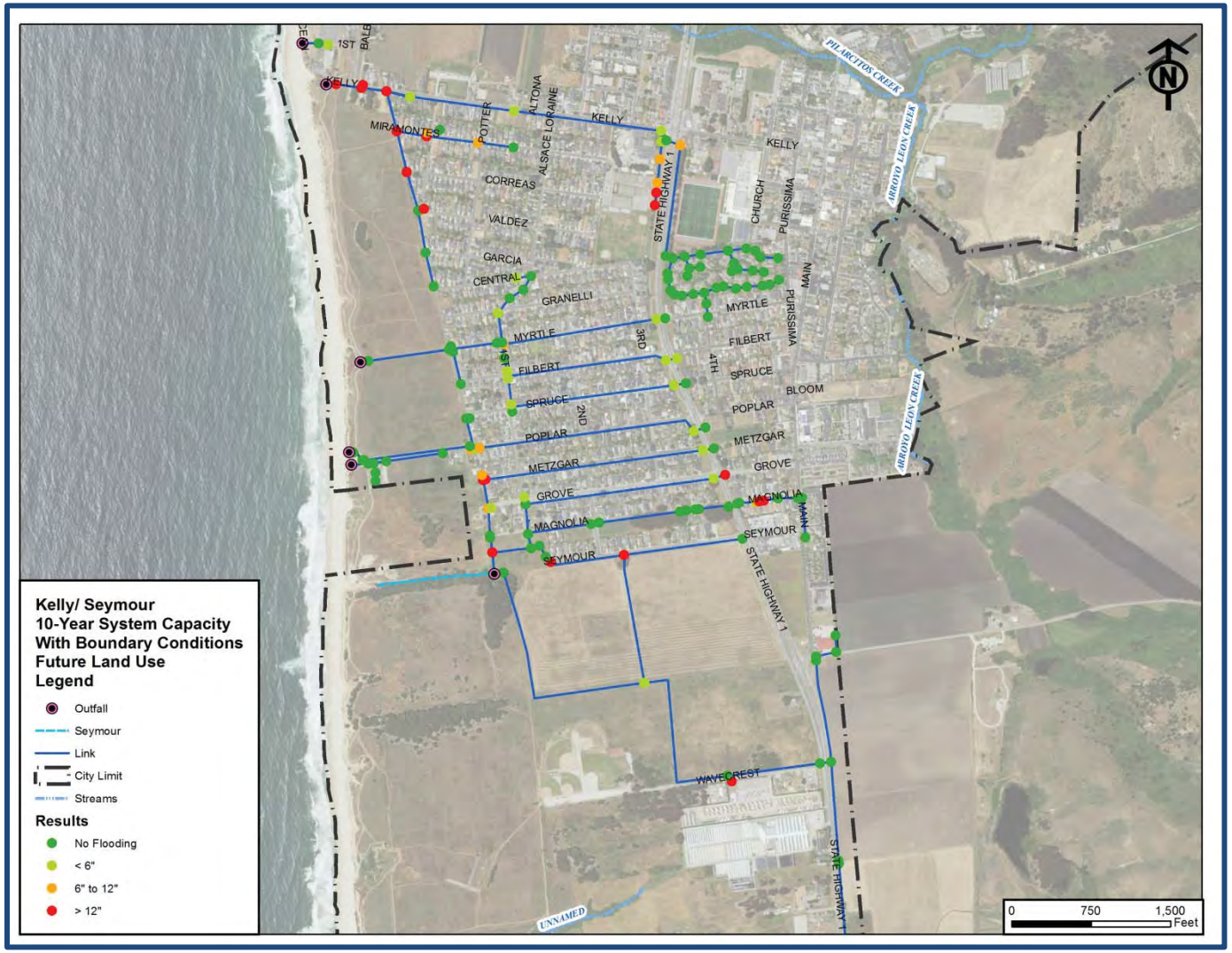


Figure 4-19: Pacific Ocean/ Seymour 10-Year System Capacity with Boundary Conditions and Existing Land Use

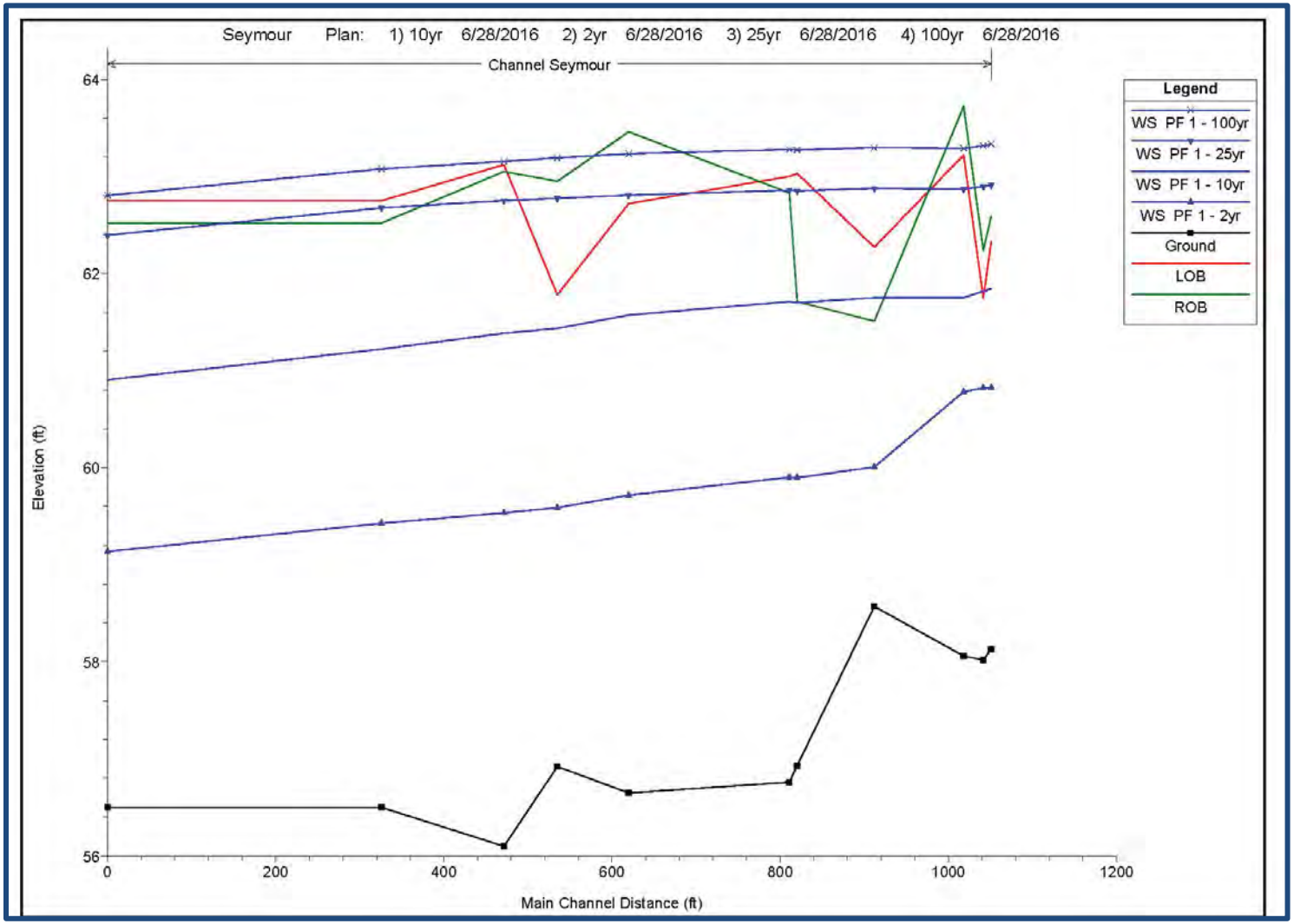


Figure 4-20: Seymour RAS Profile with Existing Land Use Conditions

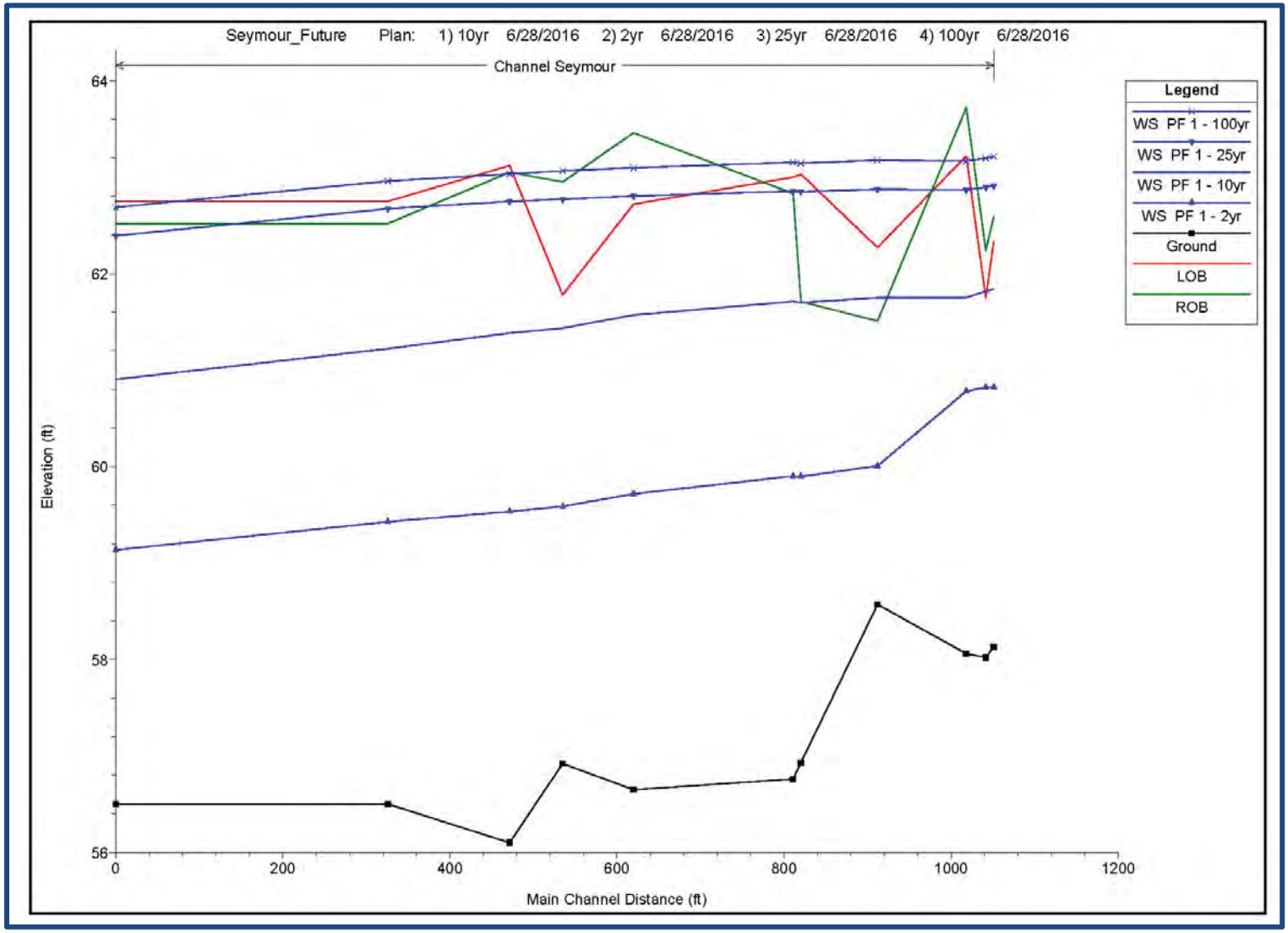


Figure 4-21: Seymour RAS Profile with Future Land Use

Golf Course

Overview

The Golf Course drainage area is approximately 557 acres The drainage area has a total of 12,038 linear feet (2.28 miles) of modeled storm drain network equal to or greater than 12-inches in diameter. The Golf Course drainage area flows generally west to the Pacific Ocean.

Identified Deficiencies

There are no identified deficiencies that impact the City's right-of-way in the Golf Course drainage area.

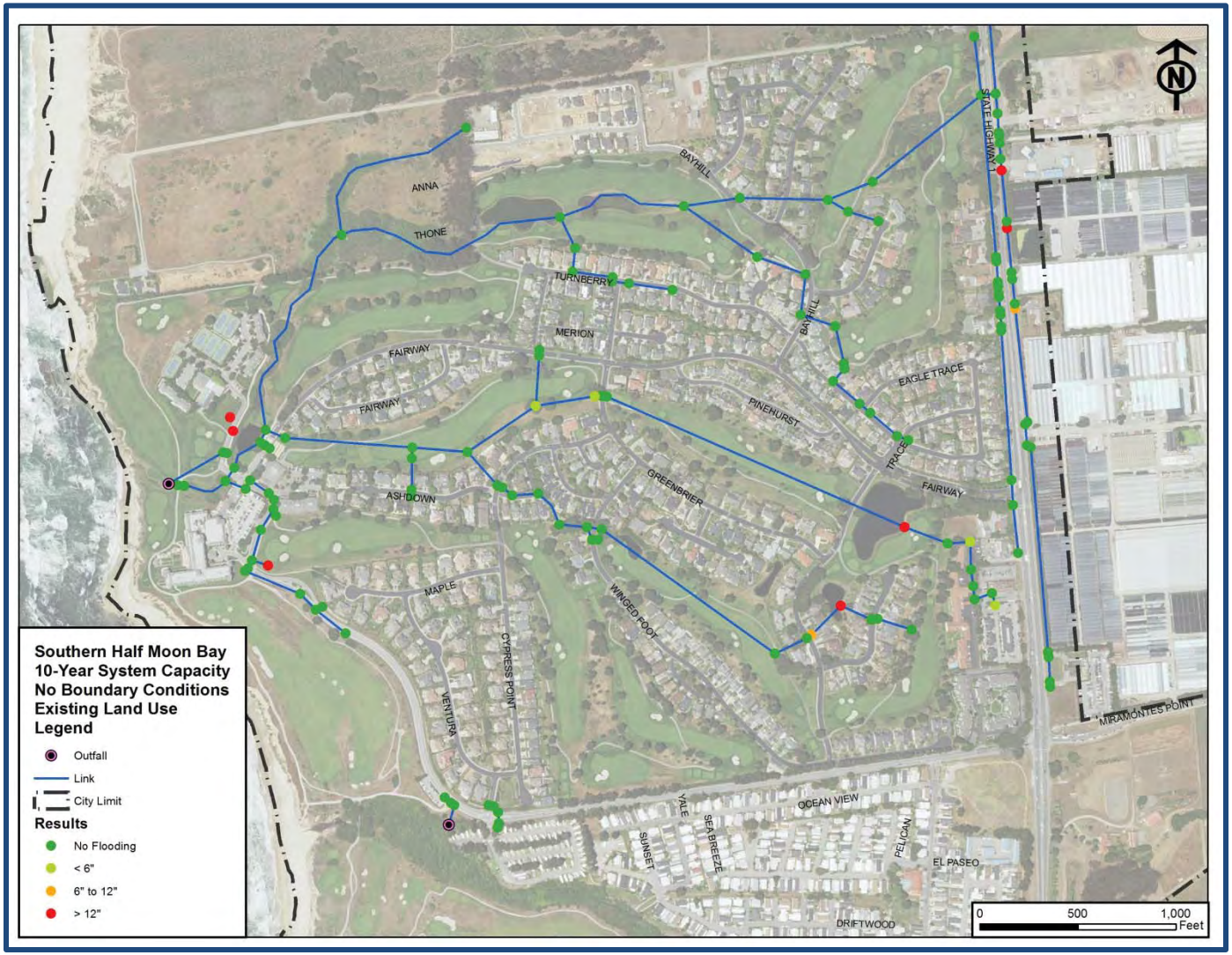


Figure 4-22: Southern Half Moon Bay 10-Year Storm Capacity with No Boundary Conditions and Existing Land Use

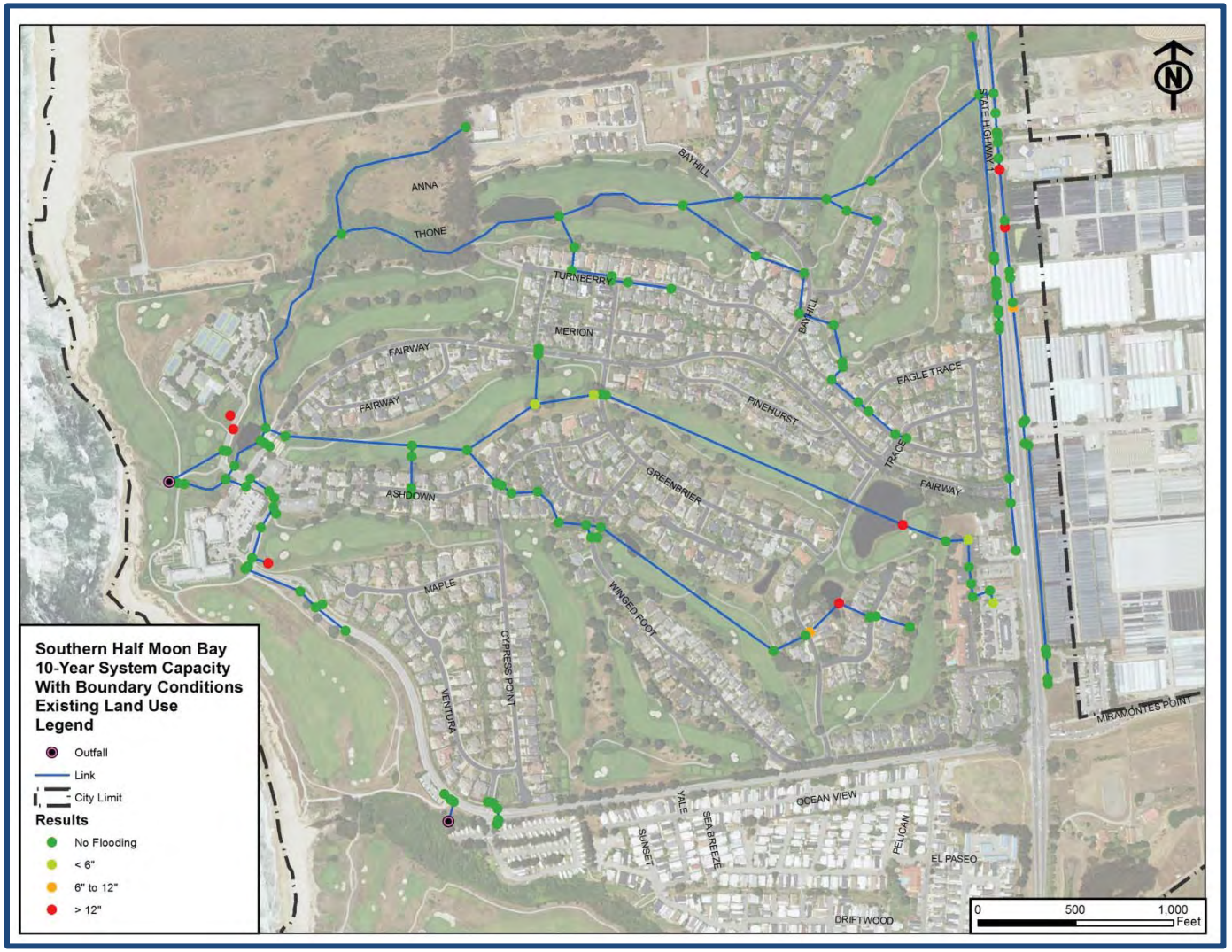


Figure 4-23: Southern Half Moon Bay 10-Year Storm Capacity with Boundary Conditions and Existing Land Use

