FINAL DESIGN REPORT
FOR
SOUTH MISSION BEACH
STORM DRAIN IMPROVEMENTS
AND
GREEN INFRASTRUCTURE

(60% Design Submittal)

Job Number 18022-E

August 26, 2019

RICK
ENGINEERING COMPANY

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August 26, 2019

TABLE OF CONTENTS

Figures

Tables

Appendices

Map Pockets

CD Pocket

1.0 INTRODUCTION

This design report summarizes hydrologic and hydraulic analysis, and storm water quality treatment (green infrastructure) for the proposed South Mission Beach Storm Drain Improvements and Green Infrastructure Project (herein referred to as the “project”). The hydrology & hydraulics, and storm water quality analyses performed are consistent with the methodology and approach presented in the document titled “South Mission Beach Watershed Master Plan,” (WMP) prepared by Rick Engineering Company and dated March 29, 2019. For detailed background information regarding methodology, approach, parameters, and the analysis software used, this report will refer to the relevant section of the WMP document, which is included as an electronic copy in the CD pocket of this report.

1.1. Project Description

The project is located within the South Mission Beach community in the City of San Diego. The primary objective is to implement storm drain improvements to increase conveyance capacity, and mitigate surface ponding conditions within the public right-of-way. The project also proposes the implementation of Green Infrastructure (GI) features which include eight (8) proposed biofiltration or bioretention basins to improve local storm water quality tributary to Mission Bay. Five biofiltration basins are located in the parkway area within the parking lots adjacent to Mission Boulevard, bounded by Belmont Park to the north and San Fernando Place to the south. One biofiltration basin is located east of Mission Boulevard, within the parking lot to the south at Mission Point Park. Two bioretention basins are located to the south along North Jetty Road, approximately 400 feet to the east and west of Mission Boulevard. Refer to Map Pocket 4 for a plan view layout outlining the location of the basins.

There are currently 4 gravity low-flow diversion (LFD) systems, and one existing wet well pump system which direct storm drain flows to the sanitary sewer system. The improvements proposed in this project include the installation of additional new low-flow sewer diversion systems, as well as the retrofit and enhancement of the existing systems, which direct nuisance dry-weather flows, and the first 20 minutes (first flush) of wet-weather flows into the sanitary sewer system, to improve local water quality conditions at the storm drain outfall locations.

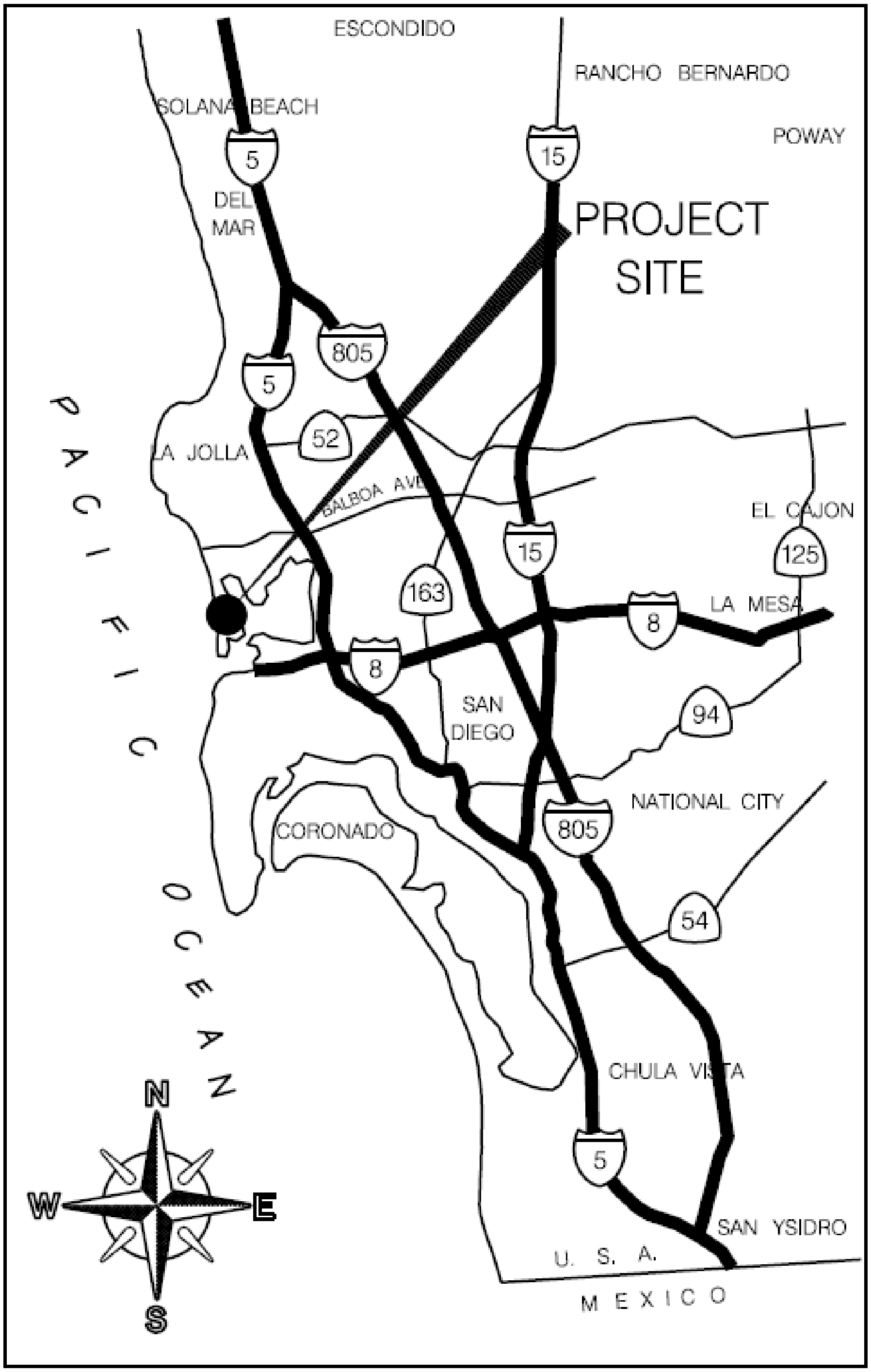
1.2. Permanent Storm Water Requirements

Though the project proposes biofiltration basins and low-flow sewer diversion systems to improve storm water quality, the project is not categorized as a “Priority Development Project” (PDP) or “Standard Development Project” (SDP) according to Chapter 1.4 of the City of San Diego Storm Water Standards (SWS) (October 2018). There are no proposed impervious surfaces consistent with those outlined in the SWS PDP categories as the project primarily proposes only the removal and replacement of impervious area associated with the trenching and resurfacing necessary to install the storm drain and low-flow diversion systems. The project’s primary purpose is to replace and extend storm drain systems to improve local drainage conditions. The proposed green infrastructure features are a proactive approach to provide improved local water quality.

The project also proposes mill and AC overlay of approximately 0.6 miles of Mission Boulevard, from San Fernando Place to North Jetty Road to restore street curb heights and increase storm water conveyance/ponding capacity within the existing right-of-way along Mission Boulevard. The storm drain trenching and resurfacing, as well as the mill and AC overlay are categorized under “routine maintenance activity” per Section 1.3, Table 1-2 of the SWS manual, and are excluded from the determination of PDP requirements. Therefore, the project is not subject to permanent storm water BMP requirements. Refer to the Storm Water Requirements Applicability Checklist (Form DS-560) in Appendix A.

The proposed water quality treatment BMPs will be located and sized where practical as directed by City staff. The water quality basins will include a bioretention soil media layer, gravel layer, underdrain and an overflow outlet (i.e. – for runoff greater than the water quality volume provided within the basin, up to and including a 100-year storm event). Two proposed bioretention basins do not include an underdrain connection. As the project is located within an older community developed prior to storm water regulations, it is anticipated that there is currently no storm water treatment for these drainage areas; thus, the proposed project will significantly improve water quality for the downstream water bodies. The project will reference the guidelines set forth in the City of San Diego Storm Water Standards, dated October 2018 (herein “Storm Water Standards”) and the “City of San Diego Low Impact Development (LID) Design Manual,” dated July 2011.

Figure 1-1: Vicinity Map



VICINITY MAP

NOT TO SCALE

2.0 GREEN INFRASTRUCTURE

Although this project is not subject to permanent storm water requirements, the design of green infrastructure features aims to follow the Municipal Separate Storm Sewer System (MS4) Permit (Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0010) as adopted by the San Diego Regional Water Quality Control Board (SDRWQCB) (herein referred to as “2013 MS4 Permit”). The requirements of the 2013 MS4 Permit went into effect on February 16, 2016 in the San Diego Region. Permanent storm water requirements are determined based on criteria set forth in the City of San Diego’s Storm Water Requirements Applicability Checklist. Projects are identified by three categories:

- Priority Development Project
- Standard Development Project
- Not subject to permanent storm water requirements

The project is not subject to permanent storm water requirements according to Chapter 1.4 of the City of San Diego Storm Water Standards Manual (October 2018). Refer to the Storm Water Requirements Applicability Checklist in Appendix A.

2.1. Water Quality Assessment Reduction Goals

The project proposes to provide water quality features in the form of biofiltration/bioretention basins and low-flow sewer diversion systems to proactively improve local water quality. A water quality assessment was previously performed during the South Mission Beach WMP to evaluate potential GI options to consider for basis of design, as explained in section 4.0 of the South Mission Beach WMP. The relevant literature pertaining to the highest priority pollutants of concern for the project area were reviewed and determined Fecal Coliform (indicator bacteria category) to be the highest priority pollutant of concern for the receiving water body. A Total Maximum Daily Load (TMDL) has not yet been developed for the receiving water body (Mission Bay Shoreline, at Bonita Cove). However, it is reasonable to use the bacteria wet weather maximum target value of 22 percent for exceedance days as a reference metric to measure and compare the maximum pollutant load reduction achieved by the proposed GI improvements.

2.2. Green Infrastructure BMP Design

As previously mentioned, this project is not subject to permanent storm water requirements and is therefore not required to meet either pollutant control or hydromodification management flow control requirements; however, this project is implementing six (6) biofiltration basin BMPs (Basins 1-5, 8), two (2) bioretention basin BMPs, and nine (9) low-flow sewer diversion systems to significantly improve water quality tributary to the receiving waters. Currently, numeric sizing standards are not required for BMPs on projects that are not subject to permanent storm water requirements; however, the proposed designs aim to provide the maximum biofiltration footprint feasible within the available landscape area, while using the 3% effective impervious drainage area as a reference metric. Refer to Appendix B for a comparison between the provided and required footprints as calculated using the City of San Diego BMP footprint calculation worksheets as reference. Refer to Appendix C for a copy of the GI plan sheets

Furthermore, a continuous simulation model using EPA SWMM Version 5 was completed to quantify the anticipated pollutant load reductions for a range of pollutant categories anticipated from adjacent land uses tributary to the storm drain outfalls. The methodology used within the EPA SWMM models is consistent with the analysis approach outlined in section 4.3 of the South Mission Beach WMP.

In comparison, pollutant control sizing requirements for PDPs require designing to the project-specific 85th percentile design storm event or the water quality storm intensity (0.2 in/hr.). The 85th percentile storm event precipitation for the project is 0.52 inches, according to the City of San Diego Storm Water Standards Manual (October 2018), 85th Percentile Isopluvials Exhibit (Figure B.1-1).

2.3. Green Infrastructure BMP Results

Incorporating Green Infrastructure in an existing development poses inherent challenges, thus the proposed Green Infrastructure BMPs are sited in locations which are feasible, practical, with consideration of construction and maintenance costs, and within City-owned parcels or paper streets.

Based on the NRCS Web Soil Survey, soils throughout the biofiltration BMP locations are within unmapped 'Urban' land which was conservatively considered as 'Type D' Soils. A

Geotechnical analysis performed by Allied Geotechnical Engineers Inc., found that in-situ infiltration testing was not possible in the vicinity of Biofiltration Basins 1-5 due presence of shallow groundwater therefore, it is anticipated that full infiltration will not be feasible for these basins and thus perforated underdrains (with an upturned elbow to mitigate groundwater intrusion) and outlet pipes are proposed. However, infiltration testing was performed by the geotechnical engineer in the vicinity of Basin 7 which concluded that the soil possessed very high permeability characteristics, as a consistent free head could not be maintained within the test hole. The infiltration rate was calculated to be 90 inches per hour as documented in the Geotechnical report, which suggests that a bioretention basin with no underdrain may be placed.

The following tables and figures present a results summary of pollutant loads measured at the storm drain outfalls in the pre- and post-project condition. The results were obtained by performing a continuous simulation model of the 2003 Water Year, utilizing rainfall data from the Lindbergh rain gage, consistent with the methodology and approach in section 4.3 of the South Mission Beach WMP.

Table 2-1: Pre-Project Fecal Coliform Exceedance Days – No Wet Weather LFD

Period Analyzed (2003 Water Year)	**Wet Days**	**Wet Weather Exceedance Days**	**Dry Weather Exceedance Days**
Oct. 1, 2002 – Sept. 30, 2003	42	20 (48%)	1

Figure 2-1: Pre-Project Fecal Coliform Modeling Results – No Wet Weather LFD

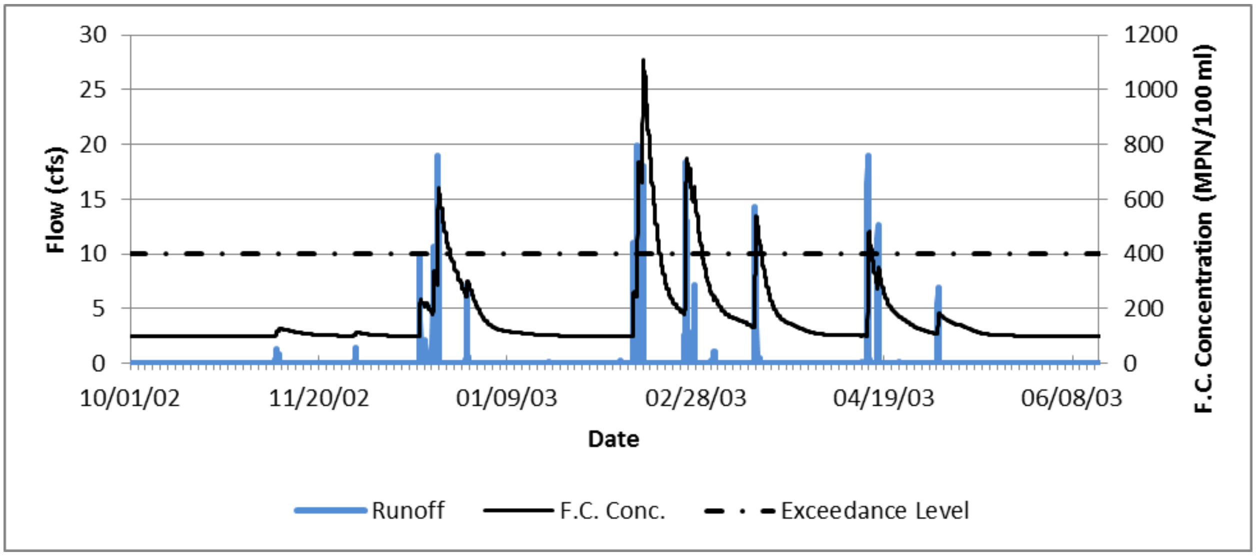


Table 2-2: Pre-Project Water Quality Performance – No Wet Weather LFD

Structure Type	Runoff Volume Removed[2] (MG/YR)	Total Runoff Volume (MG/YR)	Percent Reduction (%)
Weep sumps	0.12	17	0.7%
Sewer Diversion[4]	0	17	0%
Total	0.12	17	0.7%

Notes:

[1] Based on model results for the 2003 Water Year.

[2] The runoff volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.

[3] Results are reflective of the total infrastructure within the respective category.

[4] The existing low-flow sewer diversion systems were modeled based on no wet weather low-flow diversion. No runoff volume is removed.

Table 2-3: Post-Project Fecal Coliform Exceedance Days – First Flush LFD

Period Analyzed (2003 Water Year)	Wet Days	Wet Weather Exceedance Days	Dry Weather Exceedance Days
Oct. 1, 2002 – Sept. 30, 2003	42	16 (38%)	0

Figure 2-2: Post-Project Fecal Coliform Modeling Results – First Flush LFD

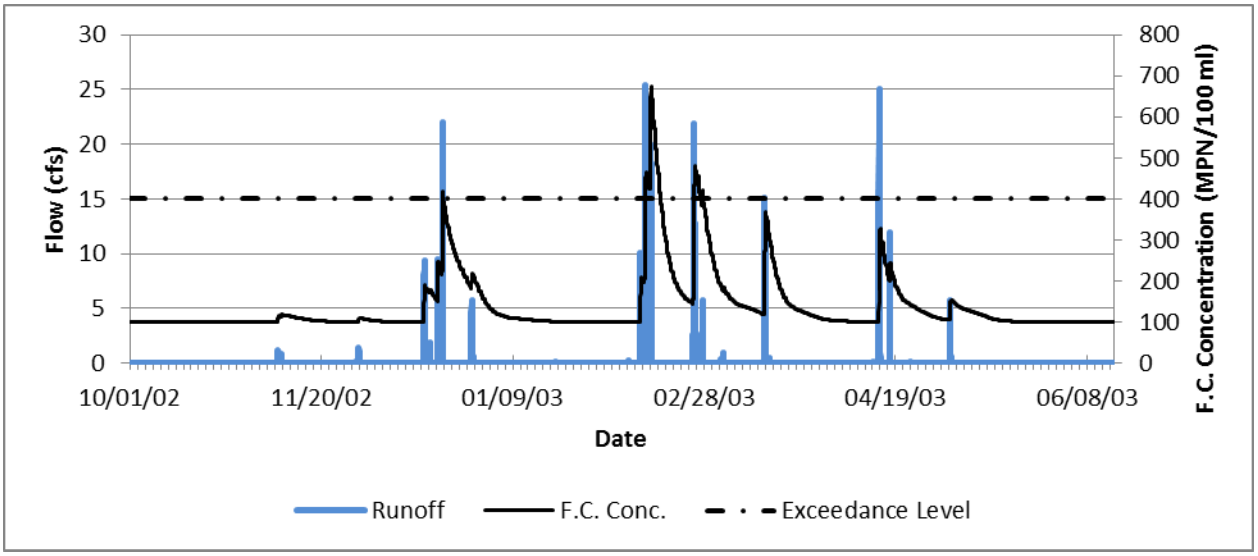


Table 2-4: Post-Project Water Quality Performance – First Flush LFD

Structure Type (GI)	**Runoff Volume Removed[1] (MG/YR)**	**Total Runoff Volume (MG/YR)**	**Percent Reduction (%)**	**Runoff Volume Treated[2] (MG/YR)**	**Percent Treated (%)**
Sewer Diversion[5]	0.1	17	0.6%		
Biofiltration Basins	2.3	17	13.5%	1.3	7.6%
Total	2.4	17	14.1%	1.3	7.6%

Notes:

[1] The volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.

[2] The volume treated refers to storm water runoff intercepted, and biofiltered by the proposed infrastructure, then discharged to the storm drain outfall location.

[3] Results are reflective of the total proposed infrastructure within the respective category.

[4] Based on model results for the 2003 Water Year.

[5] The proposed low-flow sewer diversion systems were modeled based on continuous diversion of dry weather flows and diversion of the first 20 minutes of a rain event.

3.0 HYDROLOGY

The 2017 City of San Diego Drainage Design Manual (San Diego DDM) considers the 100-Year storm event to form the basis of design for all drainage improvements within the public right-of-way. The hydrologic conditions of the project area were analyzed using the EPA SWMM Version 5 computation engine within the PCSWMM program, using the methodology and parameters outlined in section 3.2 of the South Mission Beach WMP. The 100-Year, 24-Hour storm event was analyzed in the pre- and post-project conditions, while preserving the peak 5-minute rainfall intensities and the total precipitation volume, to assess the hydrologic response of the distributed drainage areas within study area. This approach produces storm event hydrographs for the distributed drainage areas which are then routed to the storm drain system outfalls.

3.1. Computer Software – PCSWMM

PCSWMM uses EPA's SWMM Version 5 (SWMM5) engine, which uses the nonlinear reservoir hydrologic model methodology to estimate the rainfall-runoff relationship for a drainage subarea. Nonlinear reservoir modeling uses a combination of mass conservation and Manning's Equation to determine the volumetric flow rate from a subcatchment. SWMM5 requires several parameters to calculate runoff from each subcatchment. The parameters include rainfall data, area (in acres), characteristic width of the subcatchment, slope, percent impervious, Manning's "n" values for pervious and impervious overland surfaces, depression storage for pervious and impervious surfaces, percent of impervious area with no depression storage, and infiltration parameters.

For detailed information regarding the hydrologic methodology and parameters used for this design analysis, refer to Appendix A-9 of the South Mission Beach WMP located in the CD Pocket of this report.

3.2. Results

The pre-project condition peak flow rates at the storm drain outfalls are severely restricted primarily due to two important factors. The first is that the existing storm drain systems are undersized, consisting of 12- to 18-inch diameter shallow-sloped pipes south of San Fernando Place. The second is that there is a lack of connected catch basin collection systems to intercept and convey surface flow into the storm drain system, resulting in severe surface ponding conditions at the sag points on the site during significant storm events.

The post-project condition flow rates are significantly increased compared to pre-project. This is primarily attributed to the proposed improvements which drastically increase the storm drain backbone pipe diameters to accommodate more flow, as well as the extension of the storm drain backbones to provide lateral catch basin connection points at the sag points along Mission Boulevard. Because the storm drain system discharges to an enclosed bay, the significant increase in outfall flow rates is not anticipated to generate adverse impact downstream.

A summary of the pre- and post-project hydrologic results at each storm drain outfall is provided in the following tables.

Table 3-1: Pre-Project Condition Hydrologic Summary

		100-year Storm Event
Outfall ID (WMP)	**Tributary Area (ac.)**	**Peak Flow Rate, Q_{100} (cfs)**
120001	15.6	6.7
120002	18.9	11.4
120003	9.6	21.2
120004	1.4	3.1
120005	23.7	5.2
120006	1.6	3.4
120007	5.0	16.2

Table 3-2: Post-Project Condition Hydrologic Summary

			100-year Storm Event
Outfall ID (WMP)	**Storm Drain System Number**	**Tributary Area (ac.)**	**Peak Flow Rate, Q_{100} (cfs)**
120001	System-1	20.3	146.1
120003	System-7	9.6	14.8
120004	System-2	15.1	180.1
120005	System-5	0.4	14.1
120006	System-8	1.6	3.9
120007	System-9	5.3	36.4
120009	System-3	20.8	181.5
120010	System-6	2.7	6.8

4.0 HYDRAULICS

4.1. Inlet Sizing

Inlet and street flow spread width analyses were completed using FHWA Hydraulic Toolbox computer software to analyze the proposed modified Type-I catch basins. The catch basins were sited at existing weep sump locations, at the interface between Mission Boulevard and the connecting alleys and cross streets, to intercept and convey as much storm water within the project as possible, while providing a lateral gravity flow connection to the extended storm drain backbone system, and minimizing conflict with other existing wet and dry utilities. FHWA Hydraulic Toolbox output reports are provided in Appendix D. Example modified Type-I catch basin details are provided in Appendix D.

4.2. Storm Drain Design

The recommended storm drain improvements outlined in the South Mission Beach WMP were used as a starting point for the engineering design plans. Subsequent revisions from the WMP storm drain recommendations were coordinated with City staff input and incorporated into the engineering design plans. These revisions included:

- Establishing 0.5% as the minimum longitudinal slope for the storm drain backbone.
- Consolidating dual pipe designs into an equivalent single pipe design.
- Revising elliptical pipe designs into equivalent circular pipe design.
- Minor storm drain re-alignments to mitigate utility conflicts.
- Consolidating two storm drain outfalls into one.

Due to the low-lying topography of the project area coupled with the tidal influence of the bay, the storm drain design proposes the inclusion of modified cleanout structures incorporating a tide gate upstream of the major storm drain outfalls to mitigate tidal influence from backing up into the storm drain system mainlines.

4.2.1. Storm Drain Hydraulic Analysis

The EPA SWMM Version 5 computation engine embedded in the PCSWMM program was used to analyze the conveyance capacity and calculate hydraulic grade lines of the proposed storm drain systems. The program was set up to utilize the dynamic wave routing method which solves the full set of St. Venant flow equations of continuity and conservation of momentum, which allows the calculations to account for pressurized flow, and backwater conditions in storm drain systems. For detailed information on the hydraulic methodology, refer to Appendix A-9 of the South Mission Beach WMP.

A tailwater condition of 2.6' Elevation which corresponds to the Mean Higher-High Water elevation was used in the storm drain hydraulic analysis as the downstream Water Surface Elevation. This value was referenced from the La Jolla tidal gage data which is available from NOAA. Refer to section 3.3.1 of the South Mission Beach WMP for additional detail.

The "Simplified Structure Head Loss Coefficient, K" table values in the 2017 City of San Diego Drainage Design Manual (Table 4-8) were incorporated into the EPA SWMM program parameters. These were used to estimate the minor energy head losses that occur at junction structures. The "K" values were assigned with consideration of the confluence angle with the connecting downstream pipe segment. The "K" values located between the tabulated confluence angle values were linearly interpolated and applied to the storm drain analysis.

The proposed storm drain system improvements will be constructed of Reinforced Concrete Pipe (RCP) or equivalent. Water-tight joints will be used due to the significant tidal influence, pressurized pipe conditions, and low elevations along the storm drain alignments. The Manning's roughness coefficient "n" used for the hydraulic calculations for RCP is 0.013, per the San Diego DDM.

4.2.2. Storm Drain Analysis Results

The post-project storm drain analysis results were exported from the PCSWMM program as storm drain profiles which include flow rates, velocities, and hydraulic grade lines, in PDF format. Refer to Appendix E for a copy of the storm drain profile PDF exported from PCSWMM and Map Pocket 4 for a plan view layout.

5.0 OPERATION AND MAINTENANCE PLAN (OMP)

5.1. Maintenance Responsibility

The City of San Diego Transportation and Storm Water Department (TSW) will be the responsible party for operation and maintenance of the Green Infrastructure BMPs.

5.2. Inspection and Maintenance Activities

The landscaped areas for the project require permanent maintenance. The discussions below provide inspection criteria, maintenance indicators, and maintenance activities for the project BMPs that require permanent maintenance.

Landscaped Areas

The inspection and maintenance activities described herein are for landscaped areas provided for the project.

During inspection, the inspector shall check for the maintenance indicators given below:

- Erosion in the form of rills or gullies
- Ponding water
- Bare areas or less than 70% vegetation cover
- Animal burrows, holes, or mounds
- Trash
- Sediment or debris accumulation

Routine maintenance of vegetated areas shall include mowing and trimming vegetation, and removal and proper disposal of trash.

If erosion, ponding water, bare areas, poor vegetation establishment, or disturbance by animals are identified during the inspection, additional (non-routine) maintenance will be required to correct the problem.

As applicable, Integrated Pest Management (IPM) procedures must be incorporated in any corrective measures that are implemented in response to damage by pests. This may include using physical barriers to keep pests out of landscaping; physical pest elimination techniques, such as, weeding, squashing, trapping, washing, or pruning out pests; relying on natural enemies to eat pests; or proper use of pesticides as a last line of defense. More information can be obtained at the UC Davis website (http://www.ipm.ucdavis.edu/WATER/U/index.html).

Outlet Protection

Routine maintenance of outlet protection shall include removing trash, debris, and leaves. This would specifically include areas of riprap and/or landscape cobble rock for locations of concentrated flows entering landscape or bioretention areas. If soil erosion is found, reposition or increase limits of riprap or landscape rock to fully cover eroded area.

Concrete Stamping

Inspection/maintenance of the concrete stamping shall be performed. During inspection, the inspector(s) shall check for the maintenance indicators given below:

- Faded, vandalized, or otherwise unreadable concrete stamping.

There are no routine maintenance activities for the concrete stamping. If inspection indicates the concrete stamping is intact, no action is required. If inspection indicates the concrete stamping is not legible, the concrete stamping shall be repaired or replaced as applicable.

5.3. Inspection and Maintenance Activities for the Green Infrastructure BMP

Biofiltration Basin

During inspection, the inspector shall check for the maintenance indicators given below:

- Accumulation of sediment, litter and/or debris at the inlets/outlets
- Standing water in the storage and draining layer indicating clogging in the underdrains
- Dislodged energy dissipaters or erosion
- Overgrown vegetation

Routine maintenance of the Biofiltration Basin shall include removal and proper disposal of accumulated materials (e.g., sediment, litter), trimming vegetation, and replenishing mulch every one (1) to two (2) years. After installation inspection should occur once a month for 4-6 months. After this time period inspection should occur annually, particularly after there has been heavy rain or storms.

If inspection indicates that the underdrains for the Biofiltration Basins are clogged, the additional non-routine maintenance will be required to backwash and clear the underdrains.

5.4. Inspection and Maintenance Frequency

The table below lists the BMPs to be inspected and maintained and the minimum frequency of inspection and maintenance activities.

Table 5-1: Summary Table of Inspection and Maintenance Frequency

BMP	Inspection Frequency	Maintenance Frequency
Landscaped Areas	Monthly	Routine mowing and trimming and trash removal: monthly Non-routine maintenance as-needed based on maintenance indicators in Section 5.2.1
Outlet Protection	Monthly	Routine maintenance to remove trash, debris, and leaves. Repair any damage to roof drains. Immediately reposition all displaced energy dissipaters. If soil erosion is found, reposition or increase limits of energy dissipater to fully cover eroded area. Non-routine maintenance as-needed
Concrete Stamping (or equivalent)	Annual	As-needed based on maintenance indicators in Section 5.2
Biofiltration Basin (Green Infrastructure)	Annual, and after major storm events	Routine maintenance to remove accumulated materials at the inlets and outlets: annually, on or before September 30th. As-needed maintenance based on maintenance indicators in Section 5.2.1

The frequencies given in the Summary Table of Inspection and Maintenance Frequency are minimum recommended frequencies for inspection and maintenance activities for the project. Typically, the frequency of maintenance required for permanent BMPs is site and drainage area specific. If it is determined during the regularly scheduled inspection and/or routine maintenance that a BMP requires more frequent maintenance (e.g., to remove accumulated trash) it may be necessary to increase the frequency of inspection and/or routine maintenance.

6.0 CONCLUSION

This design report summarizes the design approach and criteria utilized to address drainage and Green Infrastructure components of this storm drain improvement project.

The primary objective of the project is to improve conveyance capacity of the storm drain infrastructure in the South Mission Beach area. As a result, the post-project condition hydrologic results are significantly greater at the storm drain outfalls compared to the pre-project condition. The project is discharging to an enclosed bay, and adverse hydrologic and hydraulic impacts to downstream water bodies are not expected.

The project is not categorized as a "Priority Development Project" according to Chapter 1.4 of the City of San Diego Storm Water Standards Manual Part I (October 2018). Its purpose is to implement storm drain and green infrastructure improvements. There are no proposed impervious surfaces and only includes the removal and replacement of impervious area associated with the trenching and resurfacing necessary to install the replacement storm drain and sub-drains. Therefore, the project is not subject to permanent storm water BMP requirements. Refer to the Storm Water Requirements Applicability Checklist (Form DS-560) in Appendix A.

The project also proposes the implementation of Green Infrastructure (GI) features which include six (6) biofiltration basin BMPs (Basins 1-5, 8), two (2) bioretention basin BMPs, and nine (9) low-flow sewer diversion systems to significantly improve water quality tributary to Mission Bay. Based on EPA SWMM modeling results, the eight (8) proposed basins will treat up to approximately 7.6% of the total runoff generated in the entire study area. In addition, the basins will also capture approximately 13.5% of runoff from the entire study area, and store/partially infiltrate below the underdrain. The low-flow diversion systems will be optimized to divert approximately 0.6% of the total runoff generated for the entire project area to the sewer system during the first flush (20 minutes) of a wet-weather event.

The volume of captured and diverted runoff is significant given the limited physical area, surrounding topography, the existing utilities in close proximity to the proposed BMPs, and inherent vertical constraints of retrofitting existing infrastructure to accommodate a gravity-fed water quality treatment system.

The proposed Biofiltration/bioretention and low-flow diversion systems for the project will require permanent maintenance. The operation and maintenance information provided in Section 5.0 of this report provides inspection criteria, maintenance indicators, and maintenance activities for the above-listed GI features that will require permanent maintenance.

APPENDIX A

Storm Water Requirements Applicability Checklist (DS-560)

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM
DS-560
November 2018

Project Address: South of W. Mission Bay Drive and Mission Blvd.

Project Number:

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1] , which is administered by the State Regional Water Quality Control Board.

For all projects complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water Discharges Associated with Construction Activities, also known as the State Construction General Permit (CGP)? (Typically projects with land disturbance greater than or equal to 1 acre.)

☒ Yes; SWPPP required, skip questions 2-4 ☐ No; next question

2. Does the project propose construction or demolition activity, including but not limited to, clearing, grading, grubbing, excavation, or any other activity resulting in ground disturbance and/or contact with storm water?

☐ Yes; WPCP required, skip questions 3-4 ☐ No; next question

3. Does the project propose routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as pipeline/utility replacement)

☐ Yes; WPCP required, skip question 4 ☐ No; next question

4. Does the project only include the following Permit types listed below?

- Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
- Individual Right of Way Permits that exclusively include only ONE of the following activities: water service, sewer lateral, or utility service.
- Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, pot holing, curb and gutter replacement, and retaining wall encroachments.

☐ Yes; no document required

Check one of the boxes below, and continue to PART B:

☒ If you checked "Yes" for question 1,
a SWPPP is REQUIRED. Continue to PART B

☐ If you checked "No" for question 1, and checked "Yes" for question 2 or 3,
a WPCP is REQUIRED. If the project proposes less than 5,000 square feet of ground disturbance AND has less than a 5-foot elevation change over the entire project area, a Minor WPCP may be required instead. **Continue to PART B.**

☐ If you checked "No" for all questions 1-3, and checked "Yes" for question 4
PART B **does not apply and no document is required. Continue to Section 2.**

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[1] More information on the City's construction BMP requirements as well as CGP requirements can be found at: www.sandiego.gov/stormwater/regulations/index.shtml

PART B: Determine Construction Site Priority

This prioritization must be completed within this form, noted on the plans, and included in the SWPPP or WPCP. The city reserves the right to adjust the priority of projects both before and after construction. Construction projects are assigned an inspection frequency based on if the project has a "high threat to water quality." The City has aligned the local definition of "high threat to water quality" to the risk determination approach of the State Construction General Permit (CGP). The CGP determines risk level based on project specific sediment risk and receiving water risk. Additional inspection is required for projects within the Areas of Special Biological Significance (ASBS) watershed. **NOTE:** The construction priority does **NOT** change construction BMP requirements that apply to projects; rather, it determines the frequency of inspections that will be conducted by city staff.

Complete PART B and continued to Section 2

1. ☐ **ASBS**
   a. Projects located in the ASBS watershed.

2. ☐ **High Priority**
   a. Projects that qualify as Risk Level 2 or Risk Level 3 per the Construction General Permit (CGP) and not located in the ASBS watershed.
   b. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and not located in the ASBS watershed.

3. ☒ **Medium Priority**
   a. Projects that are not located in an ASBS watershed or designated as a High priority site.
   b. Projects that qualify as Risk Level 1 or LUP Type 1 per the CGP and not located in an ASBS watershed.
   c. WPCP projects (>5,000sf of ground disturbance) located within the Los Penasquitos watershed management area.

4. ☐ **Low Priority**
   a. Projects not subject to a Medium or High site priority designation and are not located in an ASBS watershed.

SECTION 2. Permanent Storm Water BMP Requirements.

Additional information for determining the requirements is found in the Storm Water Standards Manual.

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

Projects that are considered maintenance, or otherwise not categorized as "new development projects" or "redevelopment projects" according to the Storm Water Standards Manual are not subject to Permanent Storm Water BMPs.

If "yes" is checked for any number in Part C, proceed to Part F and check "Not Subject to Permanent Storm Water BMP Requirements".

If "no" is checked for all of the numbers in Part C continue to Part D.

1.	Does the project only include interior remodels and/or is the project entirely within an existing enclosed structure and does not have the potential to contact storm water?	☐ Yes ☒ No
2.	Does the project only include the construction of overhead or underground utilities without creating new impervious surfaces?	☒ Yes ☐ No
3.	Does the project fall under routine maintenance? Examples include, but are not limited to: roof or exterior structure surface replacement, resurfacing or reconfiguring surface parking lots or existing roadways without expanding the impervious footprint, and routine replacement of damaged pavement (grinding, overlay, and pothole repair).	☒ Yes ☐ No

PART D: PDP Exempt Requirements.

PDP Exempt projects are required to implement site design and source control BMPs.

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was checked for all questions in Part D, continue to Part E.

1. **Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:**
    - **Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;**
    - **Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;**
    - **Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?**

    ☐ Yes; PDP exempt requirements apply ☐ No; next question

2. Does the project ONLY include retrofitting or redeveloping existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets guidance in the City's Storm Water Standards Manual?

    ☐ Yes; PDP exempt requirements apply ☐ No; project not exempt.

PART E: Determine if Project is a Priority Development Project (PDP).

Projects that match one of the definitions below are subject to additional requirements including preparation of a Storm Water Quality Management Plan (SWQMP).

If "yes" is checked for any number in PART E, continue to PART F and check the box labeled "Priority Development Project".

If "no" is checked for every number in PART E, continue to PART F and check the box labeled "Standard Development Project".

1. **New Development that creates 10,000 square feet or more of impervious surfaces collectively over the project site.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☐ Yes ☐ No
2. **Redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surfaces on an existing site of 10,000 square feet or more of impervious surfaces.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☐ Yes ☐ No
3. **New development or redevelopment of a restaurant.** Facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 5,000 square feet or more of impervious surface. ☐ Yes ☐ No
4. **New development or redevelopment on a hillside.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site) and where the development will grade on any natural slope that is twenty-five percent or greater. ☐ Yes ☐ No
5. **New development or redevelopment of a parking lot that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).** ☐ Yes ☐ No
6. **New development or redevelopment of streets, roads, highways, freeways, and driveways.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site). ☐ Yes ☐ No

7. **New development or redevelopment discharging directly to an Environmentally Sensitive Area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands). ☐ Yes ☐ No

8. **New development or redevelopment projects of a retail gasoline outlet (RGO) that create and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. ☐ Yes ☐ No

9. **New development or redevelopment projects of an automotive repair shops that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539. ☐ Yes ☐ No

10. **Other Pollutant Generating Project.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☐ Yes ☐ No

PART F: Select the appropriate category based on the outcomes of PART C through PART E.

1. The project is **NOT SUBJECT TO PERMANENT STORM WATER REQUIREMENTS**. ☒
2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management ☐

Name of Owner or Agent *(Please Print)*	Title
Signature	Date

APPENDIX B

Biofiltration Footprint Calculation Worksheets – For Reference

The City of SAN DIEGO

Project Name		South Mission Beach Storm Drain and GI	
BMP ID		Basin 1	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	61000	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.74	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1956	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2934	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	752	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	1467	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1048	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1354	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1354	sq. ft.
23	Provided BMP Footprint	625	sq. ft.
24	Is Line 23 ≥ Line 22?	**No, Increase the BMP Footprint**	

The City of SAN DIEGO

Project Name	South Mission Beach Storm Drain and GI
BMP ID	Basin 2

Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	124230	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.85	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	4576	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	6864	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1760	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	3432	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	2451	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	3168	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	3168	sq. ft.
23	Provided BMP Footprint	3181	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

Project Name		South Mission Beach Storm Drain and GI	
BMP ID		Basin 3	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	55950	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.8	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1940	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2909	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	746	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	1455	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1039	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1343	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1343	sq. ft.
23	Provided BMP Footprint	1560	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	South Mission Beach Storm Drain and GI	
	BMP ID	Basin 4	

Sizing Method for Pollutant Removal Criteria

Worksheet B.5-1

1	Area draining to the BMP	104723	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.67	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3040	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4561	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1169	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	2280	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1629	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	2105	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2105	sq. ft.
23	Provided BMP Footprint	2455	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	**Project Name**	South Mission Beach Storm Drain and GI	
	BMP ID	Basin 5	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	110690	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.76	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3645	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	5468	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1402	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	2734	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1953	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	2524	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2524	sq. ft.
23	Provided BMP Footprint	2150	sq. ft.
24	Is Line 23 ≥ Line 22?	**No, Increase the BMP Footprint**	

The City of SAN DIEGO

Project Name		South Mission Beach Storm Drain and GI	
BMP ID		Basin 6	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	205700	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.8	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	7131	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	10696	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	2743	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	5348	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	3820	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	4937	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	4937	sq. ft.
23	Provided BMP Footprint	4270	sq. ft.
24	Is Line 23 ≥ Line 22?	**No, Increase the BMP Footprint**	

The City of SAN DIEGO	**Project Name**	South Mission Beach Storm Drain and GI	
	BMP ID	Basin 7	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	31030	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.65	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	874	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1311	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	336	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	656	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	468	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	605	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	605	sq. ft.
23	Provided BMP Footprint	720	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

Project Name	South Mission Beach Storm Drain and GI		
BMP ID	Basin 8		

Sizing Method for Pollutant Removal Criteria

Worksheet B.5-1

1	Area draining to the BMP	69435	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.64	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1926	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	15	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	0	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2888	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	741	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	1444	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1032	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1333	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1333	sq. ft.
23	Provided BMP Footprint	468	sq. ft.
24	Is Line 23 ≥ Line 22?	**No, Increase the BMP Footprint**	

APPENDIX C

Green Infrastructure Plan Sheets and Details

G-3

KEY MAP

PLANS FOR THE CONSTRUCTION OF
SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE
KEY MAP

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 3 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

APPROVED:
FOR CITY ENGINEER DATE
MAHMOUD ORIQAT
PRINT DCE NAME RCE#

SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

KEVIN R. GIBSON
NO. 52295

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SEE SHEETS
CCS27 COORDINATE

SEE SHEETS
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

41306-03-D

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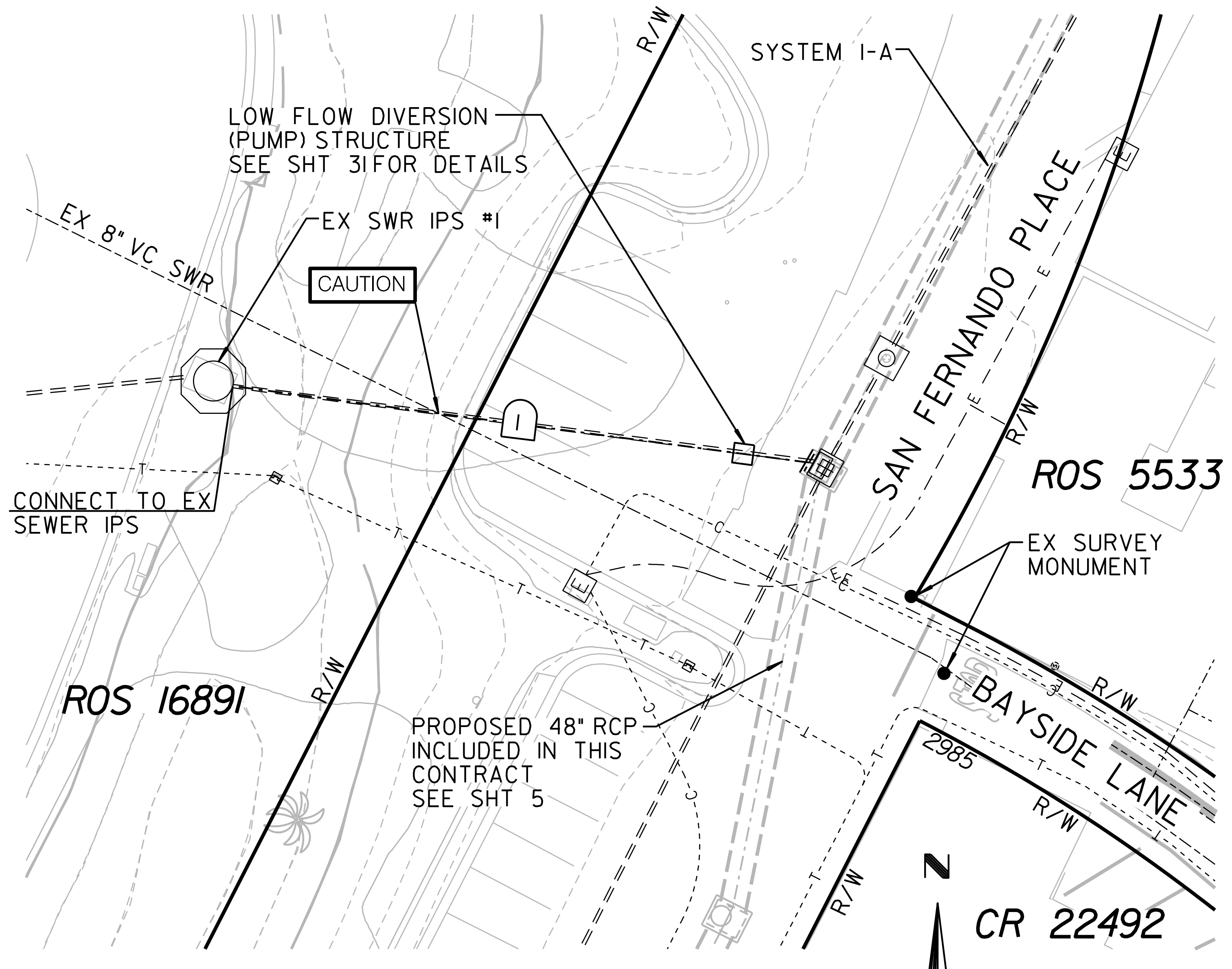
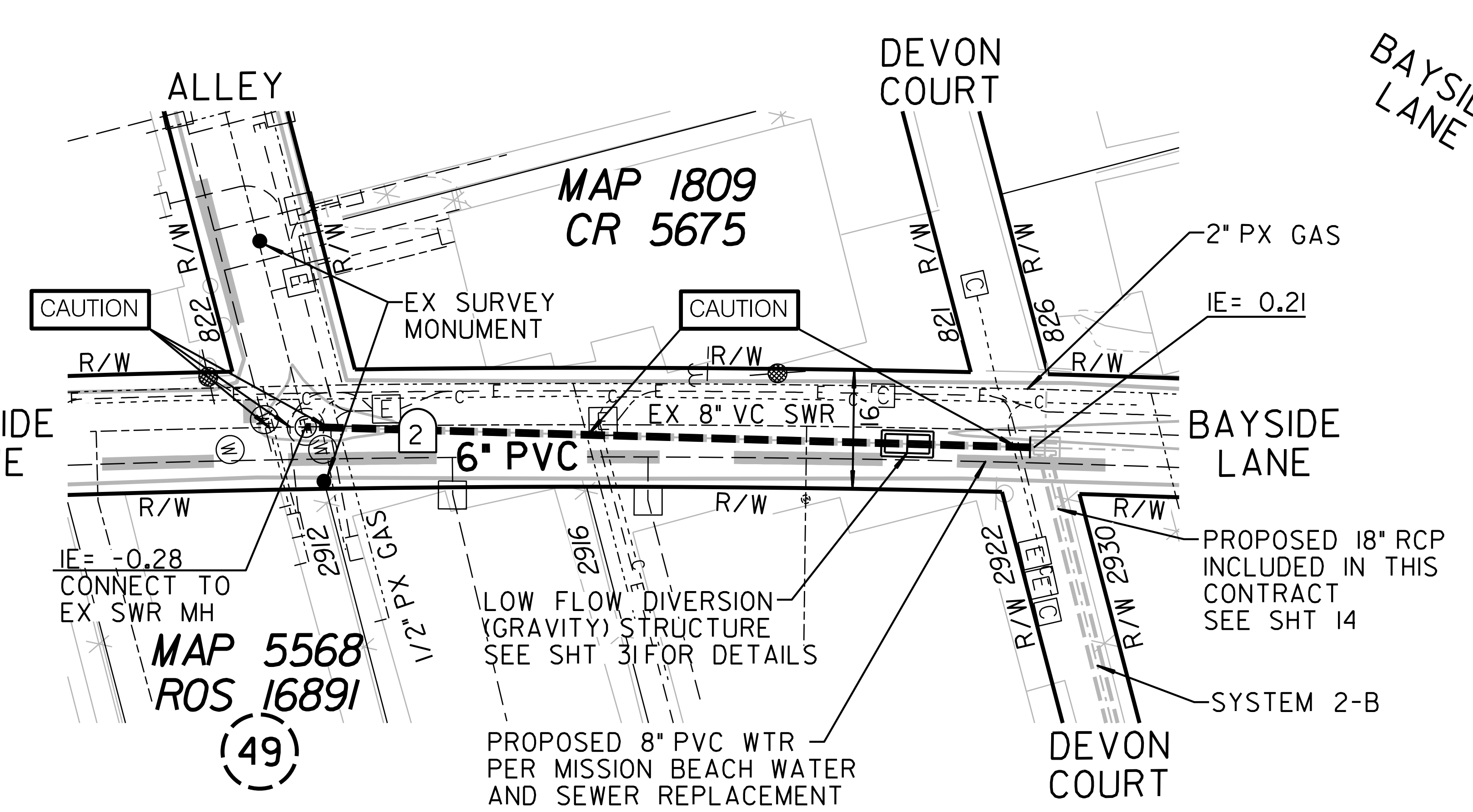
60% SUBMITTAL

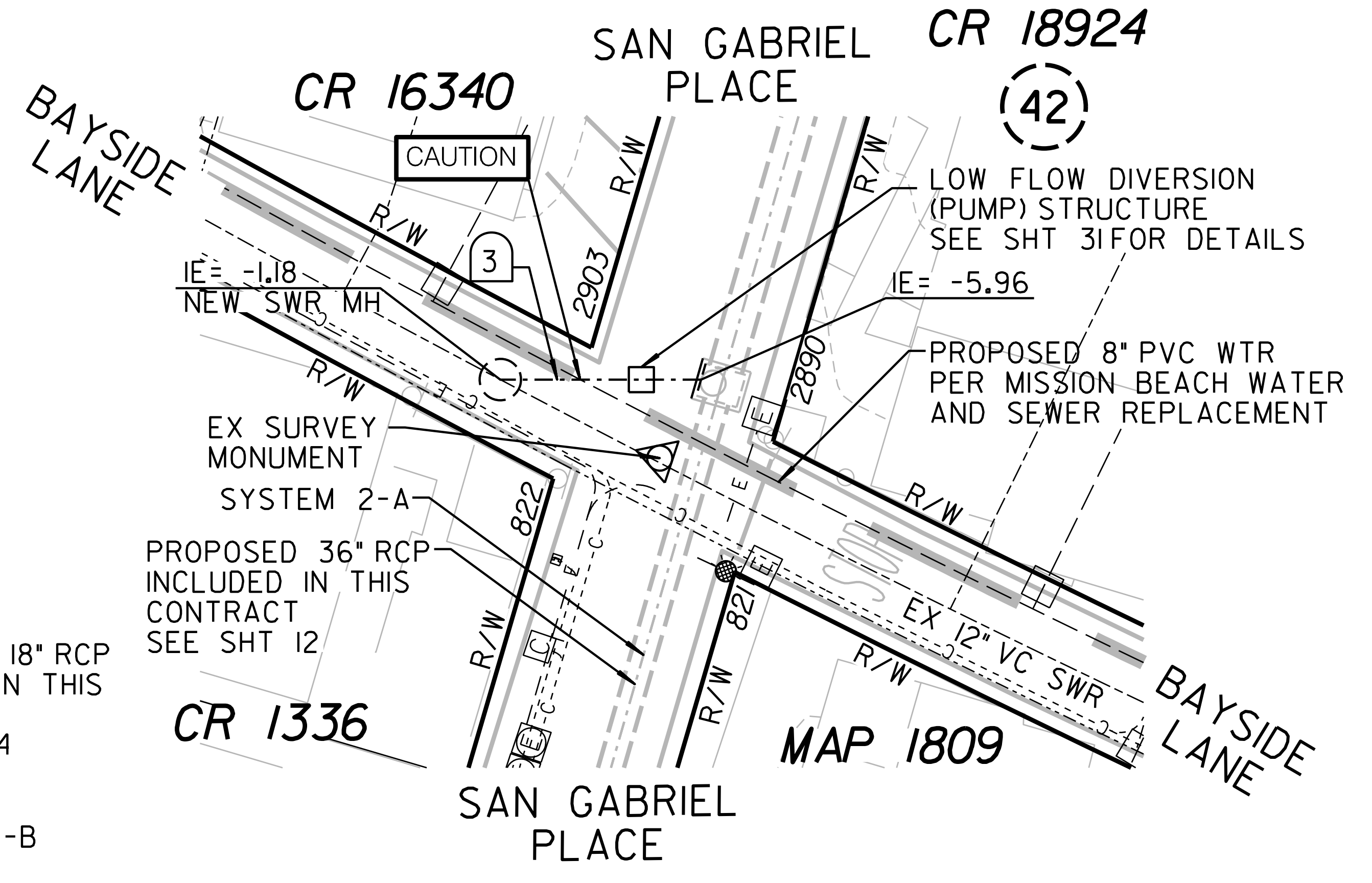
LOW FLOW DIVERSION (GRAVITY) SYSTEM 2



LOW FLOW DIVERSION (PUMP) SYSTEM 1-A



LOW FLOW DIVERSION (GRAVITY) SYSTEM 2-B



LOW FLOW DIVERSION (PUMP) SYSTEM 2-A

STORM DRAIN DATA TABLE

NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N27° 37′31"W		87.37′	SIZE TBD
2	N27° 32′56"W		97.99′	6" PVC (SCHEDULE 80)
3	N29° 10′18"W		24.03′	SIZE TBD

0 20 40 80
SCALE 1"=20'

LOW FLOW DIVERSION PLAN 1

C-25

SOUTH MISSION BEACH STORM DRAIN AND GREEN INFRASTRUCTURE
LOW FLOW DIVERSION PLAN 1
SYSTEMS 1-A, 2-B, 2-A

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 28 OF 68 SHEETS

WBS B-18118 (GI)
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ORIGINAL	RICK			

KEVIN R. GIBSON
NO. 52295

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PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

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1858-6249
CCS83 COORDINATE

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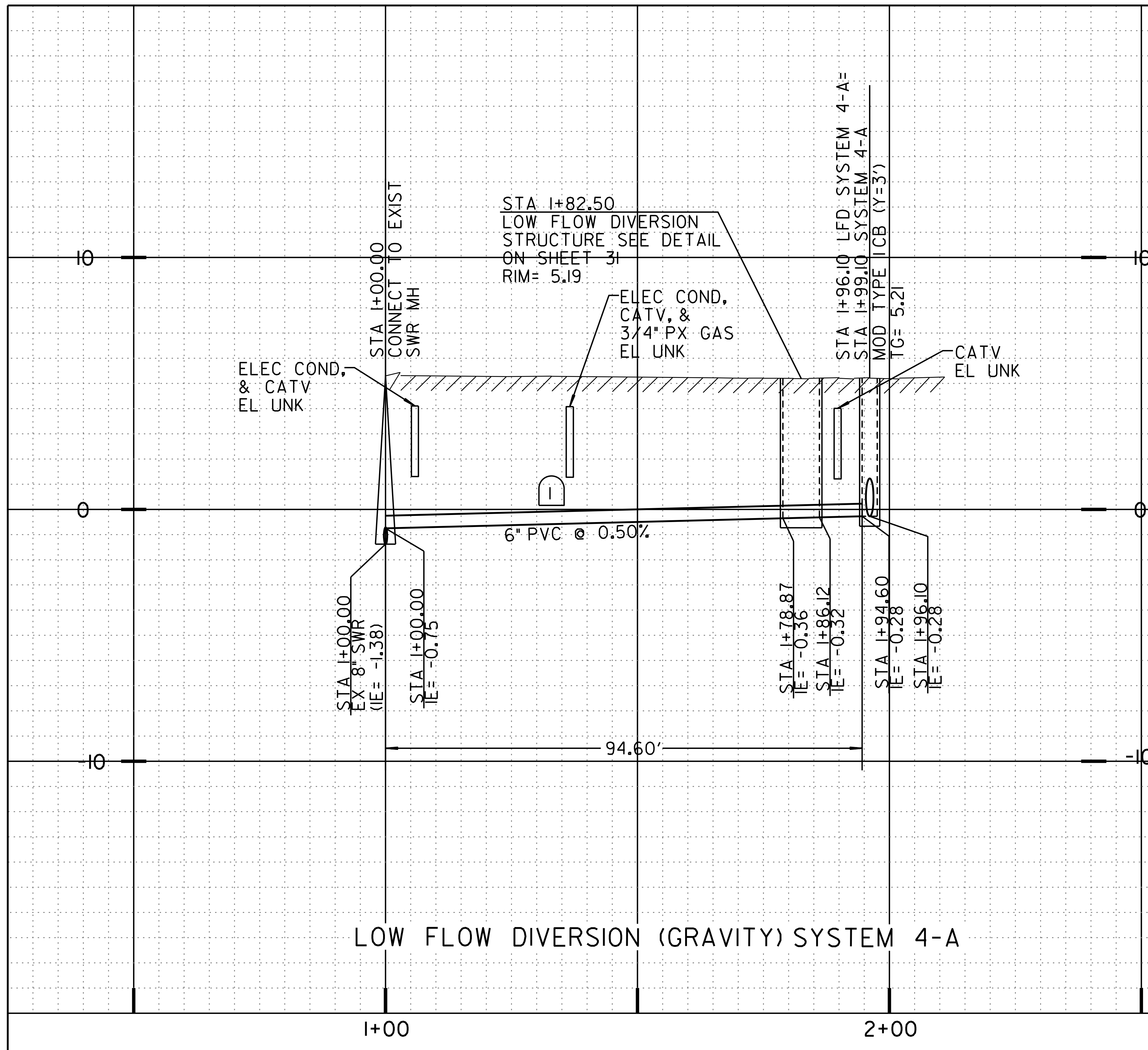
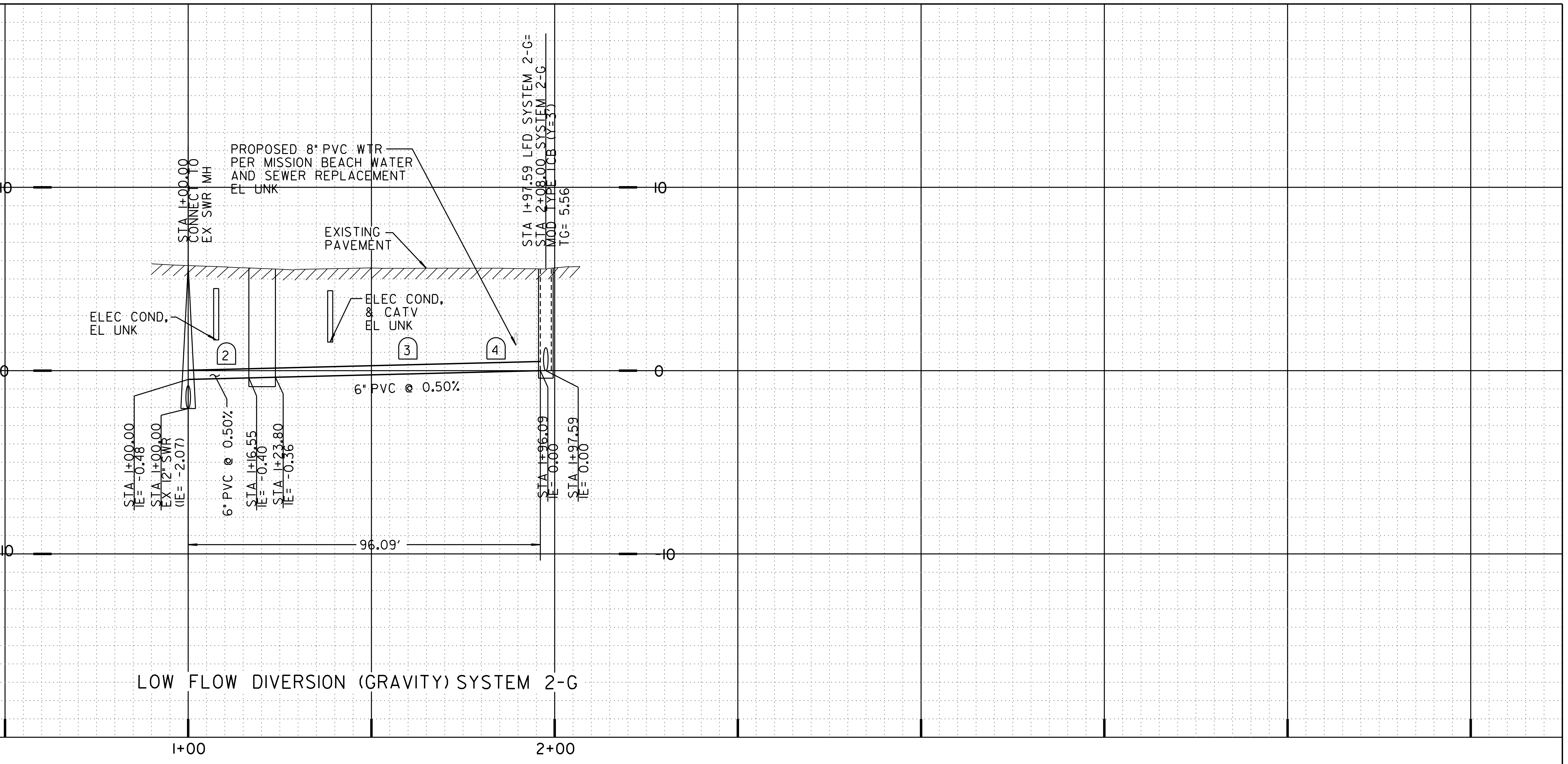
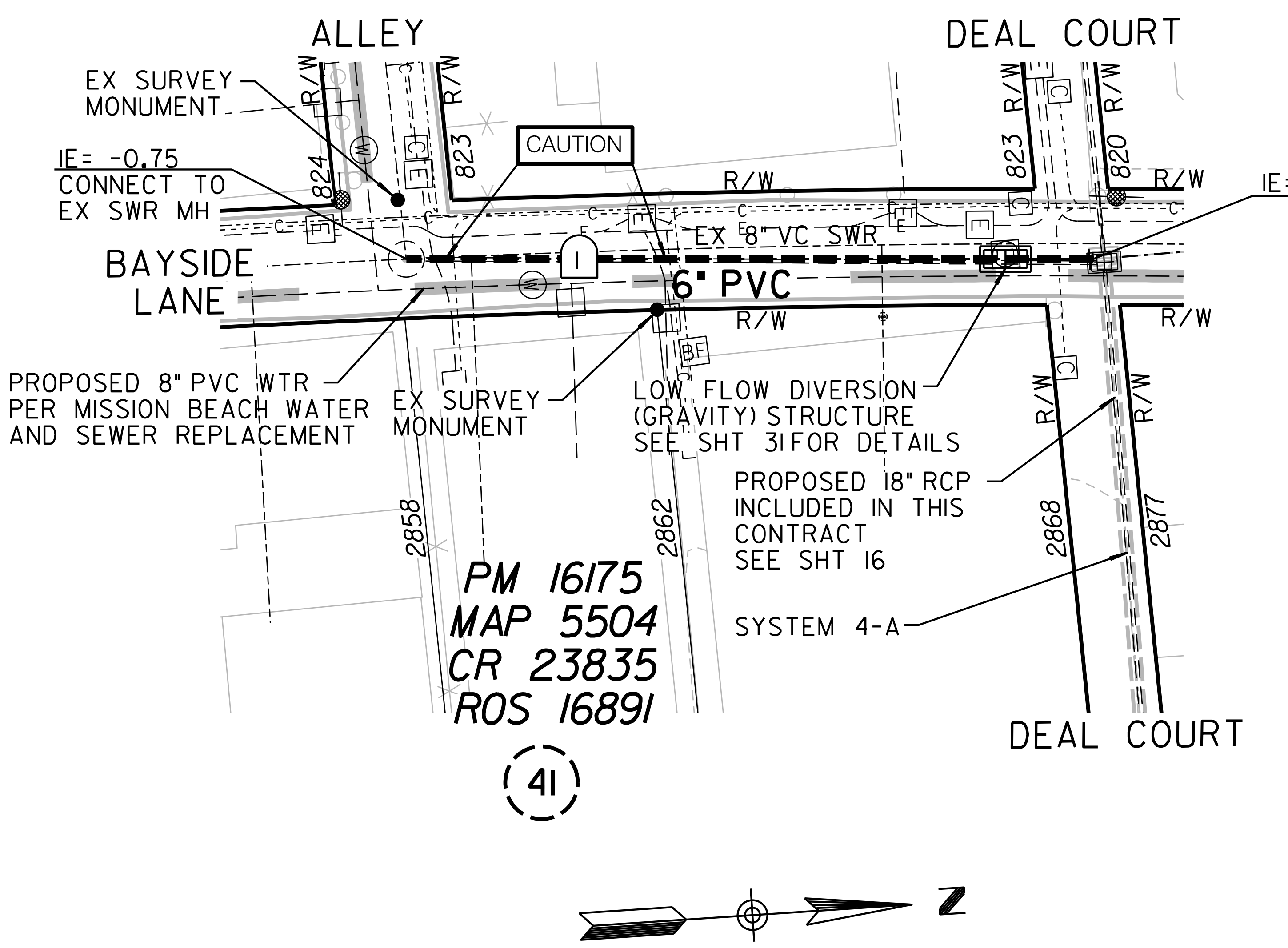


LOW FLOW DIVERSION (GRAVITY) SYSTEM 4-A

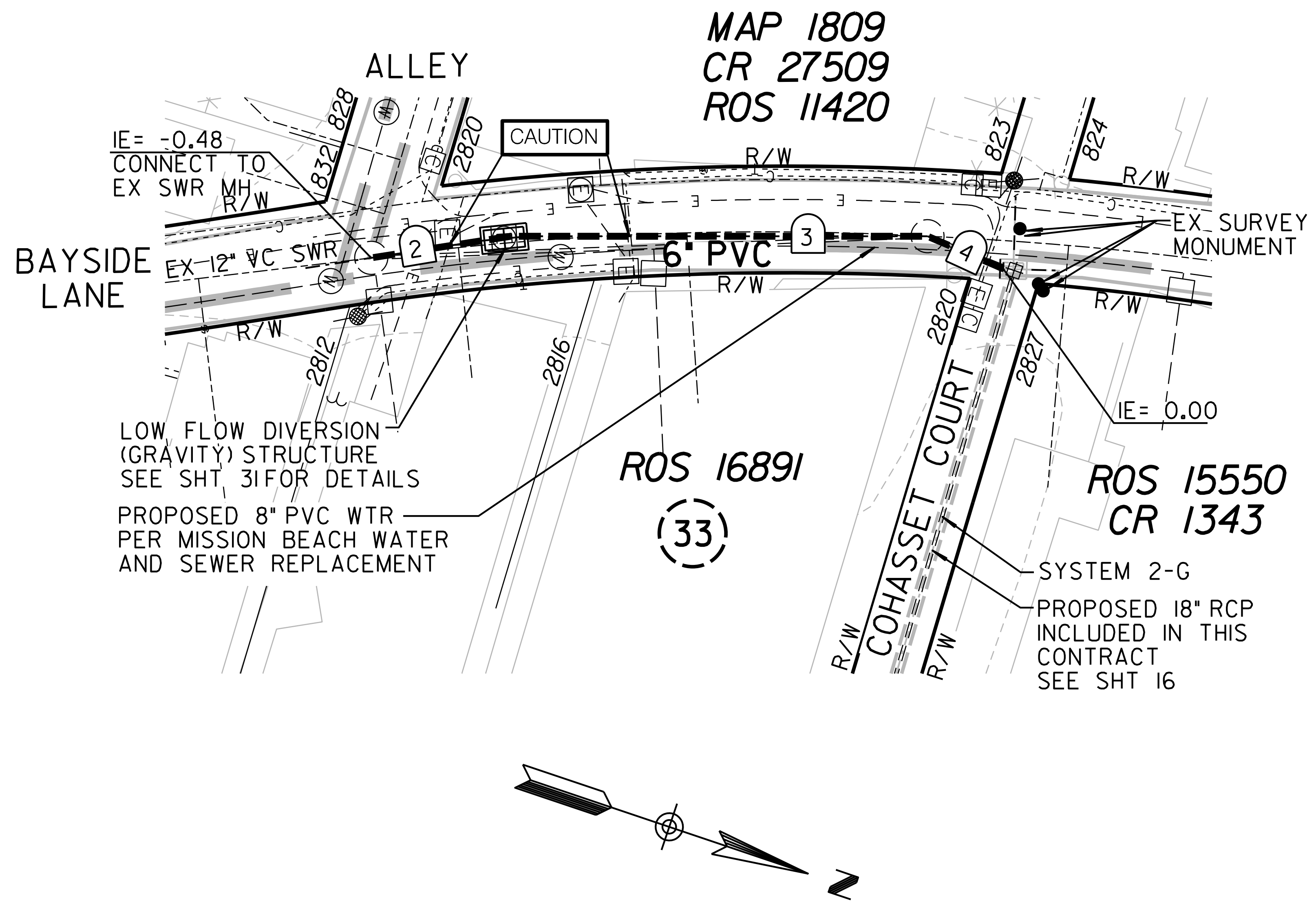


LOW FLOW DIVERSION (GRAVITY) SYSTEM 2-G

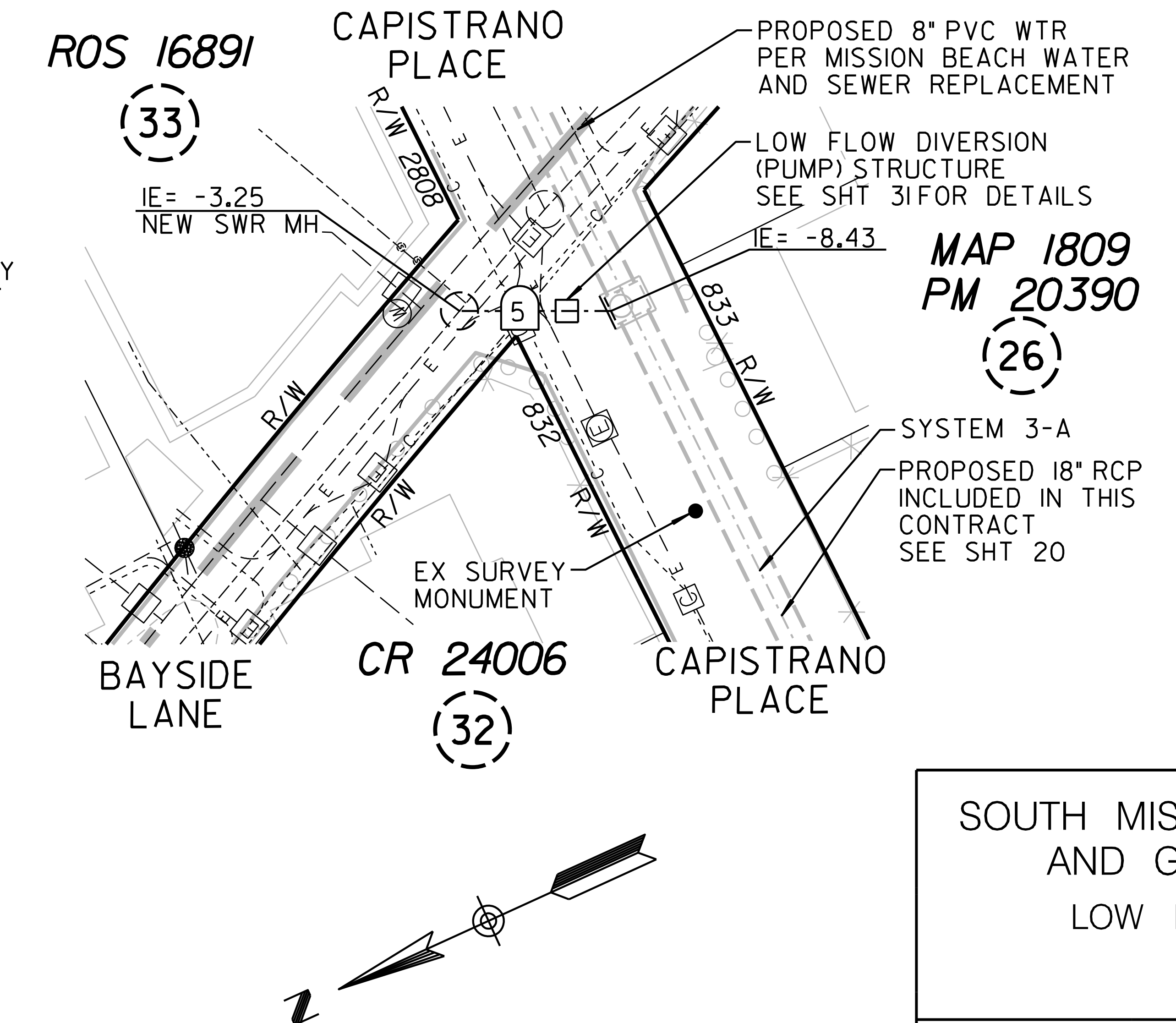
LOW FLOW DIVERSION PLAN 2



LOW FLOW DIVERSION (GRAVITY) SYSTEM 4-A



LOW FLOW DIVERSION (GRAVITY) SYSTEM 2-G



LOW FLOW DIVERSION (PUMP) SYSTEM 3-A

STORM DRAIN DATA TABLE

NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N03° 47'54"E		94.60'	6" PVC (SCHEDULE 80)
2	N05° 01'16"W		21.19'	6" PVC (SCHEDULE 80)
3	N03° 47'54"E		62.54'	6" PVC (SCHEDULE 80)
4	N27° 05'43"E		12.38'	6" PVC (SCHEDULE 80)
5	N03° 47'54"E		20.21'	SIZE TBD

0 20 40 80
SCALE 1"=20'

C–26

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE
LOW FLOW DIVERSION PLAN 2
SYSTEMS 4–A, 2–G, 3–A

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 29 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

KEVIN R. GIBSON
NO. 52295

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SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

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CCS83 COORDINATE

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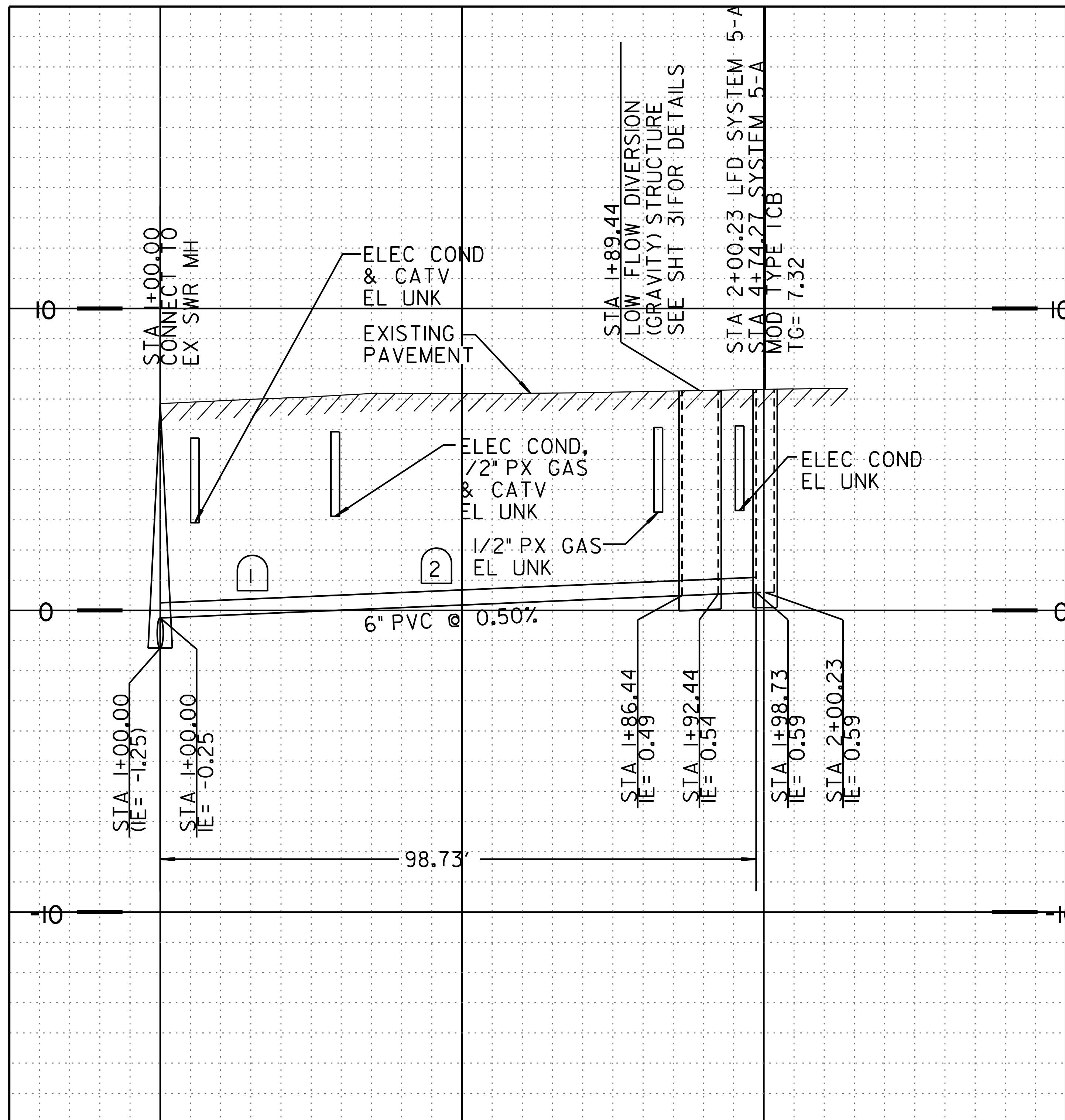
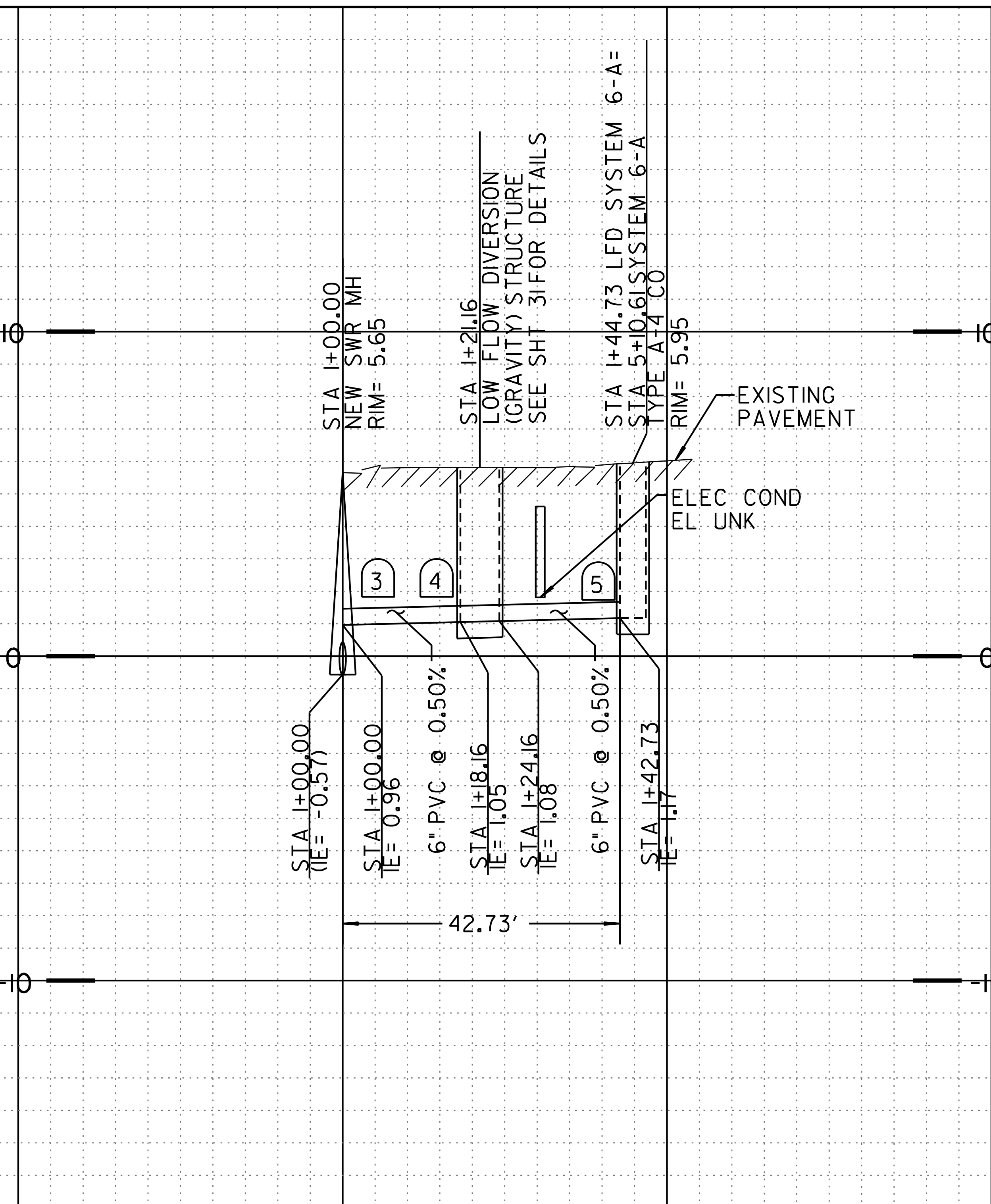
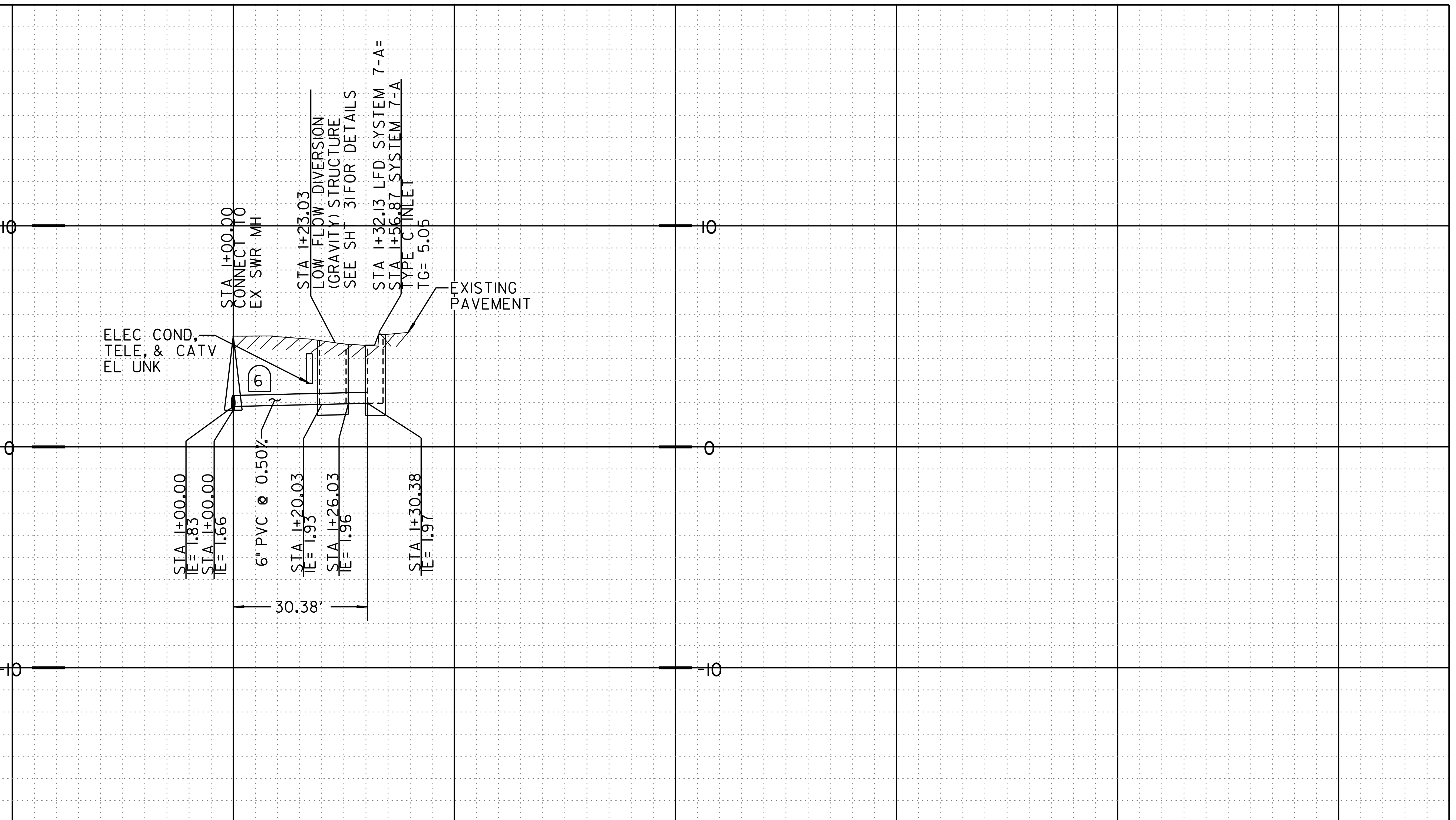


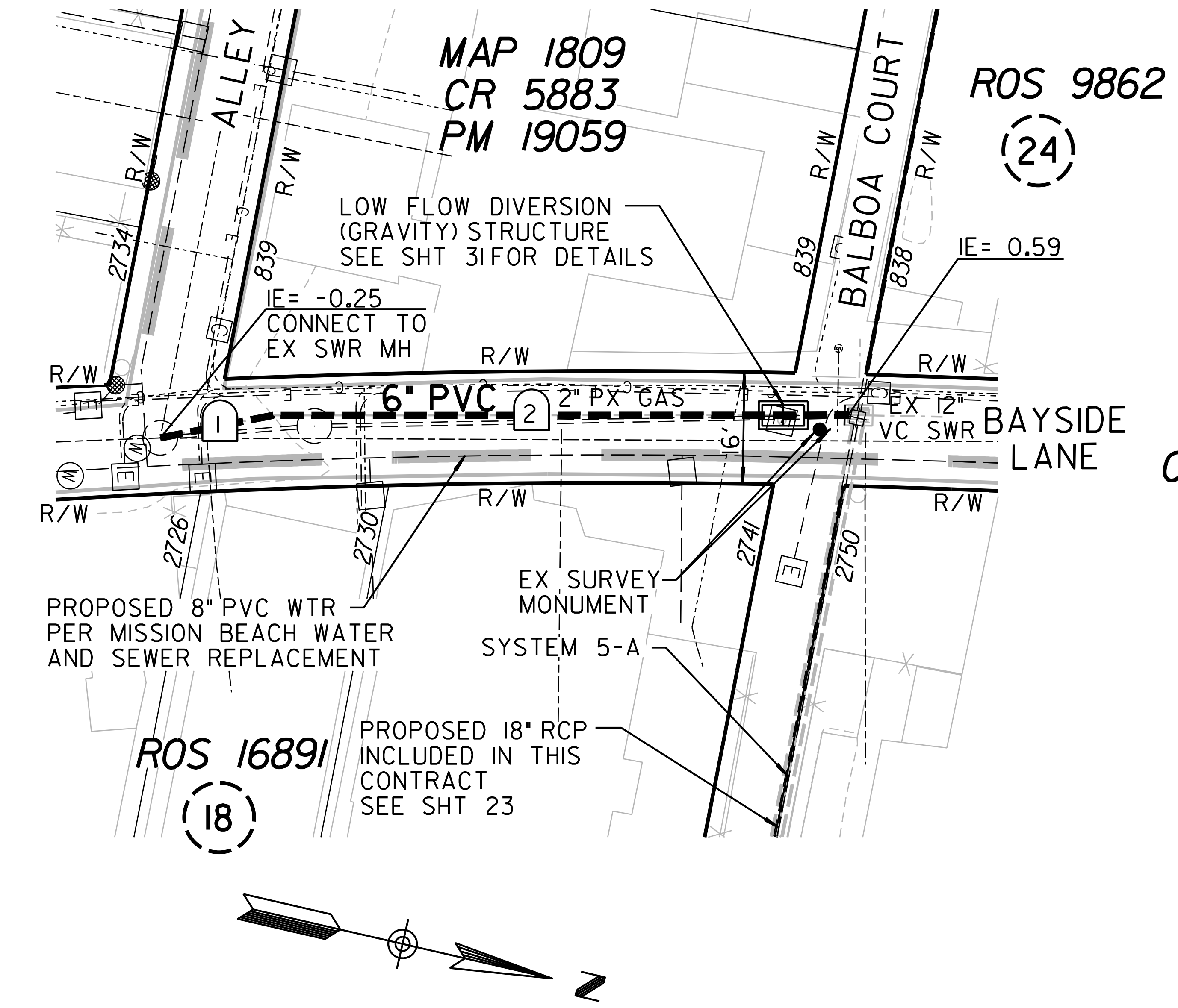
LOW FLOW DIVERSION (GRAVITY) SYSTEM 5-A



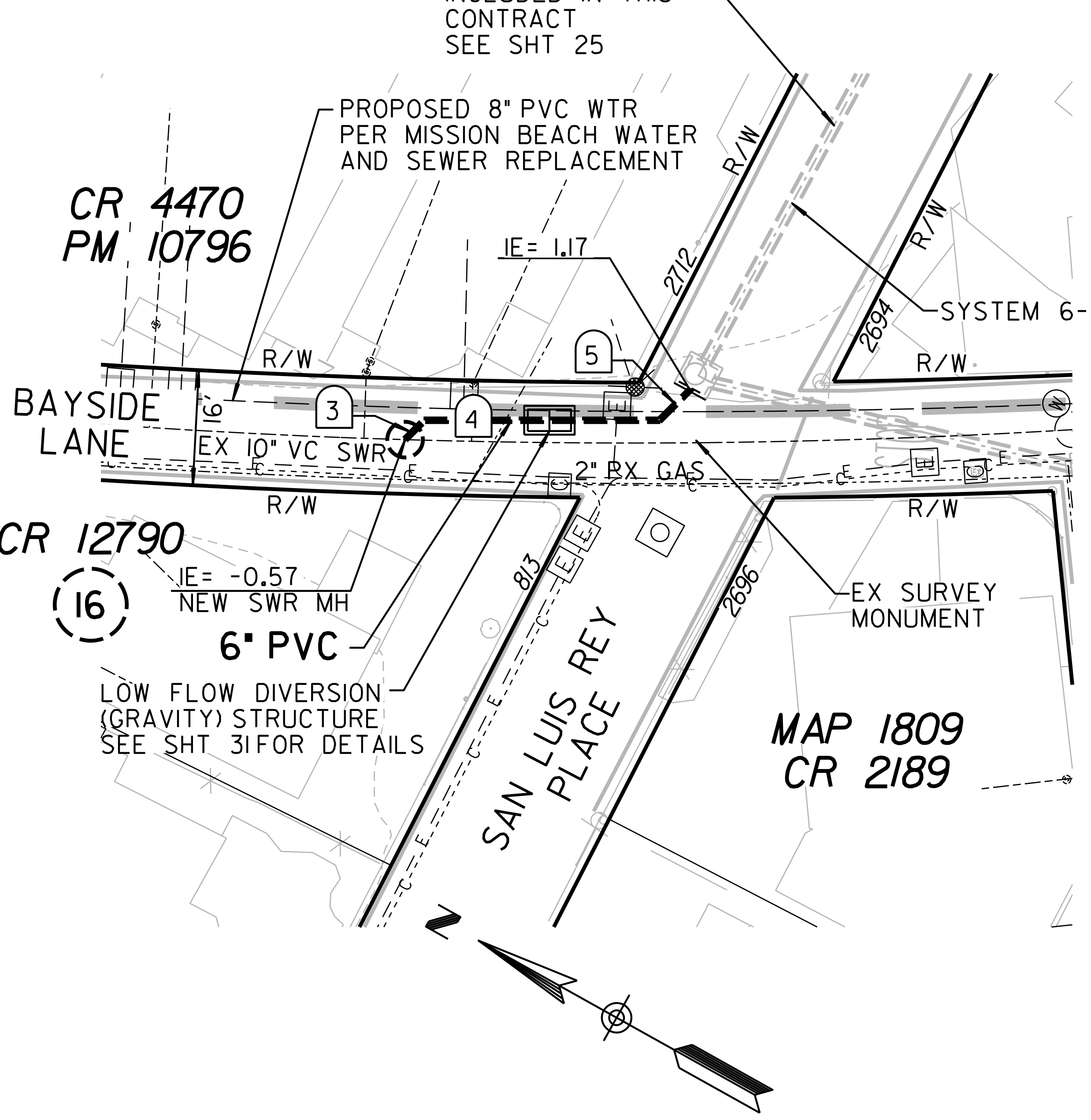
LOW FLOW DIVERSION (GRAVITY) SYSTEM 6-A



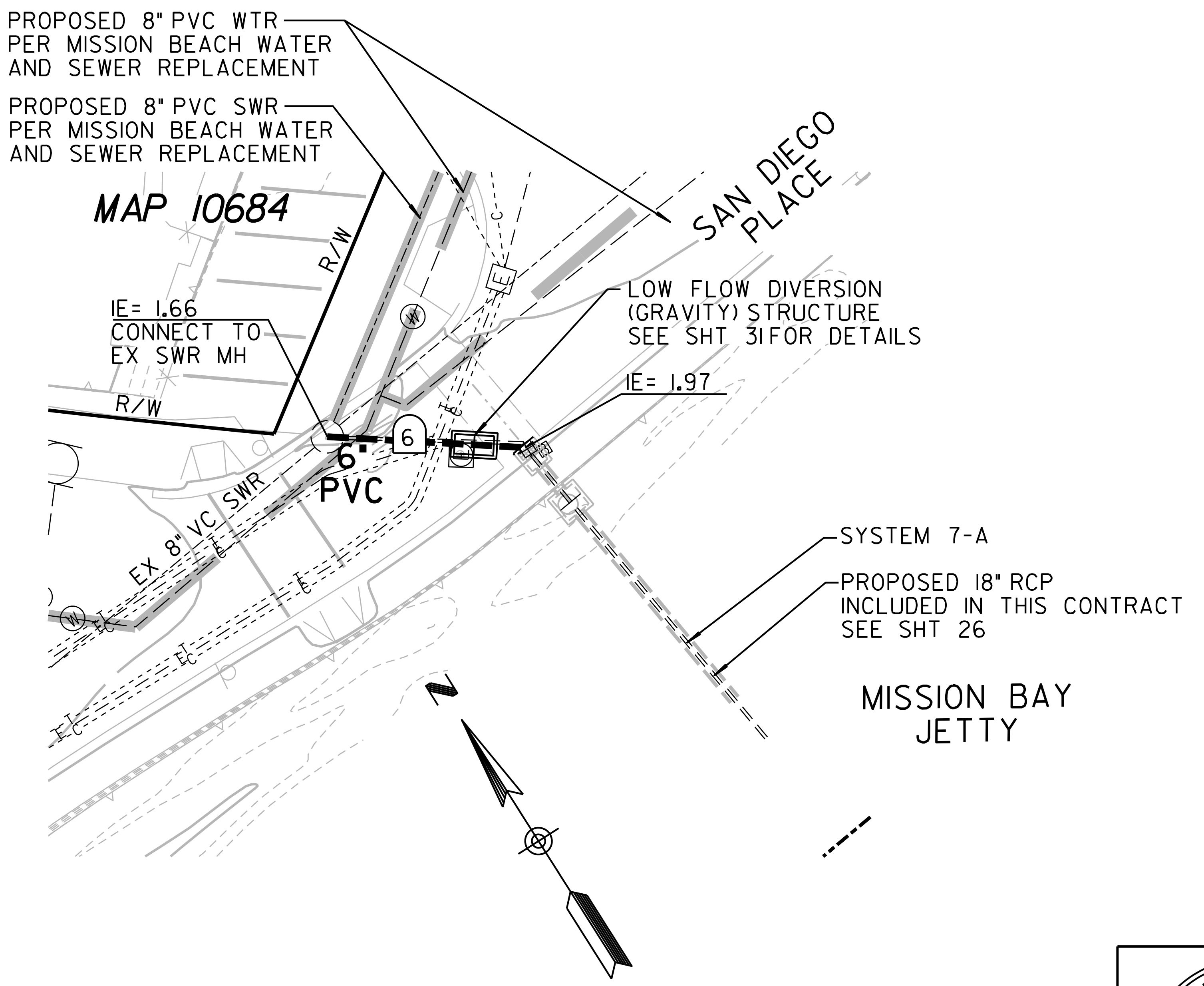
LOW FLOW DIVERSION (GRAVITY) SYSTEM 7-A



LOW FLOW DIVERSION (GRAVITY) SYSTEM 5-A



LOW FLOW DIVERSION (GRAVITY) SYSTEM 6-A



LOW FLOW DIVERSION (GRAVITY) SYSTEM 7-A

STORM DRAIN DATA TABLE

NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N24° 19'21"W		16.40'	6" PVC (SCHEDULE 80)
2	N13° 04'21"W		82.33'	6" PVC (SCHEDULE 80)
3	N58° 02'12"W		3.80'	6" PVC (SCHEDULE 80)
4	N13° 02'12"W		32.64'	6" PVC (SCHEDULE 80)
5	N58° 02'12"W		6.29'	6" PVC (SCHEDULE 80)
6	N54° 31'23"W		30.38'	6" PVC (SCHEDULE 80)

LOW FLOW DIVERSION PLAN 3

C-27

0 20 40 80
SCALE 1"=20'

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE
LOW FLOW DIVERSION PLAN 3
SYSTEMS 5-A, 6-A, 7-A

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 30 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

KEVIN R. GIBSON
NO. 52295

APPROVED:
FOR CITY ENGINEER
DATE
MAHMOUD ORIQAT
PRINT DCE NAME
RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

218-1689
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1858-6249
CCS83 COORDINATE

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

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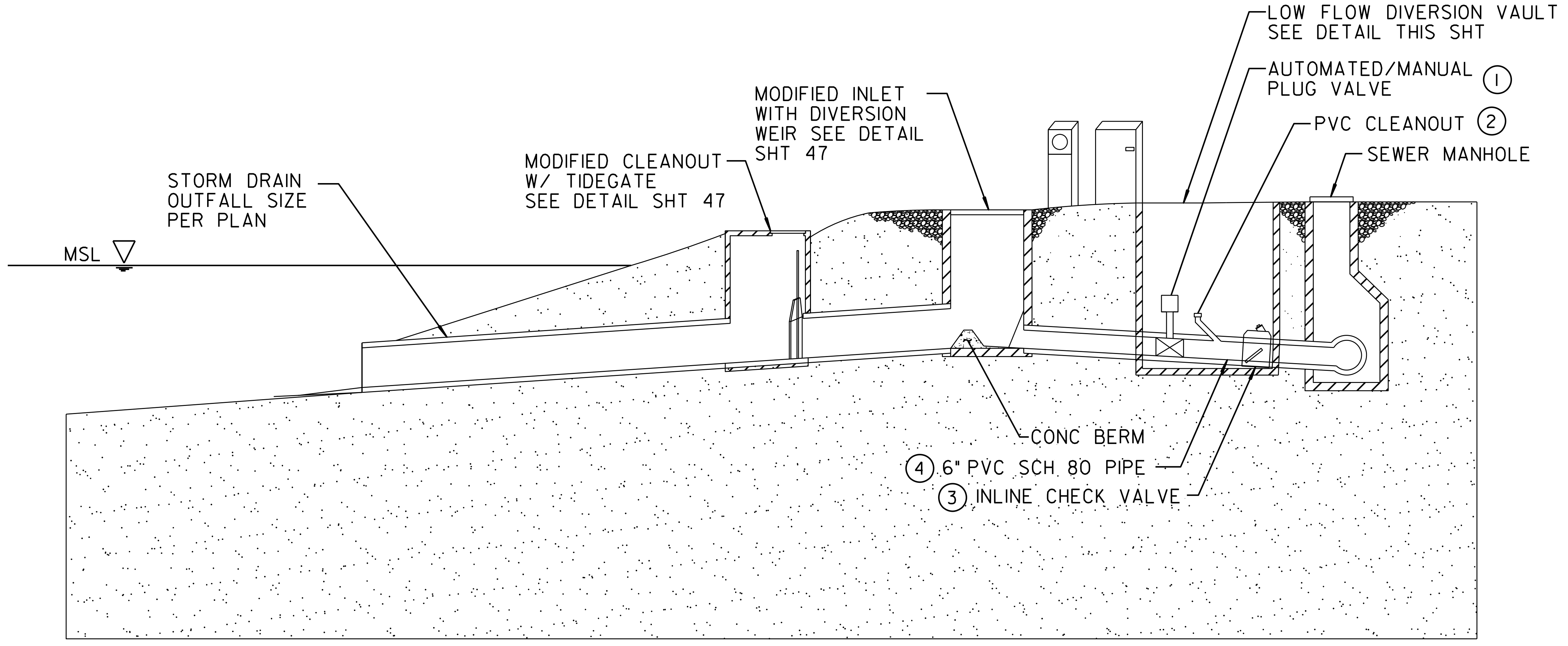
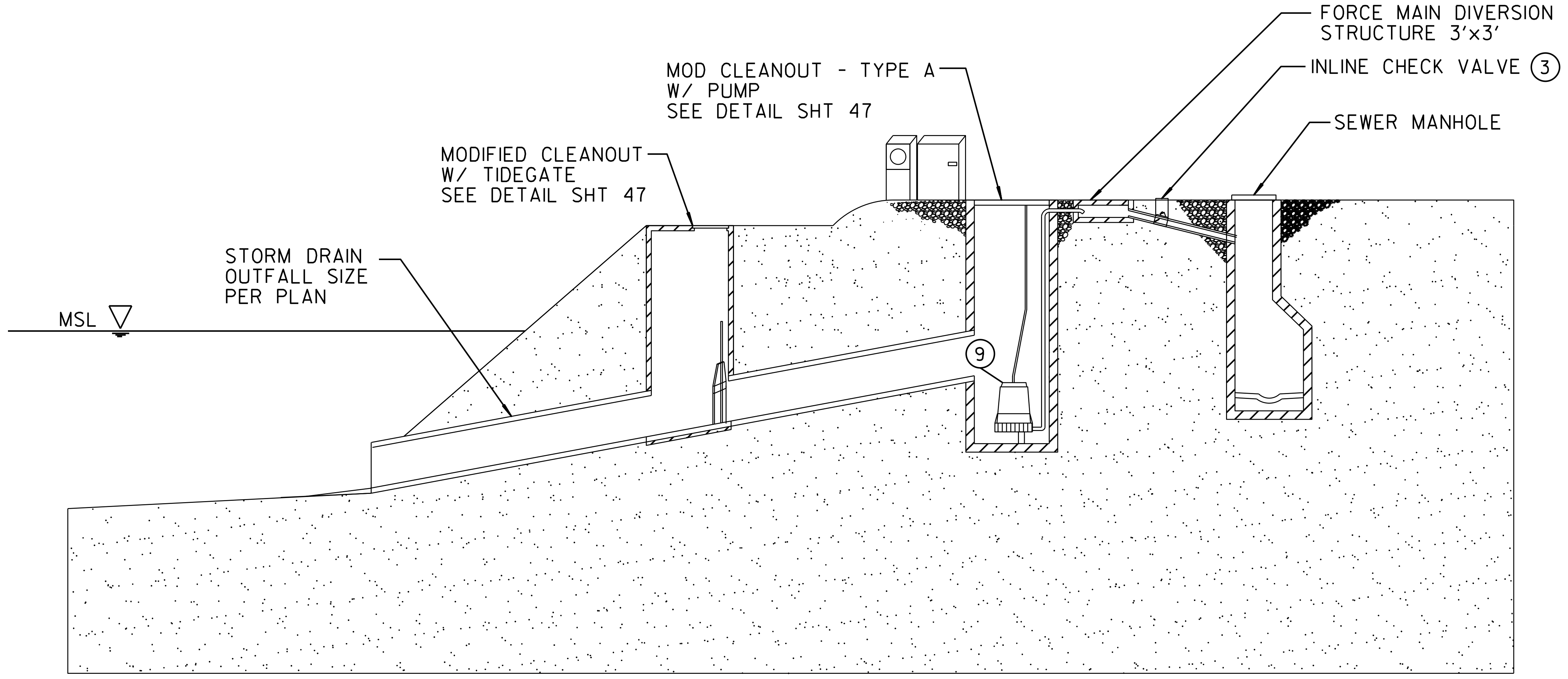


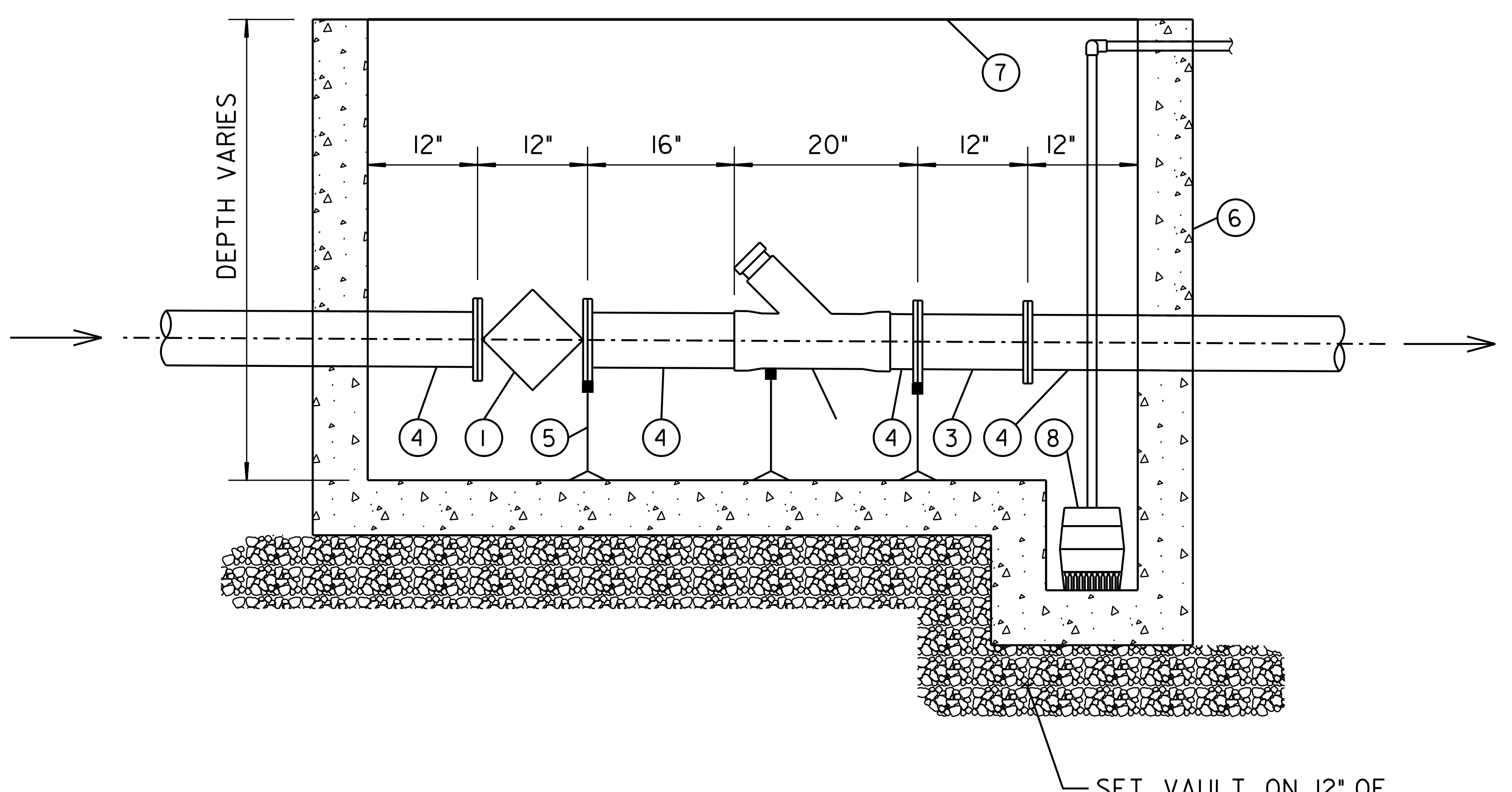
LOW FLOW DIVERSION (GRAVITY) TYPICAL SECTION

NOT TO SCALE

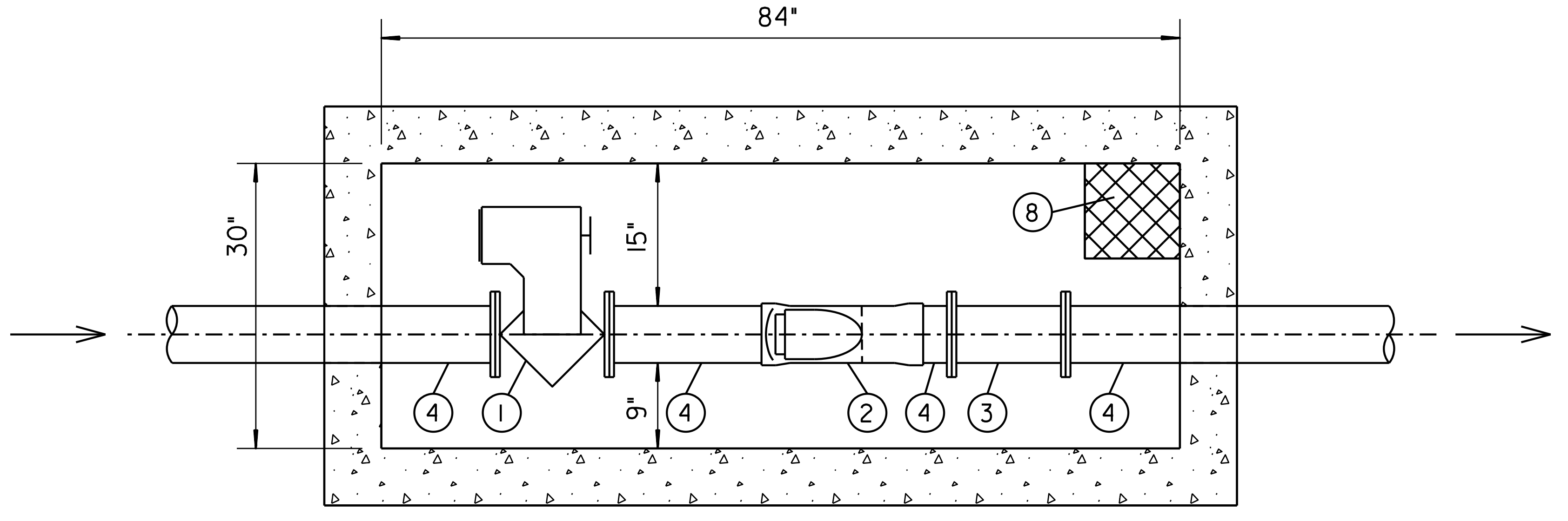


LOW FLOW DIVERSION (PUMP) TYPICAL SECTION

NOT TO SCALE



ELEVATION VIEW



PLAN VIEW

LOW FLOW DIVERSION (GRAVITY) VAULT

NOT TO SCALE

MATERIALS LIST

① 6" ECCENTRIC PLUG VALVE, CLASS 150 FLANGED, WITH 16 MILS EPOXY LINING AND COATING, WITH ELECTRIC MOTOR ACTUATOR AND MANUAL BYPASS HANDWHEEL.

② 6" PVC SCHEDULE 80 WYE, SOLVENT WELDED, SPEARS PART NO. 875-060 OR EQUAL, WITH 6" THREADED CAP ON WYE.

③ WAPRO WASTOP NPS 6" INLINE CHECK VALVE, MODEL WS146-S2-316, 316 STAINLESS STEEL BODY AND FLANGES, CLASS 125 LB FLANGE DRILL PATTERN, SILICONE INTERNAL MEMBRANE MATERIAL.

④ 6" PVC SCHEDULE 80 PIPE, FLANGED BY SOLVENT WELD END.

⑤ PIPE SUPPORT, ALL 304 STAINLESS STEEL COMPONENTS INCLUDING ANCHOR BOLTS TO CONCRETE VAULT FLOOR, TYP. OF 3.

⑥ 2.5" x 7" INSIDE DIMENSION x DEPTH AS REQUIRED PRECAST CONCRETE VAULT, WITH INTEGRAL FLOOR SUMP, MINIMUM 6" WALLS AND FLOOR. VAULT SUPPLIER TO SUBMIT CALCULATIONS FOR REQUIRED THICKNESS OF WALLS AND FLOOR. COAT OUTSIDE OF VAULT WITH CONCRETE CURING/WATERPROOFING COMPOUND. SEAL JOINTS WITH WATERPROOF MASTIC.

⑦ TWO-PIECE GALVANIZED STEEL CHECKER PLATE VAULT COVER RATED FOR H-20 TRAFFIC LOADING, WITH 316 STAINLESS STEEL HOLD-DOWN BOLTS, FOUR PER PANEL.

⑧ 10" x 10" x 12" DEEP SUMP INTEGRAL TO VAULT WITH 1/3RD HORSEPOWER SUMP PUMP, HYDROMATIC SHEF30, 36 GPM AT 10 FEET TDH, OR EQUIVALENT, AND 1-1/2" SCH 40 PVC PUMP DISCHARGE PIPING ROUTED TO SEWER.

⑨ WET PIT SUBMERSIBLE, VORTEX IMPELLER PUMP, HYDROMATIC MODEL S4LRC, OR EQUIVALENT, 4" DISCHARGE, 3.25" SOLIDS HANDLING, 1150 RPM, 10 HORSEPOWER, MAXIMUM CAPACITY OF 700 GPM (1.5 CFS) AT 20 FEET TDH.

LOW FLOW DIVERSION DETAILS

C–28

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

LOW FLOW DIVERSION DETAILS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 31 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

APPROVED:
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MAHMOUD ORIQAT
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SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

KEVIN R. GIBSON
NO. 52295

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SEE SHEETS
CCS27 COORDINATE

SEE SHEETS
CCS83 COORDINATE

CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____

41306–31–D

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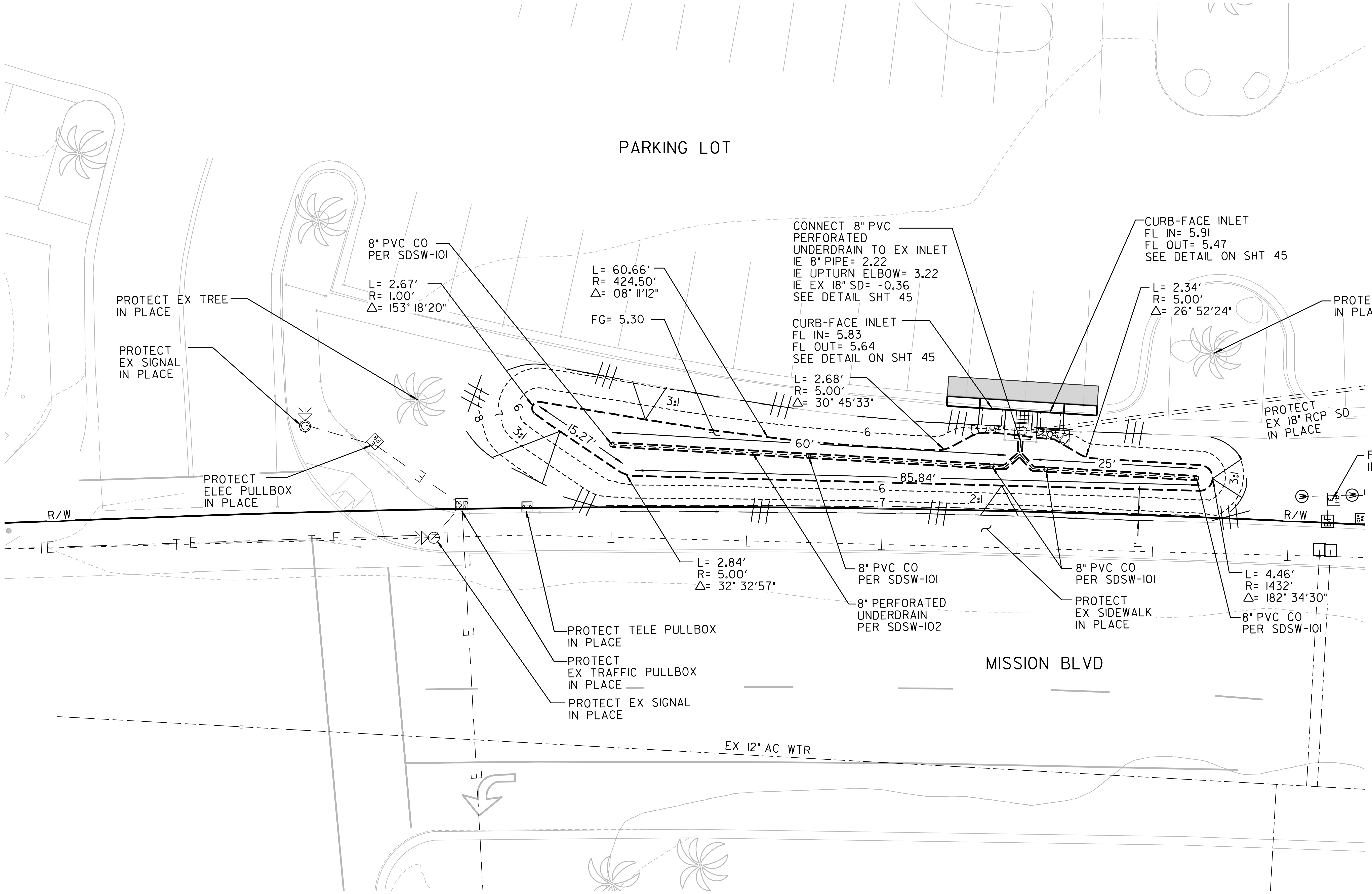

BASIN 1

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.7'

0 10 20 30
SCALE 1"=10'

GREEN INFRASTRUCTURE 1

C-34

SOUTH MISSION BEACH STORM DRAIN AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 1
BASIN 1

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 37 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

NO. 52295

APPROVED:
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PRINT DCE NAME ____ RCE# ____

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ORIGINAL	RICK			

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RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

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41306–37–D

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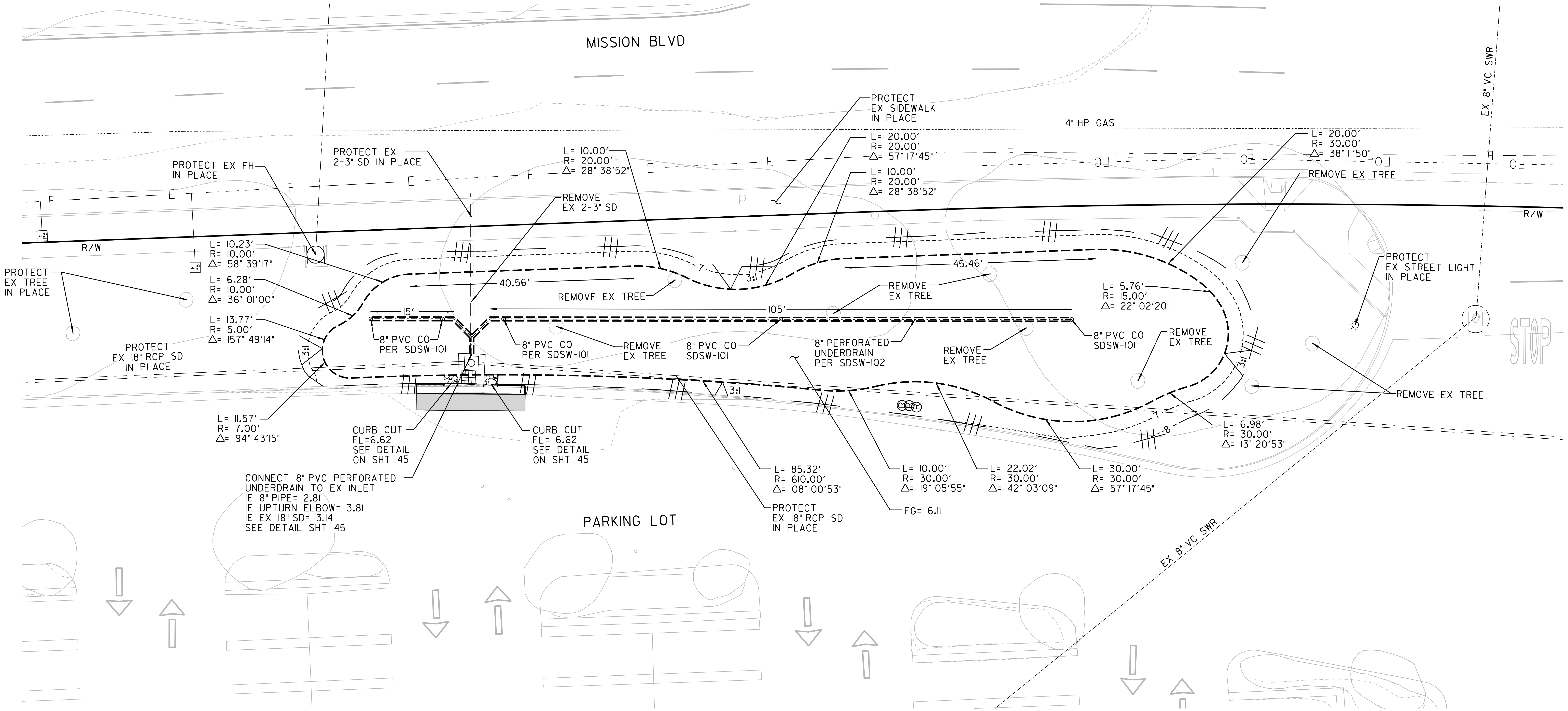

BASIN 2

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.7'

CAUTION

4" PX GAS! CONTRACTOR TO VERIFY EXACT LOCATION AND MUST NOTIFY SDG&E THREE (3) WEEKS IN ADVANCE PRIOR TO EXCAVATION SDG&E STANDBY REQUIRED

0 10 20 30
SCALE 1"=10'

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C–35

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 2
BASIN 2

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 38 OF 68 SHEETS

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PROJECT MANAGER

CHECKED BY:
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INSPECTOR
DATE STARTED
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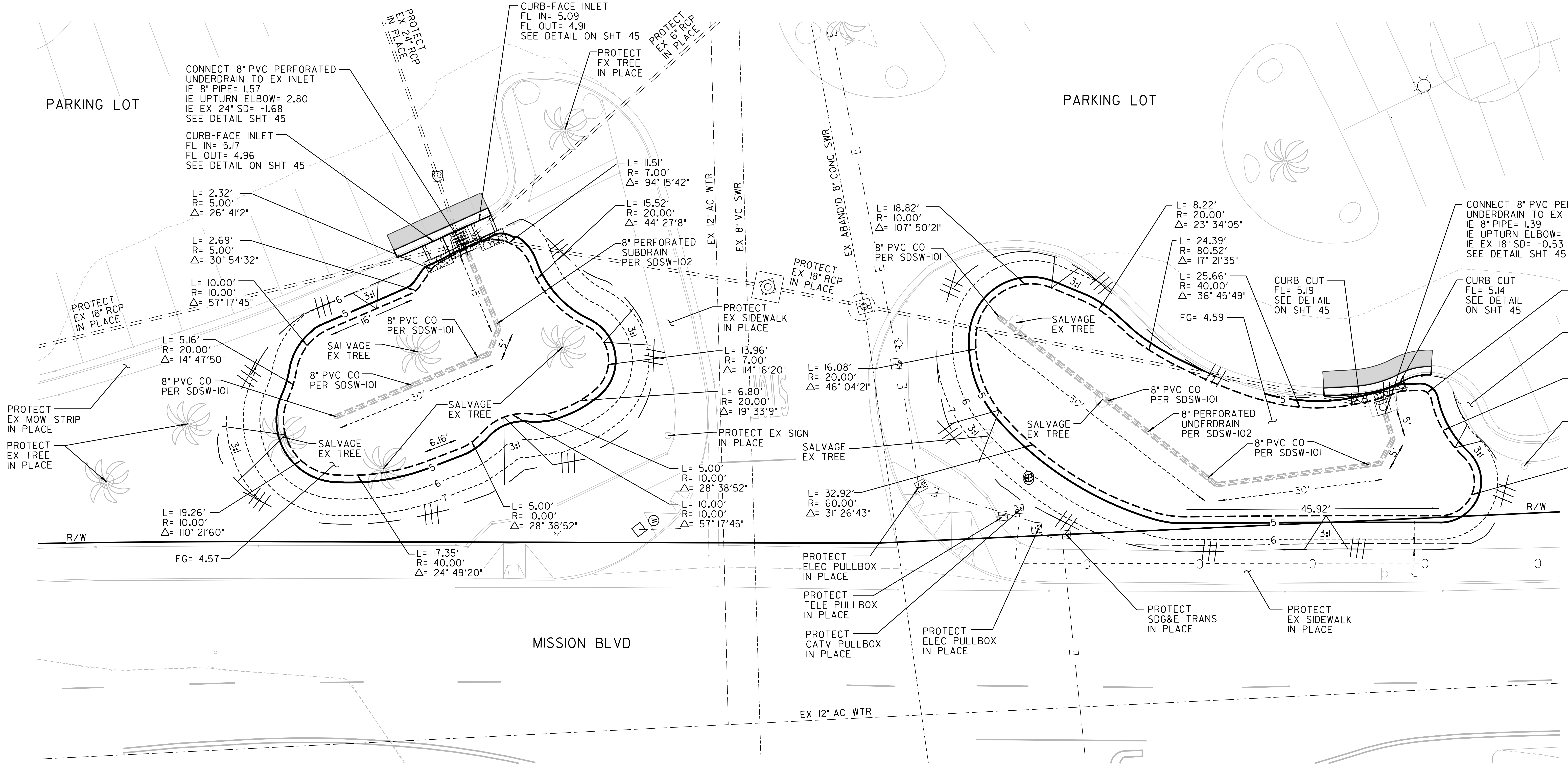
41306–38–D

GREEN INFRASTRUCTURE 2

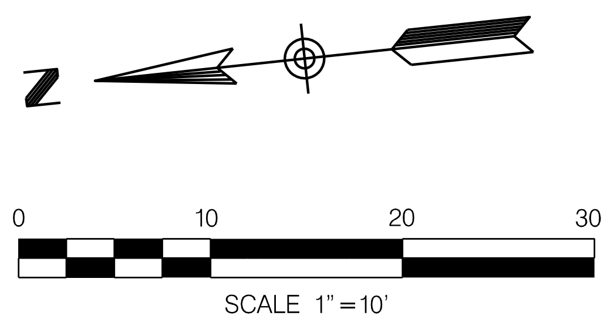
60% SUBMITTAL



BASIN 3 & 5

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.7′



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SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 3
BASIN 3 & 5

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 39 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

REGISTERED PROFESSIONAL ENGINEER
KEVIN R. GIBSON
NO. 52295
STATE OF CALIFORNIA

APPROVED:
FOR CITY ENGINEER ______ DATE ______
MAHMOUD ORIQAT
PRINT DCE NAME ______ RCE# ______

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LYNN HASSOUN
PROJECT ENGINEER

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1858-6249
CCS83 COORDINATE

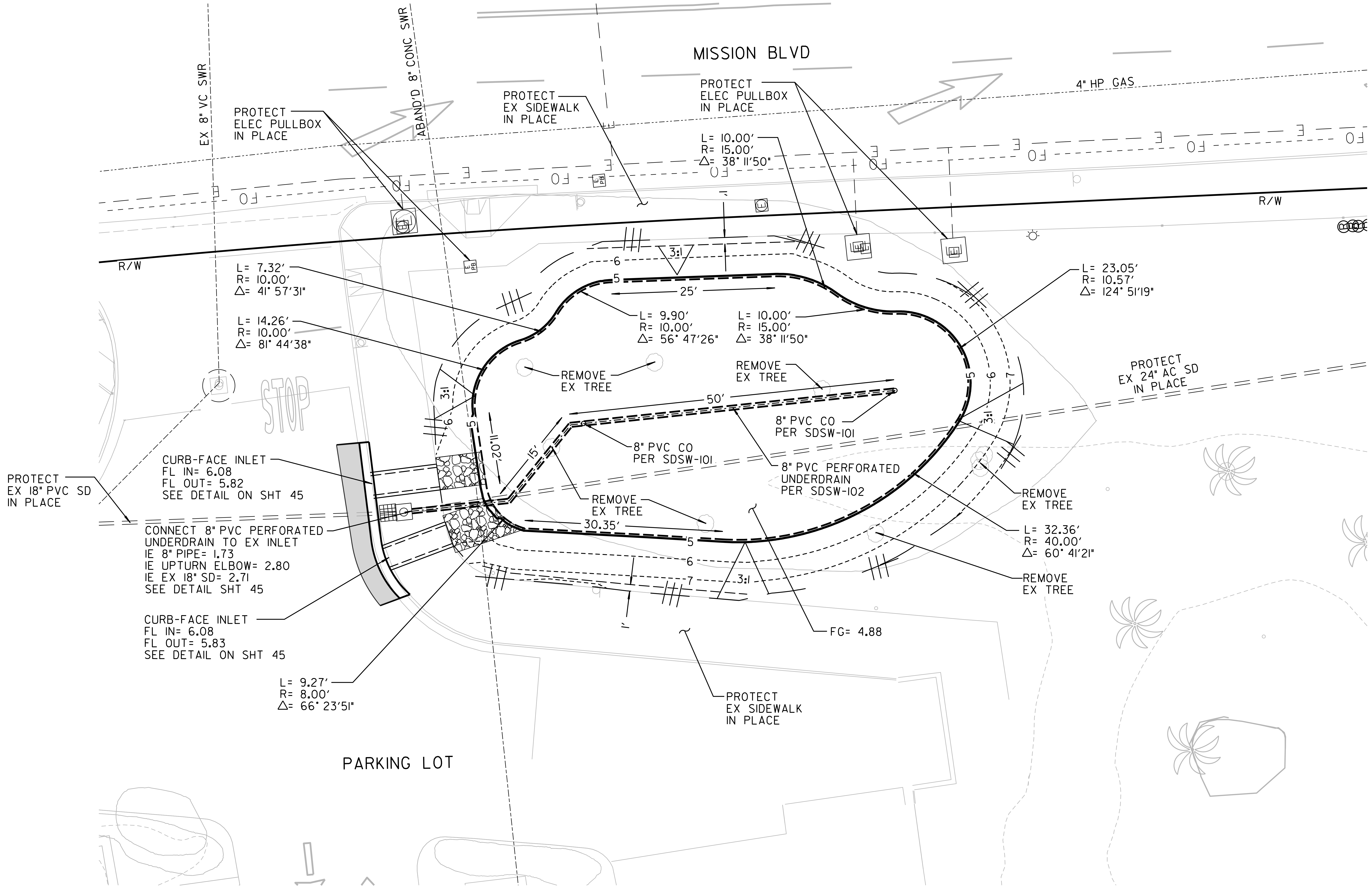
CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

41306–39–D

C–36

GREEN INFRASTRUCTURE 3

60% SUBMITTAL



BASIN 4

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.7'

C-37

GREEN INFRASTRUCTURE 4

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 4
BASIN 4

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 40 OF 68 SHEETS

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B-18118 (SD)

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PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
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1858-6249
CCS83 COORDINATE

KEVIN R. GIBSON
NO. 52295

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

41306–40–D

CAUTION

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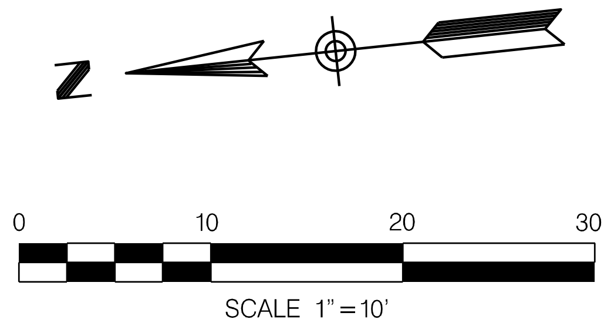
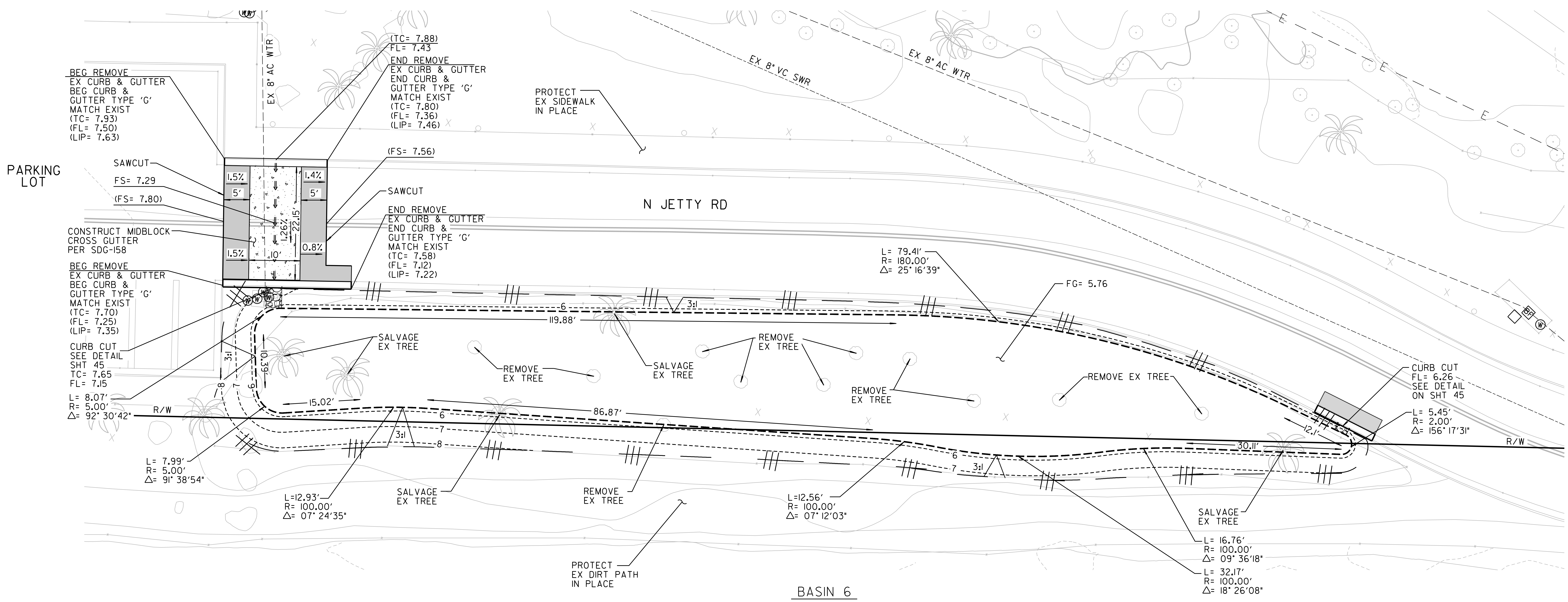
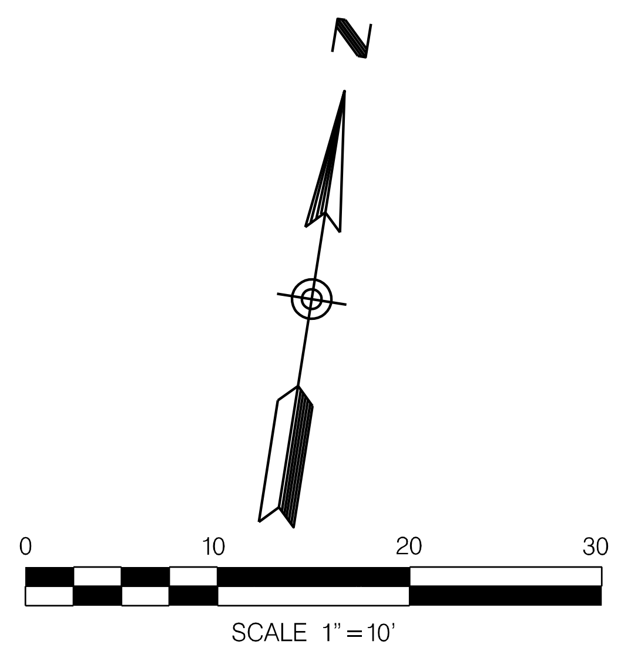


60% SUBMITTAL



NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.6'



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C-38

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 5
BASIN 6

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 41 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

KEVIN R. GIBSON
NO.52295

APPROVED:
FOR CITY ENGINEER DATE
MAHMOUD ORIQAT
PRINT DCE NAME RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

218-1689
CCS27 COORDINATE

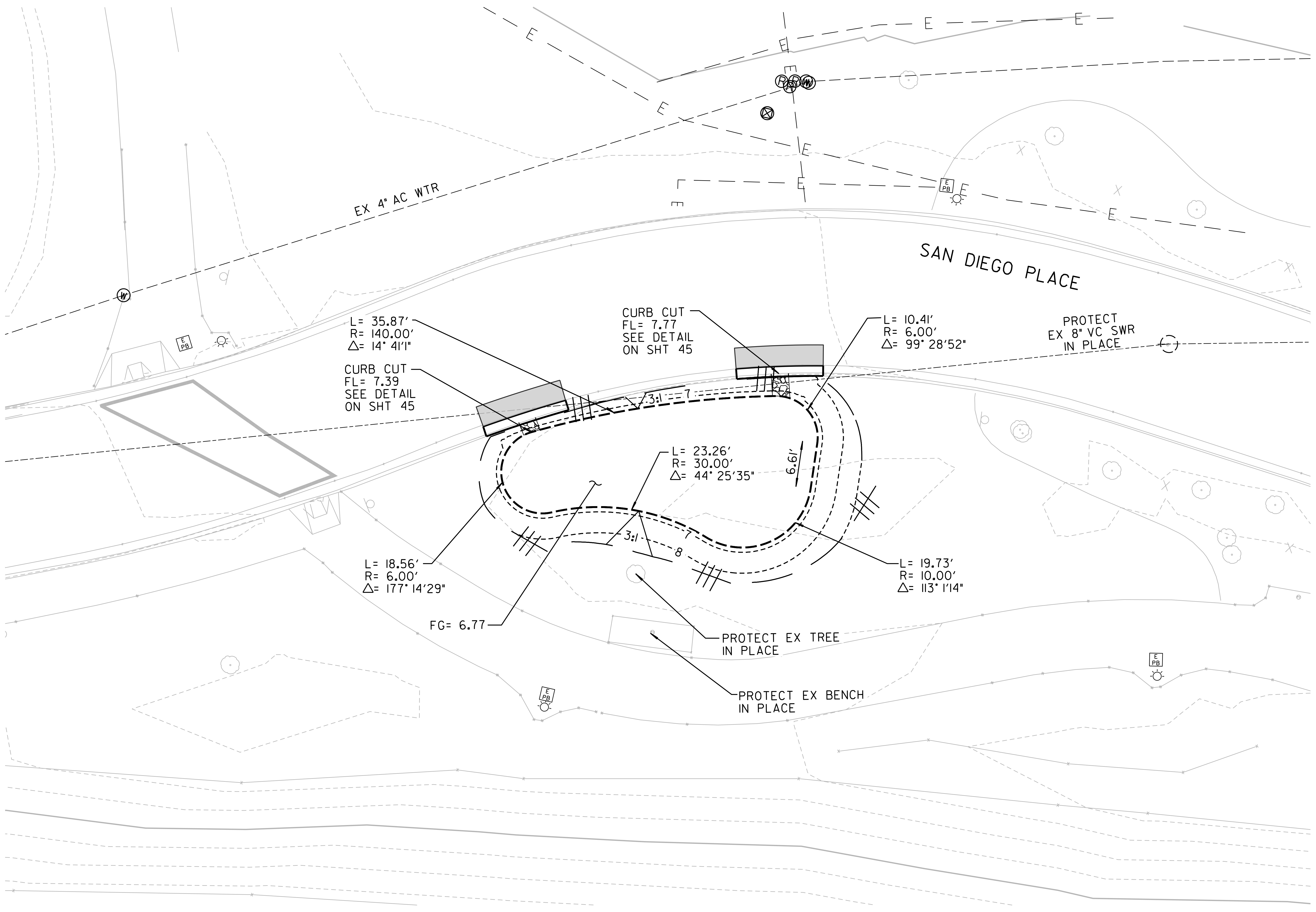
1858-6249
CCS83 COORDINATE

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

41306–41–D

GREEN INFRASTRUCTURE 5

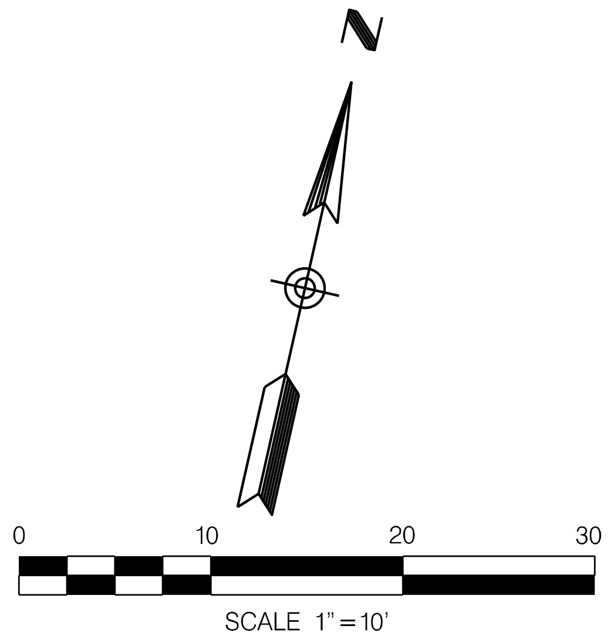
60% SUBMITTAL



BASIN 7

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.6'



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SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 6
BASIN 7

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 42 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

KEVIN R. GIBSON
NO. 52295

APPROVED:
FOR CITY ENGINEER
DATE
MAHMOUD ORIQAT
PRINT DCE NAME
RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

218-1689
CCS27 COORDINATE

1858-6249
CCS83 COORDINATE

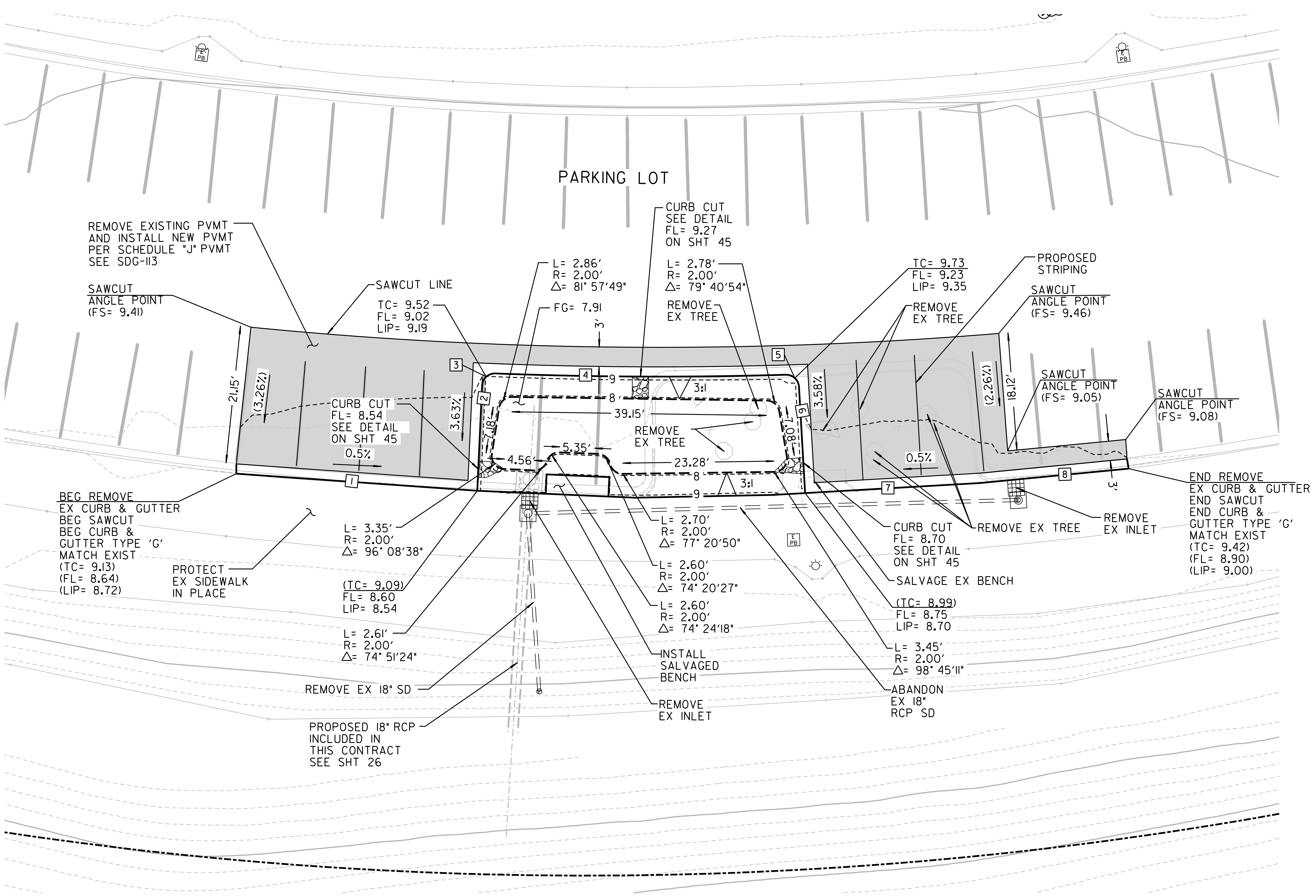
CONTRACTOR
DATE STARTED
INSPECTOR
DATE COMPLETED

41306-42-D

60% SUBMITTAL

GREEN INFRASTRUCTURE 6

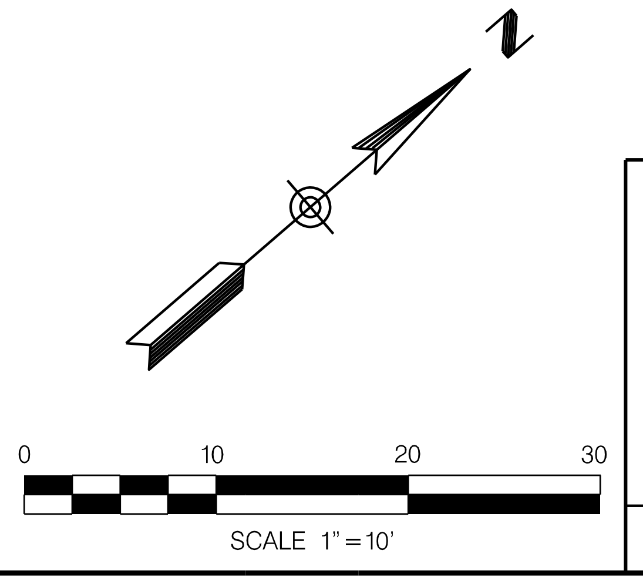
CURB DATA				
NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N44° 49'45"E		37.15'	TYPE 'G' CURB & GUTTER
2	N46° 38'01"W		16.16'	TYPE 'G' CURB & GUTTER
3	△ = 89° 39'30"	2.00'	3.13'	TYPE 'G' CURB & GUTTER
4	△ = 03° 58'22"	643.64'	44.63'	TYPE 'G' CURB & GUTTER
5	△ = 88° 25'06"	2.00'	3.09'	TYPE 'G' CURB & GUTTER
6	N52° 31'48"W		16.36'	TYPE 'G' CURB & GUTTER
7	N37° 28'12"E		26.98'	TYPE 'G' CURB & GUTTER
8	N35° 15'52"E		22.91'	TYPE 'G' CURB & GUTTER



BASIN 8

NOTES:
1. FOR CONSTRUCTION OF WATER QUALITY BASINS SEE BASIN DETAILS SHT 44

2. APPROXIMATE GROUND WATER ELEVATION 2.6'



GREEN INFRASTRUCTURE 7

C-40

SOUTH MISSION BEACH STORM DRAIN AND GREEN INFRASTRUCTURE

GREEN INFRASTRUCTURE 7
BASIN 8

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 43 OF 68 SHEETS

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B-18118 (SD)

KEVIN R. GIBSON
NO. 52295

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FOR CITY ENGINEER ____ DATE ____
MAHMOUD ORIQAT
PRINT DCE NAME ____ RCE# ____

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SUBMITTED BY:
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PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

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CCS83 COORDINATE

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INSPECTOR ____ DATE COMPLETED ____

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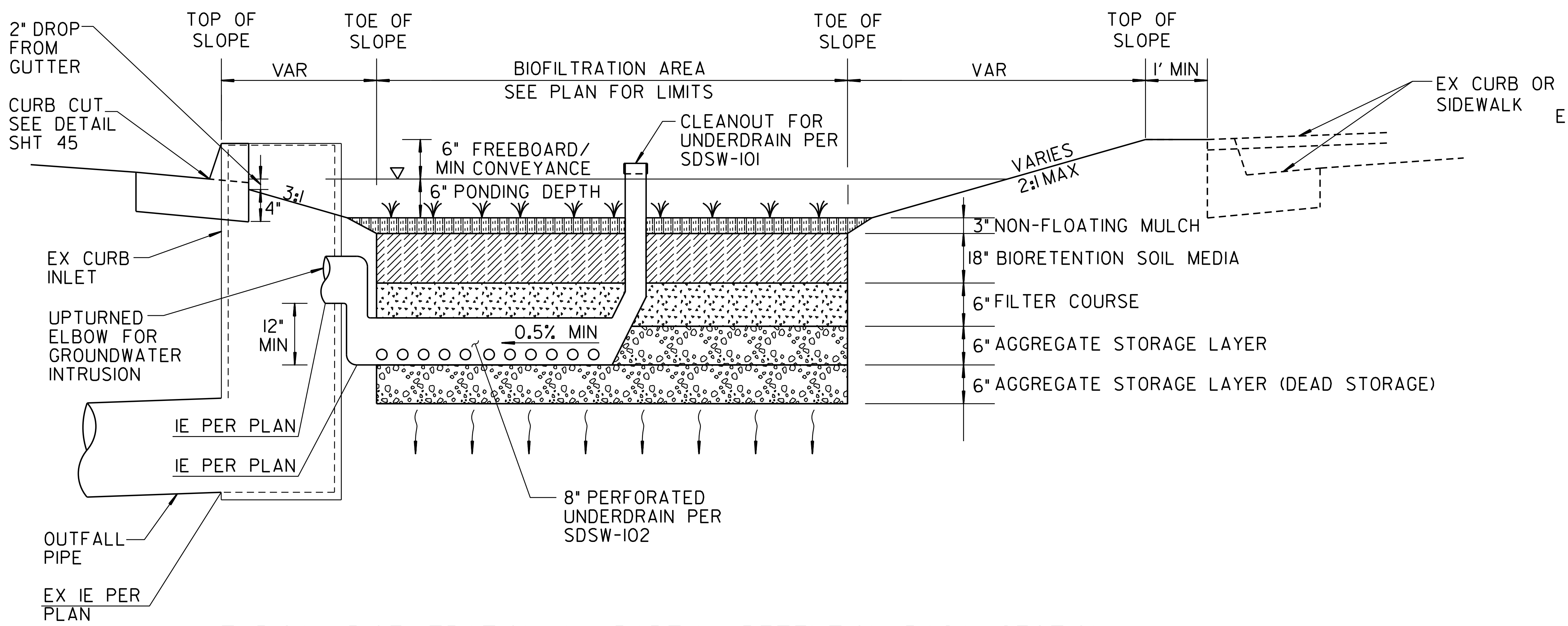
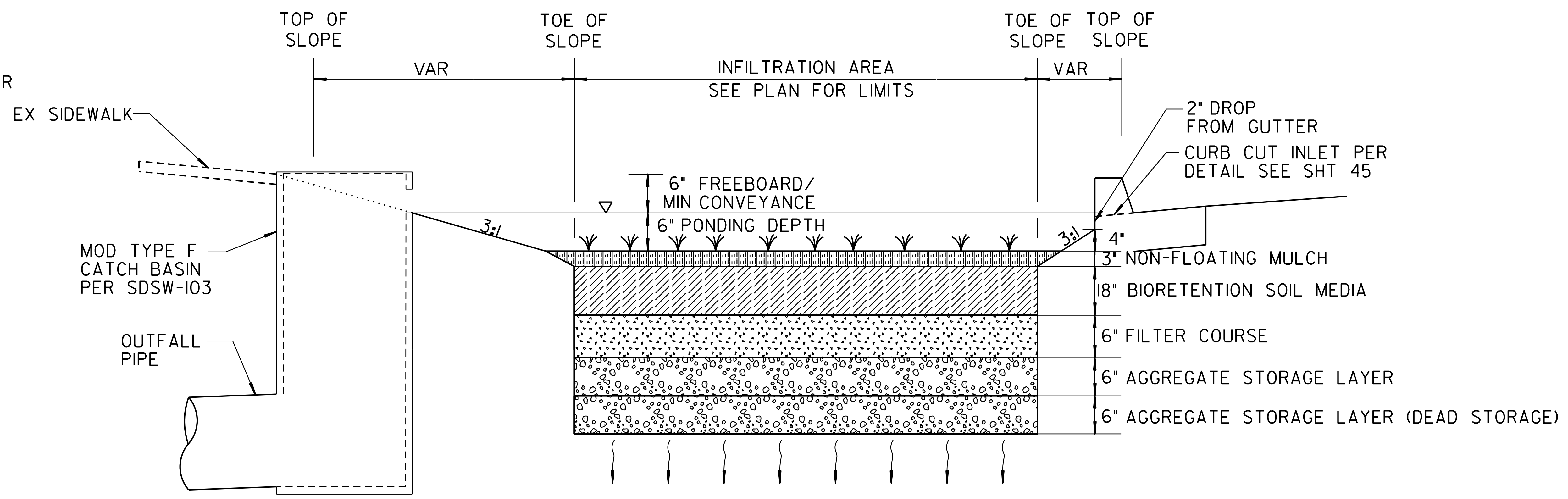


TYPICAL BIOFILTRATION W/ PARTIAL RETENTION BASIN SECTION
NOT TO SCALE



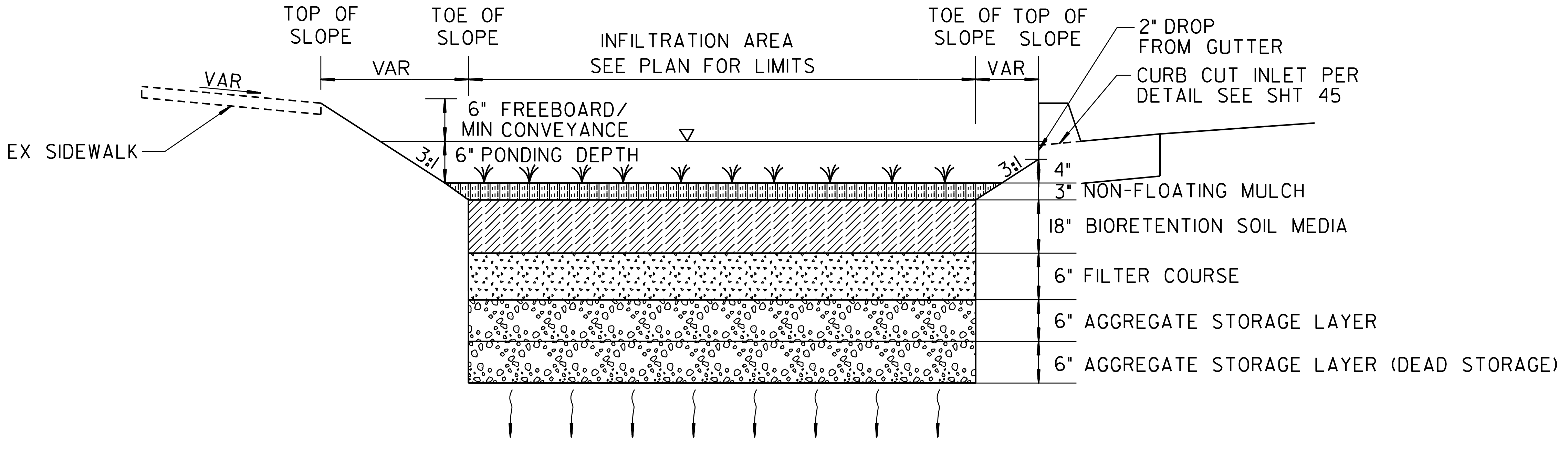
TYPICAL BIORETENTION BASIN SECTION
NOT TO SCALE

BIOFILTRATION W/ PARTIAL INFILTRATION BASIN INFORMATION TABLE

BASIN NO.	FREEBOARD/CONVEYANCE (FT)	PONDING DEPTH (FT)	BIORETENTION SOIL (FT)	SIDE SLOPE	BOTTOM AREA (FT^2)	PONDING AREA (FT^2)
1	0.50	0.50	1.50	2:1-3:1	625	955
2	0.50	0.50	1.50	3:1	3,181	4,030
3	0.50	0.50	1.50	3:1	1,560	1,805
4	0.50	0.50	1.50	3:1	2,455	2,750
5	0.50	0.50	1.50	3:1	2,150	2,490

BIORETENTION BASIN INFORMATION TABLE

BASIN NO.	FREEBOARD/CONVEYANCE (FT)	PONDING DEPTH (FT)	BIORETENTION SOIL (FT)	SIDE SLOPE	BOTTOM AREA (FT^2)	PONDING AREA (FT^2)
8	0.50	0.50	1.50	3:1	468	640



TYPICAL BIORETENTION BASIN SECTION
NOT TO SCALE

BIORETENTION BASIN INFORMATION TABLE

BASIN NO.	FREEBOARD/CONVEYANCE (FT)	PONDING DEPTH (FT)	BIORETENTION SOIL (FT)	SIDE SLOPE	BOTTOM AREA (FT^2)	PONDING AREA (FT^2)
6	0.50	0.50	1.50	3:1	4,270	4,955
7	0.50	0.50	1.50	3:1	720	895

WATER QUALITY BASIN DETAILS

C–41

SOUTH MISSION BEACH STORM DRAIN
AND GREEN INFRASTRUCTURE
WATER QUALITY BASIN DETAILS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 44 OF 68 SHEETS

WBS B-18118 (GI)
B-18118 (SD)

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PRINT DCE NAME
RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	RICK			

SUBMITTED BY:
RONALD FAMORCAN
PROJECT MANAGER

CHECKED BY:
LYNN HASSOUN
PROJECT ENGINEER

SEE SHEETS
CCS27 COORDINATE

SEE SHEETS
CCS83 COORDINATE

KEVIN R. GIBSON
NO. 52295

CONTRACTOR
INSPECTOR
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DATE COMPLETED

41306–44–D

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APPENDIX D

Inlet and Street Spread Width Calculations – FHWA Hydraulic Toolbox

Hydraulic Analysis Report

Project Data

Project Title: SMB STORM DRAIN AND GI 60% DESIGN

Designer:

Project Date: Thursday, August 22, 2019

Project Units: U.S. Customary Units

Notes:

Curb and Gutter Analysis: LINE 1A-10

Notes: STA 6+89.33

Gutter Input Parameters

Longitudinal Slope of Road: 0.0150 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 2.2400 cfs

Gutter Result Parameters

Width of Spread: 8.8236 ft

Gutter Depression: 0.0000 in

Area of Flow: 0.7786 ft^2

Eo (Gutter Flow to Total Flow): 0.3919

Gutter Depth at Curb: 2.1177 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.3482 ft

Computed Width of Spread at Sag: 18.3951 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1A-20

Notes: STA 10+37.29

Gutter Input Parameters

Longitudinal Slope of Road: 0.0040 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 6.3700 cfs

Gutter Result Parameters

Width of Spread: 16.7296 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.7988 ft^2

Eo (Gutter Flow to Total Flow): 0.2218

Gutter Depth at Curb: 4.0151 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.6989 ft

Computed Width of Spread at Sag: 35.9316 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1B-5

Notes: STA 1+52.12

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 9.5100 cfs

Gutter Result Parameters

Width of Spread: 20.5200 ft

Gutter Depression: 0.0000 in

Area of Flow: 4.2107 ft^2

Eo (Gutter Flow to Total Flow): 0.1835

Gutter Depth at Curb: 4.9248 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.9130 ft

Computed Width of Spread at Sag: 46.6342 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1C-5

Notes: STA 1+01.50

Gutter Input Parameters

Longitudinal Slope of Road: 0.0020 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 4.7400 cfs

Gutter Result Parameters

Width of Spread: 17.0527 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.9080 ft^2

Eo (Gutter Flow to Total Flow): 0.2180

Gutter Depth at Curb: 4.0927 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.5739 ft

Computed Width of Spread at Sag: 29.6815 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1C-10

Notes: STA 1+68.12

Gutter Input Parameters

Longitudinal Slope of Road: 0.0140 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 7.0600 cfs

Gutter Result Parameters

Width of Spread: 13.7475 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.8899 ft^2

Eo (Gutter Flow to Total Flow): 0.2654

Gutter Depth at Curb: 3.2994 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.7485 ft

Computed Width of Spread at Sag: 38.4117 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1D-5

Notes: STA 1+01.50

Gutter Input Parameters

Longitudinal Slope of Road: 0.0040 ft/ft
Cross-Slope of Pavement: 0.0200 ft/ft
Uniform Gutter Geometry
Manning's n: 0.0150
Gutter Width: 1.5000 ft
Design Flow: 4.5100 cfs

Gutter Result Parameters

Width of Spread: 14.6977 ft
Gutter Depression: 0.0000 in
Area of Flow: 2.1602 ft^2
Eo (Gutter Flow to Total Flow): 0.2498
Gutter Depth at Curb: 3.5275 in

Inlet Input Parameters

Inlet Location: Inlet in Sag
Percent Clogging: 50.0000 %
Inlet Type: Grate
Grate Type: P - 1-7/8 - 4
Grate Width: 1.9688 ft
Grate Length: 3.3300 ft
Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft
Effective Perimeter: 3.6338 ft
Area: 5.2448 ft^2
Effective Area: 2.6224 ft^2
Depth at center of grate: 0.5552 ft
Computed Width of Spread at Sag: 28.7455 ft
Flow type: Weir Flow
Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1D-10

Notes: STA 1+69.59

Gutter Input Parameters

Longitudinal Slope of Road: 0.0150 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 6.9700 cfs

Gutter Result Parameters

Width of Spread: 13.5056 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.8240 ft^2

Eo (Gutter Flow to Total Flow): 0.2697

Gutter Depth at Curb: 3.2414 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.7422 ft

Computed Width of Spread at Sag: 38.0930 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1E-5

Notes: STA 1+00.96

Gutter Input Parameters

Longitudinal Slope of Road: 0.0040 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 2.7700 cfs

Gutter Result Parameters

Width of Spread: 12.2423 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.4987 ft^2

Eo (Gutter Flow to Total Flow): 0.2946

Gutter Depth at Curb: 2.9382 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.4012 ft

Computed Width of Spread at Sag: 21.0432 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 1E-10

Notes: STA 1+66.27

Gutter Input Parameters

Longitudinal Slope of Road: 0.0170 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 5.0500 cfs

Gutter Result Parameters

Width of Spread: 11.6908 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.3668 ft^2

Eo (Gutter Flow to Total Flow): 0.3069

Gutter Depth at Curb: 2.8058 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.5987 ft

Computed Width of Spread at Sag: 30.9194 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2A-35

Notes: STA 13+09.93

Gutter Input Parameters

Longitudinal Slope of Road: 0.0050 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 3.4600 cfs

Gutter Result Parameters

Width of Spread: 12.7619 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.6287 ft^2

Eo (Gutter Flow to Total Flow): 0.2838

Gutter Depth at Curb: 3.0629 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.4653 ft

Computed Width of Spread at Sag: 24.2494 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2B-15

Notes: STA 4+04.00

Gutter Input Parameters

Longitudinal Slope of Road: 0.0020 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 8.6000 cfs

Gutter Result Parameters

Width of Spread: 21.3213 ft

Gutter Depression: 0.0000 in

Area of Flow: 4.5460 ft^2

Eo (Gutter Flow to Total Flow): 0.1770

Gutter Depth at Curb: 5.1171 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.8538 ft

Computed Width of Spread at Sag: 43.6736 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2C-5

Notes: STA 1+01.50

Gutter Input Parameters

Longitudinal Slope of Road: 0.0100 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 3.2900 cfs

Gutter Result Parameters

Width of Spread: 10.9969 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.2093 ft^2

Eo (Gutter Flow to Total Flow): 0.3240

Gutter Depth at Curb: 2.6392 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.4499 ft

Computed Width of Spread at Sag: 23.4809 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2C-10

Notes: STA 1+64.33

Gutter Input Parameters

Longitudinal Slope of Road: 0.0260 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 12.3600 cfs

Gutter Result Parameters

Width of Spread: 15.1015 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.2805 ft^2

Eo (Gutter Flow to Total Flow): 0.2437

Gutter Depth at Curb: 3.6244 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 1.0873 ft

Computed Width of Spread at Sag: 55.3509 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2D-5

Notes: STA 1+01.50

Gutter Input Parameters

Longitudinal Slope of Road: 0.0040 ft/ft
Cross-Slope of Pavement: 0.0200 ft/ft
Uniform Gutter Geometry
Manning's n: 0.0150
Gutter Width: 1.5000 ft
Design Flow: 3.0600 cfs

Gutter Result Parameters

Width of Spread: 12.7081 ft
Gutter Depression: 0.0000 in
Area of Flow: 1.6149 ft^2
Eo (Gutter Flow to Total Flow): 0.2849
Gutter Depth at Curb: 3.0499 in

Inlet Input Parameters

Inlet Location: Inlet in Sag
Percent Clogging: 50.0000 %
Inlet Type: Grate
Grate Type: P - 1-7/8 - 4
Grate Width: 1.9688 ft
Grate Length: 3.3300 ft
Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft
Effective Perimeter: 3.6338 ft
Area: 5.2448 ft^2
Effective Area: 2.6224 ft^2
Depth at center of grate: 0.4287 ft
Computed Width of Spread at Sag: 22.4199 ft
Flow type: Weir Flow
Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2D-10

Notes: STA 1+62.20

Gutter Input Parameters

Longitudinal Slope of Road: 0.0280 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 4.8300 cfs

Gutter Result Parameters

Width of Spread: 10.4703 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.0963 ft^2

Eo (Gutter Flow to Total Flow): 0.3382

Gutter Depth at Curb: 2.5129 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.5812 ft

Computed Width of Spread at Sag: 30.0436 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2E-5

Notes: STA 1+01.50

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 2.2700 cfs

Gutter Result Parameters

Width of Spread: 11.9914 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.4379 ft^2

Eo (Gutter Flow to Total Flow): 0.3001

Gutter Depth at Curb: 2.8779 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.3513 ft

Computed Width of Spread at Sag: 18.5502 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 2E-10

Notes: STA 1+63.67

Gutter Input Parameters

Longitudinal Slope of Road: 0.0260 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 4.4100 cfs

Gutter Result Parameters

Width of Spread: 10.2607 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.0528 ft^2

Eo (Gutter Flow to Total Flow): 0.3443

Gutter Depth at Curb: 2.4626 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.5470 ft

Computed Width of Spread at Sag: 28.3336 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3A-10

Notes: STA 3+74.45

Gutter Input Parameters

Longitudinal Slope of Road: 0.0070 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 0.7800 cfs

Gutter Result Parameters

Width of Spread: 6.8533 ft

Gutter Depression: 0.0000 in

Area of Flow: 0.4697 ft^2

Eo (Gutter Flow to Total Flow): 0.4829

Gutter Depth at Curb: 1.6448 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.1724 ft

Computed Width of Spread at Sag: 9.6019 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3B-5

Notes: STA 1+00.96

Gutter Input Parameters

Longitudinal Slope of Road: 0.0100 ft/ft
Cross-Slope of Pavement: 0.0200 ft/ft
Uniform Gutter Geometry
Manning's n: 0.0150
Gutter Width: 1.5000 ft
Design Flow: 5.6600 cfs

Gutter Result Parameters

Width of Spread: 13.4780 ft
Gutter Depression: 0.0000 in
Area of Flow: 1.8166 ft^2
Eo (Gutter Flow to Total Flow): 0.2702
Gutter Depth at Curb: 3.2347 in

Inlet Input Parameters

Inlet Location: Inlet in Sag
Percent Clogging: 50.0000 %
Inlet Type: Grate
Grate Type: P - 1-7/8 - 4
Grate Width: 1.9688 ft
Grate Length: 3.3300 ft
Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft
Effective Perimeter: 3.6338 ft
Area: 5.2448 ft^2
Effective Area: 2.6224 ft^2
Depth at center of grate: 0.6460 ft
Computed Width of Spread at Sag: 33.2839 ft
Flow type: Weir Flow
Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3B-10

Notes: STA 1+64.53

Gutter Input Parameters

Longitudinal Slope of Road: 0.0240 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 7.1900 cfs

Gutter Result Parameters

Width of Spread: 12.5113 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.5653 ft^2

Eo (Gutter Flow to Total Flow): 0.2889

Gutter Depth at Curb: 3.0027 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.7577 ft

Computed Width of Spread at Sag: 38.8698 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3C-5

Notes: STA 1+00.96

Gutter Input Parameters

Longitudinal Slope of Road: 0.0130 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 10.4300 cfs

Gutter Result Parameters

Width of Spread: 16.1366 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.6039 ft^2

Eo (Gutter Flow to Total Flow): 0.2293

Gutter Depth at Curb: 3.8728 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.9710 ft

Computed Width of Spread at Sag: 49.5328 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3C-10

Notes: STA 1+69.37

Gutter Input Parameters

Longitudinal Slope of Road: 0.0210 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 13.8600 cfs

Gutter Result Parameters

Width of Spread: 16.4084 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.6923 ft^2

Eo (Gutter Flow to Total Flow): 0.2258

Gutter Depth at Curb: 3.9380 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 1.1736 ft

Computed Width of Spread at Sag: 59.6650 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3D-5

Notes: STA 1+00.96

Gutter Input Parameters

Longitudinal Slope of Road: 0.0100 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 9.4000 cfs

Gutter Result Parameters

Width of Spread: 16.3021 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.6576 ft^2

Eo (Gutter Flow to Total Flow): 0.2272

Gutter Depth at Curb: 3.9125 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.9059 ft

Computed Width of Spread at Sag: 46.2815 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3D-10

Notes: STA 1+70.69

Gutter Input Parameters

Longitudinal Slope of Road: 0.0140 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 12.5300 cfs

Gutter Result Parameters

Width of Spread: 17.0472 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.9061 ft^2

Eo (Gutter Flow to Total Flow): 0.2180

Gutter Depth at Curb: 4.0913 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 1.0973 ft

Computed Width of Spread at Sag: 55.8483 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3E-5

Notes: STA 1+00.96

Gutter Input Parameters

Longitudinal Slope of Road: 0.0140 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 10.4300 cfs

Gutter Result Parameters

Width of Spread: 15.9139 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.5325 ft^2

Eo (Gutter Flow to Total Flow): 0.2323

Gutter Depth at Curb: 3.8193 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.9710 ft

Computed Width of Spread at Sag: 49.5328 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3G-5

Notes: STA 1+16.87

Gutter Input Parameters

Longitudinal Slope of Road: 0.0013 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 10.3000 cfs

Gutter Result Parameters

Width of Spread: 24.7326 ft

Gutter Depression: 0.0000 in

Area of Flow: 6.1170 ft^2

Eo (Gutter Flow to Total Flow): 0.1538

Gutter Depth at Curb: 5.9358 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.9629 ft

Computed Width of Spread at Sag: 49.1286 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3F-5

Notes: STA 1+52.78

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft
Cross-Slope of Pavement: 0.0200 ft/ft
Uniform Gutter Geometry
Manning's n: 0.0150
Gutter Width: 1.5000 ft
Design Flow: 5.7300 cfs

Gutter Result Parameters

Width of Spread: 16.9694 ft
Gutter Depression: 0.0000 in
Area of Flow: 2.8796 ft^2
Eo (Gutter Flow to Total Flow): 0.2189
Gutter Depth at Curb: 4.0727 in

Inlet Input Parameters

Inlet Location: Inlet in Sag
Percent Clogging: 50.0000 %
Inlet Type: Grate
Grate Type: P - 1-7/8 - 4
Grate Width: 1.9688 ft
Grate Length: 3.3300 ft
Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft
Effective Perimeter: 3.6338 ft
Area: 5.2448 ft^2
Effective Area: 2.6224 ft^2
Depth at center of grate: 0.6513 ft
Computed Width of Spread at Sag: 33.5497 ft
Flow type: Weir Flow
Efficiency: 1.0000

Curb and Gutter Analysis: LINE 3H-5

Notes: STA 1+16.48.55

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 2.6800 cfs

Gutter Result Parameters

Width of Spread: 12.7618 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.6286 ft^2

Eo (Gutter Flow to Total Flow): 0.2838

Gutter Depth at Curb: 3.0628 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.3924 ft

Computed Width of Spread at Sag: 20.6063 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 5A-10

Notes: STA 4+74.27

Gutter Input Parameters

Longitudinal Slope of Road: 0.0050 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 1.3700 cfs

Gutter Result Parameters

Width of Spread: 9.0164 ft

Gutter Depression: 0.0000 in

Area of Flow: 0.8130 ft^2

Eo (Gutter Flow to Total Flow): 0.3848

Gutter Depth at Curb: 2.1639 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.2509 ft

Computed Width of Spread at Sag: 13.5292 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 6A-15

Notes: STA 5+65.44

Gutter Input Parameters

Longitudinal Slope of Road: 0.0050 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 6.0500 cfs

Gutter Result Parameters

Width of Spread: 15.7370 ft

Gutter Depression: 0.0000 in

Area of Flow: 2.4765 ft^2

Eo (Gutter Flow to Total Flow): 0.2347

Gutter Depth at Curb: 3.7769 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.6753 ft

Computed Width of Spread at Sag: 34.7511 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: LINE 6A-20

Notes: STA 6+49.98

Gutter Input Parameters

Longitudinal Slope of Road: 0.0030 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 2.6700 cfs

Gutter Result Parameters

Width of Spread: 12.7439 ft

Gutter Depression: 0.0000 in

Area of Flow: 1.6241 ft^2

Eo (Gutter Flow to Total Flow): 0.2842

Gutter Depth at Curb: 3.0585 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 50.0000 %

Inlet Type: Grate

Grate Type: P - 1-7/8 - 4

Grate Width: 1.9688 ft

Grate Length: 3.3300 ft

Local Depression: 4.0000 in

Inlet Result Parameters

Perimeter: 7.2675 ft

Effective Perimeter: 3.6338 ft

Area: 5.2448 ft^2

Effective Area: 2.6224 ft^2

Depth at center of grate: 0.3915 ft

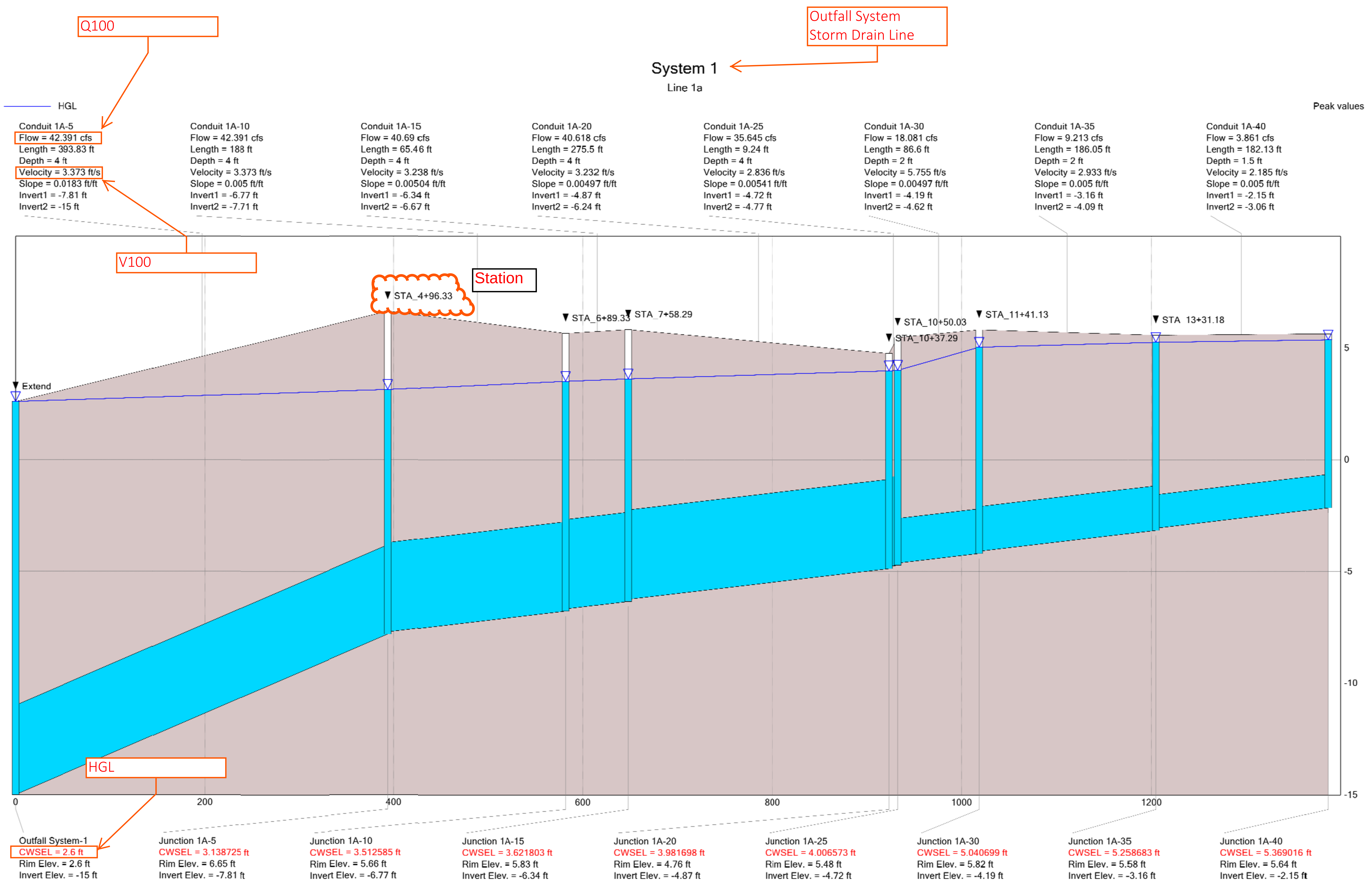
Computed Width of Spread at Sag: 20.5575 ft

Flow type: Weir Flow

Efficiency: 1.0000

APPENDIX E

SWMM Storm Drain HGL Profiles



Q100

Outfall System
Storm Drain Line

V100

Station

HGL

Conduit 1A-5
Flow = 42.391 cfs
Length = 393.83 ft
Depth = 4 ft
Velocity = 3.373 ft/s
Slope = 0.0183 ft/ft
Invert1 = -7.81 ft
Invert2 = -15 ft

Conduit 1A-10
Flow = 42.391 cfs
Length = 188 ft
Depth = 4 ft
Velocity = 3.373 ft/s
Slope = 0.005 ft/ft
Invert1 = -6.77 ft
Invert2 = -7.71 ft

Conduit 1A-15
Flow = 40.69 cfs
Length = 65.46 ft
Depth = 4 ft
Velocity = 3.238 ft/s
Slope = 0.00504 ft/ft
Invert1 = -6.34 ft
Invert2 = -6.67 ft

Conduit 1A-20
Flow = 40.618 cfs
Length = 275.5 ft
Depth = 4 ft
Velocity = 3.232 ft/s
Slope = 0.00497 ft/ft
Invert1 = -4.87 ft
Invert2 = -6.24 ft

Conduit 1A-25
Flow = 35.645 cfs
Length = 9.24 ft
Depth = 4 ft
Velocity = 2.836 ft/s
Slope = 0.00541 ft/ft
Invert1 = -4.72 ft
Invert2 = -4.77 ft

Conduit 1A-30
Flow = 18.081 cfs
Length = 86.6 ft
Depth = 2 ft
Velocity = 5.755 ft/s
Slope = 0.00497 ft/ft
Invert1 = -4.19 ft
Invert2 = -4.62 ft

Conduit 1A-35
Flow = 9.213 cfs
Length = 186.05 ft
Depth = 2 ft
Velocity = 2.933 ft/s
Slope = 0.005 ft/ft
Invert1 = -3.16 ft
Invert2 = -4.09 ft

Conduit 1A-40
Flow = 3.861 cfs
Length = 182.13 ft
Depth = 1.5 ft
Velocity = 2.185 ft/s
Slope = 0.005 ft/ft
Invert1 = -2.15 ft
Invert2 = -3.06 ft

Outfall System-1
CWSEL = 2.6 ft
Rim Elev. = 2.6 ft
Invert Elev. = -15 ft

Junction 1A-5
CWSEL = 3.138725 ft
Rim Elev. = 6.65 ft
Invert Elev. = -7.81 ft

Junction 1A-10
CWSEL = 3.512585 ft
Rim Elev. = 5.66 ft
Invert Elev. = -6.77 ft

Junction 1A-15
CWSEL = 3.621803 ft
Rim Elev. = 5.83 ft
Invert Elev. = -6.34 ft

Junction 1A-20
CWSEL = 3.981698 ft
Rim Elev. = 4.76 ft
Invert Elev. = -4.87 ft

Junction 1A-25
CWSEL = 4.006573 ft
Rim Elev. = 5.48 ft
Invert Elev. = -4.72 ft

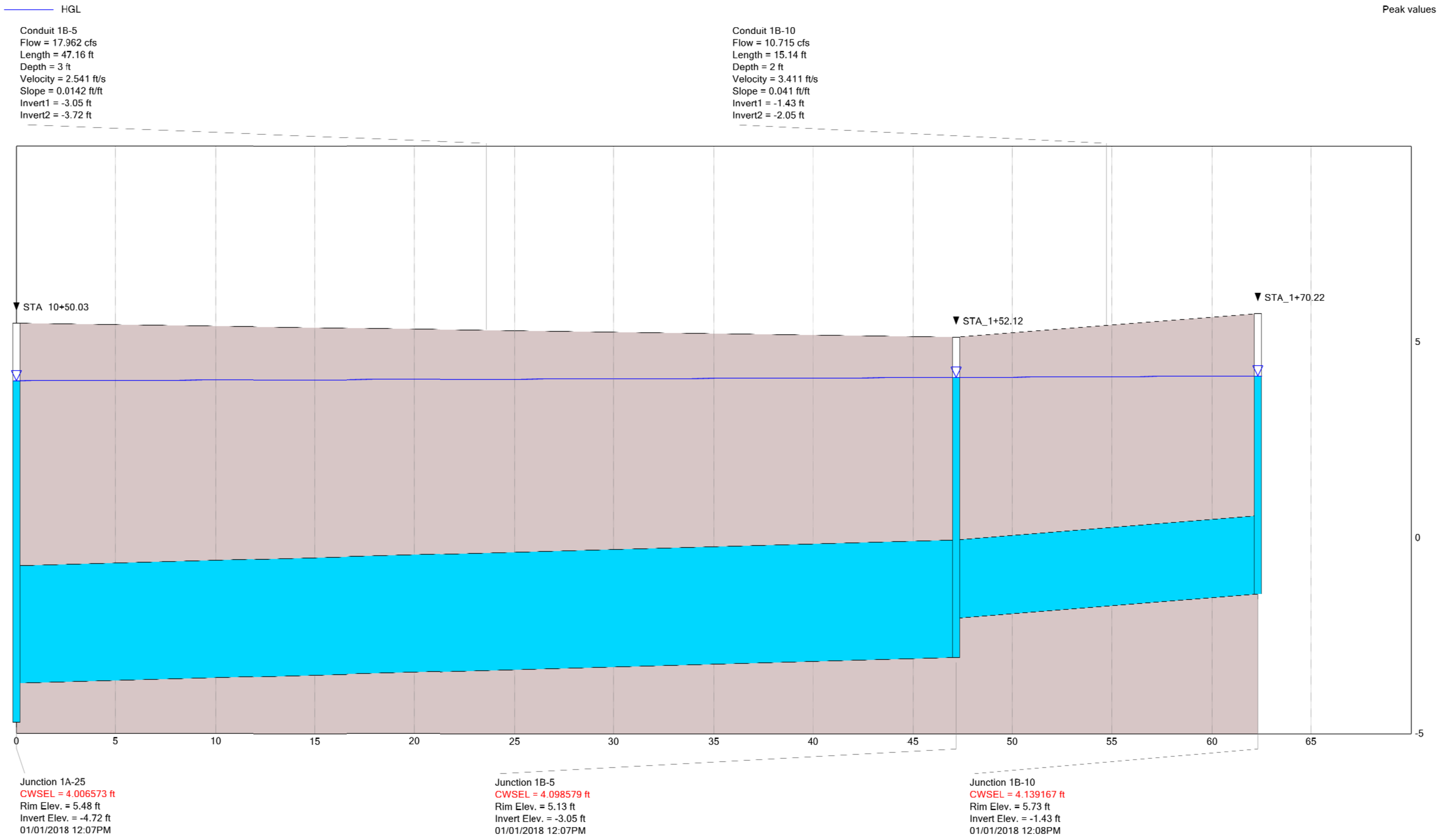
Junction 1A-30
CWSEL = 5.040699 ft
Rim Elev. = 5.82 ft
Invert Elev. = -4.19 ft

Junction 1A-35
CWSEL = 5.258683 ft
Rim Elev. = 5.58 ft
Invert Elev. = -3.16 ft

Junction 1A-40
CWSEL = 5.369016 ft
Rim Elev. = 5.64 ft
Invert Elev. = -2.15 ft

System 1

Line 1a



Conduit 1B-5
Flow = 17.962 cfs
Length = 47.16 ft
Depth = 3 ft
Velocity = 2.541 ft/s
Slope = 0.0142 ft/ft
Invert1 = -3.05 ft
Invert2 = -3.72 ft

Conduit 1B-10
Flow = 10.715 cfs
Length = 15.14 ft
Depth = 2 ft
Velocity = 3.411 ft/s
Slope = 0.041 ft/ft
Invert1 = -1.43 ft
Invert2 = -2.05 ft

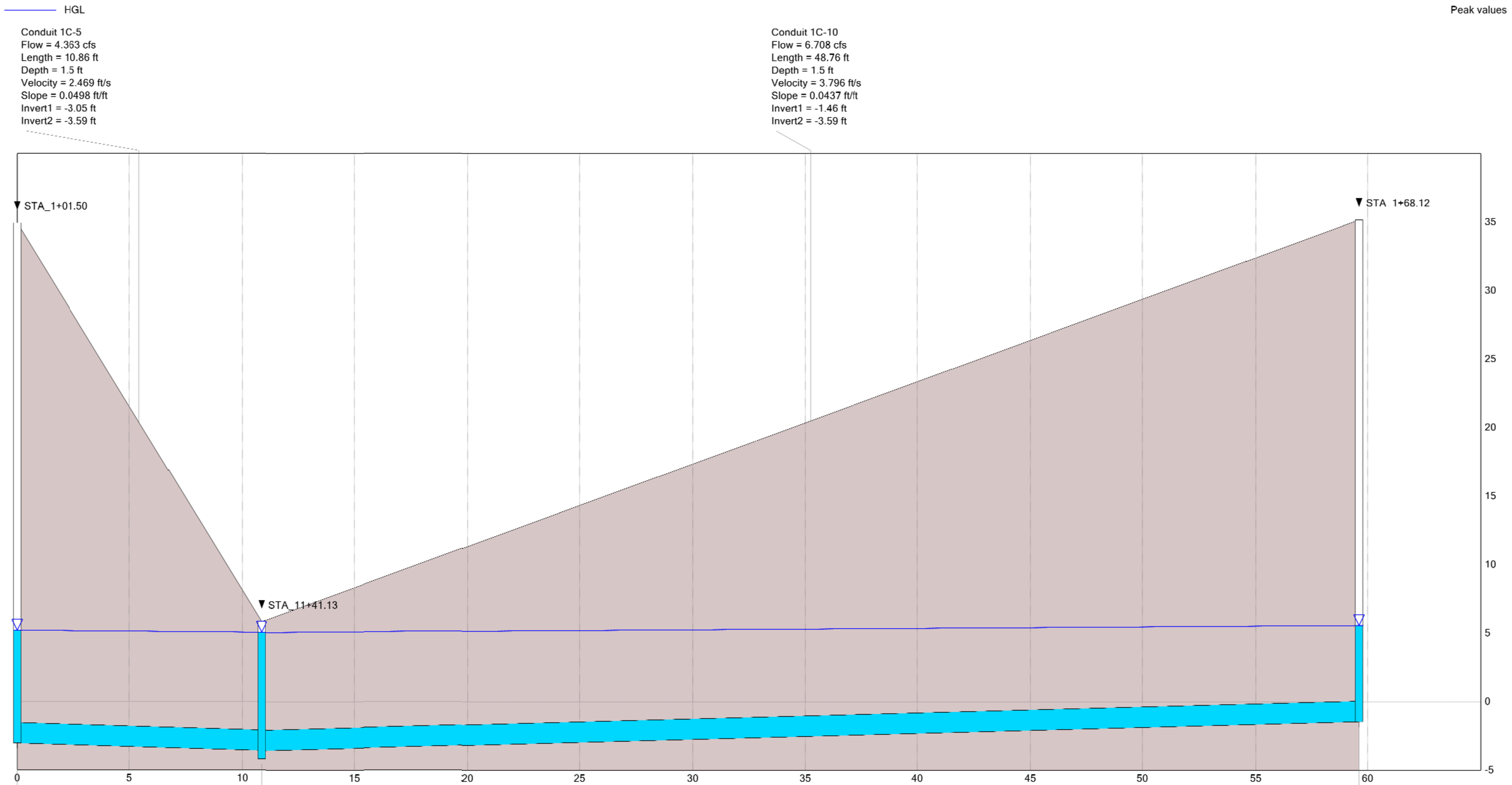
Junction 1A-25
CWSEL = 4.006573 ft
Rim Elev. = 5.48 ft
Invert Elev. = -4.72 ft
01/01/2018 12:07PM

Junction 1B-5
CWSEL = 4.098579 ft
Rim Elev. = 5.13 ft
Invert Elev. = -3.05 ft
01/01/2018 12:07PM

Junction 1B-10
CWSEL = 4.139167 ft
Rim Elev. = 5.73 ft
Invert Elev. = -1.43 ft
01/01/2018 12:08PM

System 1

Line 1c



Conduit 1C-5
Flow = 4.363 cfs
Length = 10.86 ft
Depth = 1.5 ft
Velocity = 2.469 ft/s
Slope = 0.0498 ft/ft
Invert1 = -3.05 ft
Invert2 = -3.59 ft

Conduit 1C-10
Flow = 6.708 cfs
Length = 48.76 ft
Depth = 1.5 ft
Velocity = 3.796 ft/s
Slope = 0.0437 ft/ft
Invert1 = -1.46 ft
Invert2 = -3.59 ft

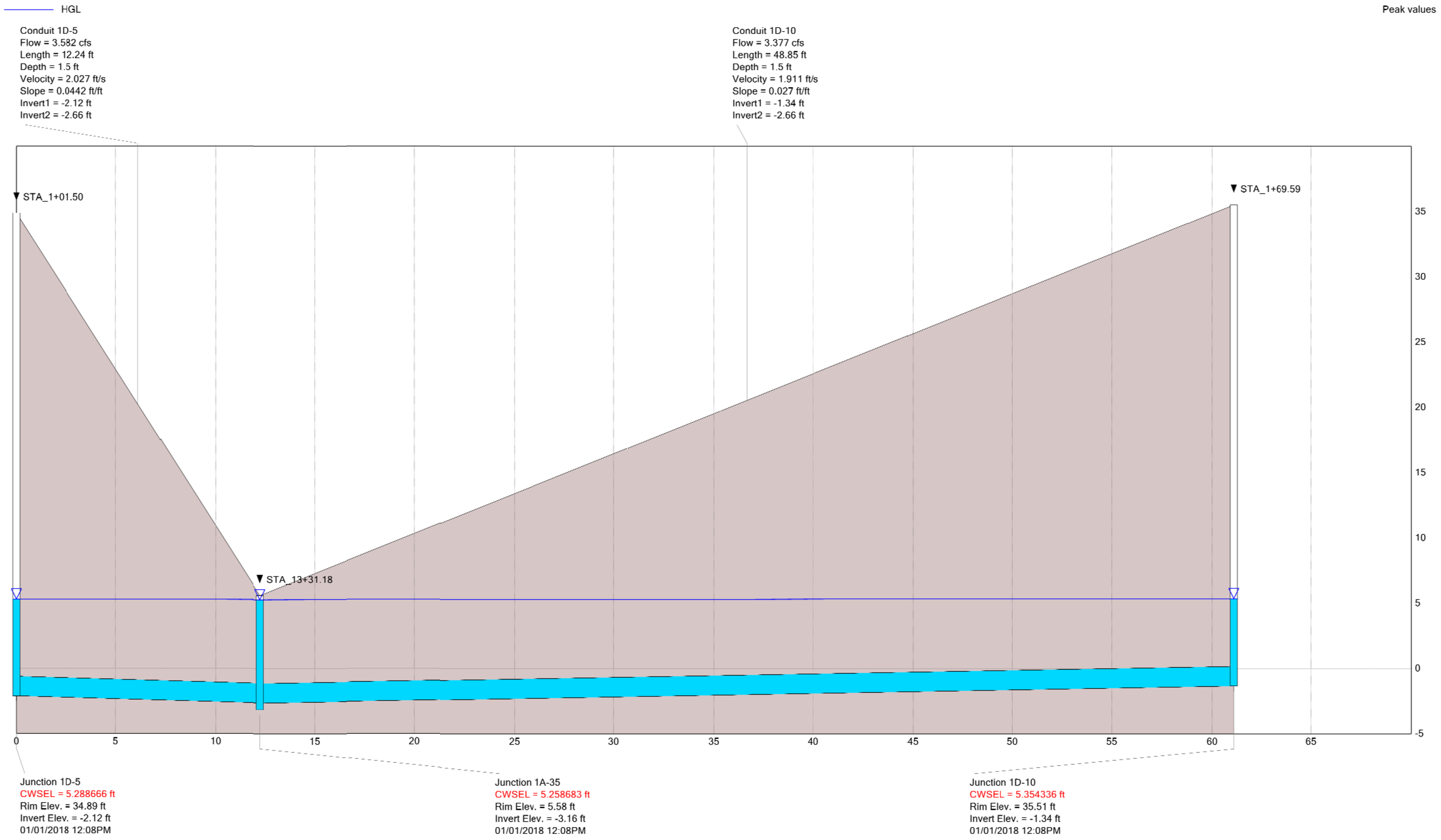
Junction 1C-5
CWSEL = 5.189662 ft
Rim Elev. = 34.94 ft
Invert Elev. = -3.05 ft
01/01/2018 12:06PM

Junction 1A-30
CWSEL = 5.040699 ft
Rim Elev. = 5.82 ft
Invert Elev. = -4.19 ft
01/01/2018 12:08PM

Junction 1C-10
CWSEL = 5.558212 ft
Rim Elev. = 35.17 ft
Invert Elev. = -1.46 ft
01/01/2018 12:06PM

System 1

Line 1d



Conduit 1D-5
Flow = 3.582 cfs
Length = 12.24 ft
Depth = 1.5 ft
Velocity = 2.027 ft/s
Slope = 0.0442 ft/ft
Invert1 = -2.12 ft
Invert2 = -2.66 ft

Conduit 1D-10
Flow = 3.377 cfs
Length = 48.85 ft
Depth = 1.5 ft
Velocity = 1.911 ft/s
Slope = 0.027 ft/ft
Invert1 = -1.34 ft
Invert2 = -2.66 ft

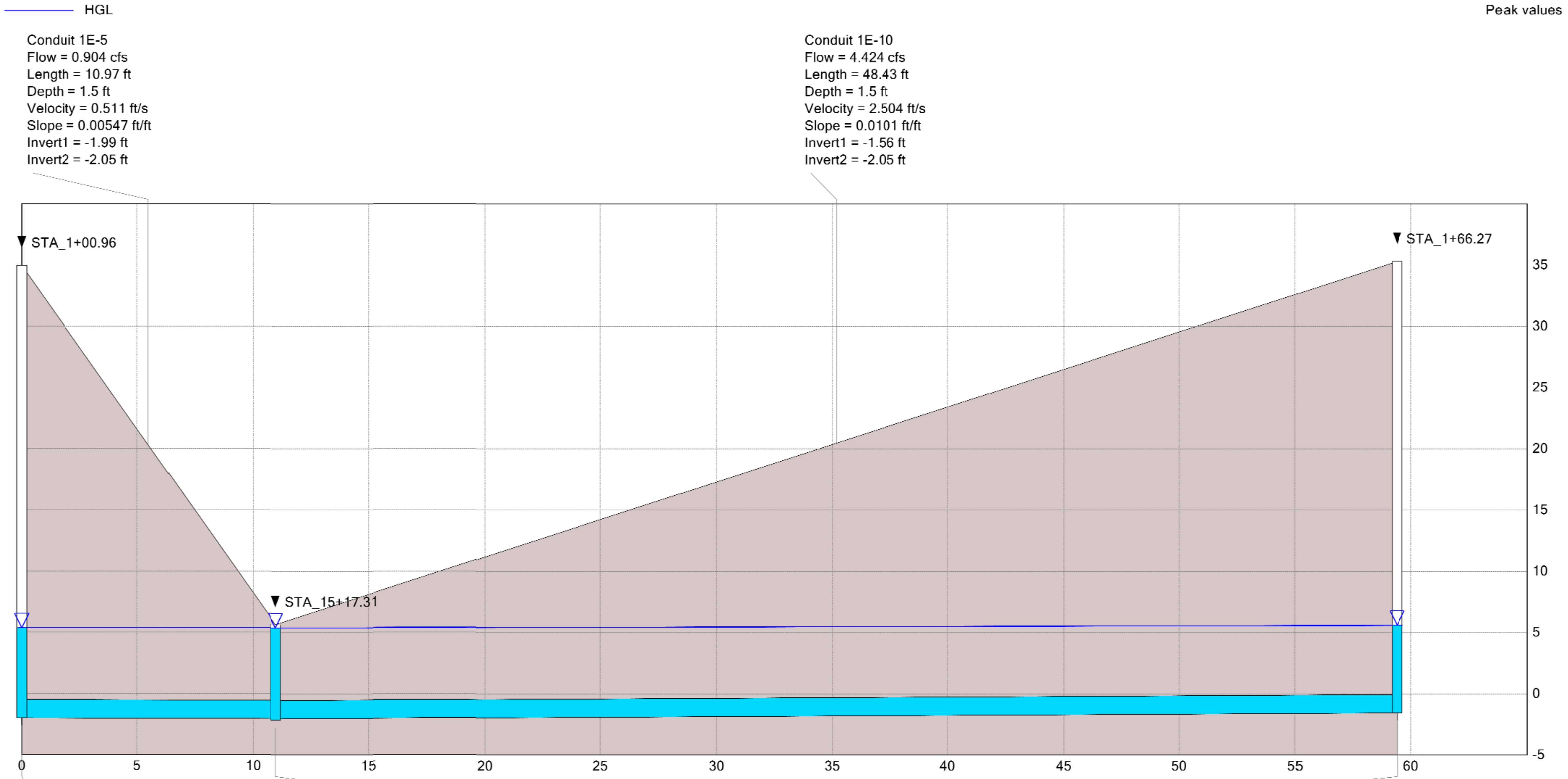
Junction 1D-5
CWSEL = 5.288666 ft
Rim Elev. = 34.89 ft
Invert Elev. = -2.12 ft
01/01/2018 12:08PM

Junction 1A-35
CWSEL = 5.258683 ft
Rim Elev. = 5.58 ft
Invert Elev. = -3.16 ft
01/01/2018 12:08PM

Junction 1D-10
CWSEL = 5.354336 ft
Rim Elev. = 35.51 ft
Invert Elev. = -1.34 ft
01/01/2018 12:08PM

System 1

Line 1e



Conduit 1E-5
Flow = 0.904 cfs
Length = 10.97 ft
Depth = 1.5 ft
Velocity = 0.511 ft/s
Slope = 0.00547 ft/ft
Invert1 = -1.99 ft
Invert2 = -2.05 ft

Conduit 1E-10
Flow = 4.424 cfs
Length = 48.43 ft
Depth = 1.5 ft
Velocity = 2.504 ft/s
Slope = 0.0101 ft/ft
Invert1 = -1.56 ft
Invert2 = -2.05 ft