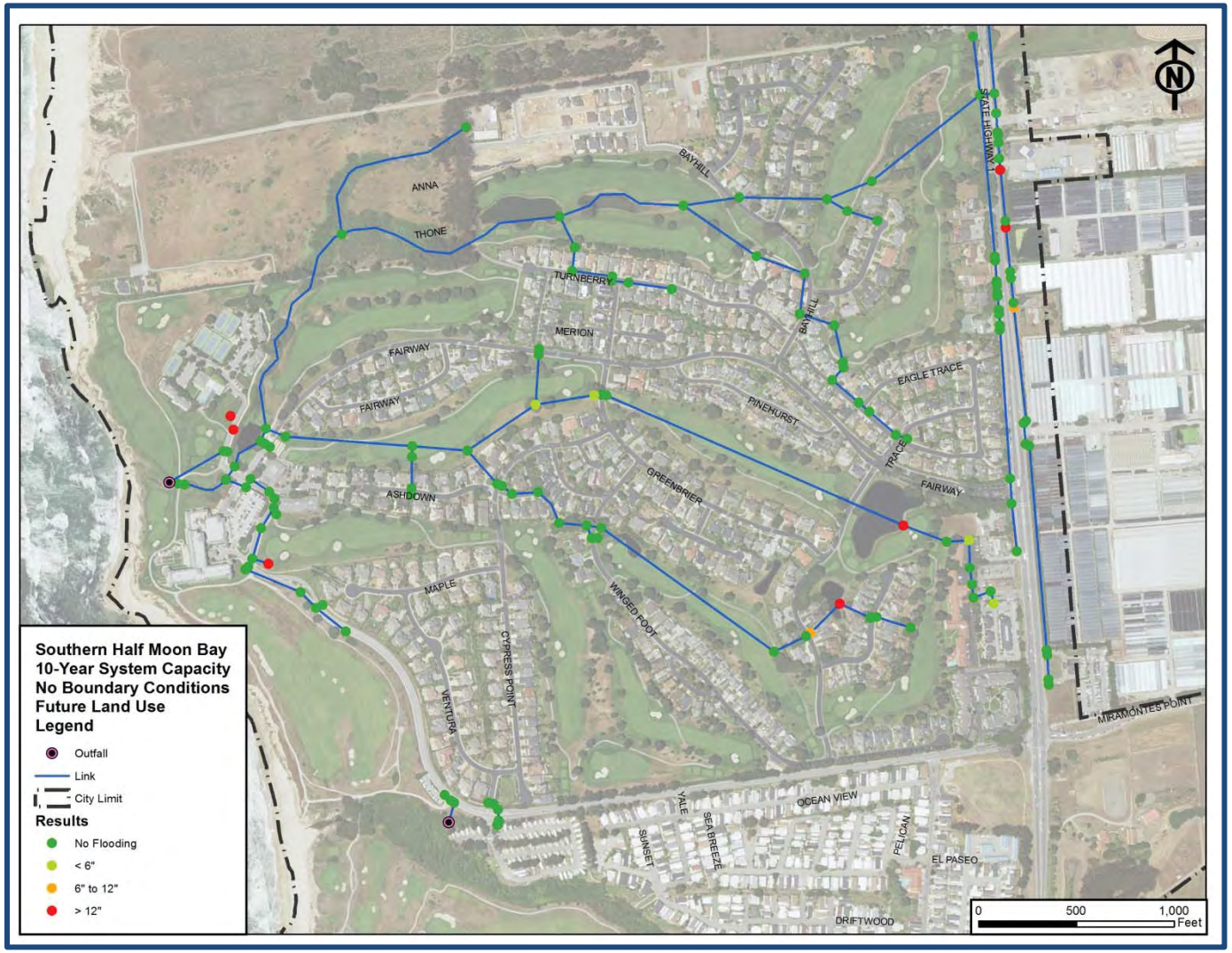


Figure 4-24: Southern Half Moon Bay 10-Year Storm Capacity with No Boundary Conditions and Future Land Use

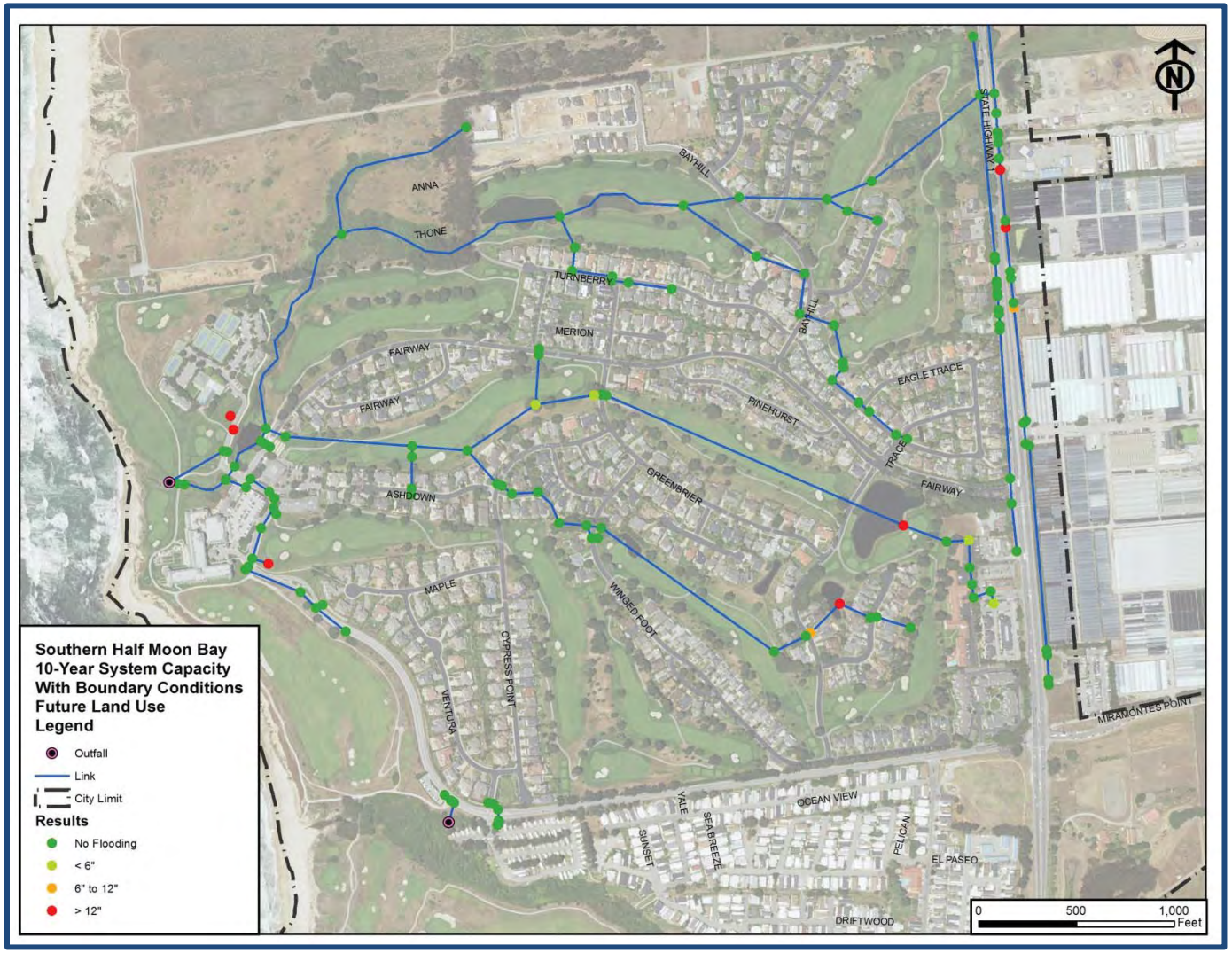


Figure 4-25: Southern Half Moon Bay 10-Year Storm Capacity with Boundary Conditions and Future Land Use

Chapter 5. Phase II Recommendations

5.1 Overview

Storm drain issues are described and categorized in Chapter 4. The next step is identifying improvements which mitigate these deficiencies. This chapter summarizes the recommended approach to Phase II of the Half Moon Bay Storm Drain Master Plan. Recommendations include the development of a Capital Improvement Program (CIP), identifying regulatory issues that may need to be addressed during implementation of CIPs, identifying water quality and conservation opportunities that may be implemented along with CIPs, and developing drainage design standards.

5.2 Develop CIP

System deficiencies identified in Phase I will be mitigated with proposed improvement projects. Improvements may range from pipeline upsizing to new pump stations to ditch improvements. Alternatives for larger projects may be developed to provide design flexibility. Condition related improvements will be developed for CMP pipe located within the City right-of-way. Projects should be prioritized based on the categorization of the deficiency and input from the City.

The cost of each identified CIP project should be estimated using a combination of unitized costs and site specific details. Contingencies should be added to account for administration, permitting, design, construction management, and construction costs. The City's assistance may be required with cost estimation for easements and land acquisition. CIPs for future land use changes (build out) should also be developed.

Based on the projects and prioritizations, a Capital Improvement Program (CIP) should be developed. The highest priority projects should be scheduled for a near-term construction window, or a construction window the City prefers after consultation. The remaining projects should be scheduled over a long-term timeframe. Cost often strongly influences project priority rankings.

Regulatory Guidelines and Requirements

National, regional, and local regulatory guidelines and requirements may not affect how improvements are developed, but will need to be taken into consideration when implementing the CIP. Consideration should be taken in the following areas:

- Floodplain management
- Stormwater management
- Surface water protection
- Groundwater protection
- Riparian and wetland protection

The most significant regulatory requirements for stormwater management in Half Moon Bay are found in the State of California's Construction General Permit (CGP) and the San Francisco Bay Municipal Regional Stormwater Permit (MRP) under the National Pollutant Discharge Elimination System (NPDES). The Phase II report should provide a general outline of the various guidelines and legal and regulatory requirements applicable for floodplain management, stormwater management, surface water and groundwater protection, and riparian and wetland protection. City and private projects within the riparian corridor, near a wetland, or within the coastal zone may also be required to have environmental and water quality permits from San Francisco Bay Area Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife, the United States Army Corps of Engineers (USACE), and the California

Coastal Commission.

Water Quality and Conservation

As of December 1, 2011, the MRP requires Low Impact Development (LID) measures for treatment of storm water runoff from all new and significant redevelopment projects. The term LID refers to practices that reduce water quality impacts by preserving and re-creating natural landscape features, minimizing imperviousness, and using stormwater as a resource, rather than a waste product. While the main focus of LID measures is to improve the quality of water discharged to receiving waters, it is possible that they may decrease peak runoff. LID measures include rainwater harvesting/reuse, infiltration, and evapotranspiration. The Phase II report should consider incorporating LID elements into CIPs.

Drainage Design Standards

The City's current drainage design standards should be revised and augmented to meet existing and future needs. These revisions should make the City standards consistent with methods applied to this master planning effort and flood control measures of other agencies which may operate and maintain important drainage facilities within Half Moon Bay (such as Pilarcitos Creek and Frenchman's Creek). The new drainage standards should include methods for:

- calculating runoff,
- sizing drainage facilities and flood control channels,
- designing standards for inlets, pipes and manholes,
- designing pump stations,
- determining detention sizing criteria, and more.

Proposed standards should also incorporate current NPDES requirements, LID requirements, and other regional standards. A standard policy for on-site detention systems that can be used in the construction of private development projects should be developed.

Appendix A

Rainfall Data

Rainfall computed for the 2-yr, 10-yr, 25-yr, and 100-yr 24-hr storms using the 5 minute pattern for MAP=28" from the Santa Clara Hydrology Drainage Manual.

Table 1. Fractions of Total Rainfall for 24-Hour, 5-Minute Pattern for MAP=16"

Time	5-min fraction	Percent of Rainfall	Time	5-min fraction	Percent of Rainfall	Time	5-min fraction	Percent of Rainfall
0:00	1.851	0.1543	3:50	7.389	0.6157	7:40	6.307	0.5256
0:05	1.851	0.1543	3:55	7.389	0.6157	7:45	6.307	0.5256
0:10	1.851	0.1543	4:00	6.585	0.5487	7:50	6.307	0.5256
0:15	1.851	0.1543	4:05	6.585	0.5487	7:55	6.307	0.5256
0:20	1.851	0.1543	4:10	6.585	0.5487	8:00	3.960	0.3300
0:25	1.851	0.1543	4:15	6.585	0.5487	8:05	3.960	0.3300
0:30	1.851	0.1543	4:20	6.585	0.5487	8:10	3.960	0.3300
0:35	1.851	0.1543	4:25	6.585	0.5487	8:15	3.960	0.3300
0:40	1.851	0.1543	4:30	6.585	0.5487	8:20	3.960	0.3300
0:45	1.851	0.1543	4:35	6.585	0.5487	8:25	3.960	0.3300
0:50	1.851	0.1543	4:40	6.585	0.5487	8:30	3.960	0.3300
0:55	1.851	0.1543	4:45	6.585	0.5487	8:35	3.960	0.3300
1:00	1.698	0.1415	4:50	6.585	0.5487	8:40	3.960	0.3300
1:05	1.698	0.1415	4:55	6.585	0.5487	8:45	3.960	0.3300
1:10	1.698	0.1415	5:00	6.375	0.5312	8:50	3.960	0.3300
1:15	1.698	0.1415	5:05	6.375	0.5312	8:55	3.960	0.3300
1:20	1.698	0.1415	5:10	6.375	0.5312	9:00	2.951	0.2459
1:25	1.698	0.1415	5:15	6.375	0.5312	9:05	2.951	0.2459
1:30	1.698	0.1415	5:20	6.375	0.5312	9:10	2.951	0.2459
1:35	1.698	0.1415	5:25	6.375	0.5312	9:15	2.951	0.2459
1:40	1.698	0.1415	5:30	6.375	0.5312	9:20	2.951	0.2459
1:45	1.698	0.1415	5:35	6.375	0.5312	9:25	2.951	0.2459
1:50	1.698	0.1415	5:40	6.375	0.5312	9:30	2.951	0.2459
1:55	1.698	0.1415	5:45	6.375	0.5312	9:35	2.951	0.2459
2:00	3.601	0.3001	5:50	6.375	0.5312	9:40	2.951	0.2459
2:05	3.601	0.3001	5:55	6.375	0.5312	9:45	2.951	0.2459
2:10	3.601	0.3001	6:00	41.376	3.4480	9:50	2.951	0.2459
2:15	3.601	0.3001	6:05	41.376	3.4480	9:55	2.951	0.2459
2:20	3.601	0.3001	6:10	12.372	1.0310	10:00	4.131	0.3443
2:25	3.601	0.3001	6:15	12.372	1.0310	10:05	4.131	0.3443
2:30	3.601	0.3001	6:20	12.372	1.0310	10:10	4.131	0.3443
2:35	3.601	0.3001	6:25	12.372	1.0310	10:15	4.131	0.3443
2:40	3.601	0.3001	6:30	11.323	0.9436	10:20	4.131	0.3443
2:45	3.601	0.3001	6:35	11.323	0.9436	10:25	4.131	0.3443
2:50	3.601	0.3001	6:40	11.323	0.9436	10:30	4.131	0.3443
2:55	3.601	0.3001	6:45	11.323	0.9436	10:35	4.131	0.3443
3:00	7.389	0.6157	6:50	11.323	0.9436	10:40	4.131	0.3443
3:05	7.389	0.6157	6:55	11.323	0.9436	10:45	4.131	0.3443
3:10	7.389	0.6157	7:00	6.307	0.5256	10:50	4.131	0.3443
3:15	7.389	0.6157	7:05	6.307	0.5256	10:55	4.131	0.3443
3:20	7.389	0.6157	7:10	6.307	0.5256	11:00	4.869	0.4058
3:25	7.389	0.6157	7:15	6.307	0.5256	11:05	4.869	0.4058
3:30	7.389	0.6157	7:20	6.307	0.5256	11:10	4.869	0.4058
3:35	7.389	0.6157	7:25	6.307	0.5256	11:15	4.869	0.4058
3:40	7.389	0.6157	7:30	6.307	0.5256	11:20	4.869	0.4058
3:45	7.389	0.6157	7:35	6.307	0.5256	11:25	4.869	0.4058

Time	5-min fraction	Percent of Rainfall	Time	5-min fraction	Percent of Rainfall	Time	5-min fraction	Percent of Rainfall
11:30	4.869	0.4058	15:40	3.086	0.2572	19:50	2.160	0.1800
11:35	4.869	0.4058	15:45	3.086	0.2572	19:55	2.160	0.1800
11:40	4.869	0.4058	15:50	3.086	0.2572	20:00	1.851	0.1543
11:45	4.869	0.4058	15:55	3.086	0.2572	20:05	1.851	0.1543
11:50	4.869	0.4058	16:00	2.778	0.2315	20:10	1.851	0.1543
11:55	4.869	0.4058	16:05	2.778	0.2315	20:15	1.851	0.1543
12:00	3.689	0.3074	16:10	2.778	0.2315	20:20	1.851	0.1543
12:05	3.689	0.3074	16:15	2.778	0.2315	20:25	1.851	0.1543
12:10	3.689	0.3074	16:20	2.778	0.2315	20:30	1.851	0.1543
12:15	3.689	0.3074	16:25	2.778	0.2315	20:35	1.851	0.1543
12:20	3.689	0.3074	16:30	2.778	0.2315	20:40	1.851	0.1543
12:25	3.689	0.3074	16:35	2.778	0.2315	20:45	1.851	0.1543
12:30	3.689	0.3074	16:40	2.778	0.2315	20:50	1.851	0.1543
12:35	3.689	0.3074	16:45	2.778	0.2315	20:55	1.851	0.1543
12:40	3.689	0.3074	16:50	2.778	0.2315	21:00	4.475	0.3729
12:45	3.689	0.3074	16:55	2.778	0.2315	21:05	4.475	0.3729
12:50	3.689	0.3074	17:00	1.543	0.1286	21:10	4.475	0.3729
12:55	3.689	0.3074	17:05	1.543	0.1286	21:15	4.475	0.3729
13:00	3.837	0.3197	17:10	1.543	0.1286	21:20	4.475	0.3729
13:05	3.837	0.3197	17:15	1.543	0.1286	21:25	4.475	0.3729
13:10	3.837	0.3197	17:20	1.543	0.1286	21:30	4.475	0.3729
13:15	3.837	0.3197	17:25	1.543	0.1286	21:35	4.475	0.3729
13:20	3.837	0.3197	17:30	1.543	0.1286	21:40	4.475	0.3729
13:25	3.837	0.3197	17:35	1.543	0.1286	21:45	4.475	0.3729
13:30	3.837	0.3197	17:40	1.543	0.1286	21:50	4.475	0.3729
13:35	3.837	0.3197	17:45	1.543	0.1286	21:55	4.475	0.3729
13:40	3.837	0.3197	17:50	1.543	0.1286	22:00	3.549	0.2958
13:45	3.837	0.3197	17:55	1.543	0.1286	22:05	3.549	0.2958
13:50	3.837	0.3197	18:00	2.006	0.1671	22:10	3.549	0.2958
13:55	3.837	0.3197	18:05	2.006	0.1671	22:15	3.549	0.2958
14:00	2.778	0.2315	18:10	2.006	0.1671	22:20	3.549	0.2958
14:05	2.778	0.2315	18:15	2.006	0.1671	22:25	3.549	0.2958
14:10	2.778	0.2315	18:20	2.006	0.1671	22:30	3.549	0.2958
14:15	2.778	0.2315	18:25	2.006	0.1671	22:35	3.549	0.2958
14:20	2.778	0.2315	18:30	2.006	0.1671	22:40	3.549	0.2958
14:25	2.778	0.2315	18:35	2.006	0.1671	22:45	3.549	0.2958
14:30	2.778	0.2315	18:40	2.006	0.1671	22:50	3.549	0.2958
14:35	2.778	0.2315	18:45	2.006	0.1671	22:55	3.549	0.2958
14:40	2.778	0.2315	18:50	2.006	0.1671	23:00	1.851	0.1543
14:45	2.778	0.2315	18:55	2.006	0.1671	23:05	1.851	0.1543
14:50	2.778	0.2315	19:00	2.160	0.1800	23:10	1.851	0.1543
14:55	2.778	0.2315	19:05	2.160	0.1800	23:15	1.851	0.1543
15:00	3.086	0.2572	19:10	2.160	0.1800	23:20	1.851	0.1543
15:05	3.086	0.2572	19:15	2.160	0.1800	23:25	1.851	0.1543
15:10	3.086	0.2572	19:20	2.160	0.1800	23:30	1.851	0.1543
15:15	3.086	0.2572	19:25	2.160	0.1800	23:35	1.851	0.1543
15:20	3.086	0.2572	19:30	2.160	0.1800	23:40	1.851	0.1543
15:25	3.086	0.2572	19:35	2.160	0.1800	23:45	1.851	0.1543
15:30	3.086	0.2572	19:40	2.160	0.1800	23:50	1.851	0.1543
15:35	3.086	0.2572	19:45	2.160	0.1800	23:55	1.851	0.1543

Table 2. Rainfall for a 2-yr 24 hour storm based on MAP 28"

Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)
0:00	0.0558	3:00	0.2225	6:00	1.2462	9:00	0.0889	12:00	0.1111	15:00	0.0929	18:00	0.0604	21:00	0.1348
0:05	0.0558	3:05	0.2225	6:05	1.2462	9:05	0.0889	12:05	0.1111	15:05	0.0929	18:05	0.0604	21:05	0.1348
0:10	0.0558	3:10	0.2225	6:10	0.3726	9:10	0.0889	12:10	0.1111	15:10	0.0929	18:10	0.0604	21:10	0.1348
0:15	0.0558	3:15	0.2225	6:15	0.3726	9:15	0.0889	12:15	0.1111	15:15	0.0929	18:15	0.0604	21:15	0.1348
0:20	0.0558	3:20	0.2225	6:20	0.3726	9:20	0.0889	12:20	0.1111	15:20	0.0929	18:20	0.0604	21:20	0.1348
0:25	0.0558	3:25	0.2225	6:25	0.3726	9:25	0.0889	12:25	0.1111	15:25	0.0929	18:25	0.0604	21:25	0.1348
0:30	0.0558	3:30	0.2225	6:30	0.3410	9:30	0.0889	12:30	0.1111	15:30	0.0929	18:30	0.0604	21:30	0.1348
0:35	0.0558	3:35	0.2225	6:35	0.3410	9:35	0.0889	12:35	0.1111	15:35	0.0929	18:35	0.0604	21:35	0.1348
0:40	0.0558	3:40	0.2225	6:40	0.3410	9:40	0.0889	12:40	0.1111	15:40	0.0929	18:40	0.0604	21:40	0.1348
0:45	0.0558	3:45	0.2225	6:45	0.3410	9:45	0.0889	12:45	0.1111	15:45	0.0929	18:45	0.0604	21:45	0.1348
0:50	0.0558	3:50	0.2225	6:50	0.3410	9:50	0.0889	12:50	0.1111	15:50	0.0929	18:50	0.0604	21:50	0.1348
0:55	0.0558	3:55	0.2225	6:55	0.3410	9:55	0.0889	12:55	0.1111	15:55	0.0929	18:55	0.0604	21:55	0.1348
1:00	0.0511	4:00	0.1983	7:00	0.1900	10:00	0.1244	13:00	0.1156	16:00	0.0837	19:00	0.0651	22:00	0.1069
1:05	0.0511	4:05	0.1983	7:05	0.1900	10:05	0.1244	13:05	0.1156	16:05	0.0837	19:05	0.0651	22:05	0.1069
1:10	0.0511	4:10	0.1983	7:10	0.1900	10:10	0.1244	13:10	0.1156	16:10	0.0837	19:10	0.0651	22:10	0.1069
1:15	0.0511	4:15	0.1983	7:15	0.1900	10:15	0.1244	13:15	0.1156	16:15	0.0837	19:15	0.0651	22:15	0.1069
1:20	0.0511	4:20	0.1983	7:20	0.1900	10:20	0.1244	13:20	0.1156	16:20	0.0837	19:20	0.0651	22:20	0.1069
1:25	0.0511	4:25	0.1983	7:25	0.1900	10:25	0.1244	13:25	0.1156	16:25	0.0837	19:25	0.0651	22:25	0.1069
1:30	0.0511	4:30	0.1983	7:30	0.1900	10:30	0.1244	13:30	0.1156	16:30	0.0837	19:30	0.0651	22:30	0.1069
1:35	0.0511	4:35	0.1983	7:35	0.1900	10:35	0.1244	13:35	0.1156	16:35	0.0837	19:35	0.0651	22:35	0.1069
1:40	0.0511	4:40	0.1983	7:40	0.1900	10:40	0.1244	13:40	0.1156	16:40	0.0837	19:40	0.0651	22:40	0.1069
1:45	0.0511	4:45	0.1983	7:45	0.1900	10:45	0.1244	13:45	0.1156	16:45	0.0837	19:45	0.0651	22:45	0.1069
1:50	0.0511	4:50	0.1983	7:50	0.1900	10:50	0.1244	13:50	0.1156	16:50	0.0837	19:50	0.0651	22:50	0.1069
1:55	0.0511	4:55	0.1983	7:55	0.1900	10:55	0.1244	13:55	0.1156	16:55	0.0837	19:55	0.0651	22:55	0.1069
2:00	0.1084	5:00	0.1920	8:00	0.1193	11:00	0.1467	14:00	0.0837	17:00	0.0465	20:00	0.0558	23:00	0.0558
2:05	0.1084	5:05	0.1920	8:05	0.1193	11:05	0.1467	14:05	0.0837	17:05	0.0465	20:05	0.0558	23:05	0.0558
2:10	0.1084	5:10	0.1920	8:10	0.1193	11:10	0.1467	14:10	0.0837	17:10	0.0465	20:10	0.0558	23:10	0.0558
2:15	0.1084	5:15	0.1920	8:15	0.1193	11:15	0.1467	14:15	0.0837	17:15	0.0465	20:15	0.0558	23:15	0.0558
2:20	0.1084	5:20	0.1920	8:20	0.1193	11:20	0.1467	14:20	0.0837	17:20	0.0465	20:20	0.0558	23:20	0.0558
2:25	0.1084	5:25	0.1920	8:25	0.1193	11:25	0.1467	14:25	0.0837	17:25	0.0465	20:25	0.0558	23:25	0.0558
2:30	0.1084	5:30	0.1920	8:30	0.1193	11:30	0.1467	14:30	0.0837	17:30	0.0465	20:30	0.0558	23:30	0.0558
2:35	0.1084	5:35	0.1920	8:35	0.1193	11:35	0.1467	14:35	0.0837	17:35	0.0465	20:35	0.0558	23:35	0.0558
2:40	0.1084	5:40	0.1920	8:40	0.1193	11:40	0.1467	14:40	0.0837	17:40	0.0465	20:40	0.0558	23:40	0.0558
2:45	0.1084	5:45	0.1920	8:45	0.1193	11:45	0.1467	14:45	0.0837	17:45	0.0465	20:45	0.0558	23:45	0.0558
2:50	0.1084	5:50	0.1920	8:50	0.1193	11:50	0.1467	14:50	0.0837	17:50	0.0465	20:50	0.0558	23:50	0.0558
2:55	0.1084	5:55	0.1920	8:55	0.1193	11:55	0.1467	14:55	0.0837	17:55	0.0465	20:55	0.0558	23:55	0.0558

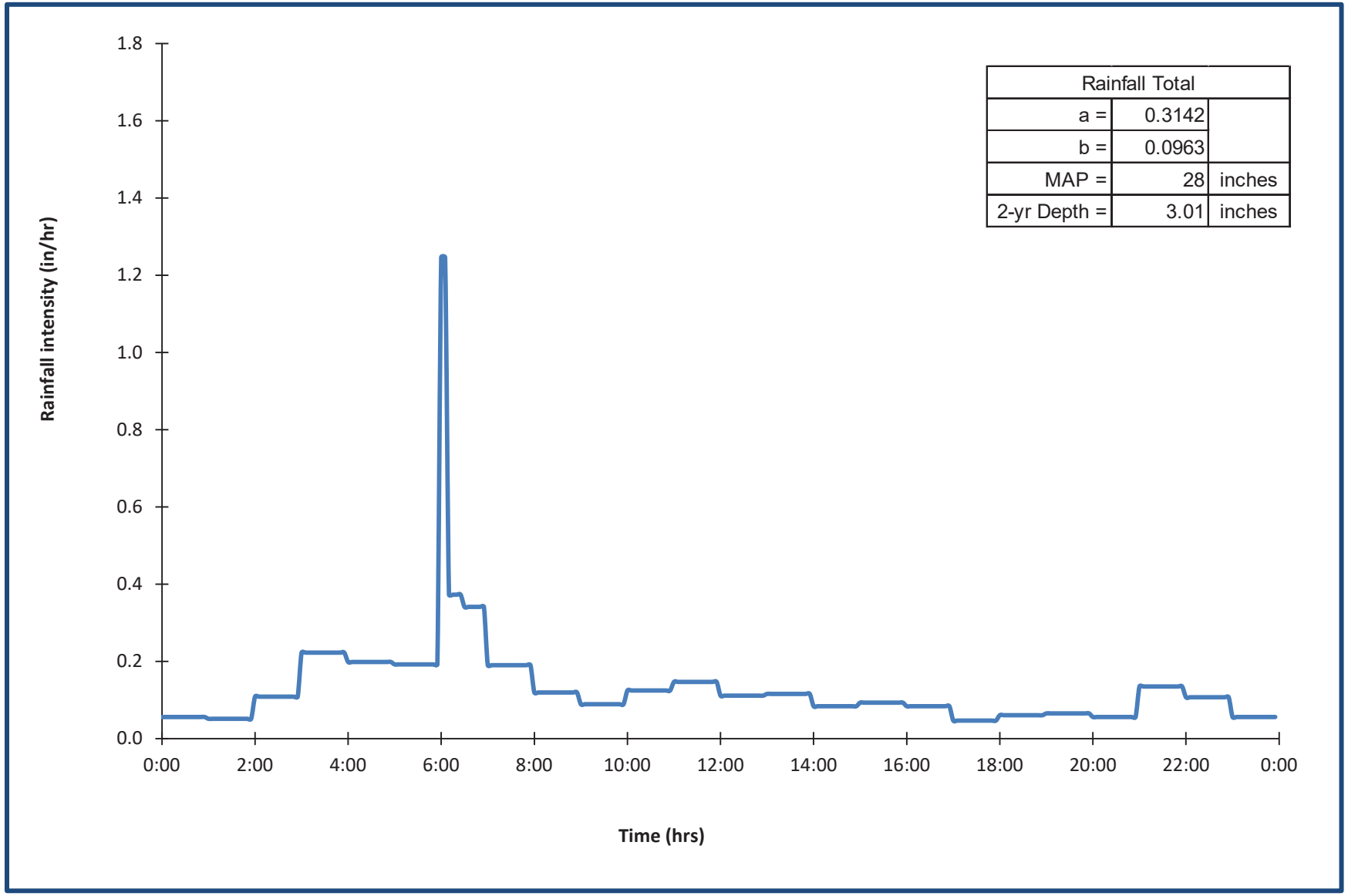


Figure 1. Rainfall for a 2-yr 24-hr storm based on MAP 28"

Table 3. Rainfall for a 10-yr 24-hr storm based on MAP 28"

Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)
0:00	0.0948	3:00	0.3782	6:00	2.1178	9:00	0.1510	12:00	0.1888	15:00	0.1580	18:00	0.1027	21:00	0.2290
0:05	0.0948	3:05	0.3782	6:05	2.1178	9:05	0.1510	12:05	0.1888	15:05	0.1580	18:05	0.1027	21:05	0.2290
0:10	0.0948	3:10	0.3782	6:10	0.6333	9:10	0.1510	12:10	0.1888	15:10	0.1580	18:10	0.1027	21:10	0.2290
0:15	0.0948	3:15	0.3782	6:15	0.6333	9:15	0.1510	12:15	0.1888	15:15	0.1580	18:15	0.1027	21:15	0.2290
0:20	0.0948	3:20	0.3782	6:20	0.6333	9:20	0.1510	12:20	0.1888	15:20	0.1580	18:20	0.1027	21:20	0.2290
0:25	0.0948	3:25	0.3782	6:25	0.6333	9:25	0.1510	12:25	0.1888	15:25	0.1580	18:25	0.1027	21:25	0.2290
0:30	0.0948	3:30	0.3782	6:30	0.5796	9:30	0.1510	12:30	0.1888	15:30	0.1580	18:30	0.1027	21:30	0.2290
0:35	0.0948	3:35	0.3782	6:35	0.5796	9:35	0.1510	12:35	0.1888	15:35	0.1580	18:35	0.1027	21:35	0.2290
0:40	0.0948	3:40	0.3782	6:40	0.5796	9:40	0.1510	12:40	0.1888	15:40	0.1580	18:40	0.1027	21:40	0.2290
0:45	0.0948	3:45	0.3782	6:45	0.5796	9:45	0.1510	12:45	0.1888	15:45	0.1580	18:45	0.1027	21:45	0.2290
0:50	0.0948	3:50	0.3782	6:50	0.5796	9:50	0.1510	12:50	0.1888	15:50	0.1580	18:50	0.1027	21:50	0.2290
0:55	0.0948	3:55	0.3782	6:55	0.5796	9:55	0.1510	12:55	0.1888	15:55	0.1580	18:55	0.1027	21:55	0.2290
1:00	0.0869	4:00	0.3370	7:00	0.3228	10:00	0.2114	13:00	0.1964	16:00	0.1422	19:00	0.1106	22:00	0.1817
1:05	0.0869	4:05	0.3370	7:05	0.3228	10:05	0.2114	13:05	0.1964	16:05	0.1422	19:05	0.1106	22:05	0.1817
1:10	0.0869	4:10	0.3370	7:10	0.3228	10:10	0.2114	13:10	0.1964	16:10	0.1422	19:10	0.1106	22:10	0.1817
1:15	0.0869	4:15	0.3370	7:15	0.3228	10:15	0.2114	13:15	0.1964	16:15	0.1422	19:15	0.1106	22:15	0.1817
1:20	0.0869	4:20	0.3370	7:20	0.3228	10:20	0.2114	13:20	0.1964	16:20	0.1422	19:20	0.1106	22:20	0.1817
1:25	0.0869	4:25	0.3370	7:25	0.3228	10:25	0.2114	13:25	0.1964	16:25	0.1422	19:25	0.1106	22:25	0.1817
1:30	0.0869	4:30	0.3370	7:30	0.3228	10:30	0.2114	13:30	0.1964	16:30	0.1422	19:30	0.1106	22:30	0.1817
1:35	0.0869	4:35	0.3370	7:35	0.3228	10:35	0.2114	13:35	0.1964	16:35	0.1422	19:35	0.1106	22:35	0.1817
1:40	0.0869	4:40	0.3370	7:40	0.3228	10:40	0.2114	13:40	0.1964	16:40	0.1422	19:40	0.1106	22:40	0.1817
1:45	0.0869	4:45	0.3370	7:45	0.3228	10:45	0.2114	13:45	0.1964	16:45	0.1422	19:45	0.1106	22:45	0.1817
1:50	0.0869	4:50	0.3370	7:50	0.3228	10:50	0.2114	13:50	0.1964	16:50	0.1422	19:50	0.1106	22:50	0.1817
1:55	0.0869	4:55	0.3370	7:55	0.3228	10:55	0.2114	13:55	0.1964	16:55	0.1422	19:55	0.1106	22:55	0.1817
2:00	0.1843	5:00	0.3263	8:00	0.2027	11:00	0.2492	14:00	0.1422	17:00	0.0790	20:00	0.0948	23:00	0.0948
2:05	0.1843	5:05	0.3263	8:05	0.2027	11:05	0.2492	14:05	0.1422	17:05	0.0790	20:05	0.0948	23:05	0.0948
2:10	0.1843	5:10	0.3263	8:10	0.2027	11:10	0.2492	14:10	0.1422	17:10	0.0790	20:10	0.0948	23:10	0.0948
2:15	0.1843	5:15	0.3263	8:15	0.2027	11:15	0.2492	14:15	0.1422	17:15	0.0790	20:15	0.0948	23:15	0.0948
2:20	0.1843	5:20	0.3263	8:20	0.2027	11:20	0.2492	14:20	0.1422	17:20	0.0790	20:20	0.0948	23:20	0.0948
2:25	0.1843	5:25	0.3263	8:25	0.2027	11:25	0.2492	14:25	0.1422	17:25	0.0790	20:25	0.0948	23:25	0.0948
2:30	0.1843	5:30	0.3263	8:30	0.2027	11:30	0.2492	14:30	0.1422	17:30	0.0790	20:30	0.0948	23:30	0.0948
2:35	0.1843	5:35	0.3263	8:35	0.2027	11:35	0.2492	14:35	0.1422	17:35	0.0790	20:35	0.0948	23:35	0.0948
2:40	0.1843	5:40	0.3263	8:40	0.2027	11:40	0.2492	14:40	0.1422	17:40	0.0790	20:40	0.0948	23:40	0.0948
2:45	0.1843	5:45	0.3263	8:45	0.2027	11:45	0.2492	14:45	0.1422	17:45	0.0790	20:45	0.0948	23:45	0.0948
2:50	0.1843	5:50	0.3263	8:50	0.2027	11:50	0.2492	14:50	0.1422	17:50	0.0790	20:50	0.0948	23:50	0.0948
2:55	0.1843	5:55	0.3263	8:55	0.2027	11:55	0.2492	14:55	0.1422	17:55	0.0790	20:55	0.0948	23:55	0.0948