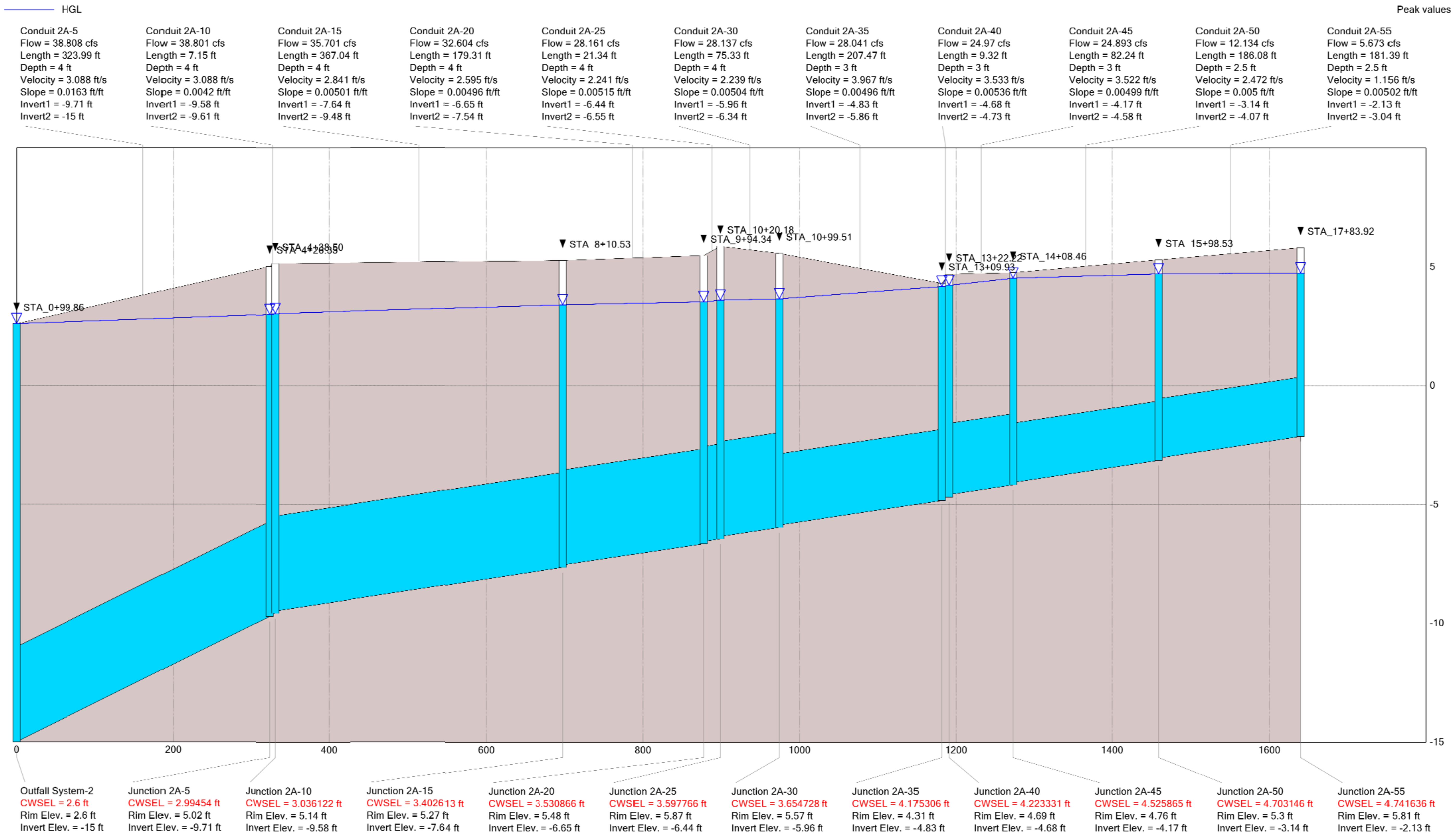
Junction 1E-5
CWSEL = 5.356262 ft
Rim Elev. = 34.96 ft
Invert Elev. = -1.99 ft
01/01/2018 12:07PM

Junction 1A-40
CWSEL = 5.369016 ft
Rim Elev. = 5.64 ft
Invert Elev. = -2.15 ft
01/01/2018 12:07PM

Junction 1E-10
CWSEL = 5.588904 ft
Rim Elev. = 35.3 ft
Invert Elev. = -1.56 ft
01/01/2018 12:06PM

System 2

Line 2a



System 2

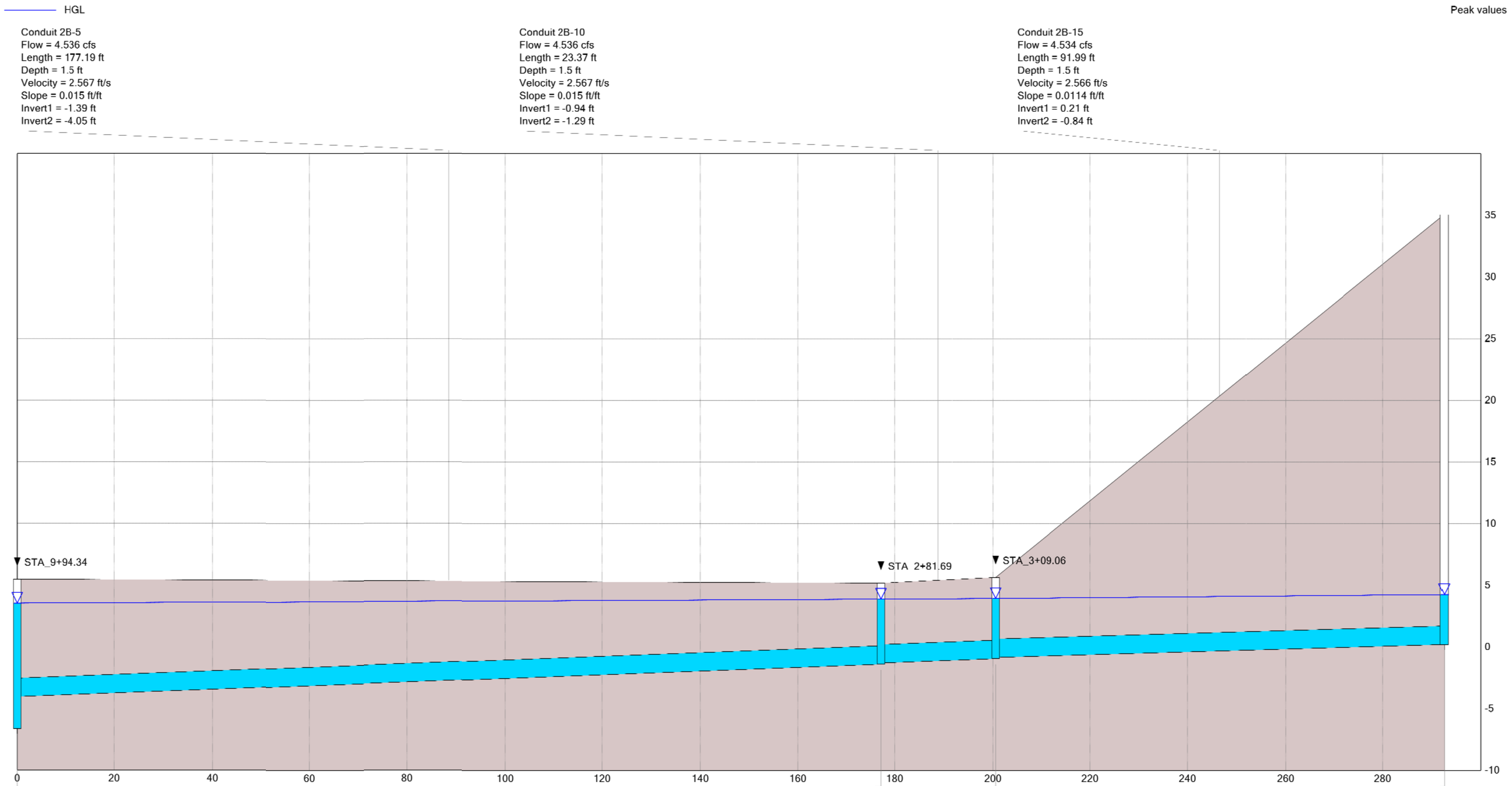
Line 2b

Peak values

Conduit 2B-5
Flow = 4.536 cfs
Length = 177.19 ft
Depth = 1.5 ft
Velocity = 2.567 ft/s
Slope = 0.015 ft/ft
Invert1 = -1.39 ft
Invert2 = -4.05 ft

Conduit 2B-10
Flow = 4.536 cfs
Length = 23.37 ft
Depth = 1.5 ft
Velocity = 2.567 ft/s
Slope = 0.015 ft/ft
Invert1 = -0.94 ft
Invert2 = -1.29 ft

Conduit 2B-15
Flow = 4.534 cfs
Length = 91.99 ft
Depth = 1.5 ft
Velocity = 2.566 ft/s
Slope = 0.0114 ft/ft
Invert1 = 0.21 ft
Invert2 = -0.84 ft



Junction 2A-20
CWSEL = 3.530866 ft
Rim Elev. = 5.48 ft
Invert Elev. = -6.65 ft
01/01/2018 12:07PM

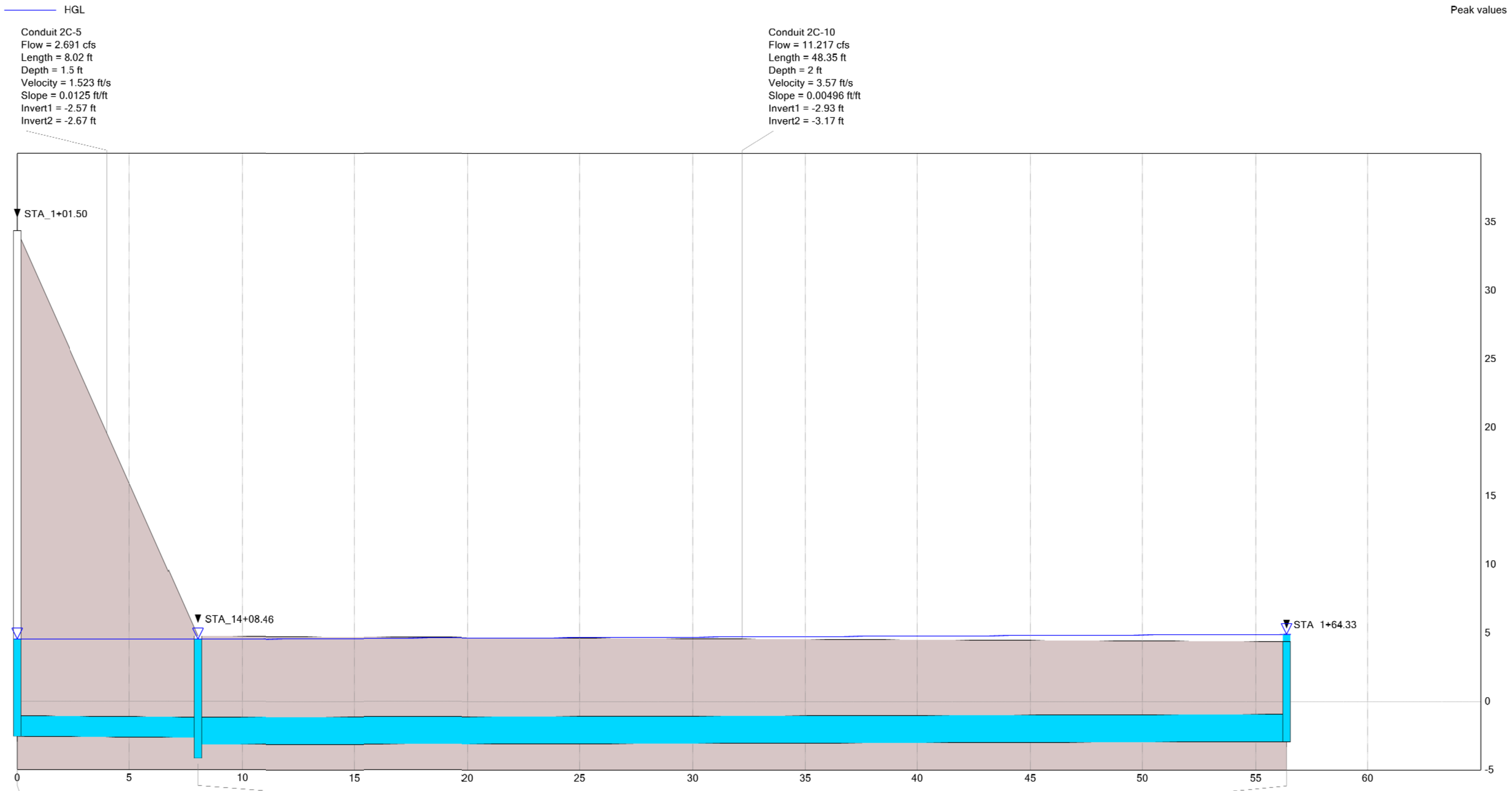
Junction 2B-5
CWSEL = 3.885794 ft
Rim Elev. = 5.19 ft
Invert Elev. = -1.39 ft
01/01/2018 12:06PM

Junction 2B-10
CWSEL = 3.932924 ft
Rim Elev. = 5.65 ft
Invert Elev. = -0.94 ft
01/01/2018 12:07PM

Junction 2B-15
CWSEL = 4.257563 ft
Rim Elev. = 35.05 ft
Invert Elev. = 0.21 ft
01/01/2018 12:07PM

System 2

Line 2c



Conduit 2C-5
Flow = 2.691 cfs
Length = 8.02 ft
Depth = 1.5 ft
Velocity = 1.523 ft/s
Slope = 0.0125 ft/ft
Invert1 = -2.57 ft
Invert2 = -2.67 ft

Conduit 2C-10
Flow = 11.217 cfs
Length = 48.35 ft
Depth = 2 ft
Velocity = 3.57 ft/s
Slope = 0.00496 ft/ft
Invert1 = -2.93 ft
Invert2 = -3.17 ft

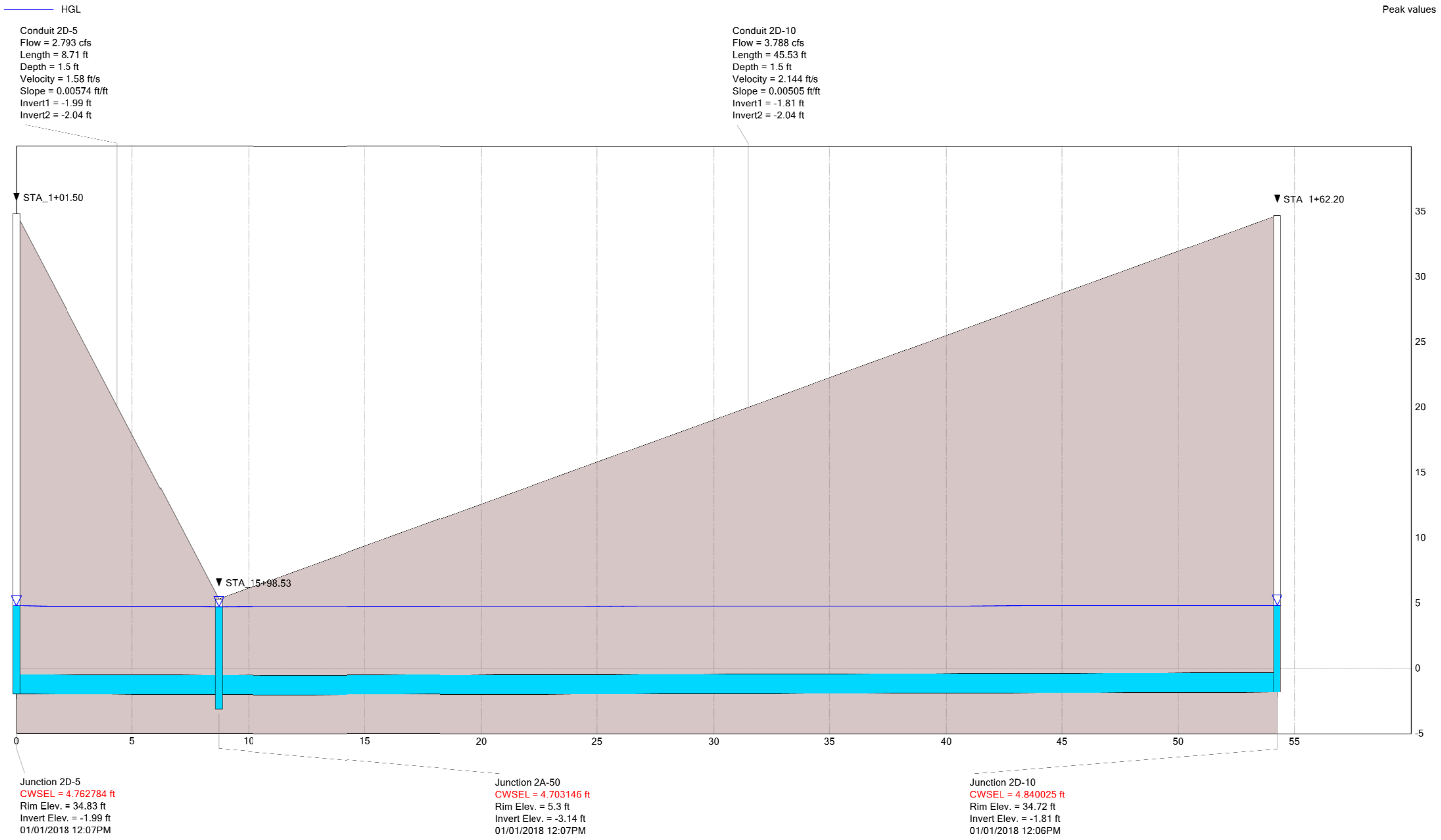
Junction 2C-5
CWSEL = 4.535108 ft
Rim Elev. = 34.36 ft
Invert Elev. = -2.57 ft
01/01/2018 12:07PM

Junction 2A-45
CWSEL = 4.525865 ft
Rim Elev. = 4.76 ft
Invert Elev. = -4.17 ft
01/01/2018 12:07PM

Junction 2C-10
CWSEL = 4.907903 ft
Rim Elev. = 4.38 ft
Invert Elev. = -2.93 ft
01/01/2018 12:07PM

System 2

Line 2d



Conduit 2D-5
Flow = 2.793 cfs
Length = 8.71 ft
Depth = 1.5 ft
Velocity = 1.58 ft/s
Slope = 0.00574 ft/ft
Invert1 = -1.99 ft
Invert2 = -2.04 ft

Conduit 2D-10
Flow = 3.788 cfs
Length = 45.53 ft
Depth = 1.5 ft
Velocity = 2.144 ft/s
Slope = 0.00505 ft/ft
Invert1 = -1.81 ft
Invert2 = -2.04 ft

Junction 2D-5
CWSEL = 4.762784 ft
Rim Elev. = 34.83 ft
Invert Elev. = -1.99 ft
01/01/2018 12:07PM

Junction 2A-50
CWSEL = 4.703146 ft
Rim Elev. = 5.3 ft
Invert Elev. = -3.14 ft
01/01/2018 12:07PM

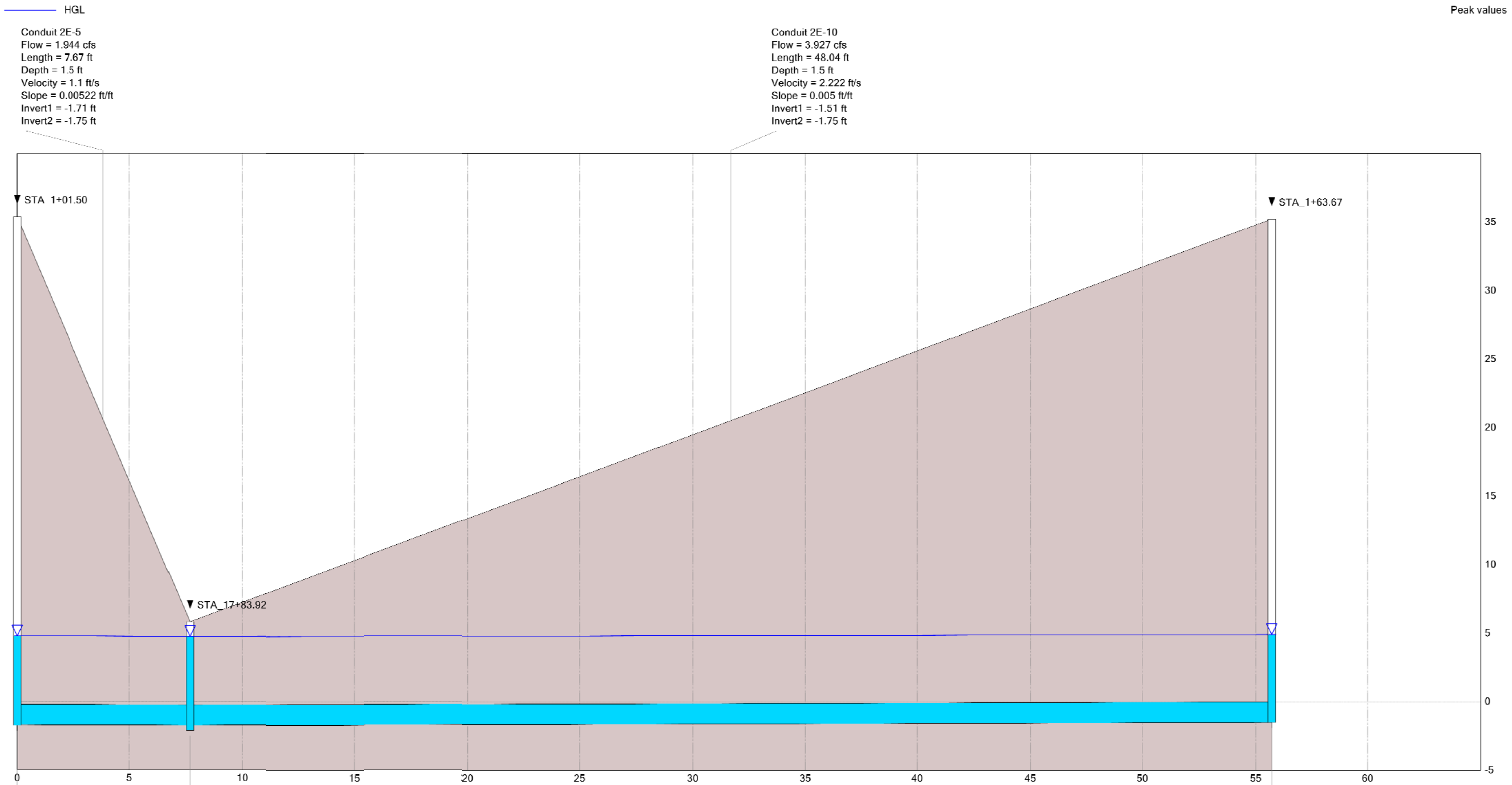
Junction 2D-10
CWSEL = 4.840025 ft
Rim Elev. = 34.72 ft
Invert Elev. = -1.81 ft
01/01/2018 12:06PM

System 2

Line 2e

Conduit 2E-5
Flow = 1.944 cfs
Length = 7.67 ft
Depth = 1.5 ft
Velocity = 1.1 ft/s
Slope = 0.00522 ft/ft
Invert1 = -1.71 ft
Invert2 = -1.75 ft

Conduit 2E-10
Flow = 3.927 cfs
Length = 48.04 ft
Depth = 1.5 ft
Velocity = 2.222 ft/s
Slope = 0.005 ft/ft
Invert1 = -1.51 ft
Invert2 = -1.75 ft



Junction 2E-5
CWSEL = 4.769848 ft
Rim Elev. = 35.38 ft
Invert Elev. = -1.75 ft
01/01/2018 12:07PM

Junction 2A-55
CWSEL = 4.741636 ft
Rim Elev. = 5.81 ft
Invert Elev. = -2.13 ft
01/01/2018 12:07PM

Junction 2E-10
CWSEL = 4.903817 ft
Rim Elev. = 35.23 ft
Invert Elev. = -1.51 ft
01/01/2018 12:06PM

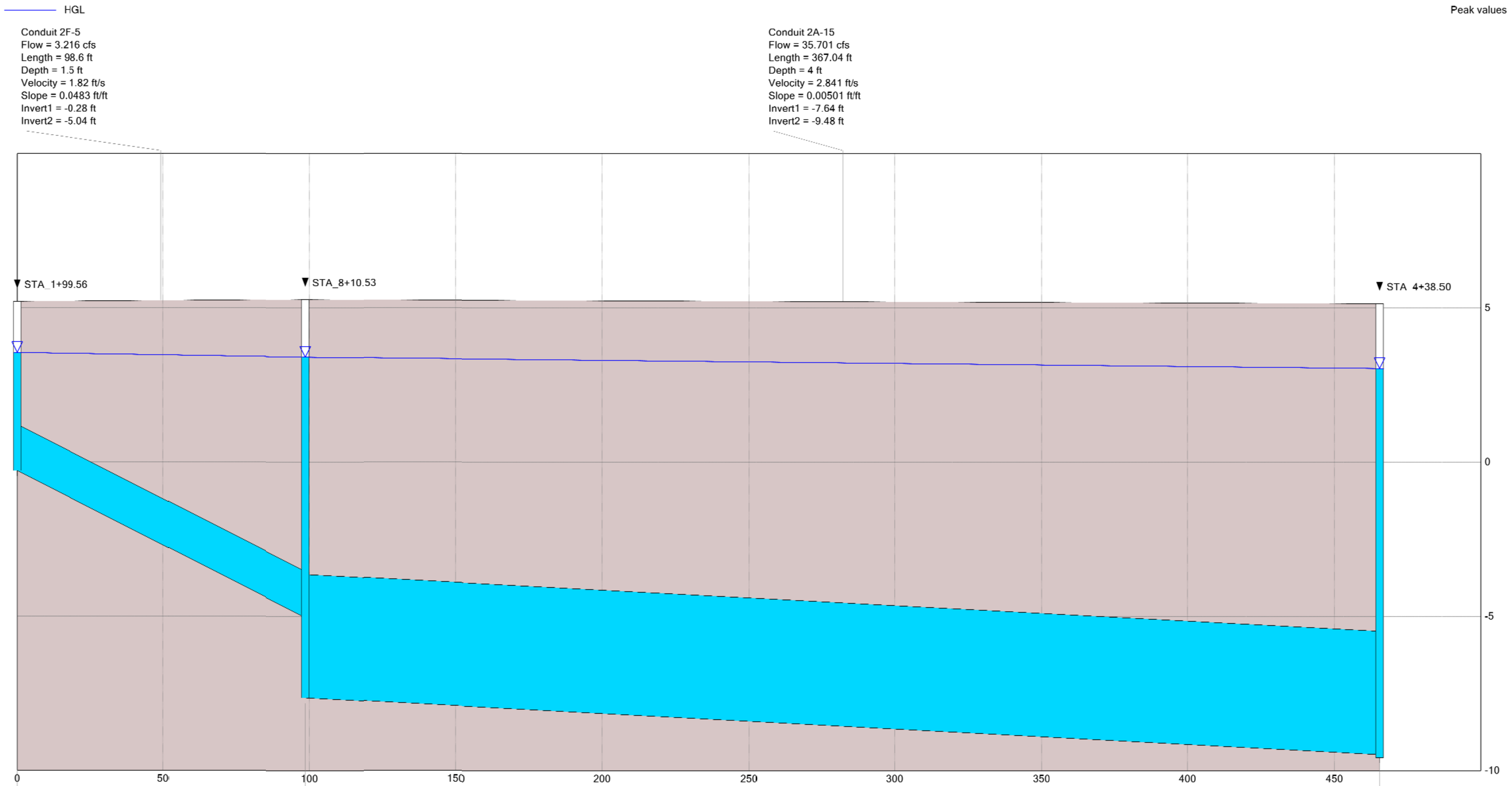
System 2

Line 2f

Peak values

Conduit 2F-5
Flow = 3.216 cfs
Length = 98.6 ft
Depth = 1.5 ft
Velocity = 1.82 ft/s
Slope = 0.0483 ft/ft
Invert1 = -0.28 ft
Invert2 = -5.04 ft

Conduit 2A-15
Flow = 35.701 cfs
Length = 367.04 ft
Depth = 4 ft
Velocity = 2.841 ft/s
Slope = 0.00501 ft/ft
Invert1 = -7.64 ft
Invert2 = -9.48 ft



Junction 2F-5
CWSEL = 3.550509 ft
Rim Elev. = 5.21 ft
Invert Elev. = -0.28 ft
01/01/2018 12:06PM

Junction 2A-15
CWSEL = 3.402613 ft
Rim Elev. = 5.27 ft
Invert Elev. = -7.64 ft
01/01/2018 12:07PM

Junction 2A-10
CWSEL = 3.036122 ft
Rim Elev. = 5.14 ft
Invert Elev. = -9.58 ft
01/01/2018 12:06PM

System 2

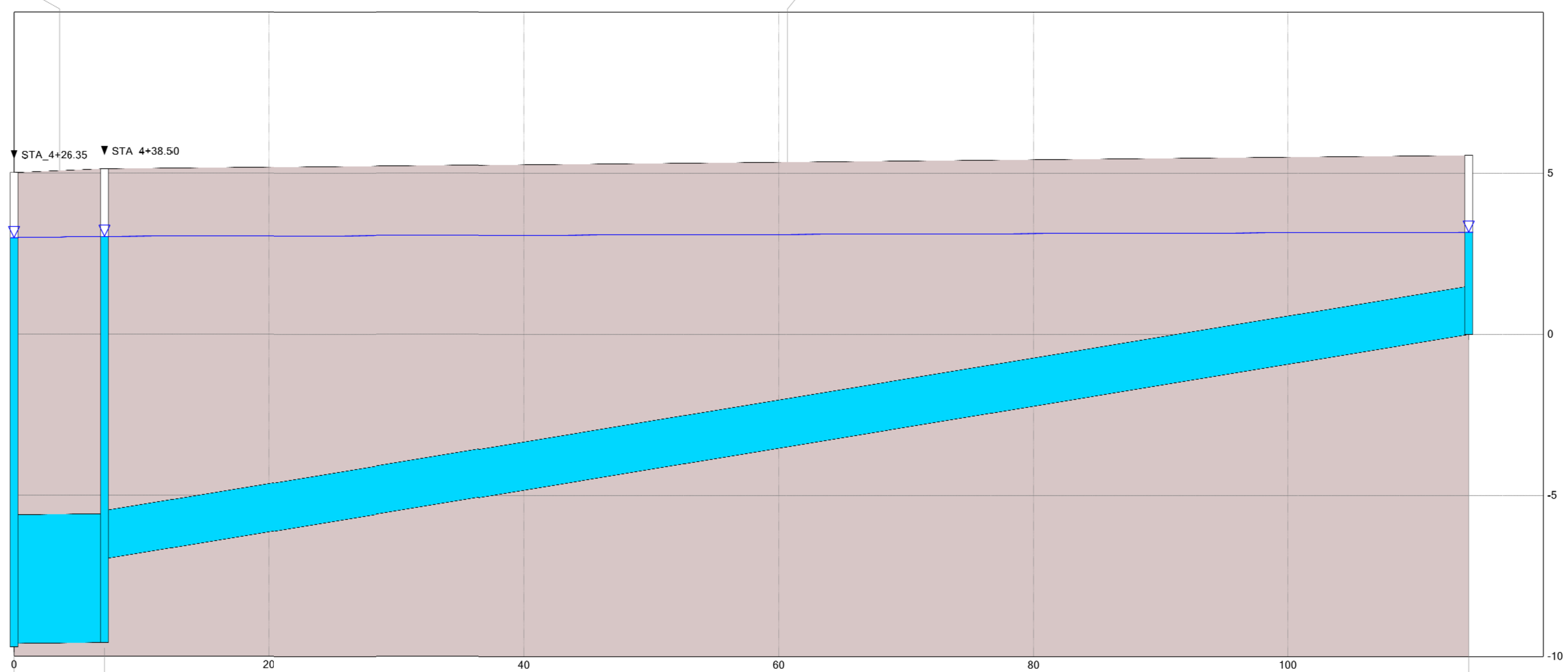
Line 2g

HGL

Peak values

Conduit 2A-10
Flow = 38.801 cfs
Length = 7.15 ft
Depth = 4 ft
Velocity = 3.088 ft/s
Slope = 0.0042 ft/ft
Invert1 = -9.58 ft
Invert2 = -9.61 ft

Conduit 2G-5
Flow = 6.056 cfs
Length = 107.05 ft
Depth = 1.5 ft
Velocity = 4.42 ft/s
Slope = 0.0653 ft/ft
Invert1 = 0 ft
Invert2 = -6.98 ft



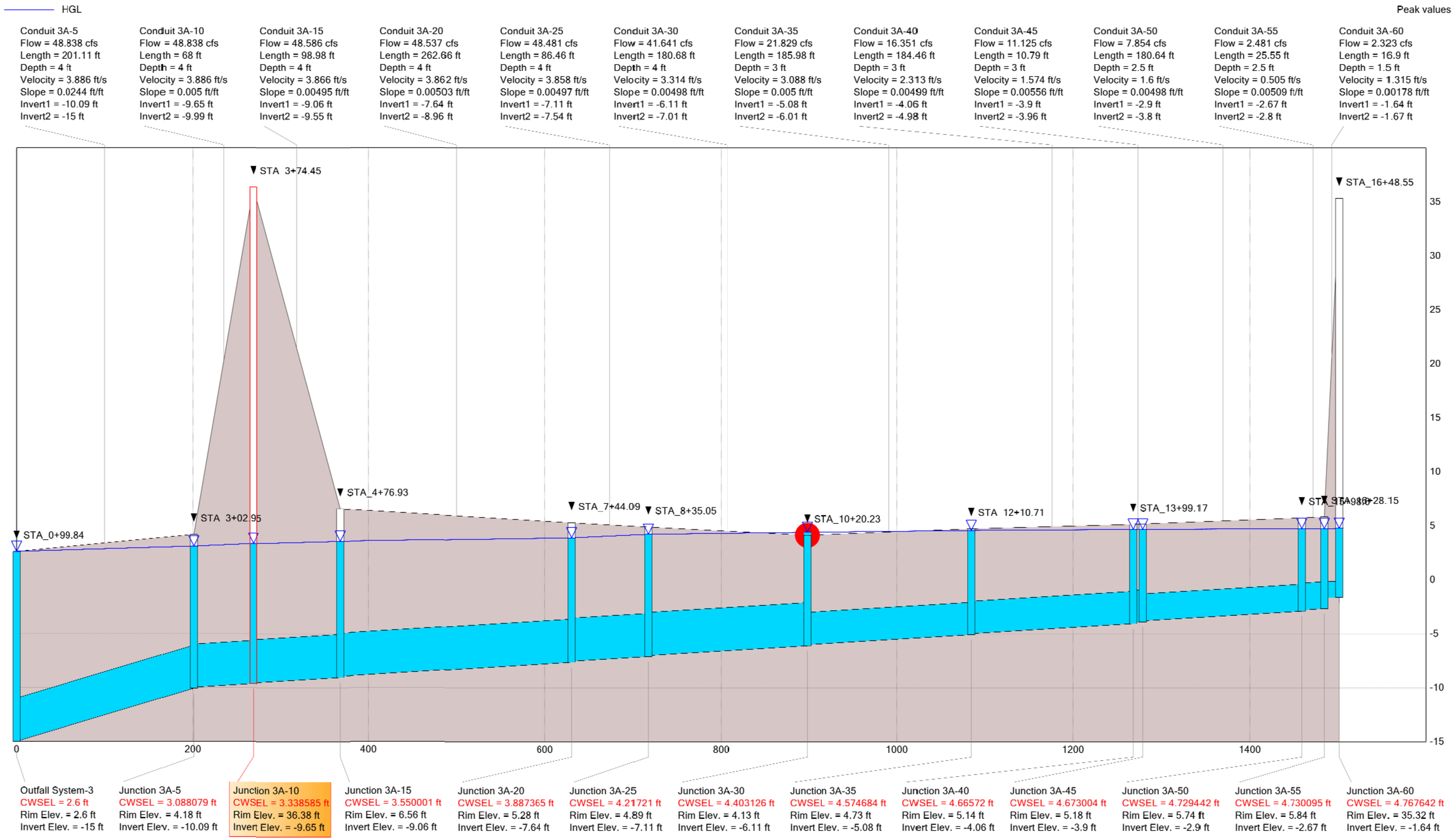
Junction 2A-5
CWSEL = 2.99454 ft
Rim Elev. = 5.02 ft
Invert Elev. = -9.71 ft
01/01/2018 12:06PM

Junction 2A-10
CWSEL = 3.036122 ft
Rim Elev. = 5.14 ft
Invert Elev. = -9.58 ft
01/01/2018 12:06PM

Junction 2G-5
CWSEL = 3.173209 ft
Rim Elev. = 5.56 ft
Invert Elev. = 0 ft
01/01/2018 12:06PM

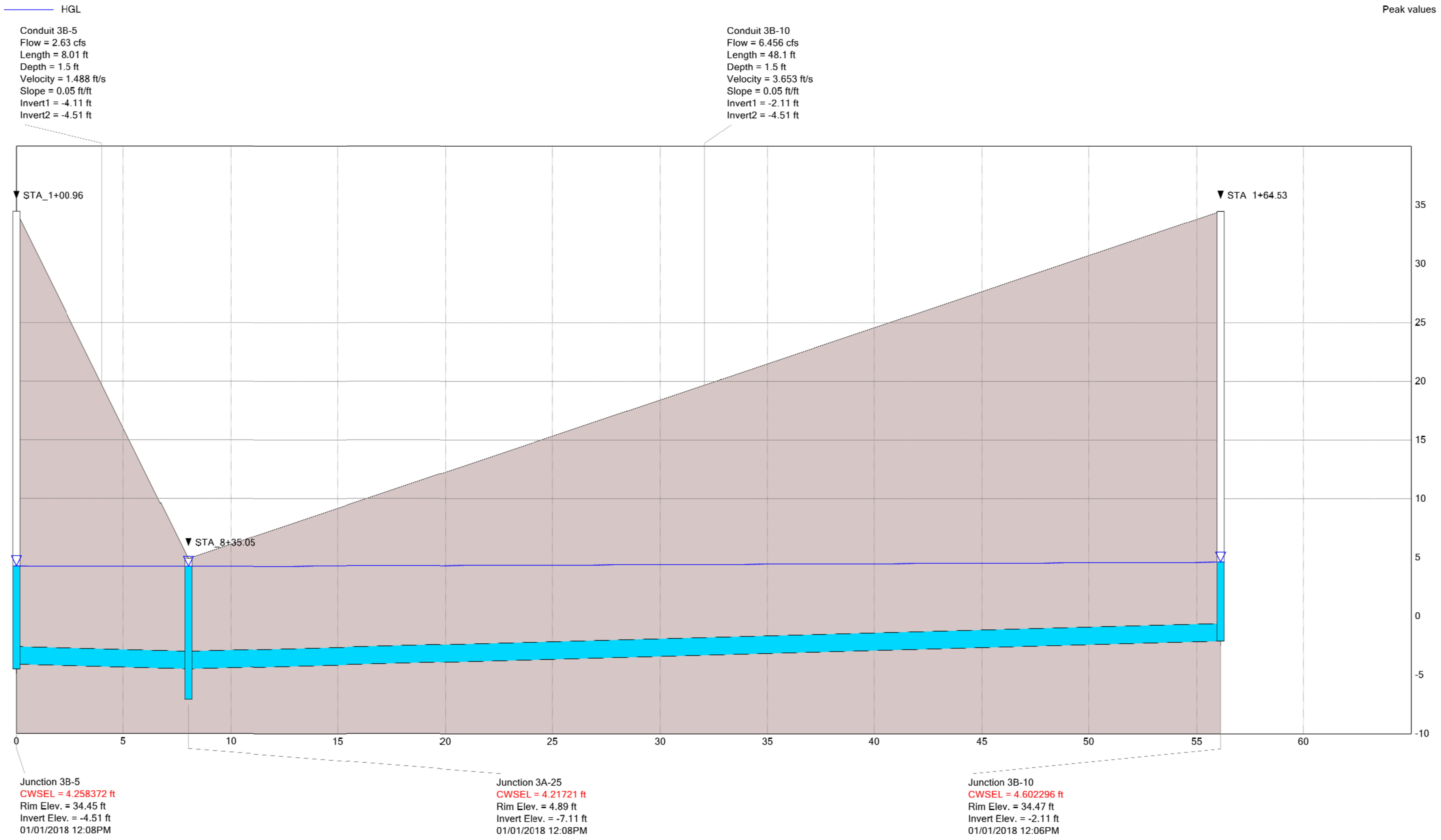
System 3

Line 3a



System 3

Line 3b



Conduit 3B-5
Flow = 2.63 cfs
Length = 8.01 ft
Depth = 1.5 ft
Velocity = 1.488 ft/s
Slope = 0.05 ft/ft
Invert1 = -4.11 ft
Invert2 = -4.51 ft

Conduit 3B-10
Flow = 6.456 cfs
Length = 48.1 ft
Depth = 1.5 ft
Velocity = 3.653 ft/s
Slope = 0.05 ft/ft
Invert1 = -2.11 ft
Invert2 = -4.51 ft

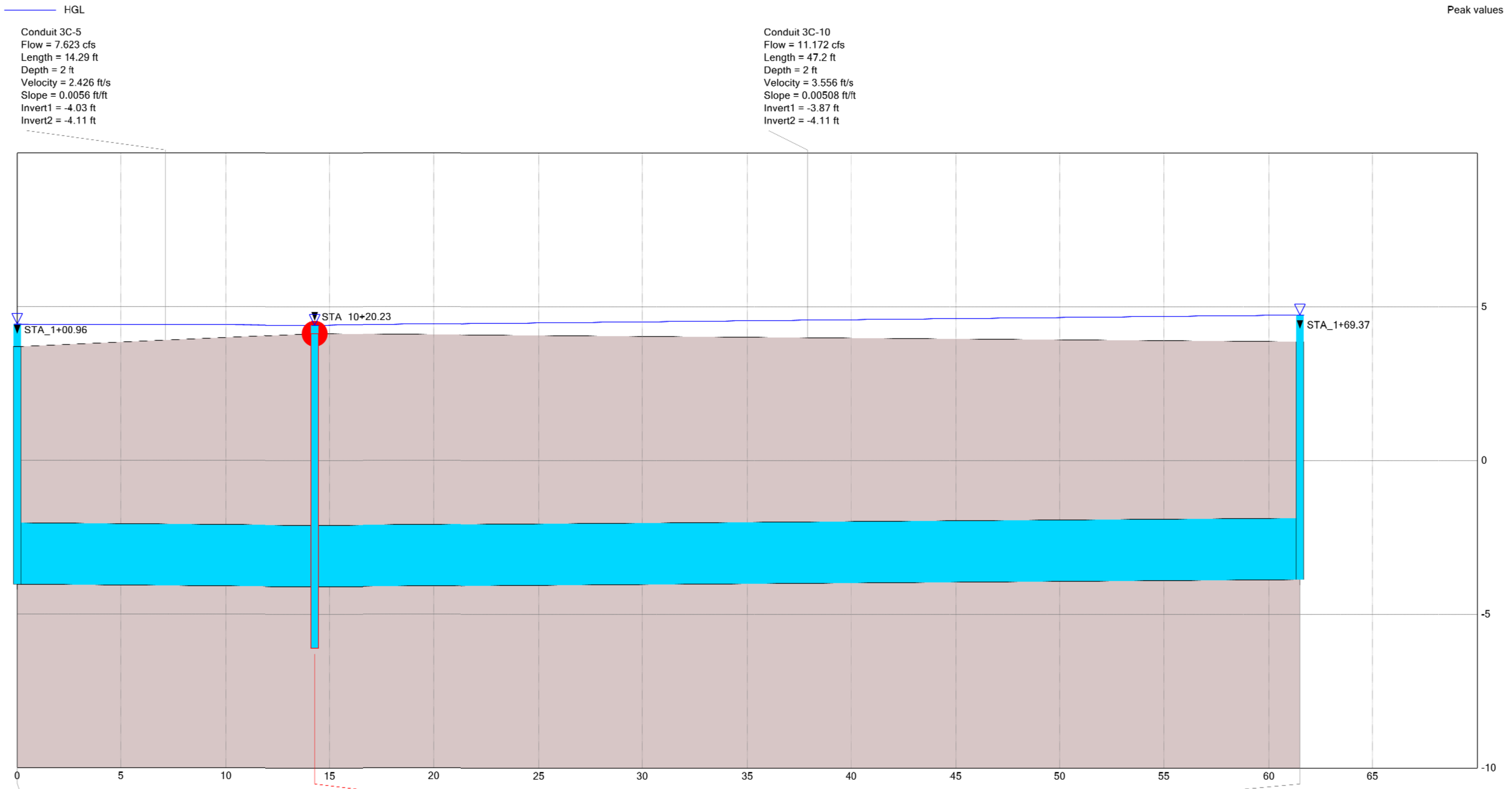
Junction 3B-5
CWSEL = 4.258372 ft
Rim Elev. = 34.45 ft
Invert Elev. = -4.51 ft
01/01/2018 12:08PM

Junction 3A-25
CWSEL = 4.21721 ft
Rim Elev. = 4.89 ft
Invert Elev. = -7.11 ft
01/01/2018 12:08PM

Junction 3B-10
CWSEL = 4.602296 ft
Rim Elev. = 34.47 ft
Invert Elev. = -2.11 ft
01/01/2018 12:06PM

System 3

Line 3c



Conduit 3C-5
Flow = 7.623 cfs
Length = 14.29 ft
Depth = 2 ft
Velocity = 2.426 ft/s
Slope = 0.0056 ft/ft
Invert1 = -4.03 ft
Invert2 = -4.11 ft

Conduit 3C-10
Flow = 11.172 cfs
Length = 47.2 ft
Depth = 2 ft
Velocity = 3.556 ft/s
Slope = 0.00508 ft/ft
Invert1 = -3.87 ft
Invert2 = -4.11 ft

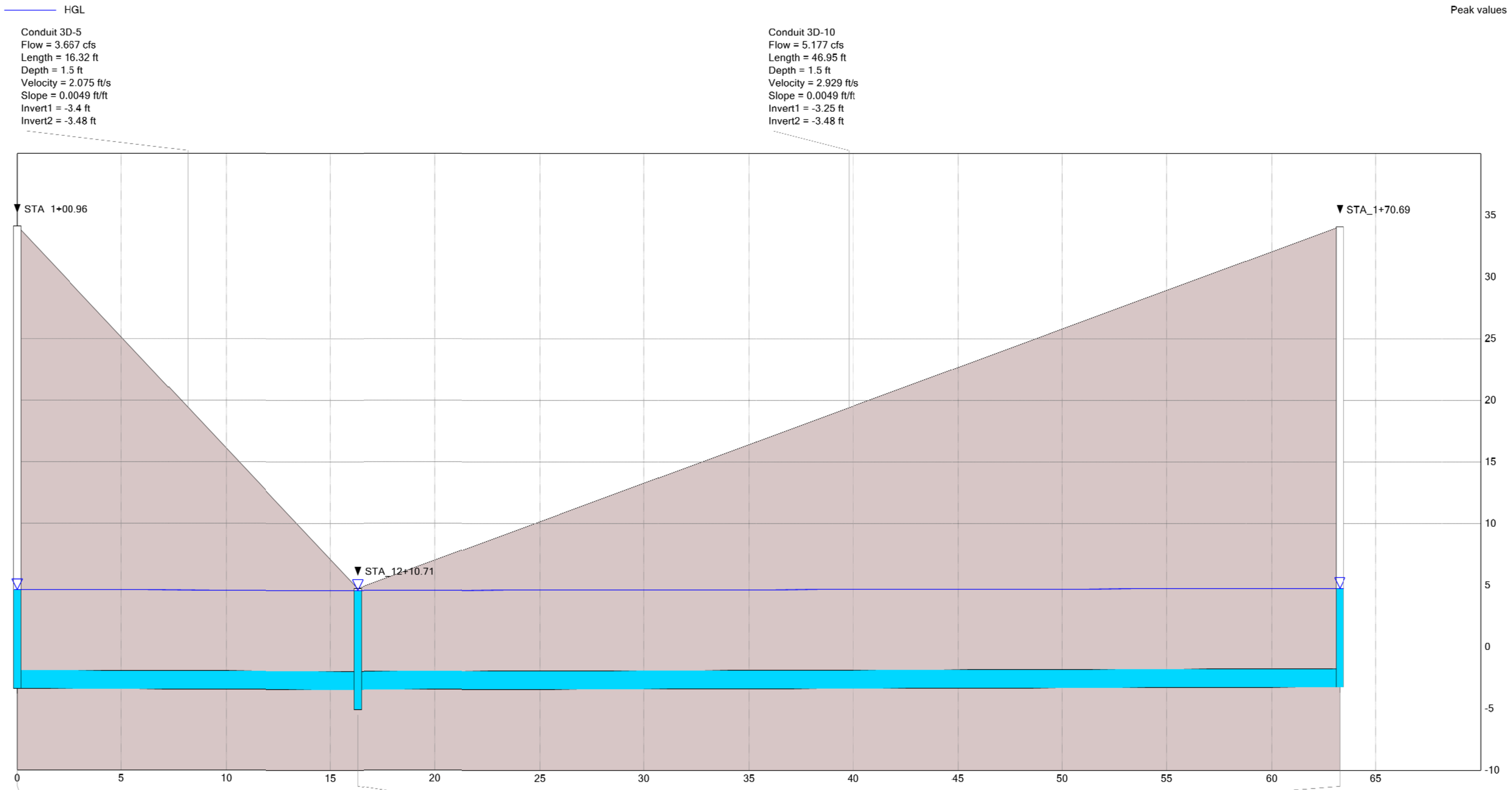
Junction 3C-5
CWSEL = 4.430999 ft
Rim Elev. = 3.7 ft
Invert Elev. = -4.03 ft
01/01/2018 12:08PM

Junction 3A-30
CWSEL = 4.403126 ft
Rim Elev. = 4.13 ft
Invert Elev. = -6.11 ft
01/01/2018 12:08PM

Junction 3C-10
CWSEL = 4.73566 ft
Rim Elev. = 3.87 ft
Invert Elev. = -3.87 ft
01/01/2018 12:09PM

System 3

Line 3d



Conduit 3D-5
Flow = 3.657 cfs
Length = 16.32 ft
Depth = 1.5 ft
Velocity = 2.075 ft/s
Slope = 0.0049 ft/ft
Invert1 = -3.4 ft
Invert2 = -3.48 ft

Conduit 3D-10
Flow = 5.177 cfs
Length = 46.95 ft
Depth = 1.5 ft
Velocity = 2.929 ft/s
Slope = 0.0049 ft/ft
Invert1 = -3.25 ft
Invert2 = -3.48 ft

Junction 3D-5
CWSEL = 4.613481 ft
Rim Elev. = 34.13 ft
Invert Elev. = -3.4 ft
01/01/2018 12:07PM

Junction 3A-35
CWSEL = 4.574684 ft
Rim Elev. = 4.73 ft
Invert Elev. = -5.08 ft
01/01/2018 12:08PM

Junction 3D-10
CWSEL = 4.751953 ft
Rim Elev. = 34.09 ft
Invert Elev. = -3.25 ft
01/01/2018 12:10PM

System 3

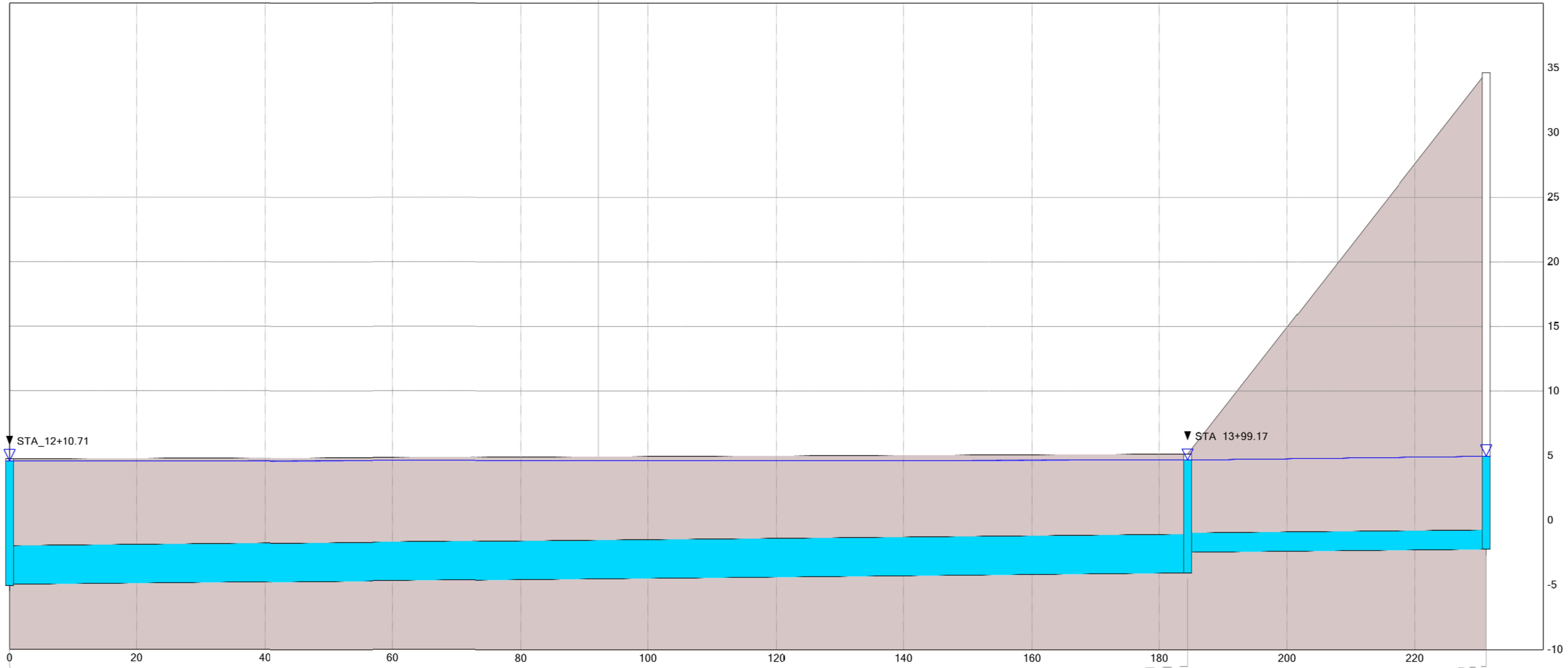
Line 3e

HGL

Peak values

Conduit 3A-40
Flow = 16.351 cfs
Length = 184.46 ft
Depth = 3 ft
Velocity = 2.313 ft/s
Slope = 0.00499 ft/ft
Invert1 = -4.06 ft
Invert2 = -4.98 ft

Conduit 3E-5
Flow = 5.433 cfs
Length = 46.71 ft
Depth = 1.5 ft
Velocity = 3.074 ft/s
Slope = 0.00492 ft/ft
Invert1 = -2.23 ft
Invert2 = -2.46 ft



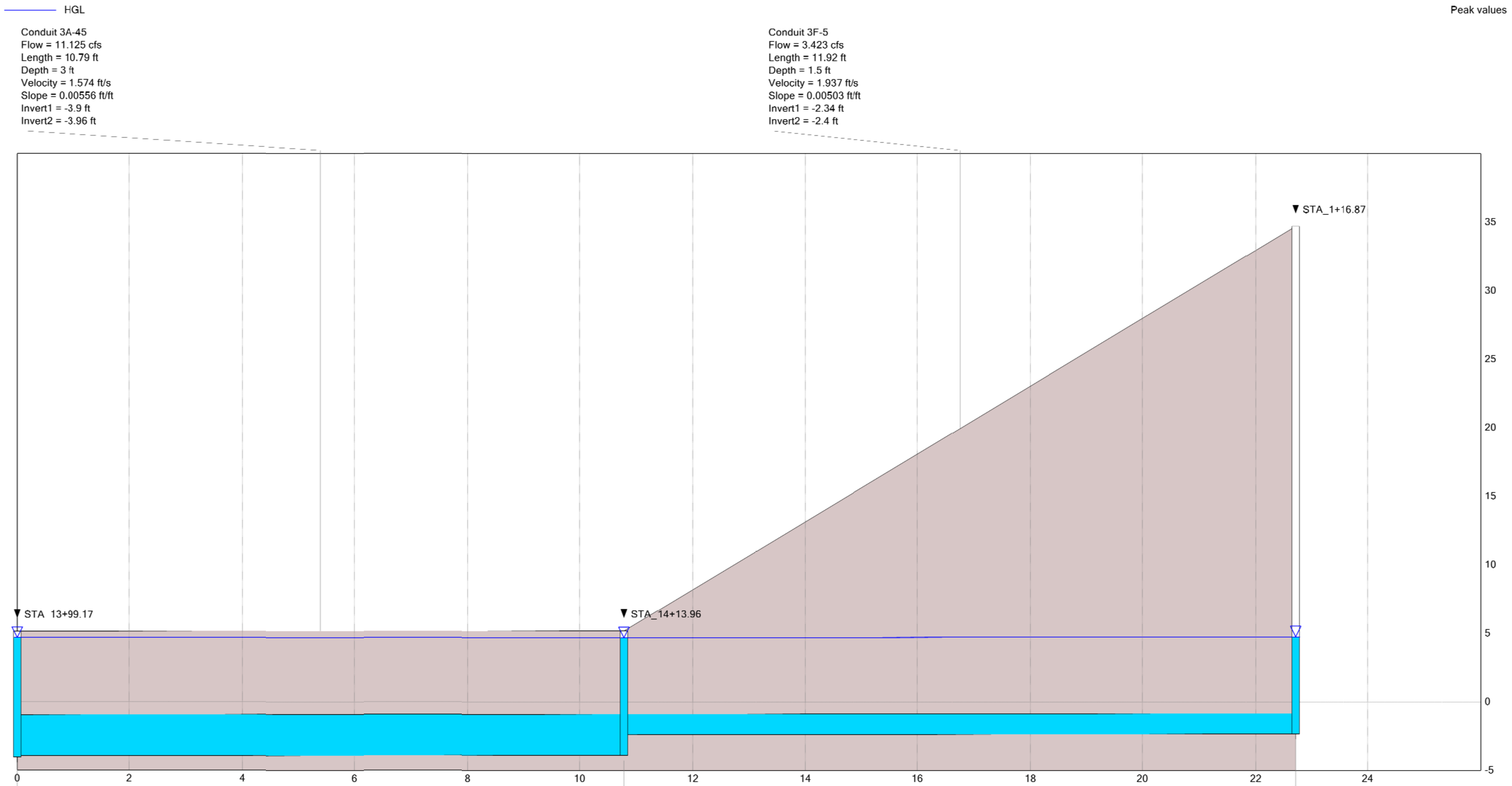
Junction 3A-35
CWSEL = 4.574684 ft
Rim Elev. = 4.73 ft
Invert Elev. = -5.08 ft
01/01/2018 12:08PM

Junction 3A-40
CWSEL = 4.66572 ft
Rim Elev. = 5.14 ft
Invert Elev. = -4.06 ft
01/01/2018 12:08PM

Junction 3E-5
CWSEL = 4.961674 ft
Rim Elev. = 34.65 ft
Invert Elev. = -2.23 ft
01/01/2018 12:06PM

System 3

Line 3f



Conduit 3A-45
Flow = 11.125 cfs
Length = 10.79 ft
Depth = 3 ft
Velocity = 1.574 ft/s
Slope = 0.00556 ft/ft
Invert1 = -3.9 ft
Invert2 = -3.96 ft

Conduit 3F-5
Flow = 3.423 cfs
Length = 11.92 ft
Depth = 1.5 ft
Velocity = 1.937 ft/s
Slope = 0.00503 ft/ft
Invert1 = -2.34 ft
Invert2 = -2.4 ft

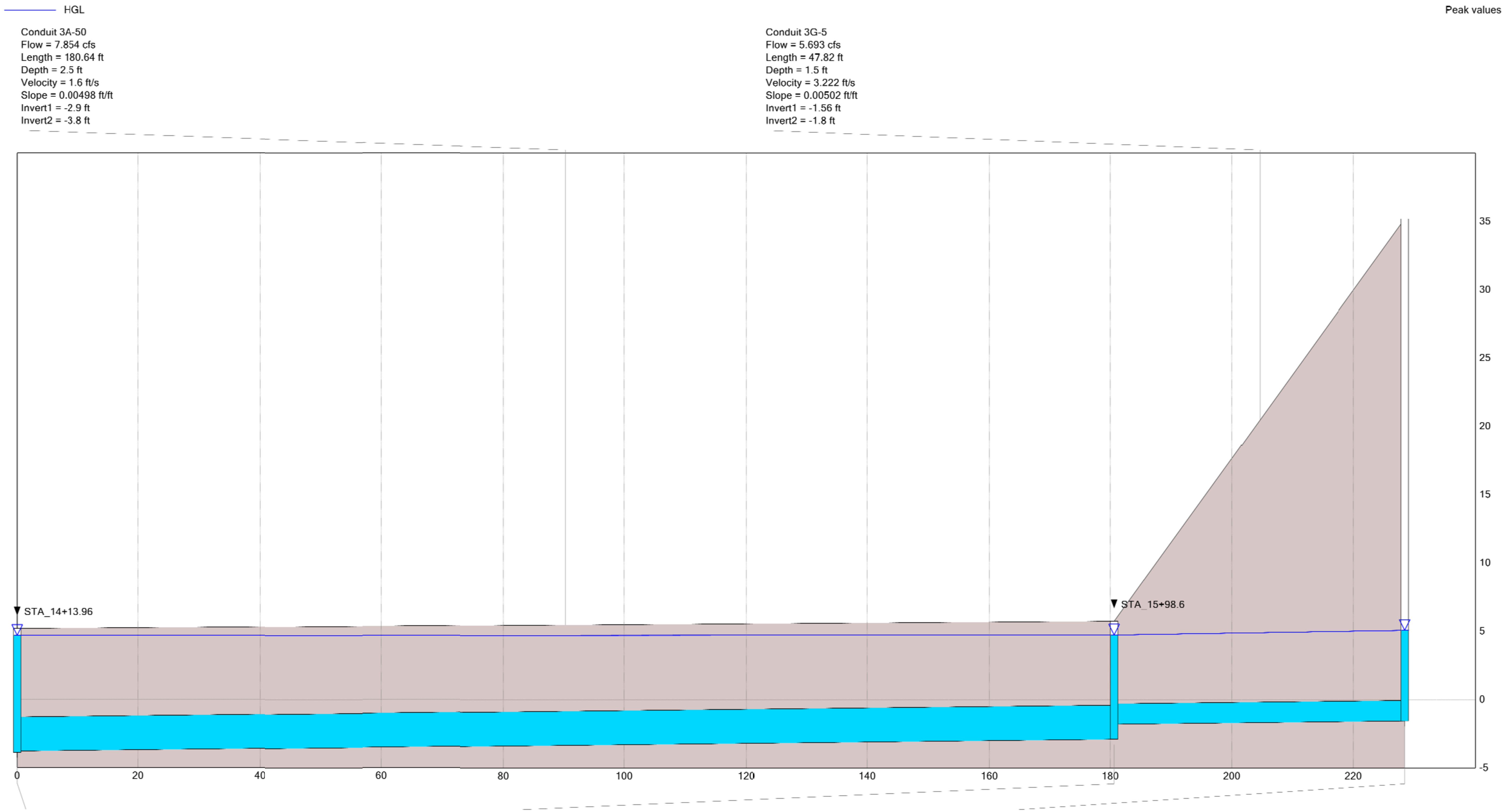
Junction 3A-40
CWSEL = 4.66572 ft
Rim Elev. = 5.14 ft
Invert Elev. = -4.06 ft
01/01/2018 12:08PM

Junction 3A-45
CWSEL = 4.673004 ft
Rim Elev. = 5.18 ft
Invert Elev. = -3.9 ft
01/01/2018 12:08PM

Junction 3F-5
CWSEL = 4.748382 ft
Rim Elev. = 34.7 ft
Invert Elev. = -2.34 ft
01/01/2018 12:07PM

System 3

Line 3g



Conduit 3A-50
Flow = 7.854 cfs
Length = 180.64 ft
Depth = 2.5 ft
Velocity = 1.6 ft/s
Slope = 0.00498 ft/ft
Invert1 = -2.9 ft
Invert2 = -3.8 ft

Conduit 3G-5
Flow = 5.693 cfs
Length = 47.82 ft
Depth = 1.5 ft
Velocity = 3.222 ft/s
Slope = 0.00502 ft/ft
Invert1 = -1.56 ft
Invert2 = -1.8 ft

Junction 3A-45
CWSEL = 4.673004 ft
Rim Elev. = 5.18 ft
Invert Elev. = -3.9 ft
01/01/2018 12:08PM

Junction 3A-50
CWSEL = 4.729442 ft
Rim Elev. = 5.74 ft
Invert Elev. = -2.9 ft
01/01/2018 12:07PM

Junction 3G-5
CWSEL = 5.070263 ft
Rim Elev. = 35.2 ft
Invert Elev. = -1.56 ft
01/01/2018 12:06PM

System 5

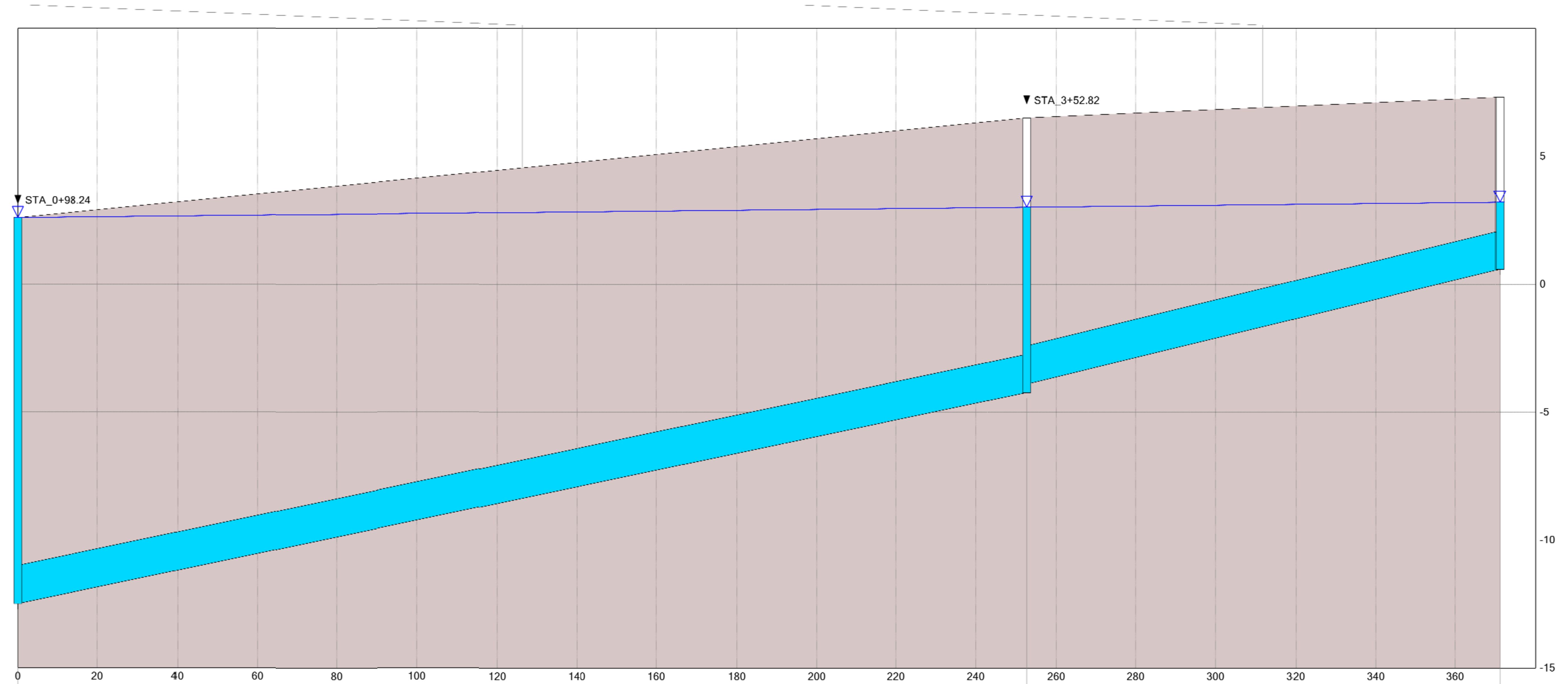
Line 5a

HGL

Peak values

Conduit 5A-5
Flow = 2.289 cfs
Length = 252.58 ft
Depth = 1.5 ft
Velocity = 1.295 ft/s
Slope = 0.0328 ft/ft
Invert1 = -4.23 ft
Invert2 = -12.5 ft

Conduit 5A-10
Flow = 2.289 cfs
Length = 118.49 ft
Depth = 1.5 ft
Velocity = 1.295 ft/s
Slope = 0.0379 ft/ft
Invert1 = 0.59 ft
Invert2 = -3.9 ft



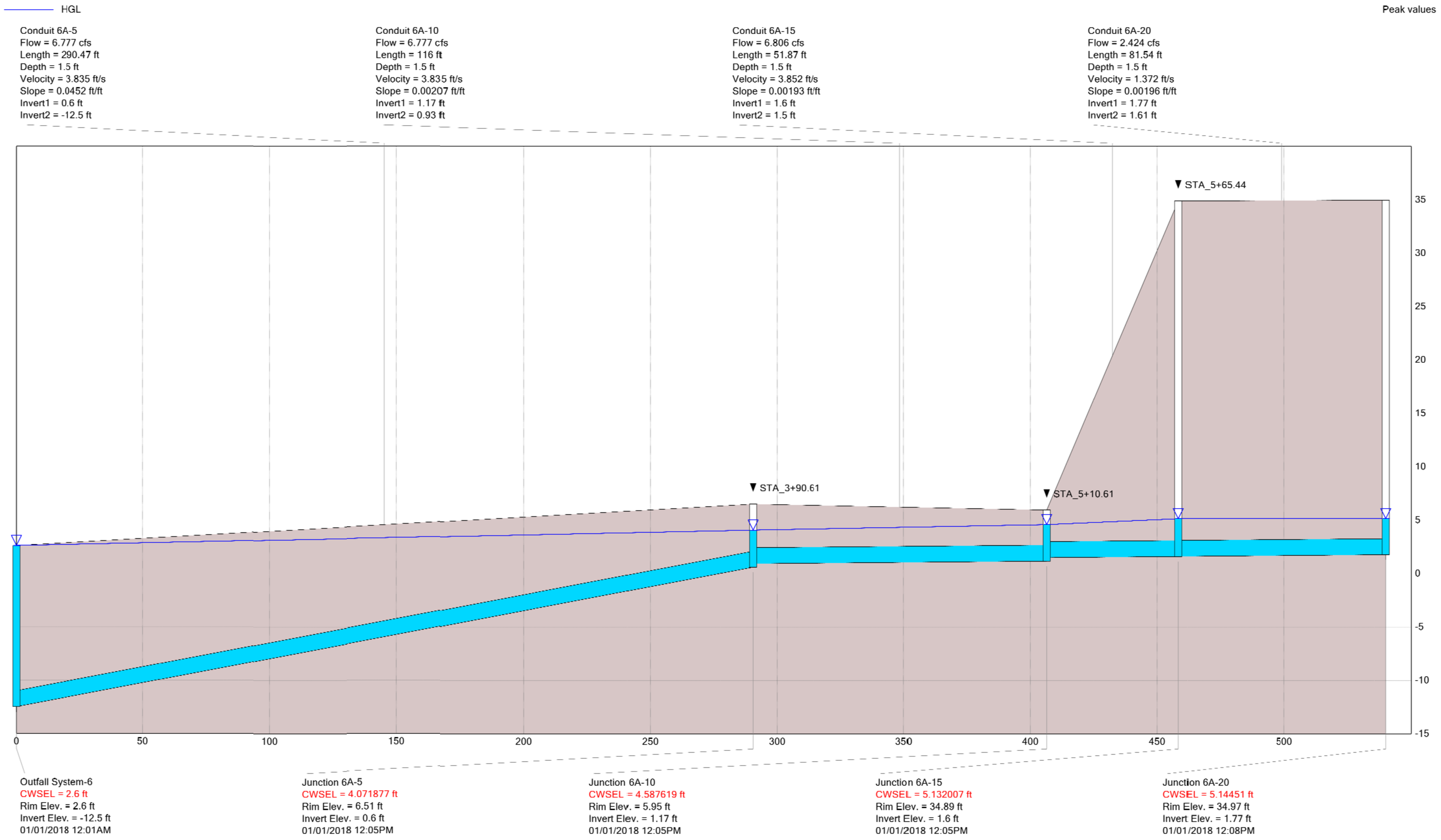
Outfall System-5
CWSEL = 2.6 ft
Rim Elev. = 2.6 ft
Invert Elev. = -12.5 ft
01/01/2018 12:01AM

Junction 5A-5
CWSEL = 3.01231 ft
Rim Elev. = 6.51 ft
Invert Elev. = -4.23 ft
01/01/2018 12:03AM

Junction 5A-10
CWSEL = 3.20877 ft
Rim Elev. = 7.32 ft
Invert Elev. = 0.59 ft
01/01/2018 12:03AM

System 6

Line 6a



Conduit 6A-5
Flow = 6.777 cfs
Length = 290.47 ft
Depth = 1.5 ft
Velocity = 3.835 ft/s
Slope = 0.0452 ft/ft
Invert1 = 0.6 ft
Invert2 = -12.5 ft

Conduit 6A-10
Flow = 6.777 cfs
Length = 116 ft
Depth = 1.5 ft
Velocity = 3.835 ft/s
Slope = 0.00207 ft/ft
Invert1 = 1.17 ft
Invert2 = 0.93 ft

Conduit 6A-15
Flow = 6.806 cfs
Length = 51.87 ft
Depth = 1.5 ft
Velocity = 3.852 ft/s
Slope = 0.00193 ft/ft
Invert1 = 1.6 ft
Invert2 = 1.5 ft

Conduit 6A-20
Flow = 2.424 cfs
Length = 81.54 ft
Depth = 1.5 ft
Velocity = 1.372 ft/s
Slope = 0.00196 ft/ft
Invert1 = 1.77 ft
Invert2 = 1.61 ft

Outfall System-6
CWSEL = 2.6 ft
Rim Elev. = 2.6 ft
Invert Elev. = -12.5 ft
01/01/2018 12:01AM

Junction 6A-5
CWSEL = 4.071877 ft
Rim Elev. = 6.51 ft
Invert Elev. = 0.6 ft
01/01/2018 12:05PM

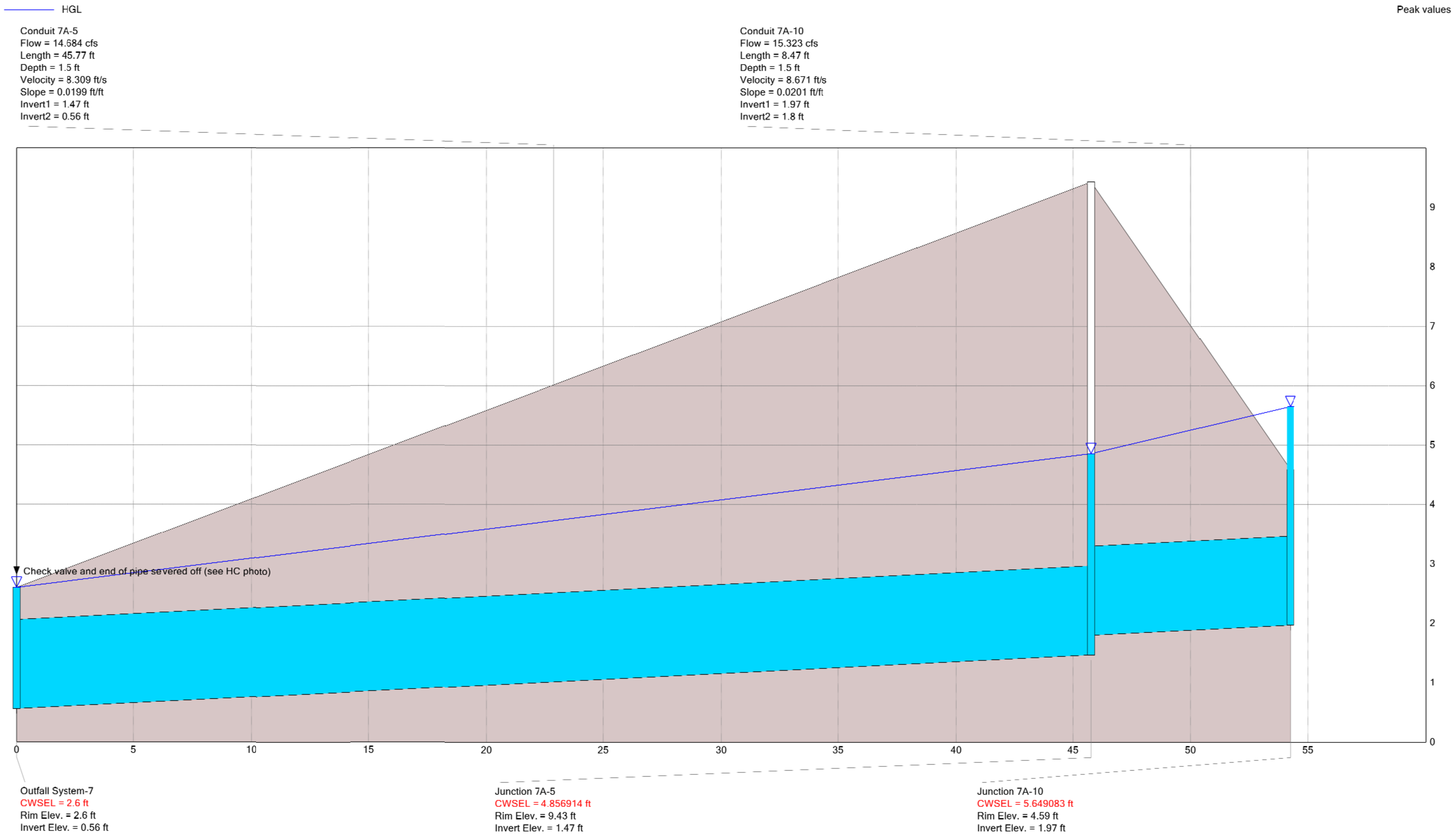
Junction 6A-10
CWSEL = 4.587619 ft
Rim Elev. = 5.95 ft
Invert Elev. = 1.17 ft
01/01/2018 12:05PM

Junction 6A-15
CWSEL = 5.132007 ft
Rim Elev. = 34.89 ft
Invert Elev. = 1.6 ft
01/01/2018 12:05PM

Junction 6A-20
CWSEL = 5.14451 ft
Rim Elev. = 34.97 ft
Invert Elev. = 1.77 ft
01/01/2018 12:08PM

System 7

Line 7a



Conduit 7A-5
Flow = 14.684 cfs
Length = 45.77 ft
Depth = 1.5 ft
Velocity = 8.309 ft/s
Slope = 0.0199 ft/ft
Invert1 = 1.47 ft
Invert2 = 0.56 ft

Conduit 7A-10
Flow = 15.323 cfs
Length = 8.47 ft
Depth = 1.5 ft
Velocity = 8.671 ft/s
Slope = 0.0201 ft/ft
Invert1 = 1.97 ft
Invert2 = 1.8 ft

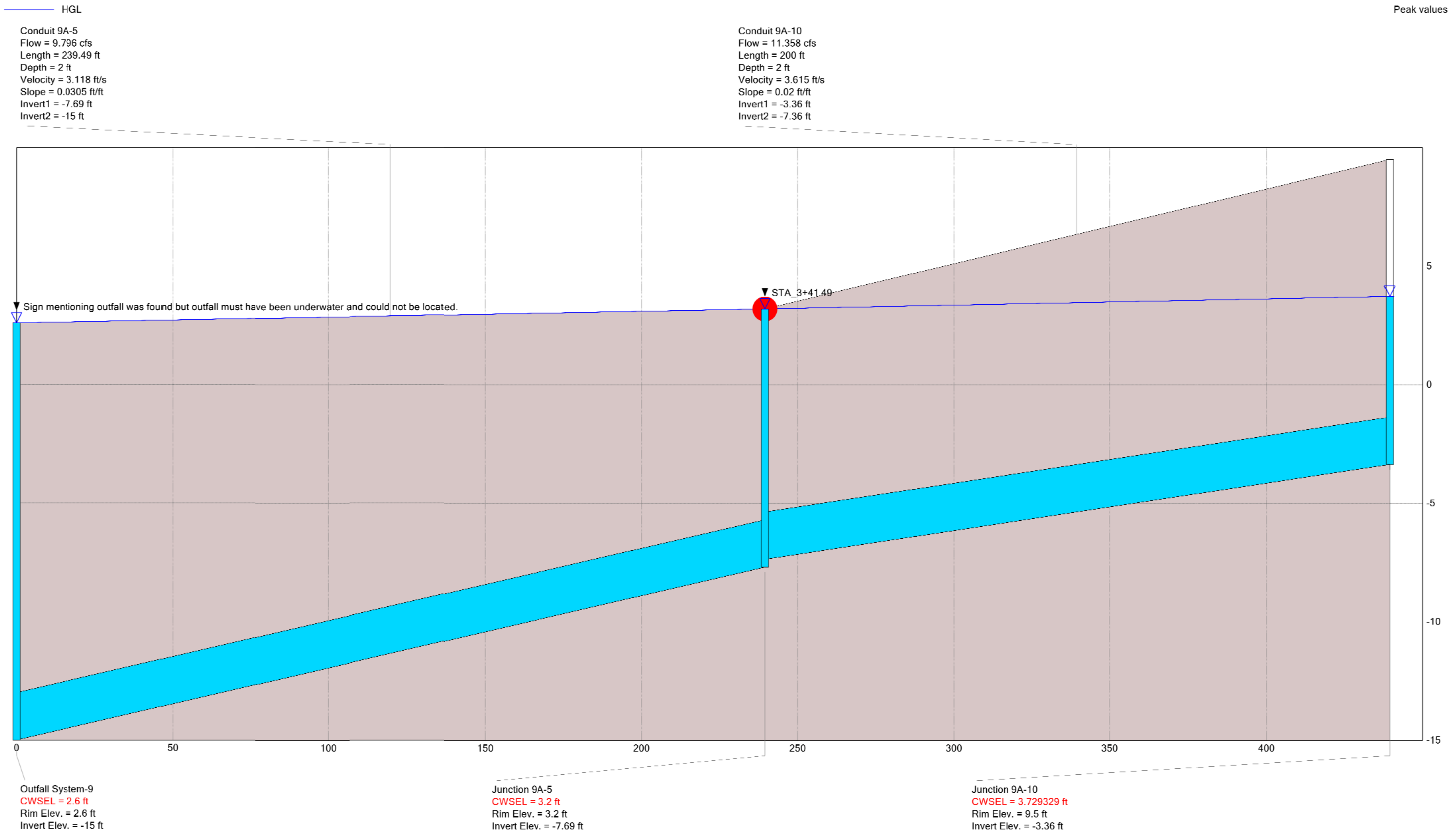
Outfall System-7
CWSEL = 2.6 ft
Rim Elev. = 2.6 ft
Invert Elev. = 0.56 ft

Junction 7A-5
CWSEL = 4.856914 ft
Rim Elev. = 9.43 ft
Invert Elev. = 1.47 ft

Junction 7A-10
CWSEL = 5.649083 ft
Rim Elev. = 4.59 ft
Invert Elev. = 1.97 ft

System 9

Line 9a



Conduit 9A-5
Flow = 9.796 cfs
Length = 239.49 ft
Depth = 2 ft
Velocity = 3.118 ft/s
Slope = 0.0305 ft/ft
Invert1 = -7.69 ft
Invert2 = -15 ft

Conduit 9A-10
Flow = 11.358 cfs
Length = 200 ft
Depth = 2 ft
Velocity = 3.615 ft/s
Slope = 0.02 ft/ft
Invert1 = -3.36 ft
Invert2 = -7.36 ft

Outfall System-9
CWSEL = 2.6 ft
Rim Elev. = 2.6 ft
Invert Elev. = -15 ft

Junction 9A-5
CWSEL = 3.2 ft
Rim Elev. = 3.2 ft
Invert Elev. = -7.69 ft

Junction 9A-10
CWSEL = 3.729329 ft
Rim Elev. = 9.5 ft
Invert Elev. = -3.36 ft

MAP POCKET 1

Existing Condition Surface Ponding Extents – Mean Higher High Water (100-Year)

\\sdfile4\Projdata\18022-E_SouthMissionWMP\GIS\FinalDesign\ExistingInundation_DSheet.mxd
8/26/2019 9:56:57 AM

South Mission Beach - Storm Drain Improvements and GI

Pre-Project Surface Ponding Extents - Mean Higher High Water (MHHW, EL 2.6 ft.), 100-YR

RICK
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www.rickengineering.com

Scale in Feet
0 150 300 450
North

Date of Exhibit: 01.02.2015
DigitalGlobe Aerial Image: 04.2013
Topographic Source: City of San Diego 1999 (SanGIS)

J-18022-E

MAP POCKET 2

Proposed Condition Surface Ponding Extents – Mean Higher High Water (100-Year)

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8/26/2019 9:53:38 AM

South Mission Beach - Storm Drain Improvements and GI

Post-Project Surface Ponding Extents - Mean Higher High Water (MHHW, EL 2.6 ft.), 100-YR

RICK
ENGINEERING COMPANY
www.rickengineering.com

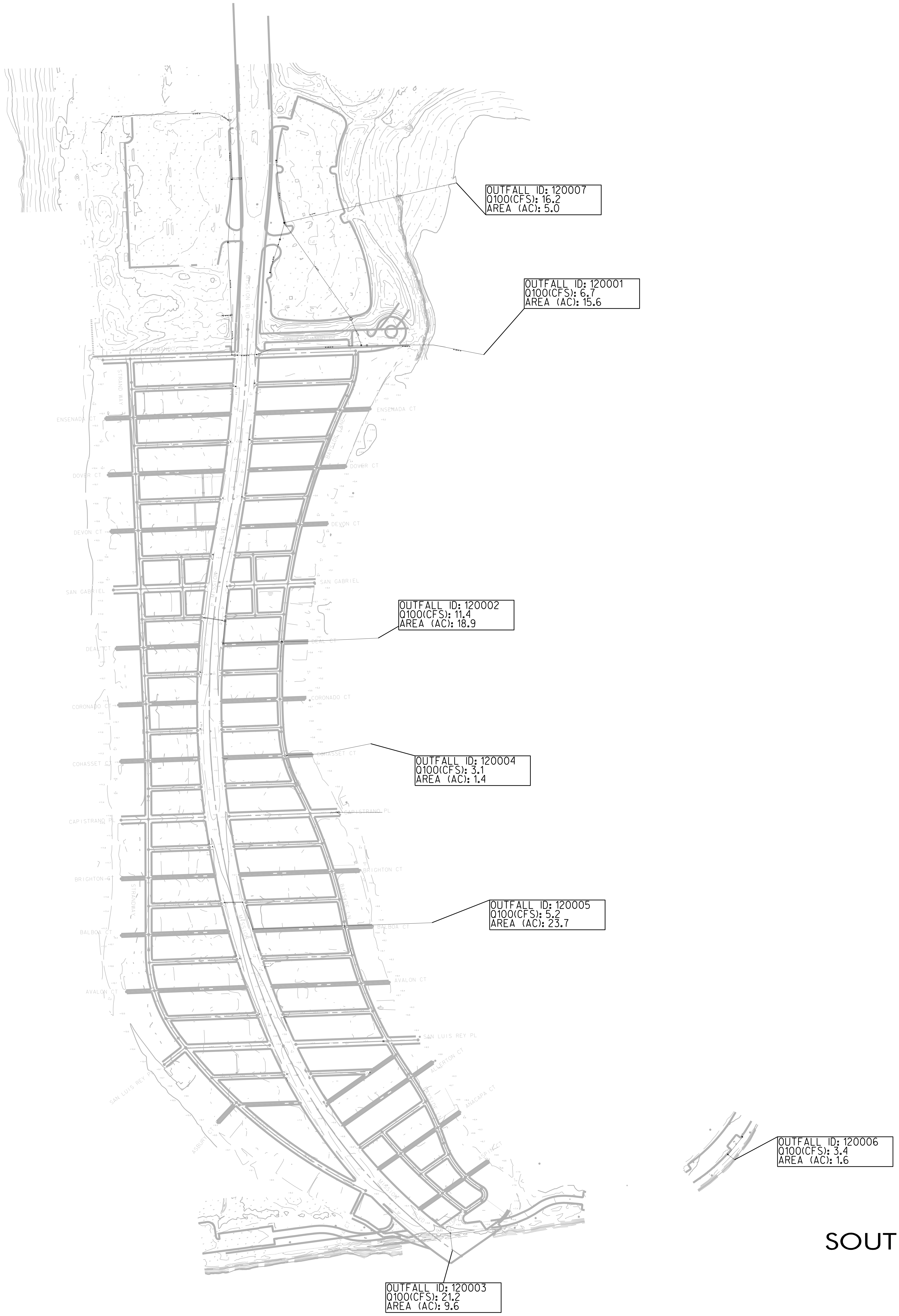
Scale in Feet
0 150 300 450
North

Date of Exhibit: 01.02.2015
DigitalGlobe Aerial Image: 04.2013
Topographic Source: City of San Diego 1999 (SanGIS)

J-18022-E

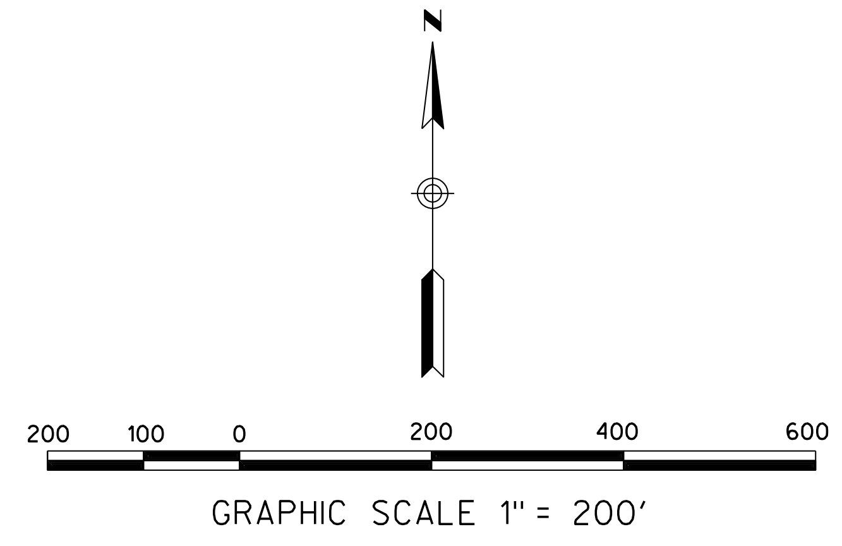
MAP POCKET 3

Pre-Project Drainage Map



LEGEND:

PROPOSED STORM DRAIN



GRAPHIC SCALE 1" = 200'

PRE-PROJECT DRAINAGE MAP
FOR
SOUTH MISSION BEACH STORM DRAIN AND GI
60% DESIGN

J-18022E

Date: August 26, 2019

RICK™
ENGINEERING COMPANY
San Diego

5620 FRIARS ROAD
SAN DIEGO, CA 92110
619-291-0707
(FAX) 619-291-4165
rickengineering.com
Riverside - Orange - Sacramento - San Luis Obispo - Phoenix - Tucson - Denver

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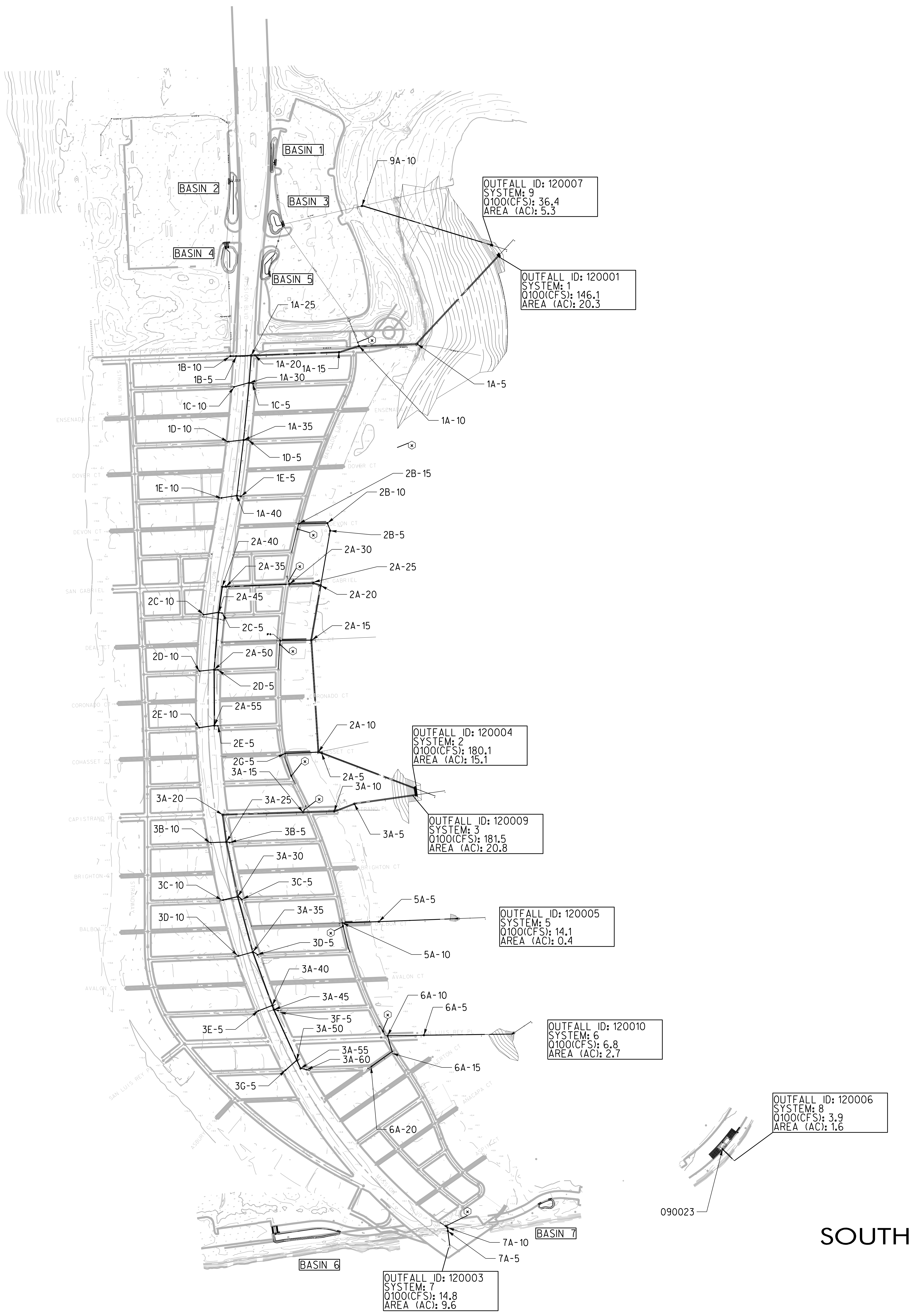
NOT FOR CONSTRUCTION - EXHIBIT FOR 60% DESIGN ONLY

MAP POCKET 4

Post-Project Drainage Map



LEGEND:

═══	PROPOSED STORM DRAIN
XXXXX	BASIN ID
XXXXX ⟶	NODE ID
⊗	LOW FLOW DIVERSION (GRAVITY) STRUCTURE

200 100 0 200 400 600

GRAPHIC SCALE 1" = 200'

POST-PROJECT DRAINAGE MAP
FOR
SOUTH MISSION BEACH STORM DRAIN AND GI
60% DESIGN

J-18022E

Date: August 26, 2019

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Compact Disc (CD):

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South Mission Beach Watershed Master Plan – PDF

THE CITY OF SAN DIEGO

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM
DS-560
FEBRUARY 2016

Project Address:
2868 Bayside Walk (neareset property)

Project Number *(for City Use Only)*:

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1] , which is administered by the State Water Resources Control Board.

For all project complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water Discharges Associated with Construction Activities, also known as the State Construction General Permit (CGP)? (Typically projects with land disturbance greater than or equal to 1 acre.)

☐ Yes; SWPPP required, skip questions 2-4 ☑ No; next question

2. Does the project propose construction or demolition activity, including but not limited to, clearing, grading, grubbing, excavation, or any other activity that results in ground disturbance and contact with storm water runoff?

☑ Yes; WPCP required, skip 3-4 ☐ No; next question

3. Does the project propose routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as pipeline/utility replacement)

☐ Yes; WPCP required, skip 4 ☐ No; next question

4. Does the project only include the following Permit types listed below?

- Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
- Individual Right of Way Permits that exclusively include only ONE of the following activities: water service, sewer lateral, or utility service.
- Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, pot holing, curb and gutter replacement, and retaining wall encroachments.

☐ Yes; no document required

Check one of the boxes to the right, and continue to PART B:

☐ If you checked "Yes" for question 1, **a SWPPP is REQUIRED. Continue to PART B**

☐ If you checked "No" for question 1, and checked "Yes" for question 2 or 3, **a WPCP is REQUIRED.** If the project proposes less than 5,000 square feet of ground disturbance AND has less than a 5-foot elevation change over the entire project area, a Minor WPCP may be required instead. **Continue to PART B.**

☐ If you checked "No" for all questions 1-3, and checked "Yes" for question 4 PART B **does not apply and no document is required. Continue to Section 2.**

---

[1] More information on the City's construction BMP requirements as well as CGP requirements can be found at: www.sandiego.gov/stormwater/regulations/index.shtml

PART B: Determine Construction Site Priorit

This prioritization must be completed within this form, noted on the plans, and included in the SWPPP or WPCP. The city reserves the right to adjust the priority of projects both before and after construction. Construction projects are assigned an inspection frequency based on if the project has a “high threat to water quality.” The City has aligned the local definition of “high threat to water quality” to the risk determination approach of the State Construction General Permit (CGP). The CGP determines risk level based on project specific sediment risk and receiving water risk. Additional inspection is required for projects within the Areas of Special Biological Significance (ASBS) watershed. **NOTE:** The construction priority does **NOT** change construction BMP requirements that apply to projects; rather, it determines the frequency of inspections that will be conducted by city staff.

Complete PART B and continued to Section 2

1. ☐ **ASBS**

a. Projects located in the ASBS watershed.

2. ☐ **High Priority**

a. Projects 1 acre or more determined to be Risk Level 2 or Risk Level 3 per the Construction General Permit and not located in the ASBS watershed.

b. Projects 1 acre or more determined to be LUP Type 2 or LUP Type 3 per the Construction General Permit and not located in the ASBS watershed.

3. ☐ **Medium Priority**

a. Projects 1 acre or more but not subject to an ASBS or high priority designation.

b. Projects determined to be Risk Level 1 or LUP Type 1 per the Construction General Permit and not located in the ASBS watershed.

4. ☑ **Low Priority**

a. Projects requiring a Water Pollution Control Plan but not subject to ASBS, high, or medium priority designation.

SECTION 2. Permanent Storm Water BMP Requirements.

Additional information for determining the requirements is found in the Storm Water Standards Manual.

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

Projects that are considered maintenance, or otherwise not categorized as “new development projects” or “redevelopment projects” according to the Storm Water Standards Manual are not subject to Permanent Storm Water BMPs.

If “yes” is checked for any number in Part C, proceed to Part F and check “Not Subject to Permanent Storm Water BMP Requirements”.

If “no” is checked for all of the numbers in Part C continue to Part D.

1. Does the project only include interior remodels and/or is the project entirely within an existing enclosed structure and does not have the potential to contact storm water? ☐ Yes ☑ No
2. Does the project only include the construction of overhead or underground utilities without creating new impervious surfaces? ☐ Yes ☑ No
3. Does the project fall under routine maintenance? Examples include, but are not limited to: roof or exterior structure surface replacement, resurfacing or reconfiguring surface parking lots or existing roadways without expanding the impervious footprint, and routine replacement of damaged pavement (grinding, overlay, and pothole repair). ☐ Yes ☑ No

PART D: PDP Exempt Requirements.

PDP Exempt projects are required to implement site design and source control BMPs.

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was checked for all questions in Part D, continue to Part E.

1. Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:
   - Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;
   - Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;
   - Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?

   ☐ Yes; PDP exempt requirements apply ☑ No; next question

2. Does the project ONLY include retrofitting or redeveloping existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets guidance in the City's Storm Water Standards Manual?

   ☐ Yes; PDP exempt requirements apply ☑ No; project not exempt. PDP requirements apply

PART E: Determine if Project is a Priority Development Project (PDP).

Projects that match one of the definitions below are subject to additional requirements including preparation of a Storm Water Quality Management Plan (SWQMP).

If "yes" is checked for any number in PART E, continue to PART F.

If "no" is checked for every number in PART E, continue to PART F and check the box labeled "Standard Development Project".

1. **New Development that creates 10,000 square feet or more of impervious surfaces collectively over the project site.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☐ Yes ☑ No
2. **Redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surfaces on an existing site of 10,000 square feet or more of impervious surfaces**. This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ☐ Yes ☑ No
3. **New development or redevelopment of a restaurant.** Facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 5,000 square feet or more of impervious surface. ☐ Yes ☑ No
4. **New development or redevelopment on a hillside.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site) and where the development will grade on any natural slope that is twenty-five percent or greater. ☐ Yes ☑ No
5. **New development or redevelopment of a parking lot that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).** ☐ Yes ☑ No
6. **New development or redevelopment of streets, roads, highways, freeways, and driveways.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site). ☐ Yes ☐ No

7. **New development or redevelopment discharging directly to an Environmentally Sensitive Area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands). ☐ Yes ☑ No

8. **New development or redevelopment projects of a retail gasoline outlet (RGO) that create and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. ☐ Yes ☑ No

9. **New development or redevelopment projects of an automotive repair shops that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539. ☐ Yes ☑ No

10. **Other Pollutant Generating Project.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☐ Yes ☑ No

PART F: Select the appropriate category based on the outcomes of PART C through PART E.

1. The project is **NOT SUBJECT TO STORM WATER REQUIREMENTS**. ☐
2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☑
3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management ☐

Name of Owner or Agent *(Please Print)*: Title:

Signature: Date:

South Mission Beach Watershed Master Plan

March 29, 2019

Presented To

City of San Diego Public Works Department
525 B Street, Suite 750, MS 908A
San Diego, CA 92101

Presented By

Rick Engineering Company
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San Diego, CA 92110

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Prepared by:

Name Date
Title

Reviewed by:

Name Date
Title

Authorized by:

Name Date
Title

Contents

Tables

Figures

Appendices

Acronyms/Abbreviations

Acronym / Abbreviation	Definition
BSA	biological study area
BMP	best management practice
CCA	California Coastal Act
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CDP	Coastal Development Permit
CEMP	California Eelgrass Mitigation Policy
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CIP	capital improvement program
CoSMoS	Coastal Storm Modeling System
CR	cost ratio
Cfs	cubic feet per second
CWA	Clean Water Act
DEM	digital elevation model
DV	diversion valve
EFH	Essential Fish Habitat
EMC	event mean concentration
EPA	U.S. Environmental Protection Agency
ESA	environmentally sensitive area
FGC	California Fish and Game Code
Ft	foot, feet
FY	fiscal year
GIS	geographic information system
H&H	hydrology and hydraulics
HAPC	Habitat Area of Particular Concern
HAT	highest astronomical tide
HHT	highest high tide
IP	integrated project
IPS	interceptor pump station
LCP	Local Coastal Program
LECC	Law Enforcement Coordinating Council
LF	linear foot, linear feet
LFD	low-flow diversion
LiDAR	Light Detection and Ranging

Acronym / Abbreviation	Definition
LOS	level of service
M&A	Merkel & Associates, Inc.
MBTA	Migratory Bird Treaty Act
MHHW	Mean Higher-High Water
MHPA	Multi-Habitat Planning Area
MHW	Mean High Water
MLLW	Mean Lower-Low Water
MB PEIR	Mission Bay Programmatic Environmental Impact Report
MMPA	Marine Mammals Protection Act
MPN	most probable number
MS4	municipal separate storm sewer system
MSCP	Multiple Species Conservation Plan
MSL	Mean Sea Level (0 Ft. elevation on NGVD 1929)
NGA	National Geospatial-Intelligence Agency
NGVD29	National Geodetic Vertical Datum of 1929
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	operations and maintenance
QA/QC	quality assurance/quality control
PFDS	Precipitation Frequency Data Server
PTS	permanent hearing threshold shifts
R&HA	Rivers and Harbors Act of 1899
RCP	reinforced concrete pipe
ROW	right-of-way
RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SanGIS	San Diego Geographic Information Source
SEL	sound exposure level
SLR	Sea Level Rise
SSURGO	Soil Survey Geographic Database
SWMM	Storm Water Management Model
SWRCB	State Water Resources Control Board
SWSM	Storm Water Standards Manual (City of San Diego)
TMDL	total maximum daily load
TSS	total suspended solids
TTS	temporary threshold shifts
TZn	total zinc
USACE	U.S. Army Corps of Engineers

Acronym / Abbreviation	Definition
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UUP	Utilities Undergrounding Program
WAMP	watershed asset management plan
WE&RF	Water Environment & Reuse Foundation
WMA	watershed management area
WMP	watershed master plan
WQIP	water quality improvement plan
WWTP	wastewater treatment plant

1.0 Introduction

This Watershed Master Plan (WMP) specifically identifies and addresses drainage, water quality, and environmental issues for the South Mission Beach study area, which has been historically challenged with poor drainage due to localized sumps and tidally influenced flooding. The total South Mission Beach study area encompasses approximately 76 acres of drainage area within the City of San Diego (the City) and consists of existing development which is bounded to the north by Belmont Park and to the south by the entrance channel to Mission Bay. The intent of this WMP is to determine reasonable storm water infrastructure improvements that can be recommended within the existing constraints of the study area to address the current drainage problems affecting the community, while also improving the storm water quality conditions. The WMP analyzes the proficiency of the existing storm drain infrastructure, and quantifies benefits of proposed drainage and water quality improvements as compared to the existing condition drainage patterns. Environmental considerations have also been incorporated as they pertain to biological resources in the study area that may be impacted and/or improved upon.

This WMP was a collaborative effort by Rick Engineering Company and their respective sub-consultants (the Project Team) working on behalf of the City.

Figure 1-1 and the following paragraphs provide an overview of WMP components and overall processes.

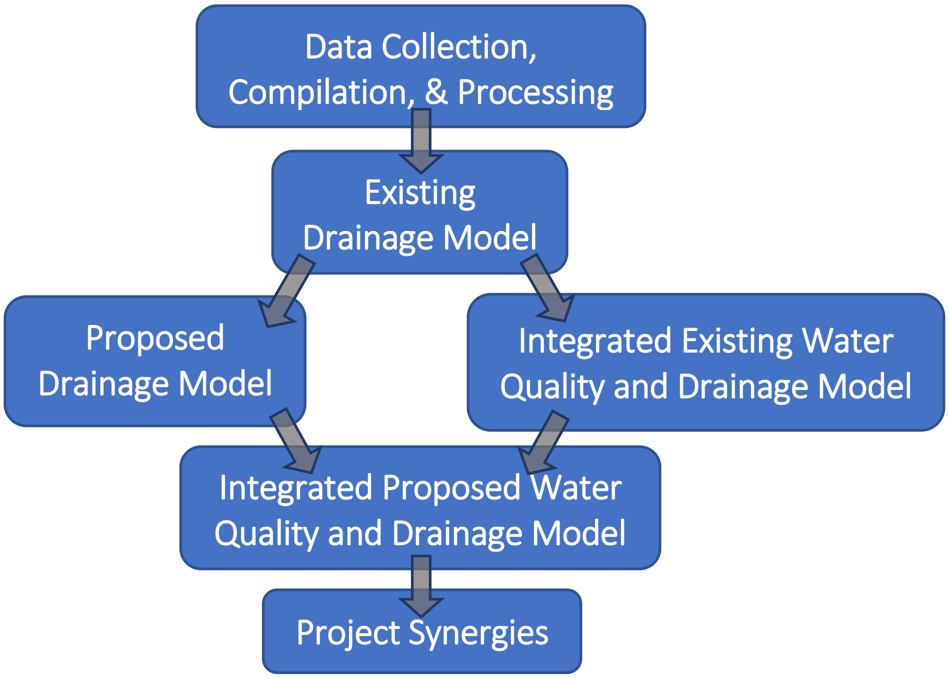


Figure 1-1: WMP Framework

This South Mission Beach WMP is a component of an overarching integrated Capital Improvement Program (CIP) approach to implement wet utility improvements (drainage, sewer, and water improvements) within the South Mission Beach area. In concurrence with this WMP effort, the City of San Diego Public Utilities Department (PUD) is conducting a sewer & water replacement project which targets the replacement of approximately 3.4 miles of existing water mains and 0.5 miles of existing sewer mains in the South Mission Beach study area. Through an integrated CIP approach, the City will be able to assess the benefit of drainage and water quality recommendations presented in this WMP along with the PUD recommendations for sewer and water line replacement to bundle and/or subdivide comprehensive infrastructure improvement projects accordingly. The CIP scale project(s) can be used to immediately transition into 30% design. This integrated approach will reduce the need to perform surface improvements multiple times, while minimizing community impacts and lags in the implementation of improvements due to road moratoriums, which restrict the frequency of construction within developed right-of-way (ROW).

The first component in the WMP framework is the data collection regarding the existing storm drain infrastructure and drainage conditions, including corrections to a Geographic Information System (GIS) inventory of structure and conveyance features within the study area. The City has recently completed design and is nearing completion on undergrounding overhead utilities within the South Mission Beach study area through the Utilities Undergrounding Program (UUP) Project Block 2S1. An abundance of survey data regarding present-day underground utilities was made available from this undergrounding project effort. The data collection step included reviewing the available survey data and as-built drawings; Google Earth observations; and field visits to verify the location and properties of each drainage structure and conveyance asset. The results of the data collection effort were used to update the City's GIS inventory of storm drain structure and conveyance features within the study area for use in the computer modeling effort. The second process in the WMP framework is modeling the existing drainage condition to establish a baseline and identify existing drainage issues within the study area. The third step in the framework involves two processes; the proposed drainage model and the integrated existing water quality and drainage model. During this step, proposed drainage recommendations are incorporated into the baseline drainage model. A model of the existing water quality condition is integrated into the existing drainage condition. Then finally in the fourth step of the framework the proposed drainage improvement and water quality opportunities are modeled together. The final step in the Watershed Master Plan process is the identification of project synergies in which drainage and water quality recommendations are bundled together.

1.1 Regulatory Framework

When evaluating potential infrastructure improvements, the City must be responsive to a number of regulatory drivers that apply to drainage, storm water infrastructure management, water quality, and environmental impacts, including any potentially applicable Total Maximum Daily Loads (TMDLs), the Municipal Separate Storm Sewer System (MS4) permit, and environmental permit requirements specific to each storm drain outfall system. These regulatory drivers are typically focused on addressing one particular storm water-related component, each with different compliance metrics, timelines, and monitoring requirements. Understanding the nuances inherent in meeting the overall regulatory framework in the watershed was a critical component in developing the WMP and is summarized in the sections below.

1.1.1 Drainage Infrastructure Requirements

The City of San Diego maintains certain regulatory standards for storm water improvements as stipulated in the *City of San Diego Drainage Design Manual*, dated January 2017. One of this study's objectives was to assess the existing drainage infrastructure to determine the current Level of Service (LOS) relative to the City's policies for drainage design. Based on the *City of San Diego Drainage Design Manual*, for tributary areas under one (1) square mile, the storm water conveyance system shall be designed so that the combination of storm drain system capacity and overflow (streets and gutter) will be able to carry the 100-year frequency storm without damage to or flooding of adjacent existing buildings or potential building sites. Therefore this WMP modeled the 100-year storm event to assess LOS. Any facilities determined to be deficient in capacity to convey the 100-year storm event were addressed in the "proposed improvement" phase of the drainage analysis. The WMP provides a greater level of detail and assessment than the preceeding Watershed Asset Management Plan (WAMP), and will allow for the use of LOS (based on hydraulic considerations) to complement the general condition assessment identified in the WAMP.

To maintain a balanced approach to the drainage portion of the infrastructure improvements, a combination of upsizing storm drains while allowing flows in excess of the storm drain conveyance capacity to flow on the surface within the City right-of-way (ROW) to the maximum extent practicable has been used for severely deficient systems. The computer modeling approach utilized has the capability to quantify the shallow surface attenuation (aka – detention) occurring in the ROW and its effect to the peak flows entering the storm drain system (peak flow rates entering the system are attenuated, which reduces the size of required improvements). This approach includes identifying and addressing locations within the study area where street conveyance capacity is limited due to reduced curb heights from excessive street asphalt overlay.

1.1.2 TMDL and MS4 Permit Requirements

The South Mission Beach study area is located within the Scripps subwatershed which is part of the Mission Bay Watershed Management Area (WMA). The Mission Bay WMA Copermittees developed a Water Quality Improvement Plan (WQIP) that included watershed-wide water quality models that evaluated the pollutants of concern for both wet and dry weather conditions. The Mission Bay WQIP includes information related to the pollutants of concern and identifies highest priority water quality conditions in the Mission Bay WMA; however, the WQIP states that the identified highest priority water quality conditions are applicable to Tecolote Creek (indicator bacteria identified), the La Jolla Area of Special Biological Significant (ASBS) (sediment identified), and various locations along the Pacific Ocean Shoreline (indicator bacteria identified). The WQIP goes on to state that no highest priority water quality conditions have been identified for the Mission Bay subwatersheds, because priority water quality conditions for those waterbodies did not meet the criteria in the priority and highest priority water quality conditions selection methodology utilized. A portion of the study area is identified on the 303(d) list as impaired for bacteria (Pacific Ocean Shoreline along Bonita Cove, the upper portion of Mariners Basin); however, it is not currently regulated by any TMDLs.

Based on the study area's proximity and discharge to Mission Bay, the 303(d) listing of Bonita Cove, and the water quality objectives (WQOs) of the WQIP, the project goals for water quality improvement utilize bacteria as the primary pollutant of concern, while also targeting load reduction for a variety of other pollutants associated with storm water runoff in an existing developed area.

1.1.3 Environmental Permit Requirements

Multiple federal and state agencies as well as the City of San Diego have jurisdictional authority over areas studied within the WMP. An analysis was conducted to determine the limits of jurisdictional waters within the Biological Study Area (BSA). The investigation included an evaluation of the potential for presence of wetlands as well as preliminary determination of the non-wetland jurisdictional boundaries of waters within the BSA.

A variety of federal, state, and local regulations may apply to the proposed project. These regulations are listed herein with a brief description.

1.1.3.1 Federal Water Pollution Control Act (Clean Water Act), 1972

Under Section 404 (33 U.S.C. 1344), permits need to be obtained from the USACE for discharge of dredged or fill material into waters of the U.S. Under Section 401 of the CWA, Water Quality Certification from the Regional Water Quality Control Board (RWQCB) would need to be obtained if there are to be any impacts to waters of the U.S.

1.1.3.2 Rivers & Harbors Act of 1899 (33 U.S.C. 401)

The Rivers & Harbors Act of 1899 (R&HA) is intended to protect the navigability of the nation’s waterways. The term “navigable waters of the U.S.” is defined in 33 CFR Part 329.4 as “those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.”

At its core, the R&HA provides for the regulation of obstructions in the waterway and includes regulation of all structures and work. Under section 10 of the R&HA, the Corps regulates structures and work within navigable waters such as tidal waters of Mission Bay. The regulatory reach of the Rivers & Harbors Act extends up to the mean high water line.

1.1.3.3 Federal Endangered Species Act (ESA)

The federal ESA (16 U.S.C. 1513-1543) was enacted in 1973 to provide protection to threatened and endangered species and their associated ecosystems. “Take” of a listed species is prohibited except when authorization has been granted through a permit under Sections 4(d), 7, or 10(a) of the act. Take is defined as harassing, harming, shooting, wounding, killing, trapping, capturing, or collecting, or attempting to engage in any of these activities without a permit.

1.1.3.4 Migratory Bird Treaty Act (MBTA)

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) was enacted in 1918. Its purpose is to prohibit the kill or transport of native migratory birds, or any part, nest, or egg of any such bird unless allowed by another regulation adopted in accordance with the MBTA. The MBTA authority does not extend to activities beyond the nests, eggs, feathers, or specific bird parts (i.e., activities or habitat modification in the vicinity of nesting birds that do not result in “take” as defined under the MBTA are not prohibited).

1.1.3.5 California Fish and Game Code (FGC)

The California Fish and Game Code (FGC) regulates the taking or possession of birds, mammals, fish, amphibian and reptiles, as well as natural resources such as wetlands and waters of the state. It includes the California Endangered Species Act (CESA) (Sections 2050-2115).

The definition of "take" under the FGC is not distinct from the definition of "take" under CESA, which is defined as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill" (FGC Code §86); however, it is important to note that the state definition of "take" again does not include a "harm and harassment" clause, and thus, activities or habitat modification in the vicinity of nesting birds that do not result in "take" as defined under the FGC/CESA are not prohibited.

1.1.3.6 Porter-Cologne Water Quality Control Act

This act is substantively the California version of the Federal CWA. It provides for statewide coordination of water quality regulations through the establishment of the State Water Resources Control Board (SWRCB) and nine separate RWQCBs that oversee water quality regulation on a day-to-day basis at the regional watershed basin level.

The RWQCB San Diego Region, under the SWRCB, regulates wastewater discharges to "waters of the State", which is defined in section 13050(e) of the California Water Code as "any surface water or groundwater, including saline waters, within the boundaries of the State." For waters of the State that are federally regulated under the CWA, the RWQCB must provide state water quality certification pursuant to Section 401 of the CWA for activities that may result in discharge of pollutants into WoUS.

1.1.3.7 California Coastal Act (CCA)

Under the CCA of 1976, the California Coastal Commission (CCC) regulates activities that would affect wetlands occurring in the California coastal zone through the CCA. The City has a certified Local Coastal Program (LCP), which covers the developed private lands within South Mission Beach and the adopted Mission Bay Master Plan Update covering lands within Mission Bay Park. The City has been delegated primary authority for implementation of the Coastal Act within Mission Beach under the Mission Beach Precise Plan and Local Coastal Program Addendum (June 26, 2017, Resolution R-311205). However, the Coastal Commission has retained jurisdiction within many parts of South Mission Beach as well as Mission Bay Park and the waters of Mission Bay. As a result, infrastructure projects that cross into and out of areas under LCP and CCC jurisdiction, such as drainage improvements contemplated under the WMP, would be permitted through a consolidated permitting approach within the Coastal Commission being the permitting agency for the entire project.

1.1.3.8 California Environmental Quality Act (CEQA)

CEQA requires that biological resources be considered when assessing the environmental impacts resulting from proposed actions (California Natural Resources Agency 2009). CEQA does not specifically define what constitutes an "adverse effect" on a biological resource. Instead, lead agencies are charged with determining what specifically should be considered an impact. The City of San Diego has adopted its own CEQA significance determination thresholds consistent with CEQA requirements (City of San Diego 2011).

1.1.3.9 Local Regulations and Standards

The WMP project falls under the local land use authority of the City of San Diego. The City is charged with implementation of development controls under local ordinances and policies and adopted plans such as the Mission Bay Master Plan Update, Mission Beach Precise Plan and Local Coastal Program Addendum. The City is also mandated to meet state and federal obligations for water resources protection that are derived through the CWA. The City is charged with implementation of the Coastal Act within the limits of the Mission Beach Precise Plan. For the full project action, the City will be responsible for environmental evaluation of the project as the lead agency under CEQA and will issue a Site Development Permit for the project. The project is subject to the San Diego Municipal Code: Land Development Code and thus has been assessed in accordance with the City's Biological Guidelines (City of San Diego 2012). Because of the trans-jurisdictional nature of the utility infrastructure, it is anticipated the City will cede Coastal jurisdiction to the Coastal Commission for a consolidated Coastal Development Permit issuance.

2.0 High Resolution Geospatial Data

A high resolution geospatial dataset is essential to perform the detailed hydrologic and hydraulic drainage and water quality analyses. Geospatial data necessary for these modeling efforts include: an accurate topographic representation of the study area, ground cover/land use information, and existing storm drain inventory. Additional information regarding other existing utility infrastructure in the area (underground gas, electric, fiber optic, water, and sewer lines) is also desirable for evaluating potential conflicts when recommending infrastructure improvements. During the course of this WMP process, Geographic Information System (GIS) data was compiled from various sources to develop a comprehensive data set to be used in the modeling process.

While evaluating the data initially collected, it was determined that certain data components (such as the storm drain inventory junction points and linework) did not accurately reflect the field conditions and/or did not align spatially when compared against the aerial imagery of the study area. An effort to correct and compile the data from various sources into one comprehensive dataset was undertaken. Of particular focus during this effort was to ensure a correct spatial representation of the storm drain infrastructure, and collect any missing information. A revised dataset will also be useful for any future projects that the City or other consultants undertake within the study area. Figure 2-1, displays a snapshot of the changes that were made to the GIS inventory, which demonstrates the amount of new information that was compiled in a representative portion of the study area.

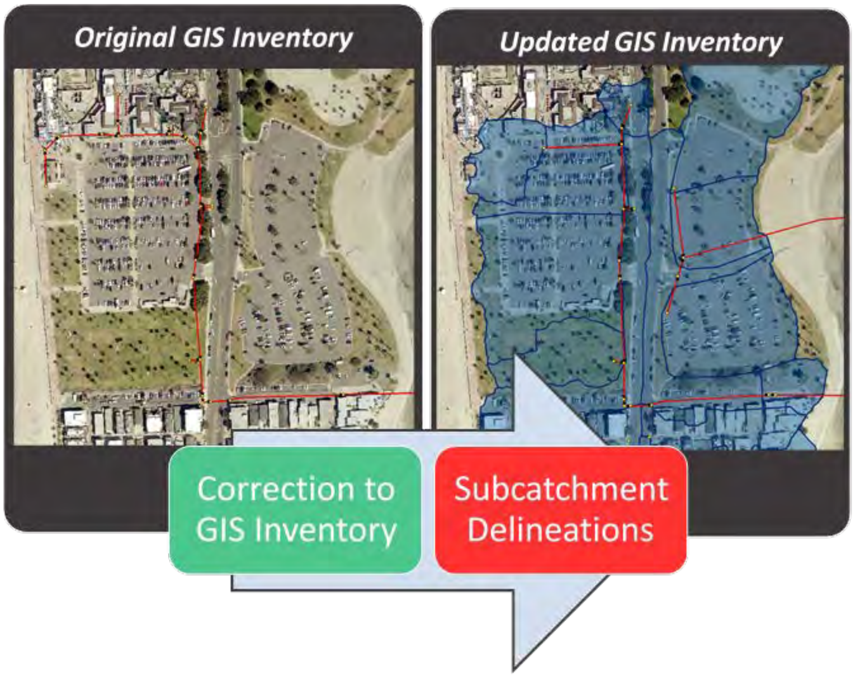


Figure 2-1: Snapshot of New Storm Drain Information Added to GIS Inventory

The following sections of this report describe the geospatial data received, the process of correcting and compiling certain data sets, and the resultant data from the correction process.

This section presents:

- Raw data layers received and sources (Section 2.1)
- Data adjustment and correction process (Section 2.2)
- Summary of the revised dataset (Section 2.3)

2.1 Raw Geospatial Data

The Project Team collected data sets from various sources for this WMP. All utilized data sets are summarized in Table 2-1 with their associated version dates.

Table 2-1. Geospatial data inventory

Data File Name	File Description	Version Date	Source (Agency)
LiDAR	Light Detection and Ranging (Used for Topography)	2014	SanGIS, SANDAG, NGA, LECC, Regional Public Safety GIS, 18 Incorporated Cities
SDG&E BLOCK S21.tif	Aerial Imagery	September 14, 2011	City of San Diego, SDG&E (Utility Undergrounding)
SDGE_2S1d.dtm	Digital Terrain Model - Topographic data (used for 2-D surface)	September 14, 2011	City of San Diego, SDG&E (Utility Undergrounding)
Drain_Structure.shp	Storm Drain Structures (inlets, cleanouts, outfalls)	October 17, 2018	City of San Diego, SanGIS, SANDAG
Drain_Conveyance.shp	Storm Drain Pipes and Open Channels	October 17, 2018	City of San Diego, SanGIS, SANDAG
SMissionBeach_DiversionValve	South Mission Beach Low Flow Sewer Diversion Valve GIS Features	October 17, 2018	City of San Diego
SMissionBeach_IPS	South Mission Beach Interceptor Pump Station GIS Feature	October 17, 2018	City of San Diego
LANDUSE_CURRENT.shp	Current Land Use Shapefile	January 1, 2017	SanGIS, SANDAG
SSURGO2007.shp	Hydrologic Soils Group Shapefile	January 1, 2007	United States Department of Agriculture
PARCELS.shp	San Diego County Parcels	February 05, 2018	SanGIS, SANDAG, Assessor/Recorder/County Clerk
FEMA NFHL Layers	Federal Emergency Management Agency – National Flood Hazard Layer	April 7, 2016	Federal Emergency Management Agency
WATER_HYDRANTS_SD.shp	Water Hydrant Layer	March 5, 2018	SanGIS, SANDAG
WATER_MAIN_SD.shp	Water Mainline Layer	March 5, 2018	SanGIS, SANDAG
SEWER_MANHOLE_SD.shp	Sewer Manhole Layer	March 5, 2018	SanGIS, SANDAG
SEWER_MAIN_SD.shp	Sewer Manhole Layer	March 5, 2018	SanGIS, SANDAG
MUNICIPAL_BOUNDARIES.shp	Municipal Boundaries	December 3, 2018	SanGIS, SANDAG
Eelgrass.shp	Eelgrass Habitat extents	August 23, 2016	Merkel & Associates, Inc.
Bathymetry.shp	Bathymetry of all Mission Bay – Mean Lower-Low Water vertical datum	August 23, 2016	Merkel & Associates, Inc.
USACE_MiB_ChannelLimits.shp	Federally maintained limits of entrance channel to Mission Bay	March 15, 2019	U.S. Army Corps of Engineers, Los Angeles District

2.2 Corrections to GIS Storm Drain Inventory

Corrections to the GIS storm drain inventory features contained in the 'Drain_Structure' and 'Drain_Conveyance' files were required to model the existing conditions of the South Mission Beach study area. The Project Team was tasked with revising the storm drain inventory to more accurately reflect the current existing condition of the study area. For the purpose of preparing a WMP, the storm drain data necessary for this study consists of the horizontal layout of the existing storm drain system, size and material of conduits, and flowline elevations (if feasible). As displayed in Figure 2-2., storm drain inventory revisions were conducted in a two-step process; (1) desktop analyses and (2) field verification.

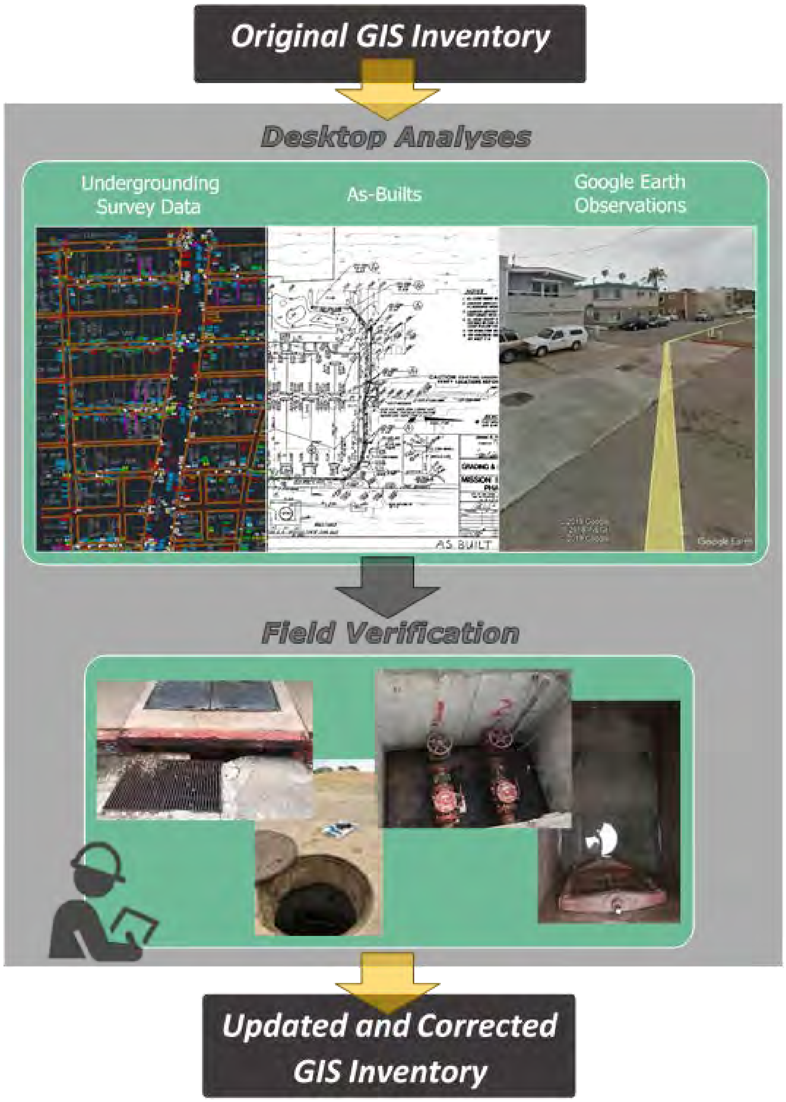


Figure 2-2. Corrections to GIS Inventory Flowchart.

2.2.1 Desktop Analyses

Desktop analyses involved revising the storm drain structures and conveyance information based on survey data, as-built drawings, aerial imagery, and Google Earth observations. The horizontal location of drainage structures in the inventory was corrected to match the aerial imagery. The Project Team utilized survey data from an overhead utilities undergrounding block study (SDG&E Project Block 2S1) provided by City staff to revise invert and rim elevation data for a majority of drainage structures in the inventory. The survey data from the utilities undergrounding block study encompassed only the central portions of the WMP study area. As a result, some drainage structures and conveyance segments in the northern and southern portions of the WMP study area did not have available survey data. The Project Team obtained and verified invert elevations for structures that were not in the survey study by reviewing as-built drawings and measuring structure depths during field visits. The Project Team used a Digital Elevation Model (DEM) to update rim elevations for structures not previously identified in the received data. This DEM was generated from the surface Digital Terrain Model (DTM) provided by City staff (SDGE_2S1d.dtm), which contains surface elevation data based on the National Geodetic Vertical Datum 1929 (NGVD29) elevations.

For structures in which invert elevations were not accessible on site and data was not available in the survey study and as-built drawings, engineering judgment was used to assign an invert elevation based on upstream and downstream drainage connections. Google Earth and Street View were used to update the location and type of each drainage structure during the desktop analysis stage prior to conducting field observations. By conducting thorough desktop analyses, The Project Team was able to streamline the number of field visits for the field verification step.

2.2.2 Field Verification

Several field visits were conducted as part of the WMP effort to supplement the desktop analyses in correcting the GIS inventory and to obtain insight from maintenance staff. These assessments included storm drain system inventory verification to assess the status of assets including inlet locations and sizes, storm drain diameters and materials, structure depths, connectivity, and drainage patterns.

In addition, field visits with City staff gave the Project Team valuable insight into historical drainage and water quality issues within the South Mission Beach study area. City Maintenance staff identified weep sumps they constructed in order to help reduce flooding in residential areas. These weep sumps regularly require pumping during storm events (see Figure 2-3 – top left photo). Numerous areas with localized sumps were observed (see Figure 2-3 top right photo). City maintenance staff also identified areas with inadequate curb height due to pavement overlay (see Figure 2-3 – bottom photo). Historical asphalt road overlay has been detrimental to the use of the roadway for storm water conveyance and storage attenuation. In many instances, curb heights were observed to only be one to three inches high, and the presence of sand bags stockpiled near buildings suggest flooding occurs on a regular basis.

Figure 2-3: Pumping storm water out of weep sump during a storm event (Top Left). Localized sump (Top Right). Flooding overtopping curb due to reduced curb height from pavement overlay (Bottom)

2.3 Revised Geospatial Data

The main objective of the GIS storm drain data revisions were to ensure that a complete and accurate representation of the existing drainage system was reflected on the 'Drain_Conveyance' and 'Drain_Structure' GIS shapefiles. The revisions incorporated into the GIS shapefiles will be provided back to the City for use outside of this WMP.

Table 2-2 displays the data sources utilized to update the properties of assets in the storm drain GIS inventory. All assumptions and data sources were recorded within comment fields for each asset in the GIS inventory files.

Table 2-2: Data Source of Drainage Asset Properties

	Desktop Analyses			**Field Verification**
	Survey Data	As-built Data	DEM	
Drain_Structures				
Status (Abandoned or Active)				X
Location	X	X		X
Type of Structures	X	X		X
Type of Inlets (Inlets Only)	X	X		X
Rim Elevation	X		X	X
Invert Elevation	X	X		X
Depth				X
Drain_Conveyance				
Status (Abandoned or Active)				X
Location / Orientation		X		X
Type of Conveyance		X		X
Material		X		X
Diameter		X		X
Pipe Offsets		X		X

Table 2-3 provides a summary of the changes to the original storm drain inventory received from the City. The existing inventory was updated for storm drains that were larger than 18 inches in diameter (or considered part of the primary backbone system). The inventory was also updated to add missing drainage structures such as inlets, pipe segments, cleanouts, outlets, and weep sumps. As shown, several structures and conveyance segments were added to the inventory, including two (2) storm drain outfalls.

Table 2-3. Summary of original and existing (revised) storm drain inventory

Asset Type	Original Data Set Provided	Existing Condition Revised Data	Change in Features	Percent Change
Structure				
Headwall[1]	4	1	-3	-75%
Inlet	22	23	1	5%
Connector	6	3	-3	-50%
Cleanout	9	9	0	0%
Outlet	5	7	2	40%
Tide Gate	2	2	0	0%
Weep Sump	12	17	5	42%
Low Flow Diversion Valve	4	4	0	0%
Interceptor Pump Station	1	1	0	0%
Conveyance				
Ditch (Feet)[2]	89	0	-89	-100%
Storm Drain Pipe (Feet)	4250	5018	768	33%
Encased Storm Drain Pipe (Feet)[3]	142	91	-51	-36%

[1] The Headwall feature in the revised dataset represents a downstream node for a 3” PVC overflow drain connected from a curb inlet to the street flowline.

[2] The Ditch conveyance features in the original dataset were removed as they were not found during field observations.

[3] The encased storm drain pipe features are segments of encased PVC pipe across driveway entrances.

3.0 Drainage Assessment

Drainage assessment was accomplished using an integrated 1-D/2-D hydrologic and hydraulic (H&H) model that combines surface and sub-surface drainage patterns within the study area. One of the most beneficial aspects of integrated 1-D/2-D modeling is the ability to render high-resolution surface inundation and storage of storm water flow for the duration of a design storm. An existing condition model was prepared, which presented a high resolution visual rendering of the combined surface and sub-surface drainage patterns within the study area. Results from the "existing condition" model were used as the basis for informing proposed drainage infrastructure recommendations to be included in a "proposed condition" model. For the purposes of this study, the 100-year storm event was used to evaluate the storm drain infrastructure to inform infrastructure improvements. Other storm events (2-year, 10-year, and 50-year) were also modeled in order to understand the performance of the drainage conveyance system during storms with a higher probability of occurrence.

The existing condition H&H model highlighted several areas where the existing drainage infrastructure (i.e., inlets, storm drains, and surface street conveyance) is considered deficient in terms of storm water conveyance during a 100-year storm event. These deficiencies include locations with storm water ponding above the curb and extending onto the sidewalk and into private property. The proposed condition model attempted to address deficient storm water conveyance systems by presenting a combination of storm drain pipe replacement/upsizing, new storm drain pipe alignments, and additional storm drain inlets, for a more efficient storm water conveyance.

The 2-D component of the analysis also allowed for the evaluation of the benefit provided to surface conveyance capacity after the addition of storm drain infrastructure. The objective was to reduce flood depths in the right-of-way (ROW) to 6 inches or less, (i.e., flood depths would be less than the standard curb height per City of San Diego Standard Drawings – 2018 and storm water conveyance would be contained within the ROW). Additional information regarding the specific drainage H&H methodology used in this study can be found in a memo located in Appendix A-9.

The study also incorporated a potential impact analysis due to rising sea levels based on the range of sea level rise (SLR) projections for San Diego Bay outlined in the *Sea Level Rise Adaptation Strategy for San Diego Bay* (2012) mapped to the Coastal Storm Modeling System (CoSMoS) layers developed by the United States Geological Survey (USGS). The City has directed these scenarios to be used for a separate study in the Mission Bay area (Mission Bay Programmatic Environmental Impact Report (MB PEIR)). These SLR values were incorporated in this study as well. The recommended SLR values to be analyzed are: 0.5m (1.6 ft.) for the year 2050, and 1.5m (4.9 ft.) for the year 2100, both of which are part of the "high-end scenario".

The integrated H&H model developed for the South Mission Beach study area incorporated two scenario iterations for a 100-year storm event with tailwater conditions incorporating the recommended values for SLR projected by the years 2050 and 2100. These scenarios are reflective of the tailwater effects that would occur on the system assuming Mission Bay water surface elevations are at the current Mean Higher-High Water (MHHW) elevation (currently 2.59' per the La Jolla Tide Gage converted to NGVD 29) in combination with the projected sea level rise increment resulting in: a projected MHHW tailwater condition of 4.19 ft. for year 2050, and a projected MHHW tailwater condition of 7.49 ft. for year 2100.

The results that will be presented in summary tables within this section are reflective of a Mean Sea Level (MSL) tailwater condition during the 2-, 10-, 50-, and 100-year, 24-hour storm events. This tailwater condition was selected as the basis of analysis to present results that evaluate the average performance of the storm drain conveyance system in order to inform recommendations based on pipe conveyance capacities. This approach provides a consistent baseline for analyzing the gravity flow condition of the storm drain system, with the understanding that a 'Highest Tide' tailwater condition in a model simulation would be very conservative to assume that occurs at the same time as a 100-year storm event (resulting in a statistical frequency much larger than a 100-year storm event, which is the typical design standard to be evaluated).

Additional 2-D inundation maps from drainage analysis scenarios with tailwater conditions reflecting the current Mean Higher-High Water (MHHW), Highest Astronomical Tide (HAT), Highest Observed Tide (Max Tide) elevations per the NOAA La Jolla Tide Gage (https://tidesandcurrents.noaa.gov) adjusted to NGVD 29, and the projected Sea Level Rise (SLR) impacts on the existing and proposed conditions will be provided for reference in Section 3.3.1 and the online Web Application, to show effects of various tail water influences for each of the storm events modeled (i.e. – Tail Water = Tide Elevation plus SLR).

This section presents the following:

- Overview of the existing drainage patterns (section 3.1)
- Model setup methodology (section 3.2)
- Modeling Results (section 3.3)

3.1 Drainage Patterns

The entire study area spans approximately 76 acres of total drainage area. The study area consists primarily of dense residential land use, with the inclusion of large paved parking areas on the far north and south. A Boardwalk exists along the westerly side of the study area, extending from West Mission Bay Drive to North Jetty Road, separating the developed area from the beach to the west as the entire study area is a fairly flat low-lying coastal area. A high point is located on the west edge of the study area near the Boardwalk, and the developed area generally slopes eastward toward four (4) main sag points on Mission Boulevard at San Fernando Place, an alley between San Gabriel Place and Deal Court, an alley between Brighton Court and Balboa Court, and North Jetty Road. These sag points along Mission Boulevard represent the lowest surface elevations within the study area. Mission Boulevard is the main north/south-bound street located in the middle of the major drainage area. East of Mission Boulevard, there are small localized sag points along Bayside Lane at: Devon Court, Deal Court, Cohasset Court, Balboa Court, and Asbury Court, which collect drainage from the surrounding areas.

The drainage infrastructure is primarily located along Mission Boulevard, and in a few low points along the Bayside Lane alleyway, east of Mission Boulevard. These collection points and systems discharge to seven existing (7) storm drain outfalls: five (5) of which are located within Mariner's Basin (including Bonita Cove), and two (2) which are located along the entrance channel into Mission Bay. The main sag points along Mission Boulevard that contain storm drain infrastructure are located at San Fernando Place, the alley between San Gabriel Place and Deal Court, the alley between Brighton Court and Balboa Court, and at the southern intersection with North Jetty Road. There is no significant storm drain infrastructure located west of Mission Boulevard. Refer to the storm drain inventory maps included in Appendix A-7 for additional information.

There are several unique features to the drainage infrastructure in South Mission Beach, which are briefly described below and shown on exhibits in Appendix A:

Weep Sumps

Throughout the study area, there are many alleys and streets that intersect Mission Boulevard and form small localized sag/sump locations. Due to the history of the study area, it is not clear whether these localized sump locations were intended in the original design of Mission Boulevard given the lack of storm drain infrastructure at these locations. At many of these locations, "weep sump" structures which are not connected to a storm drain system have previously been constructed. These weep sump structures resemble grate inlet catch basins with no storm drain pipe connections into or out of the structures, and they have an open bottom to allow storm water to infiltrate into the native subgrade. At certain significant areas which were identified by City maintenance staff as prone to inundation from storm water runoff (one example being Devon Ct. and Bayside Ln.), these weep sump structures provide a necessary collection point for storm water to be pumped out by the City of San Diego maintenance staff via the use of dewatering pumps (currently Wacker Neuson type pumps).

Diversion Valves

Diversion valve (DV) systems are located near the downstream end of four (4) storm drain systems which direct low flows from the storm drain into the sanitary sewer system. These diversion valves are located near Deal Ct/Bayside Ln, Cohasset Ct/Bayside Ln, Balboa Ct/Bayside Ln, and N. Jetty Road/Mission Blvd. During a field visit to the South Mission Beach study area, it was explained by City of San Diego maintenance staff that these diversion valves were initially installed with a wireless radio control system which would open and close the valves to direct the initial 20 minutes of a storm event into the sanitary sewer system via gravity flow. Over time, the systems degraded and no longer functioned with the automated signals which led to the necessity for field maintenance crews to manually open and close the valves to preserve some of the benefit provided by these systems. Currently, these low flow diversion valves are mainly kept in an open position to direct dry weather flows into the Sanitary Sewer. During storm events, these diversion valves are manually closed to prevent the sanitary sewer system from being overwhelmed by excessive storm water flows.

Interceptor Pump Station (IPS) 13

This is a structure located in the landscape area North of San Fernando Pl and Bayside Ln intersection, at the south edge of the Bonita Cove parking lot. This system interconnects the storm drain system at the Bonita Cove parking lot and the storm drain mainline along San Fernando Pl to pump storm water in these systems into the sanitary sewer system which flows south along Bayside Ln. This system was observed in operation during a field visit with City of San Diego staff.

Tide Gates

Tide gates were observed to be installed upstream of the main storm drain outfalls located inside cleanout structures and manually operated by the City of San Diego maintenance field crew.

3.1.1 Subcatchment Delineations

The Project Team utilized a semi-automated delineation tool in PCSWMM to create an initial delineation of subcatchments and flow paths for each of the 40 inlets and weep sumps. Due to the high resolution of the topographic data, the PCSWMM delineation tool was able to identify flow paths along curbed roadways, through backyards, and across driveways; thus establishing an effective baseline for subcatchment delineations. After the initial subcatchment delineation by the PCSWMM tool, the Project Team quality checked the subcatchment boundaries and made adjustments where necessary. Figure 3-1. presents existing condition subcatchments.

Figure 3-1. Catch basin drainage areas of existing condition.

3.1.2 Surface Conveyance

An important component of the storm water conveyance system in the South Mission Beach study area is the street surface. Mission Boulevard is the main road that runs north-south across the study area and the curb and gutter system functions as an open channel, collecting surface runoff flowing from all the intersecting streets and alleys, and conveying those flows to the nearest storm drain system. From a major drainage perspective, there are four (4) main sump locations along Mission Boulevard at San Fernando Place, an alley between San Gabriel Place and Deal Court, an alley between Brighton Court and Balboa Court, and the intersection at North Jetty Road. In addition to these major roadway sump locations, smaller localized sump conditions are formed along Mission Boulevard with every street or alley intersection. During storm events, this overall system forms a condition similar to an "ice cube tray," wherein the smaller local sump areas will pond up until they spill over from local sump to local sump before being collected by the storm drain infrastructure at the major sump locations.

In addition to the issue of localized sumps existing throughout the study area, the current street cross section along Mission Boulevard has been subjected to periodic asphalt overlay throughout the years which has raised the pavement section and reduced the available curb depth. This has reached a level where the current curb depths are approximately 2-inches to 3-inches throughout the study area compared to the standard 6-inch curb per San Diego regional standards. This effect has drastically reduced the storage and conveyance capacity of the street surface and has contributed to an increase in the amount of surface flooding that occurs during storm events. During field visits, it was apparent that the street conveyance throughout the site, along Mission Blvd, had been compromised due to excessive AC overlay throughout the years. A recent subsurface geotechnical exploration showed the pavement section along Mission Boulevard, south of San Fernando Place, consisted of: 4 to 6 inches of AC, 6 to 9.5 inches of concrete, and a miscellaneous base material. Refer to the geotechnical investigation report included in Appendix E for additional information.

Given that the storm drain improvements in the proposed condition model aimed to reduce overall surface ponding conditions below 6 inches, the 2-D mesh which forms the surface conveyance layer in the storm water model was manually adjusted by lowering the surface elevation of Mission Boulevard an average of 3-inches throughout the study area to simulate a street section that had been resurfaced to re-establish a standard 6-inch curb. A widespread mill and overlay of Mission Boulevard is an option that is recommended to be explored further. The results of the proposed condition model are contingent upon this action.

Refer to the proposed condition maps located in Appendix A-7 for a visual overview of the surface conveyance conditions modeled, including the re-established 6-inch curb along Mission Boulevard.

3.2 Model Setup

3.2.1 Existing Condition Model Methodology

The corrected GIS storm drain inventory discussed in section 2.2 was imported into PCSWMM and formed the basis of the 1-D conveyance portion of the study area model. Storm drain networks were visually inspected horizontally with reference to aerial imagery and vertically by viewing the storm drain profiles generated within the program for quality control.

A DEM was also critical in developing the 2-D model surface to represent storm water flows in streets, alleys, and open space areas. A directional 2-D mesh was applied in these areas to represent the preferential direction of flow. This surface was coupled to the 1-D storm drain inventory to match the rim elevations at points of connection to the storm drain conveyance system.

It should be noted that for the existing condition drainage models, the effects of the low flow diversion valve systems, and Interceptor Pump Station 13 (IPS-13) were not incorporated. This presents a conservative analysis of the baseline conveyance capacity for the existing storm drain system purely from a gravity flow perspective. This model will be used in order to inform design decisions which will address the deficiencies in the storm drain conveyance system from the collection point to the designated outfall without the supplemental diversion systems.

Table 3-1 below shows a breakdown of the storm drain pipes analyzed in the existing condition model.

Table 3-1: Existing Condition Storm Drain Pipe Diameters and Lengths Modeled

Diameter (in)	Length (ft)	Pipe and Culvert Count	%
3	65	1	1%
8	264	3	5%
12	1,409	10	28%
15	858	3	17%
18	1,324	13	26%
21	257	1	5%
24	932	5	18%
Total	**5,109**	**36**	**100%**

Model results were obtained for the 24-hour storms at the 2-, 10-, 50-, and 100-year return period from the precipitation data obtained from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server (PFDS) as discussed in the memo located in Appendix A-9 of this report. The 24-hour storm events were judged to be the most pertinent storm events due to the volume of runoff generated and the peak flows generated at the main outfall of each storm drain system. The 100-year storm event was modeled for the purpose of evaluating the level of service of the storm water conveyance system relative to the City's design standards. The 2-, 10-, and 50- year storms were modeled in order to understand the performance of the drainage conveyance system during storms with a higher probability of occurrence. See Appendix A-9 for a summary of the hydrologic results of the single-storm model simulations at each storm drain outfall modeled within the study area.

3.2.2 Proposed Condition Model Methodology

Results from the existing condition models were evaluated in several aspects to determine an effective balanced approach that will reduce the amount of surface ponding, and provide increased storm drain pipe capacities in the study area.

During the process of developing the proposed condition model to convey the 100-year storm flows, additional constraints became apparent due to the site topography and the density of development in the study area. Consideration was given to the following:

- Increasing overall storm drain pipe conveyance capacity
- Extending storm drain systems further upstream
- Increasing the amount of inlet catch basins.
- Replacing existing weep sumps with inlet catch basins connected to the storm drain system.
- Exploring alternative storm drain alignments within City right-of-way.
- Installation of tide/flap gates.

It was determined that large tributary drainage areas generated runoff that could not be effectively collected and conveyed by the current storm drain inlets located throughout the site. This effect, compounded with the undersized storm drain pipes and the tidal influence, allow large ponded areas on the street surfaces to form in the models. With this in mind, one of the first steps in generating the proposed condition model was to reduce large areas that drained to single inlets by distributing more catch basin collection points connected to the storm drain, and extending the storm drain pipe systems upstream to intercept more surface flow. The challenge with this approach is the fairly flat topography of the site which led to storm drain alignments with very flat slopes and dual pipe systems in order to maintain adequate conveyance.

Dual pipe storm drain systems allowed for increased conveyance capacity by providing additional cross-sectional area for conveyance and storage while maintaining a shallow storm drain system depth. Due to the low-lying topography of the study area and the tidal influence at the storm drain outfall locations, a shallow depth storm drain system is necessary to maintain positive drainage for the storm drain systems collecting runoff at sump locations in the study area and discharging toward the tidally influenced outfall locations.

Table 3-2 below shows a breakdown of the total amount of storm drain pipes included in the proposed condition model

Table 3-2: Proposed Condition Storm Drain Pipe Diameters and Lengths Modeled[1]

Diameter[2] (in)	Length (ft)	Pipe and Culvert Count	%
3	65	1	1%
12	102	1	1%
14x23	750	19	6%
15	0	0	0%
18	4,499	29	37%
19x30	138	3	1%
24	2,496	11	20%
30	4,268	10	35%
Total	**12,319**	**74**	**100%**

[1] Modeled pipe diameters may be revised to provide equivalent conveyance capacity during final engineering design.
[2] Elliptical Pipe dimensions are shown as "Rise" x "span."

The density of development within the study area led to situations where underground conflicts with wet and dry utilities forced the exploration of alternative storm drain alignments within the City right-of-way. Given the preferential direction of flow tended to lead through narrow right-of-way, privately owned property, or corridors thick with other underground utilities, the main storm drain pipes located at low points were re-directed to the nearest areas with minimal adjacent underground utilities to provide adequate room for construction and maintenance operations in the future.

Given that the study area is located adjacent to and drains to a tidally influenced water body, the proposed condition analysis incorporated flap gates in the model to simulate the effects of installing tide gates at the cleanouts upstream of the outfall locations.

To ensure the highest LOS of the storm drain system, emphasis must be placed on performing routine cleaning and maintenance on all storm drain inlets in the study area. This will ensure that trash and debris from the street, which could become lodged in grate and/or curb inlets, do not accumulate and interfere with storm water flows entering the subsurface conveyance system for which these recommendations have been made.

3.3 Results

3.3.1 Existing Condition

Modeling results highlighted deficiencies in the LOS of the conveyance system within the study area. This is most obvious in the storm drain networks located at major sump locations along Mission Boulevard, where a significant length of storm drain pipes identified in the inventory did not demonstrate capacity to convey the 100-year storm event. While reviewing the City's as-builts, The Project Team observed that a majority of the storm drain conveyance currently in place was designed in the 1950s. It is believed that those areas were not designed for the LOS currently required within the City of San Diego drainage design standards.

The following set of tables and figures reflect drainage results for the Existing condition with an assumed tailwater at MSL (0 Ft.). However, a number of tailwater scenarios have been modeled to indicate the LOS provided by the existing system for different "tidal" and "Sea Level Rise" (SLR) conditions including:

Table 3-3: Tidal and Sea Level Rise Scenarios Modeled[1, 2]

No Sea Level Rise incorporated	Sea Level Rise Incorporated
MSL (0 Ft.)	MHHW (2.59 Ft.) + 2050 SLR (1.6 Ft.)
MHHW (2.59 Ft.)	MHHW (2.59 Ft.) + 2100 SLR (4.9 Ft.)
HAT[3] (4.41 Ft.)	
Max Tide[3] – 11/25/2015 (5.08)	

[1] **MSL** – Mean Sea Level, **MHHW** – Mean Higher-High Water, **HAT** – Highest Astronomical Tide, **Max Tide** – Highest Observed Tide on 11/25/2015, **SLR** – Sea Level Rise

[2] Tidal datums referenced from La Jolla tide gage obtained from NOAA (https://tidesandcurrents.noaa.gov) converted to NGVD 29

[3] HAT and Max Tide scenarios were only modeled for the 100-year storm events as "high end" tide scenarios.

Refer to Appendix A-6.1 for additional inundation maps and summary results of the additional modeled scenarios.

Table 3-4 and Figure 3-2 provide a summary of results for storm drain conveyance capacity in each storm event modeled with the Mean Sea Level tailwater condition.

Table 3-4: Existing Condition Storm Drain Conveyance Capacity Summary – MSL (Tailwater = 0 Ft.)

Conveyance Capacity (%)	2-Year Storm Pipe Length (feet)	10-Year Storm Pipe Length (feet)	50-Year Storm Pipe Length (feet)	100-Year Storm Pipe Length (feet)
< 100	3,263	3,263	2,520	2,407
100 - 150	954	471	1,215	1,327
150 - 200	323	806	806	806
> 200	568	568	568	568
Total	**5,109**	**5,109**	**5,109**	**5,109**

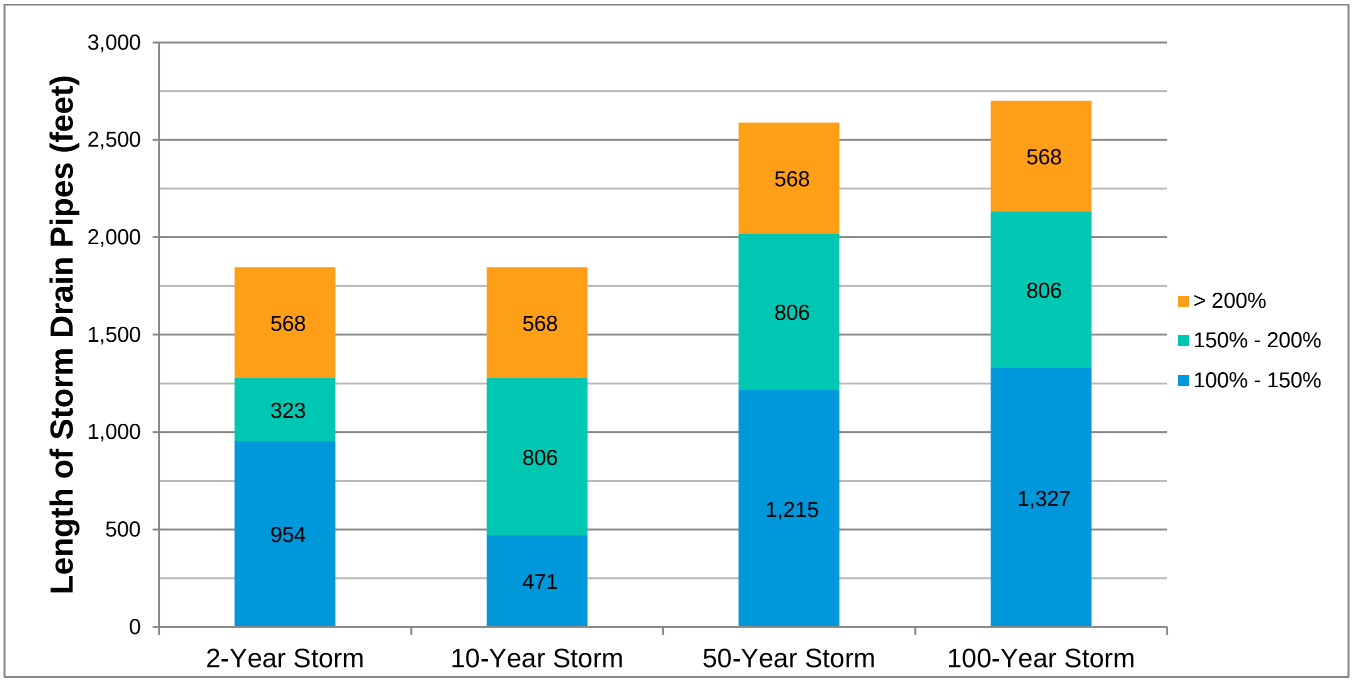


Figure 3-2: Existing Condition Storm Drain Conveyance Capacity – MSL (Tailwater = 0 Ft.)

The undersized conveyance capacity, coupled with the tidal influence on the storm drain caused a significant amount of storm water to become ponded on the street surfaces located at very low elevations throughout the study area. The result is that the storm drain pipes become full and the storm water ponds in excess of 1 foot on the surface at the low points. Table 3-5 and Figure 3-3 provide a summary overview of the peak storm water stored on the 2-D surface and the overall corresponding range of ponding depths for the storm events modeled with a Mean Sea Level tailwater condition.

Table 3-5: Existing Condition 2-D Cell Peak Storage Volume Summary – MSL (Tailwater = 0 Ft.)

Ponding Depth (inches)	2-Year Storm		10-Year Storm		50-Year Storm		100-Year Storm	
	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]
0 - 6	0.80	98	1.59	106	2.04	112	1.56	98
6 - 12	0.84	33	1.16	67	1.53	87	1.99	100
> 12	0.35	5	0.79	13	1.23	22	1.71	28
Total	**1.98**	**136**	**3.55**	**186**	**4.79**	**211**	**5.26**	**226**

[1] Structes counted are those with adjacent cell maximum depths within each of the ponding depth ranges

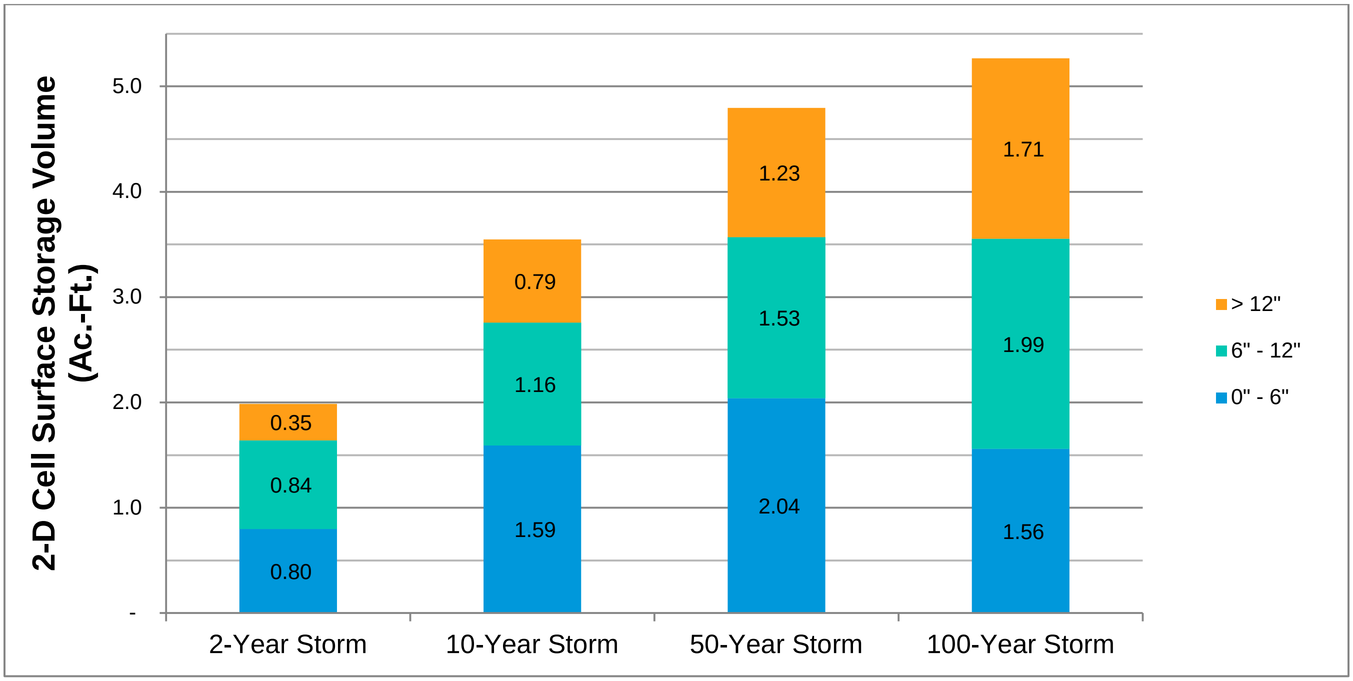


Figure 3-3: Existing Condition 2-D Cell Peak Storage Volume – MSL (Tailwater = 0 Ft.)

Refer to the existing condition maps located in Appendix A-6.1 for a visual representation of the depths and extents of surface inundation within the study area.

Table 3-6 presents a summary table of peak flow rate results at the storm drain outfall locations obtained from the modeling efforts.

Table 3-6: Existing Condition Storm Drain Outfall Summary – MSL (Tailwater = 0 Ft.)

Outfall ID	Drainage Area (Ac.)	Peak Flow Rates (cfs)				Pipe Size (in.)	Number of Pipes
		2-YR	10-YR	50-YR	100-YR		
Mariner's Basin/Bonita Cove*							
120007	5.0	8.4	9.6	12.3	13.3	24	1
120001	13.2	4.3	4.7	5.0	5.1	15	1
120002	6.3	5.1	7.2	8.0	8.0	21	1
120004	1.4	1.3	1.9	2.4	2.6	15	1
120005	11.4	3.7	4.1	4.3	4.5	15	1
Entrance Channel							
120006	1.6	0.9	2.0	3.0	3.4	18	1
120003	9.5	7.4	13.0	18.8	21.2	18	1

3.3.2 Proposed Condition

As mentioned previously, the proposed condition model extended the length of storm drain pipe in the study area to create more connections at localized low points with existing weep sump structures which will be replaced with concrete catch basin structures. The overall topography of the area was such that it created the necessity for dual pipe storm drain mainlines, in order to increase conveyance capacities. A limiting factor in the size of the pipes proposed was maintaining a minimum cover above the storm drain pipes. For this reason, some of the proposed storm drain pipe segments will still be flagged as having a flow capacity of greater than 100% signifying that the pipes are pressurizing and conveying flow in excess of the normal depth conveyance capacity. The summary results that describe the 2-D ponding depths are based on the length of Mission Boulevard south of San Fernando Place being milled approximately 3 inches to increase the surface conveyance capacity of the street.

Table 3-7 and Figure 3-4 present a summary overview of the results for the entire storm drain pipe conveyance system modeled in the proposed condition.

Table 3-7: Proposed Condition Storm Drain Conveyance Capacity Summary - MSL (Tailwater = 0 Ft.)

Conveyance Capacity (%)	2-Year Storm Pipe Length (feet)	10- Year Storm Pipe Length (feet)	50- Year Storm Pipe Length (feet)	100- Year Storm Pipe Length (feet)
< 100	12,143	10,213	8,549	7,414
100 - 150	175	1,930	3,081	3,333
150 - 200	-	175	688	1,572
> 200	-	-	-	-
Total	**12,319**	**12,319**	**12,319**	**12,319**

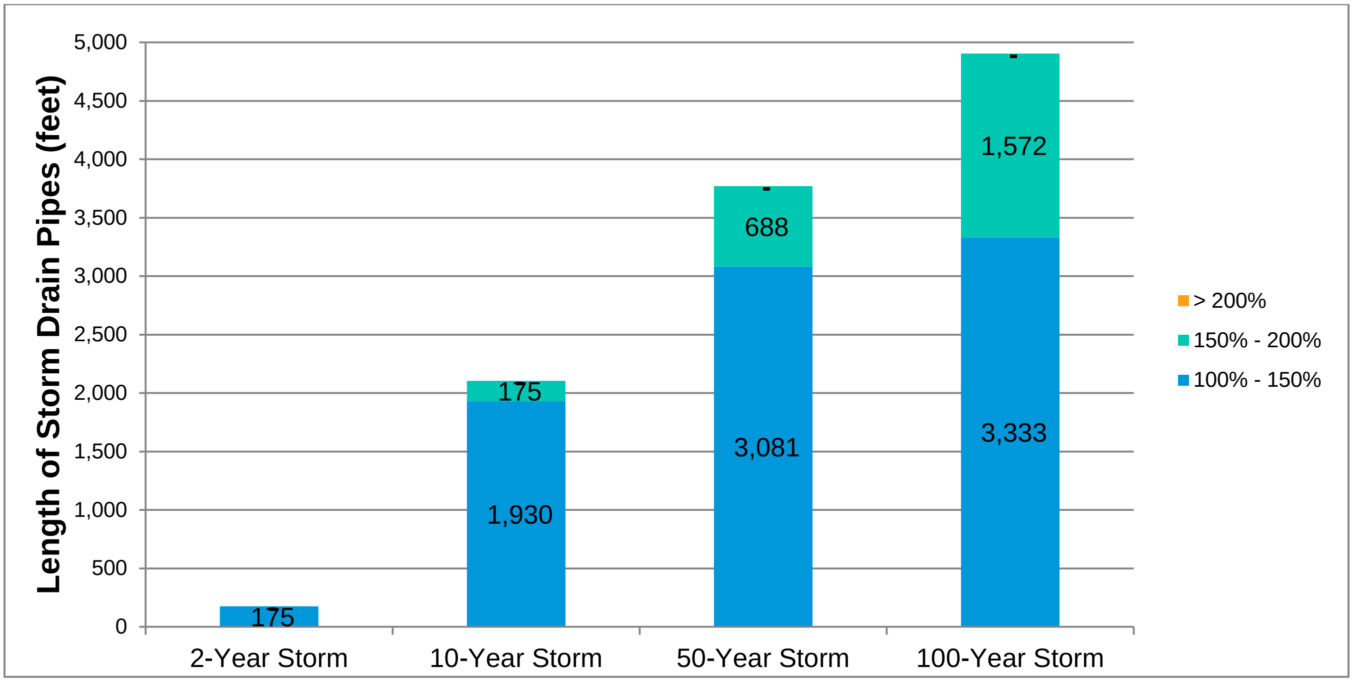


Figure 3-4: Proposed Condition Storm Drain Conveyance Capacity – MSL (Tailwater = 0 Ft.)

Though the storm drain pipe capacities suggest that the proposed infrastructure improvements will result in drainage conditions similar to the existing condition, the true benefit of implementing storm drain improvements will be realized through the reduction of impact on the street surface. By increasing the amount of sub-surface conveyance systems, the street surfaces will be prone to reduced extents, depths, and frequency of inundation.

Table 3-8 and Figure 3-5 present a summary overview of the impact that the replacement and extension of storm drain infrastructure affected on the surface ponding conditions:

Table 3-8: Proposed Condition 2-D Cell Peak Storage Volume Summary – MSL (Tailwater = 0 Ft.)

Ponding Depth (inches)	2-Year Storm		10-Year Storm		50-Year Storm		100-Year Storm	
	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]	Volume (Ac.-Ft.)	Structures (#)[1]
0 - 6	0.14	15	0.26	28	0.39	43	0.43	50
6 - 12	0.01	-	0.01	1	0.03	1	0.08	1
> 12	-	-	-	-	-	-	-	-
Total	**0.15**	**15**	**0.27**	**29**	**0.42**	**44**	**0.51**	**51**

[1] Structes counted are those with adjacent cell maximum depths within each of the ponding depth ranges

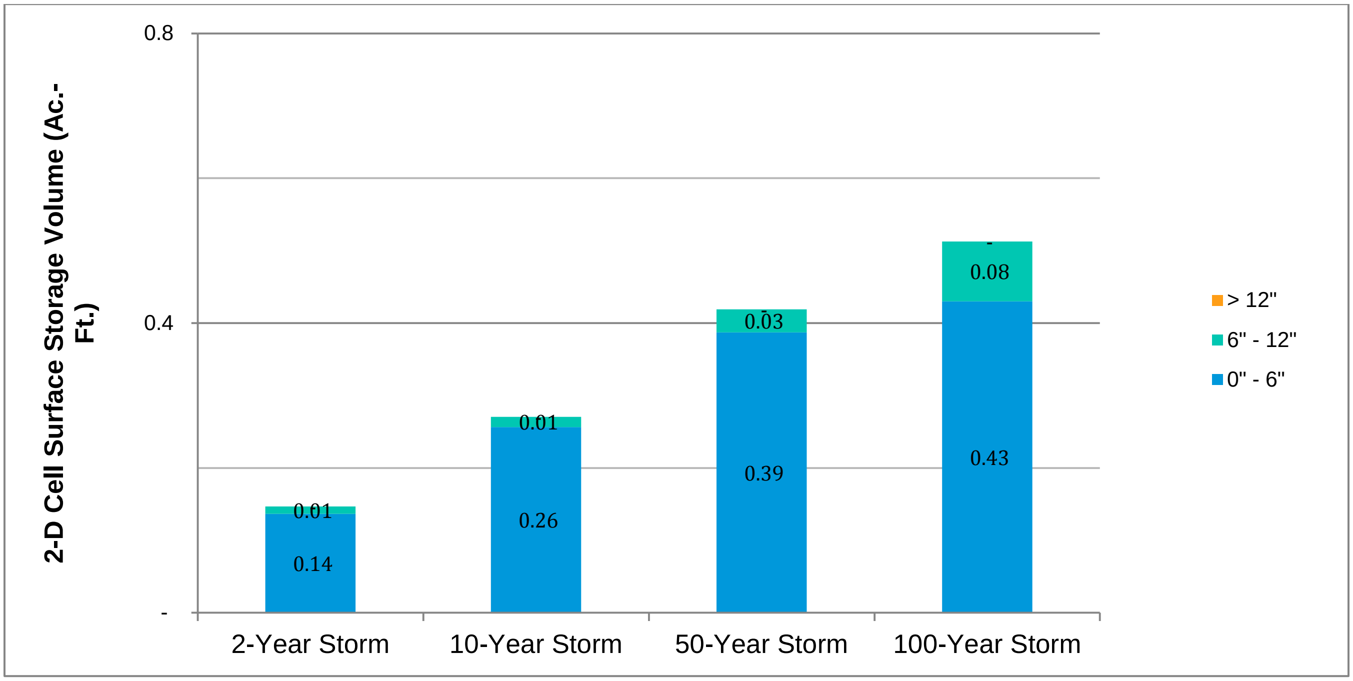


Figure 3-5: Proposed Condition 2-D Cell Peak Storage Volume – MSL (Tailwater = 0 Ft.)

Table 3-9 presents a summary of the storm drain outfalls for the proposed condition model.

Table 3-9: Proposed Condition Storm Drain Outfall Summary – MSL (Tailwater = 0 Ft.)

Existing Condition Outfall ID	Proposed Condition Outfall ID	Status	Drainage Area (Ac.)	Peak Flow Rates (cfs)				Pipe Size (in.)	Number of Pipes
				2-YR	10-YR	50-YR	100-YR		
Mariner's Basin/Bonita Cove*									
--	120007	Replace	5.0	6.4	9.6	12.3	13.3	24	1
--	120001	Replace	20.5	21.9	34.1	46.0	49.3	30	2
120002	120008	Realigned	12.3	18.1	27.3	37.0	40.6	30	2
--	120004	Replace	1.4	1.3	1.9	2.4	2.6	18	1
New	120009	New	20.7	25.4	39.4	52.4	56.6	30	2
--	120005	Replace	0.3	0.5	0.7	0.9	1.0	18	1
New	120010	New	2.9	3.9	6.0	7.9	9.0	18	1
Entrance Channel									
--	120006	Existing	1.6	0.9	2.0	3.0	3.4	18	1
--	120003	Replace	9.5	7.6	13.7	20.1	22.8	18	1

[1] Outfall 120009 results from a realignment of the existing storm drain system outletting at 120005. Outfall location 120005 was preserved and will be extended into the bay.

[2] Outfall 120010 is required to drain an existing sump area in Asbury Court that has no existing outlet.

Model results suggest that ponding in excess of 6-inch depth is significantly reduced from approximately 3.7 Ac.-Ft. in the existing condition to 0.08 Ac.-Ft. in the proposed condition for a 100-year storm event in combination with a Mean Sea Level tailwater condition.

Refer to the maps in Appendix A for more details on the 100-year model results.

4.0 Water Quality Assessment

A water quality assessment was performed as part of the WMP in order to estimate the existing condition watershed pollutant characteristics and provide a means to quantify the water quality benefits possible from proposed Green Infrastructure (GI) solutions across the watershed. The South Mission Beach study area is subject to water quality-based regulatory drivers, including the MS4 Permit and the recently issued State Trash Amendments (Resolution 2015-0019). Siting constraints for water quality solutions include a highly urbanized setting, flat topography, shallow ground water, potential tidal influence, and limited public right-of-way areas. In order to identify potential water quality improvements and their associated benefits; a complete hydrologic water quality model is needed that includes pollutant loading based on land use within the study area. The design of GI solutions is an iterative process in which each location is refined, as necessary, and re-evaluated until the appropriate levels of watershed pollutant load reductions are achieved as a result of the proposed GI features for the study area (and contributing benefit towards the overall watershed goals). The water quality assessment narrative includes a discussion of the watershed pollutants of concern and describes the model selection, water quality parameters, and results.

4.1 Priority Pollutants of Concern

The WMP water quality assessment incorporated the applicable priority pollutants of concern. The preparation of the South Mission Beach WMP included research in order to identify and document the priority pollutants of concern applicable to the South Mission Beach study area and Mission Bay Watershed. This included a review of the current 303(d) List along with the Mission Bay WQIP.

The 2014 and 2016 California Integrated Report, published by the California State Water Quality Control Board was reviewed. This report is available online and includes spreadsheet data of the 2014 and 2016 Clean Water Act Section 303(d) List for water bodies throughout California. The South Mission Beach study area drains to Mission Bay, specifically Bonita Cove, and Mariners Basin. No Total Maximum Daily Loads (TMDLs) have been developed for these water bodies. The applicable water bodies appearing on the list are summarized in Table 4-1.

Table 4-1: Summary of Water Bodies on 303(d) List[1]

Water Body (Area or Length)	Pollutant[2]	Pollutant Category
Mission Bay (1968 Acres)	Mercury	Metals/Metalloids
Mission Bay (1968 Acres)	PCBs (Polychlorinated biphenyls)	Other Organics
Mission Bay Shoreline, at Bonita Cove (0.09 Miles)	Indicator Bacteria	Fecal Indicator Bacteria
Mission Bay Shoreline, at Bonita Cove eastern shore (0.03 Miles)	Indicator Bacteria	Fecal Indicator Bacteria

[1] Source: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml
[2] Category 5 – 303(d) list requiring the development of TMDL.

The Mission Bay WQIP includes information related to the pollutants of concern and identifies highest priority water quality conditions in the Mission Bay WMA; however, the WQIP states that the identified highest priority water quality conditions are applicable to Tecolote Creek (indicator bacteria identified), the La Jolla Area of Special Biological Significant (ASBS) (sediment identified), and various locations along the Pacific Ocean Shoreline (indicator bacteria identified). The WQIP goes on to state that no highest priority water quality conditions have been identified for the Mission Bay subwatersheds, because priority water quality conditions for those waterbodies did not meet the criteria in the priority and highest priority water quality conditions selection methodology utilized. The Projectcleanwater.org Website, where the Mission Bay WQIP resides, provides general information related to each watershed in the San Diego Region and provides a platform for Copermittee/Working Groups to post updated information resulting from discussions with the Regional Board and stakeholders. The Projectcleanwater.org Website identifies indicator bacteria, nutrients, trace metals and toxics as pollutants of concern for the Mission Bay and La Jolla WMA.

Based on the research of the related available data, pollutants of concern for the South Mission Beach WMP for incorporation into the water quality assessment have been identified as summarized in Table 4-2. Fecal coliform is identified as the highest priority pollutant of concern based on the Bonita Cove 303(d) listing. Specific metals have been identified as pollutants of concern based on trace metals being identified as such on the Projectcleanwater.org Website, sources of these specific metals commonly utilized in urban settings, and the potential toxicity these metals have when present in the water column or sediment.

Table 4-2. South Mission Beach WMP Pollutants of Concern

Pollutant	Classification
Fecal Coliform	Highest Priority Pollutant of Concern
Total Copper	Priority Pollutant of Concern
Total Lead	Priority Pollutant of Concern
Total Zinc	Priority Pollutant of Concern

4.2 Water Quality Assessment Reduction Goals

Water quality assessment reduction goals were determined in order to provide a basis of design for GI solutions. In terms of selecting reduction goals, TMDLs, if developed, typically require the greatest amount of load reduction for compliance and thus TMDLs typically are the driver to identify water quality assessment reduction goals. As previously stated, the South Mission Beach watershed does not drain to a water body with a developed TMDL and thus is not currently regulated by a TMDL. A TMDL has been developed for the San Diego Region (Resolution No. R-2010-0001) and is referred to as the 20 Beaches and Creeks TMDL. As the name implies, the 20 Beaches and Creeks TMDL includes several Pacific Ocean beaches and several creeks. The 20 Beaches and Creeks TMDL lists a bacteria wet weather target of exceedance days less than or equal to 22 percent. That is for each wet weather day, 22 percent or less of the samples collected in the receiving water shall be below the water quality objectives listed in the TMDL (extracted from the *San Diego Region Basin Plan* [Basin Plan]). Considering that the highest priority pollutant of concern is fecal coliform and that Bonita Cove has a Category 5 listing on the 303(d), it is reasonable that the wet weather maximum value of 22 percent for exceedance days be applied to the South Mission Beach WMP for the purposes of defining a GI solutions basis of design. It is noted that this document does not state or imply that Bonita Cove or Mariners Basin should or should not be regulated by a bacteria TMDL, but rather that it is appropriate to use criteria similar to the 20 Beaches and Creek TMDL to estimate the target load reduction for proposed GI solutions.

Improvements to reduce bacteria loading will result in load reductions for other pollutants as well. GI solutions implemented within the watershed will function through combination of infiltration, evapotranspiration, and biofiltration processes, in addition to potential elimination of flow and associated pollutants with low flow sewer diversions. Each of these processes will provide watershed pollutant reduction for not only bacteria but also the identified metals in addition to other pollutants. The PCSWMM modeling tool was used to quantify the bacteria, and metal load reductions as part of this water quality assessment.

4.3 Model Setup

4.3.1 Model Selection

The PCSWMM modeling tool was selected for the water quality analysis based on the software's ability to seamlessly integrate 1D-2D hydrologic modeling with water quality analysis. Utilizing a single tool to perform both the flood control analysis and water quality and GI solution design analyses ensures consistency between the two modeling efforts. The PCSWMM modeling tool has the following capabilities related to water quality analysis.

- Allows for the generation of non-point source pollutant loadings for wasteload allocation studies
- Models direct contribution from rainfall and baseflow for an unlimited number of pollutants
- Allows for different semi-empirical/physically based options to represent pollutant build-up and wash-off
- Includes land use impacts and pollutant interdependence
- Models pollutant wash-off during storm events
- Provides routing of the pollutants through the conveyance system
- Simulates reduction in wash-off load due to Best Management Practices (BMPs) and exponential decay
- Models the reduction in pollutant load through treatment at nodes to represent treatment at storage units or natural processes in pipes and channels

4.3.2 Rainfall Data

The PCSWMM tool used rainfall data for the average rainfall year to perform a water quality assessment. Consistent with other efforts within the San Diego Region, the average rainfall year for the South Mission Beach WMP water quality assessment is considered October 1, 2002 through September 30, 2003 (aka – the 2003 Water Year). The 2003 Water Year (2003 WY) was used under the Mission Bay WMA WQIP analyses as a representation of typical wet and dry weather conditions, based on analysis of rainfall data across a 20-year time period.

The closest rain gages to the study are for which incremental rainfall data is available for this period of time are:

1) Fashion Valley rain gage – Automatic Local Evaluation in Real-Time (ALERT)
2) Lindbergh rain gage. – California Climatic Data Archive (CCDA)

The CCDA Lindbergh rain gage has a longer more robust period of record compared to the ALERT Fashion Valley rain gage. Historically, CCDA Lindbergh rain gage data is used to supplement data gaps in nearby ALERT stations. For this study, data for the Lindbergh Rain Gage were obtained from the Projectcleanwater.org website. Rainfall data for 1984 to 2004 were analyzed, and the 2003 WY, with 10.31 inches of rainfall, was determined to represent the average year and incorporated into the modeling tool.

Table 4-3 provides a summary of the rainfall data.

Table 4-3: Average Year Rainfall Data Summary

Period	Rain Gage	Total Rain[1]	Wet Days[2]
Oct. 1, 2002 – Sept. 30, 2003	Lindbergh	10.31 inches	42

[1] Source: https://www.projectcleanwater.org/download/rainfall-data/
[2] A wet day is considered as rainfall >=0.2 inches within 24 hours and the following 72 hours.

4.3.3 Pollutant Parameters

Priority pollutants of concern were incorporated into the PCSWMM model based on typical event mean concentration (EMC) values for the subcatchment land uses. The EMC is described as the average pollutant concentration in storm water runoff for the storm event, and typical values have been determined based on various storm water monitoring. The EMC values combined with the modeling flow rates represent the generation and transport of pollutants within the South Mission Beach study area. The EMC values incorporated into the water quality assessment are presented in Table 4-4.

Table 4-4: Modeling Event Mean Concentration Values[1]

Land Use	Fecal Coliform (MPN/100ml)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	TSS[2] (mg/L)	Nitrate[2] (mg/L)
Agriculture	6.03E+04	100.1	30.2	274.8	999	34.4
Commercial	7.99E+04	31.4	12.4	237.1	67	0.55
Educational	7.99E+04	19.9	3.6	117.6	99.6	0.61
Industrial	3.76E+03	34.5	16.4	537.6	219	0.87
Transportation	1.68E+03	52.2	9.2	292.9	77.8	0.74
Open Space	6.31E+03	10.6	3	26.3	216.6	1.17
SF Residential	3.11E+04	18.7	11.3	71.9	124.2	0.78
MF Residential	1.18E+04	12.1	4.5	125.1	39.9	1.51

[1] Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008.
[2] Not considered priority pollutants of concern; however, included in PCSWMM modeling.

4.3.4 BMP Effectiveness

The South Mission Beach WMP included research of published literature related to BMP effectiveness in order to incorporate load reduction values for storm runoff treated by and discharged from GI solutions. The Final Report, International Stormwater BMP Database, 2016 Summary Statistics (2016 BMP Database Report), published by the Water Environment & Reuse Foundation (WE&RF), dated 2017 was utilized to obtain pollutant concentration reduction values for the BMPs being proposed within the watershed. Pollutant concentration reduction values listed for bioretention BMPs in the 2016 BMP Database Report appear to correlate to BMPs defined as biofiltration in The City of San Diego Storm Water Standards manual (SWSM), dated October 1, 2018 and were considered as such by this assessment. In the case of fecal coliform, the 2016 BMP Database Report does not include data for bioretention, and thus the data for media filter type BMPs were used for biofiltration BMPs (i.e., biofiltration BMPs function similar to and have similar performance to media filter BMPs). Pollutant concentration reduction values were calculated based on the median influent and effluent values presented in the applicable BMP summary table in the 2016 BMP Database Report. Table 4-5 provides a summary of the pollutant concentration reduction values for the priority pollutants of concern. Please note that for the portion of storm water runoff treated through infiltration, effectiveness is considered as 100 percent pollutant removal.

Table 4-5: Modeling Biofiltration BMP Effectiveness Values[1]

Pollutant	Median In (MPN/ 100 mL or µg/L)	Median Out (MPN/ 100 mL or µg/L)	BMP Pollutant Removal Effectiveness
Fecal Coliform[2]	900	400	56%
Total Copper[3]	9.2	5.7	38%
Total Lead[3]	3.16	0.32	90%
Total Zinc[3]	49.8	12	76%

[1] Source: Final Report, International Stormwater BMP Database, 2016 Summary Statistics, published by the WE&RF, dated 2017.
[2] Media filter BMP data used (bioretention BMP data not available).
[3] Bioretention BMP data used.

4.3.5 Existing Weep Sumps

The existing inventory contains seventeen (17) weep sumps that very in depth and as seen in Figure 4-1 below infiltrate runoff directly into the un-improved subsurface. For modeling purposes and to establish a baseline pollutant removal these weep sumps were assigned an infiltration rate of 0.5 in/hr with a 2'x3' footprint resulting in a constant infiltration rate of 0.0000694 cfs. In the modeled condition the **weep sumps removed 0.12 Million Gallons (MG) of the 17 MGs** of runoff generated during the 2003 water year.

Figure 4-1: Existing Weep Sump

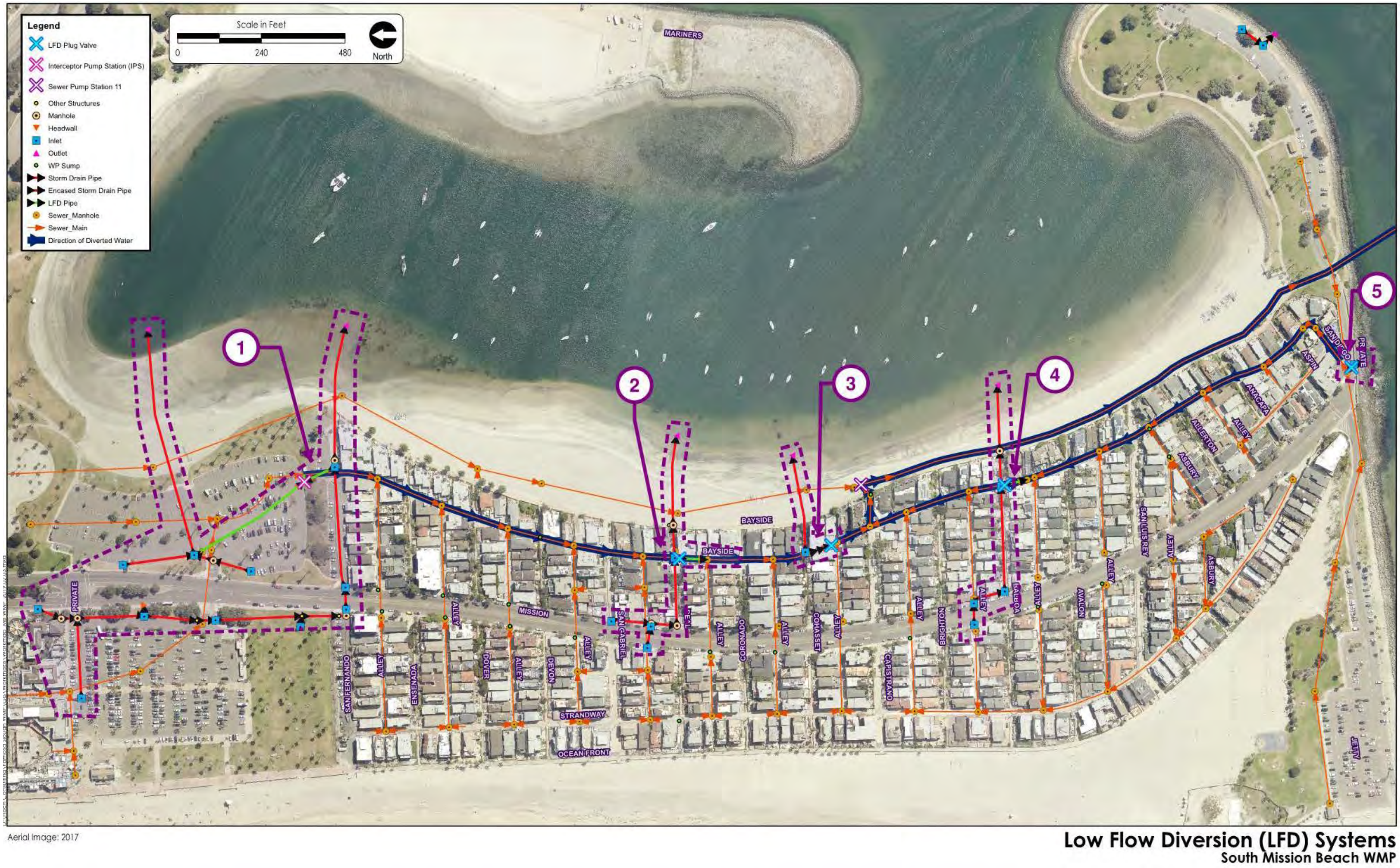
4.3.6 Existing Low-Flow Sewer Diversion Systems

The South Mission Beach study area encompasses five (5) low-flow diversion (LFD) systems as displayed in Figure 4-2. One of the LFD systems is an Interceptor Pump Station (IPS), and the other four LFD systems are Diversion Valves (DVs) which operate via gravity flow. From discussions with City Staff, the LFD systems were designed to be automated and divert dry weather flow and the first twenty minutes of all storm events to a sewer main for treatment at the Point Loma Wastewater Treatment Plant (WWTP). Flows from the first twenty minutes of all storm events (also known as the "first flush") and dry weather conditions typically contain concentrated levels of pollutants in areas with a high proportion of impervious surfaces. The five LFD systems in this study area were designed to intercept these flows from reaching coastal outfalls and divert the water to the sewer system for treatment.

From conversations with City staff it was determined that the four gravity low-flow diversion systems are currently not operating as intended, most likely due to the underground electronic equipment being compromised by water. The low-flow diversion valves are instead left open to intercept dry weather flows and are manually plugged by City maintenance staff when storm events are forecasted.

As shown in Figure 4-2, the five LFD systems divert stormwater into the sewer system. Diverted stormwater from LFD Systems #1, 2, and 3 travel south through a sewer force main until it reaches the intersection of Capistrano Place and Bayside Lane. Diverted stormwater from LFD Systems #4 and 5 travel north through a sewer main and reach the intersection of Capistrano and Bayside Lane. At this intersection, the flow from the two branches combine and travel east to Sewer Pump Station #11. Sewer Pump Station #11 pumps all diverted water into a force main that travels south along the coast and eventually crosses Mission Bay channel to Ocean Beach. From there the sewer main continues to travel south and terminates at Point Loma WWTP.

Figure 4-2: Map of LFD Systems



The study area contains two different types of LFD systems; one pumped LFD system and four gravity LFD systems. The following paragraphs describe the types of LFD systems and the layout of each of the five existing LFD systems.

LFD System #1 – Mariner's Cove Parking Lot

LFD System #1 is a pumped LFD system located on the southern shoulder of the Mariner’s Cove parking lot. As shown in Figure 4-3, this LFD system utilizes an Interceptor Pump Station (IPS-13) to divert and pump targeted stormwater into a sewer force main for treatment at the Point Loma Wastewater Treatment Plant (WWTP). As illustrated in Figure 4-4 a diversion weir within a storm drain inlet diverts dry weather flows and the first flush (first 20 minutes) of wet weather runoff into a 6-inch PVC diversion pipe that connects to a wet well. A floater device in the wet well tracks the height of the water surface, and once the water in the wet well reaches a fixed depth, mechanical pumps turn on and begin to pump the water into a sewer force main.

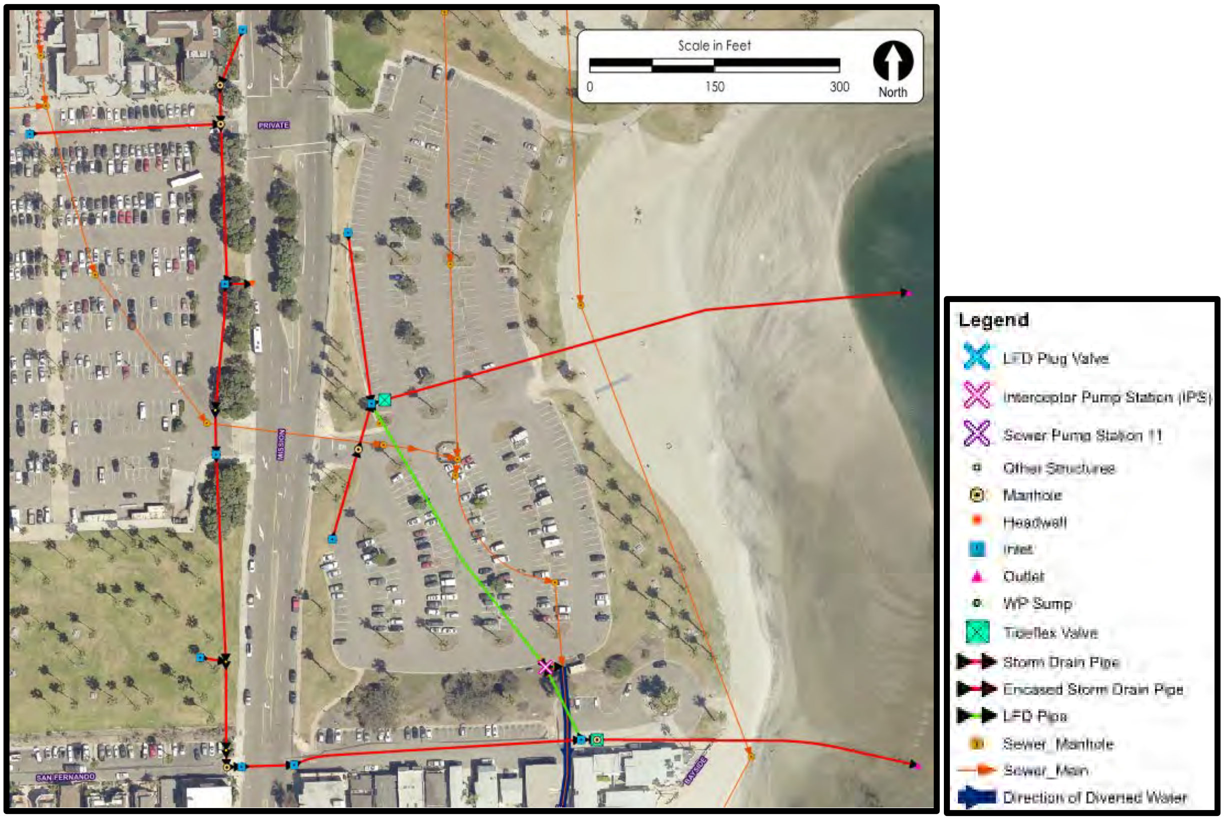


Figure 4-3: Layout of LFD System #1

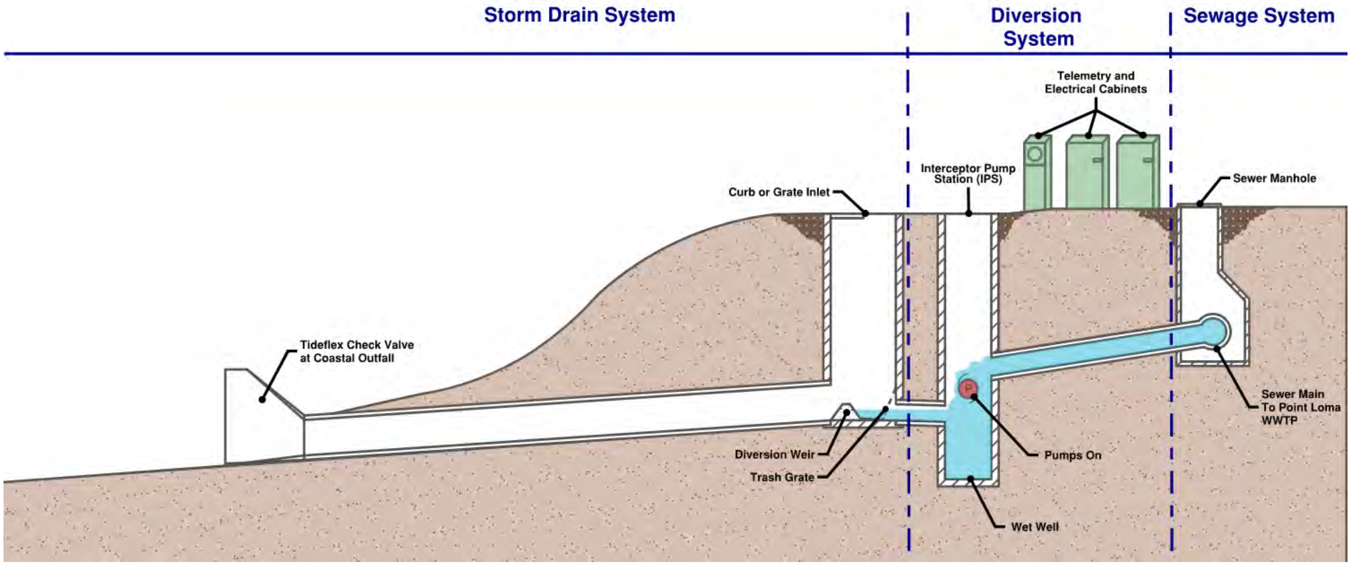


Figure 4-4: Concept Diagram of Pumped LFD System during Dry weather and First Flush Conditions

As shown in Figure 4-5, after the first 20 minutes of a storm event (also known as the "first flush"), a telemetry cabinet signals the IPS to shut down and the stormwater eventually topples the diversion weir, goes through a tideflex check valve, and outfalls on the beach. The tideflex check valve regulates the flow and ensures that seawater does not flow into the storm drain system. For certain LFD system layouts, such as this layout, the tideflex valve is located inside a manhole structure and is not fixated at the outfall as shown in the concept diagram.

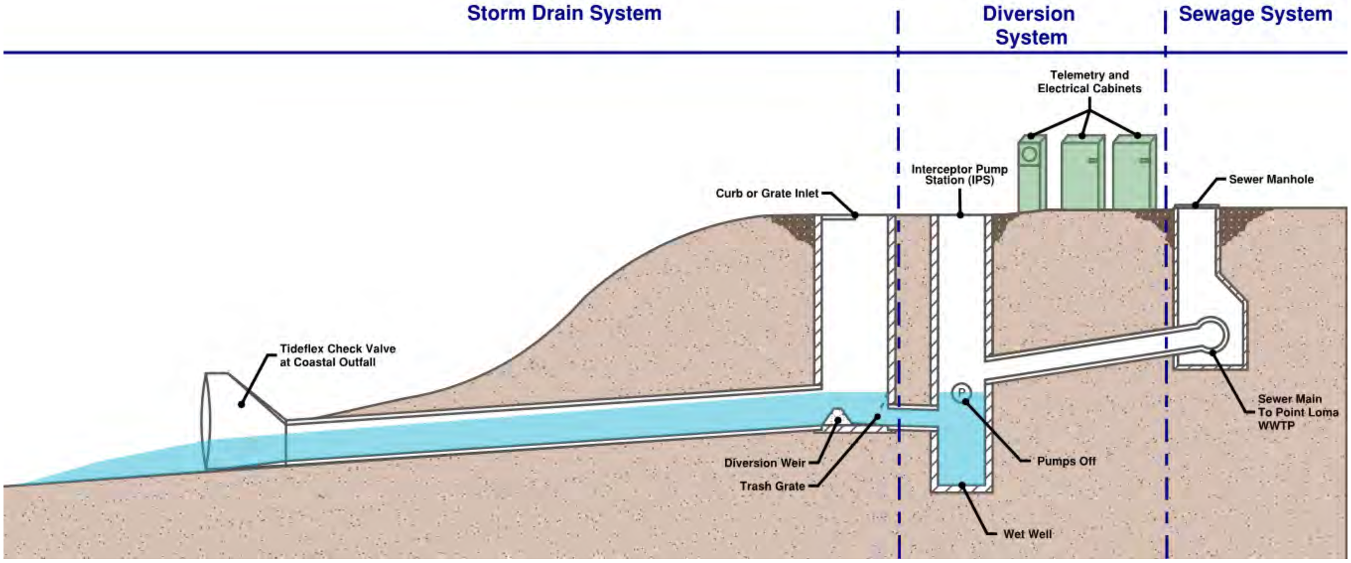


Figure 4-5: Concept Diagram of Pumped LFD System during Storm Event

LFD System #2 – Deal Court and Bayside Lane

As shown in Figure 4-6, located at the intersection of Deal Court and Bayside Lane, LFD System #2 utilizes a diversion weir and motorized plug valve to divert dry weather and "first flush" flows into a 6-inch PVC diversion pipe which connects to a sewer main. As shown in Figure 4-7, the LFD system does not require pumping and instead utilizes gravity to divert stormwater into the sewer main. A motorized plug valve is located within the diversion pipe and its operations are controlled by a telemetry cabinet. The telemetry cabinet keeps the valve open during dry weather and the first 20 minutes of a storm event and then signals valve to close after 20 minutes into a storm event.

Figure 4-6: Layout of LFD System #2

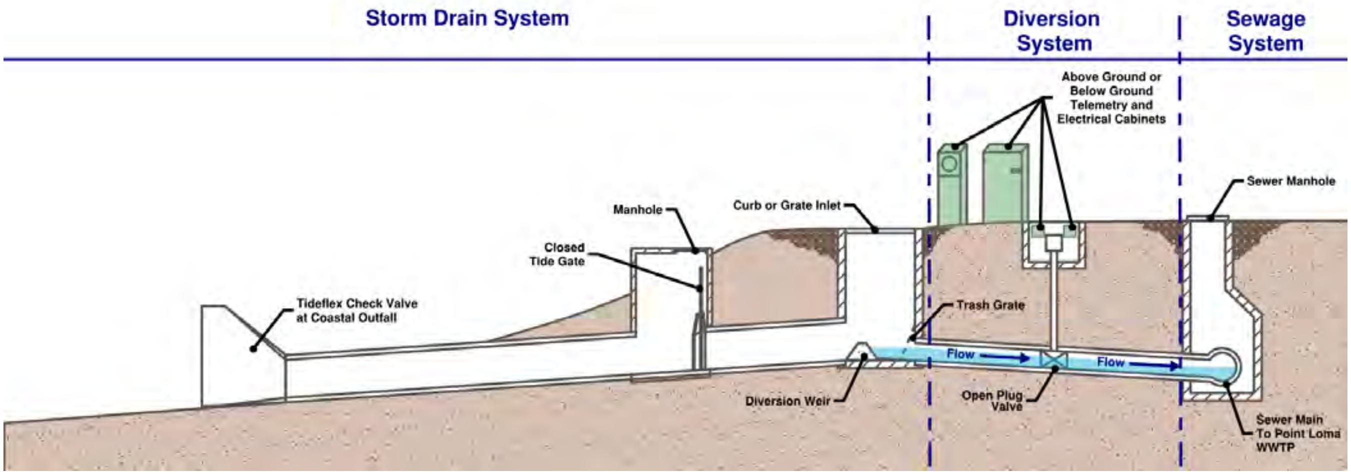


Figure 4-7: Concept Diagram of Gravity LFD System with Tide Gate During Dry weather and First Flush Conditions

Figure 4-8 illustrates the site conditions when the plug valve is closed after 20 minutes into a storm event. The storm drain system connected the LFD System #2 contains a tide gate and tideflex valve. During a storm event the tide gate is manually opened by City staff so that stormwater can exit through a tideflex valve onto the beach. For certain LFD system layouts, such as this layout, the tideflex valve is located inside a manhole structure and is not fixated at the outfall as shown in the concept diagram.