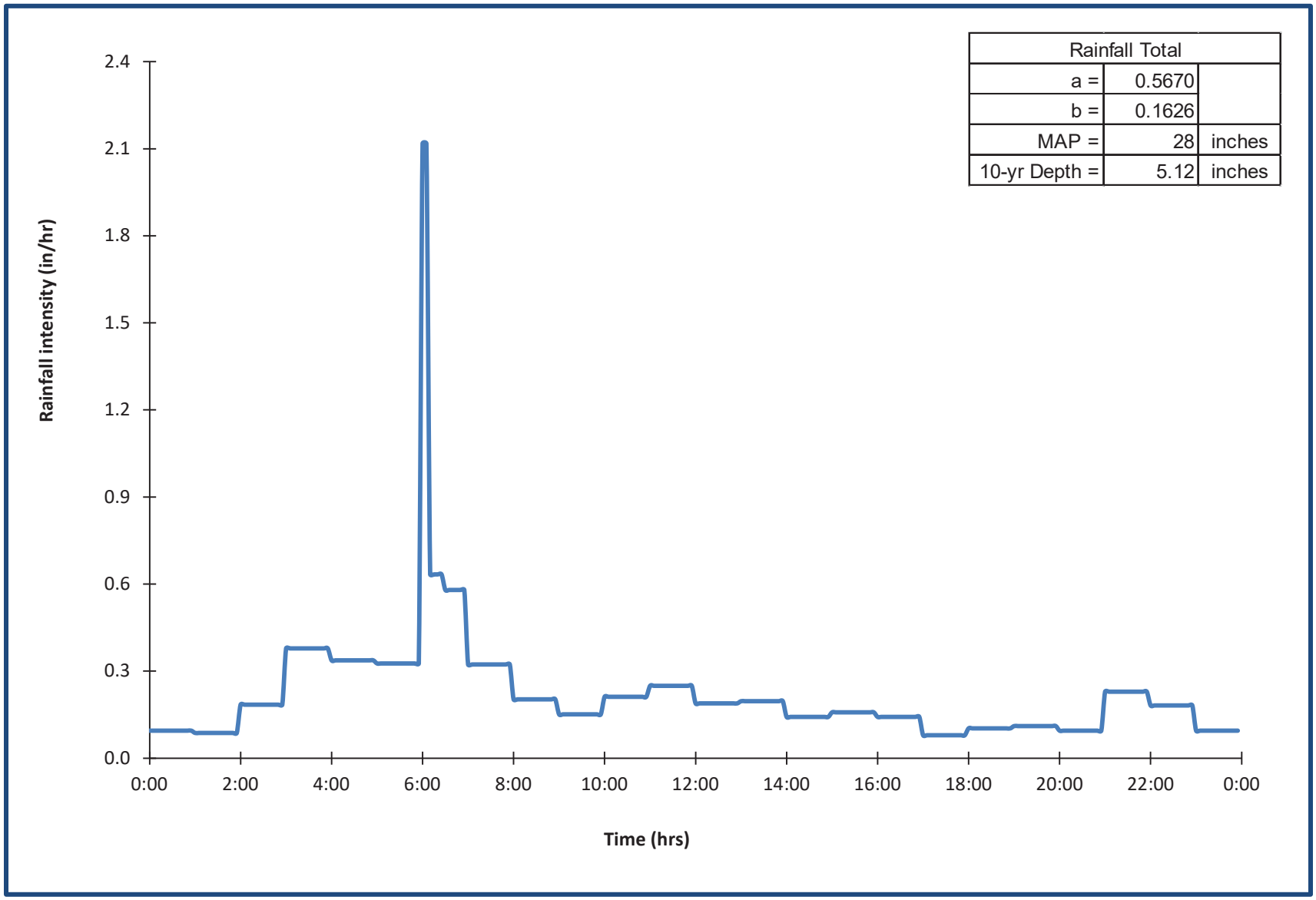


Figure 2. Rainfall for a 10-yr 24-hr storm based on MAP 28"

Table 4. Rainfall for a 25-yr 24-hr storm based on MAP 28"

Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)
0:00	0.114	3:00	0.454	6:00	2.544	9:00	0.181	12:00	0.227	15:00	0.190	18:00	0.123	21:00	0.275
0:05	0.114	3:05	0.454	6:05	2.544	9:05	0.181	12:05	0.227	15:05	0.190	18:05	0.123	21:05	0.275
0:10	0.114	3:10	0.454	6:10	0.761	9:10	0.181	12:10	0.227	15:10	0.190	18:10	0.123	21:10	0.275
0:15	0.114	3:15	0.454	6:15	0.761	9:15	0.181	12:15	0.227	15:15	0.190	18:15	0.123	21:15	0.275
0:20	0.114	3:20	0.454	6:20	0.761	9:20	0.181	12:20	0.227	15:20	0.190	18:20	0.123	21:20	0.275
0:25	0.114	3:25	0.454	6:25	0.761	9:25	0.181	12:25	0.227	15:25	0.190	18:25	0.123	21:25	0.275
0:30	0.114	3:30	0.454	6:30	0.696	9:30	0.181	12:30	0.227	15:30	0.190	18:30	0.123	21:30	0.275
0:35	0.114	3:35	0.454	6:35	0.696	9:35	0.181	12:35	0.227	15:35	0.190	18:35	0.123	21:35	0.275
0:40	0.114	3:40	0.454	6:40	0.696	9:40	0.181	12:40	0.227	15:40	0.190	18:40	0.123	21:40	0.275
0:45	0.114	3:45	0.454	6:45	0.696	9:45	0.181	12:45	0.227	15:45	0.190	18:45	0.123	21:45	0.275
0:50	0.114	3:50	0.454	6:50	0.696	9:50	0.181	12:50	0.227	15:50	0.190	18:50	0.123	21:50	0.275
0:55	0.114	3:55	0.454	6:55	0.696	9:55	0.181	12:55	0.227	15:55	0.190	18:55	0.123	21:55	0.275
1:00	0.104	4:00	0.405	7:00	0.388	10:00	0.254	13:00	0.236	16:00	0.171	19:00	0.133	22:00	0.218
1:05	0.104	4:05	0.405	7:05	0.388	10:05	0.254	13:05	0.236	16:05	0.171	19:05	0.133	22:05	0.218
1:10	0.104	4:10	0.405	7:10	0.388	10:10	0.254	13:10	0.236	16:10	0.171	19:10	0.133	22:10	0.218
1:15	0.104	4:15	0.405	7:15	0.388	10:15	0.254	13:15	0.236	16:15	0.171	19:15	0.133	22:15	0.218
1:20	0.104	4:20	0.405	7:20	0.388	10:20	0.254	13:20	0.236	16:20	0.171	19:20	0.133	22:20	0.218
1:25	0.104	4:25	0.405	7:25	0.388	10:25	0.254	13:25	0.236	16:25	0.171	19:25	0.133	22:25	0.218
1:30	0.104	4:30	0.405	7:30	0.388	10:30	0.254	13:30	0.236	16:30	0.171	19:30	0.133	22:30	0.218
1:35	0.104	4:35	0.405	7:35	0.388	10:35	0.254	13:35	0.236	16:35	0.171	19:35	0.133	22:35	0.218
1:40	0.104	4:40	0.405	7:40	0.388	10:40	0.254	13:40	0.236	16:40	0.171	19:40	0.133	22:40	0.218
1:45	0.104	4:45	0.405	7:45	0.388	10:45	0.254	13:45	0.236	16:45	0.171	19:45	0.133	22:45	0.218
1:50	0.104	4:50	0.405	7:50	0.388	10:50	0.254	13:50	0.236	16:50	0.171	19:50	0.133	22:50	0.218
1:55	0.104	4:55	0.405	7:55	0.388	10:55	0.254	13:55	0.236	16:55	0.171	19:55	0.133	22:55	0.218
2:00	0.221	5:00	0.392	8:00	0.243	11:00	0.299	14:00	0.171	17:00	0.095	20:00	0.114	23:00	0.114
2:05	0.221	5:05	0.392	8:05	0.243	11:05	0.299	14:05	0.171	17:05	0.095	20:05	0.114	23:05	0.114
2:10	0.221	5:10	0.392	8:10	0.243	11:10	0.299	14:10	0.171	17:10	0.095	20:10	0.114	23:10	0.114
2:15	0.221	5:15	0.392	8:15	0.243	11:15	0.299	14:15	0.171	17:15	0.095	20:15	0.114	23:15	0.114
2:20	0.221	5:20	0.392	8:20	0.243	11:20	0.299	14:20	0.171	17:20	0.095	20:20	0.114	23:20	0.114
2:25	0.221	5:25	0.392	8:25	0.243	11:25	0.299	14:25	0.171	17:25	0.095	20:25	0.114	23:25	0.114
2:30	0.221	5:30	0.392	8:30	0.243	11:30	0.299	14:30	0.171	17:30	0.095	20:30	0.114	23:30	0.114
2:35	0.221	5:35	0.392	8:35	0.243	11:35	0.299	14:35	0.171	17:35	0.095	20:35	0.114	23:35	0.114
2:40	0.221	5:40	0.392	8:40	0.243	11:40	0.299	14:40	0.171	17:40	0.095	20:40	0.114	23:40	0.114
2:45	0.221	5:45	0.392	8:45	0.243	11:45	0.299	14:45	0.171	17:45	0.095	20:45	0.114	23:45	0.114
2:50	0.221	5:50	0.392	8:50	0.243	11:50	0.299	14:50	0.171	17:50	0.095	20:50	0.114	23:50	0.114
2:55	0.221	5:55	0.392	8:55	0.243	11:55	0.299	14:55	0.171	17:55	0.095	20:55	0.114	23:55	0.114

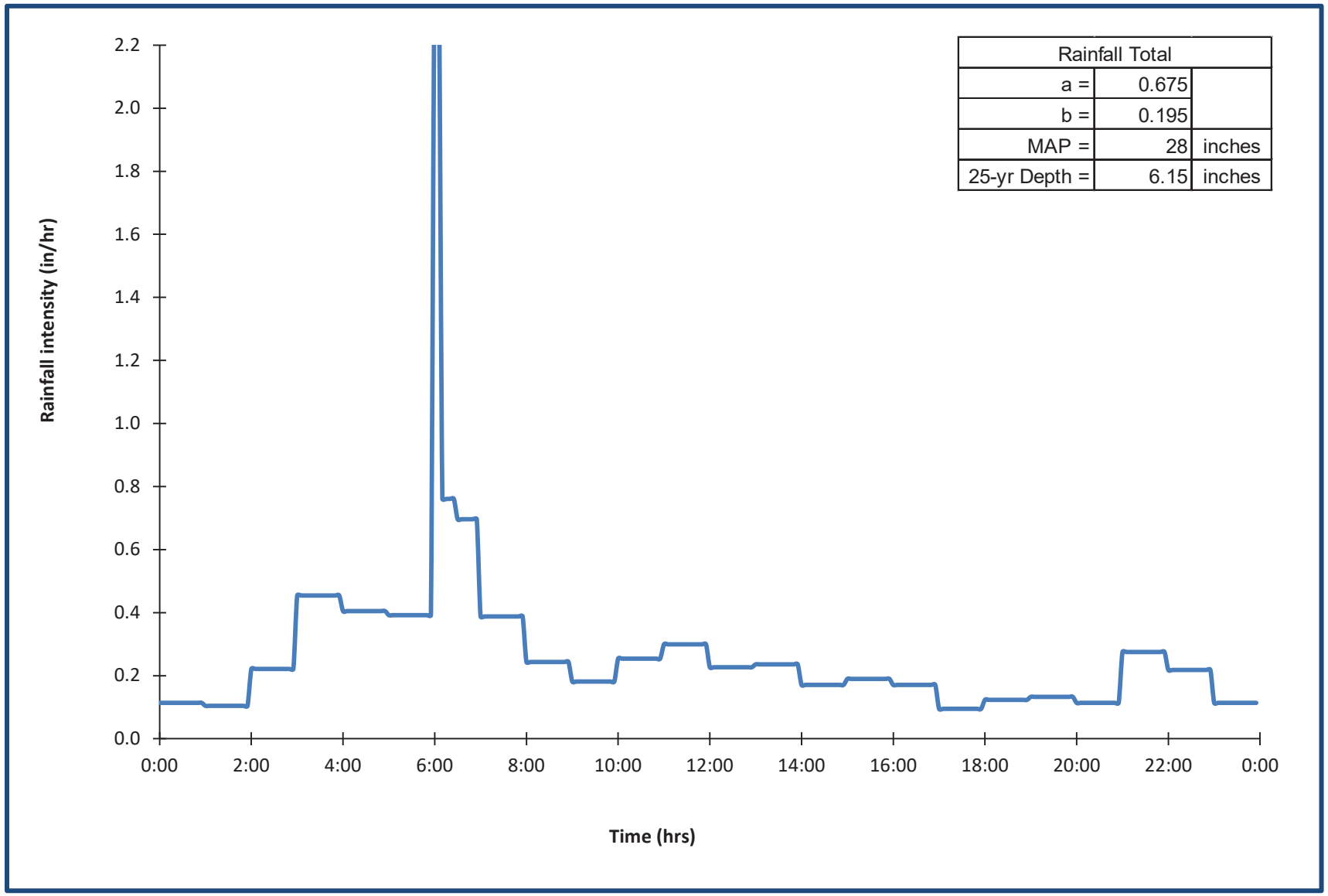


Figure 3. Rainfall for a 25-yr 24-hr storm based on MAP 28"

Table 5. Rainfall for a 100-yr 24-hr storm based on MAP 28"

Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)	Time	Intensity (in/hr)
0:00	0.141	3:00	0.564	6:00	3.157	9:00	0.225	12:00	0.281	15:00	0.235	18:00	0.153	21:00	0.341
0:05	0.141	3:05	0.564	6:05	3.157	9:05	0.225	12:05	0.281	15:05	0.235	18:05	0.153	21:05	0.341
0:10	0.141	3:10	0.564	6:10	0.944	9:10	0.225	12:10	0.281	15:10	0.235	18:10	0.153	21:10	0.341
0:15	0.141	3:15	0.564	6:15	0.944	9:15	0.225	12:15	0.281	15:15	0.235	18:15	0.153	21:15	0.341
0:20	0.141	3:20	0.564	6:20	0.944	9:20	0.225	12:20	0.281	15:20	0.235	18:20	0.153	21:20	0.341
0:25	0.141	3:25	0.564	6:25	0.944	9:25	0.225	12:25	0.281	15:25	0.235	18:25	0.153	21:25	0.341
0:30	0.141	3:30	0.564	6:30	0.864	9:30	0.225	12:30	0.281	15:30	0.235	18:30	0.153	21:30	0.341
0:35	0.141	3:35	0.564	6:35	0.864	9:35	0.225	12:35	0.281	15:35	0.235	18:35	0.153	21:35	0.341
0:40	0.141	3:40	0.564	6:40	0.864	9:40	0.225	12:40	0.281	15:40	0.235	18:40	0.153	21:40	0.341
0:45	0.141	3:45	0.564	6:45	0.864	9:45	0.225	12:45	0.281	15:45	0.235	18:45	0.153	21:45	0.341
0:50	0.141	3:50	0.564	6:50	0.864	9:50	0.225	12:50	0.281	15:50	0.235	18:50	0.153	21:50	0.341
0:55	0.141	3:55	0.564	6:55	0.864	9:55	0.225	12:55	0.281	15:55	0.235	18:55	0.153	21:55	0.341
1:00	0.130	4:00	0.502	7:00	0.481	10:00	0.315	13:00	0.293	16:00	0.212	19:00	0.165	22:00	0.271
1:05	0.130	4:05	0.502	7:05	0.481	10:05	0.315	13:05	0.293	16:05	0.212	19:05	0.165	22:05	0.271
1:10	0.130	4:10	0.502	7:10	0.481	10:10	0.315	13:10	0.293	16:10	0.212	19:10	0.165	22:10	0.271
1:15	0.130	4:15	0.502	7:15	0.481	10:15	0.315	13:15	0.293	16:15	0.212	19:15	0.165	22:15	0.271
1:20	0.130	4:20	0.502	7:20	0.481	10:20	0.315	13:20	0.293	16:20	0.212	19:20	0.165	22:20	0.271
1:25	0.130	4:25	0.502	7:25	0.481	10:25	0.315	13:25	0.293	16:25	0.212	19:25	0.165	22:25	0.271
1:30	0.130	4:30	0.502	7:30	0.481	10:30	0.315	13:30	0.293	16:30	0.212	19:30	0.165	22:30	0.271
1:35	0.130	4:35	0.502	7:35	0.481	10:35	0.315	13:35	0.293	16:35	0.212	19:35	0.165	22:35	0.271
1:40	0.130	4:40	0.502	7:40	0.481	10:40	0.315	13:40	0.293	16:40	0.212	19:40	0.165	22:40	0.271
1:45	0.130	4:45	0.502	7:45	0.481	10:45	0.315	13:45	0.293	16:45	0.212	19:45	0.165	22:45	0.271
1:50	0.130	4:50	0.502	7:50	0.481	10:50	0.315	13:50	0.293	16:50	0.212	19:50	0.165	22:50	0.271
1:55	0.130	4:55	0.502	7:55	0.481	10:55	0.315	13:55	0.293	16:55	0.212	19:55	0.165	22:55	0.271
2:00	0.275	5:00	0.486	8:00	0.302	11:00	0.371	14:00	0.212	17:00	0.118	20:00	0.141	23:00	0.141
2:05	0.275	5:05	0.486	8:05	0.302	11:05	0.371	14:05	0.212	17:05	0.118	20:05	0.141	23:05	0.141
2:10	0.275	5:10	0.486	8:10	0.302	11:10	0.371	14:10	0.212	17:10	0.118	20:10	0.141	23:10	0.141
2:15	0.275	5:15	0.486	8:15	0.302	11:15	0.371	14:15	0.212	17:15	0.118	20:15	0.141	23:15	0.141
2:20	0.275	5:20	0.486	8:20	0.302	11:20	0.371	14:20	0.212	17:20	0.118	20:20	0.141	23:20	0.141
2:25	0.275	5:25	0.486	8:25	0.302	11:25	0.371	14:25	0.212	17:25	0.118	20:25	0.141	23:25	0.141
2:30	0.275	5:30	0.486	8:30	0.302	11:30	0.371	14:30	0.212	17:30	0.118	20:30	0.141	23:30	0.141
2:35	0.275	5:35	0.486	8:35	0.302	11:35	0.371	14:35	0.212	17:35	0.118	20:35	0.141	23:35	0.141
2:40	0.275	5:40	0.486	8:40	0.302	11:40	0.371	14:40	0.212	17:40	0.118	20:40	0.141	23:40	0.141
2:45	0.275	5:45	0.486	8:45	0.302	11:45	0.371	14:45	0.212	17:45	0.118	20:45	0.141	23:45	0.141
2:50	0.275	5:50	0.486	8:50	0.302	11:50	0.371	14:50	0.212	17:50	0.118	20:50	0.141	23:50	0.141
2:55	0.275	5:55	0.486	8:55	0.302	11:55	0.371	14:55	0.212	17:55	0.118	20:55	0.141	23:55	0.141

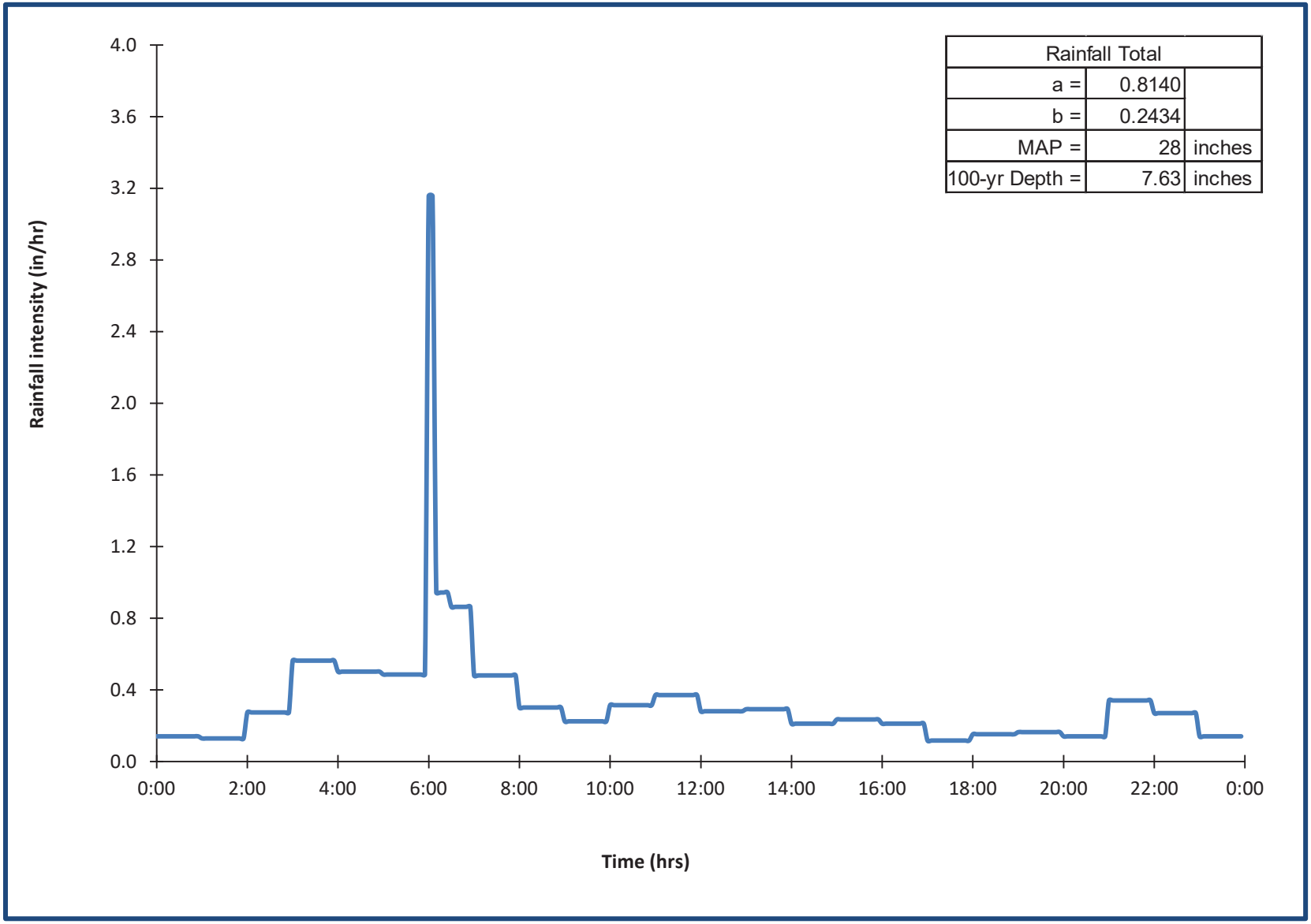


Figure 4. Rainfall for a 100-yr 24-hr storm based on MAP 28"