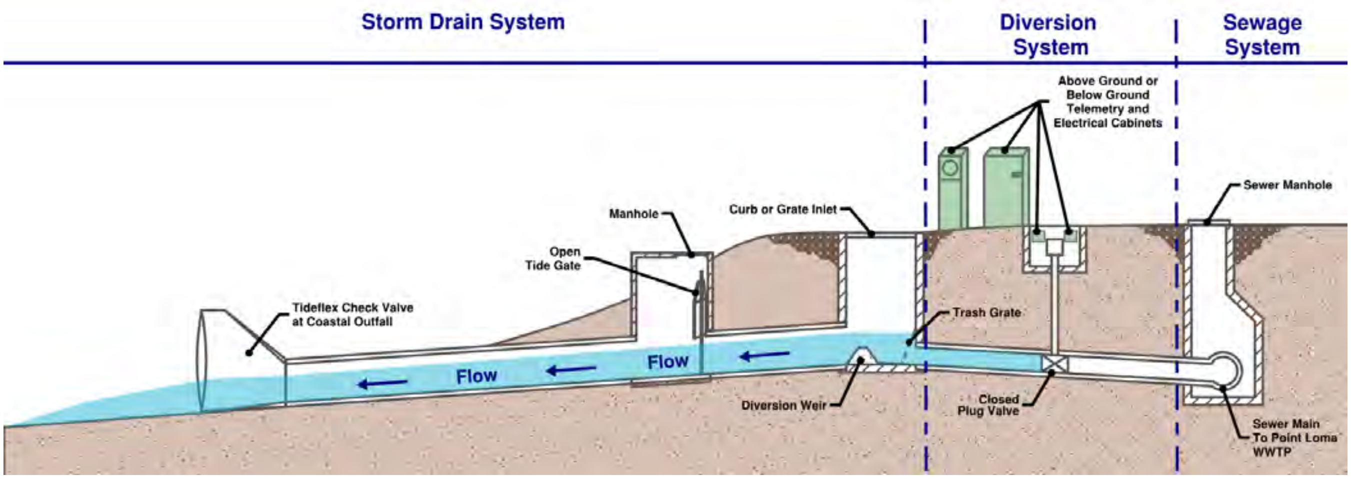


Figure 4-8: Concept Diagram of Gravity LFD System with Tide Gate During Storm Event

LFD System #3 – Cohasset Court and Bayside Lane

Located at the intersection of Cohasset Court and Bayside Lane, LFD System #3 also utilizes a gravity LFD system as described previously for LFD system #2. However, as shown in Figure 4-10 and Figure 4-11, this LFD system is connected to a storm drain system that does not contain a tide gate. The storm drain system only contains a tideflex valve as shown in Figure 4-9.

Figure 4-9: Layout of LFD System #3

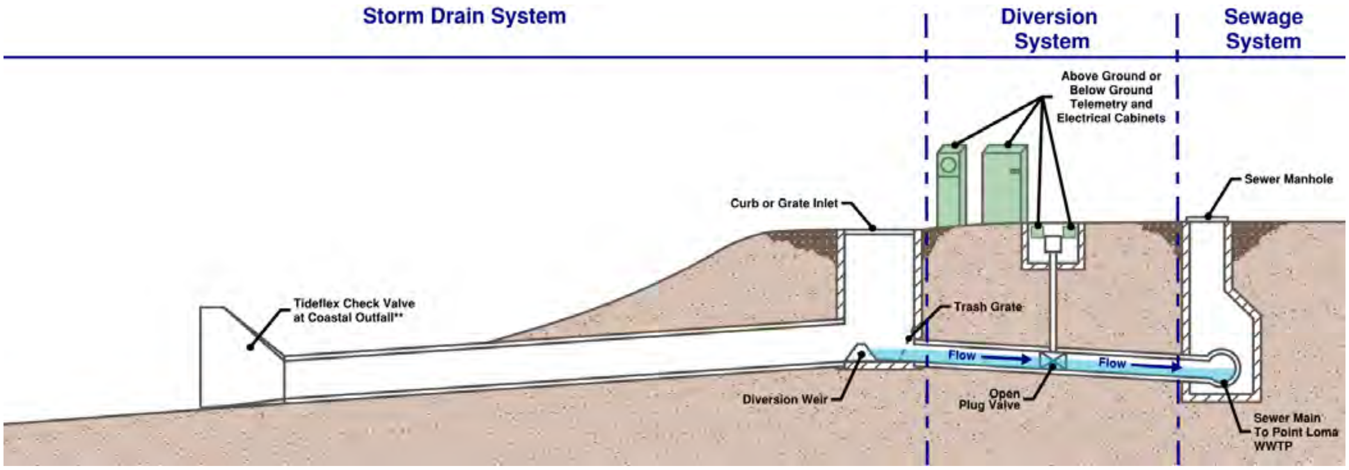


Figure 4-10: Concept Diagram of Gravity LFD System During Dry Weather and First Flush Conditions

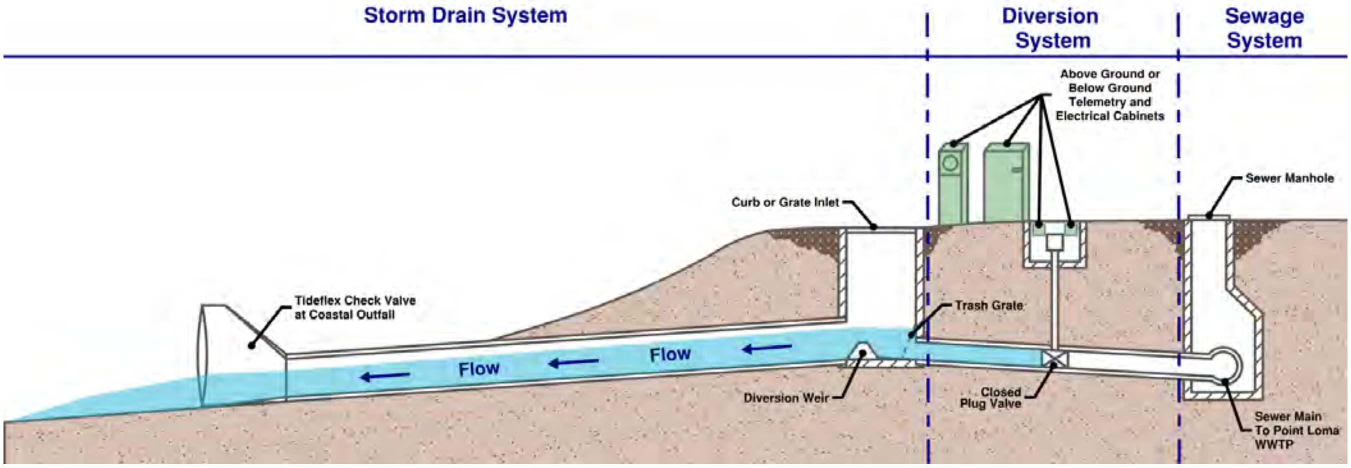


Figure 4-11: Concept Diagram of Gravity LFD System During Storm Event Conditions

LFD System #4 – Balboa Avenue and Bayside Lane

As shown in Figure 4-12, located at the intersection of Balboa Avenue and Bayside Lane, LFD System #4 also utilizes a gravity LFD system and tide gate as described previously for LFD system #2 (See Figure 4-7 and Figure 4-8).

Figure 4-12: Layout of LFD System #4

LFD System #5 – San Diego Place & Mission Boulevard

As shown in Figure 4-13, LFD System #5 is located at the intersection of San Diego Place and Mission Boulevard. A diversion weir is located within the combination curb and grate inlet. A six-inch PVC pipe diverts stormwater during low flow conditions to a sewer manhole northwest of the storm drain inlet, as illustrated in Figure 4-10 and Figure 4-11. A tideflex valve was placed at the end of the storm drain outfall, however, during field visits the Project Team observed that the tideflex valve was severed off with a portion of the storm drain pipe.

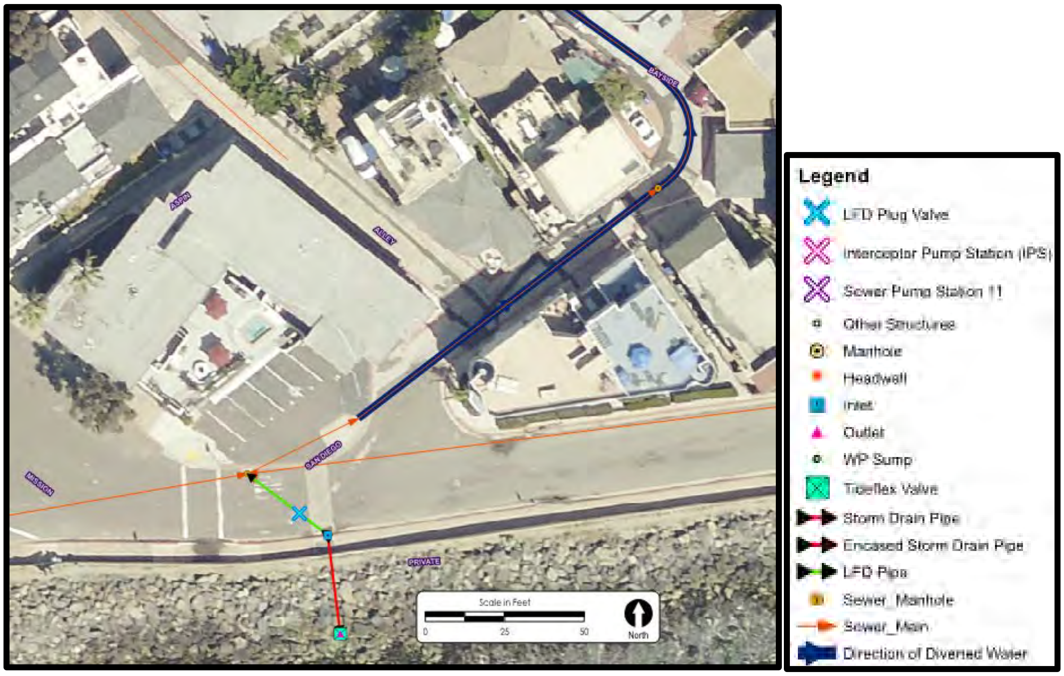
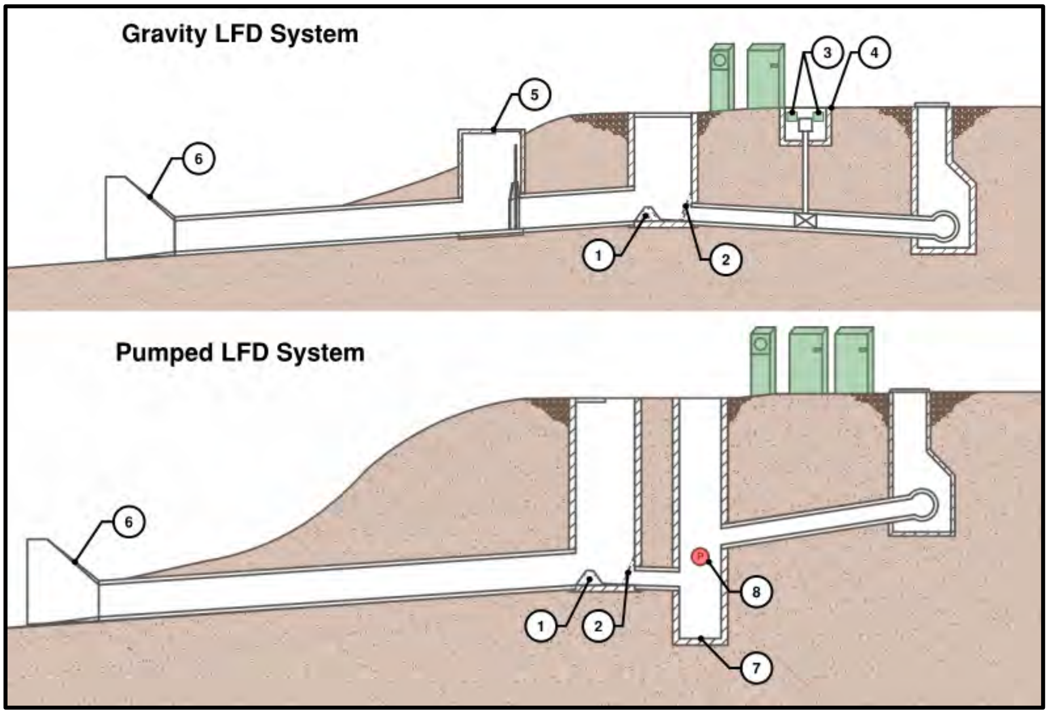


Figure 4-13: Layout of LFD System #5

From conversations with City staff, it was discovered that the LFD systems that utilized motorized diversion plug valves (LFD Systems #2, 3, 4 and 5) are not operating as intended and must be manually opened and closed. The City staff believes that the motorized functionality was damaged when water infiltrated the electronic cabinets that were stored within the plug valve handholes as shown in **Figure 6-4**. Currently, the City staff leaves the plug valves open, intercepting all dry weather flows and manually plugs the LFD system before any forecasted storm events.

Figure 4-14: LFD Plug Valve Handhole

Figure 4-15, displays site photos of the different components of the pumped and gravity LFD systems.



Legend:
(1) Diversion Weir
(2) Trash Grate
(3) Underground Telemetry and Electrical Cabinets
(4) Plug Valve Handhole
(5) Tide Gate
(6) Tideflex Check Valve
(7) Wet Well
(8) Pumps

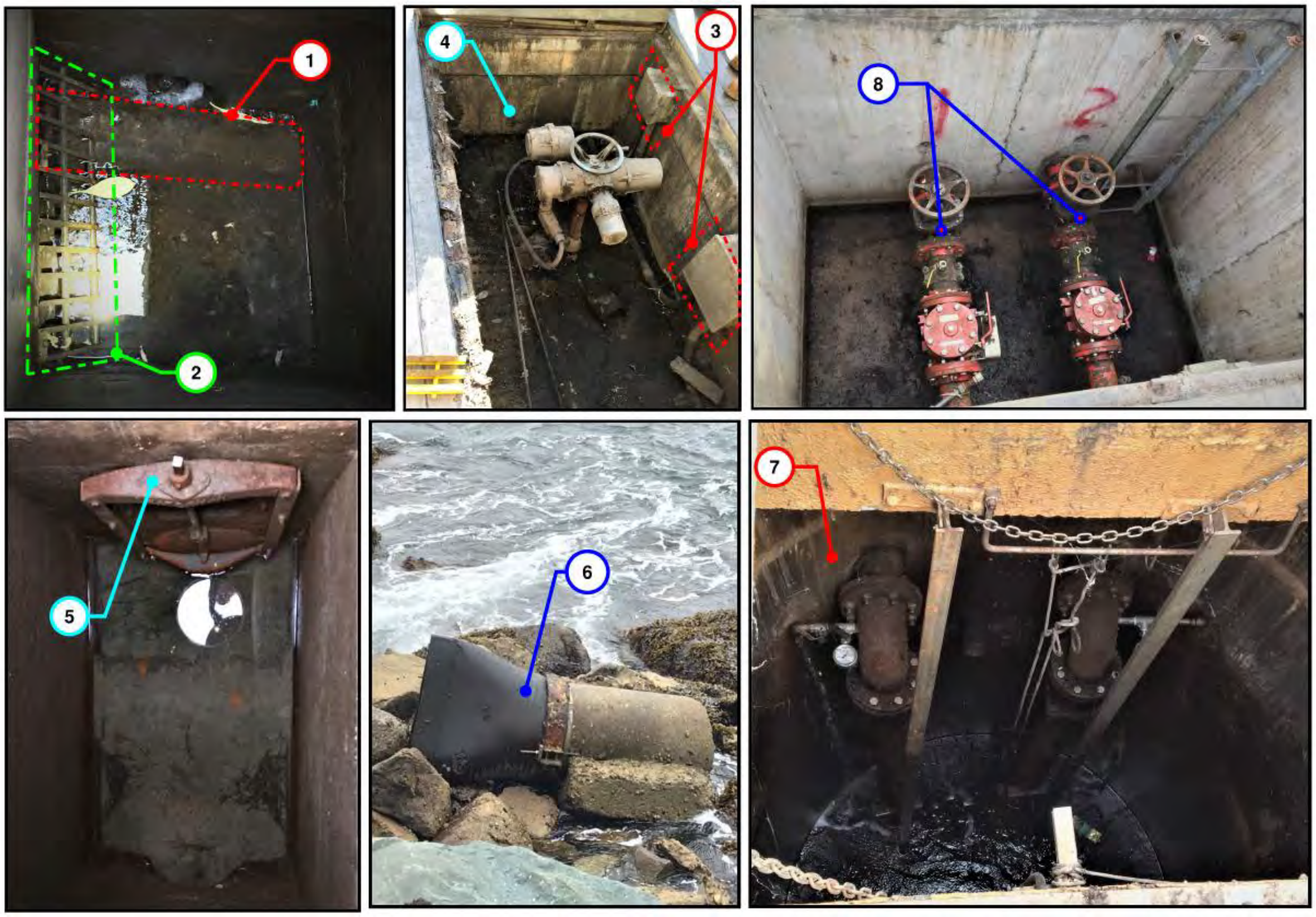


Figure 4-15: Site Photo Diagram of Components of LFD System

4.3.7 Receiving Water Analysis

Post processing of the PCSWMM output was performed in order to assess the receiving water conditions resulting from wet weather storm water runoff for both the existing and proposed conditions. This was accomplished by preparing a one-dimensional, mass balance spreadsheet continuous simulation model (CSM) as a simplified representation of the shoreline volume within Mariners Basin, including Bonita Cove, and the flushing provided to the basin by tidal flood (increasing water level) and ebb (decreasing water level) flows. Table 4-6 provides a summary of the CSM setup parameters.

Table 4-6: Mariners Basin CSM Parameters

CSM Parameter	Description
Pollutant Input	PCSWMM fecal coliform count from project modeling for the average year in one hour time steps
Mariners Basin Shoreline Volume	10,375,000 cf mean high tide 8,900,000 cf mean tide 7,525,000 cf mean low tide Based on analysis of bathymetry data.
Tidal Data	Hourly tidal data was obtained for the La Jolla, California location from the National Oceanic and Atmospheric Website (https://tidesandcurrents.noaa.gov).
Flushing Effectiveness	35% - parameter used to account for the portion of the tidal ebb and flood process that does not result in flushing (i.e., this value would be 100% if the tidal flood entered one side and tidal ebb exited the other side such as through large flapper valve, which is not the case)
Background Fecal Coliform Concentration	100 MPN/100 ml – based on the approximate average of dry weather monitoring results at Bonita Cove for fecal coliform obtained from the CEDEN Website.
Exceedance Day	400 MPN/100 ml or greater fecal coliform concentration calculated in the Mariners Basin shoreline volume for one or more time steps (i.e., hours) during the day (midnight to midnight).

4.4 Results

4.4.1 Existing Condition

The existing water quality conditions for the study area include GI elements already in place, intended to provide water quality benefits. The main BMP consists of several low flow sewer diversions from four (4) of the existing storm drain systems. These are believed to have been installed in the early 1990's, and were intended to divert dry weather runoff and the first 20 minutes of wet weather runoff to the sewer system, as part of a baywide effort for systems draining into Mission Bay. For each location, a 6-inch pipe diverts the first 6-inches of head from an existing cleanout/inlet. The diversion systems were not modeled in PCSWMM and were instead modeled in a post processing spreadsheet. The existing low-flow diversion systems were modeled in two scenarios:

1) Current existing condition (Dry Weather diversion, no Wet Weather LFD during storm events)
2) Intended automated operation (Dry Weather diversion, and Wet Weather diversion during first 20 minutes of storm events – Intended Automated LFD).

The "no wet weather LFD" scenario was selected as the existing condition for comparison purposes to inform water quality recommendations, because it is representative of the current operational condition of the low-flow diversion systems (and is also representative of the assumed condition in 2003 which is considered the baseline water quality condition as part of the overall WQIP efforts.

In addition to the low-flow sewer diversions, a number of weep sumps throughout the study area likely provide some level of dry weather infiltration, and minimal wet weather infiltration, even if not intended for this purpose. In order to account for the associated benefits (or potential benefits) of these existing structures, these were included in the existing condition water quality model.

4.4.1.1 No Wet Weather LFD

The current existing condition (no wet weather LFD) results are provided in tabular and graphic form. Table 4-9 provides a summary of the results. The 20 Beaches and Creeks TMDL lists the Scripps Hydrologic Area as having an existing wet weather frequency of 52 percent, which equates to 22 days. The 20 Beaches and Creeks TMDL is referring to the Pacific Ocean Shoreline and not Mission Bay; however, the value of 52 percent was used as an approximate reference point for the purposes of comparing the modeling results (as a rough order of magnitude check). Meaning, it is reasonable that the actual existing conditions have a wet weather exceedance day frequency of roughly 52 percent, and thus the existing condition modeling should indicate a wet weather exceedance day frequency of roughly 52 percent. The existing condition modeling results indicate that for the average rain year, storm water runoff will result in 20 wet weather exceedances and one dry weather exceedance, which equates to a 48 percent wet weather exceedance frequency (i.e., 20 / 42 = 48 percent). Figure 4-17 shows the modeled storm water runoff and modeled Mariners Basin fecal coliform concentration for the average year existing condition.

Table 4-7: Existing Condition Fecal Coliform Modeling Results – No Wet Weather LFD

Period	Wet Days	Wet Weather Exceedance Days	Dry Weather Exceedance Days
Oct. 1, 2002 – Sept. 30, 2003	42	20 (48%)	1

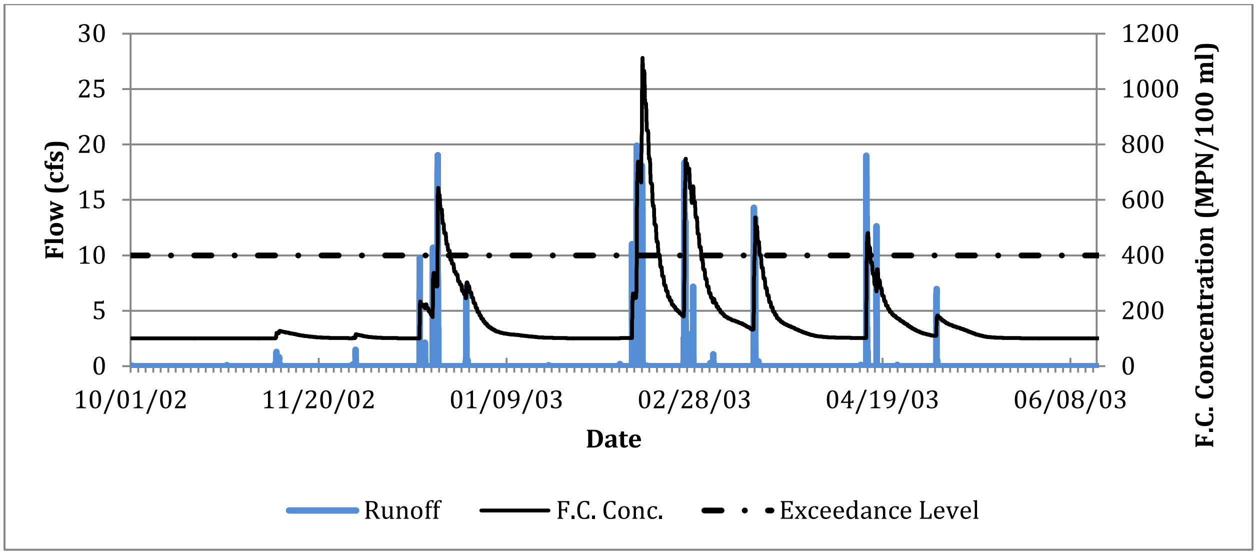


Figure 4-16: Existing Condition Fecal Coliform Modeling Results – No Wet Weather LFD

Table 4-8: Existing Condition Water Quality Performance – No Wet Weather LFD[1, 3]

	Runoff Volume Removed[2] (MG/YR)	Total Runoff Volume (MG/YR)	Percent Reduction (%)
Weep sumps	0.12	17	0.7%
Sewer Diversion[4]	0	17	0%
Total	0.12	17	0.7%

[1] Based on model results for the 2003 Water Year.
[2] The runoff volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.
[3] Results are reflective of the total infrastructure within the respective category.
[4] The existing low-flow sewer diversion systems were modeled based on no wet weather low-flow diversion. No runoff volume is removed.

4.4.1.2 Intended Automated LFD

The following tables and figures present the water quality performance results of the overall existing infrastructure, with the low-flow sewer diversion systems functioning as originally intended (diversion of dry weather flows and diversion of the first 20 minutes of wet weather conditions). These results were included to demonstrate the potential water quality benefit the low-flow diversion systems may have provided in the existing condition, if they functioned as originally intended.

Table 4-9: Existing Condition Fecal Coliform Modeling Results – Intended Automated LFD

Period	Wet Days	Wet Weather Exceedance Days	Dry Weather Exceedance Days
Oct. 1, 2002 – Sept. 30, 2003	42	19 (45%)	1

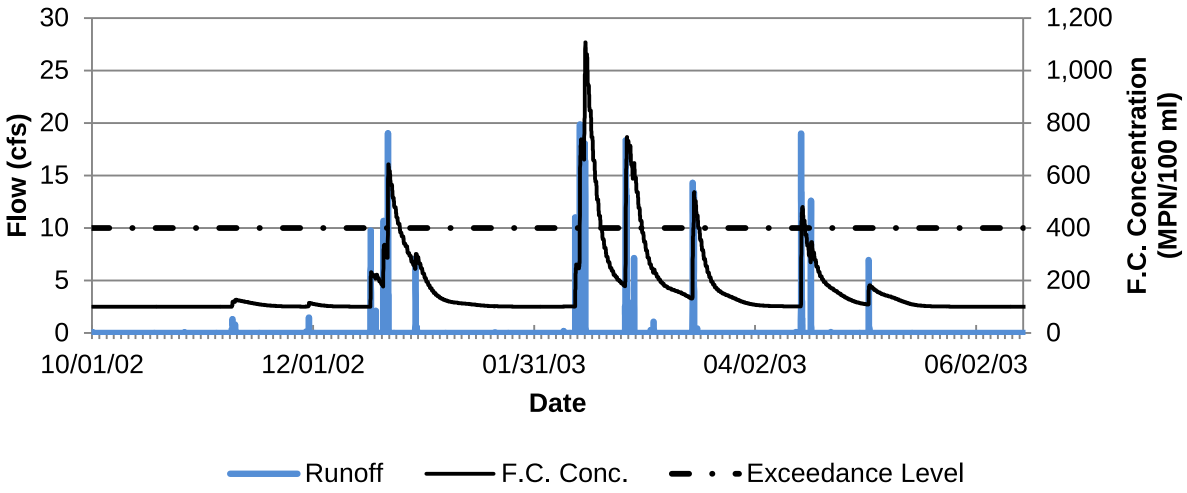


Figure 4-17: Existing Condition Fecal Coliform Modeling Results – Intended Automated LFD

Table 4-10: Existing Condition Water Quality Performance – Intended Automated LFD[1, 3]

	Runoff Volume Removed[2] (MG/YR)	Total Runoff Volume (MG/YR)	Percent Reduction (%)
Weep sumps	0.12	17	0.7%
Sewer Diversion[4]	0.05	17	0.3%
Total	0.17	17	1.0%

[1] Based on model results for the 2003 Water Year.
[2] The runoff volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.
[3] Results are reflective of the total existing infrastructure within the respective category.
[4] The existing low-flow sewer diversion systems were modeled based on continuous diversion of dry weather flows and diversion of the first 20 minutes of a rain event, as believed was the original intent.

4.4.2 Proposed Condition

Proposed condition modeling efforts consisted of analyzing two scenarios to assess the overall water quality benefit that would result from implementing all proposed GI improvements including Biofiltration basins, and low-flow diversion systems. The two proposed condition water quality scenarios analyzed present differences on the amount of time that low-flow diversion systems will function during a storm event. The modeled scenarios are as follow:

1) Automated operation (diversion during dry weather and first 20 minutes of storm events – Automated LFD).
2) Full-time operation (diversion of constant low-flows during wet and dry weather conditions – Full-Time LFD).

4.4.2.1 Automated LFD

The proposed condition model results incorporating automated operation of low-flow sewer diversion systems (diversion during first 20 minutes of storm events – Automated LFD) are provided in tabular and graphic form. Table 4-11 provides a summary of the results. The results indicate that if all proposed GI solutions were to be implemented, the subwatershed should have a quantifiable reduction in pollutant loading in comparison to the existing condition. These benefits are as a result of storm water runoff either being removed from the system (infiltrated or diverted to sewer) or treated through biofiltration. Figure 4-18 shows the modeled storm water runoff and modeled Mariners Basin (including Bonita Cove) fecal coliform concentration for the average year proposed condition.

Table 4-11: Proposed Condition Fecal Coliform Modeling Results – Automated LFD

Period	Wet Days	Wet Weather Exceedance Days	Dry Weather Exceedance Days
Oct. 1, 2002 – Sept. 30, 2003	42	16 (37%)	0

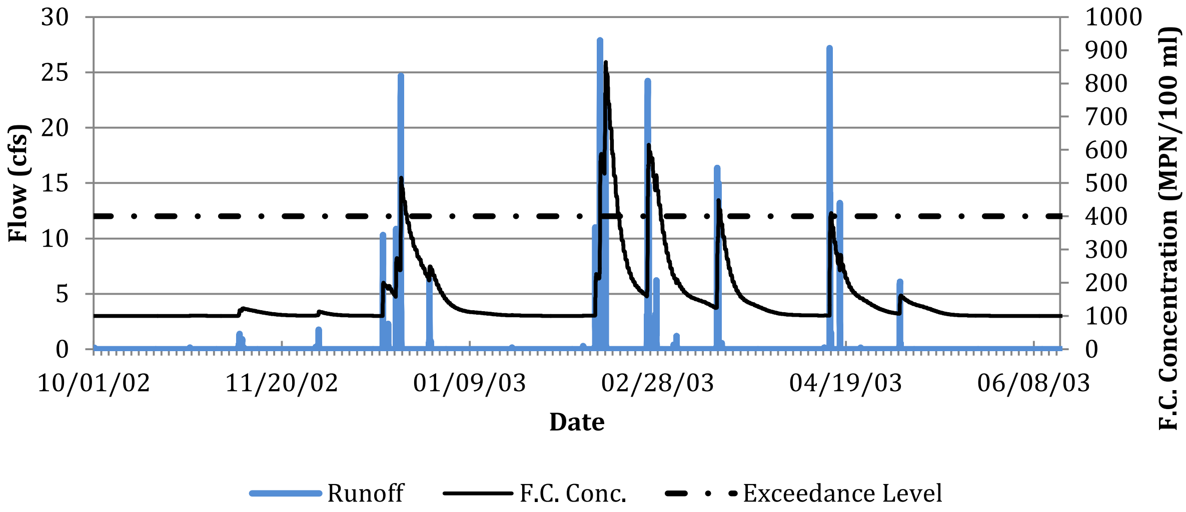


Figure 4-18: Proposed Condition Fecal Coliform Modeling Results – Automated LFD

Table 4-12: Proposed Condition Performance of Water Quality Enhancements – Automated LFD [3, 4]

	Runoff Volume Removed[1] (MG/YR)	Total Runoff Volume (MG/YR)	Percent Reduction (%)	Runoff Volume Treated[2] (MG/YR)	Percent Treated (%)
Sewer Diversion[5]	0.1	17	0.6%		
Biofiltration Basins	1.7	17	10%	1.7	10%
Total	1.8	17	10.6%	1.7	10%

[1] The volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.
[2] The volume treated refers to storm water runoff intercepted, and biofiltered by the proposed infrastructure, then discharged to the storm drain outfall location.
[3] Results are reflective of the total proposed infrastructure within the respective category.
[4] Based on model results for the 2003 Water Year.
[5] The proposed low-flow sewer diversion systems were modeled based on continuous diversion of dry weather flows and diversion of the first 20 minutes of a rain event.

4.4.2.2 Full-Time LFD

The following tables and figures present the water quality performance results of proposed GI, with the incorporation of low-flow sewer diversion systems in full-time operation (diversion of all low-flows during wet and dry weather conditions – Full-Time LFD). These results were included to demonstrate the maximum potential water quality benefit the low-flow diversion systems may provide, if this configuration is adopted.

Table 4-13: Alternative Proposed Condition Fecal Coliform Modeling Results – Full-Time LFD

Period	Wet Days	Wet Weather Exceedance Days	Dry Weather Exceedance Days
Oct. 1, 2002 – Sept. 30, 2003	42	7 (17%)	0

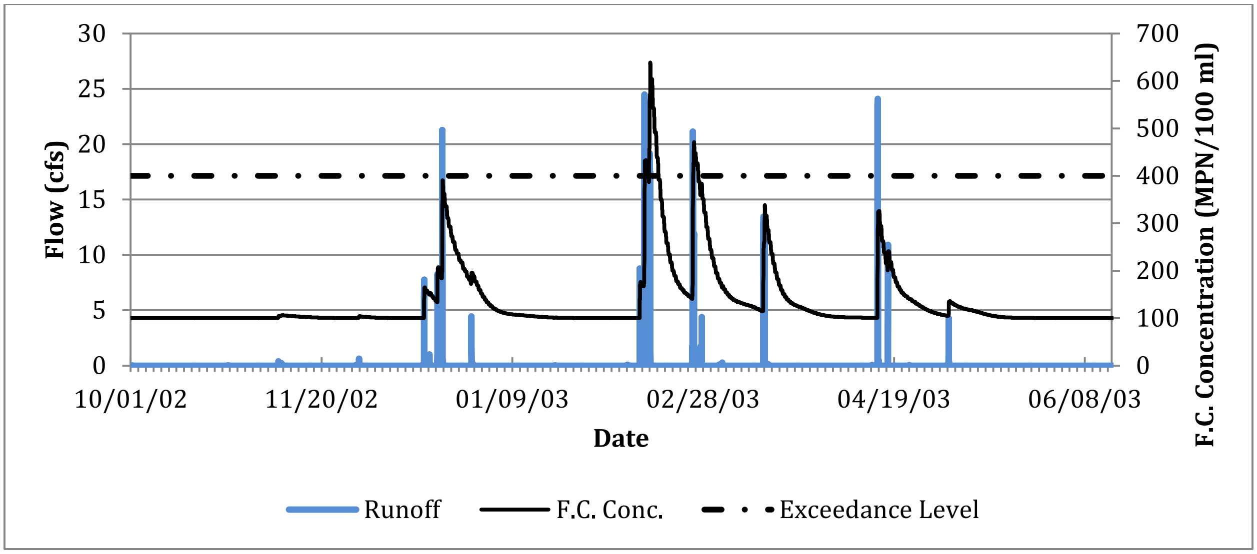


Figure 4-19: Alternative Proposed Condition Fecal Coliform Modeling Results – Full-Time LFD

Table 4-14: Alternative Proposed Condition Performance of Water Quality Enhancements – Full-Time LFD [3, 4]

	Runoff Volume Removed[1] (MG/YR)	Total Runoff Volume (MG/YR)	Percent Reduction (%)	Runoff Volume Treated[2] (MG/YR)	Percent Treated (%)
Sewer Diversion[5]	4.9	17	28.8%		
Biofiltration Basins	1.7	17	10%	1.7	10%
Total	6.6	17	38.8%	1.7	10%

[1] The volume removed refers to the overall storm water runoff which is collected by the infrastructure and prevented from reaching the storm drain outfalls via low-flow diversion to the sewer system, or infiltration to the native subgrade.

[2] The volume treated refers to storm water runoff intercepted, and biofiltered by the proposed infrastructure, then discharged to the storm drain outfall location.

[3] Results are reflective of the total proposed infrastructure within the respective category.

[4] Based on model results for the 2003 Water Year.

[5] The proposed low-flow sewer diversion systems were modeled based on full-time diversion of all low-flows during wet and dry weather conditions.

5.0 Biological and Regulatory Assessment

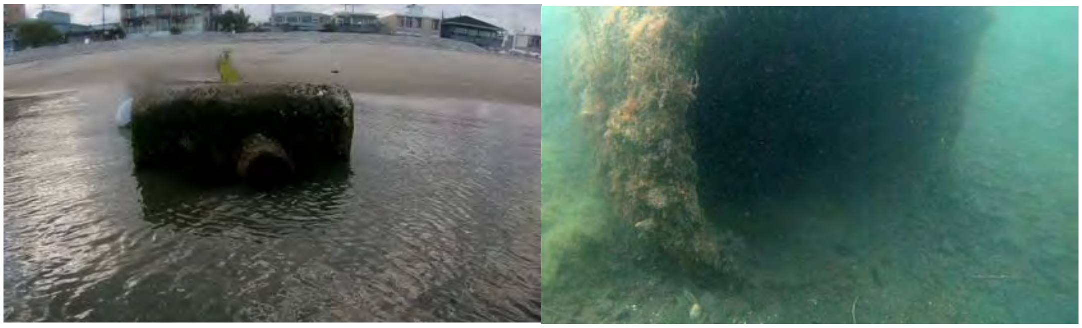
5.1 Project Elements Relevant to Biological and Regulatory Setting

Merkel & Associates, Inc. (M&A) investigated the biological resources within and adjacent to the South Mission Beach Watershed Master Plan (WMP) project area. The purposes of these investigations were to document the existing biological setting of the project, identify jurisdictional water resources and natural resources of concern, and to identify the preliminary environmental regulatory setting for the proposed work. In addition the work was conducted to provide a preliminary assessment of potential impacts and recommendations to avoid or integrate mitigation of impacts into the project design and implementation. A full report of the biological resources is provided in Appendix C.

The WMP includes storm drain discharges to Mariner's Basin and the Mission Bay Entrance Channel. For this reason, the biological study area (BSA) for the project has been expanded beyond the WMP project area to include a broader envelope potentially affected by the storm drain outfalls from South Mission Beach (Figure 5-1). Across Mariner's Basin from South Mission Beach is the Mariner's Point Least Tern Nesting Site, the largest of four such sites in Mission Bay Park. This site is in the City of San Diego's Multiple Species Conservation Plan (MSCP) Multi-Habitat Planning Area (MHPA) (City of San Diego 1997, 2014). Mariner's Basin is also part of Mission Bay Park and subject to the Mission Bay Park Master Plan Update (City of San Diego 1994, as amended 2002).

The project area consists predominantly of dense single family residential, beach rental, and small visitor serving commercial developed lands that are bounded on the west by the Pacific Ocean beach shoreline and which are bounded on the east by Mariner's Basin within Mission Bay Park. Storm drains extend onto the beaches of Mariner's Basin and into the reveted shoreline of the Mission Bay Entrance Channel.

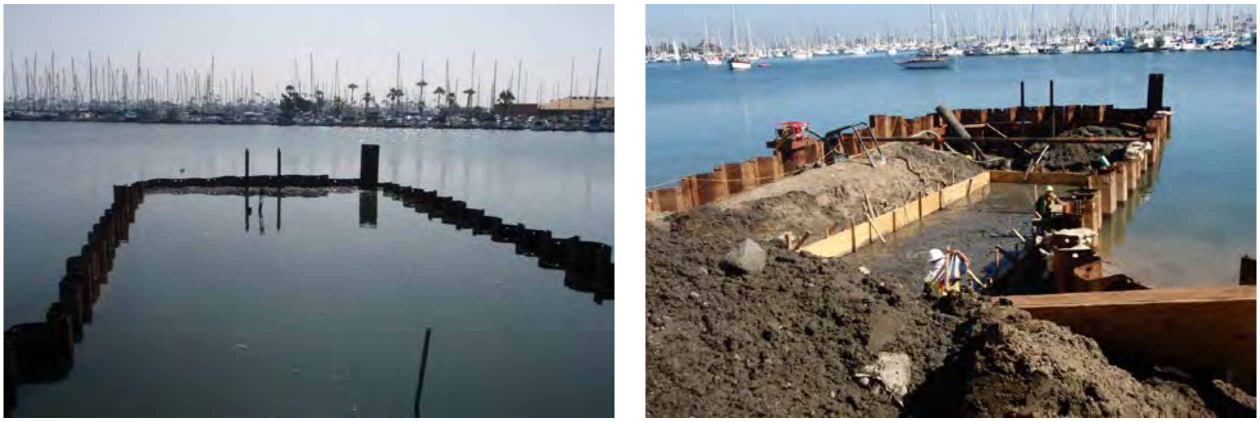
The storm drain outfalls that discharge intertidally into Mariner's Basin would be extended, lowered, enlarged, and, in one instances, relocated such that discharges would be adjusted to subtidal discharge elevations. This would relocate the drains to discharge subtidally instead of intertidally. The result would be removal of the exposed drain pipes from the beach, reduction of sand movement by storm drain flows and exposed pipelines, and separation of the public from direct storm drain discharges. These changes would be expected to reduce infill of Mariner's Basin by storm drain influence on development of littoral sand deltas.



Examples of existing South Mission Beach storm drains (left) and subtidal storm drain within Sail Bay (right).

Figure 5-1: Local Setting Map

Construction activities are expected to employ cut and cover trenching within the upland areas and either marine construction using in water excavation and placement of bedding gravel and pipe segments, or construction of temporary sheetpile containment, dewatering, and construction with standard dry environment methods within the dewatered containment. For purposes of impact analysis in this assessment, a 100 foot wide cofferdam work area has been assumed around each drain outlet. This sizing is extremely liberal with respect to potential impacts, but it would ensure that any effects of the project would be adequately inclusive during the early phases of design such that impacts would only be expected to decrease over time.



Cofferdam construction methodology is illustrated for the Bessemer Street storm drain outfalls into San Diego Bay that is similar to construction methods anticipated to be required within Mariner's Basin for subtidal outfall construction.

The extension of storm drains to subtidal discharge points will require some excavation and regarding of beach and subtidal slopes around the storm drains in remove accumulated sand deltas and flatten the subtidal slopes around and over the pipe. This will reclaim previously displaced beach sand and replace it on the intertidal and supratidal beach while removing the storm drain deltas that extend bayward from the existing intertidal drain discharge locations. This removal will reduce the potential for burial of the drain outlet due to steep slope slumping. It will remove the steep shoreline scarp and it will provide opportunities for the restoration of mitigation eelgrass.

The central portion of Mariner's Basin is a federal anchorage that is part of the Mission Bay federal channel maintained by the Army Corps of Engineers, Los Angeles District. As a result of the federal channel limits, the subtidal drain discharge points are restricted to waters outside of the federal channel limits.

The proposed project is anticipated to be implemented concurrent with other underground utilities activities within the South Mission Beach area. The work is expected to be completed during the period from June 2020 to February 2023. No work is proposed on the beach or within the waters of Mission Bay from Memorial Day to Labor Day of any given year.

5.2 Biological Setting

The BSA is located within Mission Bay Park on the coastal strand spit that separates Mission Bay from the Pacific Ocean. The BSA includes the dredged Mariner's Basin, and filled lands surrounding the basin that were both developed in the 1950s by hydraulic dredging of the active flood shoal near the mouth of False Bay. This was early in the development of the present day Mission Bay that was constructed predominantly by a relatively balanced dredging and filling of shallow bay, mudflats, and marshlands to construct uplands and deeper navigational basins.

The WMP project sites are located predominantly within urbanized land but extend into groomed recreational beaches and waters of Mission Bay. The predominant biological features within the study area are the active park lands and bay, however the BSA also includes a small area of the City's MHPA preserve that is defined as the Mariner's Point least tern nesting site .

5.2.1 Jurisdictional Waters

No federal wetlands are present within the BSA (Environmental Laboratory 1987, USACE 2008), although the area is subject to the ebb and flow of tidal waters. The limit of jurisdictional waters absent the presence of wetlands is defined by physical manifestations of water inundation. In tidal waters, two inundation levels are applicable. These are the annual highest high tide (HHT) for discharge of fill regulated under section 404 of the Clean Water Act, and the mean high water (MHW) for activities regulated under section 10 of the Rivers & Harbors Act. These elevations are relative to harmonic data that varies from location to location. Within Mission Bay, the HHT is considered to be +4.50 ft NGVD29 (+7.38 ft MLLW) and the MHW is +1.86 ft NGVD29 (+4.74 ft MLLW) (Figure 5-2).

For the purposes of the WMP investigations, planning and design is being completed using a topographic digital elevation model (DEM) derived from 2014 Light Detection and Ranging (LiDAR) data. To remain consistent with design documents, this DEM has been adopted as a base for delineating elevation driven jurisdictional boundaries. With the exception of minor grooming effects and seasonal high beach sand berming to protect against wave swell run-up, the conditions in January 2018 when field investigations were completed were determined to be generally consistent with the 2014 DEM conditions. Slight differences in the horizontal position of the jurisdictional boundaries would be expected, however because both the HHT and MHT jurisdictional boundaries are located on a moderately steep beach face, these differences would be expected to be minor.

5.2.2 Biological Habitats

The BSA holds eight mapped habitat types (Figure 5-2) within the approximately 200 acre area. The breakdown of habitats within the BSA by habitat type, area, and MSCP Tier as well as MHPA status is summarized in Table 5-1 following the Holland/Oberbauer classification system (Oberbauer et al. 2008). The individual habitats are subsequently characterized. The waters of Mission Bay were investigated to generally characterize marine resources of the bay during the preparation of the Mission Bay Natural Resources Management Plan (included in the Mission Bay Master Plan Update). The Mariner's Point California least tern nesting site within the BSA is a well-known and monitored element of the City's MHPA and its use has been documented for many years. The remainder of the BSA is highly disturbed urbanized residential, commercial, and developed parklands. These areas are not expected to support sensitive biological resources.

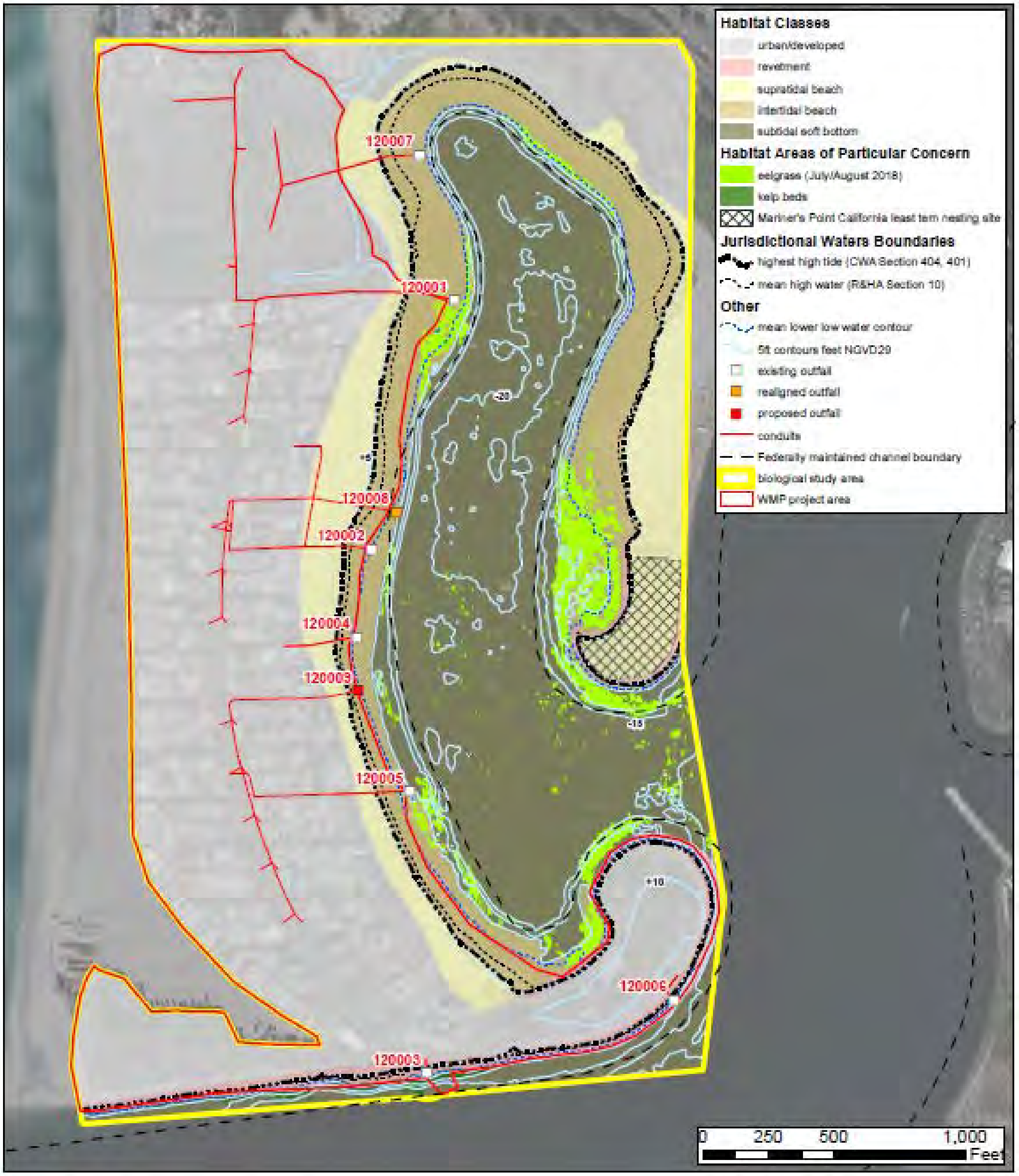


Figure 5-2: Biological and Jurisdictional Resources Map

Table 5-1: Biological Habitat Areas

Habitat/Vegetation Community	Holland/ Oberbauer Code	MSCP Tier; Habitat Type	Existing (acres)	City of San Diego *Inside MHPA*	City of San Diego *Outside MHPA*
Urban/Developed	12000	Tier IV	96.28	0	96.28
Supratidal Beach	64400		15.61		15.61
Mariners' Point Least Tern Nest Site	21230	Tier 1	2.39	2.39	0
Intertidal Beach	64000		22.51		22.51
Subtidal Soft Bottom	64122		52.13		52.13
Eelgrass Beds*	64122		5.58		5.58
Revetment	64122		4.59		4.59
Canopy Kelp Beds*	64122		1.05		1.05
Total:			**200.14**	**2.39**	**197.75**

*Dynamic habitat features that fluctuate interannually and seasonally.

5.2.2.1 Urban/Developed – (Oberbauer 12000)

Urban/Developed lands is the most abundant habitat element within the BSA. The habitat consists of the residential and commercial development areas of South Mission Beach, turfed parklands, parking lots and streets, and supratidal rip rap revetment. Within this habitat feature, hardscape is the dominant land cover and plants are limited and are either recreationally purposed turfs and trees, or part of horticultural landscaping. Native floristic species are uncommon and associated with landscaping rather than natural community assemblages. These areas of the BSA were not exhaustively investigated but rather characterized by aerial photograph inspection and brief drive through surveys of the neighborhood and developed parklands.

Wildlife species noted in this habitat consisted primarily of common urban associated species as well as species commonly found in nearshore coastal bay environments. Avian species observed included house sparrow, European starling, mourning dove, Anna's hummingbird, rock pigeon, and American crow throughout the BSA.

5.2.2.2 Supratidal Beach – (Oberbauer 64400)

A band of sand beach occurs around the shoreline of Mariner's Basin. The beach is bounded by manicured turf and walking paths. This habitat is heavily utilized for recreational purposes by visitors to Mission Bay. The supratidal beach is actively groomed by the City Parks and Recreation Department mechanized beach maintenance staff. The supratidal beach is unvegetated.

Within Mission Bay Park were additional more coastal associated species such as western gull and California gull. While these species were observed on the beach area, they were relatively ubiquitous within the parklands including beach, turf, parking lot, and on the water.

5.2.2.3 Mariner’s Point Least Tern Nesting Site – (Oberbauer 21230)

The Mariner’s Point least tern nesting site is a continuation of the upland of Mission Bay Park that has been fenced off from public use and which is maintained by San Diego Audubon Society volunteers in conjunction with the City to serve as one of the four California least tern nesting sites in Mission Bay Park. The site could be alternatively considered southern foredune or supratidal beach. While activities have been undertaken to foster native dune vegetation such as, *Ambrosia chamissonis*, *Abronia maritima*, and *Calystegia soldanella*, as well as the sensitive species *Lotus nutallianus*, the site vegetation has regularly been thinned to create a predominantly barren sandy environment suited to nesting use by least terns. The ongoing maintenance to foster dominance by native dune species, while maintaining open sandy conditions is the result of overly stabilized conditions that would ultimately convert to fully vegetated lands, should the nest site maintenance intervention cease.

The Mariner’s Point Least Tern Nesting Site is not within the South Mission WMP project area, however it is within the BSA to provide context of proximity for purposes of impact discussions. While the Mariner’s Point tern nesting site was not investigated during the present surveys, a breeding season video and acoustic monitoring effort was undertaken during 2017 within the site. During this monitoring, least terns and horned larks were the most common avian species observed on the colony site (M&A 2018).

5.2.2.4 Intertidal Beach – (Oberbauer 64000)

Intertidal beach occurs below the highest high tide along most of Mariner’s Basin. The intertidal beach is predominantly unvegetated, however at the lowest margins of the beach, some eelgrass beds occur. These are discussed as a separate habitat feature. The lower portions of the intertidal beach provide loafing and foraging area for shorebirds and gulls; however, human disturbance along the shoreline prevents extensive use of this habitat by disturbance sensitive birds. Avian species observed along the sand beach and in shallow bay waters included western gull, California gull, and great egret. Terns forage along the shallow margins of the bay within intertidal and subtidal areas. The California least tern forages in these areas when present in the Bay from about April through September.

5.2.2.5 Subtidal Soft Bottom – (Oberbauer 64122)

Below low tide, the sand beach transitions to subtidal sandy soft bottom that ultimately transitions to a mud bottom below the sandy basin slope. Subtidal soft bottom occurs from the lowest low tide down to -25 feet NGVD 29. Subtidal bottom habitat within Mariner’s Basin is predominantly unvegetated, although eelgrass occurs in some areas as discussed separately. The basin supports patches of sea pens, some sand dollars, and mobile gastropods and echinoderms (sea stars and urchins). Demersal fish such as round ray, bat ray are common on the floor of Mariner’s Basin. Other species that are more common at the south end of the basin include California halibut.

The benthic sediments within Mission Bay support a broad range of infaunal and epifaunal organisms that vary depending upon the nature of the substrate and position within the Bay. In the sandier sediments, purple olive snail, sea pansy, and moon snails are the visually dominant epifaunal species (Merkel 1988). In muddier conditions sponges, slender sea pen, the solitary hydroid, *Corymorpha*, burrowing anemones, and tube-dwelling anemones are common. The mud bottoms typically show evidence of burrowing by macroinfaunal invertebrates such as bivalves, amphipods, and bay ghost shrimp. The non-native bryozoan *Zoobotryon verticillatum* is seasonally encountered in both unvegetated as well as vegetated portions of the bay floor. Avian species that are commonly present in these subtidal environments include gulls as well as fish foraging species such as double-crested cormorants, western grebe, and California brown pelican.

5.2.2.6 Eelgrass Beds – (Oberbauer 64122)

Eelgrass vegetated habitats are an essential component of southern California's coastal marine. Eelgrass beds function as important habitat for a variety of invertebrate, fish, and avian species and are considered to be a Habitat Area of Particular Concern (HAPC) within Essential Fish Habitat (EFH) designated under the Magnuson-Stevens Act.

For many species, eelgrass beds are an essential biological habitat component for at least a portion of their life cycle, providing resting and feeding sites along the Pacific Flyway for avian species, and nursery sites for numerous species of fish. Typical eelgrass associates include pipefish, kelpfish, and surfperch, as well as schooling fish such as topsmelt and anchovy.

The eelgrass habitat within Mission Bay has been inventoried and tracked since 1988 with baywide surveys being completed in 1988, 1992, 1997, 2001, 2007, and 2013 (M&A 2013). Eelgrass is present on the shallow fringes of Mariner's Basin where slopes are gentle. The basin supports two species of eelgrass. The common eelgrass (*Zostera marina*) is found throughout the basin, while Pacific eelgrass (*Zostera pacifica*) is found in deeper waters at the mouth of Mariner's Basin.

Results of the baseline eelgrass survey completed in 2018 indicate wide distribution of eelgrass at the southern end of Mariner's Basin and much less common eelgrass at the northern end of the basin (Figure 5-2).

Eelgrass bed spatial and density metrics from the 2018 investigations are summarized in Table 5-2. Eelgrass occurs between -3 ft NGVD29 and -19 feet NGVD29 with dense beds being limited to elevations above -13 feet NGVD29. Within the survey area, eelgrass consists of scattered fringing beds along the shoreline of the basin and isolated eelgrass plants on the deeper floor of the basin near the better flushed southern end of the basin. The steep beach drop along most of Bonita Cove and the shorelines of the western and eastern margins of Mariner's Basin generally restrict eelgrass occurrence to areas where the gradual slope of the shoreline continues below the -3 ft NGVD29 elevation prior to increasing slope steepness to the bottom of the basin. In areas where the slope breaks above -3 feet, eelgrass is generally not present. While the majority of the eelgrass present within the study area is common eelgrass (*Z. marina*), Pacific eelgrass (*Z. pacifica*) was observed within Mariner's Basin Entrance and at a few locations within the Mission Bay Channel south of the West Mission Bay Drive Bridge.

Table 5-2: Eelgrass Bed Metrics as defined under the CEMP (July/August 2018)

Eelgrass Spatial Metrics	Spatial Distribution	Eelgrass Areal Extent	Vegetated Cover	Percent Vegetated Cover	Depth Range
Survey Area	100,780 m^2	34,856 m^2	27,803 m^2	79.8%	0 to -16 ft MLLW
Eelgrass Density Metrics	**Bonita Cove**	**Central Mariner's Basin**	**Mission Cove**	**Mariner's Basin Entrance**	**Mission Bay Channel**
Region Densities	138.4±33.4 (n=20)	111.2±33.8 (n=20)	205.6±78.6 (n=20)	140.8±59.1 (n=20)	164.8±64.6 (n=20)
Average Density	152.2±64.1 (n=100)				

Eelgrass was determined to be healthy throughout all of the beds, though some evidence of wasting disease blemishes were observed on the leaves within the Mission Cove beds. Epiphytic loading ranged from approximately 20 percent to 80 percent throughout the survey area, with the heaviest loading being observed within Mariner's Basin Entrance. Light sedimentation was observed within the Central Mariner's Basin beds, while all other beds were free of sedimentation. The eelgrass leaf canopy extended from 0.1 to 0.9 meters off the bottom.

5.2.2.7 Intertidal and Subtidal Revetment – (Oberbauer 64122)

Quarried rip rap revetment is located along the Mission Bay Entrance and Main Channel and wrapping into Mariner's Basin at Mission Point. This stone is unvegetated within the upper supratidal margins and is considered urban/developed lands. Within the intertidal and subtidal zones, the rock supports a host of mobile and sessile invertebrates and macroalgae. Within the highest intertidal areas, mobile organisms consisting of amphipods and lined shore crabs are the most common species. At lower elevations, barnacles are common. In subtidal environments, macroalgae dominates the rock. The introduced *Sargassum muticum* is the most common alga; however the rock also supports a host of foliose, turf, and encrusting native algae. At deeper elevations, sessile invertebrates become more common as the algae begins to thin out due to light limitation and sand scour. Birds present along the reveted shoreline include California brown pelican, double-crested cormorant, and western gulls.

5.2.2.8 Canopy Kelp – (Oberbauer 64122)

In addition to the marine algal community that dominates the subtidal revetment along the Mission Bay Entrance Channel, a short section of the revetment within the study area has a flatter relief and scattered rock that extends away from the shoreline. This area supports a small and relatively ephemeral giant kelp bed that is attached to rocks at the base of the revement and those that have been dislodged and scattered into the channel at the toe of the revement. This kelp bed does not extend up the steeper revetment into the shallower portions of the subtidal or intertidal margin and thus is not directly within the WMP project area. In January 2019 this canopy kelp was not noted, however it was present in July 2018.

5.2.3 Rare, Threatened, Endangered, Endemic and/or Sensitive Species or MSCP-Covered Species

Species identified as protected, rare, sensitive, threatened or endangered by the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), or California Department of Fish and Wildlife (CDFW) that may be expected in the project area at various times include three bird species, and two marine mammals (Table 5-3). All of these species are known in the area but the relative occurrence frequency varies.

Table 5-3: Special Status Species Observed or Expected to Occur within the Study Area

Common Name	Scientific Name	Status	Occurrence at Project Site
California Brown Pelican	*Pelecanus occidentalis californicus*	CDFW FP	Common
Double-crested Cormorant	*Phalacrocorax auritus*	CDFW WL	Common
California Least Tern	*Sternula antillarum browni*	SE, FE	Regular seasonal
Harbor Seal	*Phoca vitulina*	MMPA	Very uncommon
California Sea Lion	*Zalophus californianus*	MMPA	Uncommon
Bottlenose Dolphin	*Tursiops truncates*	MMPA	Very Uncommon
Green Sea Turtle	*Chelonia mydas*	FE	Rare

SE – State Endangered; **FE**- Federally Endangered; **FT** – Federally Threatened; **CDFW SSC**- CDFW Species of Special Concern; **CDFW-FP** – CDFW Fully Protected Species; **CDFW-WL**- CDFW Watch List; **MMPA** – species protected by the Marine Mammal Protection Act

*Least terns are a migratory species found in the area from April 1 through approximately September 1 of each year.

5.2.3.1 Sensitive Birds

California brown pelican (*Pelecanus occidentalis californicus*) and double crested cormorant (*Phalacrocorax auritus*) are protected at nesting locations and communal roosts. No nesting locations or roosts for these species are found within the BSA.

California least terns (*Sternula antillarum browni*) do forage within the project area during summer months. The nearest least tern nesting colonies is located within the BSA at Mariner's Point. This species makes opportunistic use of the bay shallows to forage for small fish.

5.2.3.2 Sensitive Mammals

Other special status species that occur on the study area include marine mammals. Most specifically these are two pinniped species, California sea lion (*Zalophus californianus*) and the much less common harbor seal (*Phoca vitulina*) and one cetacean, the bottlenose dolphin (*Tursiops truncates*). Disturbance of these species is prohibited under the Marine Mammal Protection Act (MMPA).

There are no California sea lion rookeries or major haul-out locations within Mission Bay. While they do not have any habitual use areas within the BSA, sea lions numbering one or two individuals at a time do make foraging forays into Mariner's Basin on occasion. As such, they are considered to be uncommon visitors to the project area.

The harbor seal prefers sheltered coastal waters and feeds on schooling benthic and epibenthic fish in shallow waters. Being generally less disturbance tolerant than sea lions, harbor seals are far less common in Mission Bay.

Bottlenose dolphins are commonly observed in the northern portion of San Diego Bay, particularly in the northern channels, however this species is much less common in Mission Bay. This species tends to stay within relatively deep channels where prey is most abundant and follows schools of bait fish. As a result, low dolphin occurrence in Mission Bay is somewhat driven by low entry of schooling pelagic fish into the bay.

5.2.3.3 Sensitive Turtles

The final sensitive species in the BSA is the green sea turtle (*Chelonia mydas*). The Mexican Pacific coast breeding population, to which the San Diego turtles belong, is federally listed as endangered. Green sea turtles are herbivores, feeding primarily on algae and eelgrass (*Zostera marina*). Mission Bay does not presently support an established resident population of turtles. In recent years, green sea turtles have been observed more regularly in various southern California bays and estuaries than in the past several decades.

Within Mission Bay, NMFS has provided data for turtle strandings since 1950 indicating 8 reported strandings including 2 live turtles and 6 deceased turtles. In addition, a report of an additional turtle was made by a fisherman in 2016. In addition, SeaWorld of San Diego has conducted green turtle rescue, rehabilitation, captive rearing, and releases through time. While SeaWorld's facilities are located on Mission Bay, none of the turtles released have been released into Mission Bay. Most recently SeaWorld released 15 turtles offshore in July 2016 from eggs hatched at SeaWorld in 2009. At least 2 of the green turtles released by SeaWorld in 2016 with a satellite tag on it did appear to visit Mission Bay during the fall of 2016.

Of the turtle reports, three have been in the main Mission Bay channel near the inlet to Mariner's Point within the past several years. Based on the information available, it is anticipated that turtles could occur within the BSA on rare occasions.

5.2.4 Wildlife Movement and Nursery Sites

The WMP project area within Mission Bay is not considered to be wildlife movement areas. While migratory birds make use of Mission Bay as part of their migration, the majority of the bird use by migratory birds is within areas around the Northern Wildlife Preserve at the north end of the bay and the Southern Wildlife Preserve in the San Diego River Flood Control Channel where animals are able to rest and forage with less harassment pressure than within the recreational areas of the bay where the project sites are centered.

Eelgrass is considered to be an important nursery habitat for several fish species and is considered to be Essential Fish Habitat (EFH) and a Habitat Area of Particular Concern (HAPC) under the Magnuson-Stevens Fisheries Conservation and Management Act, as well as a Special Aquatic Site under the Clean Water Act. While eelgrass habitat is considered to provide important nursery functions, there are no unique nursery functions believed to be associated with the eelgrass that may be impacted by the project over other eelgrass habitat in Mission Bay. This nursery function is one aspect of eelgrass beds that lead to the determination that impacts to eelgrass habitat would be significant without mitigation.

5.3 Project Impacts, Significance, and Recommended Mitigation

Potential project impacts were evaluated based on examination of the proposed project within the context of the biological resources documented during the field survey and those biological resources assessed as having a likely potential to occur in the project area. Direct impacts were determined by overlaying the project plans on the mapped vegetation communities/habitats in GIS ESRI software platforms. Indirect impacts were determined based on the design, intended use, and location of the proposed project elements relative to biological resources.

5.3.1 Habitats/Vegetation Communities

Implementation of the proposed project would result in permanent and temporary direct impacts to terrestrial and submerged habitats identified within (Table 5-2; Figure 5-1).

5.3.1.1 Terrestrial Habitats

Within the terrestrial habitats of urban/developed and supratidal beach, the implementation of the WMP is anticipated to result in temporary impacts since the majority of the WMP facilities are subsurface. Impacts in these areas would also be to low sensitivity habitat types. As such, they are considered to not result in significant impacts.

5.3.1.2 Intertidal and Subtidal Habitats

Intertidal and subtidal habitat impacts are similarly anticipated to be principally temporary in nature; however storm drain systems outlet removals and replacements are expected to result in permanent features in the subsurface environment while eliminating similar features within the intertidal beach environment. Repairs and retrofit of existing outlets in the existing rip-rap revetment are expected to result in limited and temporary impacts around the drains themselves. Typically the fish and invertebrate communities in soft bottom bay environments recover rapidly following impacts from sediment disturbance (M&A 2009).

The effects of extending drain outlets to lower discharge points would reduce the sand migration from intertidal to subtidal areas by elimination of the flow gradients across the intertidal beach. This would be expected to reduce the beach maintenance requirements within the intertidal areas and reduce infill of subtidal portions of Mariner’s Basin. It would also result in a long-term reduction in impacts to eelgrass habitat as a result of sand overrun of eelgrass and raising of the shallows that typically support eelgrass to elevations that are too high to support continued eelgrass presence due to desiccation stress.

Notwithstanding long-term reduction in eelgrass impact anticipated as a result of extension of the drains to subtidal elevations, the initial construction of the drains is expected to result in temporary impacts to eelgrass within the construction corridor through which the drains are extended. Eelgrass impacts are regulated under federal, state, and local regulatory programs and mitigation of impacts are subject to the adopted California Eelgrass Mitigation Policy (CEMP) (National Marine Fisheries Service 2014). Except under particular unique circumstances, the CEMP requires in kind eelgrass mitigation in southern California to be implemented by planting at not less than 1.38:1 at a planting to impact ratio and that not less than 1.2:1 mitigation to impact be achieved from the restoration efforts. Impacts and mitigation needs are estimated during the environmental review and permitting phases of project development and authorization. However, the ultimate impact determination, and subsequent mitigation required is determined at the time of project implementation through the use of pre-construction and post-construction eelgrass surveys coupled with evaluation of natural variability by coincident assessment of change within an unaffected reference site(s).

Because the details of the drain extensions remain to be developed through engineering design, an assumption has been made that temporary coffer dams would be placed around the drain extension alignment into the Bay. For analysis purposes, a very conservative cofferdam work area of 100 feet in width has been applied for analysis purposes. By applying this assumption of eelgrass impacts, it has been determined that the project may result in impacts to approximately 0.22 acre of eelgrass as a result of construction activities. The areas within the construction zone would be restored to sandy intertidal and subtidal slopes suitable to support eelgrass. Subsequently, eelgrass would be restored within the impact area. Because eelgrass within the impact area is very limited, the flattening of the subtidal slope around the storm drains will allow for an expansion of suitable habitat to support eelgrass and mitigation in accordance with the CEMP is expected to be possible within Mariner's Basin in association with the project implementation. Impacts to eelgrass are considered to be significant and requiring of mitigation in accordance with preliminary mitigation measure BIO-1.

> *BIO-1: Mitigation of any unanticipated impacts to eelgrass would be conducted in accordance with the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014). Under this policy any eelgrass impacts would require successful mitigation at a 1.2:1 replacement ratio through transplant of a minimum ratio of 1.38:1. However, should mitigation be derived from existing established mitigation banks, the applicable ratio would be 1:1 for any impacts. At the present time, mitigation is anticipated to be achieved on-site within Mariner's Basin. A mitigation and monitoring plan to support this mitigation measure shall be prepared and made part of the site development permit and is anticipated to be incorporated into federal and state permitting as well.*

The work on the revetment outlet storm drains (120003 and 120006) is limited to the repair of a broken pipe and replacement of the duck bill valve on drain 120003. This will require minor rock disturbance at the drain and replacement of the rock after the repairs are made. The activities will have a localized and temporary impact on intertidal algae and invertebrate communities at the repair location. The activities are to be performed shoreward of the existing kelp habitat and would not be expected to affect the kelp habitat. This impact is not considered to be biologically significant and would not require mitigation.

5.3.2 Jurisdictional Resources

The proposed work would extend storm drains that presently terminate within the intertidal zone within jurisdictional non-wetland waters further to subtidal elevations within the same jurisdictional waters. Some drains would be relocated and consolidated and one new drain would be added. These activities would impact existing jurisdictional waters through temporary cofferdam containment construction and dewatering.

Conversely, the repositioning of storm drain outfalls below the intertidal zone would result in a reduction of beach erosion and sediment transport into the basin. This would have the benefits of reducing the extent and frequency of eelgrass losses and it would reduce the infill of sand into the navigation areas of Mariner's Basin. As a result, the temporary impacts would be offset by permanent improvements and impacts would not be considered significant from a CEQA standpoint. However, regulatory approvals for work within waters are required from the Army Corps of Engineers, California Coastal Commission, Regional Water Quality Control Board, and the City itself. Therefore mitigation measure BIO-2 has been incorporated to ensure that applicable federal, state, and local permits are obtained for the work.

BIO-2: Prior to implementation of the project, the following permits and approvals shall be obtained, or it shall be demonstrated to the Development Services Department that such approvals are not required:

A) A R&HA Section 10 for work in traditionally navigable waters of the U.S.,
B) A CWA Section 404 for discharge of dredged or fill material within waters of the U.S.,
C) A CWA Section 401 state water quality certification for an action that may result in degradation of waters of the State, and
D) A Coastal Development Permit (CDP) issued by the California Coastal Commission.

5.3.3 Special Status Species Impacts

There were no sensitive species observed within the project sites during the field surveys. The BSA is expected to potentially be intermittently and uncommonly used by marine mammals and rarely used by green sea turtles during the period of work. Marine mammals and turtles may be adversely affected by noise generated within the water as a result of temporary cofferdam sheetpile driving activities.

For marine mammals, NMFS published technical guidance on sound characteristics that are likely to cause injury in the form of permanent hearing threshold shifts (PTS) and temporary threshold shifts (TTS) resulting in behavioral disruption which would be considered “take” in the context of the MMPA and ESA (NMFS 2018). Under the current guidance, bottlenose dolphin, a mid-frequency cetacean is expected to experience the onset of PTS with impulsive (e.g., impact hammering) is expected at peak sound pressure levels of 230 dB re: 1 µPa or 185 dB re: 1µPa^{2}s for cumulative sound exposure level (SEL$_{cum}$) over a 24 hour period. Exposure to non-impulsive sounds (e.g. vibratory pile driving) is expected to result in onset of PTS at 198 dB re: 1µPa^{2}s. For Phocid pinnipeds, including harbor seal, the onset of PTS is expected with impulsive peak sound pressure levels of 218 dB re: 1 µPa or 185 dB re: 1µPa^{2}s SEL$_{cum}$. Sound levels resulting in the onset of PTS from non-impulsive underwater noise are assumed to be 201 dB re: 1µPa^{2}s. For Otariid pinnipeds, including the California sea lion, the onset of PTS is expected with impulsive peak sound pressure levels of 232 dB re: 1 µPa or 203 dB re: 1µPa^{2}s. Sound levels resulting in the onset of PTS from non-impulsive underwater noise are assumed to be 219 dB re: 1µPa^{2}s (NMFS 2018). For non-impulsive sound the TTL onset for the bottlenose dolphin is taken to be 178 dB SEL$_{cum}$, that for the harbor seal is taken as 181 dB, and that for the sea lion is 199 dB (NMFS 2018).

For in-water noise generation, the current acoustic thresholds of PTS have been applied for marine mammals harassment includes Level A take with the potential for injury and the TTS has been applied for Level B take that may result in behavioral disruption but not injury.

Other marine species of high concern may also be impacted by in water noise. These include green sea turtles. Green sea turtles would be rarely expected to occur near the project area; however, should they be present at any time, they may be potentially exposed to construction related hydroacoustic impact. For sea turtles, the Navy established a threshold for injury from vibratory pile driving and impact driving at 190 dB$_{rms}$. Behavioral effects thresholds were noted to be more complex to establish than injury as there is limited data on turtle behavioral response to sound. In review of the literature, the lowest sound intensity stimulus that resulted in a behavioral response was 166 dB$_{rms}$ that resulted in increased swimming activity in caged green and loggerhead sea turtles (McCay et al. 2000, as reported in U.S. Navy 2013). For the present analysis, the lower noise exposure level of 166 dB$_{rms}$ has been adopted.

In 2008, NOAA Fisheries, USFWS, CDFW, and transportation agencies of California, Oregon, and Washington agreed to assess project effects using Interim Criteria for Injury to Fish from Pile Driving Activities (Fisheries

Hydroacoustics Working Group 2008). The interim criteria for assessment included both peak noise levels and accumulated sound exposure levels for impulse noise. No exposure levels were developed for non-impulsive sound. Therefore vibratory sheetpile driving would not be expected to trigger metrics relative to fish.

A multitude of noise metrics may apply to the assessment of significant effects to wildlife from in water sound generation depending upon the organism exposed and the nature of the sound to which the animal is exposed. It is anticipated that steel sheetpiles will be driven for cofferdam containment of the construction area. It is further anticipated that of the driving will be conducted using vibratory hammer. The in-water sound generation from temporary sheet piles driven into the sandy sediment environment in shallow water is expected to be relatively low. To estimate sound generation, data were derived from the Caltrans hydroacoustic compendium for a similar cofferdam at Ten Mile River Bridge in Fort Bragg. Here construction of the cofferdams consisted of driving four H-piles and a series of 2-foot-wide steel sheet piles using a vibratory pile driver with no sound attenuation. Underwater noise levels were measured during installation of sheet piles. The peak sound pressure levels in water at 10 meters from the sound source ranged from 170 dB (re: 1μPa) to 174 dB and the root mean squared (RMS) sound levels in water ranged from 140 dB_{rms} to 142 dB_{rms} (Caltrans 2015).

However, sound impacts are accumulated over time from non-impulsive sound sources. For this reason, it is necessary to estimate the duration of sound generation from vibratory pile driving during any given 24 hour period. For the present project, a high number of 40 interlocking 24-inch sheet piles has been assumed to be driven in a single day with an estimated 10 minute per pile drive time being employed. This results in an estimated pile driving of 6.7 hours during a single day. Given construction activities being limited to a period from 7am to 7 pm this would result in pile driving for 55.5% of the available work day. This is expected to be a very high estimate of driving time. With the noise level and duration of driving the accumulated SEL can be calculated and the distance from the noise source at which sound exposure thresholds considered to impact organisms can be determined. This has been done with the results expressed as isopleth distances from the pile sound sources at which thresholds will be exceeded (Table 5-4). Note that no thresholds for non-impulsive sound have been set for fish.

Table 5-4: Impact Distance from Vibratory Pile Driving for Mammals and Turtles

Species	Acute Exposure (peak sound)		Continuous Exposure (SEL)	
	Distance (m) Physical Impacts	Distance (m) Behavioral Impacts	Distance (m) Physical Impacts	Distance (m) Behavioral Impacts
Bottlenose Dolphin	NA	NA	0.1	2.2
Harbor Seal	NA	NA	0.8	4.3
California Sea Lion	NA	NA	0.1	1.3
Green Sea Turtle	NA	NA	0.1	6.4

From Table 5-4, it is clear that with the type of piles anticipated to be driven to support cofferdam construction assuming vibratory driving, there is no expectation of acoustic impact from peak sound levels to any resource for either behavioral or physical injury type impacts. For continuous sound exposure, the distances to the piles at which sound impacts would occur from chronic exposure would be too short to expect animals to remain adjacent to the work for the entire duration of pile driving activities. For this reason, no significant hydroacoustic impacts are anticipated in association with the sheet pile cofferdam construction.

Sensitive bird species that occasionally occur in the project site are the California brown pelican, double-crested cormorant, and California least tern. As discussed above, no nesting sites or communal roosts for California brown pelican or double-crested cormorant occur within or adjacent to the project area. These two species are only occasional visitors to the project area. However, both species are fish foragers (California brown pelican forages from the air, and double-crested cormorant dives from the water). Work is expected to be short-term and localized, although mobile as work progresses. Work would affect only a small area of the bay at any given time. As a result, and based on these factors, impacts of the proposed project on California brown pelican and double-crested cormorant are not considered to be significant.

California least tern nests within Mission Bay (with the closest nesting sites being at Mariner's Point. The proposed work would include driving of sheetpiles via vibratory placement and then dewatering inside of the sheet pile cofferdam to allow work in the dry. This would result in minimal turbidity generation and no impact driving that may result in both sharp noise and vibration at the tern nest site. As a result of the use of vibratory driven cofferdams no significant impacts to least tern nesting activities are anticipated to occur from the proposed work.

6.0 Recommendations

6.1 Drainage Recommendations

The following sections present summaries of the various structures associated with the drainage infrastructure

6.1.1 Inlet Recommendations

The majority of the recommendations for improving the drainage infrastructure of the South Mission Beach area consist of replacing or adding catch basin structures (inlets). Installation of 7 new catch basins connected to the storm drain system is recommended, to assist with intercepting surface flows. In addition, 25 existing catch basin structures including inlets and weep sumps are recommended to be replaced, in order to accommodate revised storm drain alignments. All infrastructure recommendations are proposed to be connected by an extended storm drain conveyance system.

Table 6-1 presents a brief summary of the inlet recommendations for the South Mission Beach study area resulting from this analysis.

Table 6-1. Inlet Recommendations Summary

Facility Type	Existing Condition	Proposed Condition				
	Existing Total	Replaced	New	Left In-Place	Removed	Recommended Total
Inlet	23	25[1]	7	13	0	45
Weep Sump[1]	17	0	0	0	17[1]	0

[1] Weep Sumps were "removed" and included with the count of total replaced inlet catch basins in the proposed condition.

The inlets identified as "left in place" were located in locations where a surface ponding drainage deficiency was not observed during modeling efforts. During design efforts, some of these inlets may be replaced to accommodate improvements and/or with consideration of the physical condition of the structure.

6.1.2 Storm Drain Recommendations

The recommendations for the storm drain pipe system consist of replacing and rea-aligning the major storm drain systems located throughout the site. This will provide increased conveyance capacity not just for the undersized portions identified in the existing condition, but also increased flows which will be collected by the additional catch basin structures which will connect to the storm drain.

Table 6-2 below provides an overview of the proposed storm drain pipe recommendations, included in the modeling efforts for the study area.

Table 6-2: Storm Drain Recommendations Summary

Facility type	Existing Condition	Proposed Condition		
	Total	Replaced/Realigned	New	Left In-Place
Storm Drain (LF)[1]	5,109	3,279	7,243	1,797

[1] Includes lengths from dual pipe systems.

The lengths of storm drain pipe identified as "left in-place" were not observed to contribute to surface ponding drainage deficiencies during the modeling efforts. During design efforts, some of these storm drain lengths may be replaced to accommodate improvements and/or with consideration to the physical conditions of the storm drain segments.

For a visual representation of the proposed storm drain improvements, refer to the maps provided in Appendix A-7.

6.1.3 Storm Drain Outfall Recommendations

Given the extensive storm drain replacement recommendations and realignments proposed, this study included a consideration for relocating existing storm drain outfalls in an effort to reduce impacts on existing beach and marine resources, most notably eelgrass. Storm water discharges from many of the storm drain systems located on the beach above average tide elevations in the Mission Bay area currently adversely result in beach erosion. In addition, beach erosion results in sand burial of eelgrass and eventual development of navigational hazards associated with protruding shoals. Figure 6-1 below illustrates the current discharge condition of storm drain outfalls within the study area.

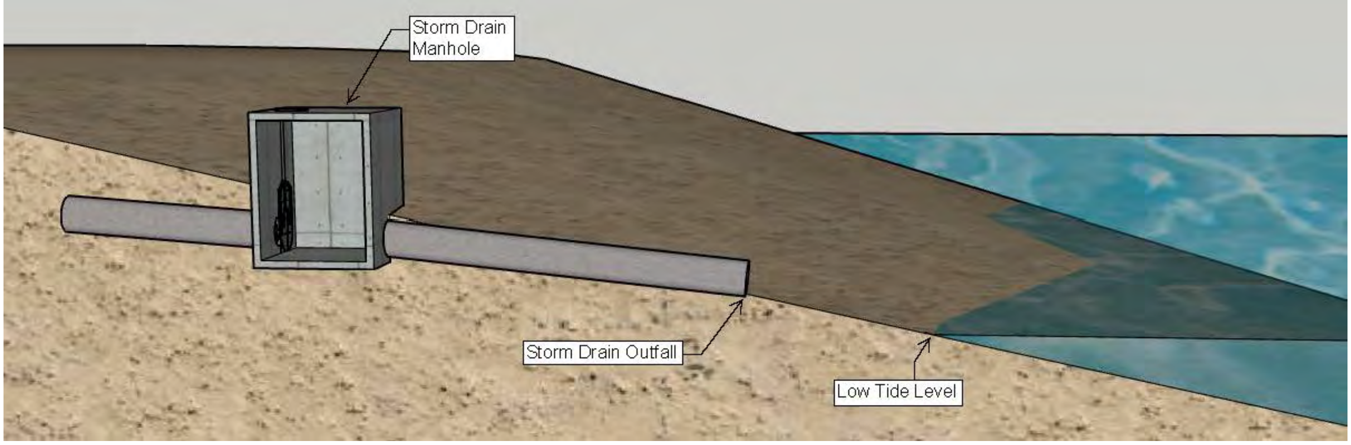


Figure 6-1: Existing Storm Drain Outfall Conditions

Previous projects completed by the City at Santa Clara Cove and Sail Bay have addressed similar issues by lowering the storm drain outfalls to emerge below the intertidal margin. The storm drain outfalls within this project area appear to be candidates for similar resolutions.

Figure 6-2 illustrates the proposed discharge conditions of storm drain outfalls by extending and lowering the point of discharge for the storm drain systems which outlet into Mariners Basin and Bonita Cove.

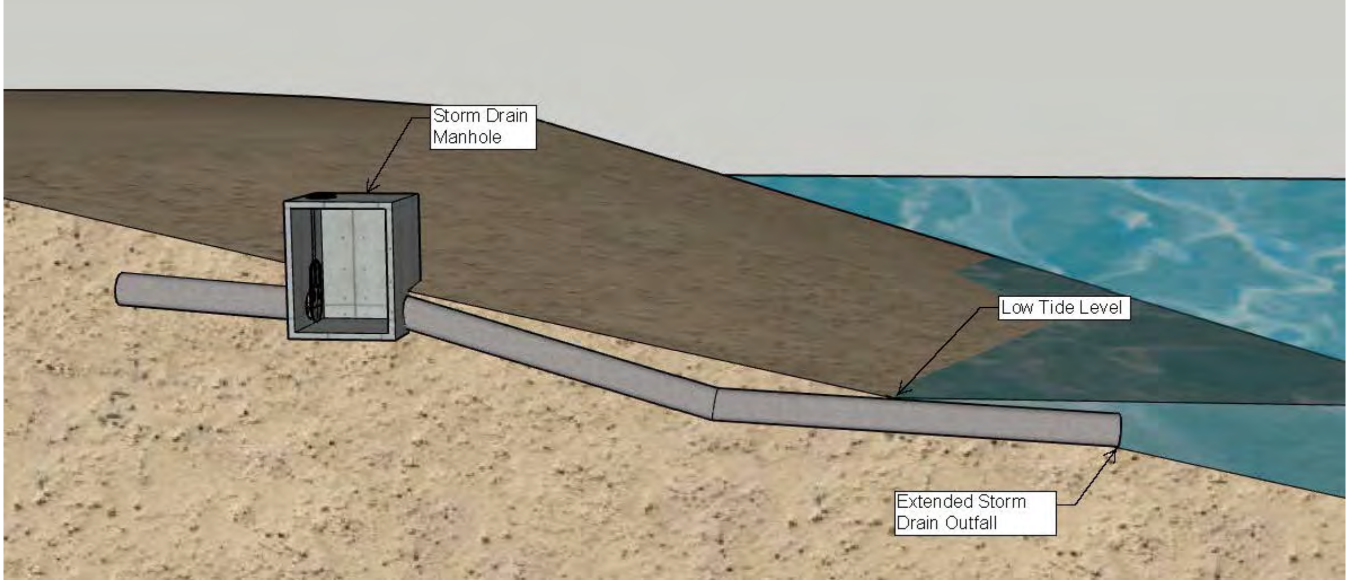


Figure 6-2: Proposed Storm Drain Outfall Extension

As part of this project an underwater storm drain outfall assessment was completed to provide additional information on the existing condition of the outfalls within the project site and the outfalls in neighboring Sail Bay. The conclusion from the outfall assessment, as outlined in Appendix F, was that the subtidal drain location would provide a superior solution to the pipe locations over construction of intertidal outfalls. This conclusion is supportable purely on the basis of infrastructure protection and longevity. However, other factors also support such a design. These include enhancement of beach aesthetics and safety, reduction in beach erosion, improvement of habitat suitability for development of eelgrass, reduction in potential water quality concerns for water contact recreation (REC - 1 beneficial uses) by separation of discharge points from direct proximity to users.

6.1.4 Surface Conveyance Recommendations

Improving the storage and flow attenuation benefits of the street surface is contingent on re-establishing a 6-inch curb and gutter system throughout the study area. As previously discussed, Mission Boulevard currently has a significantly reduced curb depth as a result of AC overlay throughout the history of the South Mission Beach area.

In order to help keep storm flows contained within the ROW, it is recommended that an effort be made to resurface the portions of Mission Boulevard that currently have reduced curb heights.

This concept is illustrated in Figure 6-3 below.

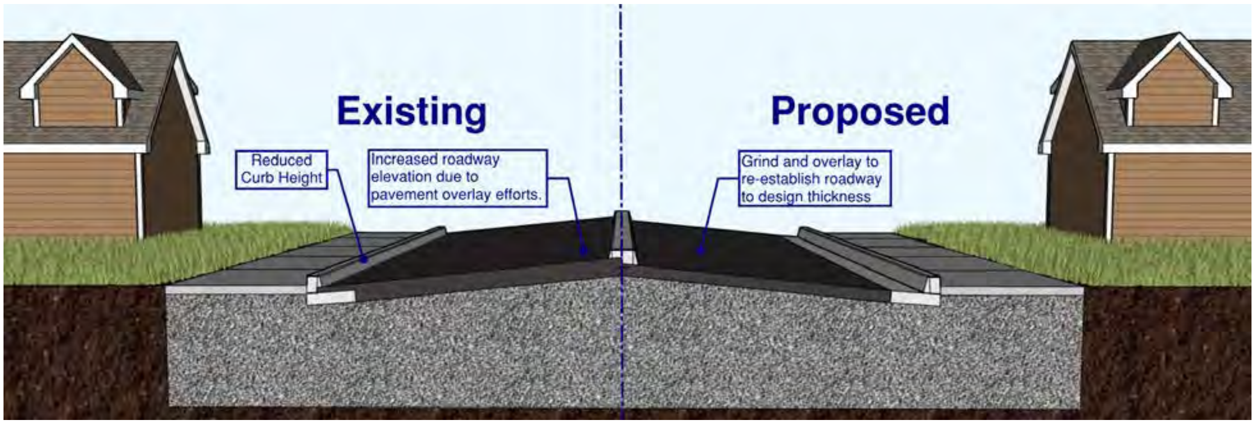


Figure 6-3: Street Surface Recommendations

For a brief overview of current curb height conditions, refer to Appendix A-1.

6.2 Water Quality Recommendations

The proposed water quality improvement recommendations for the South Mission Beach study area rely on storm water runoff being either removed from the system or treated through biofiltration. Although the primary pollutant of concern is bacteria, which is most effectively removed through the removal of runoff from the system, the structural BMP solutions identified will provide additional water quality benefit for a spectrum of pollutants. The recommended methods for removal of storm water runoff are through the use of infiltration into the subgrade or diversion into the sanitary sewer system. The recommended method of treatment is through the use of biofiltration basins as described below.

However, due to constraints not all of the water quality recommendations explored during the course of this study are able to be implemented at this time. These constraints include a high ground water table and limited allowable diversion to the sewer system during wet weather conditions.

6.2.1 Low-Flow Sewer Diversion Systems

The existing inventory consists of four (4) low-flow diversion systems plus the IPS. From discussions with City staff, it was determined that these systems were designed to be automated, and to divert dry weather flows and the first twenty minutes of all storm events from the downstream segments of the existing storm drain networks into the sanitary sewer system. It was also discussed that these diversion systems are currently not operating as intended, most likely due to the underground electronic equipment (pictured in Figure 6-4) being compromised by water, and valves becoming ceased. The low-flow diversion valves are instead left open to intercept dry weather flows and are manually plugged by City maintenance staff when any storm events are forecasted. The diversion systems were not modeled in PCSWMM and were instead modeled in a post processing spreadsheet. The existing low-flow diversion systems were modeled in two scenarios:

1) Current existing condition (no diversion during storm events)
2) Intended automated operation (diversion of the first 20 minutes of storm events).

The current existing condition (no diversion during storm events) was selected as the existing condition for comparison purposes, because it is representative of the current operational condition of the low-flow diversion systems. This scenario results in no volume of wet weather flow diverted to the sewer system.

Figure 6-4: Low-Flow Sewer Diversion Valve

6.2.1.1 Existing LFD Design Issues Identified

The following paragraphs describe issues that were identified with the design of the existing LFD system.

(1) Possibility for wastewater to enter storm drain system and spill out through coastal outfalls

One major flaw that the existing conditions pose is the risk of wastewater backing up into the storm drain system during a sewer overflow when the LFD plug valve is open (due to low flow conditions or valve failure). The plug valve could fail to operate due to numerous reasons such as electrical components being damaged or an obstruction lodged in the valve. The plug valve in the LFD system is the only form of separation of the storm drain system from the wastewater system. If wastewater was ever able to back up into the storm drain system then there could be a sewage spill on the beach by means of the storm drain coastal outfall

(2) Transport of sediment into sewer main

The design of the existing LFD system allows the transport of sediment into the sewer main during low flow conditions. Sediment in the sewer main can result in erosion of pipes, blockages, and major backups, which can further result in sewer spills or breaks in the sewer main.

(3) Possibility of seawater to enter sewer main

If tide gates and tideflex valves were to ever fail or be left open during high tide, then seawater could back up the storm drain system and enter the sewer main when the plug valve was open. Seawater entering the sewer main periodically would be an extra unaccounted flow that could result in overloading of the sewer main and/or the downstream Point Loma WWTP. Also, seawater contamination includes corrosive chloride ions that can cause and accelerate corrosion in metal pipes and WWTP facilities downstream.

6.2.1.2 Proposed Alternatives

The following paragraphs detail the alternatives that are proposed to address the current water quality issues and existing LFD design issues. However, any improvements or modifications to the LFD systems will require conversations with and approval from the City of San Diego Public Utilities Department (PUD).

(1) Replace current plug valve motor and telemetry cabinet and add an upstream sediment filter/trap and a downstream backflow valve.

Alternative #1 would replace the existing diversion structures with modern technology, add an upstream sediment trap and downstream backflow valve, bring the critical electronics above ground, and improve the waterproofing of these electrical components.

This alternative is the most minimal and conservative option as it builds off of the existing design of the LFD system. However, this alternative is not recommended because it still presents the risk of wastewater entering the storm drain system if the backflow valve was ever to fail when (1) the plug valve was open (due to valve failure or low flow conditions) and (2) during a sewer overflow.

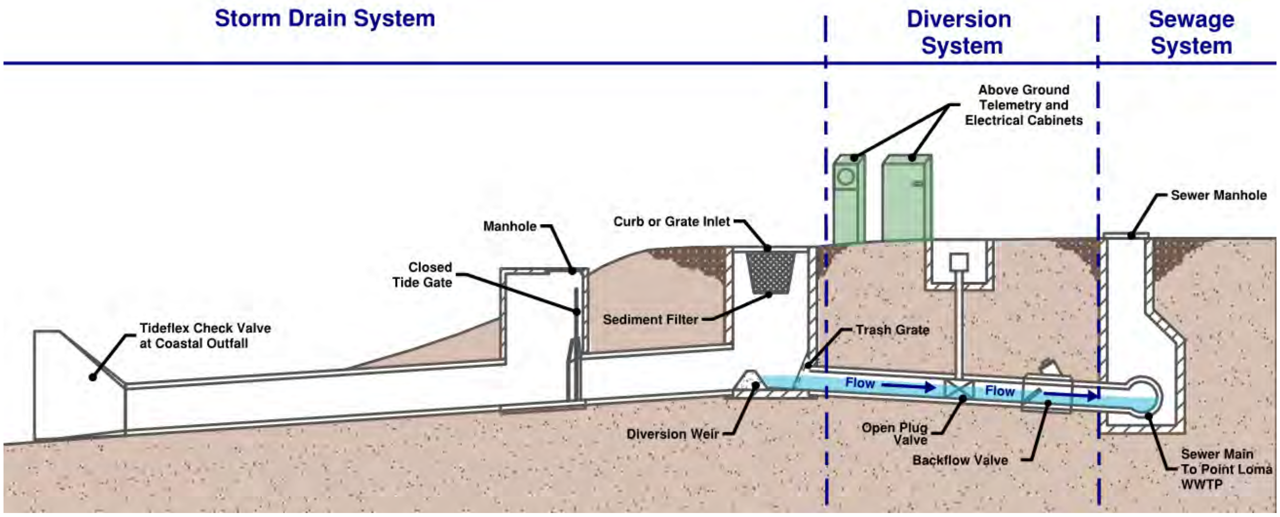


Figure 6-5: Conceptual Diagram of Proposed Alternative #1

(2) Construct a newly designed LFD system that includes an air gap

Alternative #2 proposes to construct a new LFD system that is designed to include an air gap. Instead of a diversion weir, the storm drain inlet/cleanout would contain a submersible pump that would turn on at a fixed water depth in the inlet and the pump would turn off at a calculated depth which would be equivalent to the first 20 minutes of a storm event. This submerged pump would divert water to a diversion structure which would be a shallow manhole structure with a sewer lateral. The invert elevation of the diversion structure would be higher than the rim elevation of the connected downstream sewer manhole; creating an air gap. Wastewater could only overcome this air gap if the sewer manhole was pressurized, but there would be a backflow valve within the sewer lateral that would prevent wastewater to enter the diversion structure.

This alternative would present several separations of the two systems (sewer and storm drain) and allow for several fail-safes (including the air gap, backflow valve, diversion structure, and pump) which would significantly lower the risk of wastewater entering the storm drain system.

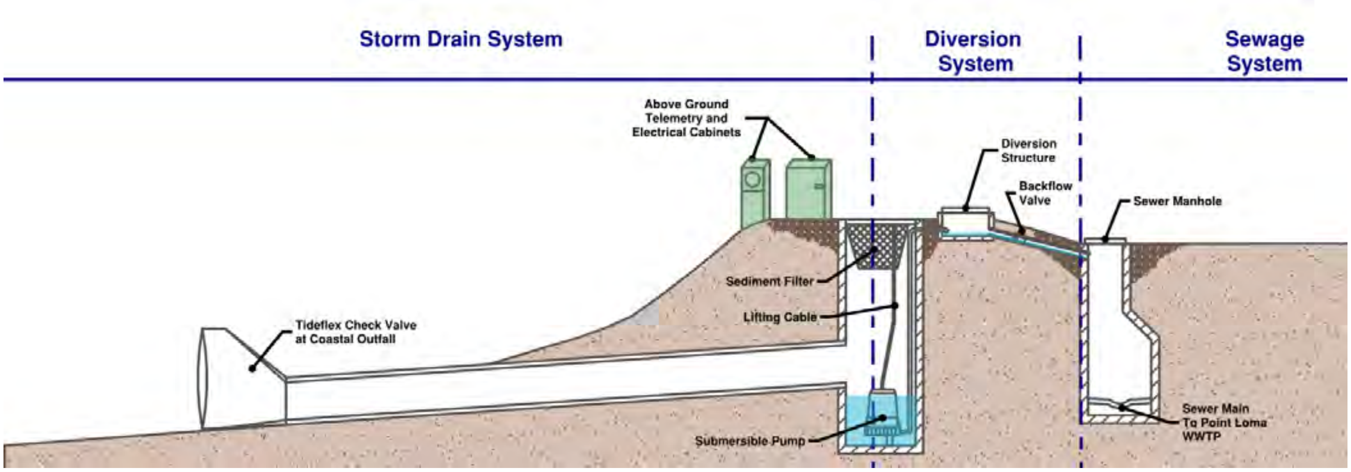


Figure 6-6: Conceptual Diagram of Proposed Alternative #2

6.2.1.3 Low-Flow Sewer Diversion Recommendations

Based on conversations with staff from multiple City departments (Transportation and Storm Water – TSW, Public Works – PW, and Public Utilities Department – PUD) the preferred concept for design of the low-flow diversion systems is Alternative #1 .

From a modeling perspective, in order to reduce the total number of wet weather exceedance days for bacteria below the desired threshold of 9 wet weather days (22% of the 42 wet weather days during the 2003 water year), a full time diversion (Full-Time LFD) of up to 0.47 cfs upstream of each storm drain outfall would be required. This would potentially be achieved by providing a cleanout structure upstream of each storm drain outfall containing a six-inch low-flow diversion pipe placed lower than the invert elevations of the main storm drain system in a way where it would operate under a hydraulic head of up to six inches to divert flow into the sewer system during the full duration of dry weather and wet weather conditions. This configuration would provide a reduction of 4.3 MG of the 17 MG of runoff generated during the 2003 water year as presented in Section 4.4.2.2.

The use of constant low-flow diversion throughout the entirety of a storm event (Full-Time LFD) was not acceptable to PUD at this time; therefore, the agreement was to design the diversion systems to provide a similar level of service as originally intended (dry weather flows, and the first 20 minutes of wet weather flows – Automated LFD). Using this intended design criteria, with updated electronics systems and design, the water quality model show the low-flow diversion systems provide a **reduction of 0.1 MG of the 17 MG of runoff** generated during the 2003 water year as presented in Section 4.4.2.1.

Pursuant to ongoing discussions with TSW, a modernization effort is underway which will allow further automation and optimization of specific parameters that will define what constitutes the beginning of a storm event and when the low-flow diversion will shut down. For example; once 0.25 inches of rainfall is detected by the nearest optical rain gage sensor, the 20 minutes would begin. This helps ensure the low-flow diversion system is functional while runoff is actually occurring at the location of the low-flow sewer diversion systems. Additional rain gage locations are currently being identified for this reason, and the use of a tide gage will also play an important role in controlling the LFD systems as well as the associated tide gates. Further refinement of this approach will be addressed during final design.