Appendix B

Storm Drain System Map

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

D:24in
D:18in
D:18in
D:36in
D:30in
D:18in
D:18in
D:15in
D:24in
D:15in
D:30in
D:36in
D:18in
D:18in
D:18in

Storm Drain System
Half Moon Bay, CA

Legend

		Pipe Material	
	Inlet		ACP
	Manhole		CMP
	Node		HDPE
	Outfall		PVC
	Channel		RCP
	Road		VCP
	Subbasin		
	City Limit		

0 300 600 1,200 Feet


N
BALBOA
KNEWING
MORRIS
FRENCHMANS CREEK
TOURAINE
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORY'N
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
SURF
RAILROAD
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92
D:24in
D:18in
D:36in
D:30in
D:15in
D:31 x 50in
D:48in
D:12in
D:54in
D:60in
D:42in
D:27in
D:84in
Storm Drain System
Half Moon Bay, CA
Legend
Inlet
Manhole
Node
Outfall
Channel
Road
Subbasin
City Limit
Pipe Material
ACP
CMP
HDPE
PVC
RCP
VCP
0 300 600 1,200
Feet

Storm Drain System
Half Moon Bay, CA

Legend

Inlet		**Pipe Material**	
Manhole		ACP	
Node		CMP	
Outfall		HDPE	
Channel		PVC	
Road		RCP	
Subbasin		VCP	
City Limit			

0 300 600 1,200 Feet

N

Storm Drain System
Half Moon Bay, CA

Legend

Inlet		**Pipe Material**	
Manhole		ACP	
Node		CMP	
Outfall		HDPE	
Channel		PVC	
Road		RCP	
Subbasin		VCP	
City Limit			

0 300 600 1,200 Feet

N

SONIC
GRANELLI
MYRTLE
RAILROAD
PACIFIC
3RD
SPRUCE
BLOOM
POPLAR
METZGAR
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH

D:30in
D:12in
D:18in
D:15in
D:8in
D:27in
D:24in
D:16in
D:24 x 38in
D:36in
D:54in

N

REDONDO BEACH
OLA
MERION
FAIRWAY
PINEHURST
TRACE
GREENBRIER
MAPLE
MIRAMONTES POINT
VENTURA
NOON
OCEAN VIEW
CREEKSIDE
CORAL
CANADA COVE
SAILFISH
SEASCAPE

D:54in D:54in D:54in D:54in D:12in D:24in D:24in D:24in D:24in D:24in D:45in D:24in D:24in D:18in D:18in D:18in D:18in D:36in D:48in D:48in D:48in D:48in D:12in D:12in D:36in D:36in D:12in D:12in D:24in D:12in D:24in D:12in D:24in D:24in D:15in D:15in D:8in D:12in D:12in D:12in

Storm Drain System
Half Moon Bay, CA

Legend

		Pipe Material
Inlet		ACP
Manhole		CMP
Node		HDPE
Outfall		PVC
Channel		RCP
Road		VCP
Subbasin		
City Limit		

0 300 600 1,200 Feet

Appendix C

Existing Land Use Results Figures

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

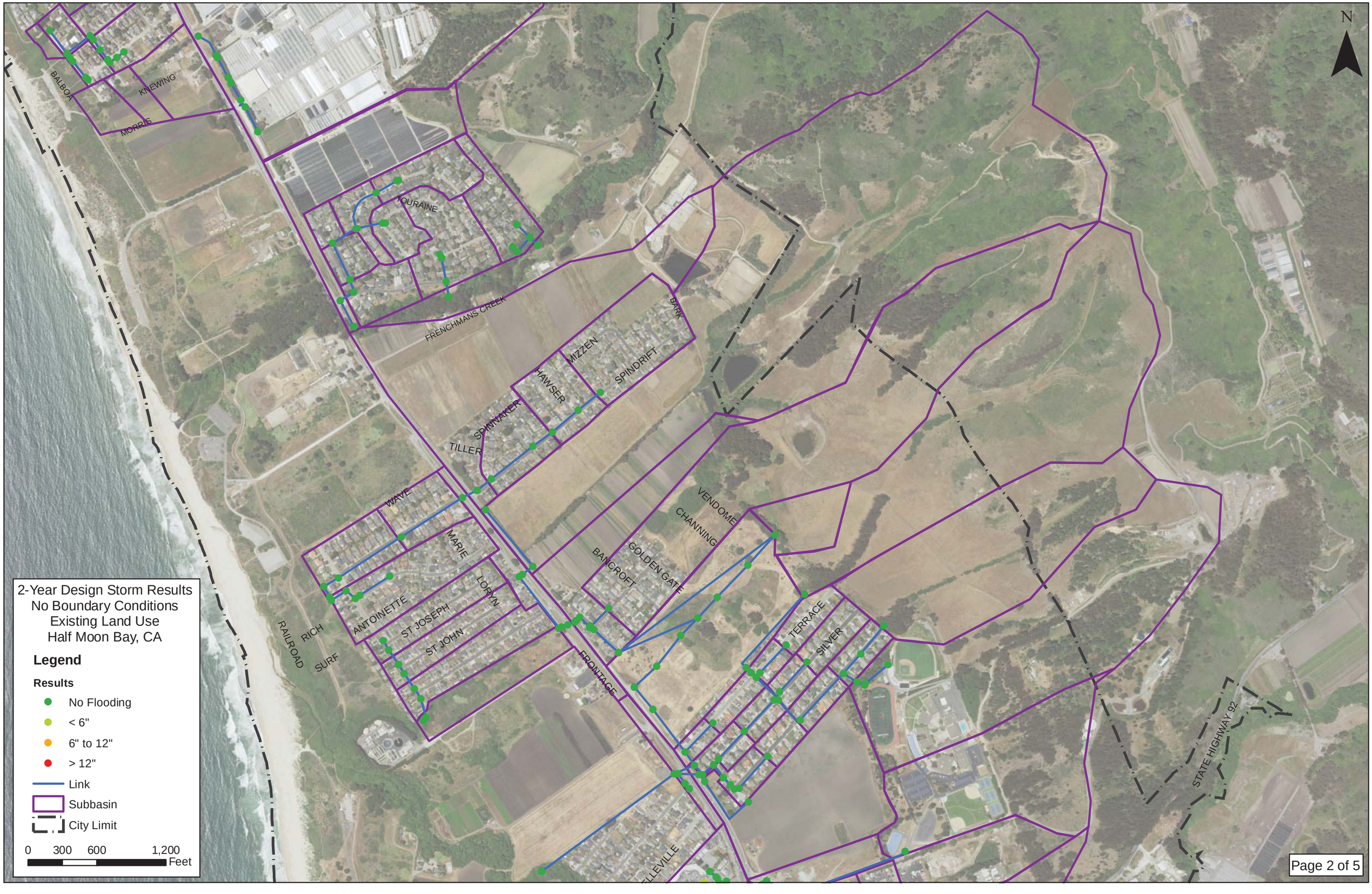
2-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
SURF
RAILROAD
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
STATE HIGHWAY 92
2-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet
Page 2 of 5

2-Year Design Storm Results
No Boundary Conditions
Exsiting Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

2-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

POON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

2-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

2-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

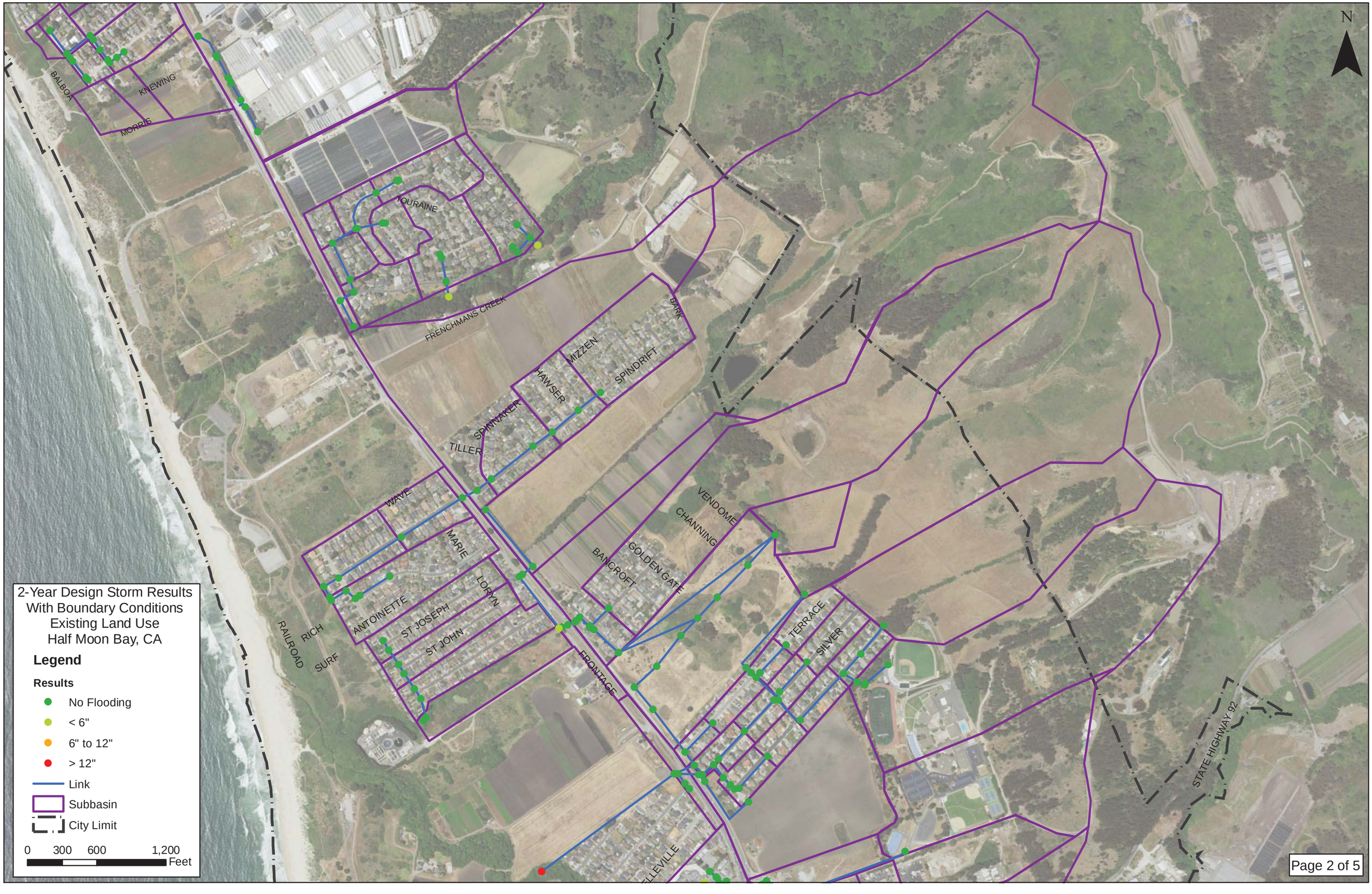
Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

MIRADA
ALTO
VENTURA
VALENCIA
RAMONA
ALAMEDA
OCEAN
ROOSEVELT
BALBOA
KNEWING
MORRIS
TOURAINE


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
SURF
RAILROAD
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
STATE HIGHWAY 92
2-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

2-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

2-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

POON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

2-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

10-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

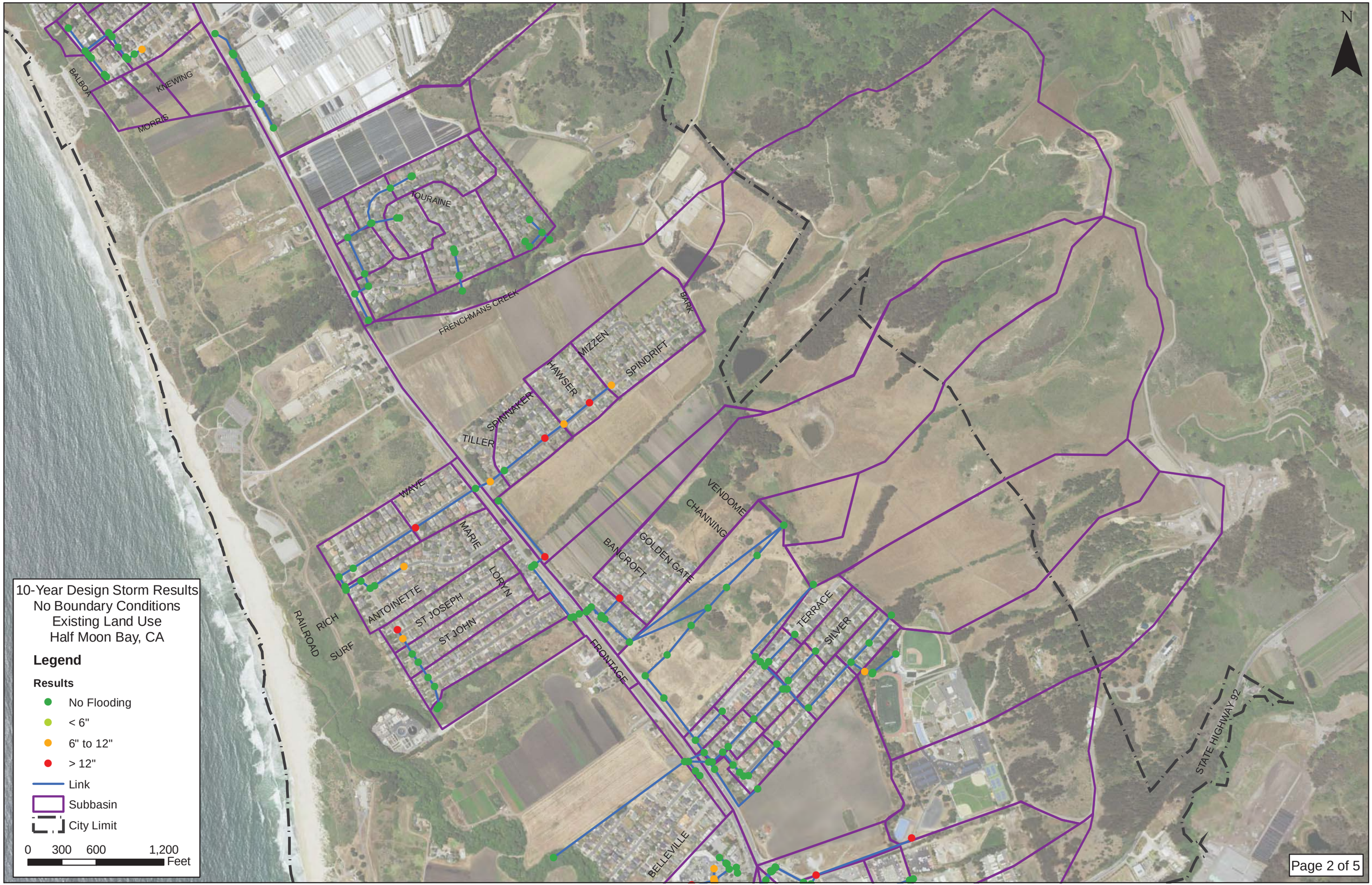
Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

MIRADA
ALTO
VENTURA
VALENCIA
RAMONA
ALAMEDA
OCEAN
ROOSEVELT
BALBOA
KNEWING
MORRIS
TOURAINE


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
RAILROAD
SURF
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92
10-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

10-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

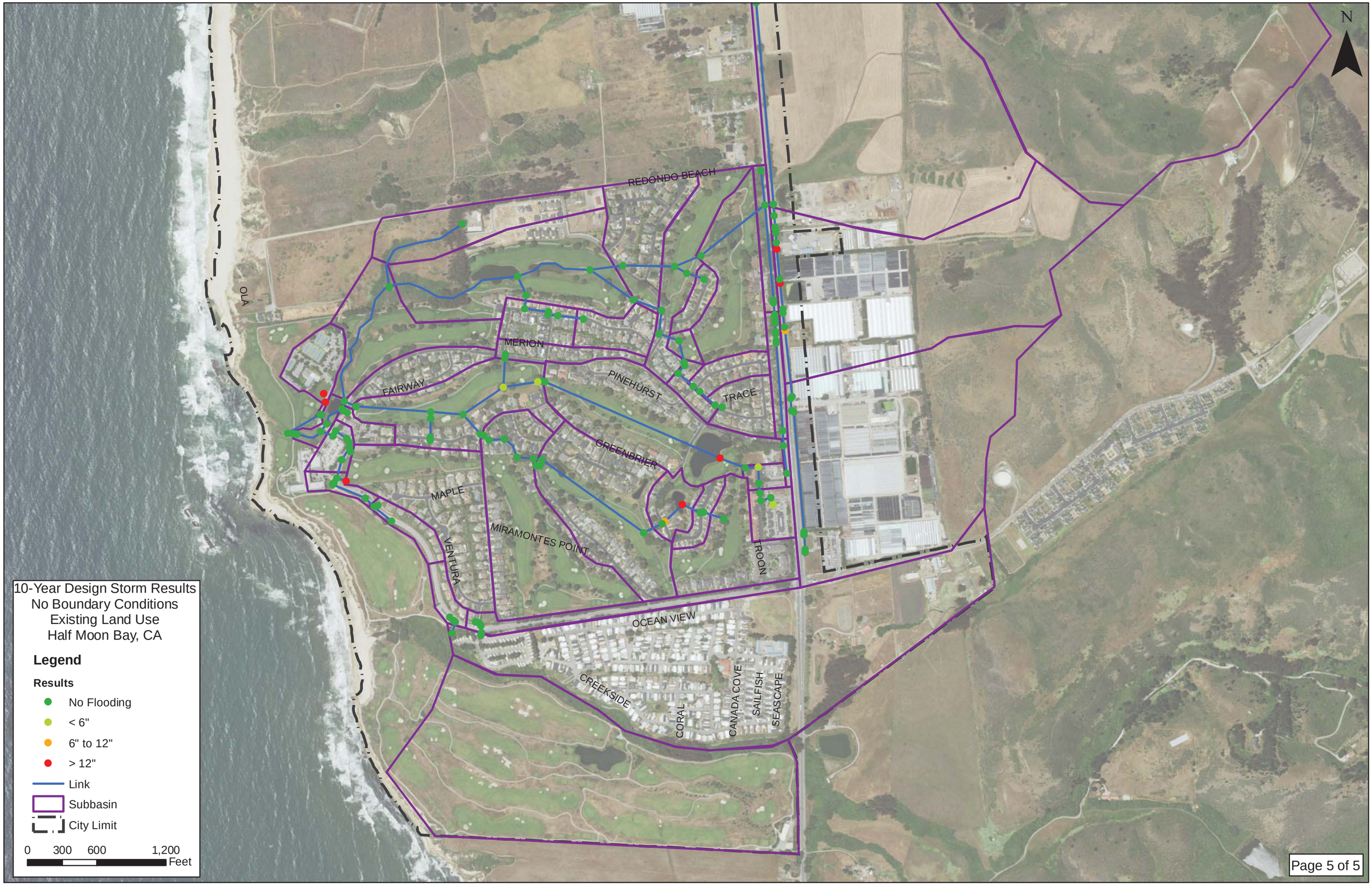
10-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
REDONDO BEACH
OLA
MERION
FAIRWAY
PINEHURST
TRACE
GREENBRIER
MAPLE
VENTURA
MIRAMONTES POINT
POON
OCEAN VIEW
CREEKSIDE
CORAL
CANADA COVE
SAILFISH
SEASCAPE
10-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

10-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RAILROAD
RICH
SURF
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

10-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

10-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

10-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

POON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

10-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

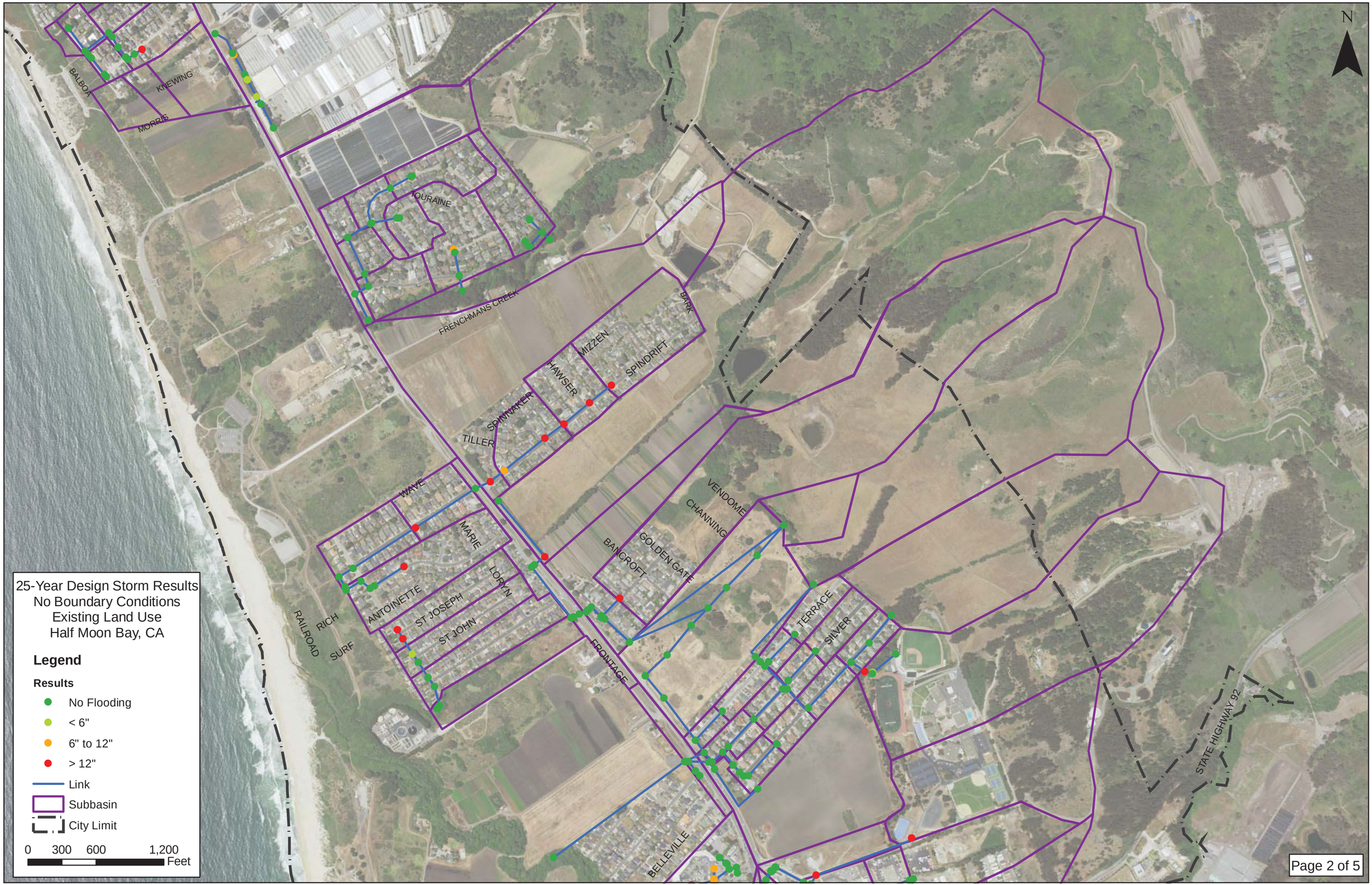
25-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180
Feet


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
SURF
RAILROAD
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92
25-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

25-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

25-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

POON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

25-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

25-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RAILROAD
RICH
SURF
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

25-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

25-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

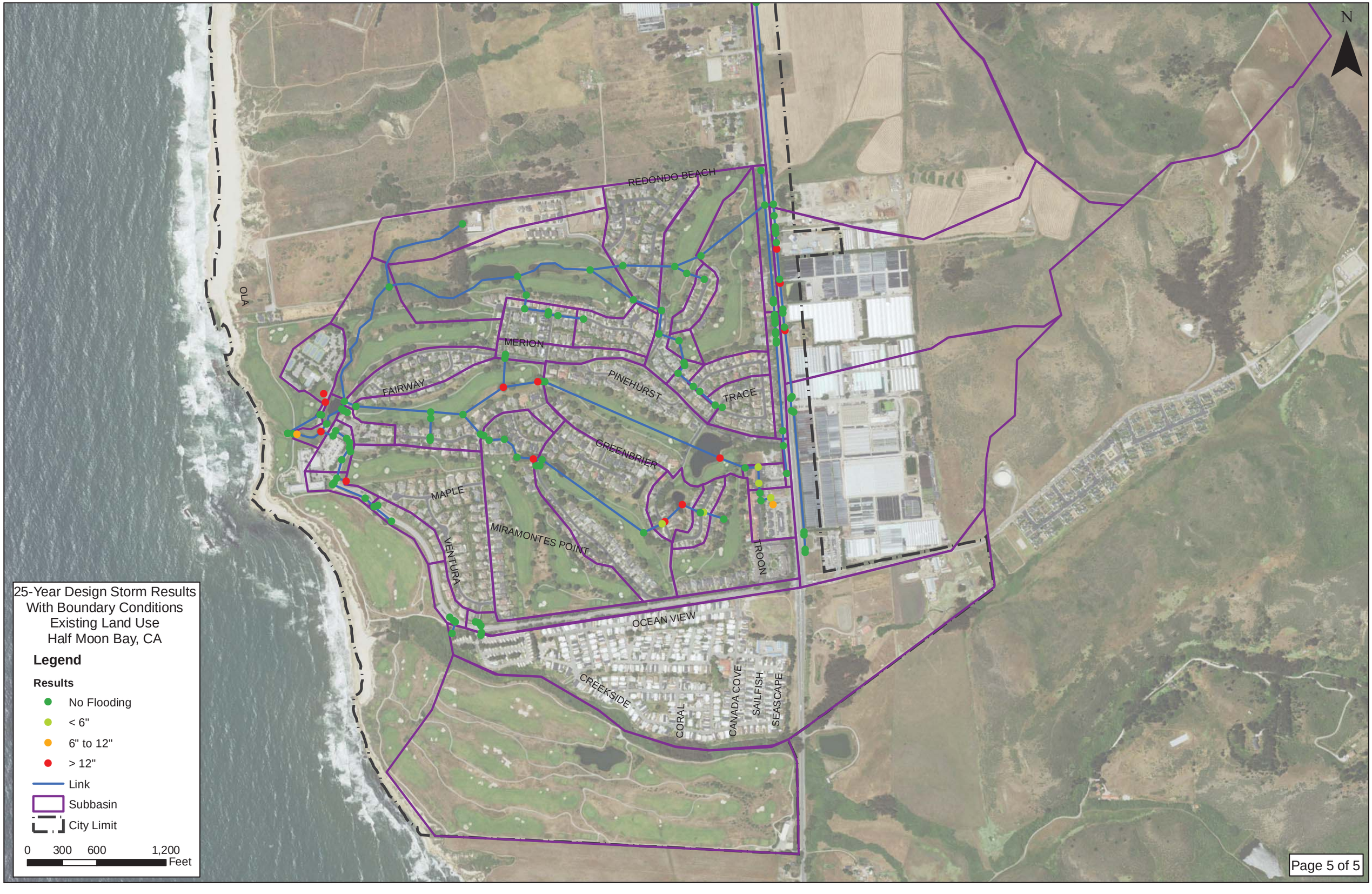
25-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet


N
REDONDO BEACH
OLA
MERION
FAIRWAY
PINEHURST
TRACE
GREENBRIER
MAPLE
MIRAMONTES POINT
VENTURA
LOON
OCEAN VIEW
CREEKSIDE
CORAL
CANADA COVE
SAILFISH
SEASCAPE
25-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

MIRAMAR

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

100-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RAILROAD
RICH
SURF
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

100-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

100-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

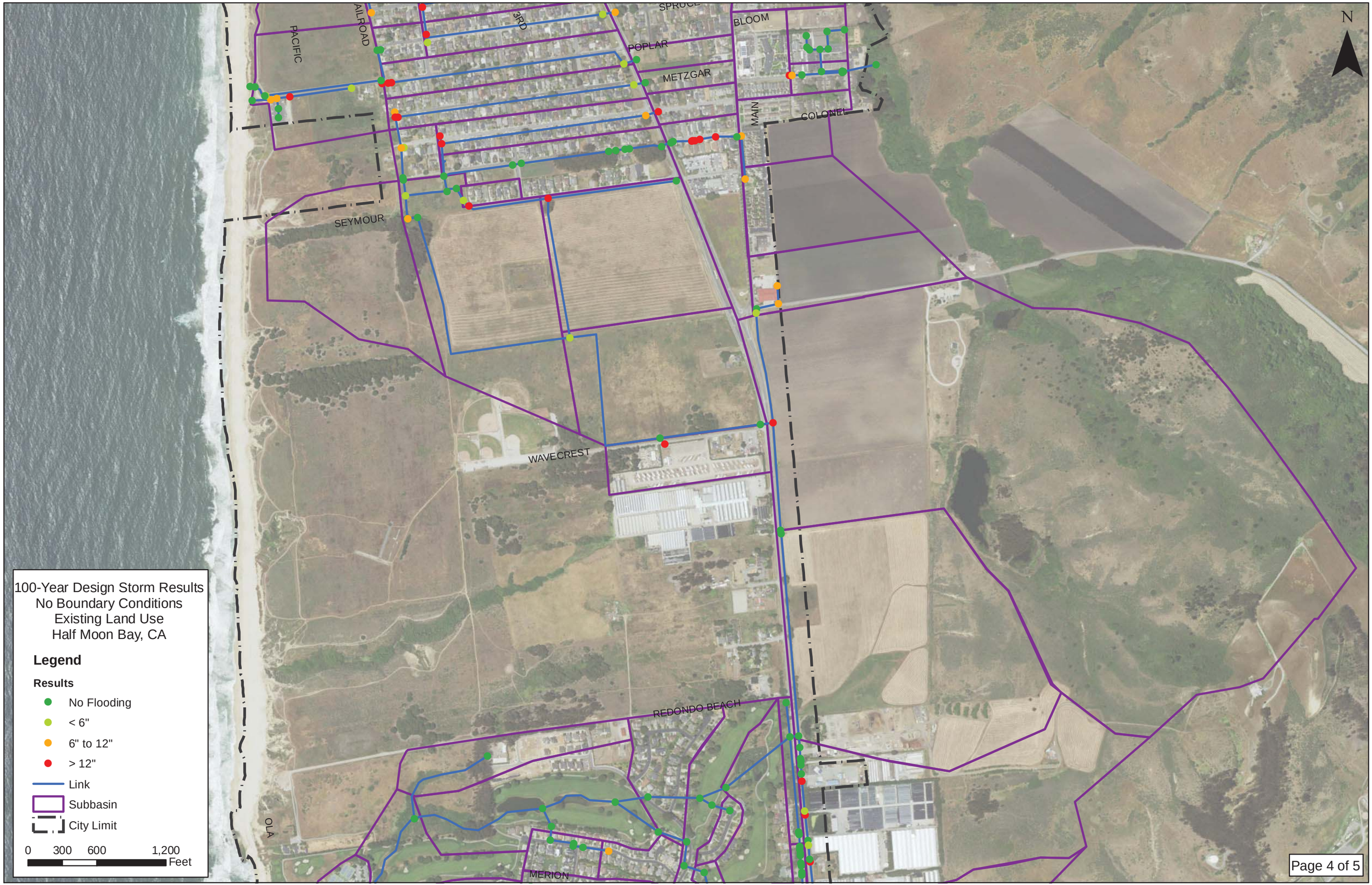
Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180 Feet

N


N
PACIFIC
AILROAD
3RD
SPRUCE
POPLAR
METZGAR
BLOOM
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH
MERION
OLA
100-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

100-Year Design Storm Results
No Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

100-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RAILROAD
RICH
SURF
FRONTAGE
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

100-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

100-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

N

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

100-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

VENTURA

MIRAMONTES POINT

POON

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

100-Year Design Storm Results
With Boundary Conditions
Existing Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

Appendix D

Future Land Use Results Figures

Appendix D

Future Land Use Results Figures

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

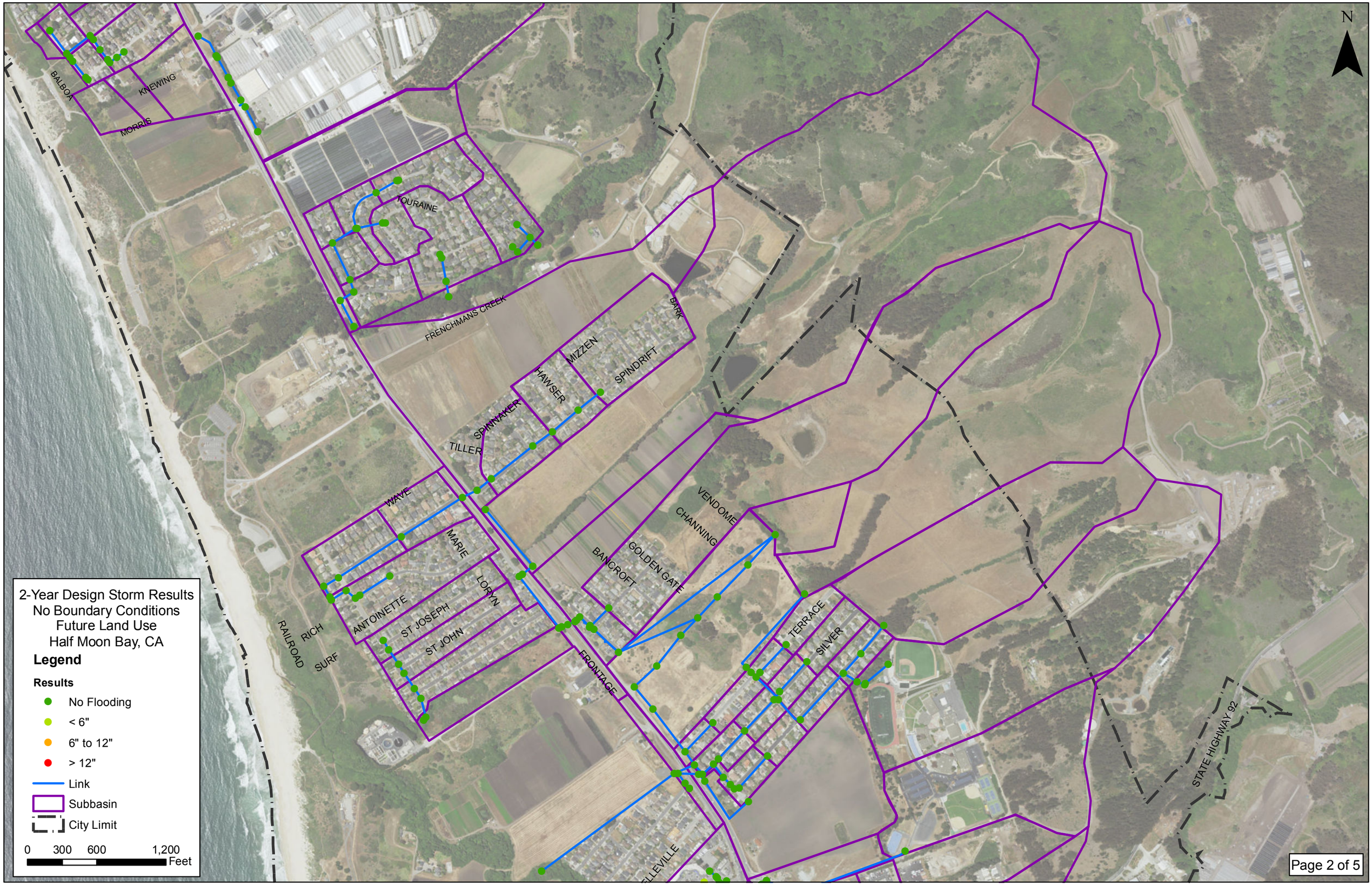
2-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