6.2.2 Biofiltration Basins with Partial Retention

A total of nine (9) biofiltration basins with partial retention, as shown in Figure 6-7, are being recommended on the north and south ends of the study area where there is believed to be adequate depth to provide both treatment through the biofiltration media and removal of runoff through partial retention and incidental infiltration. These basins are modeled with the pollutant removal rates outlined in Table 4-5 for the effluent passing through the underdrain and 100% removal of runoff being infiltrated through the subbase. The model results show the biofiltration basins provide a **reduction of 1.7 MG and a volume treated of 1.7 MG of the 17 MG of runoff** generated during the 2003 water year.

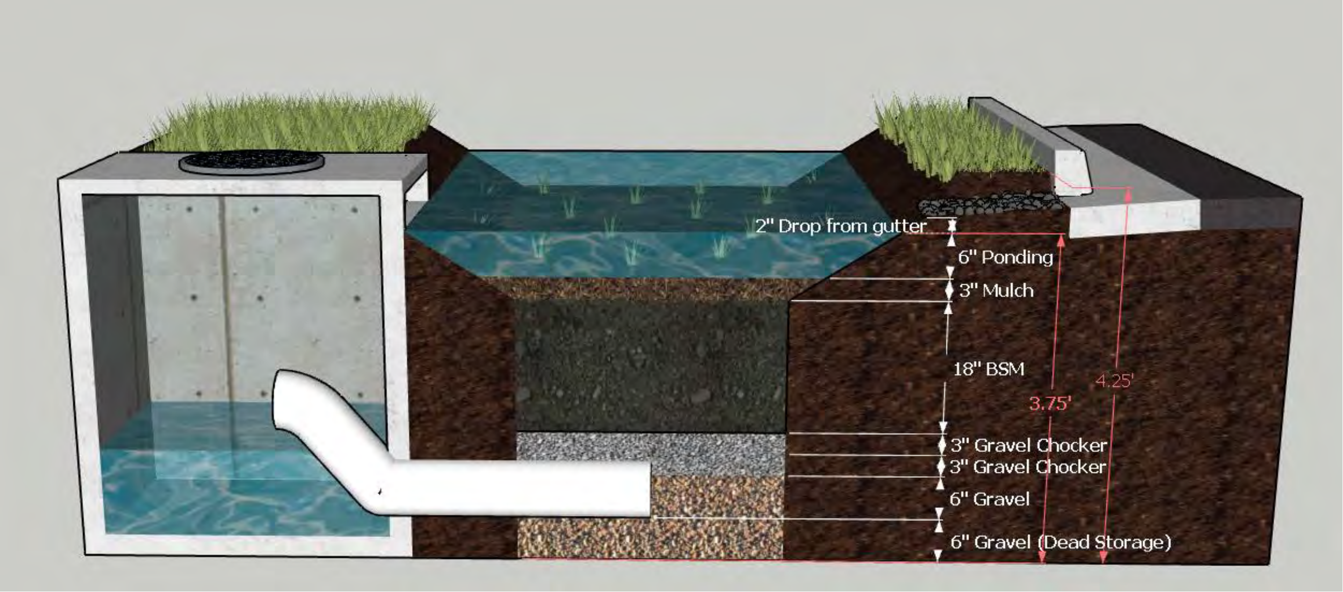


Figure 6-7: Biofiltration Basin with Partial Retention

Table 6-3: Biofiltration BMP Model Results – Fecal Coliform Removal Efficiency

	Inflow (counts)	Outflow (counts)	Removed (counts)	Removal (%)
BMP-090006-S	8.05E+10	1.24E+10	6.81E+10	85%
BMP-090009_1-S	3.90E+10	8.62E+09	3.03E+10	78%
BMP-090009_2-S	1.51E+12	4.30E+11	1.08E+12	72%
BMP-090009_3-S	4.44E+11	1.26E+11	3.17E+11	72%
BMP-090012-S	1.80E+11	4.27E+10	1.37E+11	76%
BMP-090023-S	8.02E+11	2.58E+11	5.44E+11	68%
BMP-090027-S	4.03E+11	9.84E+10	3.05E+11	76%
BMP-090028-S	2.48E+11	6.97E+10	1.78E+11	72%
BMP-090029-S	1.99E+11	4.43E+10	1.54E+11	78%
TOTALS	**3.90E+12**	**1.09E+12**	**2.81E+12**	**72%**

6.3 Individual Improvement Costs

Capital costs for individual drainage improvements are displayed in Table 6-4 below. The capital costs were developed using unit costs and lump sum costs for project components based on available costing resources, including City of San Diego and County of San Diego Unit Cost lists, and recent bidding documents for comparable improvement projects.

Table 6-4: Capital Costs of Drainage Improvements

Type of Improvement	Unit	Unit Cost
Inlet Catch Basin	EA	$7,000
Cleanout	EA	$8,000
18” Storm Drain RCP	LF	$180
14” x 23” Elliptical Storm Drain RCP	LF	$250
24” Storm Drain RCP	LF	$190
19” x 30” Elliptical Storm Drain RCP	LF	$300
30” Storm Drain RCP	LF	$200

Capital costs for individual water quality improvements are displayed in Table 6-5 below.

Table 6-5: Capital Costs of Water Quality Improvements

Type of Improvement	Unit	Unit Cost
Low – Flow Sewer Diversion System - Alternative 1	EA	$199,350
Low – Flow Sewer Diversion System – Alternative 2	EA	$205,650
Biofiltration BMP	SF	$15
Outfall Relocation with Dewatering	EA	$150,000

Capital costs for surface improvements are displayed in Table 6-6 below. The capital costs were developed based on the cost of asphalt concrete (AC) grinding and overlay required to return the curb height to six (6) inches (where feasible, or in many cases due to the existing concrete section a slightly lesser height of approximately 5-inches). In order to do this, the minimum existing curb height for each street is used to assign a dollar per square foot cost for the appropriate level of grinding and replacing. For the purpose of this study it is assumed that no full depth replacement will be performed, only over-grinding and two (2) inches of overlay will be performed.

The method for surface improvements is as follows: If the existing minimum curb height is 3 inches then in order to bring the street to a 5 inch curb there must be 4 inches of grinding and 2 inches of overlay.

Table 6-6: Capital Costs of Surface Improvements

Type of Improvement	Unit	Unit Cost
3” Ex Curb Height – 4” AC Grinding and 2” AC Overlay	SF	$4.00

NOTE: Costs are based on the price for a 2” AC grinding and 2” AC overlay being $1.85/Sq ft rounded up to $2.00/Sq ft. Therefore the costs have been increased to account for additional grinding assuming $0.50/Sq ft per additional inch of grinding, and rounded up (an additional $1/SF) for this WMP to account for other irregularities and the underlying presence of concrete.

6.4 Integrated Multi-Benefit Projects

Improvement cost estimates were prepared for each bundled project. The capital costs were calculated using unit costs and lump sum costs for project components based on available costing resources, including City of San Diego and County of San Diego Unit Cost lists, and recent bidding documents for comparable improvement projects. In order to account for capital costs such as Mobilization (10%), Bonds (2%), Traffic Control (10%), SWPPP/WPCP Implementation (2.5%), and Field Orders (2.5%), an additional 27% is added to the identified unit costs; after which a contingency of 28% to the construction costs is applied, resulting in an overall 55% bump up to account for the total capital cost for each project specific to this WMP.

Soft costs were also estimated to account for project planning, design, and permitting. Soft costs were estimated based on a percentage of the total construction cost, using 40% for preliminary purposes.

Proposed water quality and drainage improvements were strategically grouped into two (2) larger project bundles. Both water quality and drainage improvements were bundled with consideration of geographic location to coincide with the City's Sewer and Water replacement project.

Project 1) All project components located in the central portion of the study area which generally coincides with the sewer and water project footprint.

Project 2) All project components located outside the general footprint of the sewer and water project, including areas located within the Mission Bay Park Improvement Zone (surface parking lots and associated drainage and water quality improvements).

The results of the project bundling are displayed in Table 6-7 below, which also briefly describes the type of improvements included in each of the project bundles. A more thorough breakdown of individual improvement cost estimates for each bundled project is provided in Appendix D-1.

Table 6-7: Total Costs of Bundled Projects (Drainage, Water Quality, Environmental)

Project Bundle ID	Types of Improvements	Capital Cost	Soft Cost (P&D)	Total Project Cost
IP-120001	Cleanout, Inlet, Low Flow Diversion Structure, Outfall, Storm Drain Pipe, Surface Improvements	$7,211,708	$2,884,683	$10,096,391
IP-120002	Biofiltration w/ Partial Retention, Low Flow Diversion Structure, Outfall, Storm Drain Pipe	$1,743,240	$697,296	$2,440,536

7.0 Conclusions

This WMP has utilized high-resolution data with an integrated PCSWMM modeling approach to determine existing deficiencies and identify recommended improvements for water quality and drainage infrastructure, while also considering the environmental impacts and potential enhancements. This effort provides the City with a project-based roadmap that has allowed 30% design to occur in parallel with the preparation of the Final WMP, and allows project design to continue through final design to allow for bundling and/or synergies in connection with the Water and Sewer project also under design (each as immediate follow-ups to the Undergrounding Utility Project recently completed as well).

The **drainage modeling and recommendations** (section 3.0 and section 6.1) outlined in this report were able to **reduce the total volume of surface ponding from approximately 5.26 acre-feet to 0.51 acre-feet** (for the 100-year 24-hour event with a tailwater elevation of MSL). The suite of drainage recommendations, outlined in section 6.1, includes storm drain (replacement, realignment, and new), cleanouts, inlets, and outfalls (realigned to achieve environmental goals/enhancements). The drainage and associated surface improvements recommended through this WMP have a total cost of approximately $9.1 million ($6.5M for capital cost and 2.6M for soft costs).

The **water quality modeling and recommendations** (section 4.0 and section 6.2) builds upon structural GI portions of the WQIP by increasing the resolution and modeling accuracy of GI placement and performance in the project area. The suite of water quality recommendations, outlined in section 6.1, include enhanced low-flow sewer diversion systems, and biofiltration basins with partial infiltration. The modeling results **show that implementation of these GI measures could reduce the # of exceedance days from 1 Dry Weather day and 20 out of 42 Wet Days down to 0 Dry Weather days and 16 out of 42 Wet Days.** While the identified voluntary target was 9 out of 42 Wet Days, this still results in a significant improvement and also provides the City with the means to further optimize the LFD systems to achieve the target (i.e. – if a longer timeframe for LFD was allowed during storm events). The water quality improvements recommended through this WMP effort have a total cost of approximately $3.5 million and achieve a significant reduction in pollutant loading.

The biological and regulatory assessment (section 5.0) and ROV outfall investigation (Appendix F) provides a detailed discussion of the environmental permitting requirements and associated benefits of replacing and realigning the storm drain outfalls into Mariners Basin (inclusive of Bonita Cove). The use of **deepened and extended storm drains is expected to reduce navigation hazards, improve safety and aesthetics, reduce maintenance issues, and enhances the compatibility of the adjacent areas for eel grass habitat.**

The development of integrated projects (section 6.4) provides project information that can be used for project phasing and can reduce the overall project costs through synergies across design and construction. The WMP resulted in **2 projects varying in cost from $2.5 million to $10.1 million** that incorporate water quality, drainage, and environmental improvements. The combined cost for all recommendations for these projects **totals approximately $12.6 million**.

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Appendix A. – Drainage Modeling

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO

RICK ENGINEERING COMPANY

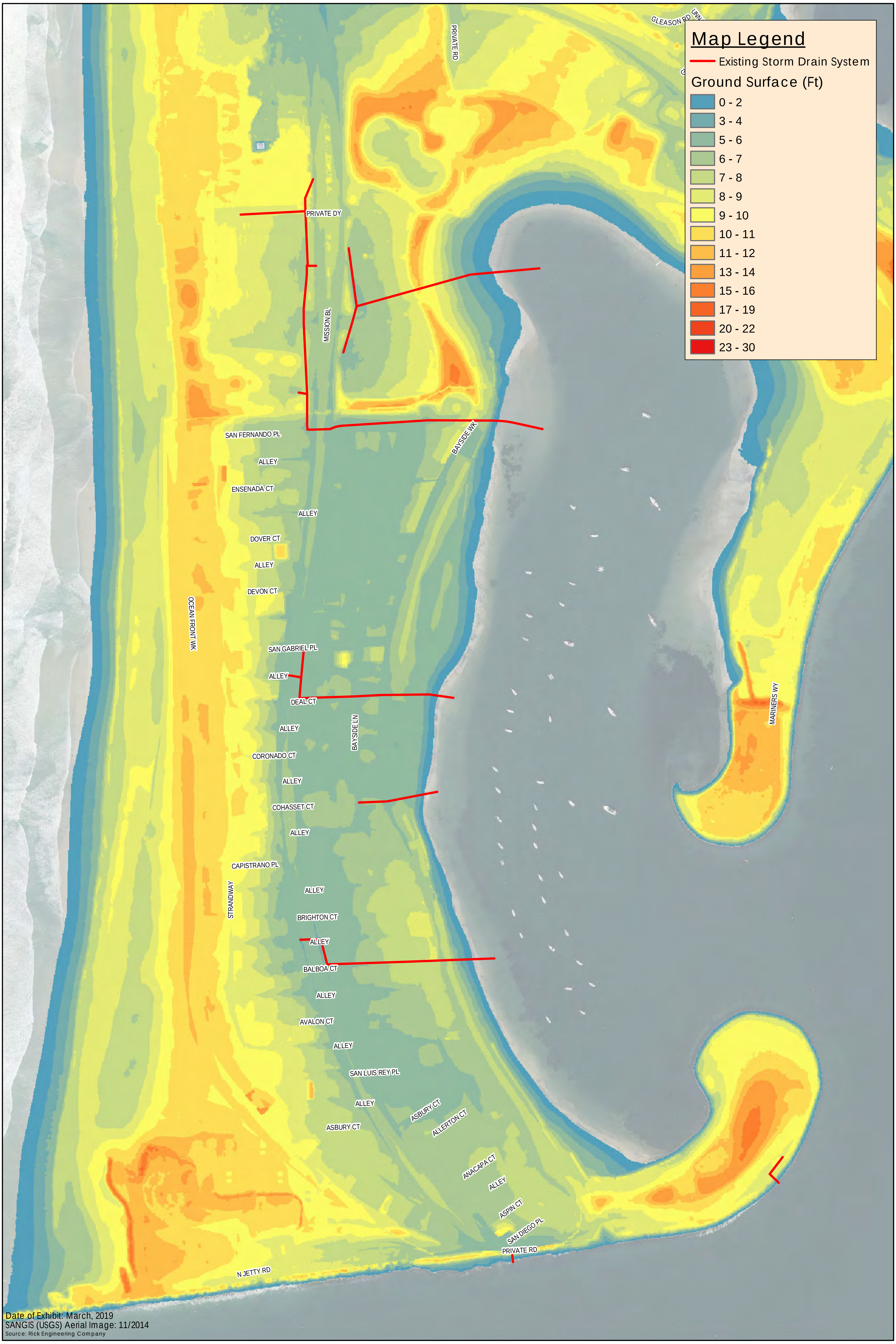
Scale in Feet
0 300 600

North

APPENDIX A - 1

DRAFT South Mission Beach WMP

Curb Height Database



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO

RICK ENGINEERING COMPANY

Scale in Feet
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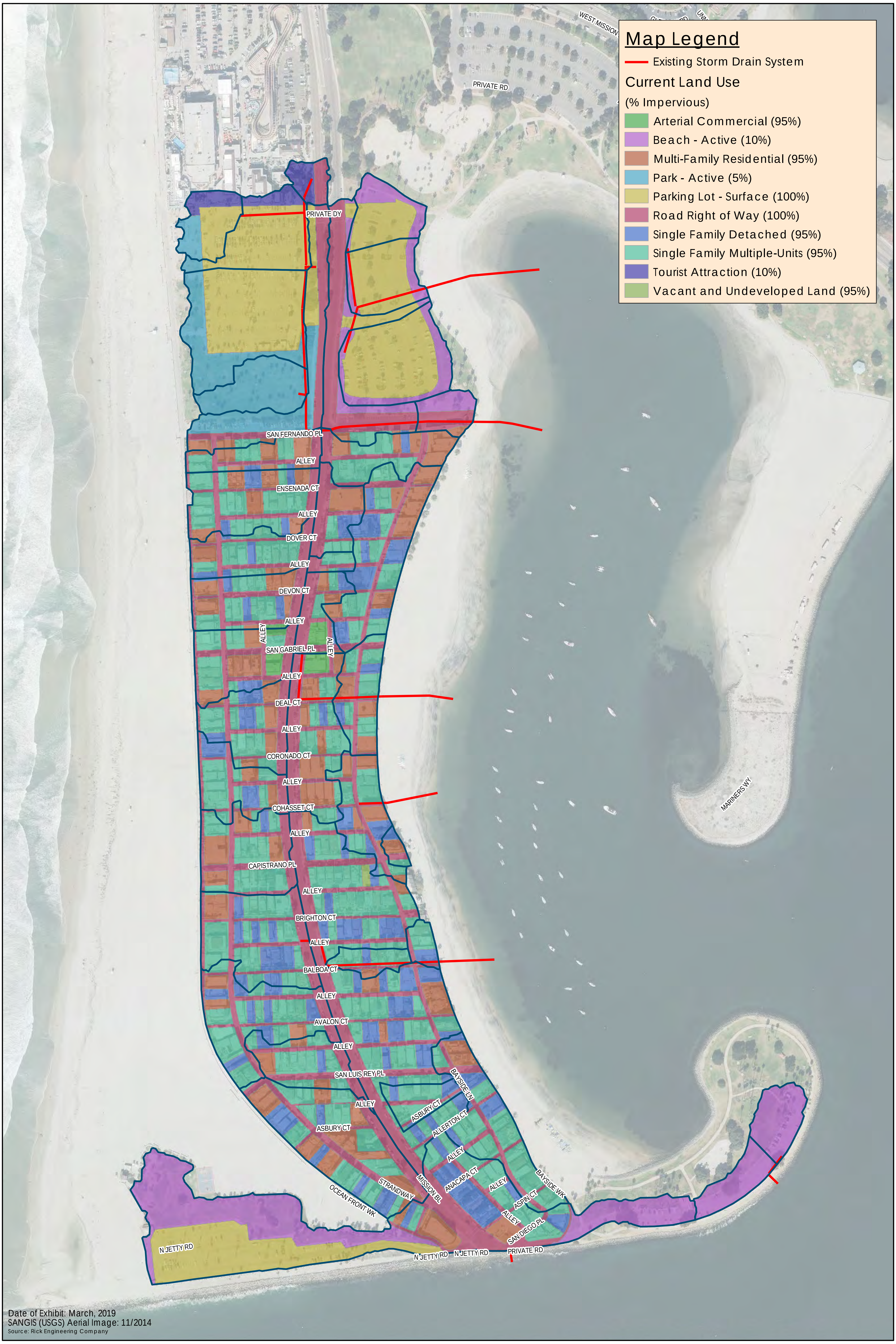
North

APPENDIX A - 2

DRAFT South Mission Beach WMP

Ground Surface Elevation Map



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 3

DRAFT South Mission Beach WMP

Land Use - Percent Impervious

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

Scale in Feet
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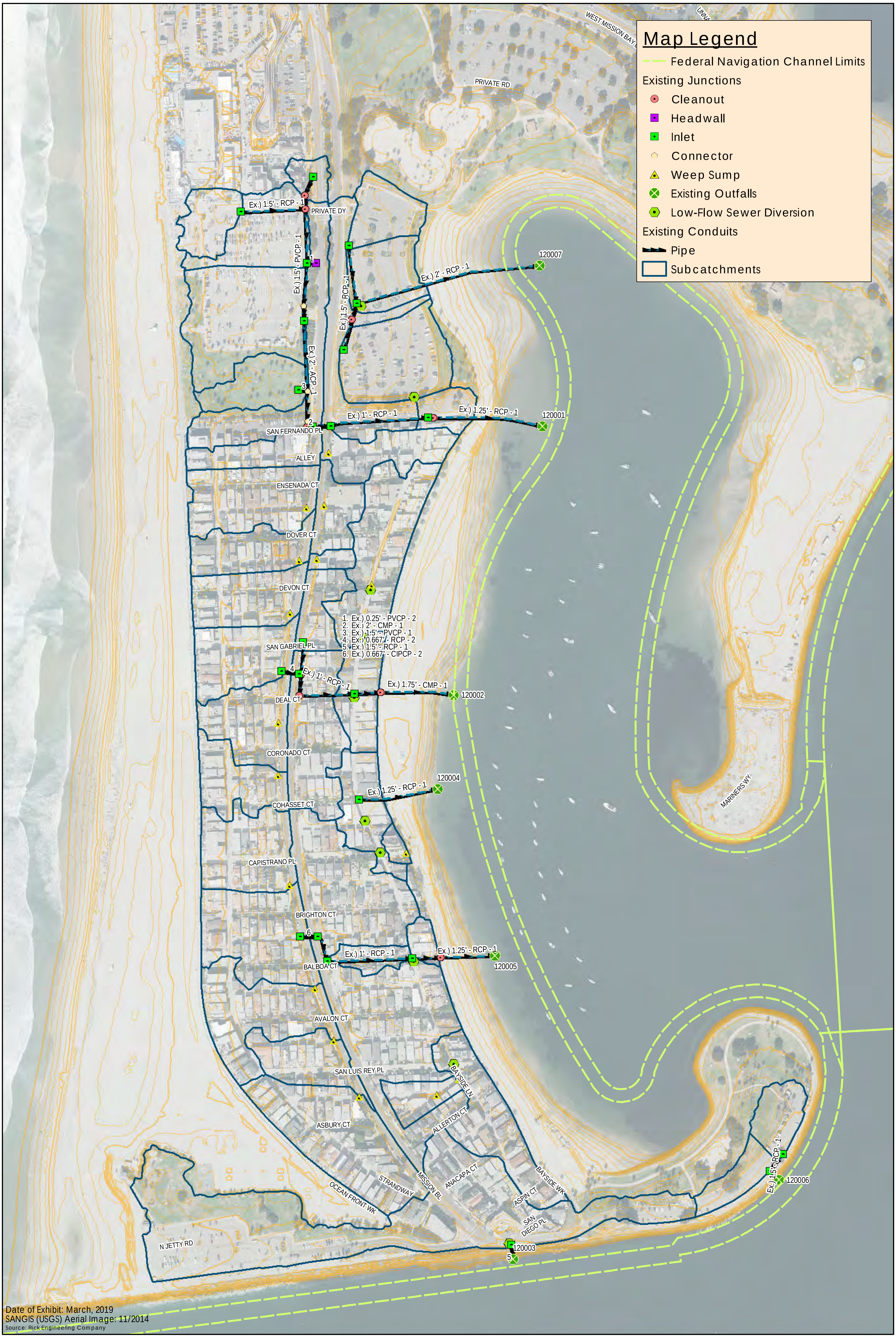
North

APPENDIX A - 4

DRAFT South Mission Beach WMP

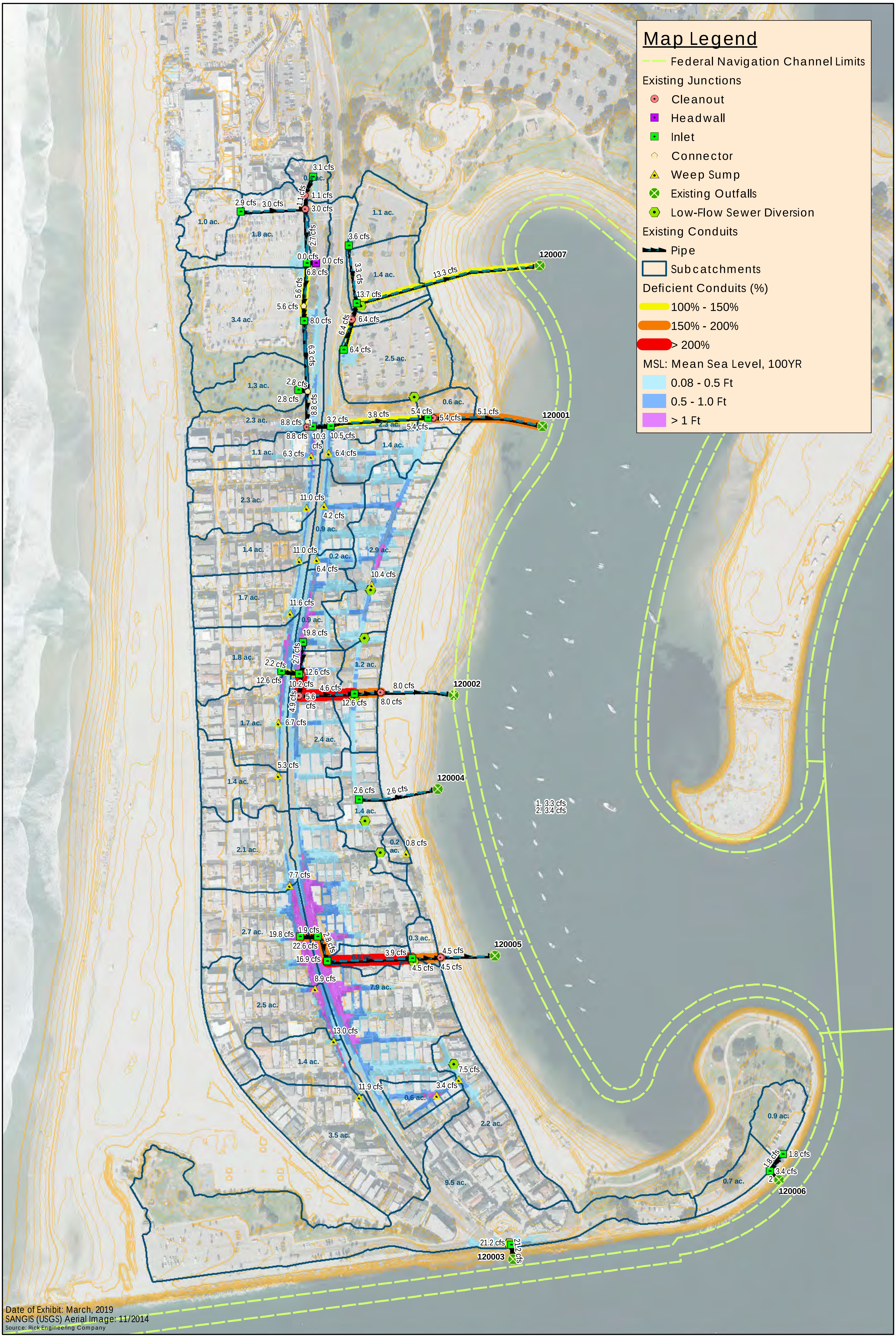
Hydrologic Soils Group



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 5

DRAFT South Mission Beach WMP
Existing Storm Drain Inventory



Scale in Feet
0 300 600
North

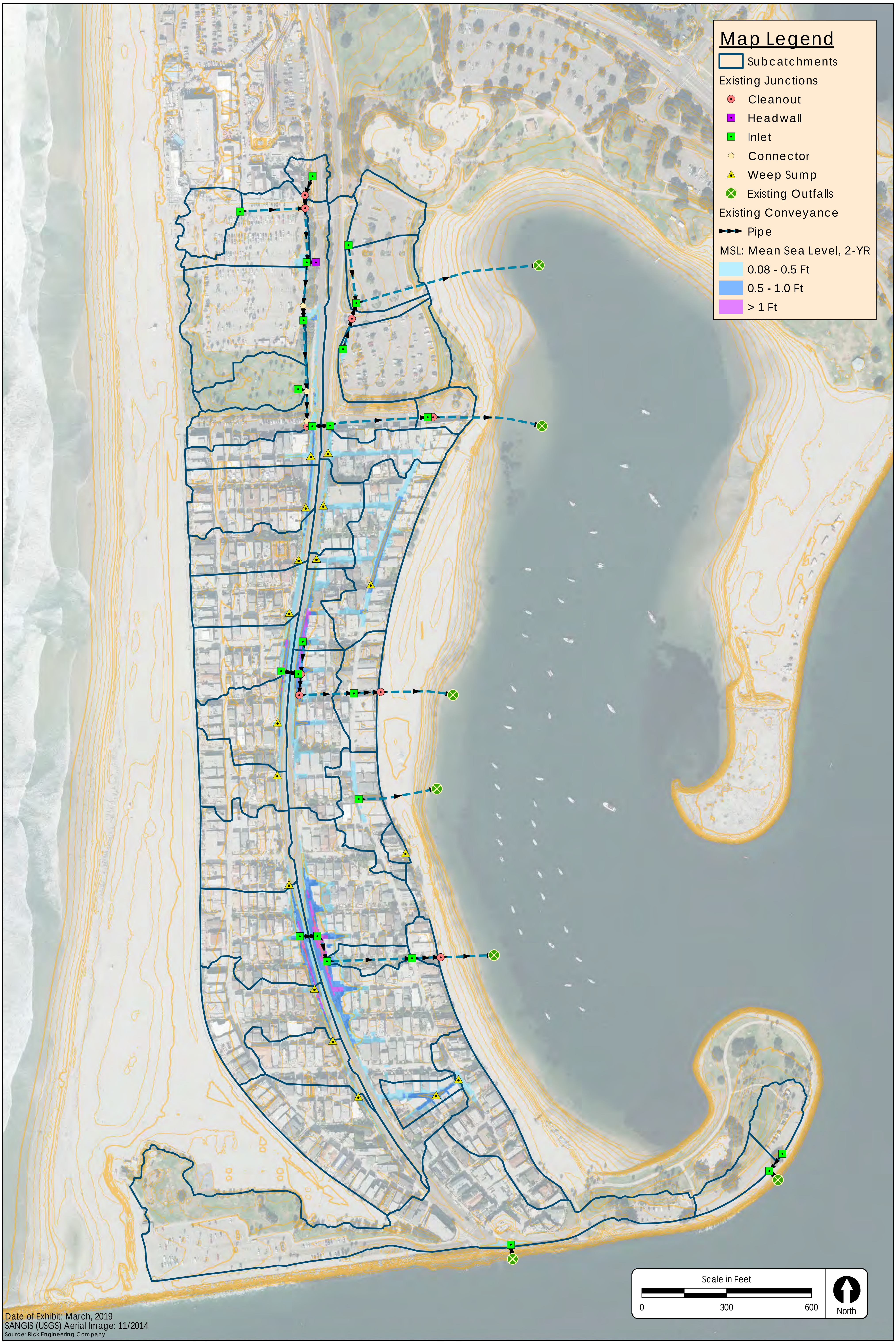
APPENDIX A - 6

DRAFT South Mission Beach WMP

Existing 100 Year Results

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

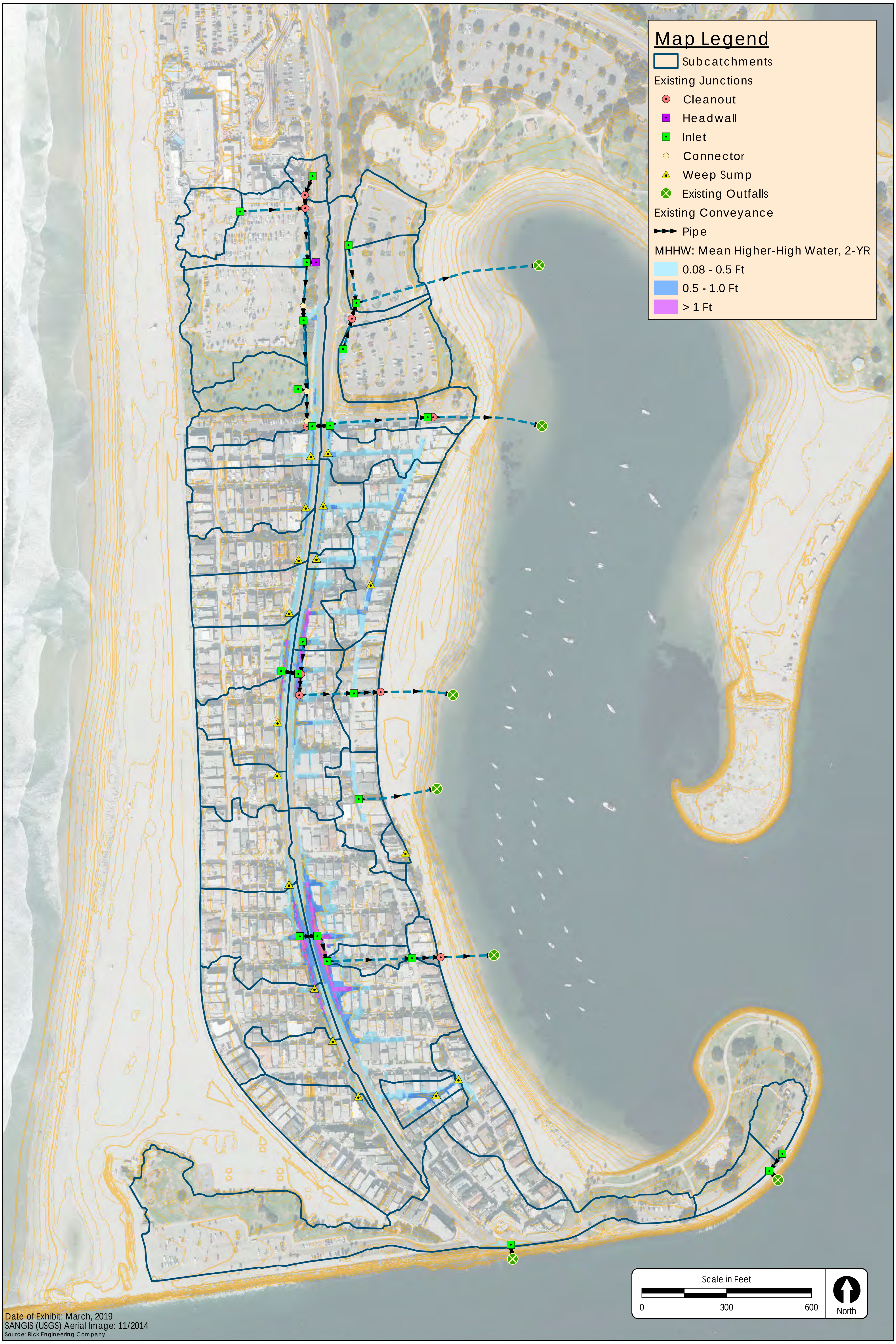
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MSL: Mean Sea Level, 2-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY

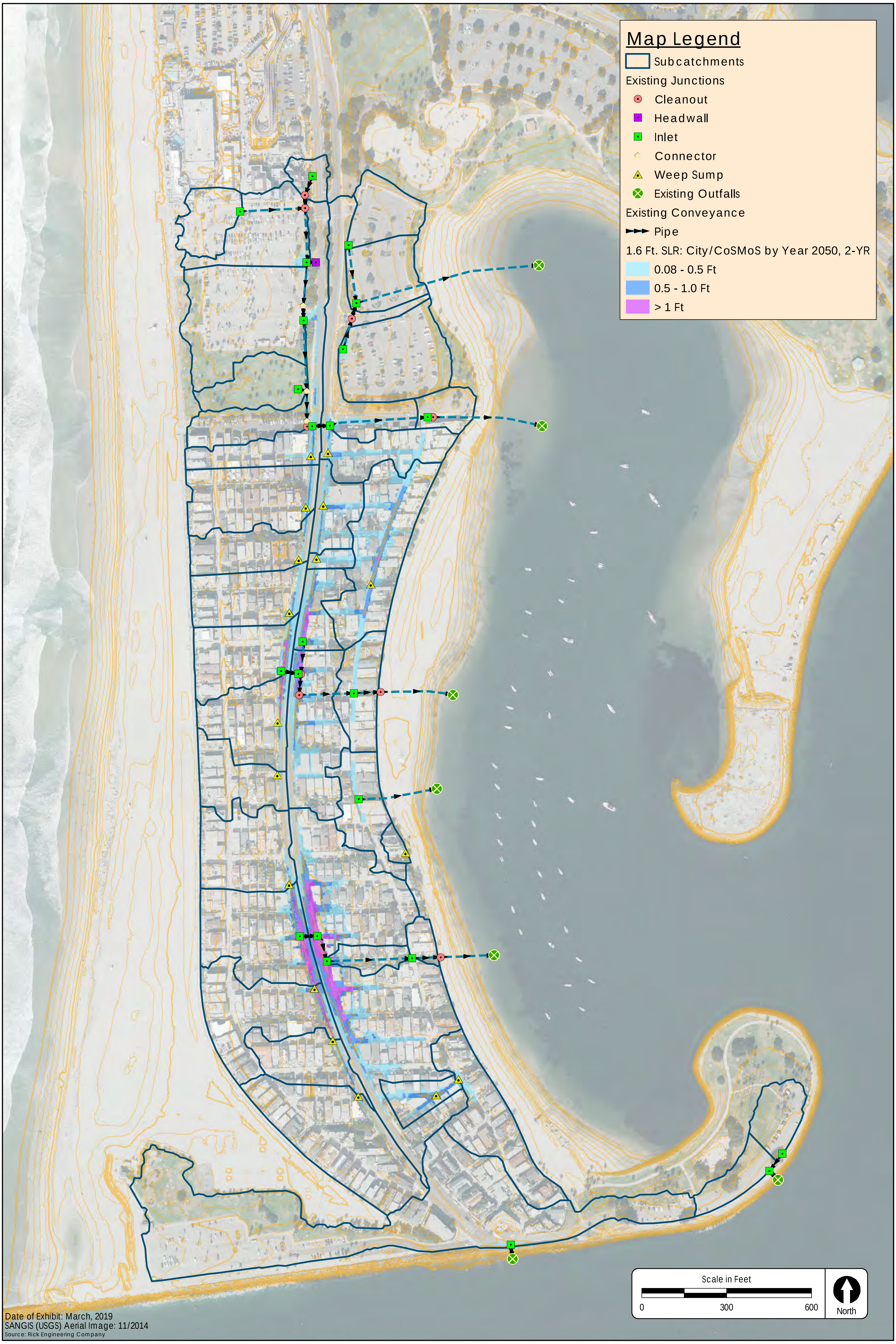


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MHHW: Mean Higher-High Water, 2-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

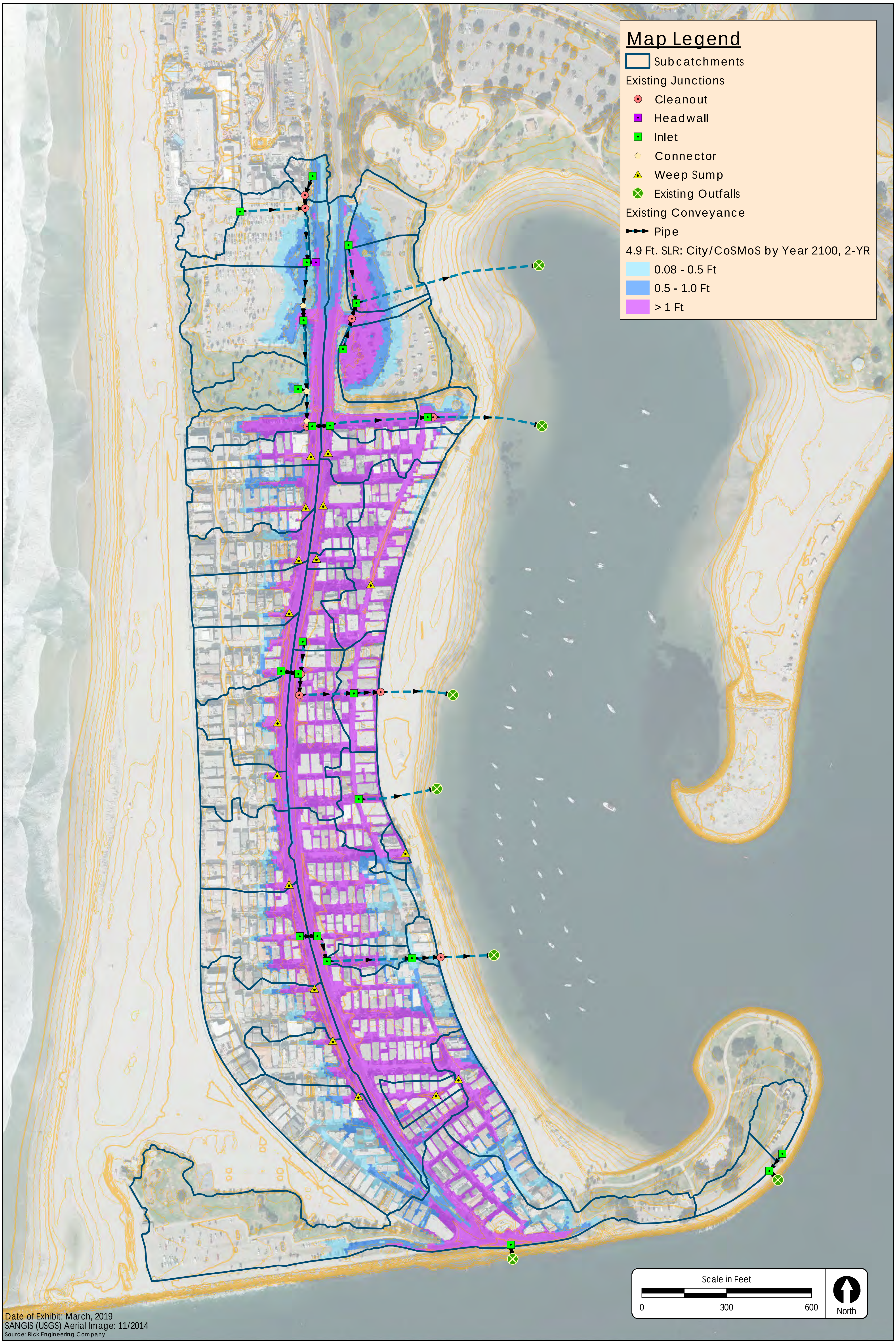
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 2-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

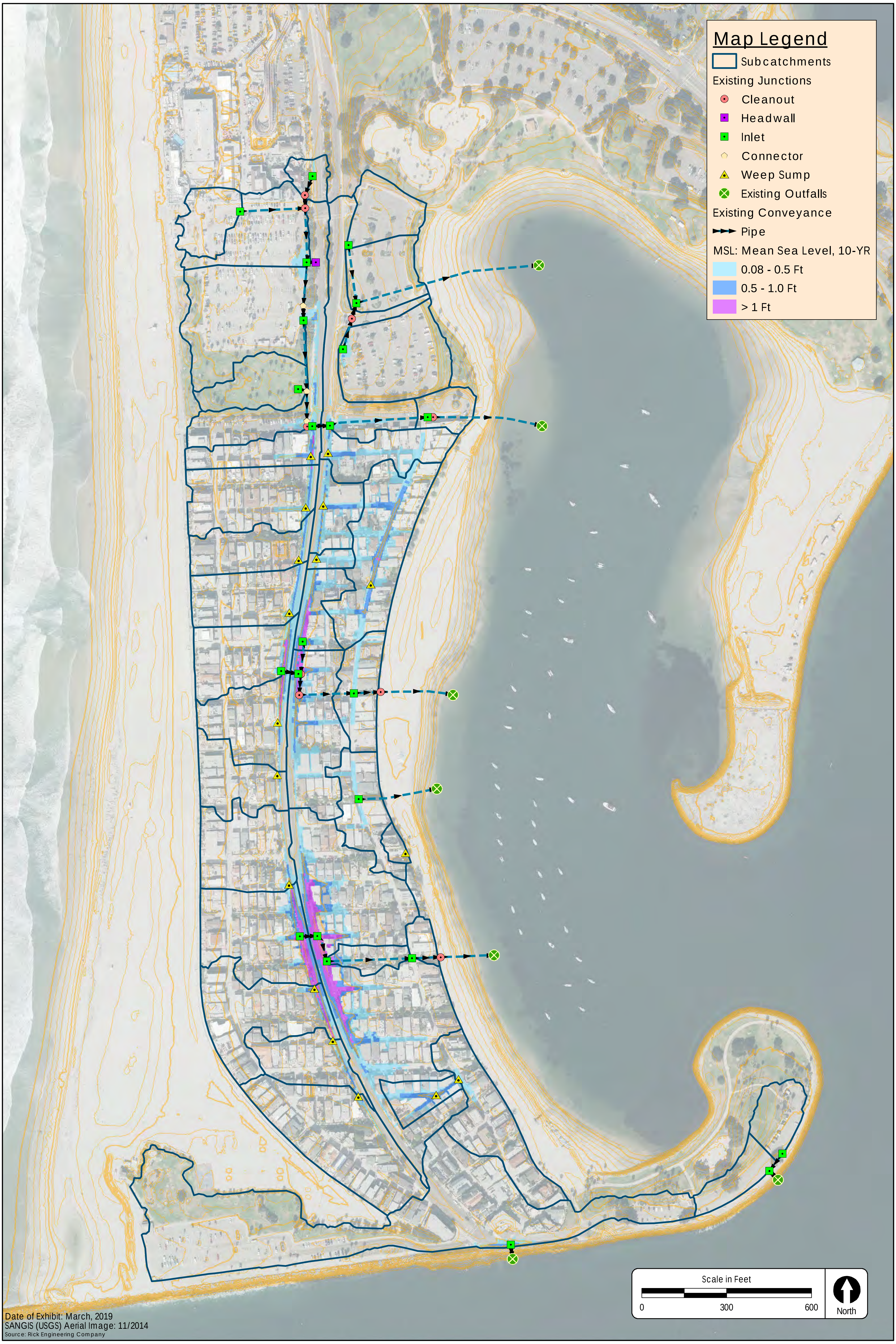
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 2-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY

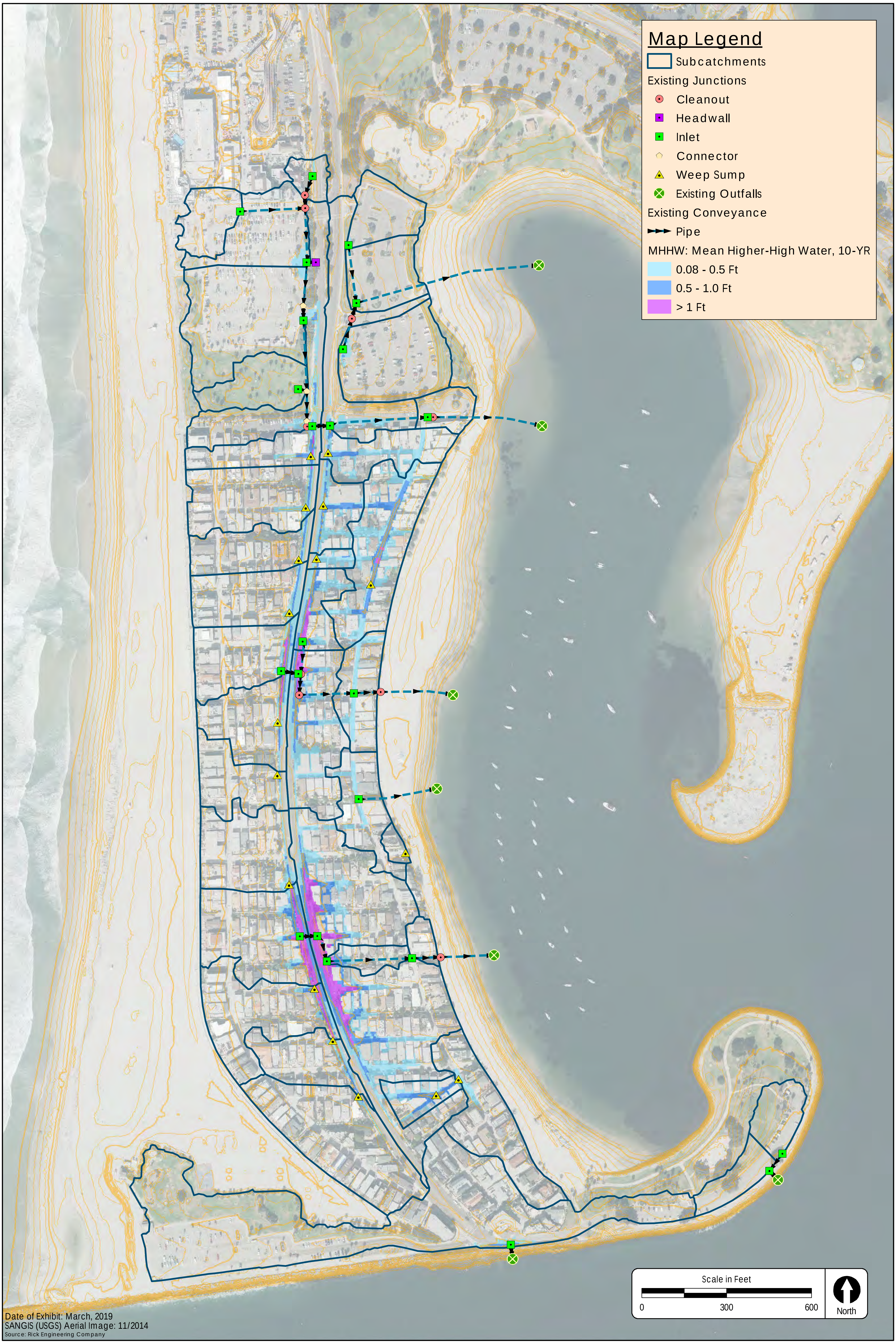


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MSL: Mean Sea Level, 10-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

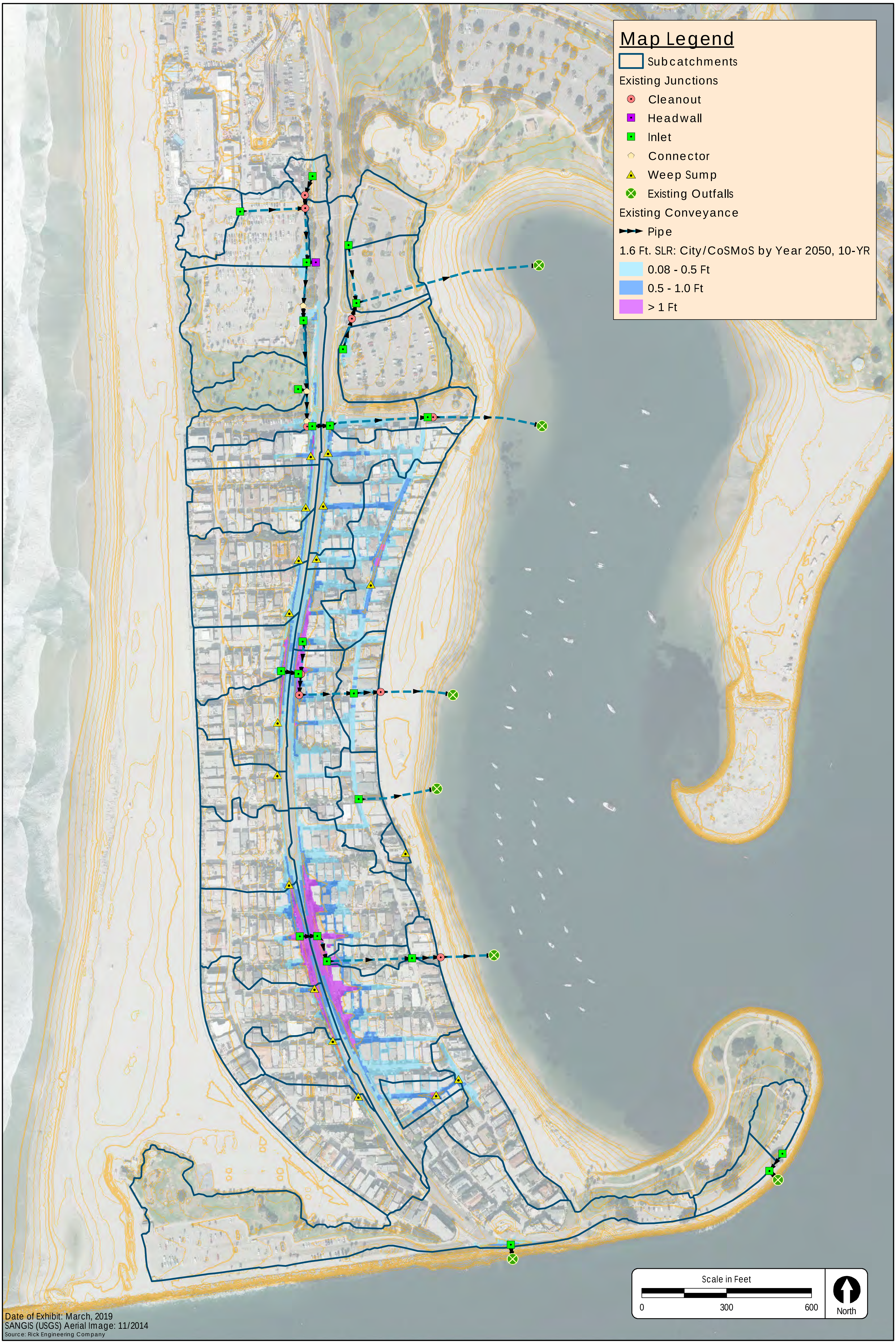
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing MHHW: Mean Higher-High Water, 10-YR

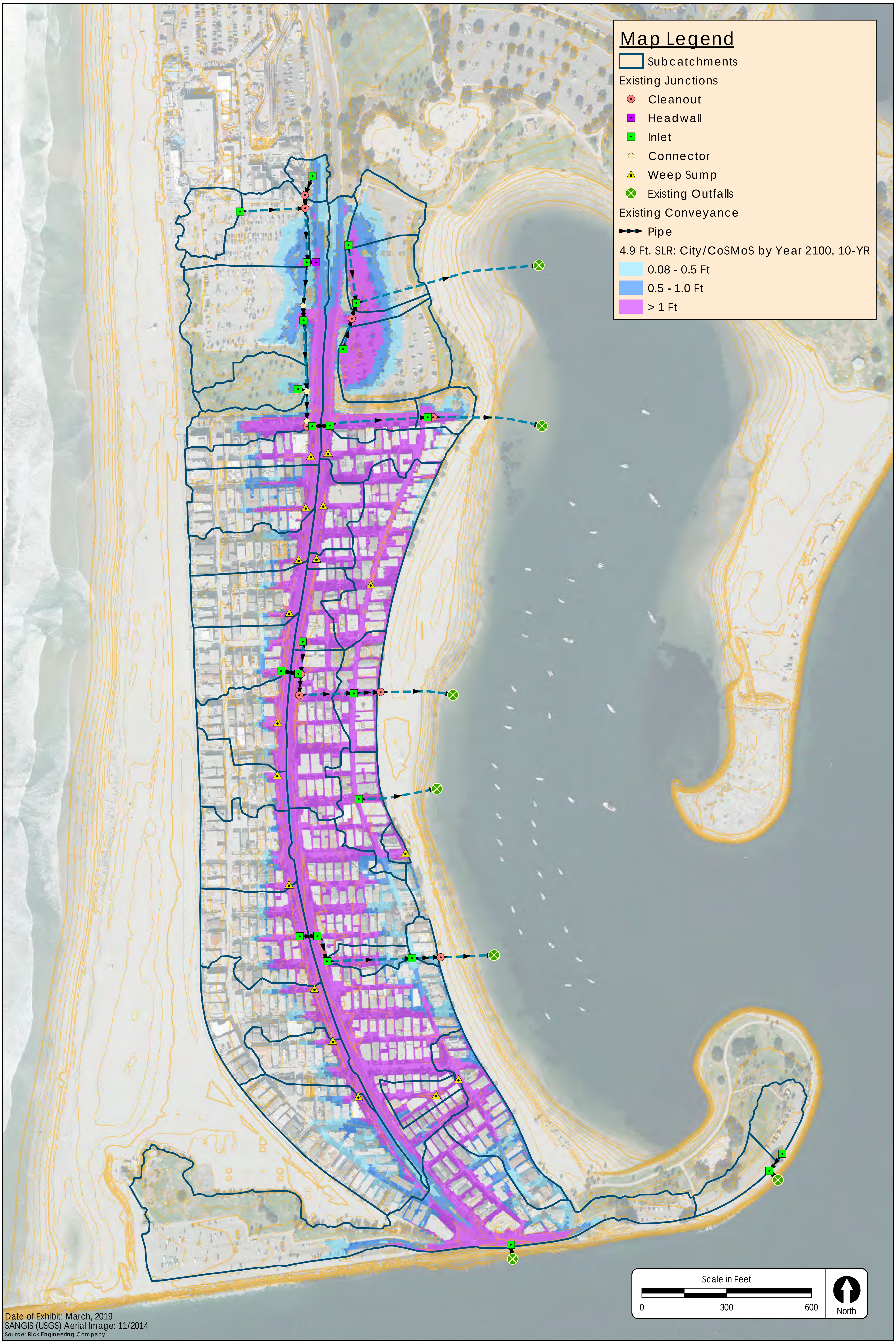


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 10-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

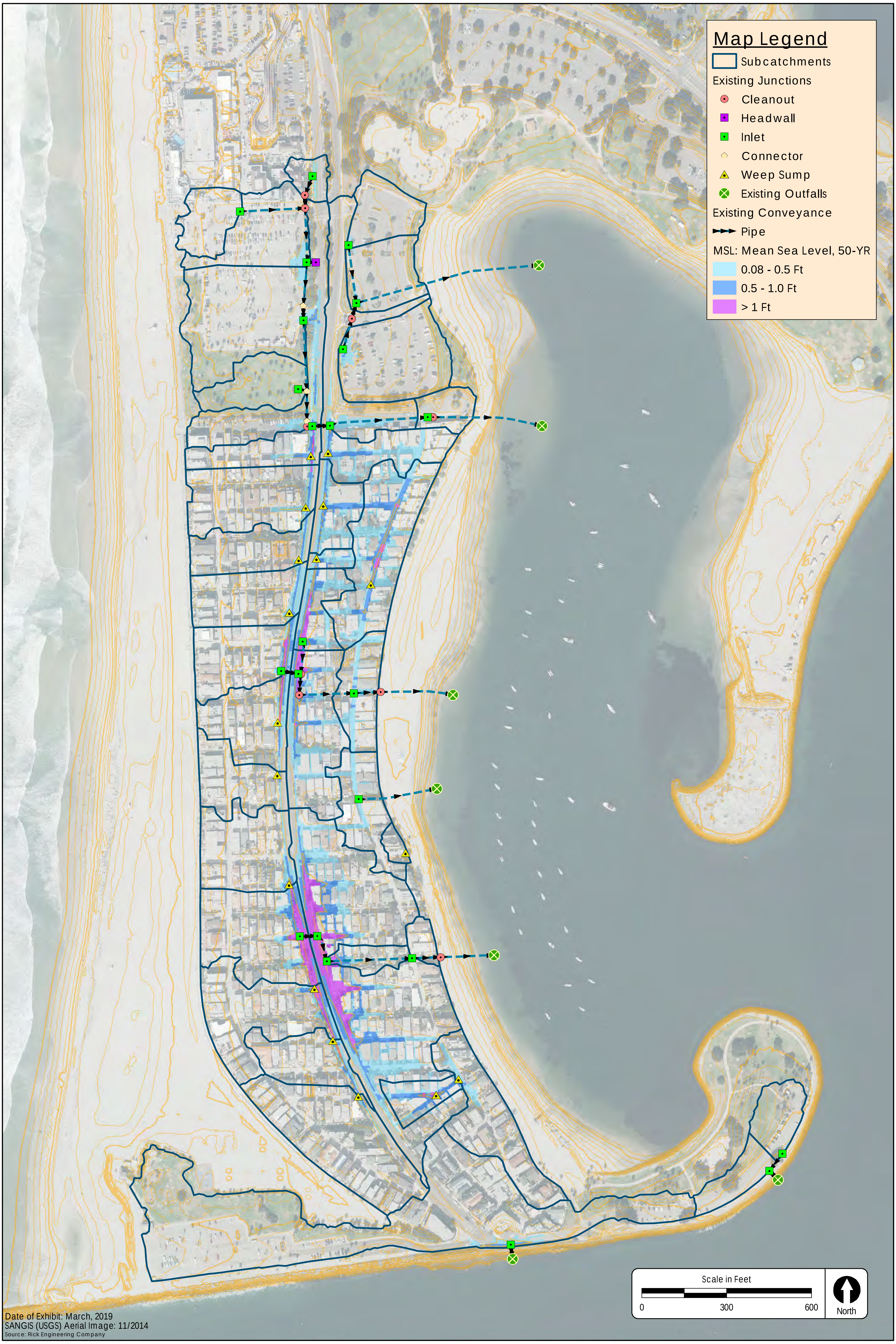
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 10-YR

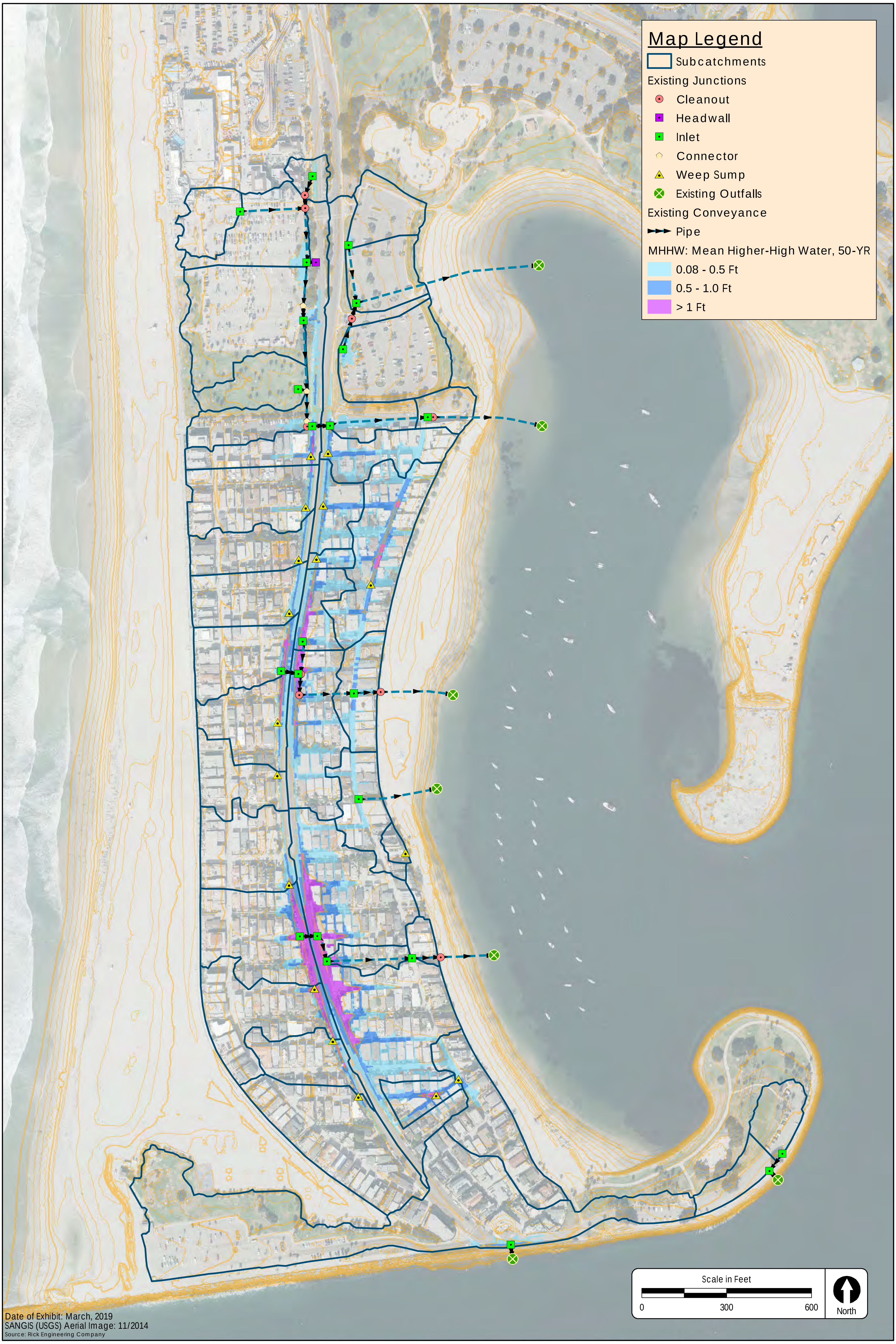


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MSL: Mean Sea Level, 50-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

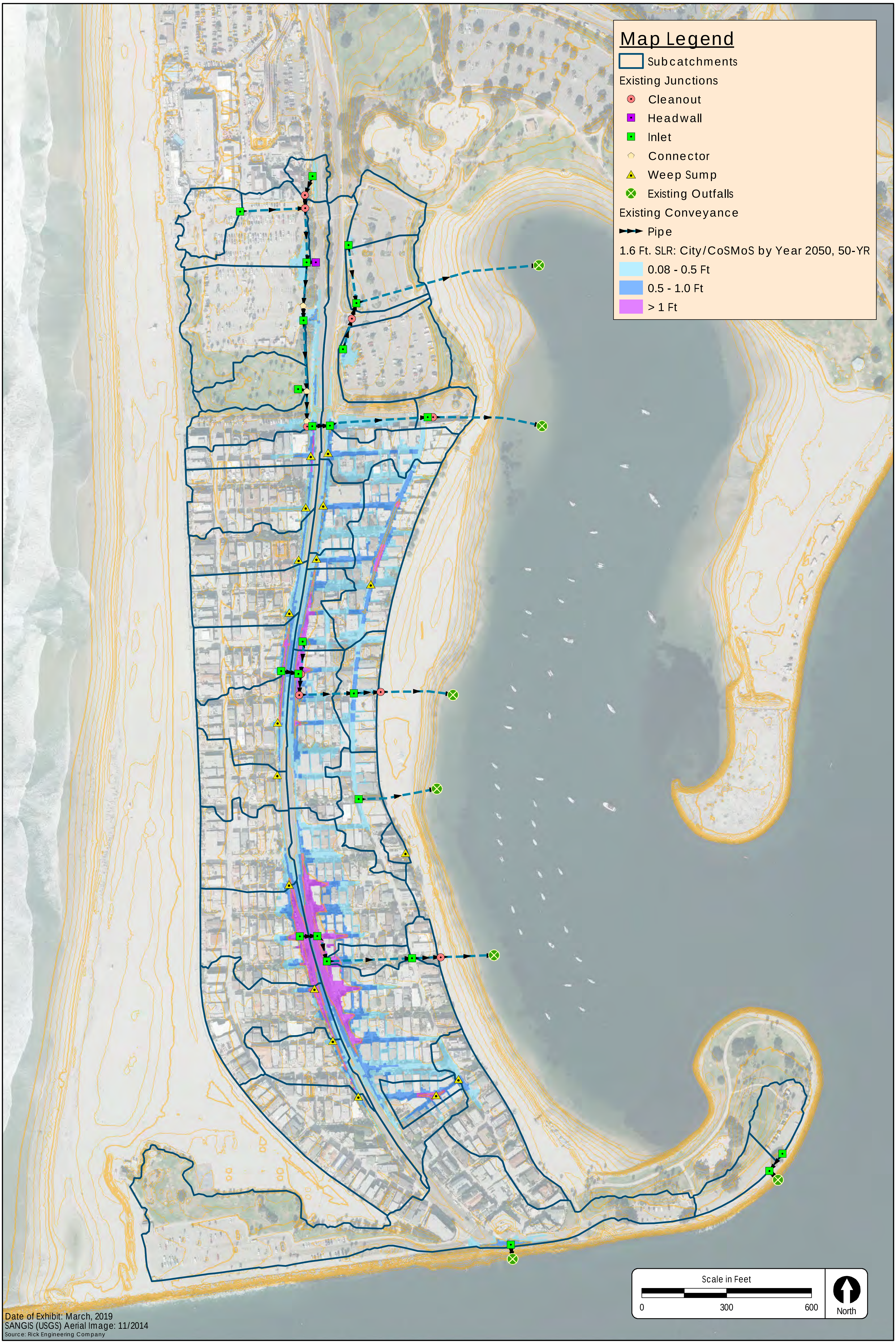
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing MHHW: Mean Higher-High Water, 50-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

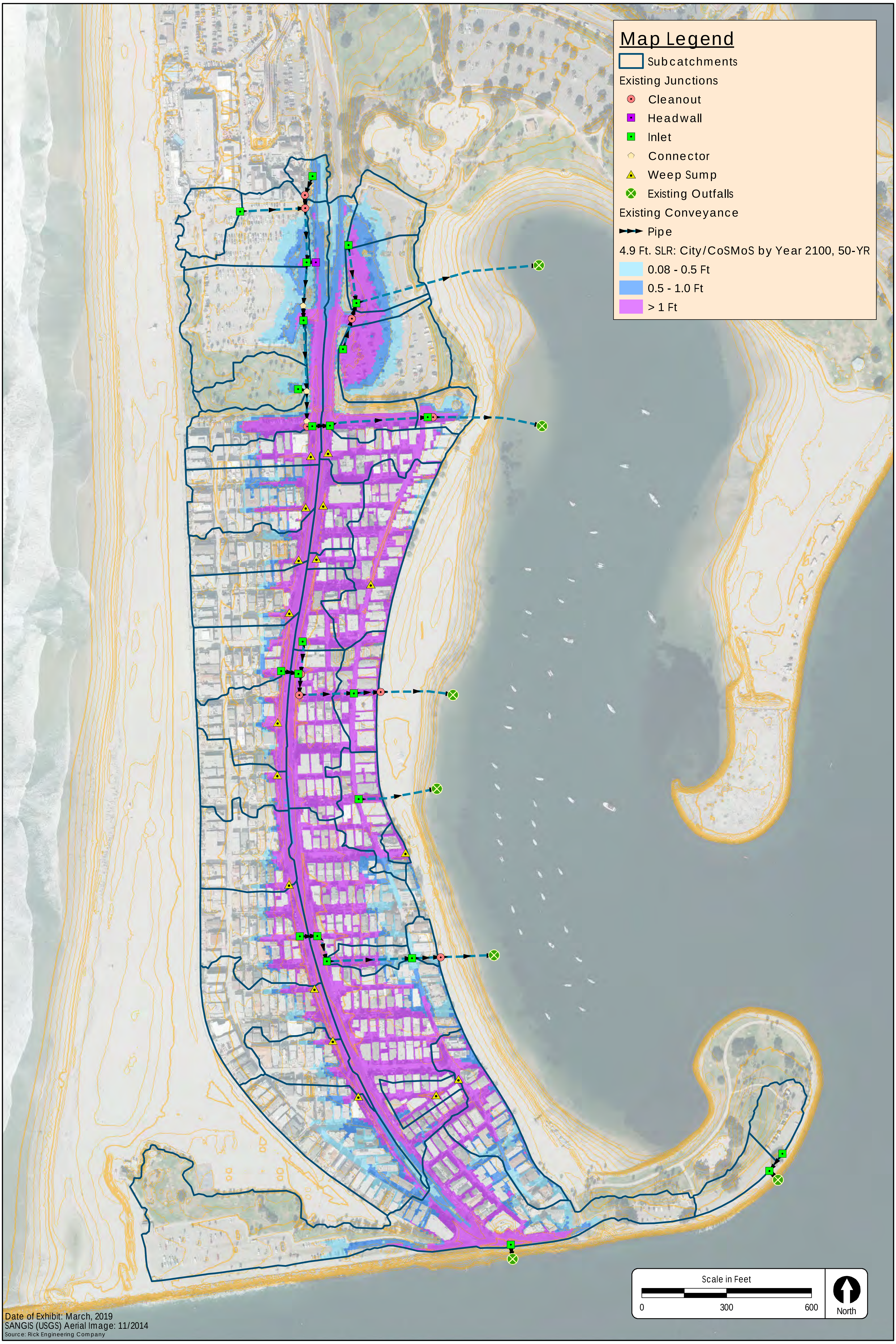
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 50-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

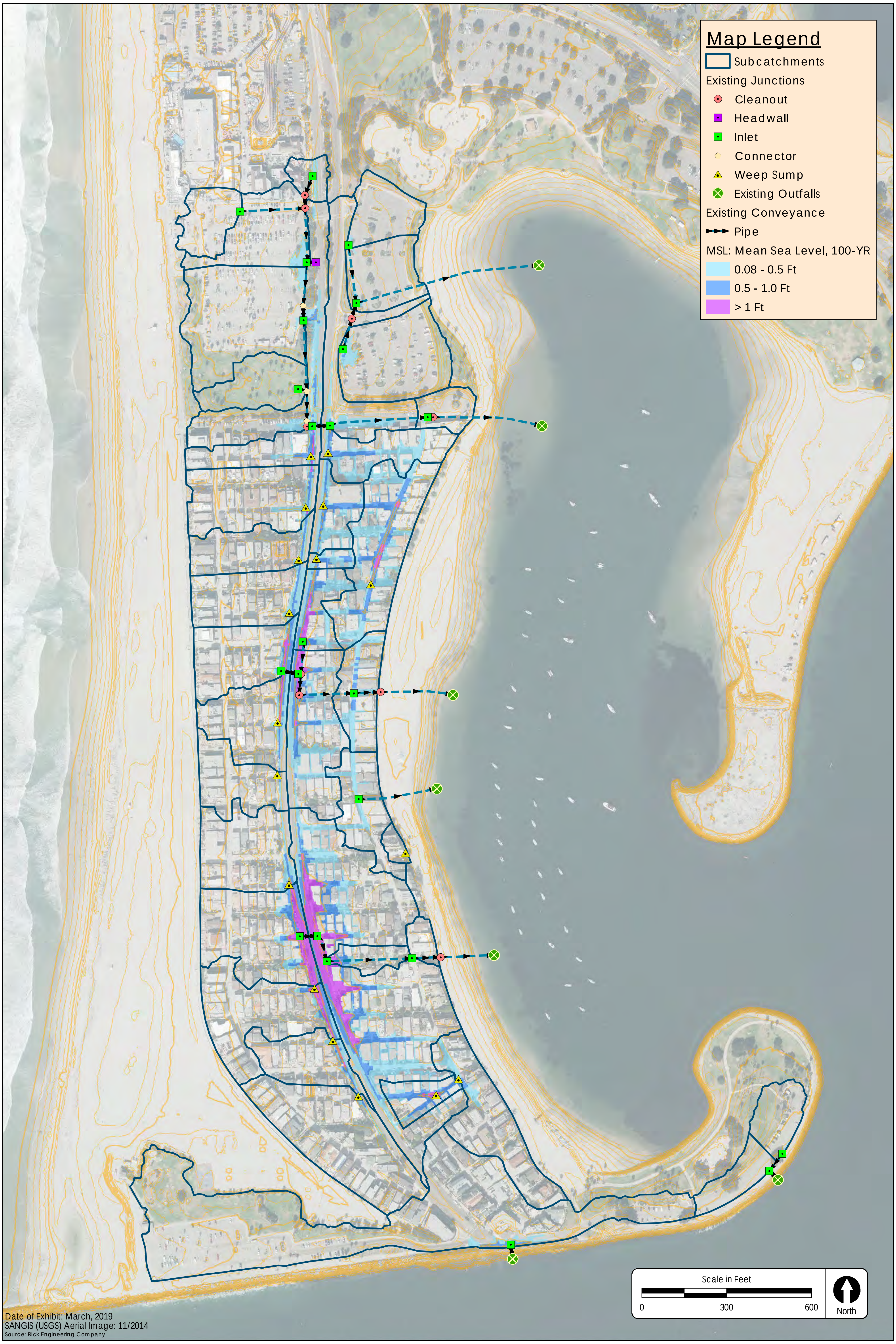
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 50-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

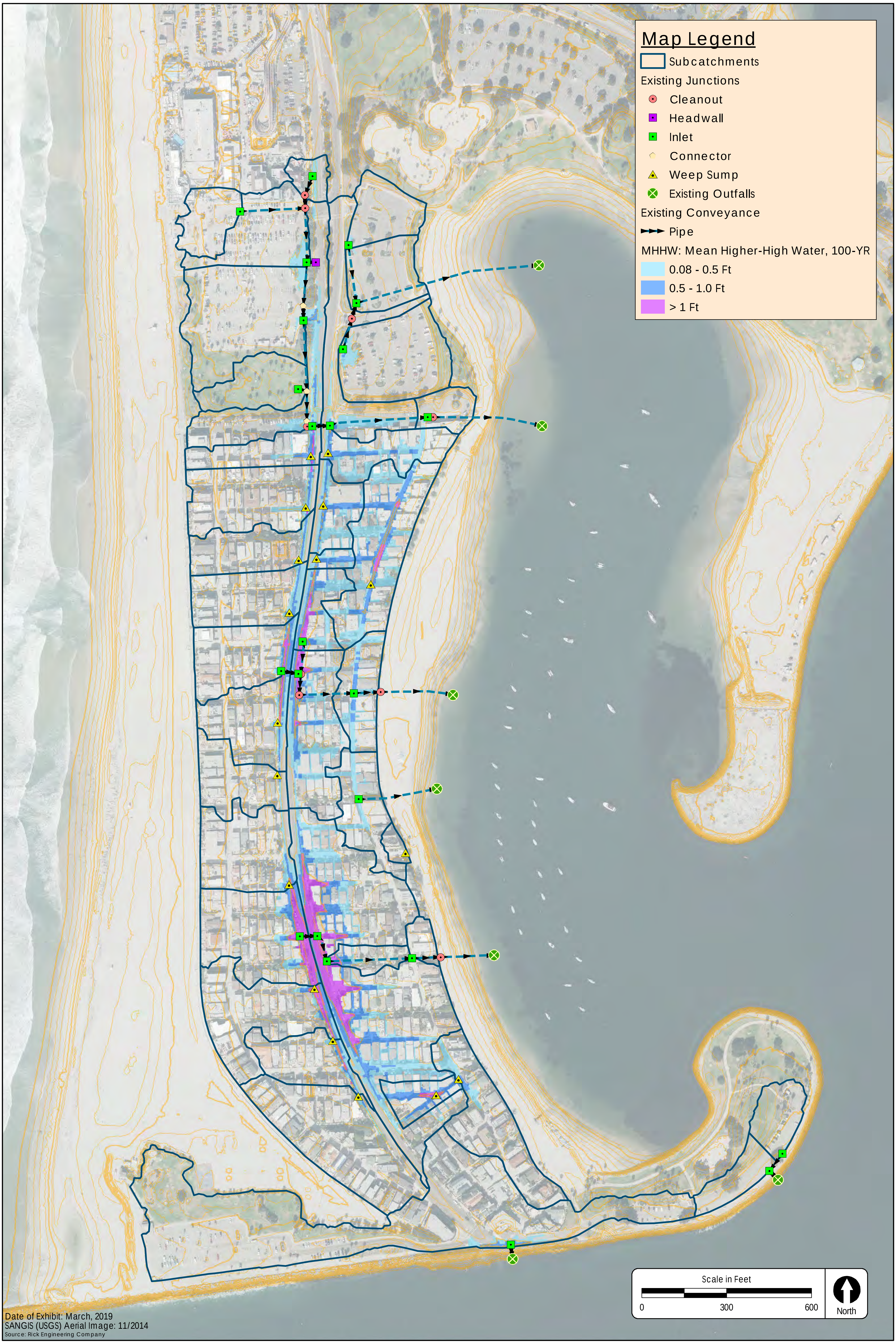
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MSL: Mean Sea Level, 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY

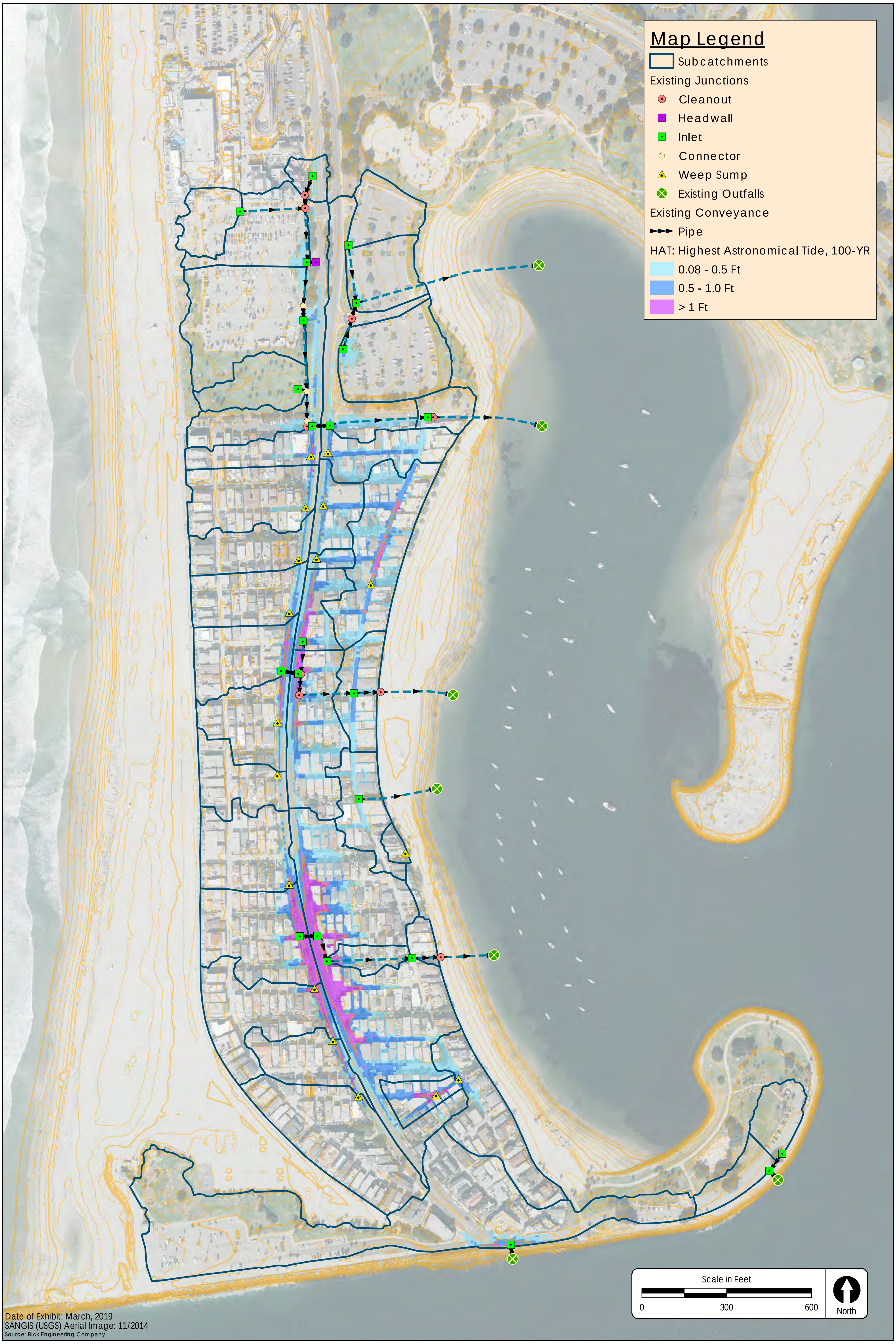


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing MHHW: Mean Higher-High Water, 100-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

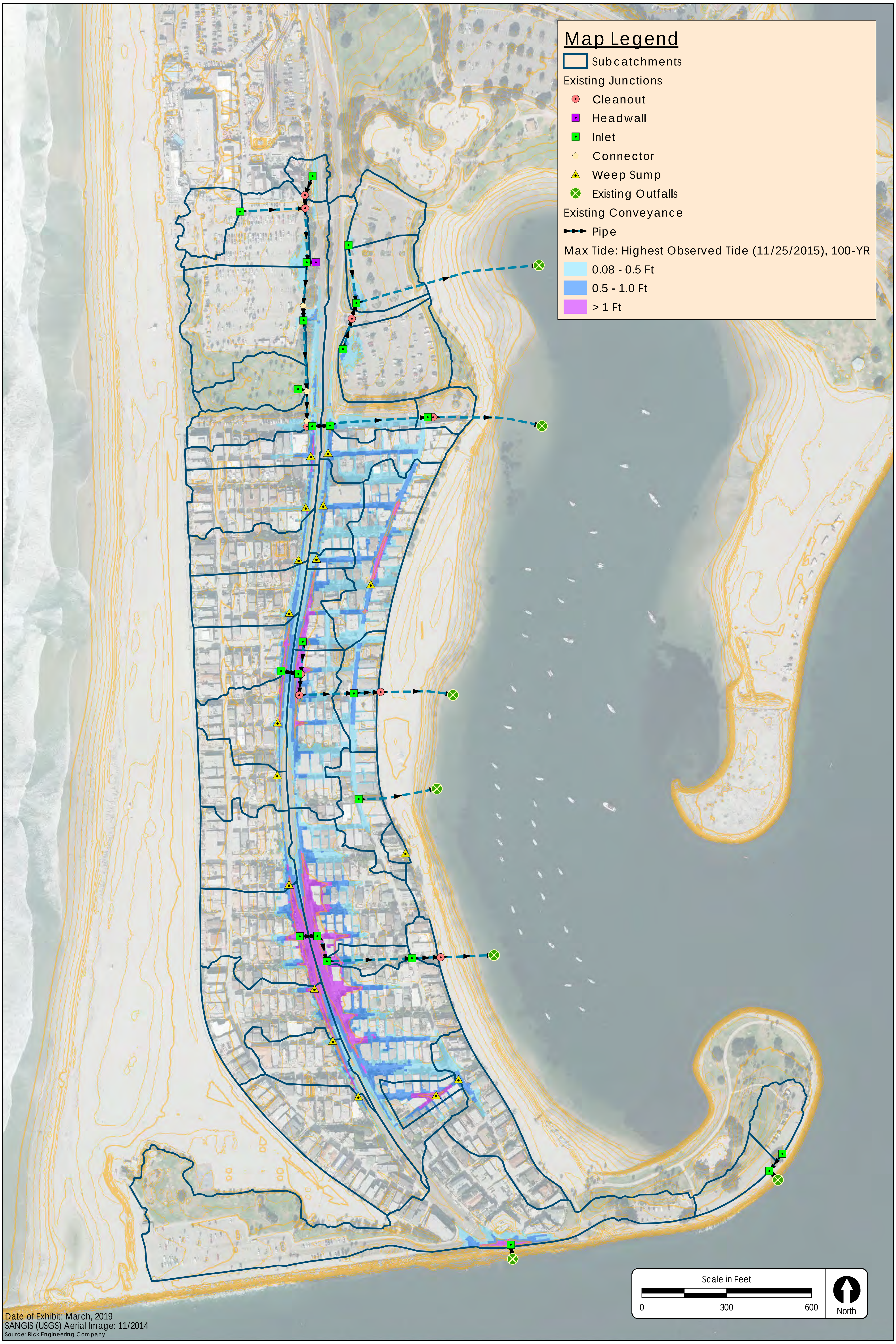
APPENDIX A - 6.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Existing HAT: Highest Astronomical Tide, 100-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

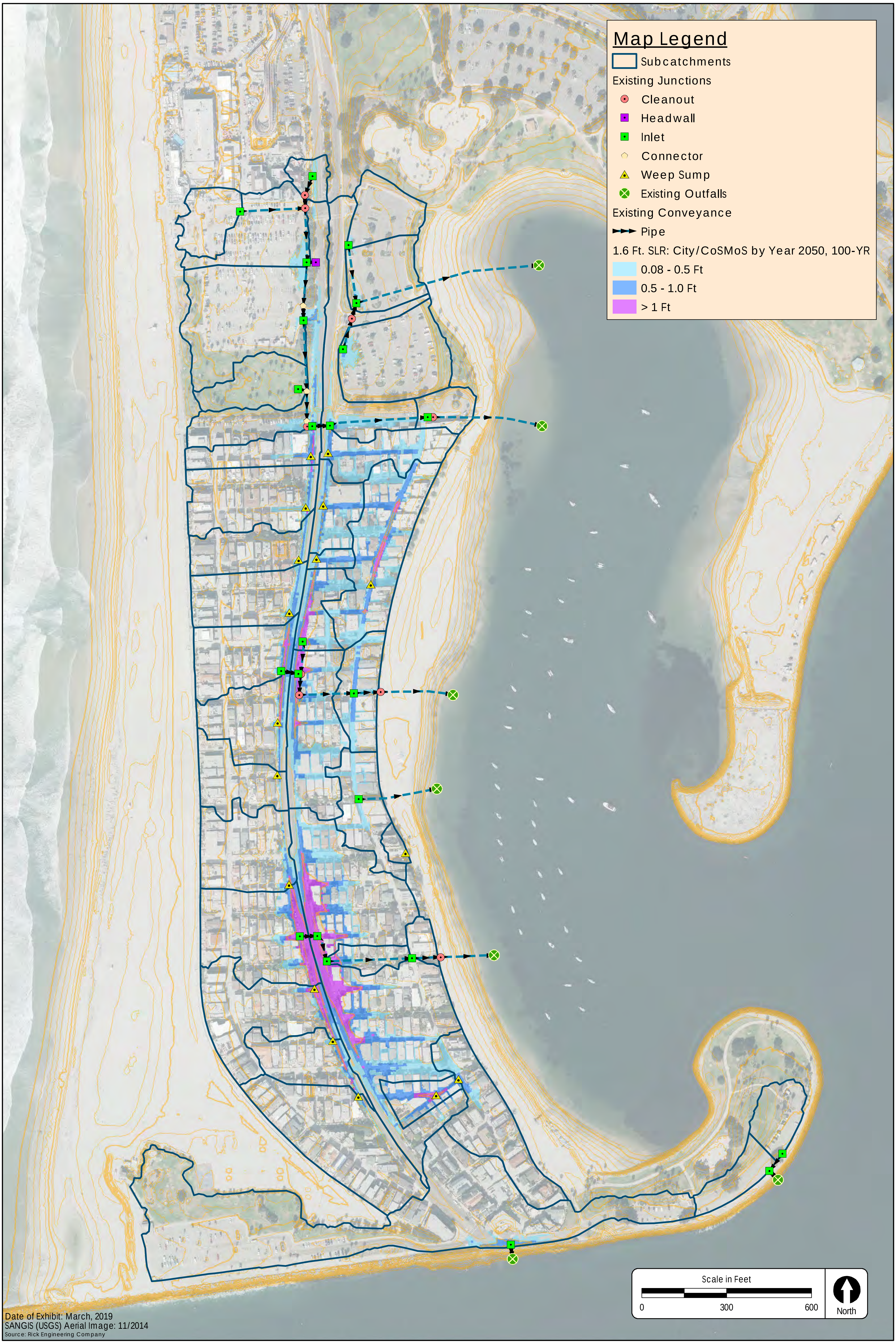
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing Max Tide: Highest Observed Tide (11/25/2015), 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

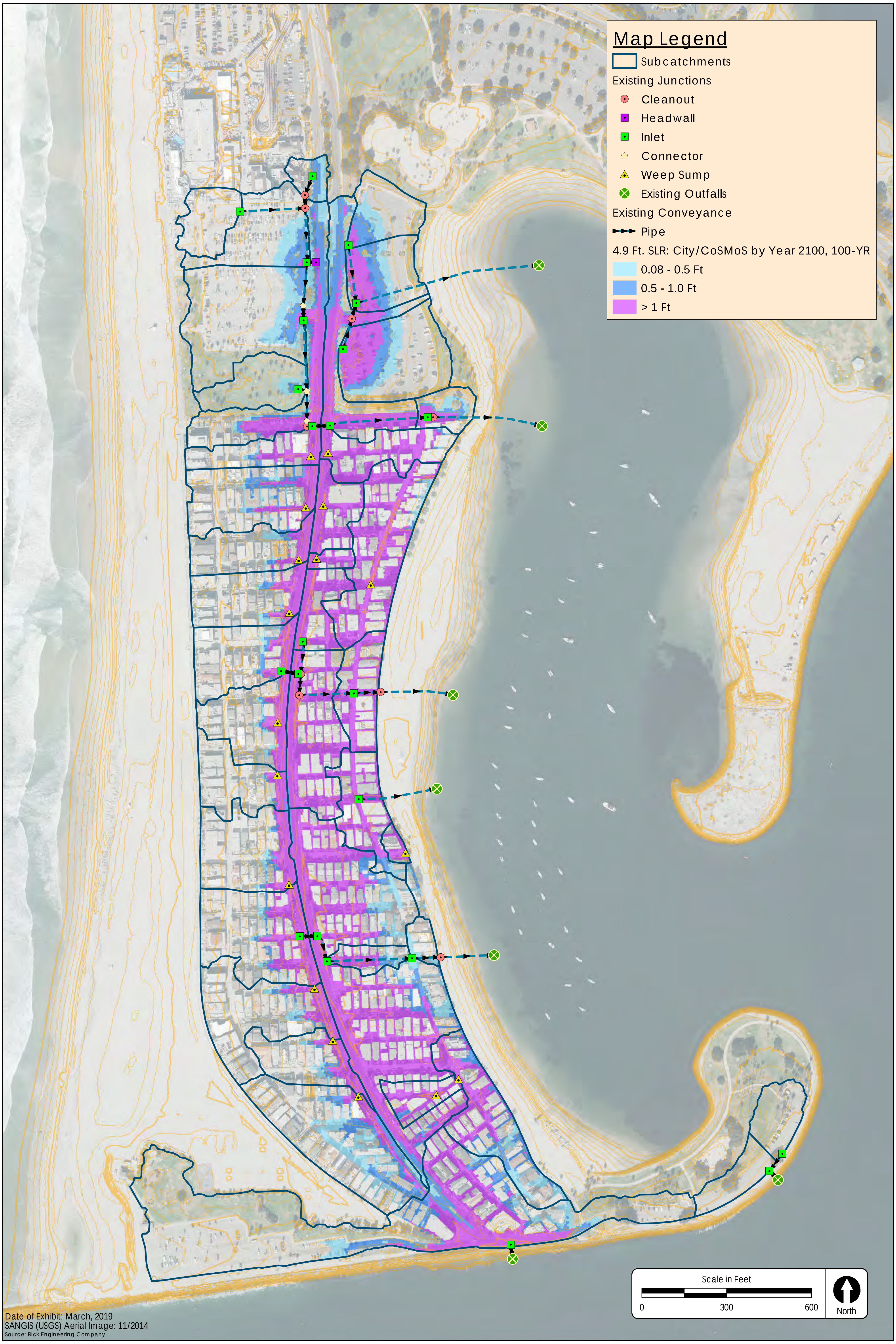
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

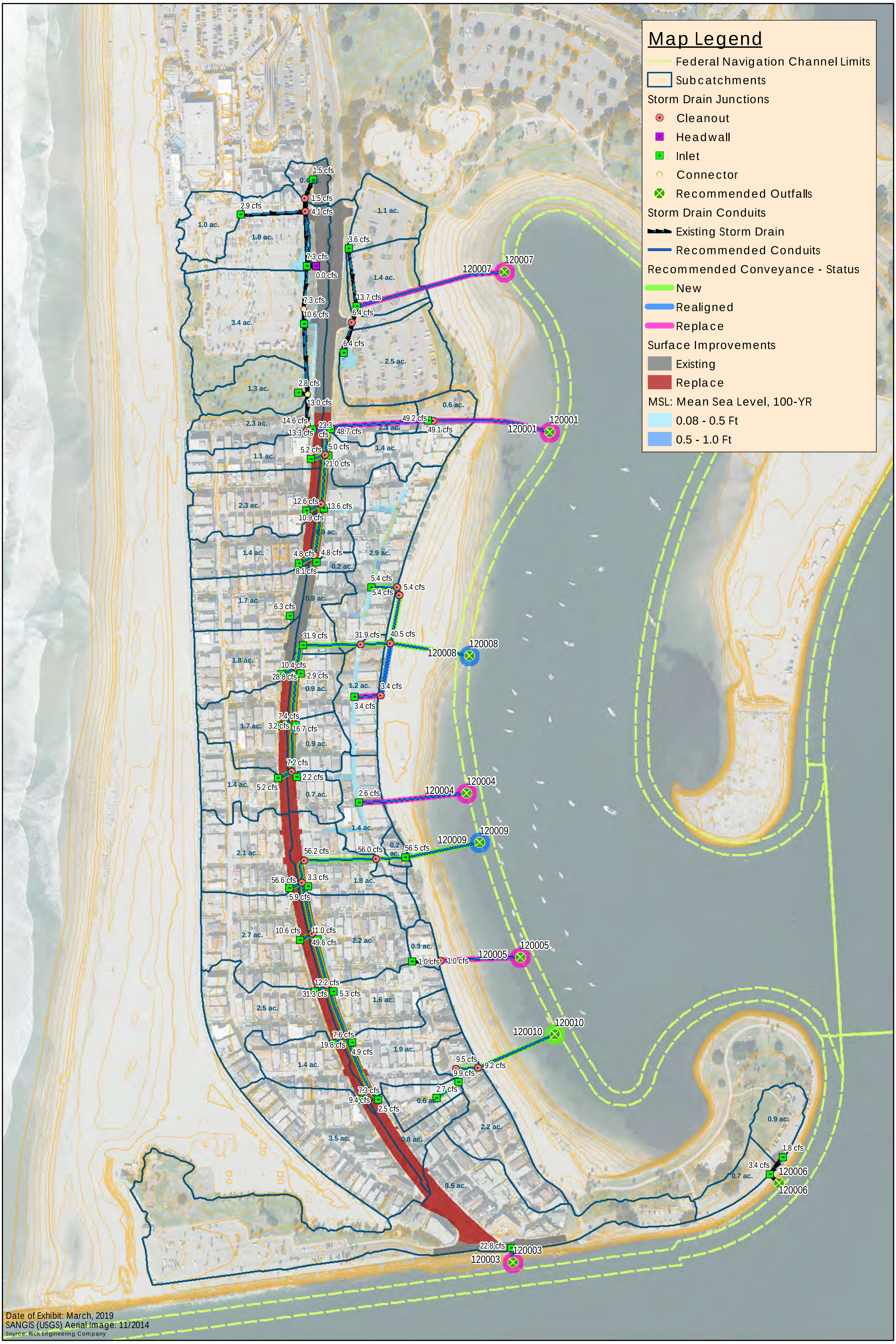
APPENDIX A - 6.1

DRAFT South Mission Beach WMP

Existing 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7

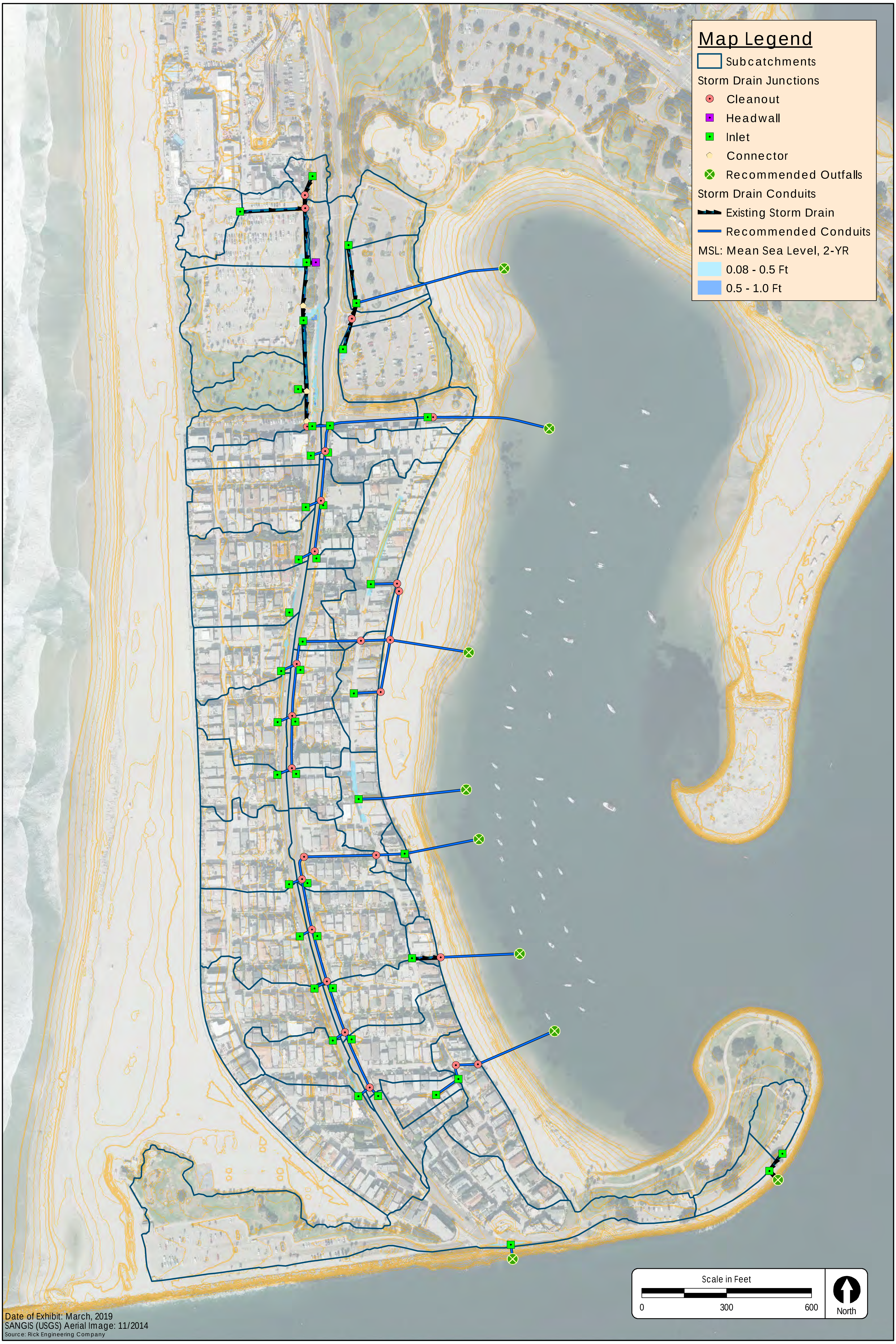
The City of SAN DIEGO

RICK ENGINEERING COMPANY

Scale in Feet
0 300 600

North

DRAFT South Mission Beach WMP
Recommended Improvements



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

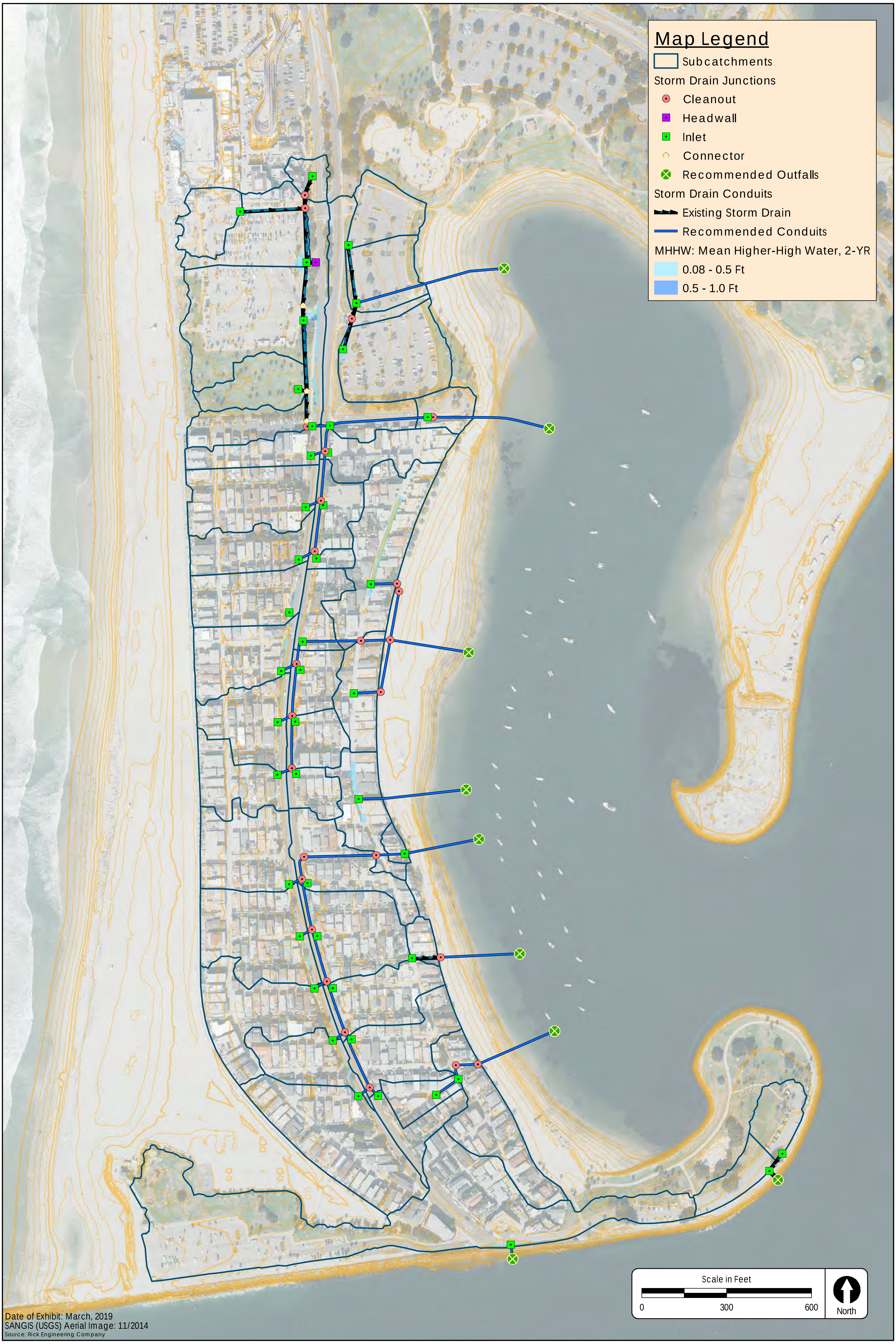
APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MSL: Mean Sea Level, 2-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