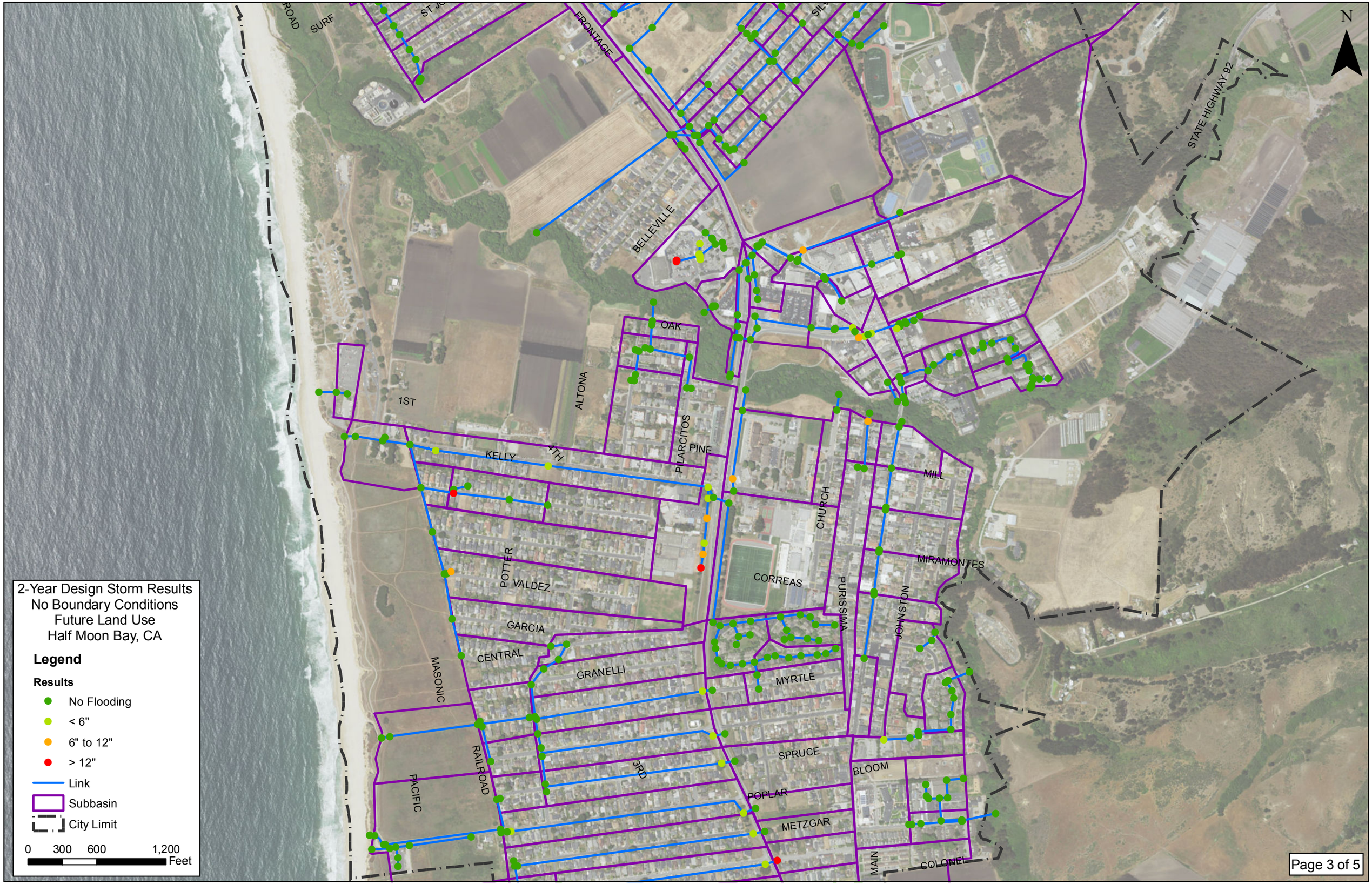
Legend

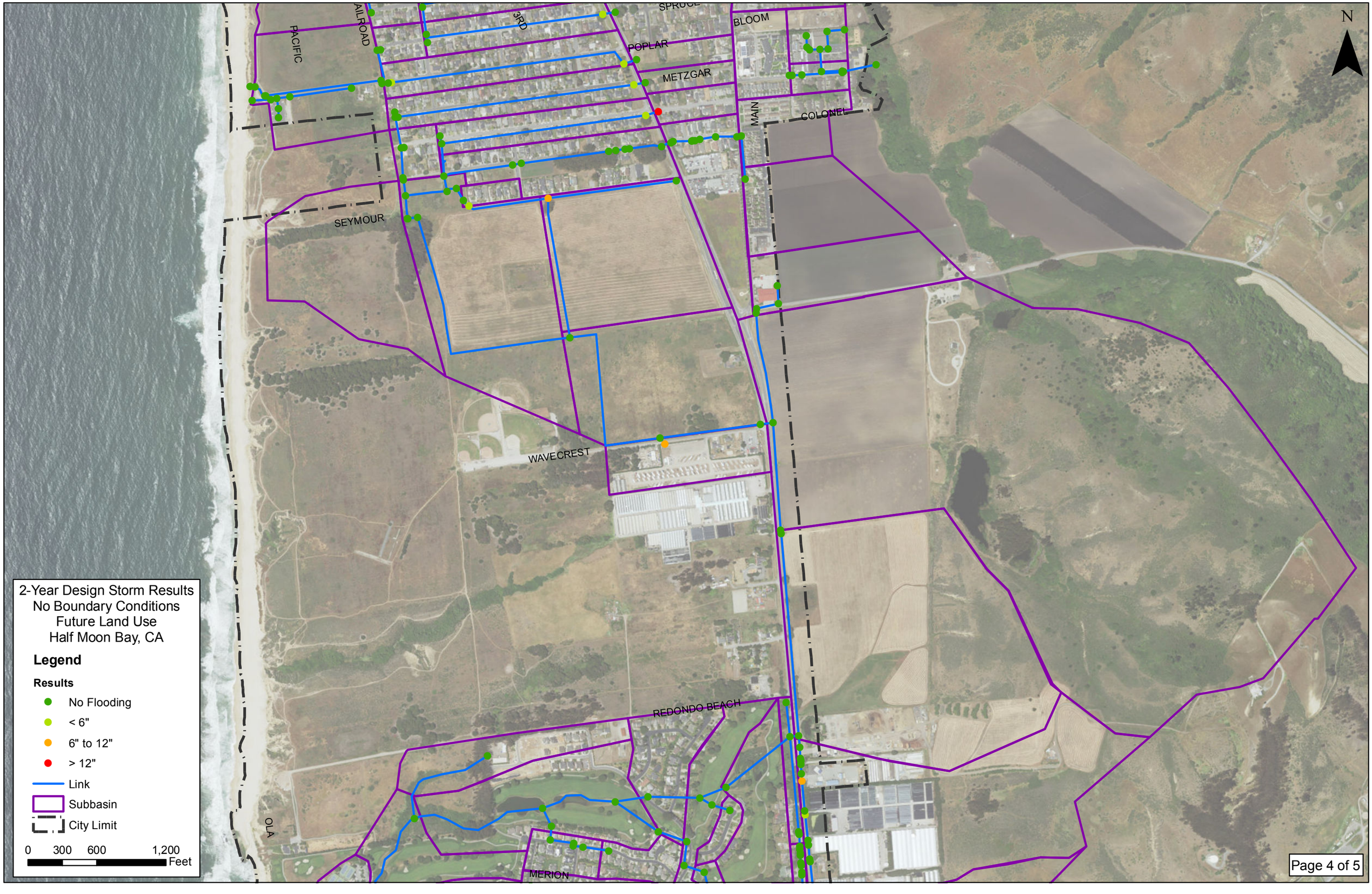
Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
RAILROAD
SURF
VENDOME
CHANNING
BANCROFT
GOLDEN GATE
FRONTAGE
TERRACE
SILVER
STATE HIGHWAY 92
2-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet


N
STATE HIGHWAY 92
SURF
FRONTAGE
BELLEVILLE
OAK
ALTONA
1ST
KELLY
4TH
PILARCITOS
PINE
MILL
CHURCH
MIRAMONTES
CORREAS
PURISSIMA
JOHNSTON
POTTER
VALDEZ
GARCIA
CENTRAL
GRANELLI
MYRTLE
MASONIC
RAILROAD
PACIFIC
3RD
SPRUCE
BLOOM
POPLAR
METZGAR
MAIN
COLONEL
2-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet
Page 3 of 5


PACIFIC
AILROAD
3RD
SPRUCE
POPLAR
METZGAR
BLOOM
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH
MERION
OLA
N
2-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOM

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

2-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

2-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

MIRADA
ALTO
VALENCIA
VENTURA
RAMONA
ALAMEDA
OCEAN
ROOSEVELT
BALBOA
KNEWING
MORRIS
TOURAINE

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
RAILROAD
SURF
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
STATE HIGHWAY 92

2-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

STATE HIGHWAY 92

SURF

ST JOHNS

FRONTAGE

SILVER

BELLEVILLE

OAK

1ST

ALTONA

PILARCITOS

PINE

4TH

KELLY

MILL

CHURCH

MIRAMONTES

CORREAS

PURISSIMA

JOHNSTON

POTTER

VALDEZ

GARCIA

CENTRAL

GRANELLI

MYRTLE

MASONIC

RAILROAD

3RD

SPRUCE

BLOOM

PACIFIC

POPLAR

METZGAR

MAIN

COLONEL

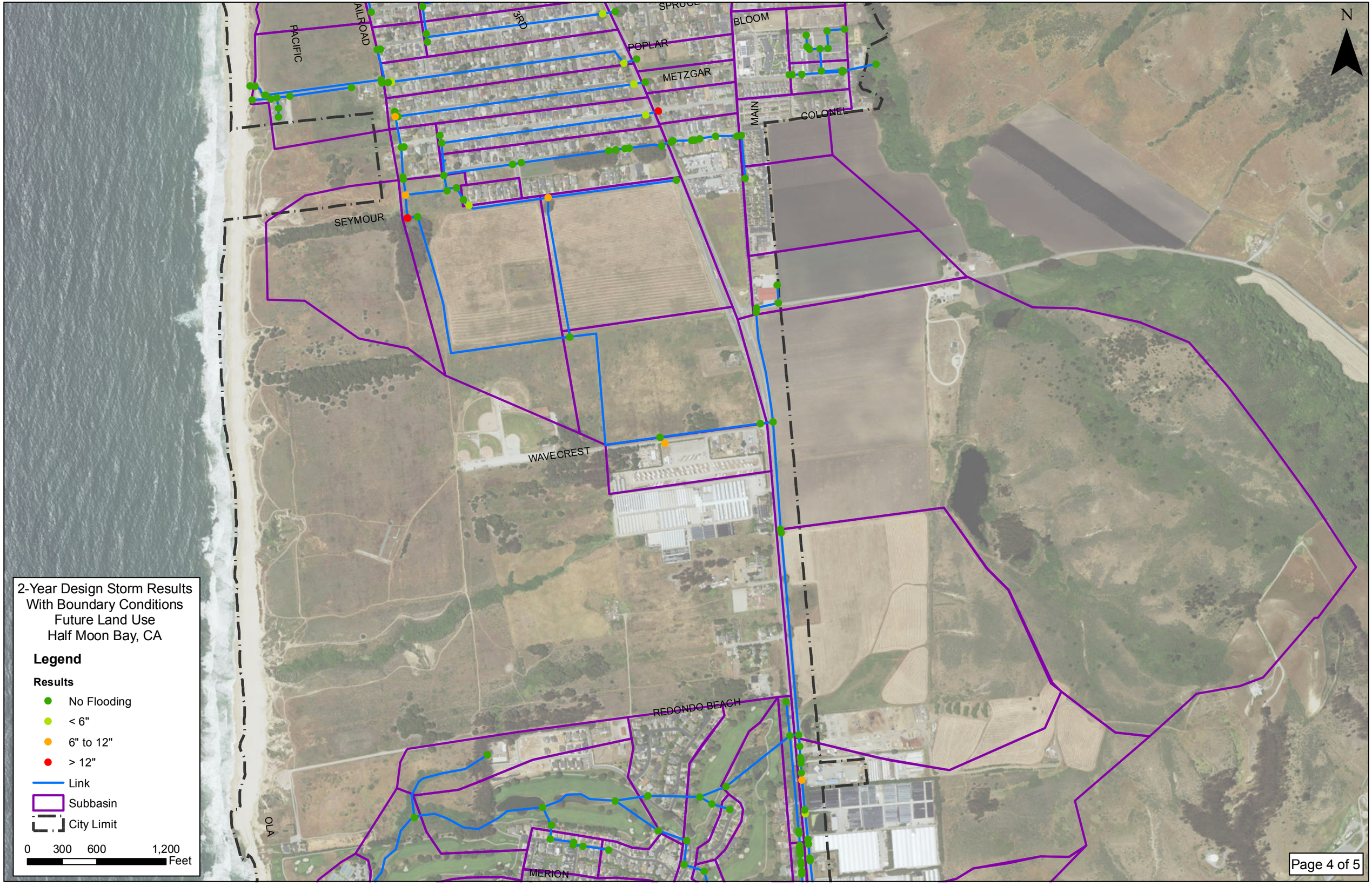
2-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
PACIFIC
AILROAD
3RD
SPRUCE
POPLAR
METZGAR
BLOOM
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH
MERION
OLA
2-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOSEVELT

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

2-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

10-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
RAILROAD
SURF
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

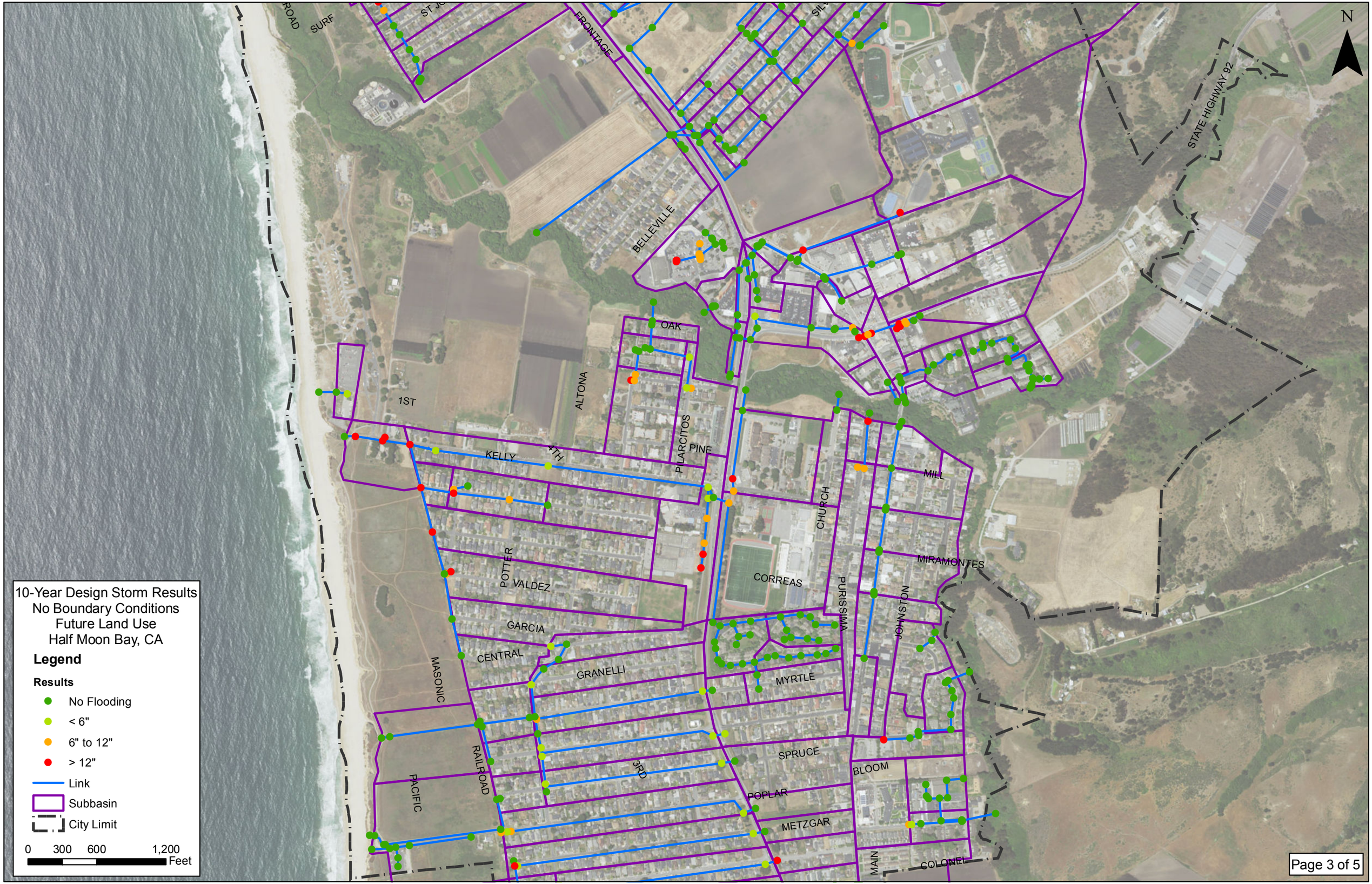
10-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
SURF
FRONTAGE
BELLEVILLE
STATE HIGHWAY 92
OAK
1ST
ALTONA
PLARCITOS
PINE
KELLY
4TH
CHURCH
MILL
MIRAMONTES
POTTER
VALDEZ
CORREAS
PURISSIMA
JOHNSTON
GARCIA
CENTRAL
GRANELLI
MYRTLE
MASONIC
RAILROAD
3RD
SPRUCE
BLOOM
PACIFIC
POPLAR
METZGAR
MAIN
COLONEL
10-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

OLA

MERION

N

10-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOM

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

10-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

10-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ST JOHN
ST JOSEPH
ANTOINETTE
RICH
SURF
RAILROAD
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

10-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

10-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

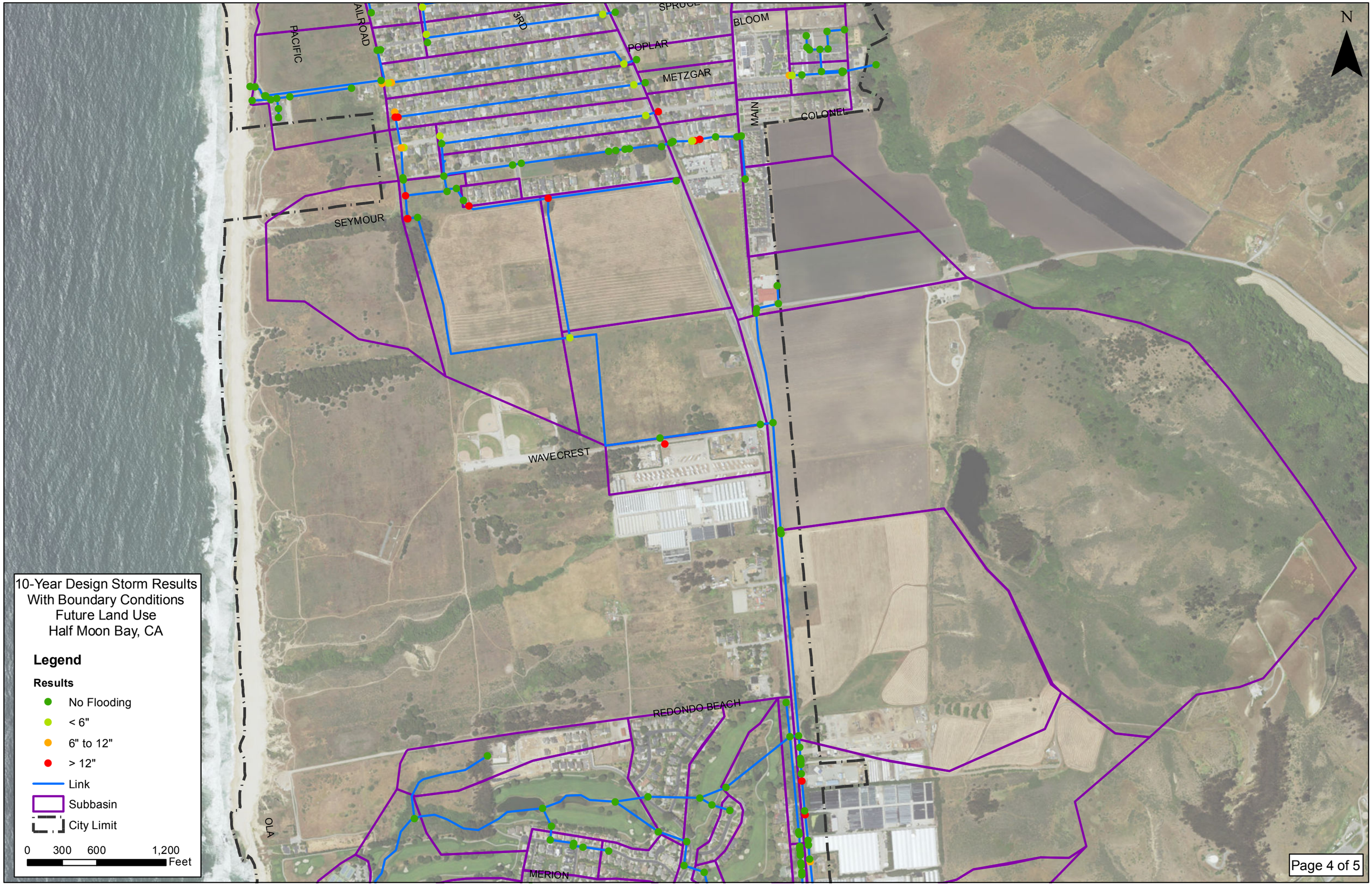
Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