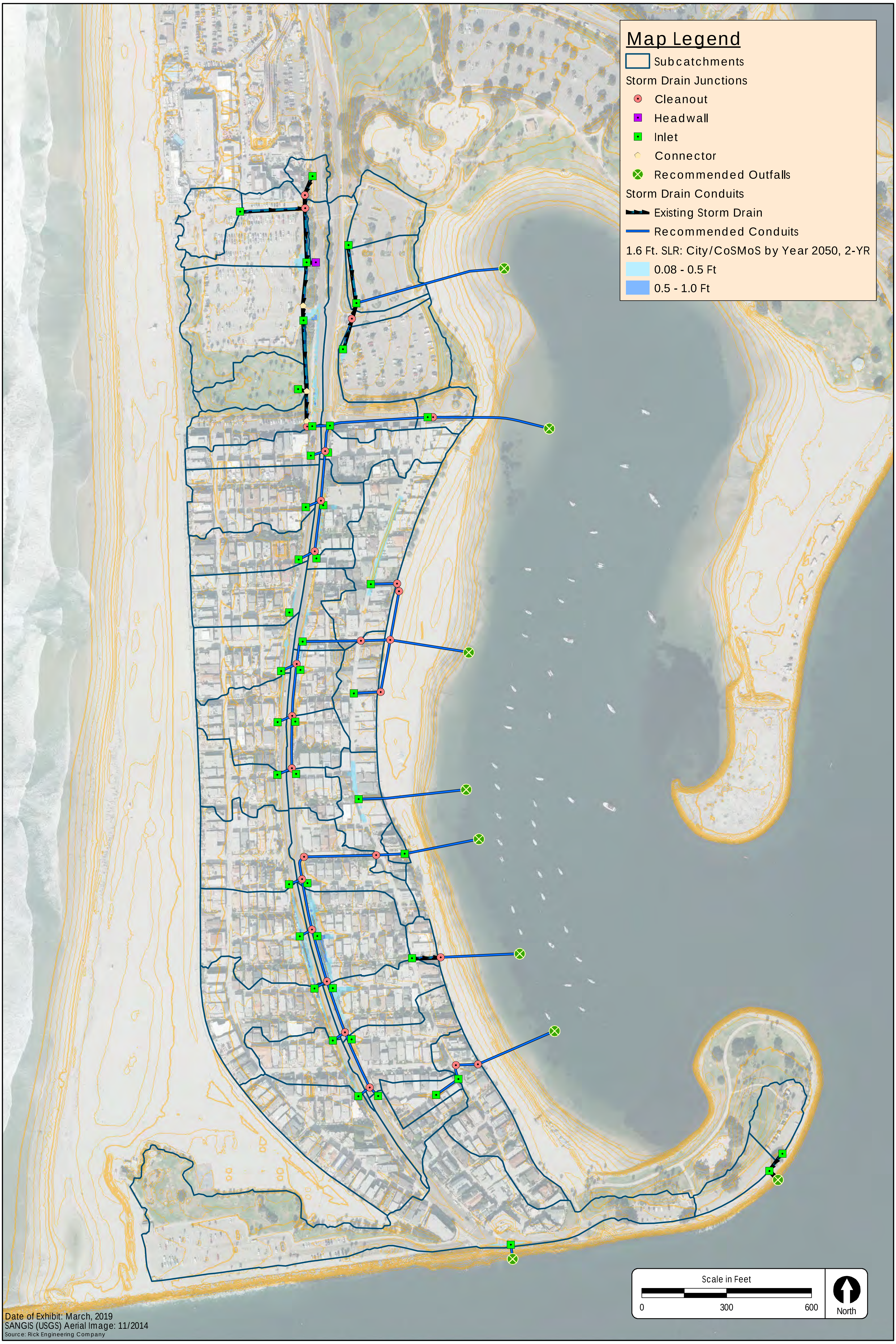
APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MHHW: Mean Higher-High Water, 2-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY

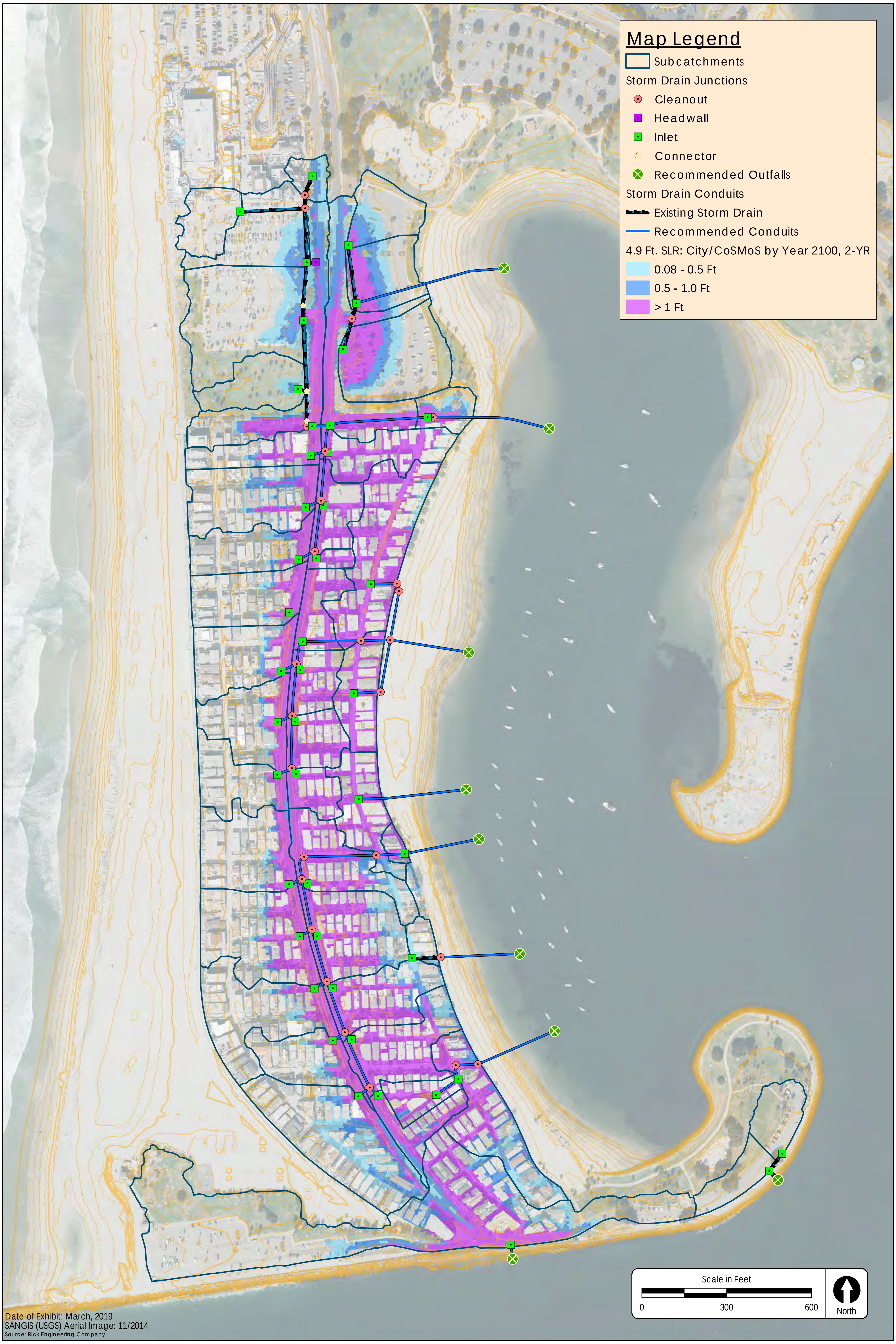


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 2-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

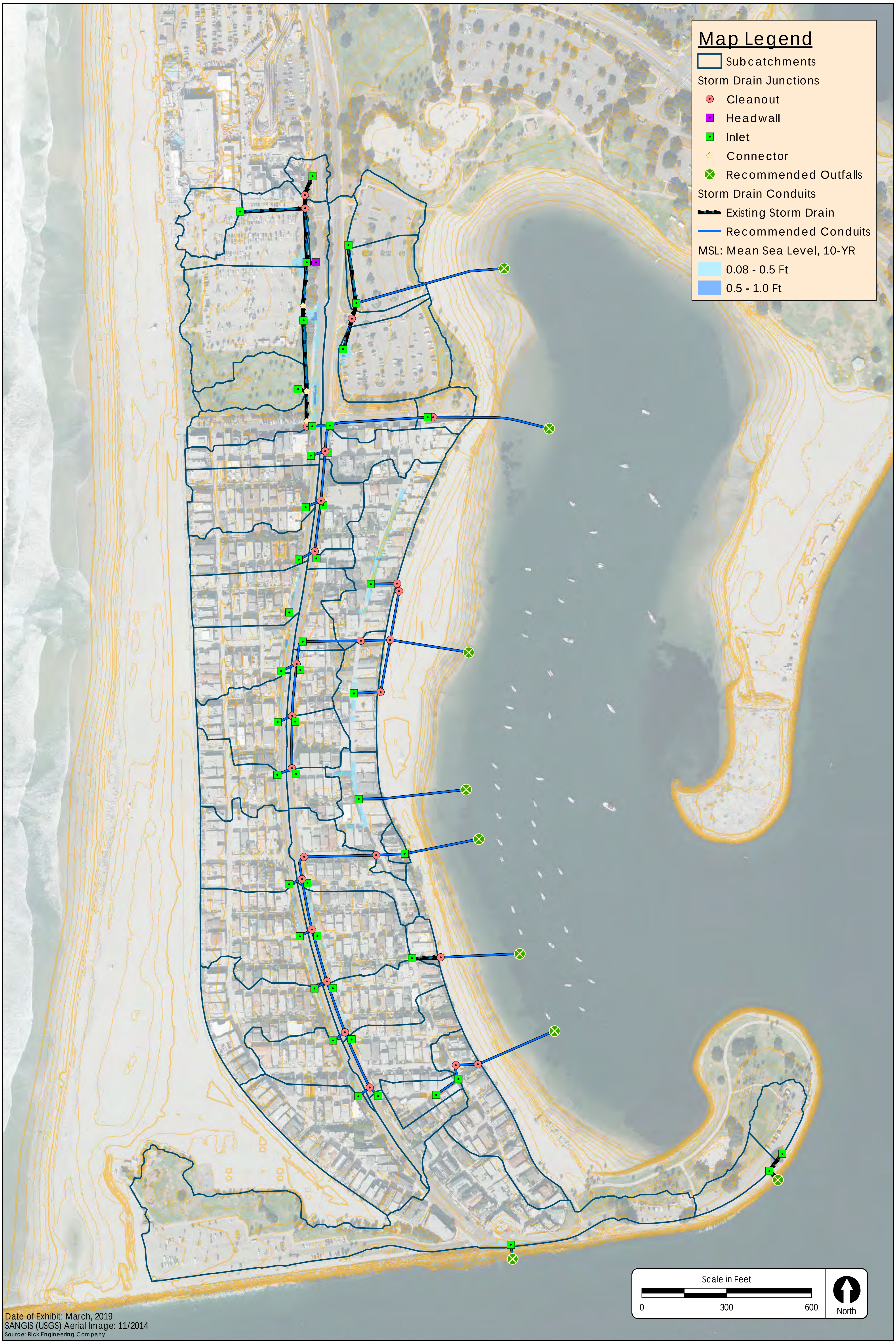
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 2-YR

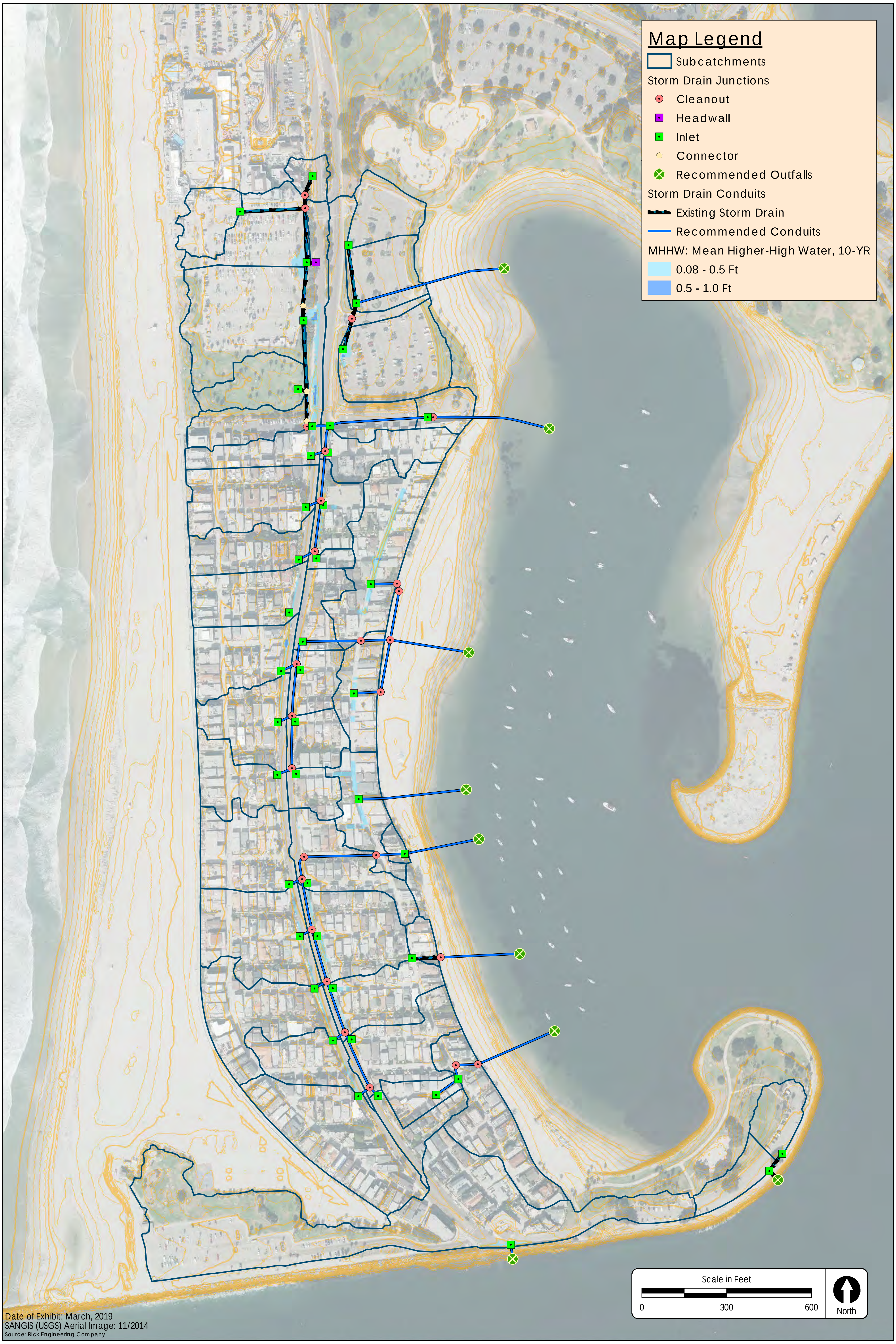


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MSL: Mean Sea Level, 10-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

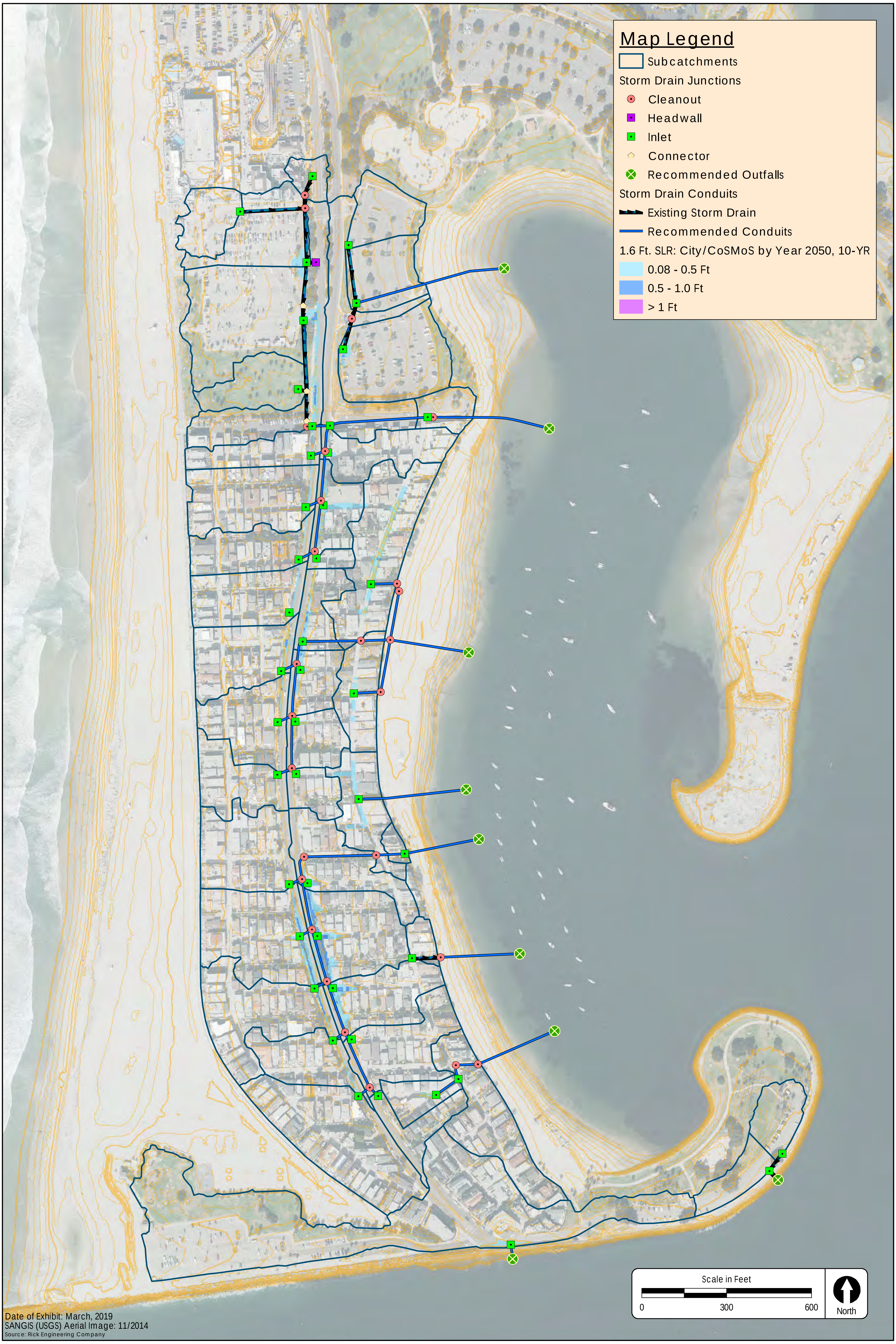
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed MHHW: Mean Higher-High Water, 10-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

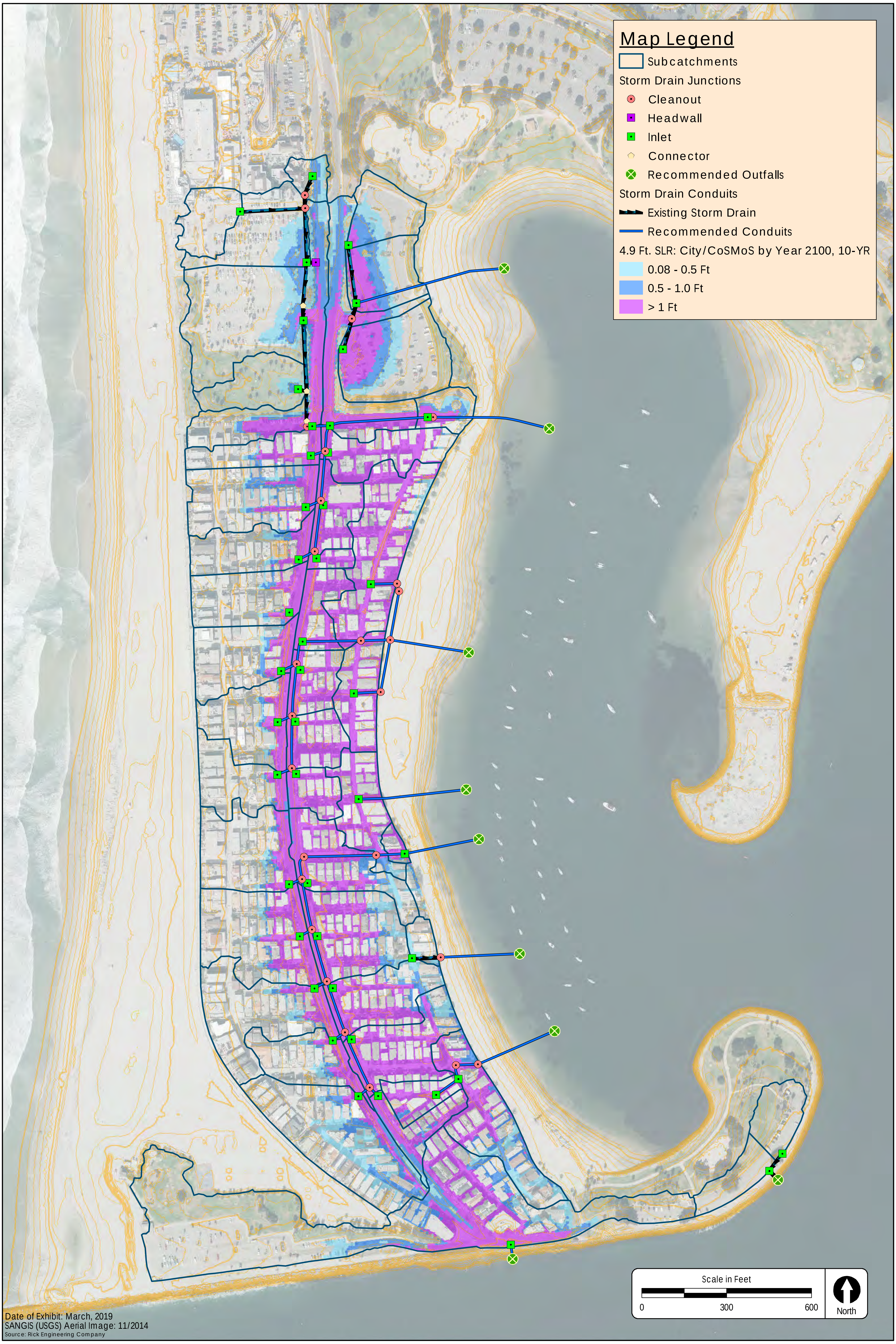
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2051, 10-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

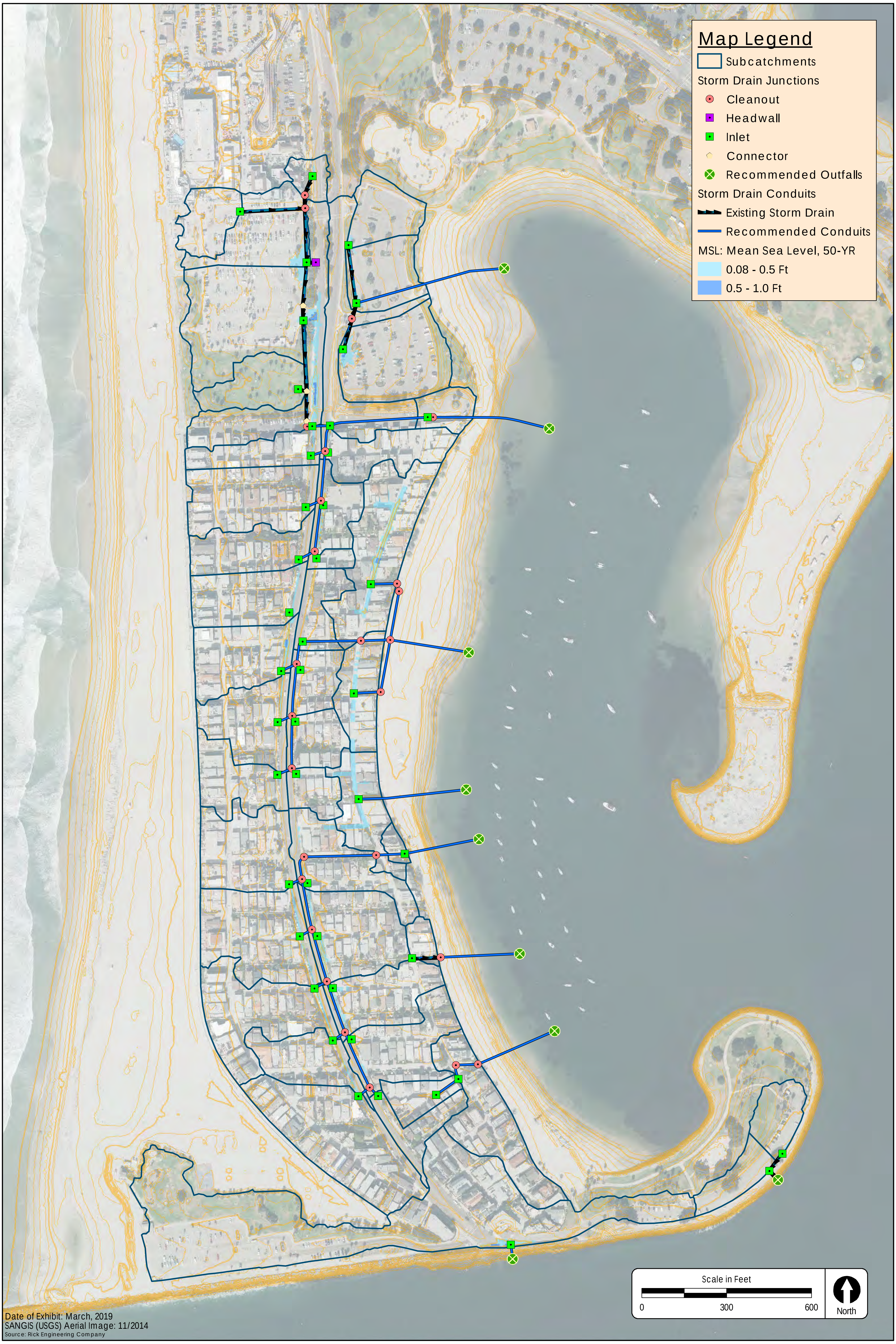
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2101, 10-YR

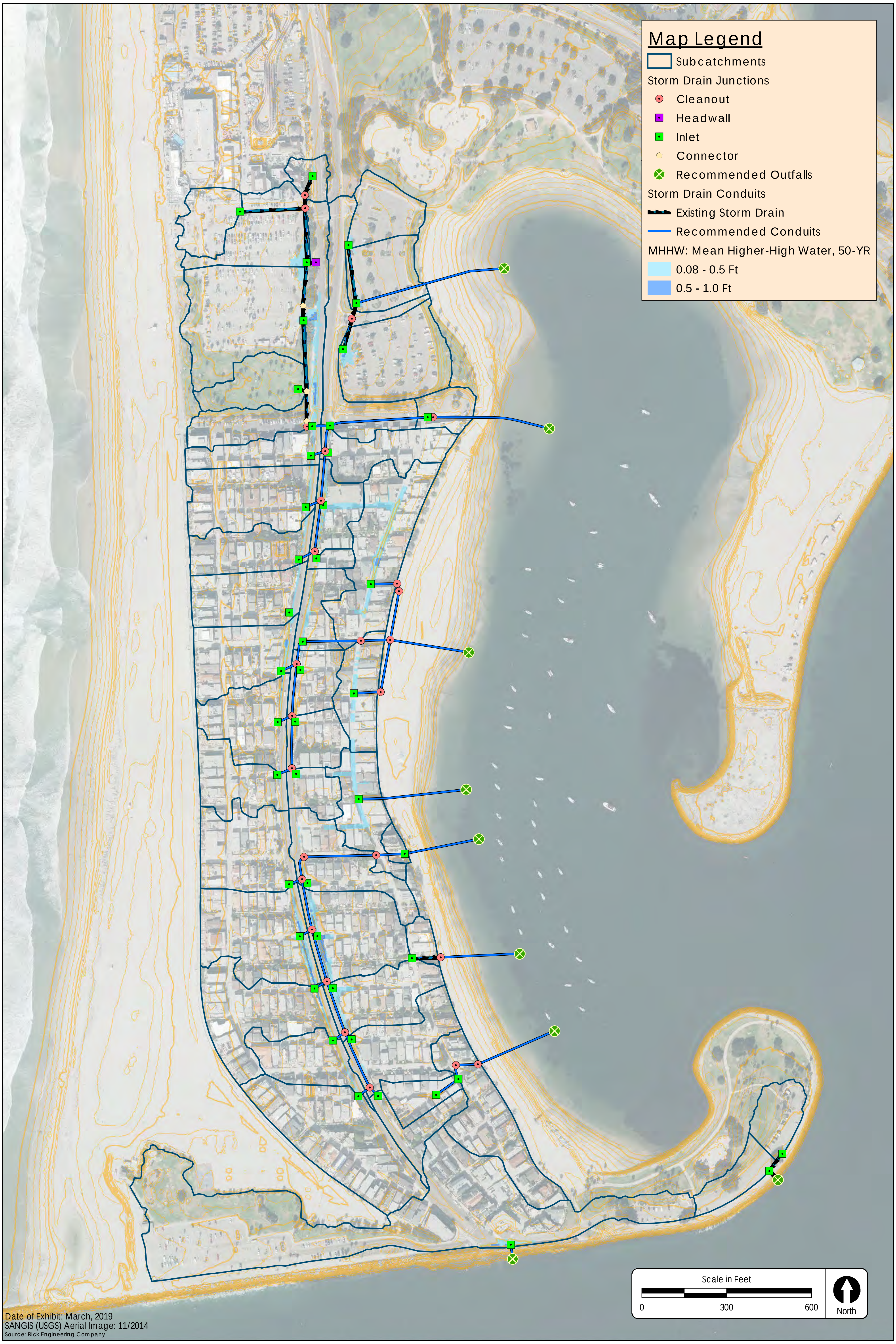


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MSL: Mean Sea Level, 50-YR

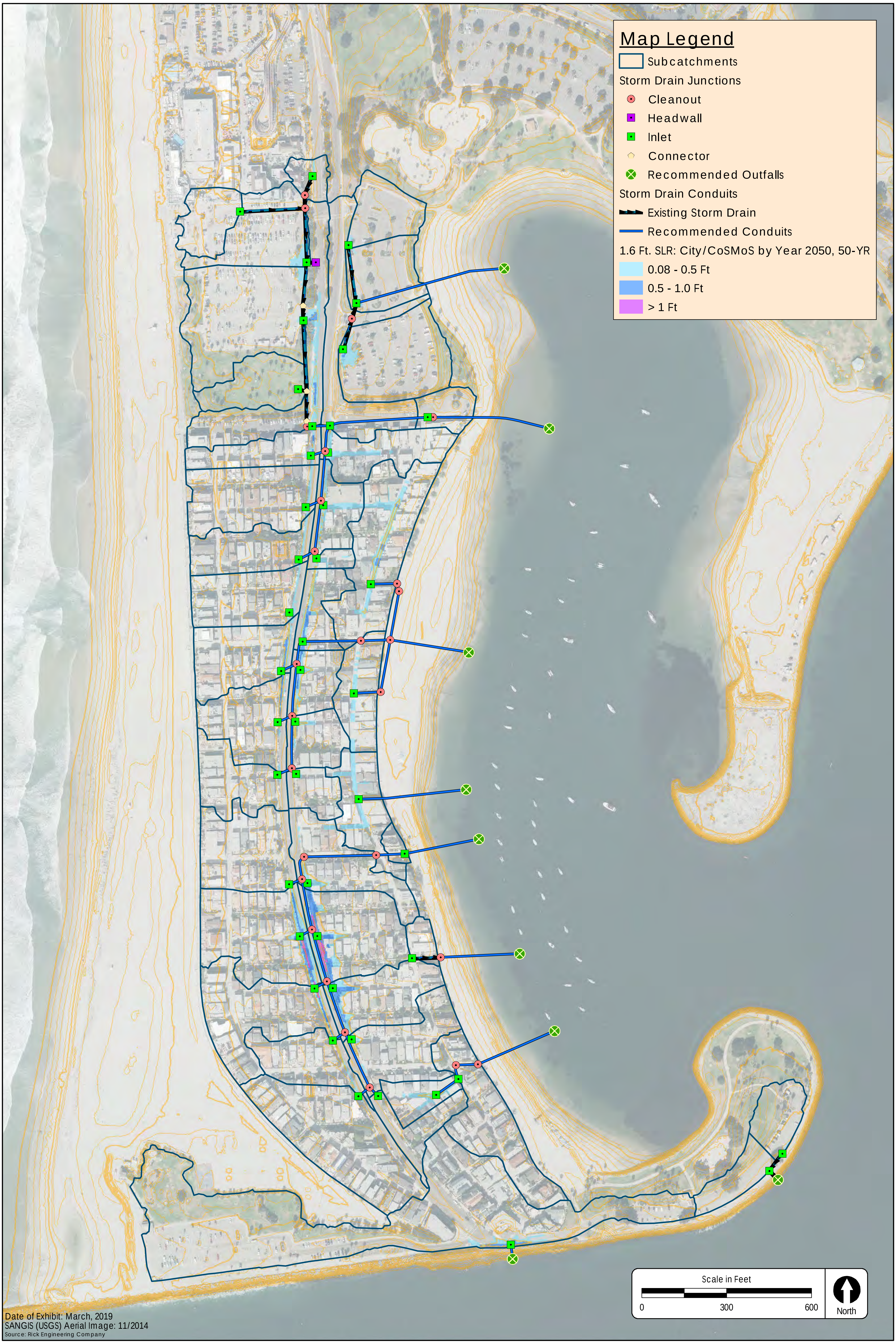


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MHHW: Mean Higher-High Water, 50-YR



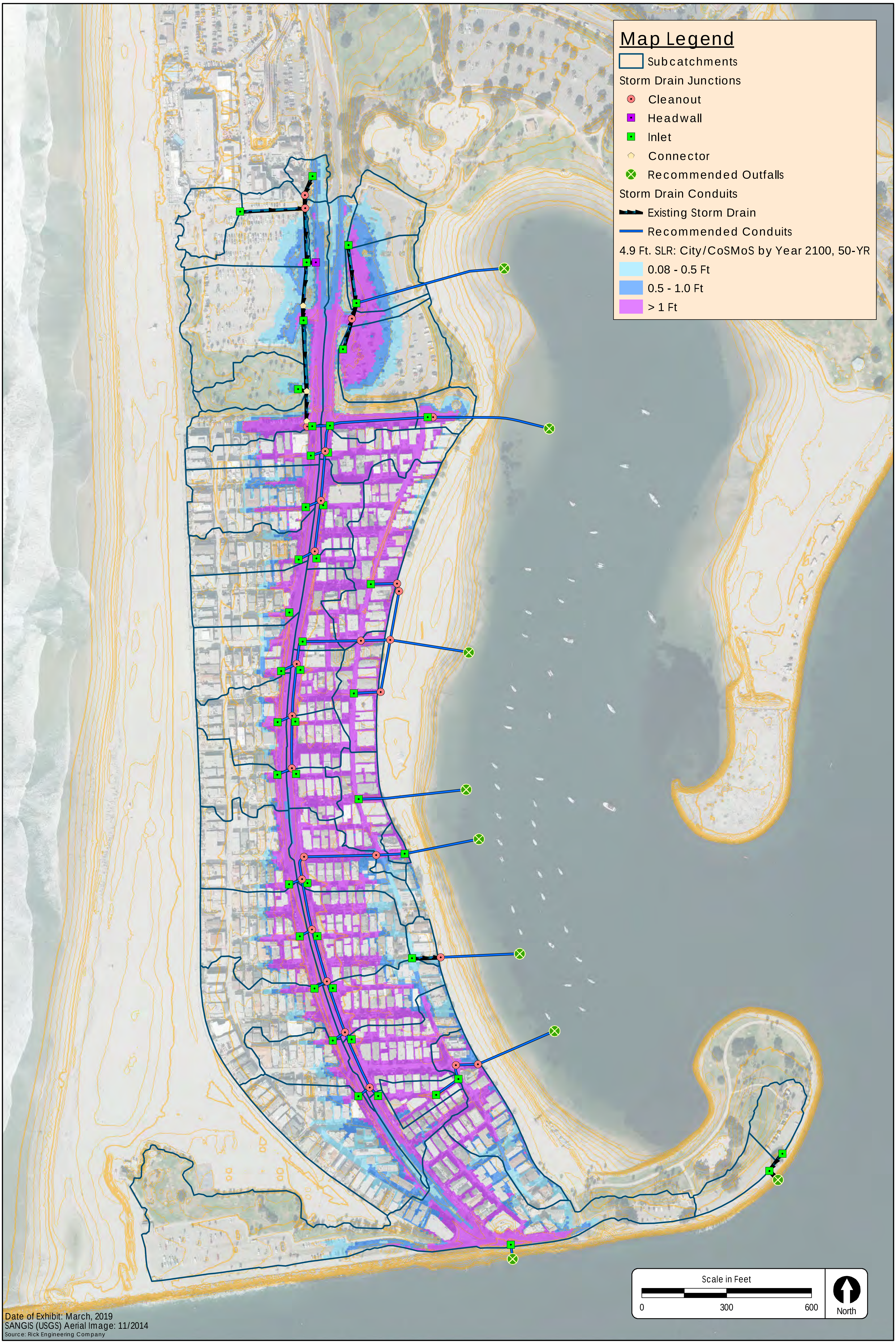
APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2052, 50-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

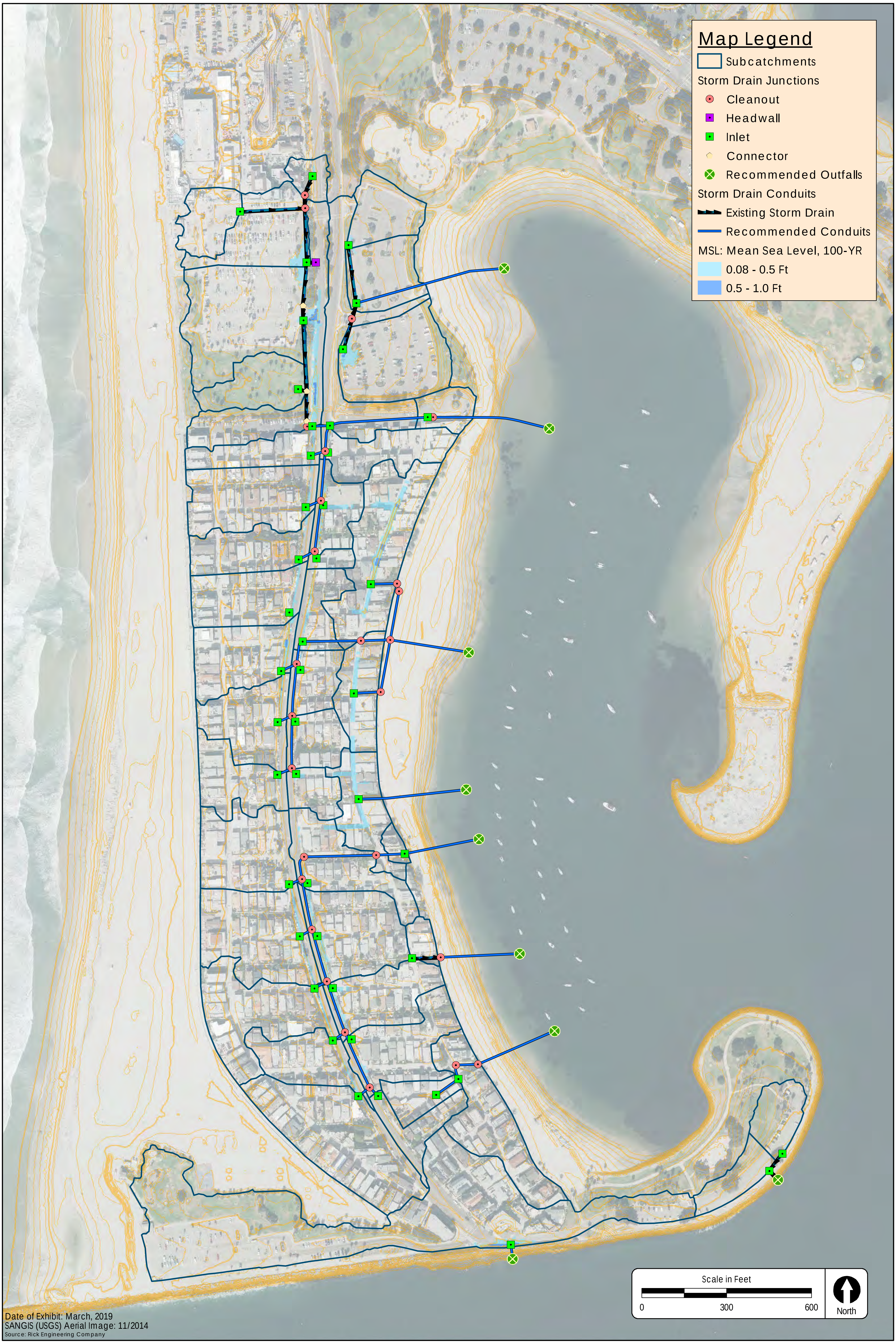
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2102, 50-YR

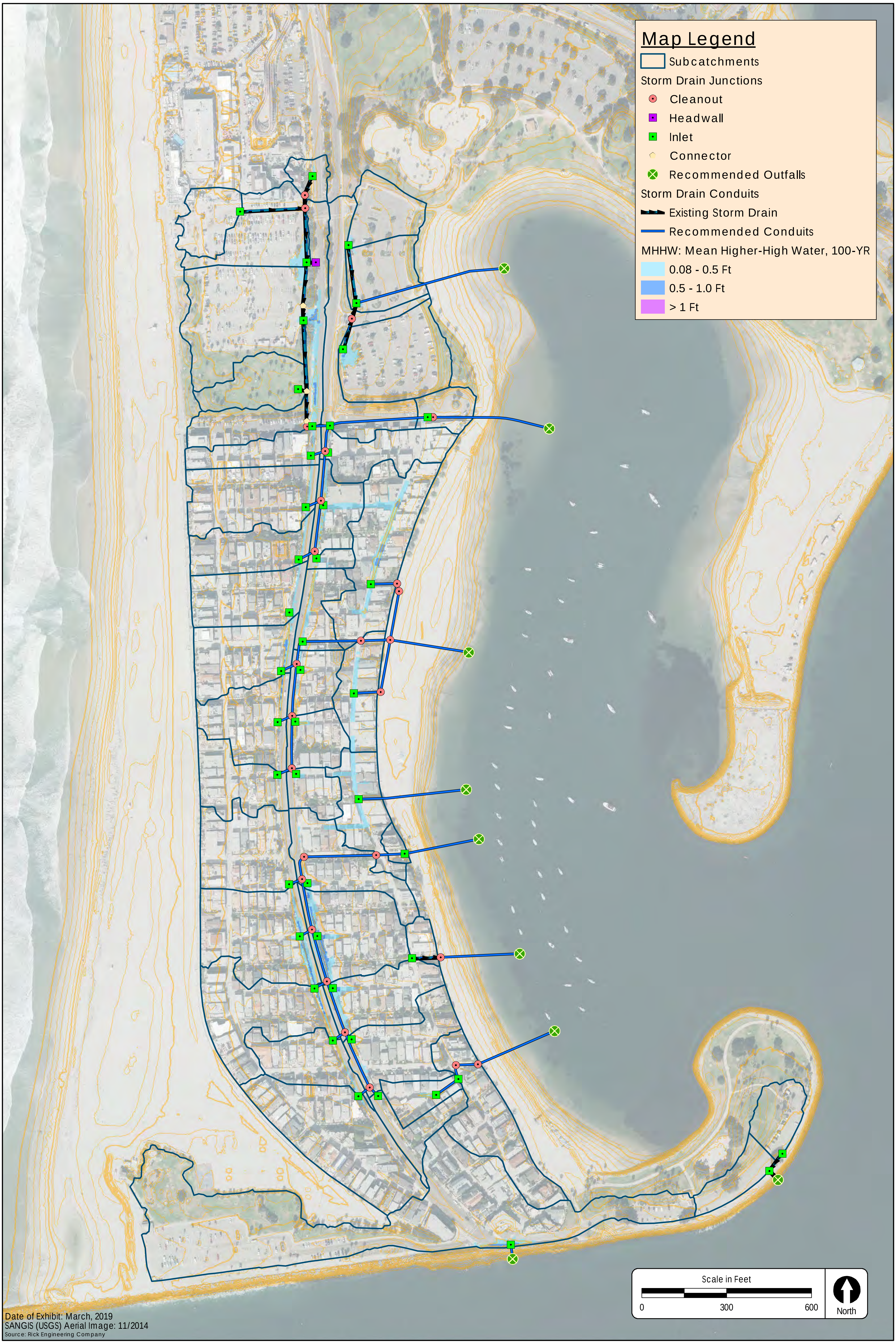


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MSL: Mean Sea Level, 100-YR

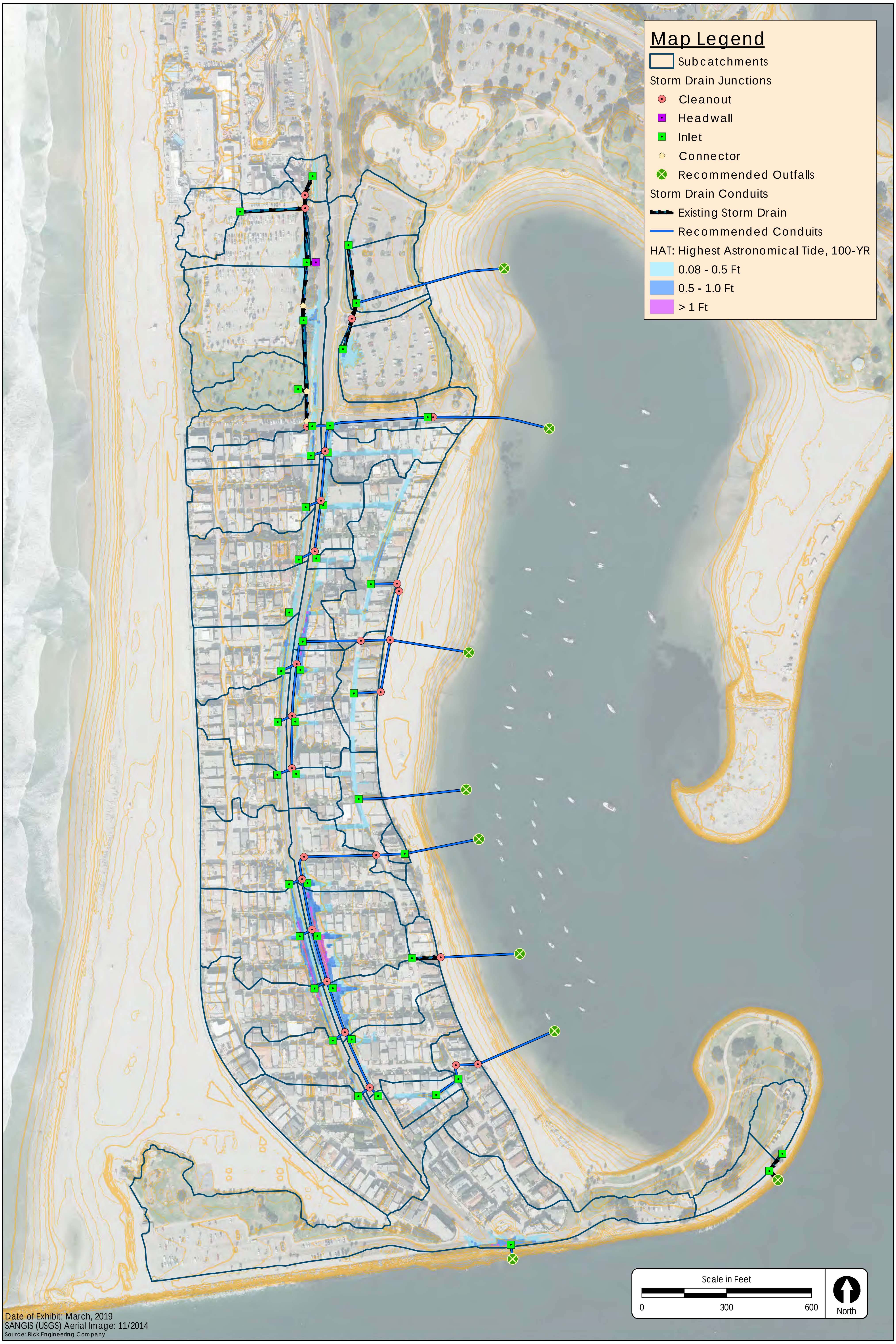


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed MHHW: Mean Higher-High Water, 100-YR

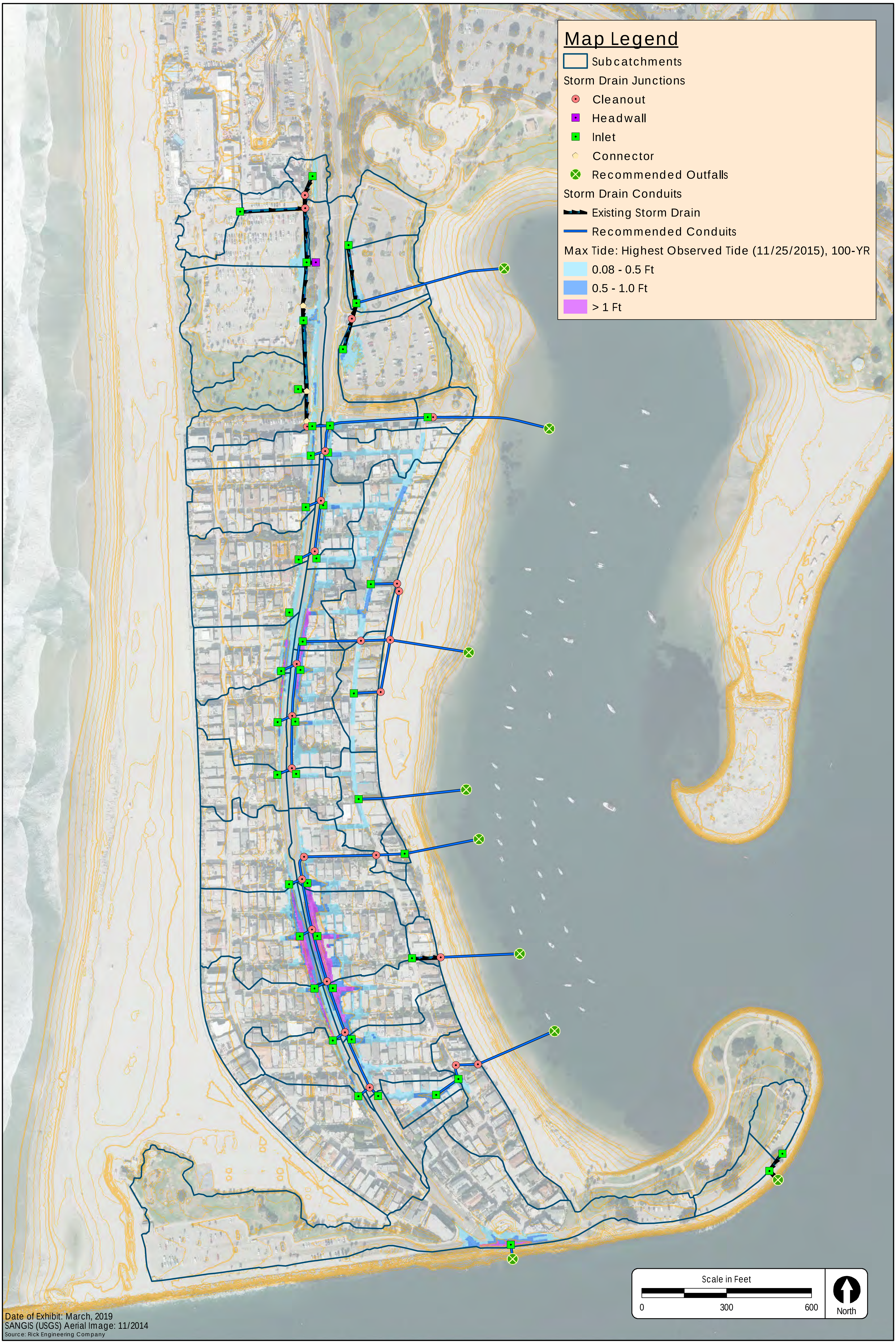


Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed HAT: Highest Astronomical Tide, 100-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

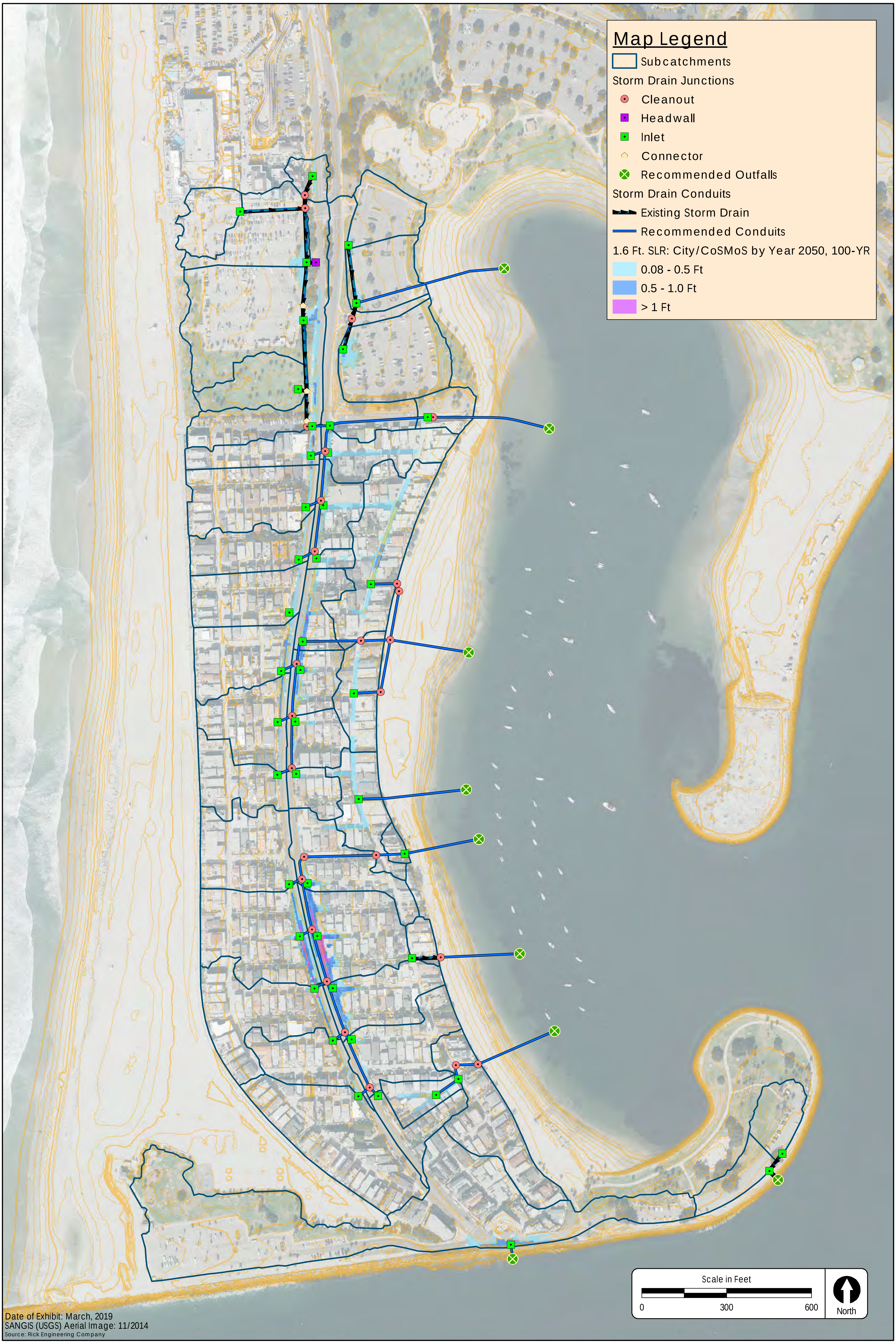
APPENDIX A - 7.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

DRAFT South Mission Beach WMP

Proposed Max Tide: Highest Observed Tide (11/25/2015), 100-YR



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

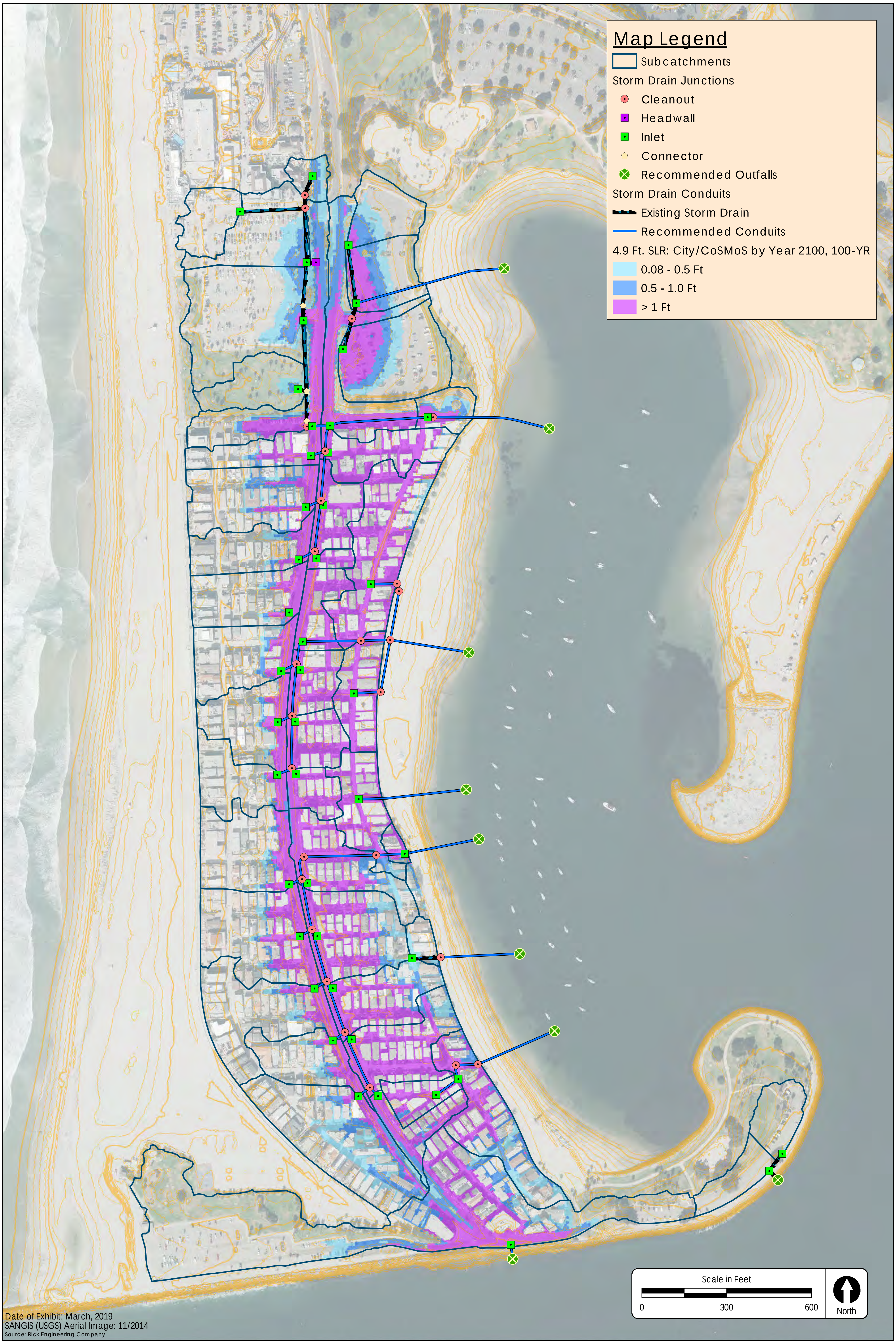
APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed 1.6 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2050, 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

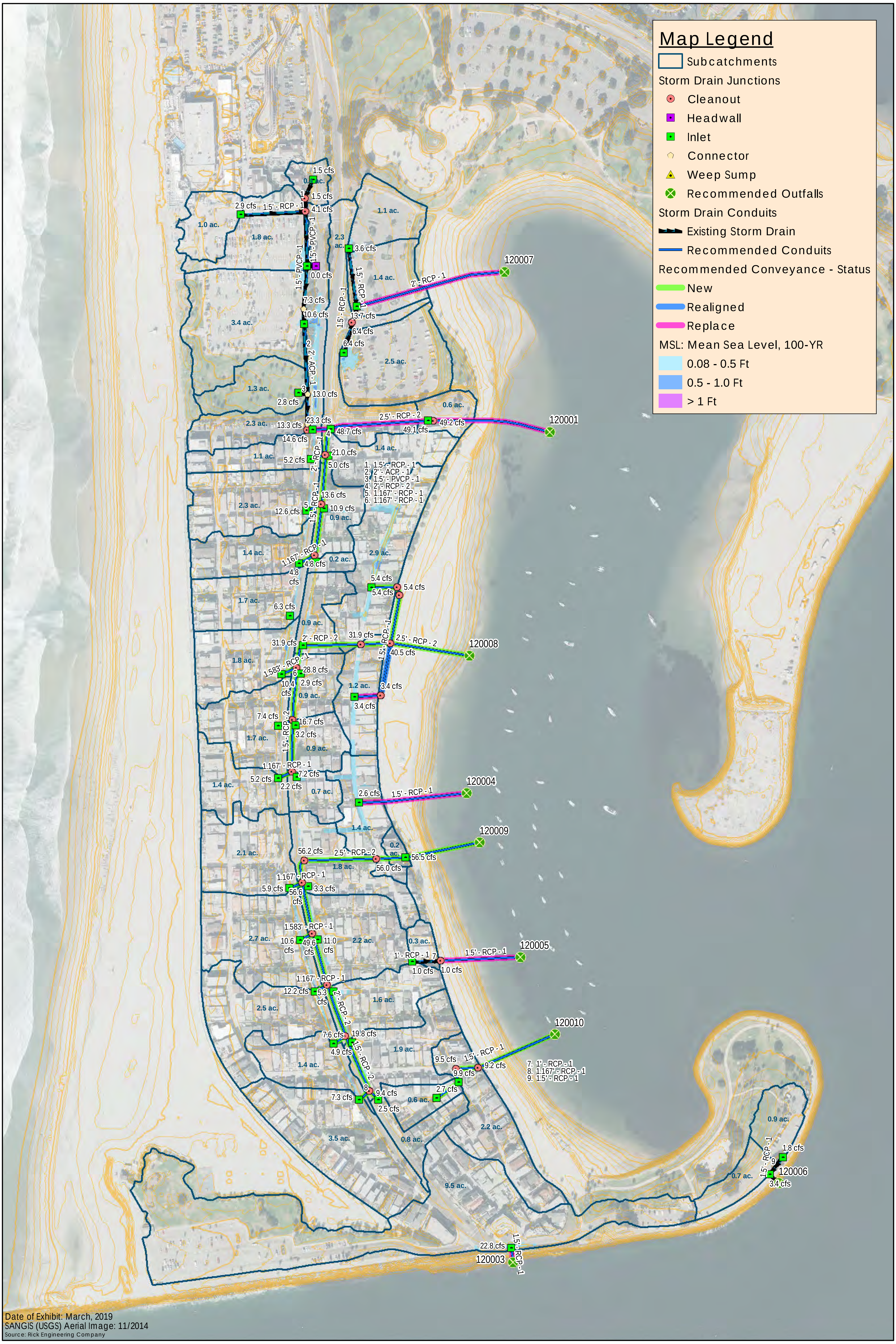
APPENDIX A - 7.1

DRAFT South Mission Beach WMP

Proposed 4.9 Ft. SLR: City/CoSMoS Sea Level Rise by Year 2100, 100-YR

The City of SAN DIEGO

RICK ENGINEERING COMPANY



Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO

RICK ENGINEERING COMPANY

Scale in Feet
0 300 600

North

APPENDIX A - 8

DRAFT South Mission Beach WMP
Recommended Pipe Sizes

1.0 Hydrologic Methodology and Modeling

PCSWMM uses EPA's SWMM Version 5 (SWMM5) engine, which uses the nonlinear reservoir model methodology to estimate the rainfall-runoff relationship for a subarea. Nonlinear reservoir modeling uses a combination of mass conservation and the Manning Equation to determine the volumetric flow rate from a subcatchment. SWMM5 requires several parameters to calculate runoff from each subcatchment. The parameters include area (in acres), characteristic width of the subcatchment, slope, percent impervious, Manning's "n" values for pervious and impervious overland surfaces, depression storage for pervious and impervious surfaces, percent of impervious area with no depression storage, and infiltration parameters.

1.1 Rainfall

Point precipitation data for the South Mission Beach study area was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server (PFDS) (NOAA 2011). This data was selected because it has a longer period of record than the data presented in the *City of San Diego Drainage Design Manual* (2017) to best reflect the historical rainfall and flooding events specific to the study area. Point rainfall data (total rainfall depth) was obtained for three rain gages nearest to the study area: La Jolla, Montgomery Field, and San Diego NWS to compare with precipitation data obtained at the centroid of the study area (See Table 1-1).

Table 1-1: San Diego County local 24-Hour NOAA precipitation depth (inches)

Gage	Lat.	Long.	2-YR, 24-HR Precip. (in.)	10-YR, 24-HR Precip. (in.)	50-YR, 24-HR Precip. (in.)	100-YR, 24-HR Precip. (in.)
La Jolla	32.8500	-117.2667	1.82	2.68	3.51	3.85
Montgomery Field	32.8167	-117.1500	1.91	2.82	3.74	4.13
San Diego NWS	32.7136	-117.17	1.77	2.69	3.63	4.04
South Mission Beach Study Area	32.7643	-117.2504	1.83	2.74	3.67	4.07

Source: NOAA 2011.
Notes: in. = inches; Lat. = latitude; Long. = longitude.

Based on this comparison, the rainfall precipitation depth data obtained at the centroid of the South Mission Beach study area is within range of nearby rain gages for the 2-, 10-, 50-, and 100-year storm events.

1.1.1 Rainfall Pattern

Setting up a storm simulation in EPA's Storm Water Management Model (SWMM) requires a hyetograph to distribute rainfall over time throughout the storm duration. Two options were considered:

- SCS Type B distribution as presented in the *City of San Diego Drainage Design Manual* (1984). (This is required for watershed hydrology studies larger than 1 sq. mi.)
- Balanced storm distribution based on USACE's guidance, *Hydrologic Analysis of Ungaged Watersheds Using HEC-1* (USACE 1982).

The 24-hour storm duration was selected for the study. The SCS Type B distribution was not suitable for the study because it underestimates the peak runoff generated as it does not provide the critical peak intensities to evaluate potential deficiencies in drainage infrastructure for the subcatchments draining to inlets. The balanced storm distribution was selected because it meets this study's goals. The balanced storm provides the peak intensities necessary to assess drainage infrastructure at the inlet scale (up to 5-minute rainfall intensities) while preserving the total volume of runoff generated from the storm duration.

1.1.2 Rainfall Hyetograph Development

To develop the unit intensity duration relationship for the South Mission Beach study area, NOAA precipitation depth data from three rain gage stations within the study area were obtained for the 2-, 10-, 50-, and 100-year, 24-hour storm events. The point rainfall depth data obtained from the NOAA PFDS was used to generate intensity-duration pairs for the given durations. These intensity-duration pairs are incorporated into the rainfall intensity hyetographs. The 100-year precipitation depth data from these rain gages and the South Mission Beach study area are shown in Figure 1-1 (NOAA 2011).

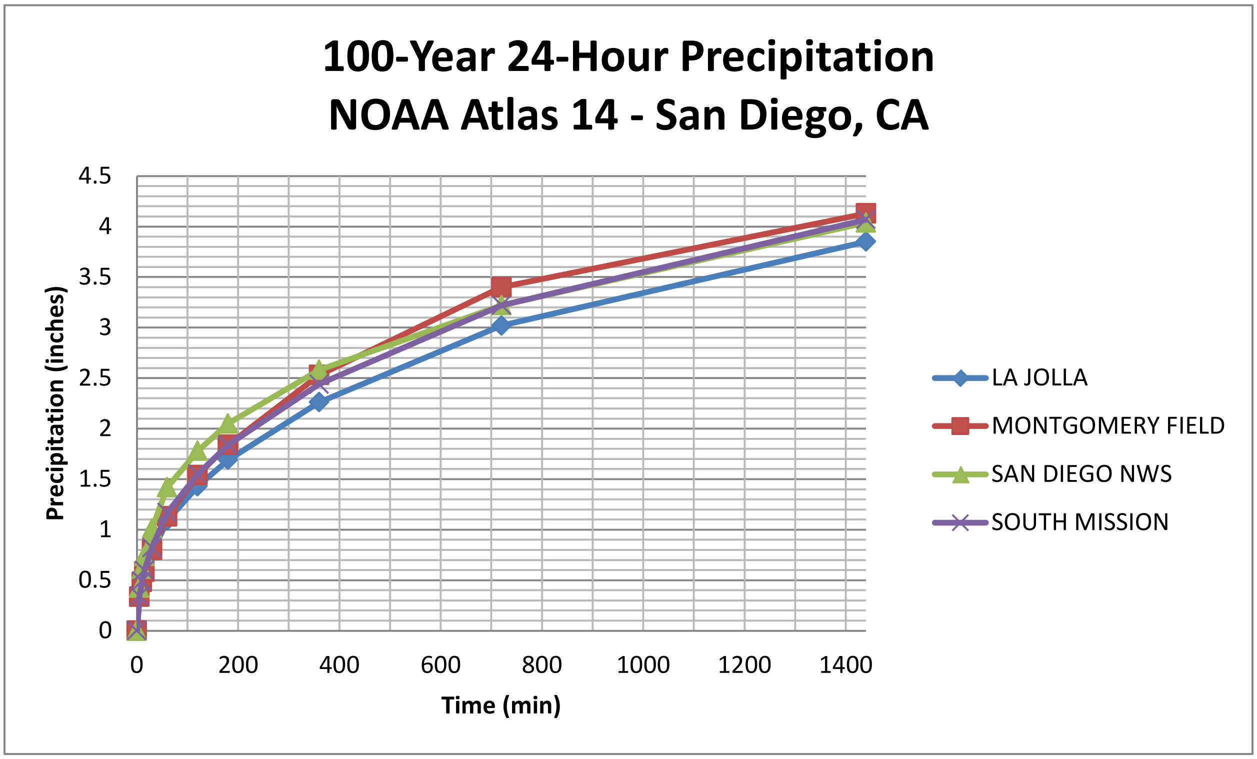


Figure 1-1: 100-year, 24-hour precipitation depth

The resulting rainfall intensity-duration data points generated from the NOAA precipitation depth data were reviewed and plotted for comparison (NOAA 2011). This was done to visually identify any discrepancy in the intensity-duration pairs when plotted. The intensity-duration pairs will appear linear on a log-log scale. The graphs showed that the rainfall intensity-duration relationship yielded a linear relationship for the rainfall data collected at the rain gages, and the precipitation data for the centroid of the study area was within range of the 3 nearby rain gages (Figure 1-2). This comparison provides a check to verify that the rainfall data obtained directly at the centroid of the South Mission Beach study area from the NOAA PFDS correlates with the data at the nearest rain gages in the vicinity of the study area.

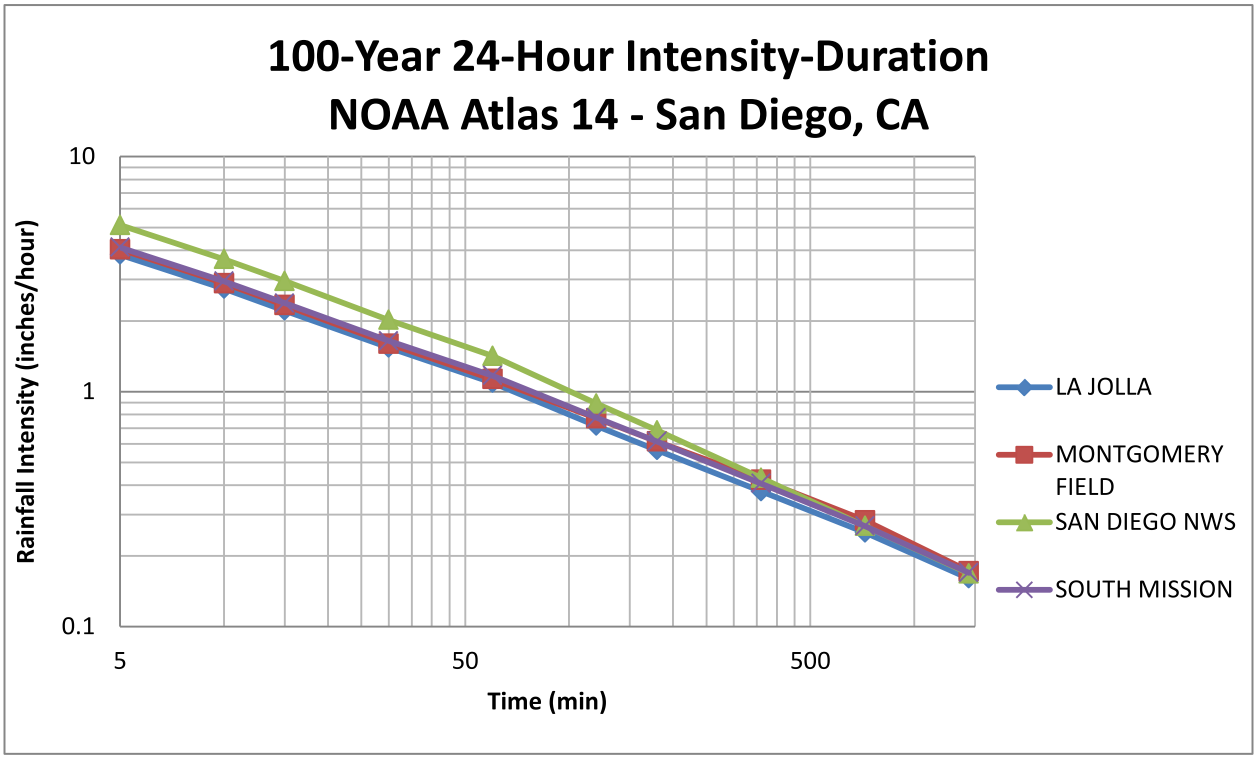


Figure 1-2: 100-year intensity-duration relationship

Since the intensities plotted showed similar patterns for all three gages and the data for the South Mission Beach area within range of the data obtained at the rain gages, it was determined that the rainfall data aggregated for the study area would be appropriate for modeling purposes. The precipitation was entered in 5-minute increments. Precipitation depths at certain durations were obtained directly from NOAA Atlas 14 as seen in the rainfall data shown in Appendix A-6 (NOAA 2011). Precipitation depths bounded by the given values were determined by log-log interpolation at 5 minute increments.

The incremental precipitation data was then arranged into a center-distributed rainfall intensity hyetograph with the peak of the storm centered at 12 hours, as seen in Figure 1-3. . A 2/3, 1/3 rainfall distribution with the storm peak occurring at 16 hours, as described in the 2003 *San Diego County Hydrology Manual*, was considered and ultimately not selected for this study. This approach delivers a greater volume of rainfall prior to the peak of the storm, which has a significant impact on storage volumes on street surfaces and storm drain facilities, compared to the center-distributed balanced storm

(1/2, 1/2 distribution). A storm distribution with the peak rainfall intensity arranged at 12 hours generates the necessary peak flows while delivering the full rainfall volume with a symmetric distribution during the 24-hour storm event.

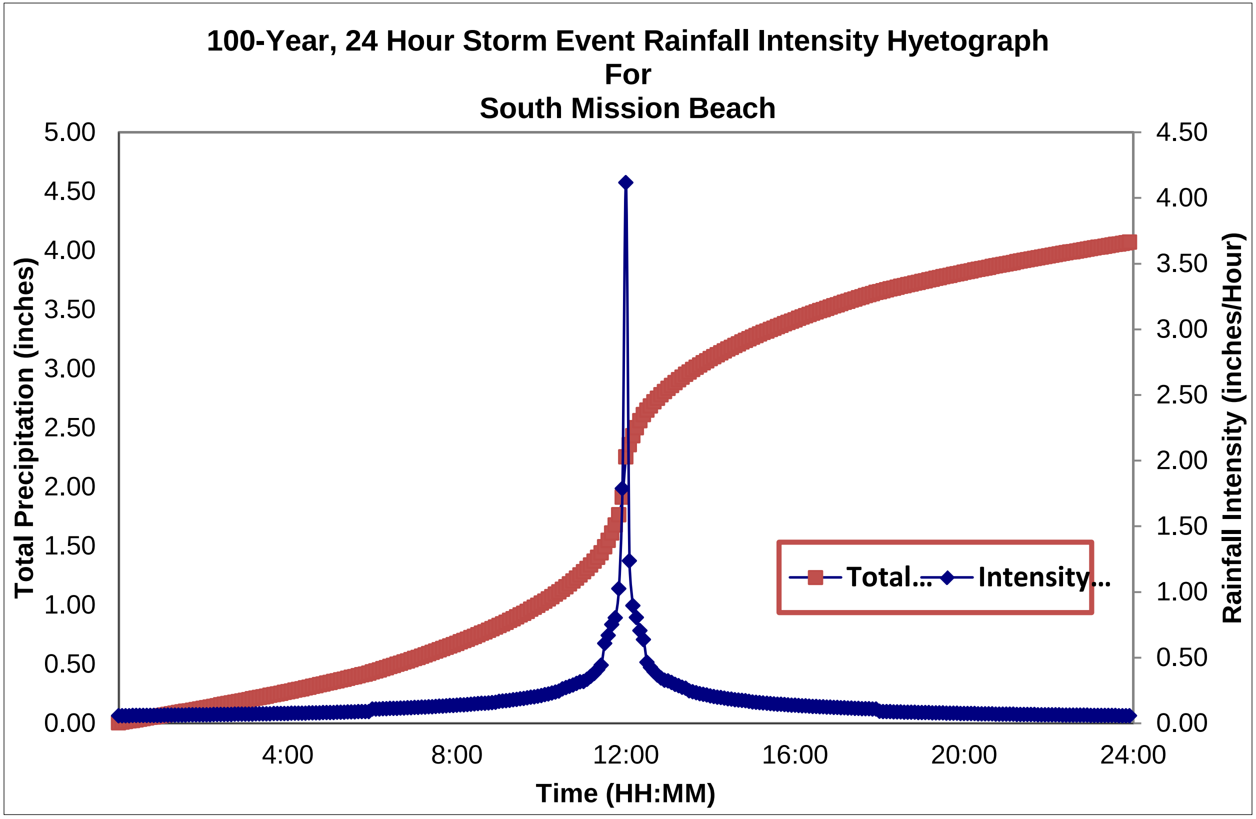


Figure 1-3: 100-year, 24-hour intensity hyetograph

1.1.3 Rainfall Losses

The Green-Ampt Method was used to estimate infiltration potential, which requires the following parameters: soil capillary suction head, soil saturated hydraulic conductivity, and initial moisture deficit (i.e., the difference between soil porosity and initial moisture content). This method is consistent with the guidance presented in the City of San Diego *Storm Water Standards Manual* (2018) for hydromodification management SWMM modeling efforts in San Diego, and further documented in the *Storm Water Management Model User's Manual Version 5.1* (Rossman & Huber, 2015).

Soil parameters were obtained using the listed values in table G.1-4, from Appendix G of the 2018 City of San Diego's *Storm Water Standards Manual* (SWSM). These Green-Ampt soil parameters listed in the SWSM were established by the manual for use in the San Diego Region, and are within the acceptable ranges specified in Tables A.2 and A.3 of the SWMM User's Manual. The distribution of hydrologic soil groups within the South Mission Beach study area is based on SANDAG's ArcGIS feature class for National Resources Conservation Service hydrologic soil groups (refer to Appendix A-4 for an exhibit documenting the mapped NRCS hydrologic soil groups within the study area). Areas with an "unknown" soil classification were assumed to be type D soils for this analysis.

The land cover feature class was used to determine the percentage of impervious area for each subcatchment based on assigned impervious percentages to each land use. The land use shapes were intersected with the inlet drainage area delineations to perform an area-weighting analysis of the average impervious cover using GIS tools. Refer to Appendix A-3 for a map which documents the land uses throughout the study area and the assigned impervious percentage for each land use.

To determine the overland Manning's "n" values and percent impervious parameters, the guidance in Appendix G of the 2018 City SWSM was followed. The "n" values are: 0.012 for impervious cover, and 0.10 for pervious cover. These values were established by the SWSM for use in the San Diego region, and are within the acceptable ranges documented in Table 3-5 of the *Storm Water Management Model Reference Manual Volume I – Hydrology* (Rossman 2016).

1.2 Hydrologic Routing

Each subcatchment is connected via a conveyance node and link network (inlets, weep sumps, and storm drain pipes), which routes runoff generated towards the storm drain system outfall. Refer to Section 2.0 for more information regarding the hydraulic analysis methodology and modeling procedures.

2.0 Hydraulic Methodology and Modeling

2.1 Flow Routing

The PCSWMM platform uses SWMM5 to perform hydraulic calculations and presents the same flow routing options as the EPA SWMM computer application. This ensures that the input parameters and results obtained are directly compatible between the proprietary PCSWMM program and the public domain EPA SWMM program. Flow routing is governed by the equations of continuity, mass, and momentum—also known as the St. Venant Flow equations—with flexibility offered to the modeler regarding the complexity of the terms considered in the equations. The program allows the modeler to select from the Steady Flow, Kinematic Wave, and Dynamic Wave routing options. The normal depth equation is used in all routing options to relate flow depth, flow rate, and surface friction.

Steady Flow routing was judged to be inappropriate for modeling this study area as it does not actually represent flow routing per a defined time step during the simulation. It is the simplest computation method that translates the inflow hydrographs directly downstream without any change in shape and simply uses the normal depth equations to relate flow rates, depths, and cross-sectional areas of the conveyance network. This method does not represent any backwater effects or pressurized flow, and does not take into account the user-defined computational time steps during the storm simulation.

Kinematic Wave routing was not selected for this study as it was incompatible with the 2-D analysis. It employs a simplified form of the momentum equation but does not take into account all of the equation’s terms. This routing method does not account for any backwater effects or pressurized flow.

Dynamic Wave routing was the option selected for all analyses performed in this study. The purpose of this study was to produce a model that would most closely relate the actual conditions of the dynamic relationship between surface and subsurface conveyance, and potential flooding concerns. This routing option considers all terms of the St. Venant Flow equations and presents the most theoretically correct results accounting for backwater effects, pressurized flow, flow attenuation, and reversal of flow. The caveat in selecting this routing option, however, was maintaining numerical stability in the model by using extremely small computational time steps that resulted in significant simulation times for 2-D analyses.

2.2 Conveyance Material and Manning’s Roughness Coefficients

The study area was mainly comprised of Reinforced Concrete Pipe (RCP) and cast-in-place concrete pipe (CIPCP) storm drain systems, although a few other storm drain materials (asbestos cement, corrugated metal, and polyvinyl chloride) were also present in the existing inventory. This was determined through examination of the GIS storm drain inventory provided by the City, which was reviewed and updated during the course of the data collection and compilation process described in section 2 of the WMP.

In PCSWMM (and EPA SWMM), the Manning roughness values are associated with a conveyance material database. Each channel, pipe, and conduit in the 1-D portion of the model must have a material code assigned to it; in that way, the resistance to flow and energy losses along the conduit length can be calculated.

Table 2-1 lists all the material types present within the study area and the associated Manning's "n" value assigned to each material code in the models.

Table 2-1: Conveyance material abbreviations and Manning's roughness coefficients

Material Code	Material Description	Roughness Coefficient
ACP	Asbestos Cement Pipe	0.013
CIPCP	Cast-in-Place Concrete Pipe	0.014
CMP	Corrugated Metal Pipe	0.024
PVC	Polyvinyl Chloride	0.013
PVCP	PVC Pipe	0.013
RCP	Reinforced Concrete Pipe	0.013

The material codes were developed based on the material of construction defined in the storm water GIS data set provided by the City of San Diego and are consistent with the codes and descriptions presented in the *City of San Diego Drainage Design Manual* (San Diego 2017). The Manning's conduit roughness values were assigned based on table C-2 of the *City of San Diego Drainage Design Manual*.

2.3 Storm Water Inlet Modeling

The GIS storm water conveyance dataset which was revised and updated during the course of the data collection and compilation process includes 23 inlet or catch basin structures for the collection of surface runoff from streets, ditches, swales, and overland flow. Undersized storm water inlets can limit the efficiency of the existing conveyance infrastructure to collect and convey runoff during storm events. The flow interception capacity of each inlet type was estimated based on the inlet structure type, location, street slope, and structure dimensions, following the 2014 *County of San Diego Hydraulic Design Manual* guidance (CSDDPW 2014). Note that the 50-percent clogging reduction factor was not applied for grated catch basin inlets. Flow interception at each inlet was included in the PCSWMM model with inflow rating curves as a function of street flow depth. The portion of storm water flows exceeding the capacity of the inlet was bypassed to the street conveyance in the 2-D models.

2.4 Coupled 1-D/2-D Model

The development of the 1-D hydraulic model includes the pipe/open channel drainage network for all pipes 18 inches and larger. Pertinent pipes having less than 18-inch diameters also were included in the model if they were considered part of the primary backbone storm drain systems. Key hydraulic structures that control the flow entering or discharging from the primary system such as inlets, culverts, outfalls, and pipes also were included in the 1-D model.

The surface storage and conveyance represented by the streets and other surfaces are accounted for in the 2-D hydraulic model of the South Mission Beach study area. The 2-D model was generated from an array of mesh (or grids) with a 10-ft. resolution to represent the surface conveyance. A 10-ft. resolution directional mesh was used to define the drainage patterns of streets and roads, and a 10-ft. resolution hexagonal mesh was applied globally to the remaining sections of the study area. The directional mesh generates 2-D surface cells which are forced along a defined preferential flow path, such as a street gutter flowline or alleyway centerline. This is useful for streets and channels. The hexagonal mesh generates 2-D surface cells which have 6 defined flow directions in order to represent more possible flow directions across surfaces with less defined flow paths. This option is useful for flatter areas that do not have clearly defined flow paths.

The overall 2-D mesh was developed from a high-resolution DEM data set by sampling elevation data at points with a 10-ft. spatial resolution and was used to preserve the preferential flow paths and street conveyance that are part of the overall storm water conveyance system.

The two systems were coupled together at points where exchange of storm water between the surface conveyance system and the engineered storm water conveyance system could occur—typically at storm drain inlets, and outlet structures. The models were linked between nodes in the 1-D minor system (subsurface) and the 2-D major system (surface). The coupled models were then run and solved simultaneously, representing the storm water conveyance and storage on the street and in the storm water collection and conveyance system. The coupling of the 1-D and 2-D models allowed for bidirectional exchange of volume between the 2-D surface conveyance system and the engineered 1-D storm water system. By coupling the models together and solving the hydraulics simultaneously, the dynamic exchange of runoff between the surface flow and storm water conveyance system facilities is described.

The coupled 1-D/2-D model was executed using the runoff hydrographs resulting from NOAA rainfalls for the 2-, 10-, 50-, and 100-year storm events based on existing land uses to assess the current system's deficiencies.

La Jolla Rain Gage

Latitude: 32.8500°

Longitude: -117.2667°

Elevation (USGS): 200 Ft.

PRECIPITATION FREQUENCY ESTIMATES										
by duration for ARI (years):	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min:	0.11	0.14	0.18	0.21	0.25	0.29	0.32	0.36	0.40	0.44
10-min:	0.16	0.20	0.26	0.30	0.36	0.41	0.46	0.51	0.58	0.64
15-min:	0.20	0.24	0.31	0.36	0.44	0.49	0.55	0.62	0.70	0.77
30-min:	0.27	0.34	0.43	0.50	0.61	0.69	0.77	0.86	0.98	1.07
60-min:	0.39	0.48	0.61	0.71	0.86	0.97	1.09	1.21	1.38	1.51
2-hr:	0.54	0.66	0.82	0.96	1.14	1.29	1.43	1.59	1.80	1.97
3-hr:	0.65	0.79	0.98	1.14	1.35	1.52	1.69	1.87	2.11	2.30
6-hr:	0.87	1.07	1.33	1.54	1.83	2.04	2.26	2.49	2.79	3.02
12-hr:	1.15	1.44	1.80	2.09	2.46	2.75	3.02	3.30	3.67	3.94
24-hr:	1.44	**1.82**	2.31	**2.68**	3.16	**3.51**	**3.85**	4.19	4.62	4.94
2-day:	1.77	2.26	2.86	3.32	3.92	4.35	4.77	5.18	5.70	6.08
3-day:	1.99	2.54	3.22	3.75	4.42	4.91	5.39	5.85	6.44	6.88
4-day:	2.15	2.76	3.51	4.09	4.84	5.38	5.91	6.42	7.08	7.56
7-day:	2.51	3.30	4.28	5.04	6.02	6.73	7.43	8.12	9.00	9.65
10-day:	2.78	3.71	4.87	5.77	6.95	7.82	8.67	9.51	10.60	11.40
20-day:	3.29	4.47	5.96	7.15	8.72	9.88	11.00	12.20	13.70	14.90
30-day:	3.86	5.27	7.07	8.51	10.40	11.90	13.30	14.80	16.70	18.20
45-day:	4.56	6.20	8.33	10.00	12.30	14.10	15.90	17.70	20.10	22.00
60-day:	5.25	7.06	9.45	11.40	14.00	16.00	18.10	20.20	23.00	25.30

Montgomery Field Rain Gage

Latitude: 32.8167°

Longitude: -117.1500°

Elevation (USGS): 350 Ft.

PRECIPITATION FREQUENCY ESTIMATES										
by duration for ARI (years):	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min:	0.12	0.15	0.20	0.23	0.27	0.30	0.34	0.37	0.42	0.45
10-min:	0.18	0.22	0.28	0.33	0.39	0.44	0.48	0.53	0.59	0.64
15-min:	0.21	0.27	0.34	0.39	0.47	0.53	0.58	0.64	0.72	0.78
30-min:	0.29	0.37	0.46	0.54	0.64	0.72	0.80	0.88	0.99	1.07
60-min:	0.41	0.52	0.65	0.76	0.91	1.02	1.13	1.24	1.40	1.51
2-hr:	0.56	0.71	0.89	1.04	1.24	1.39	1.54	1.70	1.90	2.06
3-hr:	0.68	0.85	1.07	1.25	1.48	1.66	1.84	2.03	2.27	2.45
6-hr:	0.93	1.17	1.47	1.72	2.04	2.29	2.53	2.78	3.11	3.36
12-hr:	1.25	1.57	1.99	2.31	2.75	3.08	3.40	3.73	4.16	4.48
24-hr:	1.52	**1.91**	2.42	**2.82**	3.35	**3.74**	**4.13**	4.52	5.03	5.42
2-day:	1.80	2.29	2.92	3.42	4.07	4.56	5.04	5.52	6.16	6.63
3-day:	2.01	2.59	3.32	3.90	4.67	5.24	5.80	6.36	7.10	7.66
4-day:	2.21	2.87	3.69	4.35	5.21	5.86	6.49	7.13	7.97	8.60
7-day:	2.65	3.44	4.45	5.25	6.30	7.08	7.85	8.63	9.64	10.40
10-day:	2.94	3.83	4.96	5.86	7.03	7.91	8.78	9.65	10.80	11.70
20-day:	3.53	4.64	6.04	7.15	8.61	9.70	10.80	11.90	13.30	14.40
30-day:	4.23	5.58	7.29	8.65	10.40	11.80	13.10	14.40	16.20	17.50
45-day:	4.91	6.50	8.53	10.10	12.30	13.90	15.40	17.00	19.10	20.70
60-day:	5.70	7.55	9.91	11.80	14.30	16.20	18.00	19.90	22.40	24.30

San Diego NWS Rain Gage

Latitude: 32.7136°

Longitude: -117.1700°

Elevation (USGS): 62 Ft.