SURF
FRONTAGE
BELLEVILLE
STATE HIGHWAY 92
OAK
1ST
ALTONA
PLARCITOS
PINE
KELLY
4TH
POTTER
VALDEZ
GARCIA
CENTRAL
GRANELLI
MASONIC
RAILROAD
PACIFIC
3RD
CHURCH
CORREAS
PURISSIMA
MYRTLE
SPRUCE
POPLAR
METZGAR
JOHNSTON
MILL
MIRAMONTES
BLOOM
MAIN
COLONEL


N
PACIFIC
AILROAD
3RD
SPRUCE
POPLAR
METZGAR
BLOOM
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH
MERION
OLA
10-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOSEVELT

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

10-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

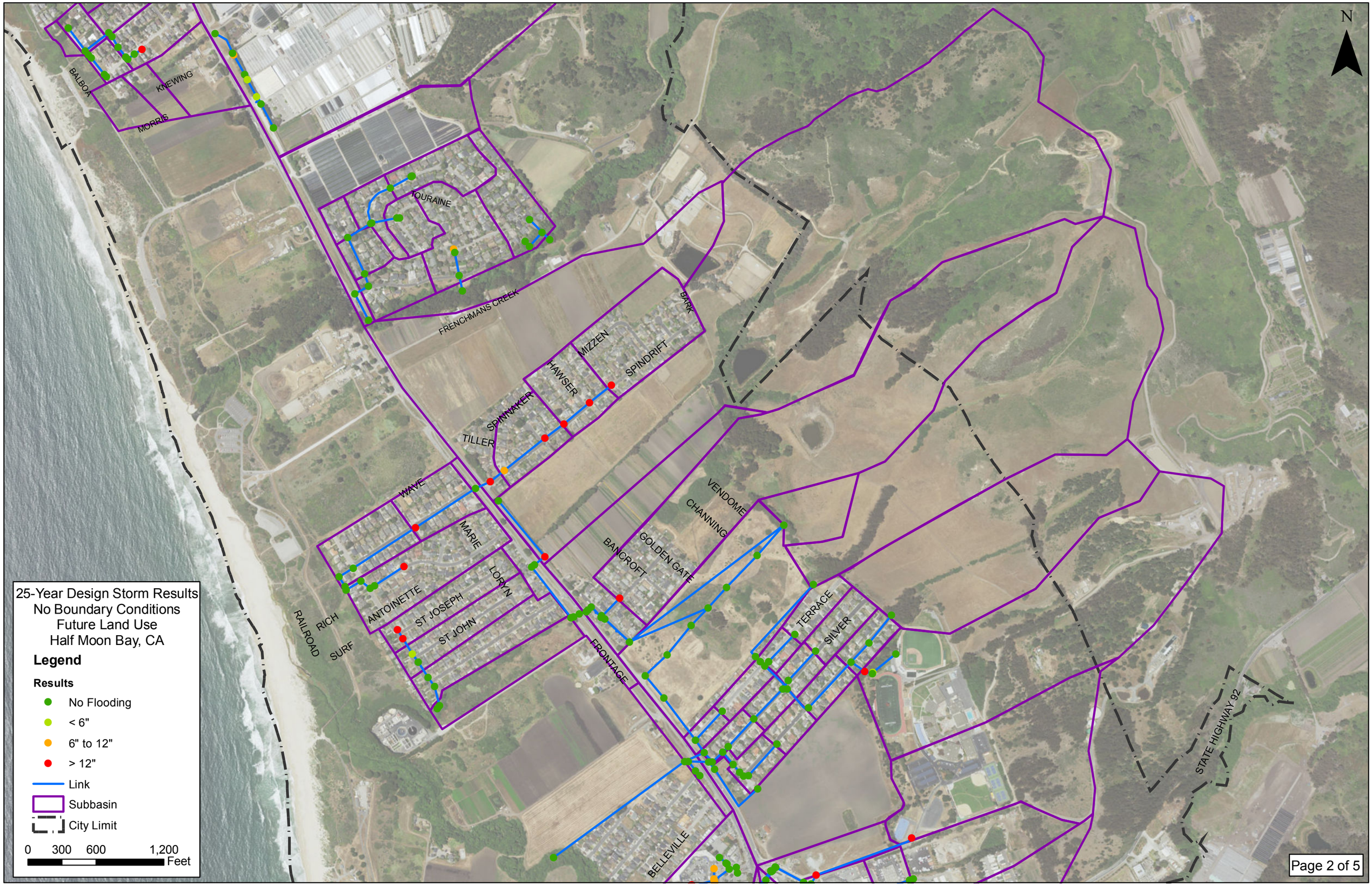
25-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180
Feet


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
MIZZEN
SPINDRIFT
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ANTOINETTE
ST JOSEPH
ST JOHN
RICH
RAILROAD
SURF
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92
25-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

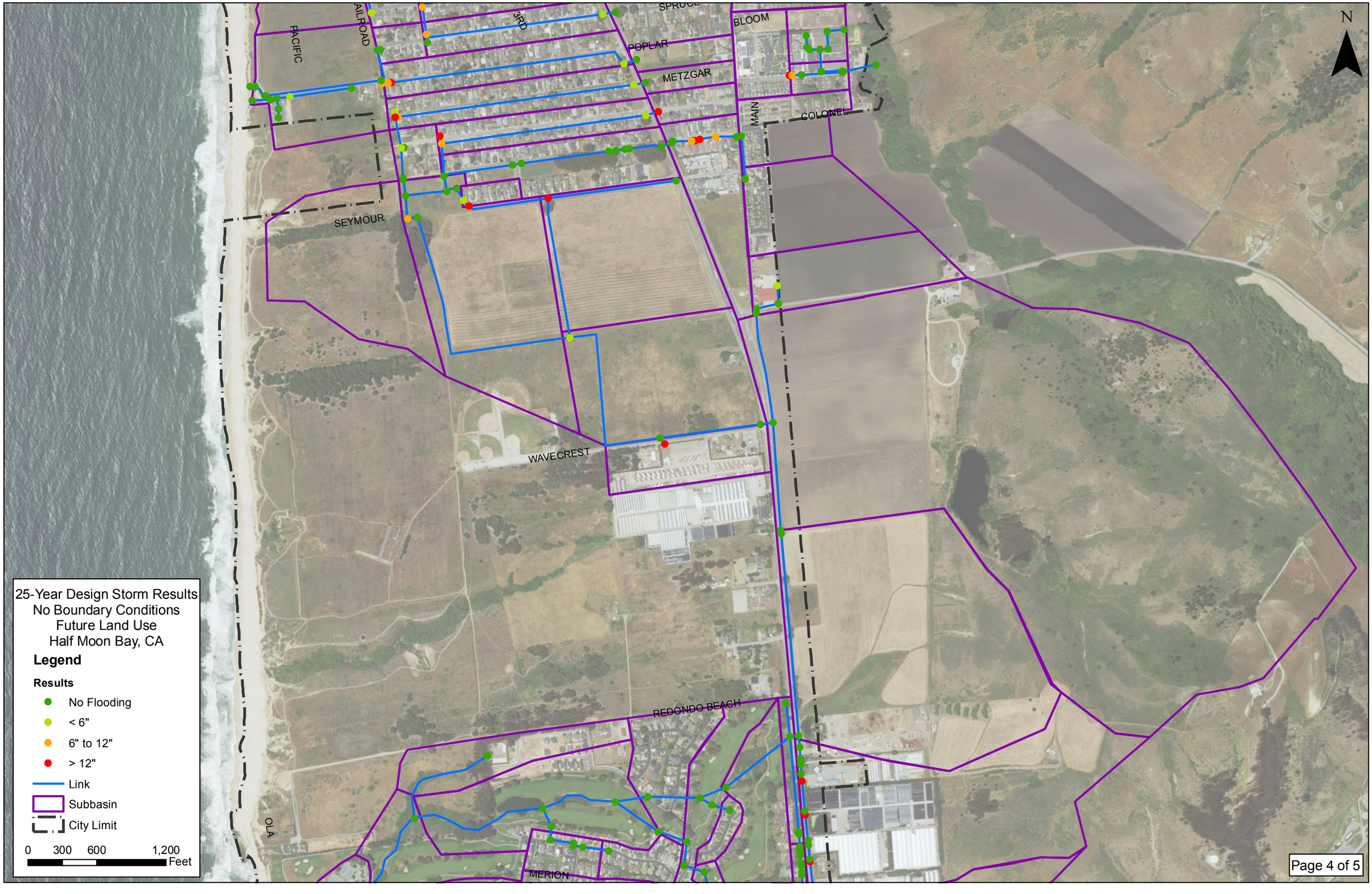
25-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
PACIFIC
AILROAD
3RD
SPRUCE
POPLAR
METZGAR
BLOOM
MAIN
COLONEL
SEYMOUR
WAVECREST
REDONDO BEACH
MERION
OLA
25-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOSEVELT

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

25-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

25-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

MIRADA
ALTO
VENTURA
VALENCIA
RAMONA
ALAMEDA
OCEAN
ROOSEVELT
BALBOA
KNEWING
MORRIS
TOURAINE

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ST JOHN
ST JOSEPH
ANTOINETTE
RICH
SURF
RAILROAD
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

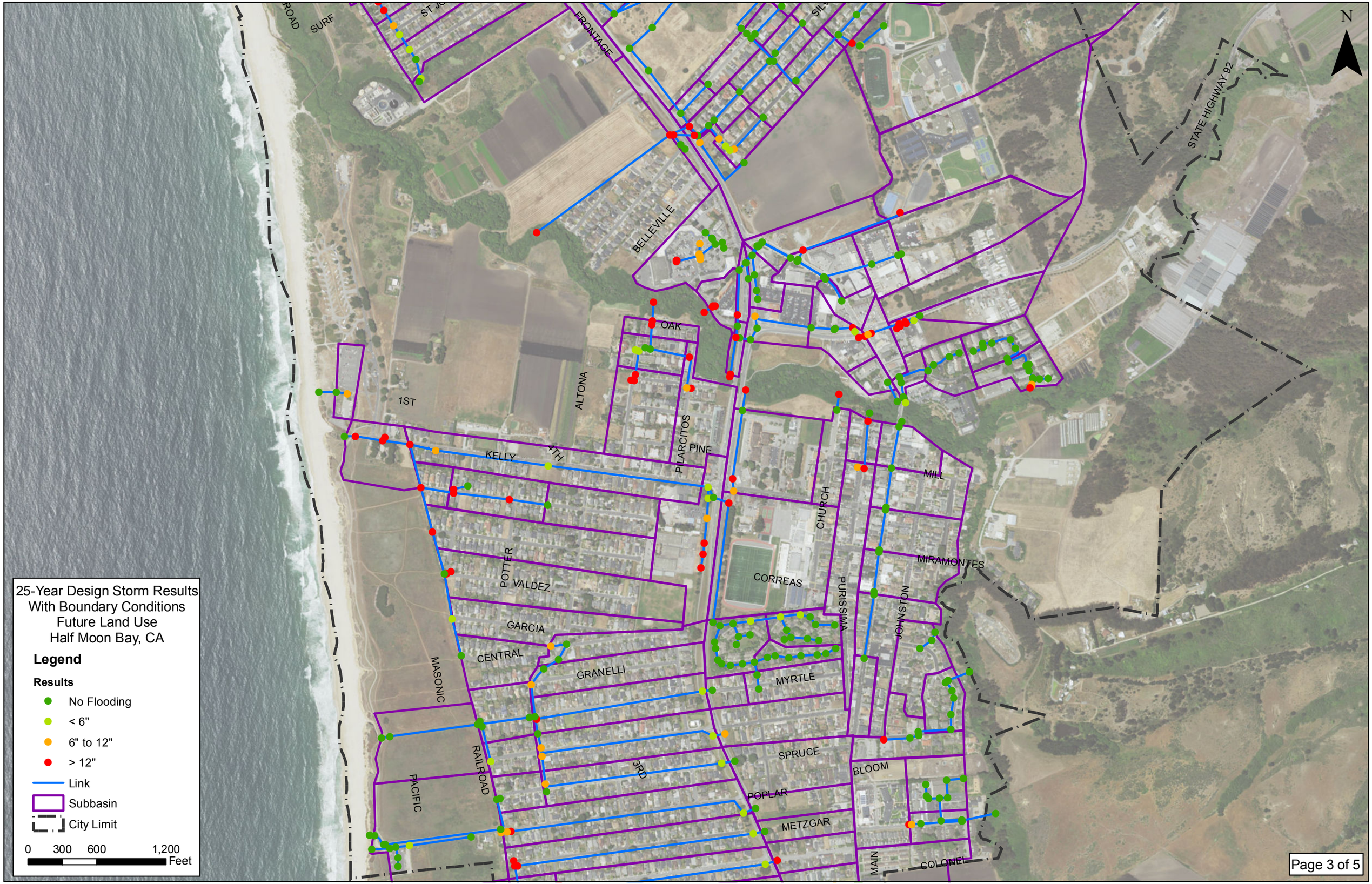
25-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
SURF
FRONTAGE
BELLEVILLE
STATE HIGHWAY 92
OAK
1ST
ALTONA
PLARCITOS
PINE
KELLY
4TH
CHURCH
MILL
MIRAMONTES
POTTER
VALDEZ
CORREAS
PURISSIMA
JOHNSTON
GARCIA
CENTRAL
GRANELLI
MYRTLE
MASONIC
RAILROAD
3RD
SPRUCE
BLOOM
PACIFIC
POPLAR
METZGAR
MAIN
COLONEL
25-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

OLA

MERION

N

25-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOM

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

25-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

MIRAMAR

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

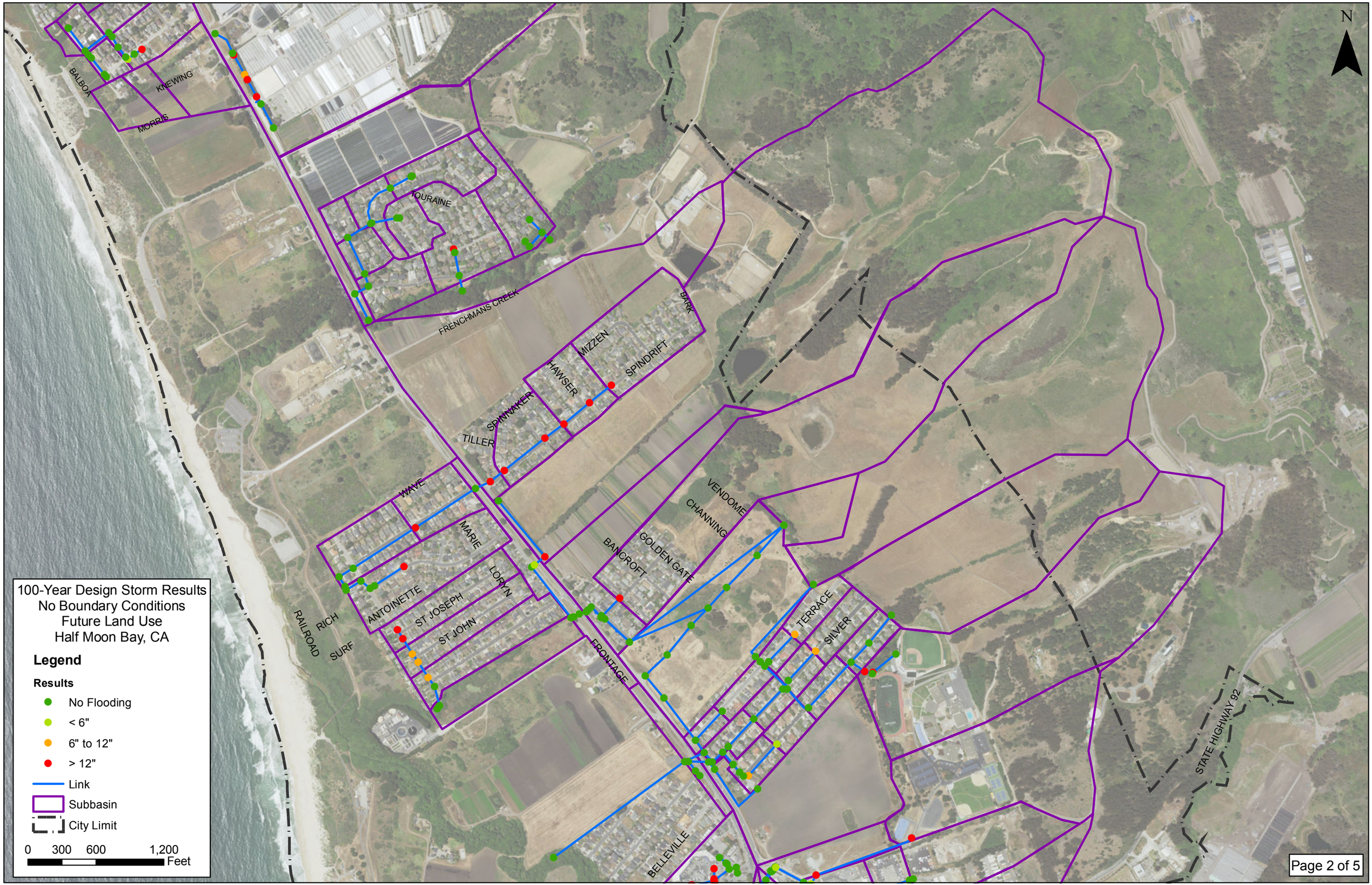
100-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet


N
BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ST JOHN
ST JOSEPH
ANTOINETTE
RICH
SURF
RAILROAD
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92
100-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA
Legend
Results
No Flooding
< 6"
6" to 12"
> 12"
Link
Subbasin
City Limit
0 300 600 1,200
Feet

N

100-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

PACIFIC

AILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

OLA

MERION

N

100-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOSEVELT

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

100-Year Design Storm Results
No Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 290 580 1,160
Feet

N

MIRADA

ALTO

VENTURA

VALENCIA

RAMONA

ALAMEDA

OCEAN

ROOSEVELT

BALBOA

KNEWING

MORRIS

TOURAINE

100-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

BALBOA
KNEWING
MORRIS
TOURAINE
FRENCHMANS CREEK
BARK
SPINDRIFT
MIZZEN
HAWSER
SPINNAKER
TILLER
WAVE
MARIE
LORYN
ST JOHN
ST JOSEPH
ANTOINETTE
RICH
SURF
RAILROAD
BANCROFT
GOLDEN GATE
CHANNING
VENDOME
FRONTAGE
TERRACE
SILVER
BELLEVILLE
STATE HIGHWAY 92

100-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200
Feet

N

100-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 295 590 1,180 Feet

PACIFIC

RAILROAD

3RD

SPRUCE

POPLAR

METZGAR

BLOOM

MAIN

COLONEL

SEYMOUR

WAVECREST

REDONDO BEACH

MERION

OLA

N

100-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

N

REDONDO BEACH

OLA

MERION

FAIRWAY

PINEHURST

TRACE

GREENBRIER

MAPLE

MIRAMONTES POINT

VENTURA

ROOSEVELT

OCEAN VIEW

CREEKSIDE

CORAL

CANADA COVE

SAILFISH

SEASCAPE

100-Year Design Storm Results
With Boundary Conditions
Future Land Use
Half Moon Bay, CA

Legend

Results

- No Flooding
- < 6"
- 6" to 12"
- > 12"
- Link
- Subbasin
- City Limit

0 300 600 1,200 Feet

Appendix E

Model Files (Electronic)