PRECIPITATION FREQUENCY ESTIMATES										
by duration for ARI (years):	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min:	0.12	0.17	0.23	0.28	0.34	0.38	0.43	0.47	0.52	0.56
10-min:	0.17	0.24	0.33	0.40	0.49	0.55	0.61	0.67	0.75	0.81
15-min:	0.20	0.29	0.40	0.48	0.59	0.66	0.74	0.81	0.91	0.97
30-min:	0.28	0.40	0.55	0.66	0.80	0.91	1.01	1.11	1.24	1.33
60-min:	0.39	0.56	0.77	0.93	1.13	1.28	1.42	1.56	1.75	1.88
2-hr:	0.54	0.74	0.99	1.18	1.43	1.61	1.78	1.95	2.16	2.32
3-hr:	0.65	0.88	1.16	1.37	1.65	1.85	2.05	2.24	2.49	2.67
6-hr:	0.86	1.13	1.47	1.74	2.08	2.33	2.58	2.82	3.13	3.37
12-hr:	1.10	1.43	1.84	2.16	2.59	2.90	3.22	3.53	3.94	4.25
24-hr:	1.38	**1.77**	2.28	**2.69**	3.22	**3.63**	**4.04**	4.45	5.00	5.42
2-day:	1.65	2.13	2.75	3.25	3.92	4.43	4.94	5.46	6.17	6.71
3-day:	1.83	2.38	3.09	3.66	4.43	5.02	5.61	6.21	7.02	7.65
4-day:	1.99	2.59	3.38	4.01	4.87	5.52	6.17	6.84	7.74	8.44
7-day:	2.31	3.06	4.02	4.80	5.85	6.64	7.45	8.27	9.37	10.20
10-day:	2.52	3.35	4.44	5.31	6.47	7.36	8.25	9.16	10.40	11.30
20-day:	3.03	4.07	5.41	6.48	7.91	8.99	10.10	11.20	12.60	13.80
30-day:	3.56	4.79	6.35	7.60	9.25	10.50	11.70	13.00	14.70	16.00
45-day:	4.21	5.61	7.40	8.81	10.70	12.10	13.40	14.80	16.70	18.10
60-day:	4.90	6.47	8.46	10.00	12.10	13.60	15.10	16.70	18.70	20.20

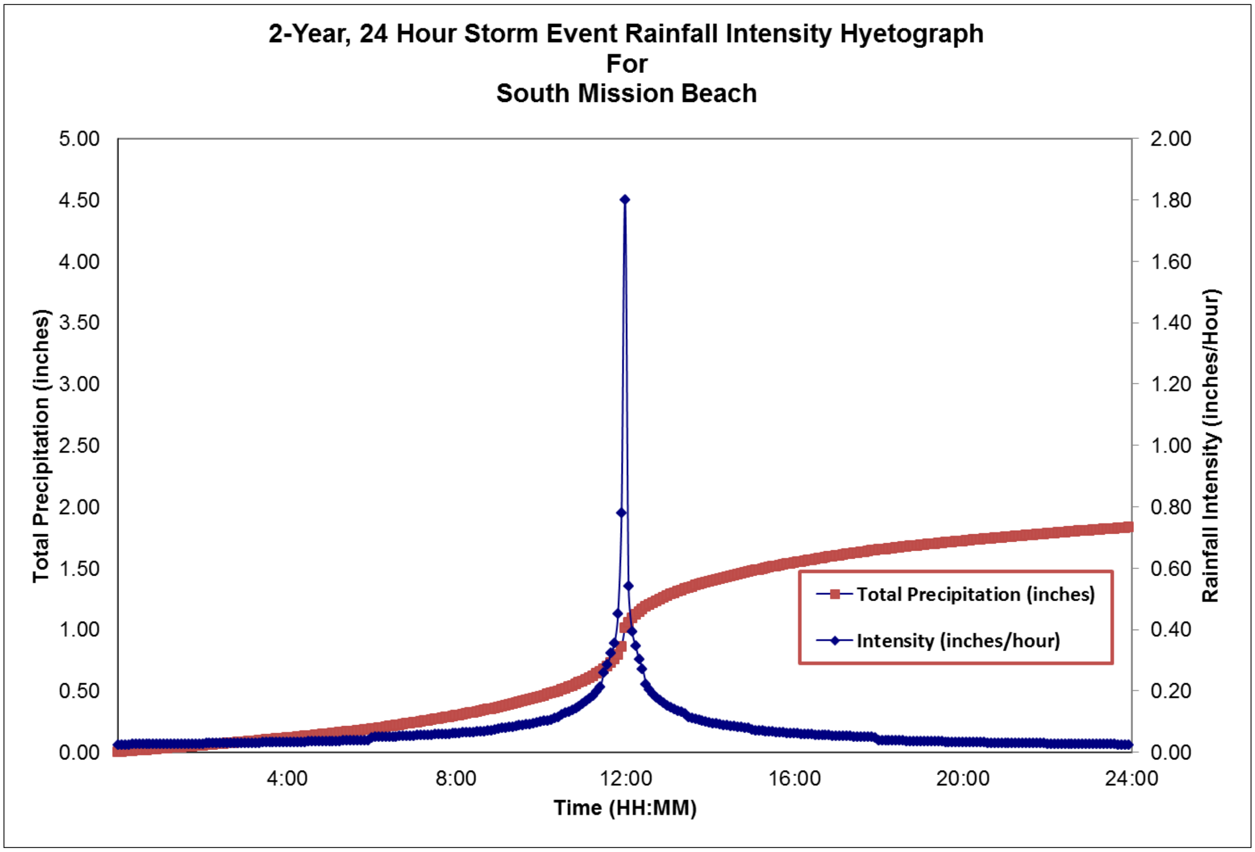
South Mission Beach Rainfall Estimates

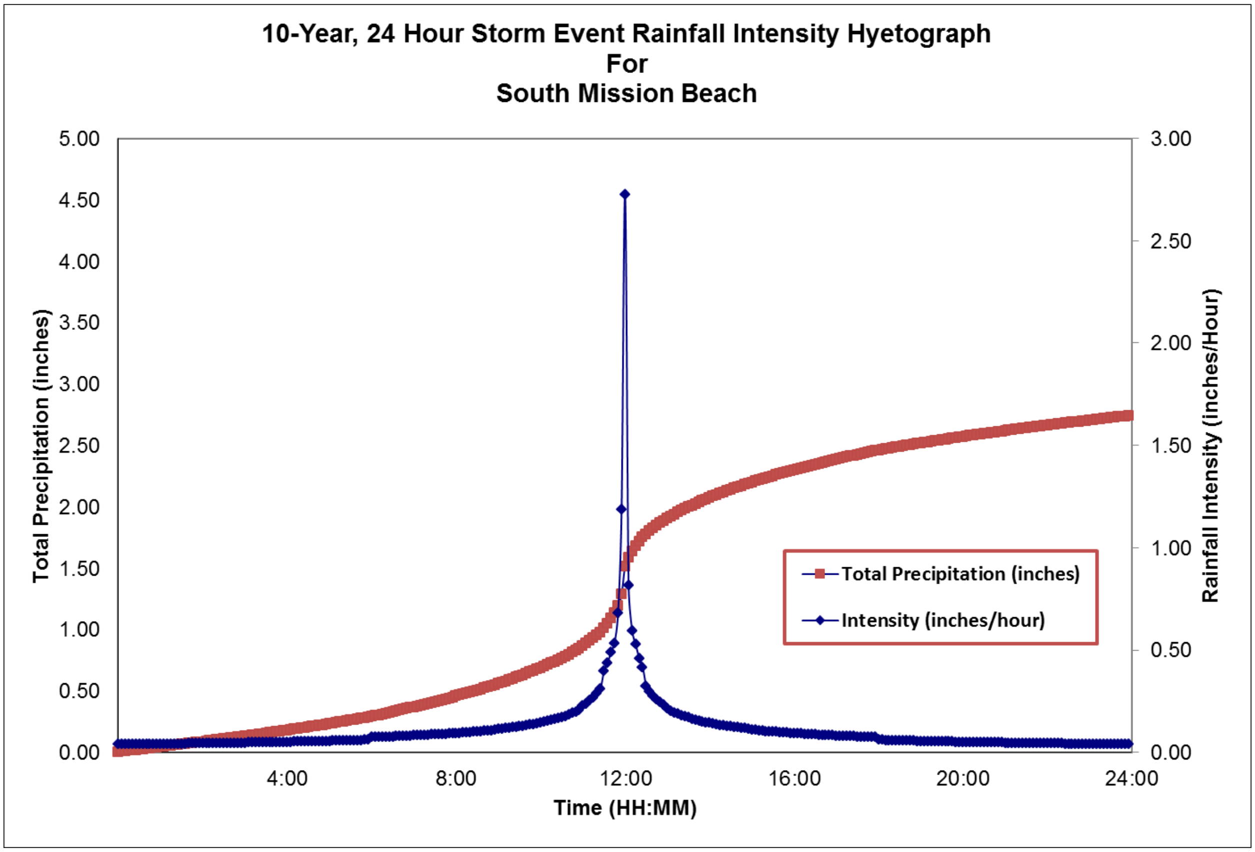
Latitude: 32.7643°

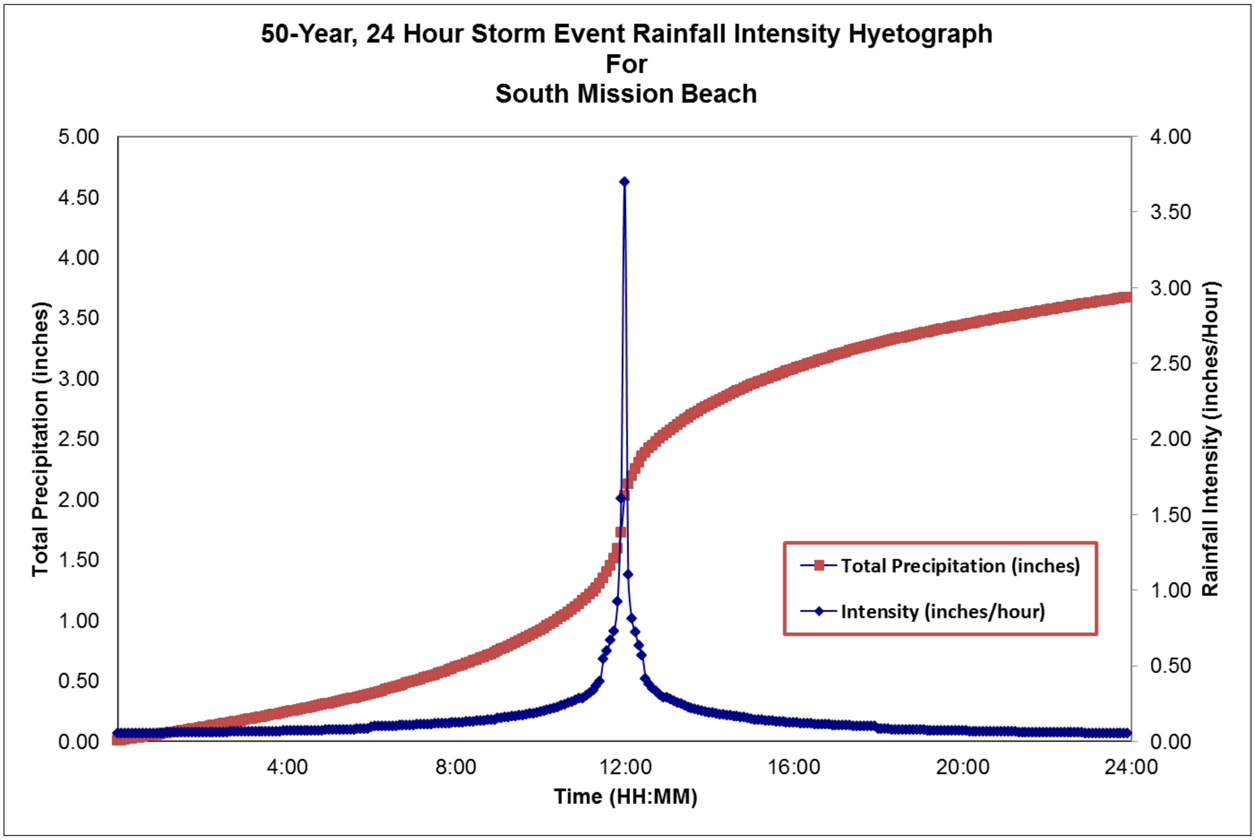
Longitude: -117.2504°

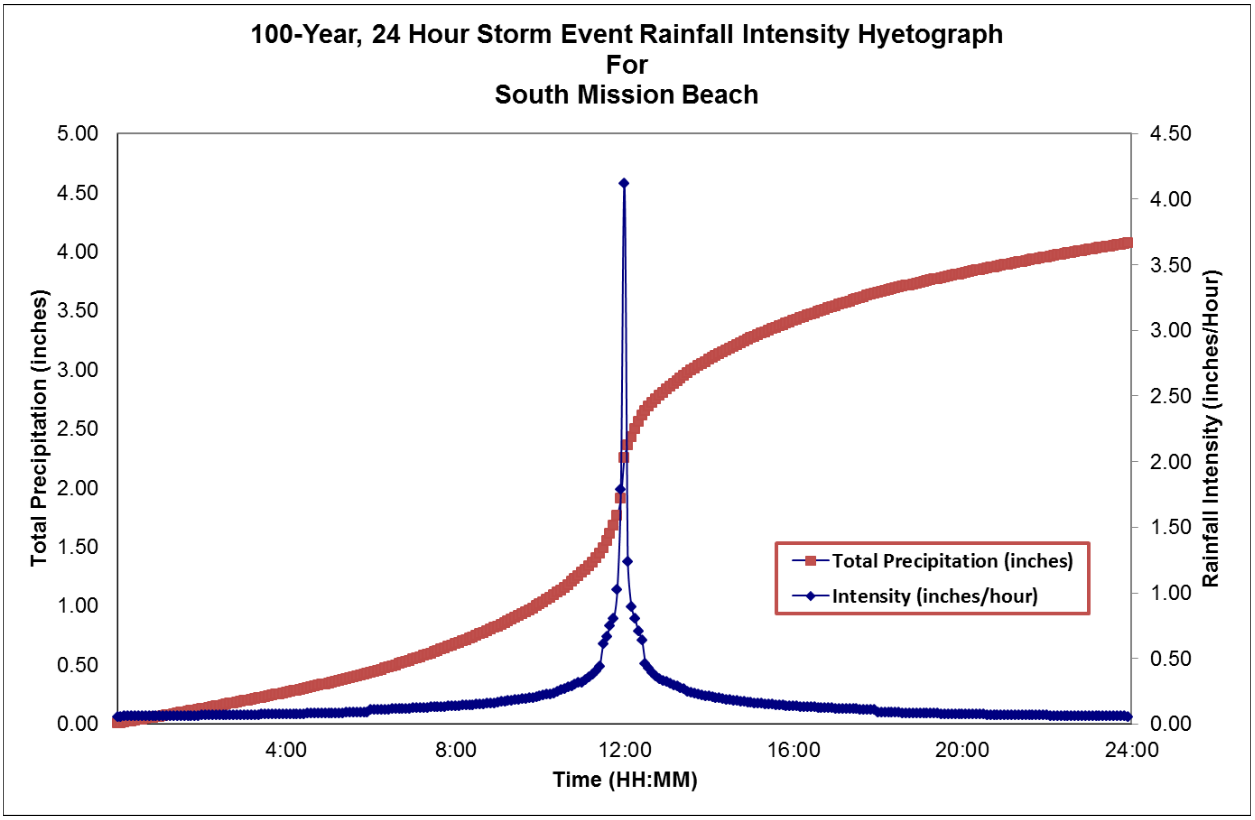
Elevation (USGS): 7.93 Ft.

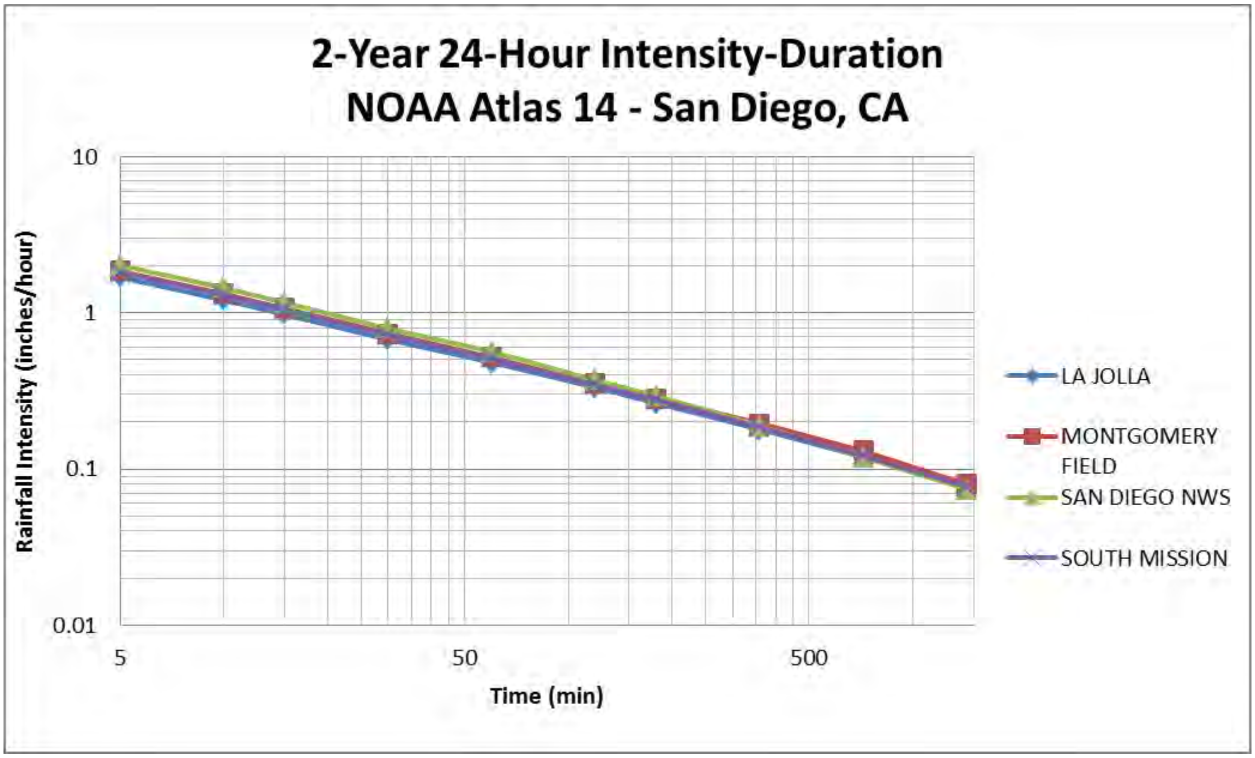
PRECIPITATION FREQUENCY ESTIMATES										
by duration for ARI (years):	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min:	0.12	0.15	0.19	0.23	0.27	0.31	0.34	0.38	0.43	0.46
10-min:	0.17	0.22	0.28	0.33	0.39	0.44	0.49	0.54	0.61	0.66
15-min:	0.20	0.26	0.34	0.39	0.47	0.53	0.60	0.66	0.74	0.80
30-min:	0.28	0.36	0.46	0.55	0.66	0.74	0.82	0.91	1.02	1.11
60-min:	0.40	0.51	0.66	0.77	0.93	1.05	1.17	1.29	1.45	1.57
2-hr:	0.55	0.69	0.88	1.04	1.24	1.39	1.55	1.71	1.92	2.08
3-hr:	0.66	0.83	1.05	1.23	1.47	1.65	1.84	2.02	2.27	2.46
6-hr:	0.88	1.11	1.41	1.64	1.96	2.20	2.44	2.68	3.00	3.25
12-hr:	1.16	1.46	1.86	2.17	2.59	2.90	3.22	3.53	3.95	4.27
24-hr:	1.44	**1.83**	2.34	**2.74**	3.27	**3.67**	**4.07**	4.47	5.00	5.40
2-day:	1.75	2.25	2.89	3.40	4.07	4.58	5.08	5.58	6.25	6.76
3-day:	1.95	2.53	3.27	3.86	4.64	5.23	5.81	6.40	7.18	7.77
4-day:	2.12	2.77	3.59	4.24	5.11	5.77	6.41	7.07	7.94	8.60
7-day:	2.49	3.29	4.29	5.09	6.16	6.96	7.75	8.56	9.63	10.40
10-day:	2.76	3.65	4.79	5.70	6.91	7.81	8.72	9.63	10.80	11.80
20-day:	3.33	4.44	5.86	6.99	8.48	9.61	10.70	11.90	13.40	14.50
30-day:	3.95	5.28	6.98	8.32	10.10	11.40	12.80	14.10	15.90	17.30
45-day:	4.66	6.21	8.17	9.74	11.80	13.40	14.90	16.50	18.60	20.20
60-day:	5.41	7.16	9.39	11.20	13.50	15.20	17.00	18.80	21.10	22.90

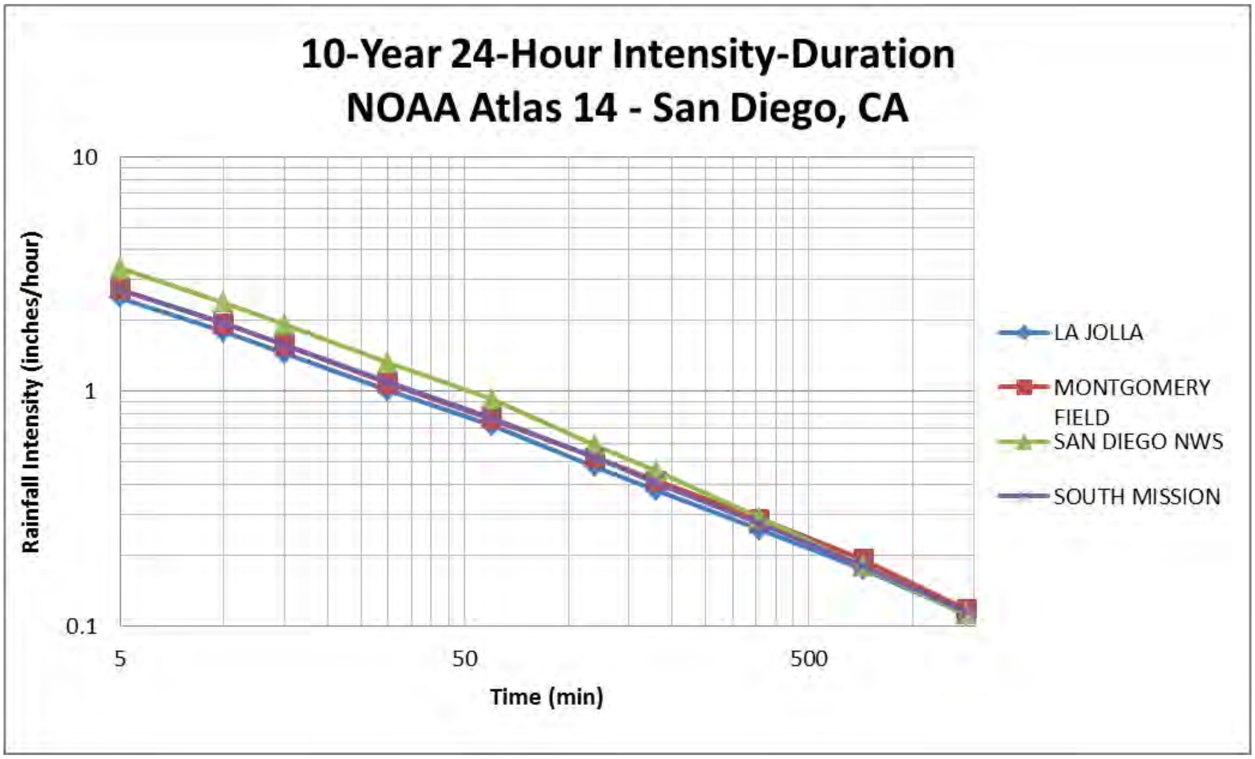

2-Year, 24 Hour Storm Event Rainfall Intensity Hyetograph
For
South Mission Beach
Total Precipitation (inches)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall Intensity (inches/Hour)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
4:00
8:00
12:00
16:00
20:00
24:00
Time (HH:MM)
Total Precipitation (inches)
Intensity (inches/hour)


10-Year, 24 Hour Storm Event Rainfall Intensity Hyetograph
For
South Mission Beach
Total Precipitation (inches)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall Intensity (inches/Hour)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
4:00
8:00
12:00
16:00
20:00
24:00
Time (HH:MM)
Total Precipitation (inches)
Intensity (inches/hour)


50-Year, 24 Hour Storm Event Rainfall Intensity Hyetograph
For
South Mission Beach
Total Precipitation (inches)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall Intensity (inches/Hour)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
4:00
8:00
12:00
16:00
20:00
24:00
Time (HH:MM)
Total Precipitation (inches)
Intensity (inches/hour)


100-Year, 24 Hour Storm Event Rainfall Intensity Hyetograph
For
South Mission Beach
Total Precipitation (inches)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Rainfall Intensity (inches/Hour)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
4:00
8:00
12:00
16:00
20:00
24:00
Time (HH:MM)
Total Precipitation (inches)
Intensity (inches/hour)


2-Year 24-Hour Intensity-Duration
NOAA Atlas 14 - San Diego, CA
Rainfall Intensity (inches/hour)
10
1
0.1
0.01
5
50
500
Time (min)
LA JOLLA
MONTGOMERY FIELD
SAN DIEGO NWS
SOUTH MISSION


10-Year 24-Hour Intensity-Duration
NOAA Atlas 14 - San Diego, CA
Rainfall Intensity (inches/hour)
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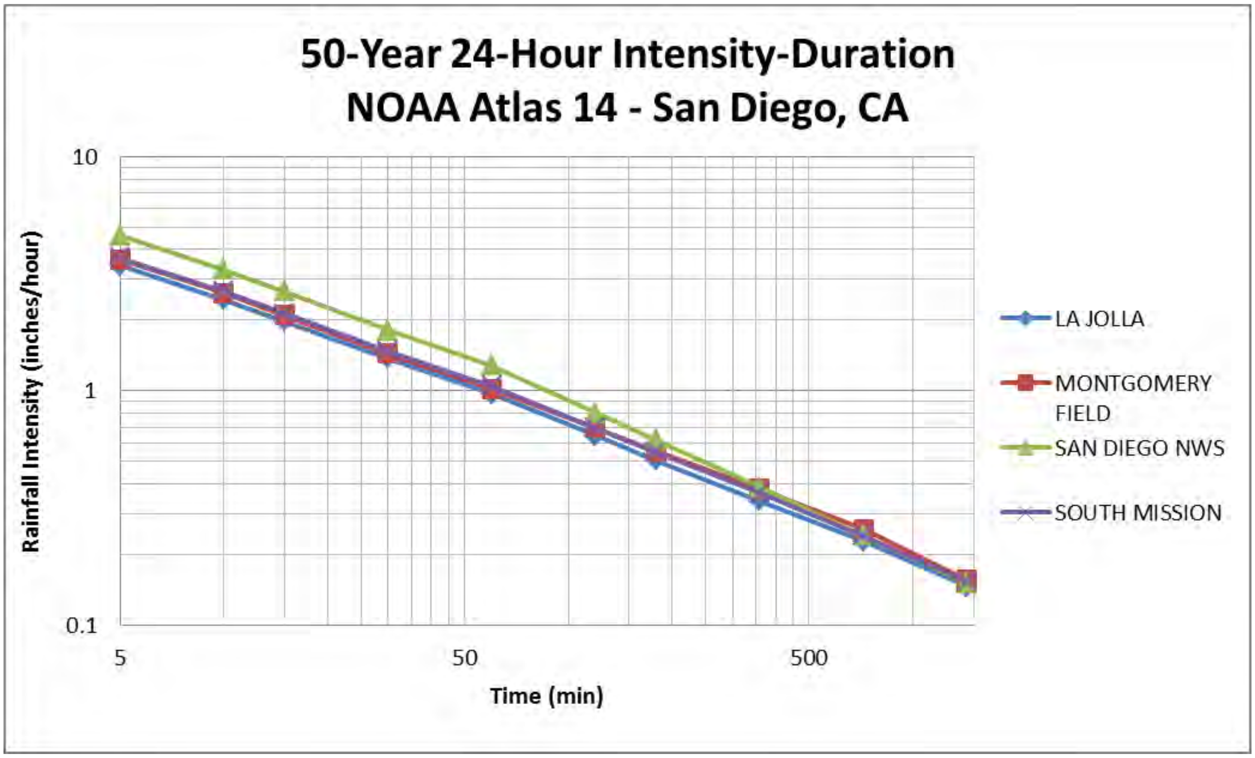
0.1
5
50
500
Time (min)
LA JOLLA
MONTGOMERY FIELD
SAN DIEGO NWS
SOUTH MISSION


50-Year 24-Hour Intensity-Duration
NOAA Atlas 14 - San Diego, CA
Rainfall Intensity (inches/hour)
10
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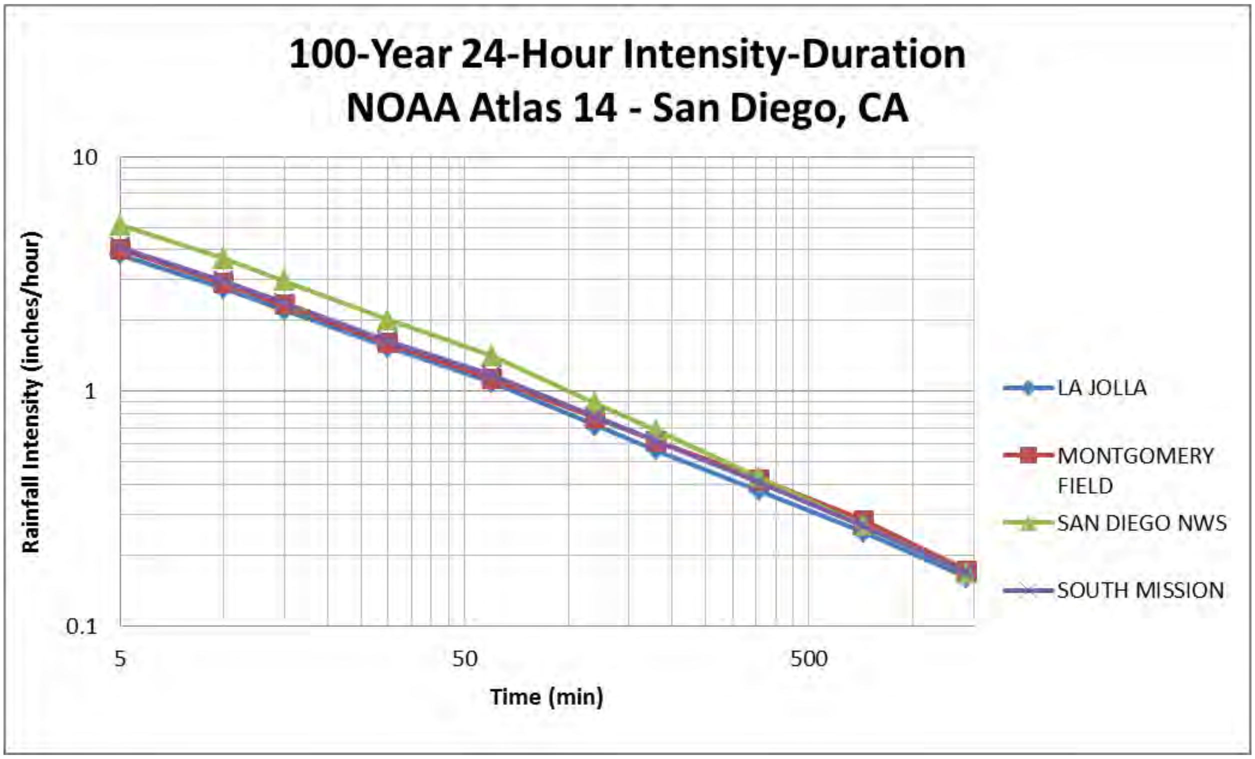
0.1
5
50
500
Time (min)
LA JOLLA
MONTGOMERY FIELD
SAN DIEGO NWS
SOUTH MISSION


100-Year 24-Hour Intensity-Duration
NOAA Atlas 14 - San Diego, CA
Rainfall Intensity (inches/hour)
10
1
0.1
5
50
500
Time (min)
LA JOLLA
MONTGOMERY FIELD
SAN DIEGO NWS
SOUTH MISSION

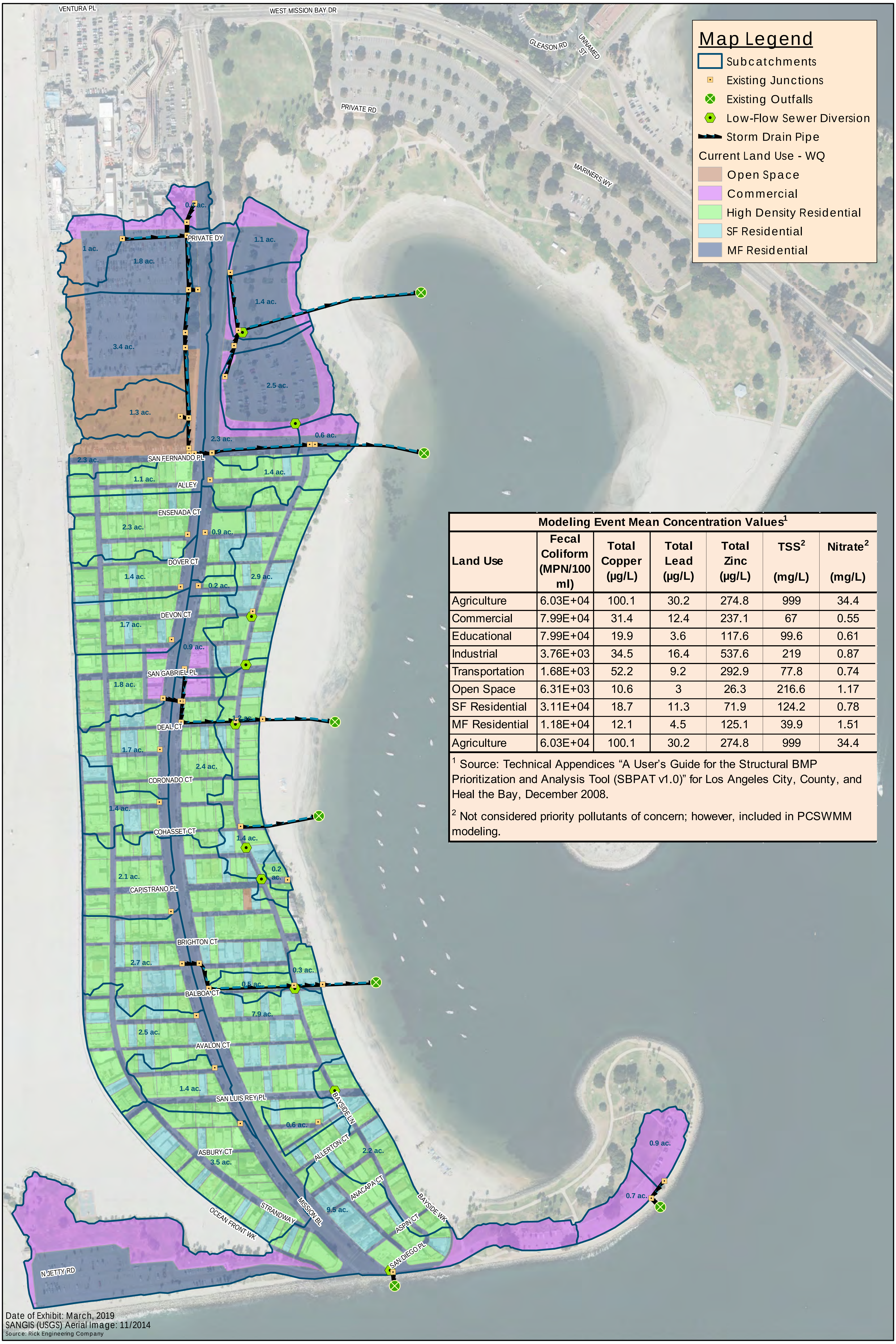
SOUTH MISSION BEACH		2-YEAR
Time (min)	Precipitation (inches)	Intensity (inches/hr)
0	0.00	0.00
5	0.15	1.80
10	0.22	1.29
15	0.26	1.04
30	0.36	0.72
60	0.51	0.51
120	0.69	0.35
180	0.83	0.28
360	1.11	0.19
720	1.46	0.12
1440	1.83	0.08

SOUTH MISSION BEACH		10-YEAR
Time (min)	Precipitation (inches)	Intensity (inches/hr)
0	0.00	0.00
5	0.23	2.72
10	0.33	1.96
15	0.39	1.58
30	0.55	1.09
60	0.77	0.77
120	1.04	0.52
180	1.23	0.41
360	1.64	0.27
720	2.17	0.18
1440	2.74	0.11

SOUTH MISSION BEACH		50-YEAR
Time (min)	Precipitation (inches)	Intensity (inches/hr)
0	0.00	0.00
5	0.31	3.70
10	0.44	2.65
15	0.53	2.14
30	0.74	1.48
60	1.05	1.05
120	1.39	0.70
180	1.65	0.55
360	2.20	0.37
720	2.90	0.24
1440	3.67	0.15

SOUTH MISSION BEACH		100-YEAR
Time (min)	Precipitation (inches)	Intensity (inches/hr)
0	0.00	0.00
5	0.34	4.12
10	0.49	2.95
15	0.60	2.38
30	0.82	1.64
60	1.17	1.17
120	1.55	0.78
180	1.84	0.61
360	2.44	0.41
720	3.22	0.27
1440	4.07	0.17

Appendix B. – Water Quality Modeling



Modeling Event Mean Concentration Values[1]

Land Use	Fecal Coliform (MPN/100 ml)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	TSS[2] (mg/L)	Nitrate[2] (mg/L)
Agriculture	6.03E+04	100.1	30.2	274.8	999	34.4
Commercial	7.99E+04	31.4	12.4	237.1	67	0.55
Educational	7.99E+04	19.9	3.6	117.6	99.6	0.61
Industrial	3.76E+03	34.5	16.4	537.6	219	0.87
Transportation	1.68E+03	52.2	9.2	292.9	77.8	0.74
Open Space	6.31E+03	10.6	3	26.3	216.6	1.17
SF Residential	3.11E+04	18.7	11.3	71.9	124.2	0.78
MF Residential	1.18E+04	12.1	4.5	125.1	39.9	1.51
Agriculture	6.03E+04	100.1	30.2	274.8	999	34.4

[1] Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008.

[2] Not considered priority pollutants of concern; however, included in PCSWMM modeling.

The City of SAN DIEGO

RICK ENGINEERING COMPANY

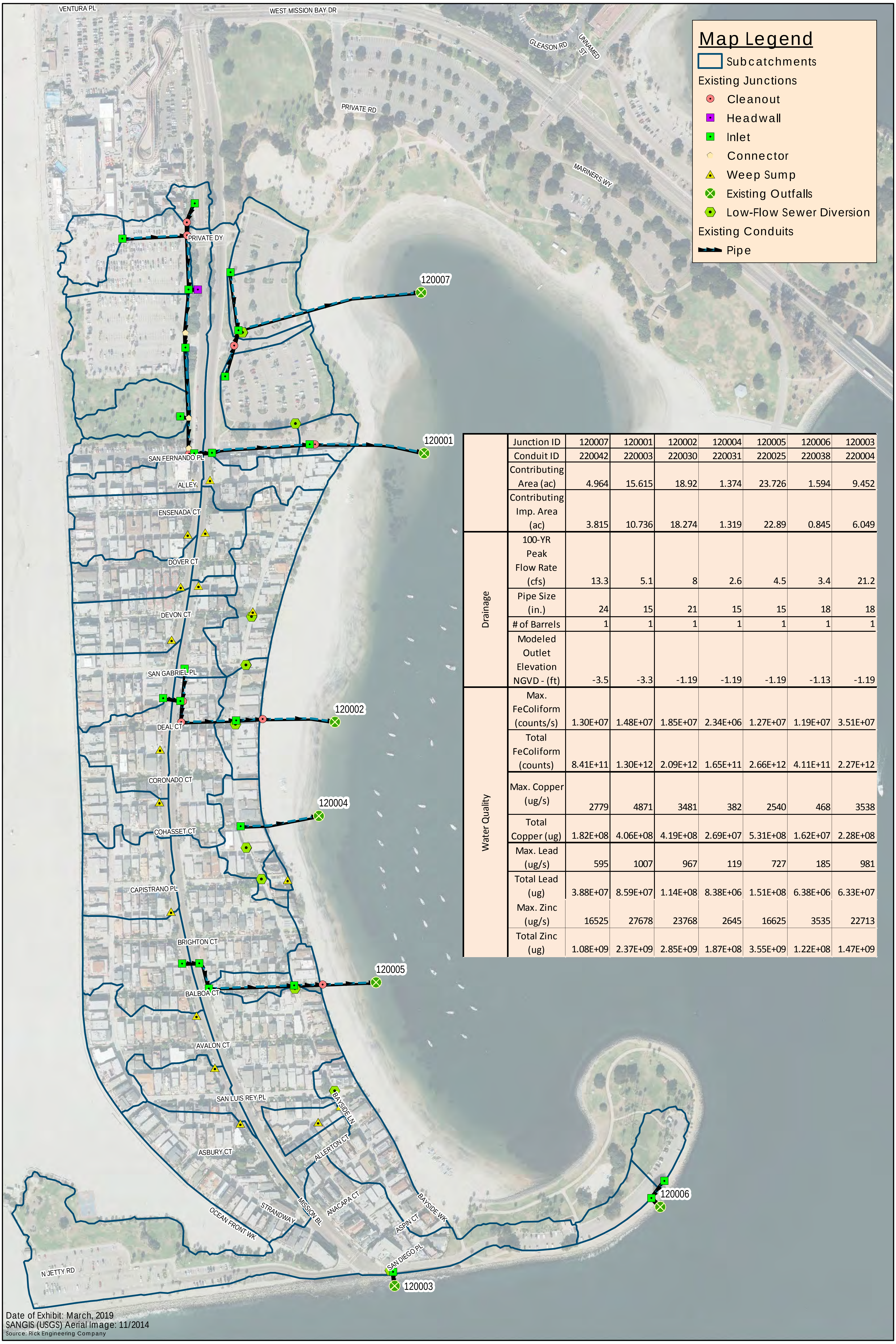
Scale in Feet
0 300 600

North

APPENDIX B - 1

DRAFT South Mission Beach WMP

Water Quality Land Use and EMCs



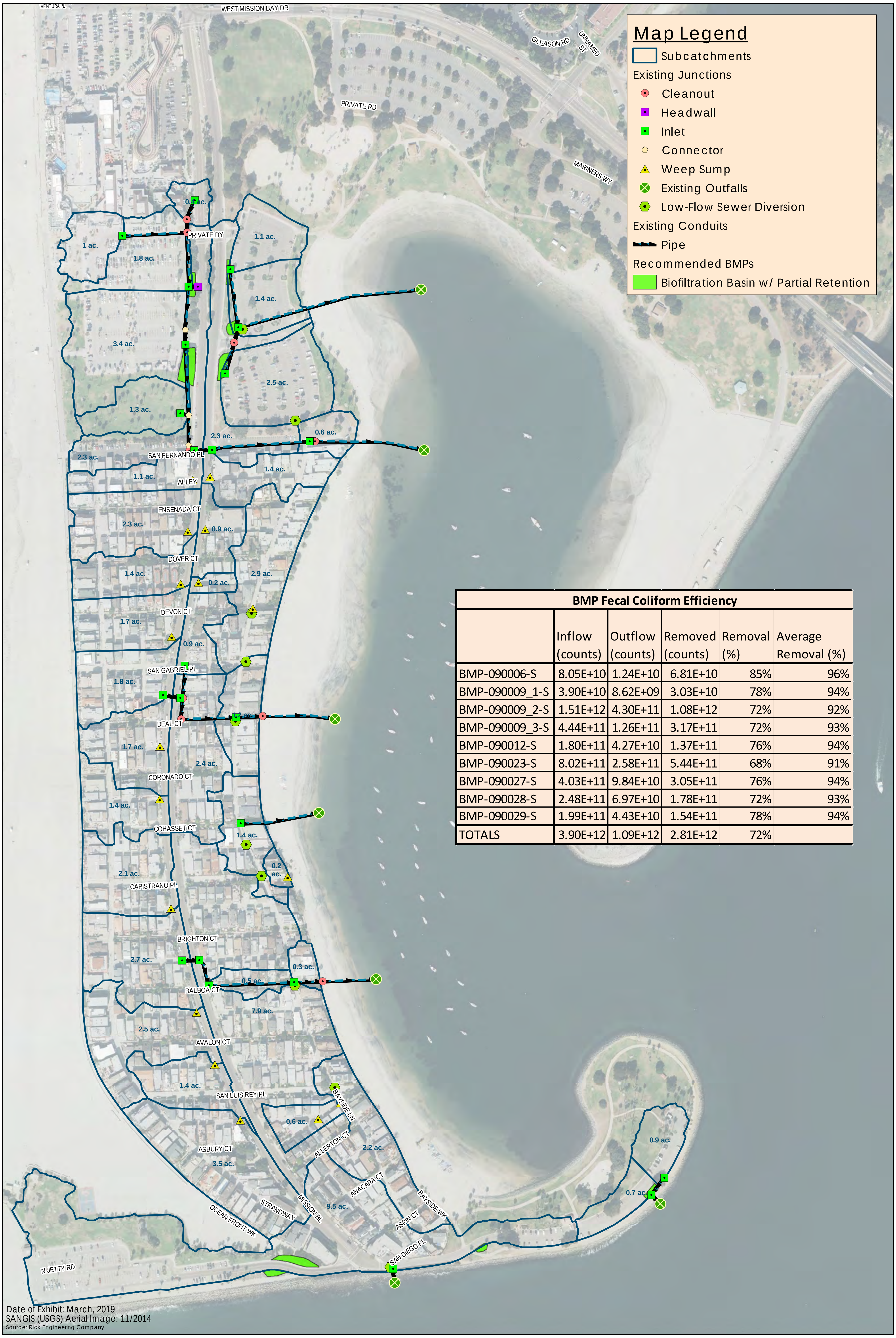
	Junction ID	120007	120001	120002	120004	120005	120006	120003
	Conduit ID	220042	220003	220030	220031	220025	220038	220004
	Contributing Area (ac)	4.964	15.615	18.92	1.374	23.726	1.594	9.452
	Contributing Imp. Area (ac)	3.815	10.736	18.274	1.319	22.89	0.845	6.049
Drainage	100-YR Peak Flow Rate (cfs)	13.3	5.1	8	2.6	4.5	3.4	21.2
	Pipe Size (in.)	24	15	21	15	15	18	18
	# of Barrels	1	1	1	1	1	1	1
	Modeled Outlet Elevation NGVD - (ft)	-3.5	-3.3	-1.19	-1.19	-1.19	-1.13	-1.19
Water Quality	Max. FeColiform (counts/s)	1.30E+07	1.48E+07	1.85E+07	2.34E+06	1.27E+07	1.19E+07	3.51E+07
	Total FeColiform (counts)	8.41E+11	1.30E+12	2.09E+12	1.65E+11	2.66E+12	4.11E+11	2.27E+12
	Max. Copper (ug/s)	2779	4871	3481	382	2540	468	3538
	Total Copper (ug)	1.82E+08	4.06E+08	4.19E+08	2.69E+07	5.31E+08	1.62E+07	2.28E+08
	Max. Lead (ug/s)	595	1007	967	119	727	185	981
	Total Lead (ug)	3.88E+07	8.59E+07	1.14E+08	8.38E+06	1.51E+08	6.38E+06	6.33E+07
	Max. Zinc (ug/s)	16525	27678	23768	2645	16625	3535	22713
	Total Zinc (ug)	1.08E+09	2.37E+09	2.85E+09	1.87E+08	3.55E+09	1.22E+08	1.47E+09

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

Scale in Feet
0 300 600
North

APPENDIX B - 2

DRAFT South Mission Beach WMP
EX. Water Quality Summary and Inventory



BMP Fecal Coliform Efficiency					
	Inflow (counts)	Outflow (counts)	Removed (counts)	Removal (%)	Average Removal (%)
BMP-090006-S	8.05E+10	1.24E+10	6.81E+10	85%	96%
BMP-090009_1-S	3.90E+10	8.62E+09	3.03E+10	78%	94%
BMP-090009_2-S	1.51E+12	4.30E+11	1.08E+12	72%	92%
BMP-090009_3-S	4.44E+11	1.26E+11	3.17E+11	72%	93%
BMP-090012-S	1.80E+11	4.27E+10	1.37E+11	76%	94%
BMP-090023-S	8.02E+11	2.58E+11	5.44E+11	68%	91%
BMP-090027-S	4.03E+11	9.84E+10	3.05E+11	76%	94%
BMP-090028-S	2.48E+11	6.97E+10	1.78E+11	72%	93%
BMP-090029-S	1.99E+11	4.43E+10	1.54E+11	78%	94%
TOTALS	3.90E+12	1.09E+12	2.81E+12	72%	

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO

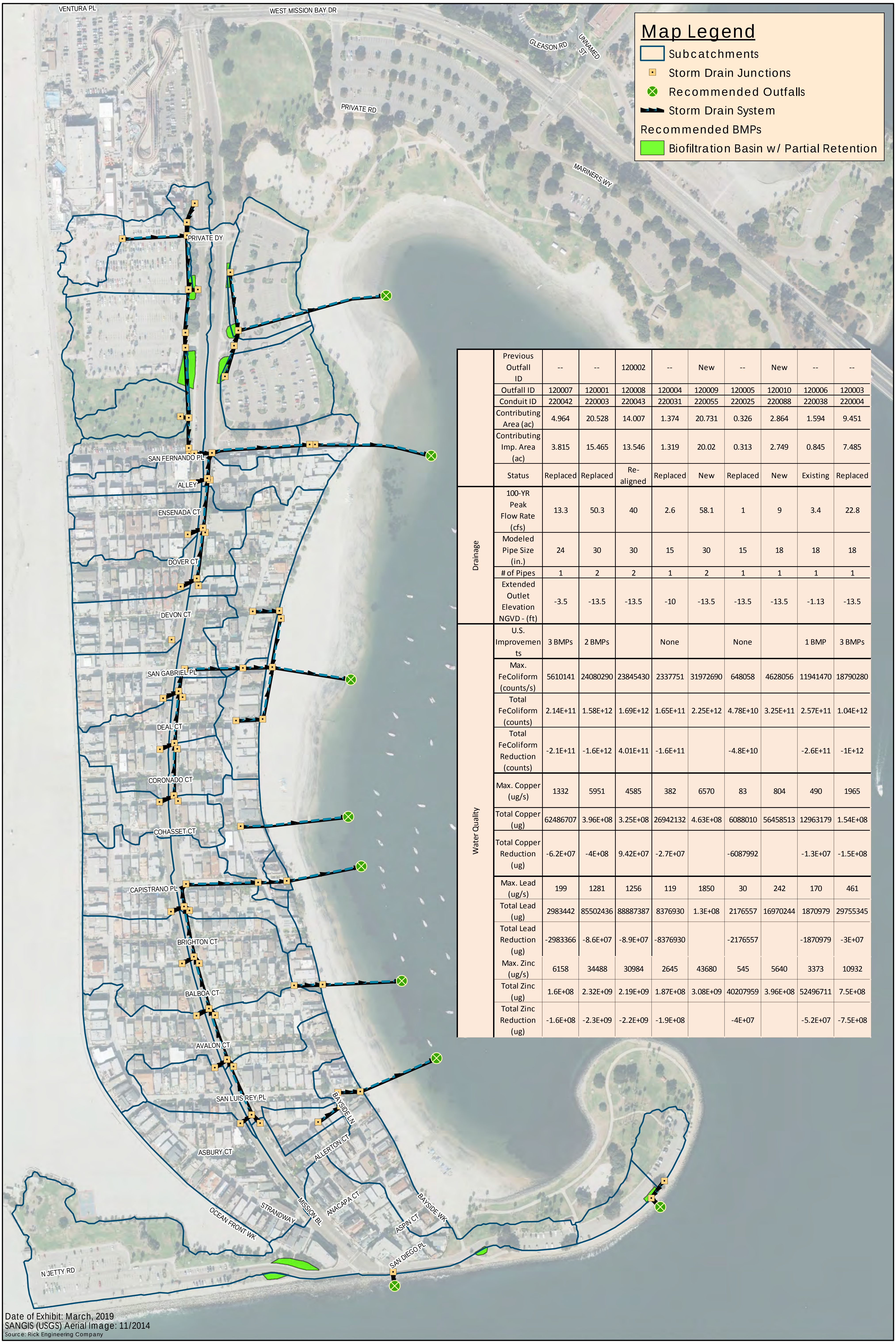
RICK ENGINEERING COMPANY

Scale in Feet
0 300 600

North

APPENDIX B - 3

DRAFT South Mission Beach WMP
Recommended Water Quality Improvements



	Previous Outfall ID	--	--	120002	--	New	--	New	--	--
	Outfall ID	120007	120001	120008	120004	120009	120005	120010	120006	120003
	Conduit ID	220042	220003	220043	220031	220055	220025	220088	220038	220004
	Contributing Area (ac)	4.964	20.528	14.007	1.374	20.731	0.326	2.864	1.594	9.451
	Contributing Imp. Area (ac)	3.815	15.465	13.546	1.319	20.02	0.313	2.749	0.845	7.485
	Status	Replaced	Replaced	Re-aligned	Replaced	New	Replaced	New	Existing	Replaced
Drainage	100-YR Peak Flow Rate (cfs)	13.3	50.3	40	2.6	58.1	1	9	3.4	22.8
	Modeled Pipe Size (in.)	24	30	30	15	30	15	18	18	18
	# of Pipes	1	2	2	1	2	1	1	1	1
	Extended Outlet Elevation NGVD - (ft)	-3.5	-13.5	-13.5	-10	-13.5	-13.5	-13.5	-1.13	-13.5
Water Quality	U.S. Improvements	3 BMPs	2 BMPs		None		None		1 BMP	3 BMPs
	Max. FeColiform (counts/s)	5610141	24080290	23845430	2337751	31972690	648058	4628056	11941470	18790280
	Total FeColiform (counts)	2.14E+11	1.58E+12	1.69E+12	1.65E+11	2.25E+12	4.78E+10	3.25E+11	2.57E+11	1.04E+12
	Total FeColiform Reduction (counts)	-2.1E+11	-1.6E+12	4.01E+11	-1.6E+11		-4.8E+10		-2.6E+11	-1E+12
	Max. Copper (ug/s)	1332	5951	4585	382	6570	83	804	490	1965
	Total Copper (ug)	62486707	3.96E+08	3.25E+08	26942132	4.63E+08	6088010	56458513	12963179	1.54E+08
	Total Copper Reduction (ug)	-6.2E+07	-4E+08	9.42E+07	-2.7E+07		-6087992		-1.3E+07	-1.5E+08
	Max. Lead (ug/s)	199	1281	1256	119	1850	30	242	170	461
	Total Lead (ug)	2983442	85502436	88887387	8376930	1.3E+08	2176557	16970244	1870979	29755345
	Total Lead Reduction (ug)	-2983366	-8.6E+07	-8.9E+07	-8376930		-2176557		-1870979	-3E+07
	Max. Zinc (ug/s)	6158	34488	30984	2645	43680	545	5640	3373	10932
	Total Zinc (ug)	1.6E+08	2.32E+09	2.19E+09	1.87E+08	3.08E+09	40207959	3.96E+08	52496711	7.5E+08
	Total Zinc Reduction (ug)	-1.6E+08	-2.3E+09	-2.2E+09	-1.9E+08		-4E+07		-5.2E+07	-7.5E+08

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO
RICK ENGINEERING COMPANY

Scale in Feet
0 300 600
North

APPENDIX B - 4

DRAFT South Mission Beach WMP
Recommended Water Quality Summary

Appendix C. – Biological Resources

M&A #18-049-01

SOUTH MISSION BEACH WATERSHED MASTER PLAN

FINAL

BIOLOGICAL RESOURCES REPORT

Existing Conditions and Preliminary Impact Considerations

March 2019

Prepared for:

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Amanda K. Gonzales

Amanda K. Gonzales, Senior Biologist

Keith W. Merkel

Keith W. Merkel, Principal Consultant

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF TERMS AND ACRONYMS

AJD	Approved Jurisdictional Determination
BS	Beaufort scale
BSA	Biological Study Area
CCA	California Coastal Act
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
City	City of San Diego
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CWA	Clean Water Act
CDP	Coastal Development Permit
DSD	Development Service Department
ESA	(Federal) Endangered Species Act
ESHA	Environmentally Sensitive Habitat Areas
ESRI	Environmental Systems Research Institute
°F	degrees Fahrenheit
FAC	Facultative Plants
FACU	Facultative Upland Plants
FACW	Facultative Wetland Plants
FGC	Fish and Game Code
GIS	Geographical Information System
GPS	Global Positioning System
JD	Jurisdictional Determination
LCP	Local Coastal Program
M&A	Merkel & Associates, Inc.
MBTA	Migratory Bird Treaty Act
MLLW	Mean Lower Low Water
HMP	(long-term) Habitat Management Plan
MMRP	Mitigation and Monitoring Program
MPH	Miles per Hour
NWW	Non-wetland Waters of the U.S.
OBL	Obligate Wetland Plants
OHWM	Ordinary High Water Mark
PJD	Preliminary Jurisdictional Determination
RWQCB	Regional Water Quality Control Board
SWANCC	Solid Waste Agency of Northern Cook County
SWRCB	State Water Resources Control Board
TNW	Traditional Navigable Waters
USACOE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMP	**Watershed Management Plan**
WoUS	Waters of the U.S.

1.0 INTRODUCTION

1.1. Purpose of the Report

Merkel & Associates, Inc. (M&A) has prepared this biological resources report for the South Mission Beach Watershed Master Plan (WMP or project). The purpose of this report is to document the existing biological setting of the project, identify jurisdictional water resources, and natural resources of concern, and to provide preliminary assessments of potential impacts of project implementation. This report makes recommendations for completion of work in a manner that would avoid or minimize project impacts and the report further identifies impacts that will likely occur and require mitigation. Preliminary recommendations for mitigation are made within this report.

This report is considered preliminary as it has been developed to support master planning efforts designed to achieve the project objectives with the least environmental impact practical. For this reason, an updated analysis will be required as further project development is completed.

1.2. Project Location

The project area is located within the City of San Diego, California. The project site includes a portion of the community of Mission Beach known as South Mission Beach located north of the Mission Bay Entrance Channel near the end of Mission Boulevard and extending northward to Belmont Park (Figure 1). The WSM includes storm drain discharges to Mariner's Basin and the Mission Bay Entrance Channel. For this reason, the biological study area has been expanded beyond the WSM project area to include a broader envelope potentially affected by the storm drain outfalls from South Mission Beach.

The project area consists predominantly of dense single family residential, beach rental, and small visitor serving commercial developed lands that are bounded on the west by the Pacific Ocean beach shoreline and which are bounded on the east by Mariner's Basin within Mission Bay Park (Figure 2). The central portion of Mariner's Basin is a federally maintained facility that is part of the Mission Bay federal channel maintained by the Army Corps of Engineers, Los Angeles District. Across Mariner's Basin from South Mission Beach is the Mariner's Point Least Tern Nesting Site, the largest of four such sites in Mission Bay Park. This site is in the City of San Diego's Multiple Species Conservation Plan (MSCP) Multi-Habitat Planning Area (MHPA). Mariner's Basin is also part of Mission Bay Park and subject to the Mission Bay Park Master Plan Update (City of San Diego 1994, as amended 2002).

While this report includes a broader biological study area (BSA) than the focused project area to provide biological context, the focal investigations have been directed to areas within 100 feet of the current and proposed drain discharge points as well as the last segment of the storm drain extending to the terminal discharge locations. The developed portions of South Mission Beach have not been investigated for biological resources as these areas are highly urbanized with limited numbers of trees, no native vegetation, and no potential for sensitive biological resources to be affected by the propose storm drain work that is principally underground activities within street and alley right-of-ways.

N
W E
S
1:24000

Project Vicinity Map

South Mission Beach Watershed Master Plan

Source: USGS 7.5' La Jolla, CA Quadrangle

Figure 1

Local Setting Map

South Mission Beach Watershed Master Plan

Aerial Source: ESRI 2017

Figure 2

1.3. Project Description

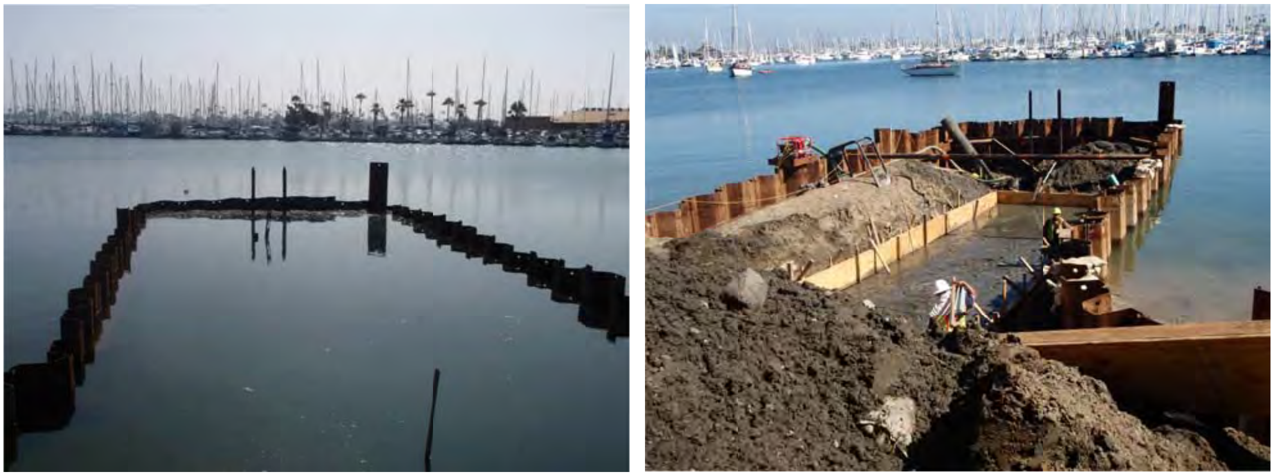
The proposed project consists of evaluating the biological and littoral zone effects of seven existing storm drains identified as Outfall IDs 120001 through 120007, one realigned storm drain outlet identified as Outfall ID 120008, and one proposed new storm drain outlet identified as Outfall ID 120009 (Figure 3). The proposed work includes a combination of actions ranging from no alteration of the conveyance outlet to removal and consolidation of outfalls, upsizing capacity, and extending outfalls. Table 1 briefly summarizes the planned activities at each drain outlet.

The overall WMP includes work within streets and alleys of South Mission Beach as well as activities on the beach adjacent to and waters within Mariner's Basin as well as on the shoreline of the Mission Bay Entrance Channel. Work within the urban developed lands of the WMP area are not addressed within this document as they have little potential for biological resource or jurisdictional waters affects.

Table 1. Summary of actions at each project outfall.

Outfall ID	Proposed Action
120001	Storm drain replaced and outfall extended
120002	Storm drain replaced by the realigned storm drain 120008
120003	Broken outfall pipe with duck bill valve to be replaced
120004	Storm drain left as is. Alternatively, the storm drain may be realigned and consolidated into one outfall with 120009
120005	Storm drain replaced and outfall extended
120006	Storm drain left as is
120007	Storm drain left as is. Sufficient conveyance capacity
120008	Storm drain realigned and outfall extended
120009	New storm drain outfall

Construction activities are expected to employ cut and cover trenching within the upland areas and either marine construction using in water excavation and placement of bedding gravel and pipe segments, or construction of temporary sheetpile containment, dewatering, and construction with standard dry environment methods within the dewatered containment. This methodology has been used for the completion of other marine outlet facilities within Mission Bay, including the subtidal storm drain outlets within Sail Bay and the Santa Clara Cove storm drain outlet. For purposes of impact analysis in this assessment, a 100 foot wide cofferdam work area has been assumed around each drain outlet. This sizing is extremely liberal with respect to potential impacts, but it would ensure that any effects of the project would be adequately inclusive during the early phases of design such that impacts would only be expected to decrease over time.



Cofferdam construction methodology is illustrated for the Bessemer Street storm drain outfalls into San Diego Bay

The extension of storm drains to subtidal discharge points will require some excavation and regarding of beach and subtidal slopes around the storm drains in remove accumulated sand deltas and flatten the subtidal slopes around and over the pipe. This will reclaim previously displaced beach sand and replace it on the intertidal and supratidal beach while removing the storm drain deltas that extend bayward from the existing intertidal drain discharge locations. This removal will reduce the potential for burial of the drain outlet due to steep slope slumping. It will remove the steep shoreline scarp and it will provide opportunities for the restoration of mitigation eelgrass.

The proposed project is anticipated to be implemented concurrent with other underground utilities activities within the South Mission Beach area. The work is expected to be completed during the period from June 2020 to February 2023. No work is proposed on the beach or within the waters of Mission Bay from Memorial Day to Labor Day of any given year.

Implementation of the proposed project is expected to occur following acquisition of all applicable permits/authorizations. Construction of the project is expected to occur over an approximate 20 month period, with the work on the outfalls on the beach and in the water being completed over a period of approximately 20 months.

1.4. Data Collection Methodologies

1.4.1. Literature and Data Review

Historical and currently available biological literature and data pertaining to the project area were reviewed prior to initiation of the field investigations. This review included examination of: 1) aerial photography for the project site (Google Earth Pro and SDG&E 2014); 2) composite topography and bathymetry for the study area from LiDAR collected digital terrain model (DTM) data (SDG&E 2014) and swath bathymetry (M&A 2016); 3) soil types mapped on the project site (SanGIS 2002); 4) City of San Diego Multiple Species Conservation Plan (MSCP)(City of San Diego 1997); 5) Mission Bay Park Master Plan Update (City of San Diego 2002); 6) federally designated critical habitat for the project vicinity (USFWS 2017a); 7) CDFW California Natural Diversity Database (CNDDB) and USFWS special status species records for the project vicinity (CDFW 2017a and USFWS 2017b, respectively); and 8) previous biological reports/data for the project site and local vicinity, including the 2013 baywide eelgrass survey (M&A 2013).

1.4.2. Biological Surveys and Investigations

1.4.2.1.Survey Date(s), Time(s), and Conditions

Field surveys of the sites have included marine resource surveys and mapping, sediment characterization sampling, upland habitat assessment and jurisdictional waters determinations. Surveys have included general biological survey to map vegetation and identify botanical and wildlife species, as well as a marine habitat survey that included eelgrass (*Zostera marina*) mapping. Table 2 summarizes the survey dates, times, and conditions.

Table 2. Survey Date(s), Time(s), and Conditions

Survey	Date	Time	Conditions (start to end) [1]	Staff
Marine Habitat	July 23, 2018	0730-1300	Weather: 0% cc Wind: 1-3 BS Temperature: 72-81° F	Jordan Volker Daniel Kahl
Marine Habitat	August 6, 2018	0730-1400	Weather: 0% cc Wind: 1-4 BS Temperature: 74-83° F	Jordan Volker Daniel Kahl
General Biology, Jurisdictional Waters	January 20, 2018	0730-1030	Weather: 100% cc Wind: 0-1 BS Temperature: 55-60° F	Keith Merkel

[1] cc = cloud cover; BS = Beaufort scale; °F = degrees Fahrenheit

1.4.2.2.Field Survey Methods

General Terrestrial Biology: Vegetation Mapping and Botanical/Wildlife Survey

M&A conducted a general biological review of the study area on with the primary focus being on the undeveloped beach and intertidal environments and upper tide lines. The investigation also included a drive through investigation of the developed portions of the South Mission Beach WMP area to confirm the absence of any substantial wildlife habitats. A focused investigation was made along the beach and rip rap environments to confirm the absence of any adjacent wetlands or any native terrestrial vegetation. During this investigation, the general condition of the beach was investigated to determine if any obvious differences existed from those previously identified in aerial surveys (latest August 2017) or LiDAR topographic mapping. No new in water investigations were conducted in January 2019, thus making the prior summer 2018 investigations the most current marine habitat surveys.

Existing habitat types were classified according to the Holland (1986) code classification system as modified by Oberbauer et al. (2008), and have been mapped in accordance with the City Biological Guidelines and Guidelines for Conducting Biological Surveys (2012).

The scientific and common names utilized for the floral and faunal resources were noted according to the following nomenclature: flora, Baldwin (2011) Calflora (2018); butterflies, Klein and San Diego Natural History Museum (2002) and Opler et al. (2010); amphibians and reptiles, Crother et al. (2012); birds, American Ornithologists' Union (1998 and 2017); and mammals, (species level) Wilson and Reeder (2005) and (sub-species level) Hall (1981).

Photographs of the project area were taken to record the biological resources present within the study area and data collected from the survey were digitized in Environmental Systems Research Institute (ESRI) Geographical Information System (GIS) software, using ArcGIS® for Desktop.

Marine Habitats and Eelgrass Survey

Intertidal marine habitats were surveyed from shore in conjunction with the general biological survey described above as well as by survey vessel with interferometric sidescan sonar and ROV. In addition, an in-water eelgrass survey was completed of the site by SCUBA diver.

Eelgrass habitat mapping was completed using interferometric sidescan sonar, which provided an image of seafloor backscatter within the entire project area. Interpretation of the backscatter data allowed for an assessment of the distribution of eelgrass. Sidescan backscatter data were acquired at a frequency of 468 kHz, with a scanning range of 31 meters for both the starboard and port channels, resulting in a 62 meter wide swath. All data were collected in latitude and longitude using the North American Datum of 1983 (NAD 83). The survey was conducted by running transects spaced to allow for overlap between adjoining sidescan swaths. Transect surveys were performed until the entirety of the survey area was captured in the survey record. Following completion of the survey, the data were converted into a geographically registered mosaic through digital post-processing, and plotted on a geo-rectified aerial image of the project area. Marine resources of interest were then digitized to show their distribution within the survey area.

Following the sidescan survey, the survey area was examined to assess the eelgrass quality, verify the sidescan data, and measure the density of actively growing leaf shoots by conducting shoot counts within a 1/16-m^2 quadrat. Twenty replicate quadrats were randomly placed within five widely distributed eelgrass beds throughout the study area to obtain a mean shoot density for the eelgrass beds.

Following completion of the survey, ISS traces were joined together and geographically registered. Eelgrass was then digitized as a theme over and projected on an aerial image of the project site to calculate the amount of eelgrass coverage and present its distribution. This method of eelgrass distribution calculation allows for monitoring eelgrass trends at the project site with a substantial degree of accuracy and repeatability over time.

The reported metrics for eelgrass are as follows:

- **Spatial Distribution –** The spatial distribution of eelgrass habitat was delineated by a contiguous boundary around all areas of vegetated eelgrass cover extending outward a distance of 5 meters. The resultant spatial distribution boundary of the eelgrass habitat was then clipped to remove areas that were determined to be unsuited to supporting eelgrass based on depth, substrate, or existing structures.
- **Areal Extent –** The eelgrass habitat areal extent includes vegetated cover and extent of unvegetated habitat that defines a coalesced bed with gaps of less than 1 meter across being considered part of the defined bed.

- **Percent Vegetated Cover -** Eelgrass vegetated cover exists when one or more leaf shoots (turions) per square meter is present. The percent bottom cover within eelgrass habitat is determined by totaling the area of vegetated eelgrass cover and dividing this by the total eelgrass habitat area.
- **Turion (Shoot) Density -** Turion density is the mean number of eelgrass leaf shoots per square meter within mapped eelgrass vegetated cover. Turion density should be reported as a mean ± the standard deviation of replicate measurements. The number of replicate measurements (n) is reported along with the mean and deviation. Turion densities are determined only within vegetated areas of eelgrass habitat; and therefore, it is not possible to measure a turion density equal to zero.

Directed Sensitive Species Survey/Assessment

Concurrent with the habitat mapping and botanical/wildlife survey, a directed survey/assessment for special status species, as defined under CEQA, was conducted within the study area. Only the South Shores staging are supported any terrestrial vegetation within work areas and as such, this area was the focus for the rare species investigations. Further, during each field visit, note was made of the absence of marine mammals within or in proximity to the project sites.

State CEQA Guidelines §15380 (Title 14, Chapter 3, Article 20) define “endangered, rare or threatened species” as “species or subspecies of animal or plant or variety of plant” listed under the Code of Federal Regulations, Title 50, Part 17.11 or 17.12 (Volume 1, Chapter I) or California Code of Regulations, Title 14, Sections 670.2 or 670.5 (Division 1, Subdivision 3, Chapter 3), or a species not included in the above listings but that can be shown to be “endangered” meaning “when its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors” or “rare” meaning “although not presently threatened with extinction, the species is existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens or the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered ‘threatened’ as that term is used in the Federal Endangered Species Act”. State CEQA guidelines Appendix G, Section IV generally refers to species that fall under the above criteria as “special status species”.

Thus, for the purposes of this report, special status species are: 1) federally and state listed species (CDFW 2017c and 2018b); 2) CDFW Species of Special Concern (SSC), Fully Protected (FP), and Watch List (WL) species (CDFW 2017a, 2017b, 2018a); 3) species designated as Special Plants or Special Animals in the CNDDB, which include all taxa inventoried by the CDFW, regardless of their legal or protection status; and 4) MSCP Narrow Endemic and Covered Species (City 1997).

The potential for sensitive species to occur on the project site was assessed based on the presence of potentially suitable habitat, as well as historical and currently available species data.

1.4.2.3.Jurisdictional Delineation

Multiple federal and state agencies as well as the City of San Diego have jurisdictional authority over waters and waterways. An analysis was conducted to determine the limits of jurisdictional waters within the BSA. The investigation included an evaluation of the potential for presence of wetlands as well as preliminary determination of the non-wetland jurisdictional boundaries of waters within the BSA.

An evaluation of the site was completed to determine whether any features existed that would warrant application of wetland determination methods noted in the *USACOE Wetland Delineation Manual* (Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACOE 2008a). Specifically, these methods apply a rule-based evaluation of the presence and extent of three parameters defining wetlands (i.e., hydrophytic vegetation, hydric soils, and wetland hydrology). In addition to completion of wetland investigations, the jurisdictional limits of non-wetland waters were also investigated. The limit of jurisdictional waters absent the presence of wetlands is defined by physical manifestations of water inundation. In tidal waters, two inundation levels are applicable. These are the annual highest high tide (HHT) for discharge of fill regulated under section 404 of the Clean Water Act, and the mean high water (MHW) for activities regulated under section 10 of the Rivers & Harbors Act. These elevations are relative to harmonic data that varies from location to location. Within Mission Bay, the HHT is considered to be +4.50 ft NGVD29 (+7.38 ft MLLW) and the MHW is +1.86 ft NGVD29 (+4.74 ft MLLW).

For the purposes of the WMP investigations, planning and design is being completed using a topographic digital elevation model (DEM) derived from 2014 LiDAR. To remain consistent with design documents, this DEM has been adopted as a base for delineating elevationally driven jurisdictional boundaries. In addition, due to the age of the existing topography, a review of recent historic photographs (Google Earth) and a January 2019 field review of the site was undertaken to confirm that conditions present within the BSA remained relatively consistent with the conditions depicted through the 2014 DEM. With the exception of minor grooming effects and seasonal high beach sand berming to protect against wave swell run-up, the conditions in January 2018 were determined to be generally consistent with the 2014 DEM conditions. Slight differences in the horizontal position of the jurisdictional boundaries would be expected, however because both jurisdictional boundaries are located on a moderately steep beach face, these differences would not be expected to be substantial.

1.4.2.4.Survey Limitations

Biological inventories are generally subject to various survey limitations. Depending on the season and time of day during which field surveys are conducted, some species may not be detected due to temporal species variability. In the present case, the BSA was examined at differing times for marine and terrestrial resources based on seasonality of resource detectability. The resources within the BSA are generally well known and highly influenced by anthropogenic activities. This makes it unlikely that substantial resources of high importance have not been documented within the area. The waters of Mission Bay were investigated to generally characterize marine resources of the bay during the preparation of the Mission Bay Natural Resources Management Plan (included in the Mission Bay Master Plan Update). In addition, the eelgrass habitat within Mission Bay has been inventoried and tracked since 1988 with baywide surveys being completed in 1988, 1992, 1997, 2001, 2007, and 2013 (Merkel & Associates 2013). The Mariner's Point California least tern nesting site within the BSA is a well-known and monitored element of the City's MHPA and its use has been documented for many years. The remainder of the BSA is highly disturbed urbanized residential, commercial, and developed parklands. These areas are not expected to support any sensitive biological resources. As such, it is believed that the investigations completed to date are adequate to characterize the nature of the biological environment for the purposes of environmental review.

1.5. Applicable Regulations

A variety of federal, state, and local regulations may apply to the proposed project. These regulations are listed herein with a brief description.

1.5.1. Federal Regulations and Standards

1.5.1.1. Federal Endangered Species Act (ESA)

The federal ESA (16 U.S.C. 1513-1543) was enacted in 1973 to provide protection to threatened and endangered species and their associated ecosystems. "Take" of a listed species is prohibited except when authorization has been granted through a permit under Sections 4(d), 7, or 10(a) of the act. Take is defined as harassing, harming, shooting, wounding, killing, trapping, capturing, or collecting, or attempting to engage in any of these activities without a permit.

1.5.1.2. Migratory Bird Treaty Act (MBTA)

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) was enacted in 1918. Its purpose is to prohibit the kill or transport of native migratory birds, or any part, nest, or egg of any such bird unless allowed by another regulation adopted in accordance with the MBTA. Under the MBTA of 1918 (16 U.S.C. section 703-712; Ch. 128; July 3, 1918; 40 Stat. 755; as amended 1936, 1956, 1960, 1968, 1969, 1974, 1978, 1986 and 1998), it is unlawful, except as permitted by the USFWS, to "take, possess, transport, sell, purchase, barter, import, or export all species of birds protected by the MBTA, as well as their feathers, parts, nests, or eggs (USFWS 2003). Take means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect (50 CFR 10.12). Birds protected by the MBTA include all birds covered by the treaties for the protection of migratory birds between the United States and Great Britain (on behalf of Canada, 1916), Mexico (1936), Japan (1972), and Russia (1976), and subsequent amendments."

It is important to note that since the MBTA addresses migratory birds by family rather than at a lower taxonomic level, most bird species are protected by the MBTA because most taxonomic families include migratory members. In addition, "take" as defined under the federal MBTA is not synonymous with "take" as defined under the federal ESA. The MBTA definition of "take" lacks a "harm and harassment" clause comparable to "take" under the ESA, thus, the MBTA authority does not extend to activities beyond the nests, eggs, feathers, or specific bird parts (i.e., activities or habitat modification in the vicinity of nesting birds that do not result in "take" as defined under the MBTA are not prohibited). Further, "a permit is not required to dislodge or destroy migratory bird nests that are not occupied by juveniles or eggs; however, any such destruction that results in take of any migratory bird is a violation of the MBTA (i.e., where juveniles still depend on the nest for survival) (USFWS 2003)."

1.5.1.3. Federal Water Pollution Control Act (Clean Water Act), 1972

In 1948, Congress first passed the Federal Water Pollution Control Act. This act was amended in 1972 and became known as the CWA. The act regulates the discharge of pollutants into waters of the U.S. (WOUS), including wetlands. The term "waters of the U.S." is defined in 33 CFR Part 328.3(a) as:

> *(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the*

> *tide; (2) All interstate waters and wetlands; (3) All other waters such as intrastate lakes, rivers, streams, (including intermittent streams), mudflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters: (i) Which are or could be used by interstate or foreign travelers for recreational or other purposes; or (ii) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (iii) Which are used or could be used for industrial purpose by industries in interstate commerce; (4) All impoundments of waters otherwise defined as waters of the U.S. under the definition; (5) Tributaries of waters identified in (a) (1) through (4) of this section; (6) The territorial seas; (7) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) (1) through (6) of this section; and (8) Waters of the U.S. do not include prior converted cropland.*

"Wetlands" are defined in 33 CFR 328.3(b) as:

> *"those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.*

Under Section 404 (33 U.S.C. 1344), permits need to be obtained from the USACOE for discharge of dredged or fill material into waters of the U.S. Under Section 401 of the CWA, Water Quality Certification from the RWQCB would need to be obtained if there are to be any impacts to waters of the U.S.

1.5.1.4. Rivers & Harbors Act of 1899 (33 U.S.C. 401)

The Rivers & Harbors Act of 1899 (R&HA) is intended to protect the navigability of the nation's waterways. The term "navigable waters of the U.S." is defined in 33 CFR Part 329.4 as "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce."

At its core, the R&HA provides for the regulation of obstructions in the waterway and includes regulation of all structures and work. Under section 10 of the R&HA, the Corps regulates structures and work within navigable waters such as tidal waters of Mission Bay. The regulatory reach of the Rivers & Harbors Act extends up to the mean high water line.

1.5.2. State Regulations and Standards

1.5.2.1. California Environmental Quality Act (CEQA)

CEQA requires that biological resources be considered when assessing the environmental impacts resulting from proposed actions. CEQA does not specifically define what constitutes an "adverse effect" on a biological resource. Instead, lead agencies are charged with determining what specifically should be considered an impact.

1.5.2.2. California Fish and Game Code (FGC)

The California Fish and Game Code (FGC) regulates the taking or possession of birds, mammals, fish, amphibian and reptiles, as well as natural resources such as wetlands and waters of the state. It includes the California Endangered Species Act (CESA) (Sections 2050-2115) and streambed and lake alteration regulations (Section 1600-1616), movement of aquatic plants, as well as provisions for legal hunting and fishing, and tribal agreements for activities involving take of native wildlife.

In addition, Sections 3503, 3503.5, and 3513 of the FGC prohibit the “take, possession, or destruction of bird nests or eggs.” Section 3503 states: “It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.” Section 3503.5 provides a refined and greater protection for birds-of-prey and states: “It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto.” The distinctions made for birds-of-prey are the inclusion of such birds themselves to the protections and the elimination of the term “needlessly” from the language of §3503. Section 3513 states: “It is unlawful to take or possess any migratory nongame bird as designated in the MBTA or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Bird Treaty Act.”

The definition of “take” under the FGC is not distinct from the definition of “take” under CESA, which is defined as “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill” (FGC Code §86); however, it is important to note that the state definition of “take” again does not include a “harm and harassment” clause, and thus, activities or habitat modification in the vicinity of nesting birds that do not result in “take” as defined under the FGC/CESA are not prohibited.

1.5.2.3. Porter-Cologne Water Quality Control Act

This act is substantively the California version of the Federal CWA. It provides for statewide coordination of water quality regulations through the establishment of the State Water Resources Control Board (SWRCB) and nine separate RWQCBs that oversee water quality regulation on a day-to-day basis at the regional watershed basin level.

The RWQCB San Diego Region, under the SWRCB, regulates wastewater discharges to “waters of the State”, which is defined in section 13050(e) of the California Water Code as “any surface water or groundwater, including saline waters, within the boundaries of the State.” For waters of the State that are federally regulated under the CWA, the RWQCB must provide state water quality certification pursuant to Section 401 of the CWA for activities that may result in discharge of pollutants into WoUS.

1.5.2.4. California Coastal Act (CCA)

Under the CCA of 1976, the California Coastal Commission (CCC) regulates activities that would affect wetlands occurring in the California coastal zone through the CCA. The City has a certified Local Coastal Program (LCP), which covers the developed private lands within South Mission Beach and the adopted Mission Bay Master Plan Update covering lands within Mission Bay Park. The City has been delegated primary authority for implementation of the Coastal Act within Mission Beach under the Mission Beach Precise Plan and Local Coastal Program Addendum (June 26, 2017, Resolution R-311205). However, the Coastal Commission has retained jurisdiction within many parts of South Mission Beach as well as Mission Bay Park and the waters of Mission Bay. As a result, infrastructure projects that cross into and out of areas under LCP and CCC jurisdiction, such as drainage improvements contemplated under the WMP, would be permitted through a consolidated permitting approach within the Coastal Commission being the permitting agency for the entire project.

Section 30121 of the CCA defines "wetland" as: "lands within the coastal zone that may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats and fens." The CCC uses the same three criteria for defining wetlands as the USACOE (i.e., hydrophytic vegetation, hydric soils, and wetland hydrology); however, only one of the three criteria needs to be present for an area to be classified as a wetland. CCC jurisdiction extends beyond streambeds to include all tidal areas and isolated wetlands; however, jurisdiction is limited to areas within the coastal zone. The CCC wetland definition is generally more encompassing than the USACOE definition in most respects; however, the language of 14 CCR 13577(b) would suggest that, where conditions are not capable of supporting hydric soils or hydrophytic vegetation, hydrologic indicators of saturation or surface waters should be expressed on an annual basis (i.e., "at some time during each year"), not just under ordinary high water conditions as is the case under the federal regulatory standard. As a result, the CCA definition of wetlands would appear to be more limited than the federal act where no soil or vegetation indicators exist. Most particularly, the CCC generally does not consider beaches, devoid of hydrophytes or hydric soils, to be wetlands.

1.5.3. Local Regulations and Standards

The WMP project falls under the local land use authority of the City of San Diego. The City is charged with implementation of development controls under local ordinances and policies and adopted plans such as the Mission Bay Master Plan Update, Mission Beach Precise Plan and Local Coastal Program Addendum. The City is also mandated to meet state and federal obligations for water resources protection that are derived through the CWA. The City is charged with implementation of the Coastal Act within the limits of the Mission Beach Precise Plan. For the full project action, the City will be responsible for environmental evaluation of the project as the lead agency under CEQA and will issue a Site Development Permit for the project.

2.0 SURVEY RESULTS

2.1. Physical Characteristics

The BSA is located within Mission Bay Park on the coastal strand spit that separates Mission Bay from the Pacific Ocean. The BSA includes the dredged Mariner's Basin, and filled lands surrounding the basin that were both developed in the 1950s by hydraulic dredging of the active flood shoal near the mouth of False Bay. This was early in the development of the present day Mission Bay that was constructed predominantly by a relatively balanced dredging and filling of shallow bay, mudflats, and marshlands to construct uplands and deeper navigational basins.

Within the BSA soils have been coarsely mapped by the USDA Soil Conservation Service (2002). From west to east soils are mapped as coastal beaches along the ocean front fringe. The mapped soils underlay existing improvements in these areas. Urban lands dominate the core of the WMP project area of South Mission Beach. Within Mission Bay Park the lands are mapped as made land while the water of Mission Bay is mapped as lagoons of the San Diego area (Figure 3). As a footnote, the mapped interface between made land and urban land is close to, but not precisely at the shoreward limits of the historic dredge material fill placed to construct Mission Bay Park.

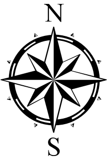
Regionally, the BSA is in the central coast ecoregion of San Diego County. The BSA is located in south Mission Bay, within the Penasquitos Hydrologic Unit/Watershed (Basin No. 4906) (Figure 4). Mission Bay is currently a dynamic low-flux sedimentary environment with sediment transport dominated by tidal and wave action. The main inputs of sediments into the bay are littoral sands entering the bay via the Mission Bay entrance channel, fluvial inputs from Rose Creek (to the north of Fiesta Island) and Tecolote Creek (to the east of Fiesta Island) as well as the San Diego River, and bay beach erosion resulting from wind, wave, and oceanic swell erosion. Other minor inputs include urban storm drains and atmospheric particulates. The main sediment outputs from the bay include tidal export out of the entrance channel, dredging, and shoal or beach reclamation activities. Patterns of accretion and erosion within Mission Bay are defined by a combination of geography and sediment sources, sediment characteristics, and bay hydrodynamics. The BSA is located in a generally well flushed area of Mission Bay with regular tidal circulation and muted oceanic swell entering Mariner's Basin as it is builds and is reflected within the Mission Bay entrance channel that passes through the southern portion of the BSA.

The elevation within the study area ranges from -25 feet NAVD29 within the deepest portions of Mariner's Basin and within the Mission Bay Entrance Channel to approximately +16 feet NAVD29 at the highest portion of the BSA on mounded park lands.

2.2. Biological Resources

The WMP project sites are located predominantly within urbanized land but extend into groomed recreational beaches and waters of Mission Bay. The predominant biological features within the study area are the active park lands and bay, however the BSA also includes a small area of the City's MHPA preserve that is defined as the Mariner's Point least tern nesting site .

The BSA holds eight mapped habitat types (Figure 5) within the approximately 200 acre area. The breakdown of habitats within the BSA by habitat type, area, and MSCP Tier as well as MHPA status is summarized in Table 3. The individual habitats are subsequently characterized.

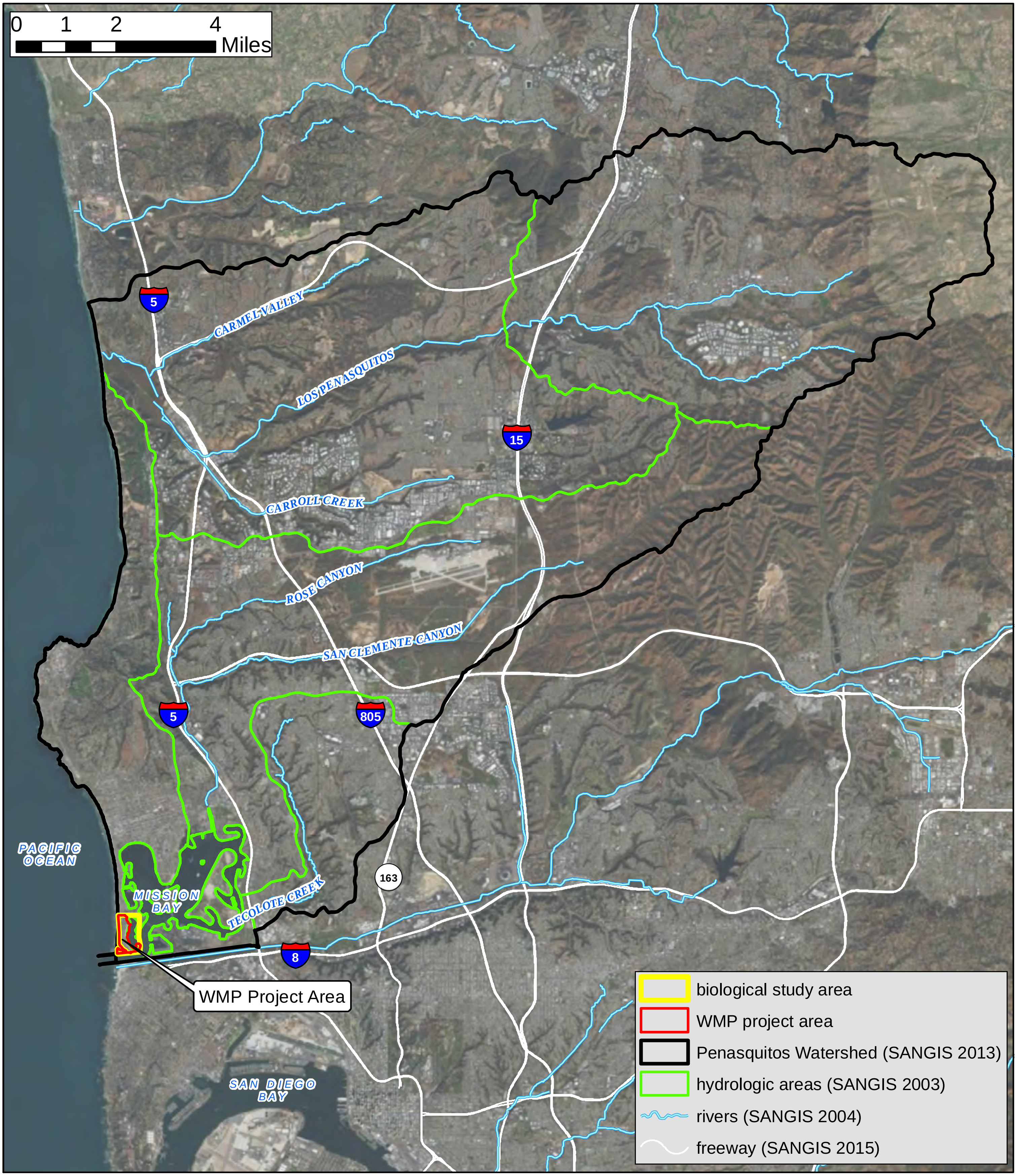


Soils Map

South Mission Beach Watershed Master Plan

Aerial Source: ESRI 2017

Figure 3



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Regional Watershed Map

South Mission Beach Watershed Master Plan

Aerial Source: ESRI 2017

Figure 4

Biological Resources & Jurisdictional Resources Map

South Mission Beach Watershed Master Plan

Aerial Source: ESRI 2017

Figure 5

Table 3. Biological Habitat Areas

Habitat/Vegetation Community	Holland/ Oberbauer Code	MSCP Tier; Habitat Type	Existing (acres)	City of San Diego *Inside MHPA*	City of San Diego *Outside MHPA*
Urban/Developed	12000	Tier IV	96.28	0	96.28
Supratidal Beach	64400		15.61		15.61
Mariners' Point Least Tern Nest Site	21230	Tier 1	2.39	2.39	0
Intertidal Beach	64000		22.51		22.51
Subtidal Soft Bottom	64122		52.13		52.13
Eelgrass Beds*	64122		5.58		5.58
Revetment	64122		4.59		4.59
Canopy Kelp Beds*	64122		1.05		1.05
Total:			**200.14**	**2.39**	**197.75**

*Dynamic habitat features that fluctuate interannually and seasonally.

2.2.1. Habitats

2.2.1.1. Urban/Developed – (Oberbauer 12000)

Urban/Developed lands within the BSA consist of the residential and commercial development areas of South Mission Beach, turfed parklands, parking lots and streets, and supratidal rip rap revetment. Within this habitat feature, hardscape is the dominant land cover and plants are limited and are either recreationally purposed turfs and trees, or part of horticultural landscaping. Native floristic species are uncommon and associated with landscaping rather than natural community assemblages. These areas of the BSA were not exhaustively investigated but rather characterized by aerial photograph inspection and brief drive through surveys of the neighborhood and developed parklands.

Wildlife species noted in this habitat consisted primarily of common urban associated species as well as species commonly found in nearshore coastal bay environments. Avian species observed included house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), mourning dove (*Zenaida macroura*), Anna's hummingbird (*Calypte anna*) and rock pigeon (*Columba livia*), and American crow (*Corvus brachyrhynchos*) throughout the BSA.

2.2.1.2. Supratidal Beach – (Oberbauer 64400)

A band of sand beach occurs around the shoreline of Mariner's Basin. The beach is bounded by manicured turf and walking paths. This habitat is heavily utilized for recreational purposes by visitors to Mission Bay. The supratidal beach is actively groomed by the City Parks and Recreation Department mechanized beach maintenance staff. The supratidal beach is unvegetated.

Within Mission Bay Park were additional more coastal associated species such as western gull (*Larus occidentalis*) and California gull (*Larus californicus*). While these species were observed on the beach area, they were relatively ubiquitous within the parklands including beach, turf, parking lot, and on the water.

2.2.1.3. Mariner's Point Least Tern Nesting Site – (Oberbauer 21230)

The Mariner's Point least tern nesting site is a continuation of the upland of Mission Bay Park that has been fenced off from public use and which is maintained by San Diego Audubon Society volunteers in conjunction with the City to serve as one of the four California least tern nesting sites in Mission Bay Park. The site could be alternatively considered southern foredune or supratidal beach. While activities have been undertaken to foster native dune vegetation such as *Camissonia cheiranthifolia suffruticosa*, *Ambrosia chamissonis*, *Abronia maritima*, and *Calystegia soldanella*, as well as the sensitive species *Lotus nutallianus*, the site vegetation has regularly been thinned to create a predominantly barren sandy environment suited to nesting use by least terns. The ongoing maintenance to foster dominance by native dune species, while maintaining open sandy conditions is the result of overly stabilized conditions that would ultimately convert to fully vegetated lands, should the nest site maintenance intervention cease.

The Mariner's Point Least Tern Nesting Site is not within the South Mission WMP project area, however it is within the BSA to provide context of proximity for purposes of impact discussions. While the Mariner's Point tern nesting site was not investigated during the present surveys, a breeding season video and acoustic monitoring effort was undertaken during 2017 within the site. During this monitoring, least terns (*Sterna antillarum browni*) and horned larks (*Eremophila alpestris*) were the most common avian species observed on the colony site (Merkel & Associates 2018).

2.2.1.4. Intertidal Beach – (Oberbauer 64000)

Intertidal beach occurs below the highest high tide along most of Mariner's Basin. The intertidal beach is predominantly unvegetated, however at the lowest margins of the beach, some eelgrass beds occur. These are discussed as a separate habitat feature. The lower portions of the intertidal beach provide loafing and foraging area for shorebirds and gulls; however, human disturbance along the shoreline prevents extensive use of this habitat by disturbance sensitive birds. Avian species observed along the sand beach and in shallow bay waters included western gull, California gull, and great egret (*Ardea alba*). Terns forage along the shallow margins of the bay within intertidal and subtidal areas. The California least tern forages in these areas when present in the Bay from about April through September.

2.2.1.5. Subtidal Soft Bottom – (Oberbauer 64122)

Below low tide, the sand beach transitions to subtidal sandy soft bottom that ultimately transitions to a mud bottom below the sandy basin slope. Subtidal soft bottom occurs from the lowest low tide down to -25 feet NGVD 29. Subtidal bottom habitat within Mariner's Basin is predominantly unvegetated, although eelgrass occurs in some areas as discussed separately. The basin supports patches of sea pens, some sand dollars, and mobile gastropods and echinoderms (sea stars and urchins). Demersal fish such as round ray (*Urobatis halleri*), bat ray (*Myliobatis californica*) are common on the floor of Mariner's Basin. Other species that are more common at the south end of the basin include California halibut (*Paralichthys californicus*).

The benthic sediments within Mission Bay support a broad range of infaunal and epifaunal organisms that vary depending upon the nature of the substrate and position within the Bay. In the sandier sediments, purple olive snail (*Olivella biplacata*), sea pansy (*Renilla koellikeri*), and moon snails (*Neverita lewisii*) are the visually dominant epifaunal species (Merkel 1988). In muddier conditions sponges, slender sea pen (*Stylatula elongata*), the solitary hydroid, *Corymorpha*, and the burrowing anemones (*Harenactis attenuata*) and tube-dwelling anemones (*Pachycerianthus fimbriatus*) are common. The mud bottoms typically show evidence of burrowing by macroinfaunal invertebrates such as bivalves (*Chione* spp., *Macoma nasuta*), the amphipod (*Grandidierella japonica*), and bay ghost shrimp (*Callianassa californiensis*). The non-native bryozoan (*Zoobotryon verticillatum*) is seasonally encountered in both unvegetated as well as vegetated portions of the bay floor.

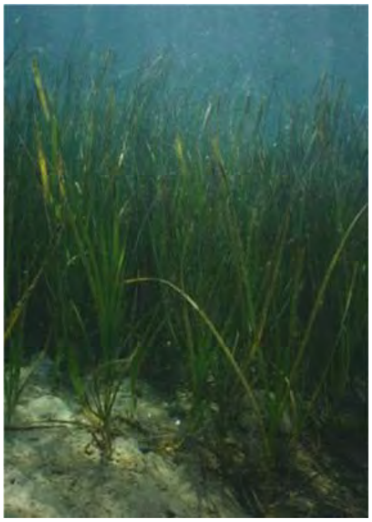
Fish that are regularly observed on the unvegetated bottom are principally demersal fish of warm water embayments and include round stingray (*Urobatis halleri*) and bat ray (*Myliobatis californica*), barred sand bass (*Paralabrax nebulifer*), gobies (Family Gobiidae), and specklfin midshipman (*Porichthys myriaster*). In the more westerly portions of the Bay, the unvegetated bottom often supports California halibut (*Paralichthys californicus*) and other flat fish such as diamond turbot (*Hypsopsetta guttulata*) which become less prevalent further into the bay.

Avian species that are commonly present in these subtidal environments include gulls as well as fish foraging species such as double-crested cormorants (*Phalacrocorax auritus*), western grebe (*Aechmophorus occidentalis*), and California brown pelican (*Pelecanus occidentalis californicus*).

2.2.1.6. Eelgrass Beds – (Oberbauer 64122)

Eelgrass vegetated habitats are an essential component of southern California's coastal marine environment. Eelgrass beds function as important habitat for a variety of invertebrate, fish, and avian species and are considered to be a Habitat Area of Particular Concern (HAPC) within Essential Fish Habitat (EFH) designated under the Magnuson-Stevens Act.

For many species, eelgrass beds are an essential biological habitat component for at least a portion of their life cycle, providing resting and feeding sites along the Pacific Flyway for avian species, and nursery sites for numerous species of fish. Typical eelgrass associates include pipefish (*Syngnathus* spp.), kelpfish (Family Clinidae), and surfperch (Family Embiotocidae), as well as schooling fish such as topsmelt (*Atherinops affinis*) and anchovy (*Anchoa* spp.).



Eelgrass (*Zostera marina*) in habitat typically found in shallow waters of Mission Bay

Eelgrass is present on the shallow fringes of Mariner's Basin where slopes are gentle. The basin supports two species of eelgrass. The common eelgrass (*Zostera marina*) is found throughout the basin, while Pacific eelgrass (*Zostera pacifica*) is found in deeper waters at the mouth of Mariner’s Basin. Results of the baseline eelgrass survey completed in 2018 indicate wide distribution of eelgrass at the southern end of Mariner’s Basin and much less common eelgrass at the northern end of the basin (Figure 5).

Eelgrass bed spatial and density metrics from the 2018 investigations are summarized in Table 4. Eelgrass occurs between -3 ft NGVD29 and -19 feet NGVD29 with dense beds being limited to elevations above -13 feet NGVD29.

Table 4. Eelgrass Bed Metrics as defined under the CEMP (July/August 2018).

Eelgrass Spatial Metrics	**Spatial Distribution**	**Eelgrass Areal Extent**	**Vegetated Cover**	**Percent Vegetated Cover**	**Depth Range**
Survey Area	100,780 m^2	34,856 m^2	27,803 m^2	79.8%	0 to -16 ft MLLW
Eelgrass Density Metrics	**Bonita Cove**	**Central Mariner's Basin**	**Mission Cove**	**Mariner's Basin Entrance**	**Mission Bay Channel**
Region Densities	138.4±33.4 (n=20)	111.2±33.8 (n=20)	205.6±78.6 (n=20)	140.8±59.1 (n=20)	164.8±64.6 (n=20)
Average Density	152.2±64.1 (n=100)				

Within the survey area, eelgrass consists of scattered fringing beds along the shoreline of the basin and isolated eelgrass plants on the deeper floor of the basin near the better flushed southern end of the basin. The steep beach drop along most of Bonita Cove and the shorelines of the western and eastern margins of Mariner’s Basin generally restrict eelgrass occurrence to areas where the gradual slope of the shoreline continues below the -3 ft NGVD29 elevation prior to increasing slope steepness to the bottom of the basin. In areas where the slope breaks above -3 feet, eelgrass is generally not present. While the majority of the eelgrass present within the study area is common eelgrass (*Z. marina*), Pacific eelgrass (*Z pacifica*) was observed within Mariner's Basin Entrance and at a few locations within the Mission Bay Channel south of the West Mission Bay Drive Bridge.

Eelgrass was determined to be healthy throughout all of the beds, though some evidence of wasting disease blemishes were observed on the leaves within the Mission Cove beds. Epiphytic loading ranged from approximately 20 percent to 80 percent throughout the survey area, with the heaviest loading being observed within Mariner's Basin Entrance. Light sedimentation was observed within the Central Mariner's Basin beds, while all other beds were free of sedimentation. The eelgrass leaf canopy extended from 0.1 to 0.9 meters off the bottom.

In addition to the summer 2018 surveys, since 1988 the City has conducted recurrent baywide eelgrass surveys to document the distribution of eelgrass both as an important natural resource with its own merits, but also as a means to track the overall health of the bay as a widely distributed simple metric of water quality properties including turbidity, dissolved oxygen, suspended sediments, plankton blooms, and temperature. Over the past three decades, six baywide surveys have been conducted in 1988, 1992, 1997, 2001, 2007, and most recently in 2013 (K. Merkel 1988, 1992, Merkel & Associates 2013). For the baywide surveys, eelgrass has historically been mapped as multiple cover classes on the bay bottom (i.e., <25%, 26-50%, 51-75%, and 76-100%). For multi-year statistics, the bottom cover classes have been pooled. The baywide surveys have revealed highly variable extents of eelgrass ranging from a low of 856.0 acres in 2007 to a high in 1997 of 1,306.6 acres (M&A 2013). Due to its deep dredged nature and steep subtidal slopes, Mariner's Basin has supported relatively limited fringing and often patchy eelgrass throughout the 30 year survey history.

2.2.1.7. Intertidal and Subtidal Revetment – (Oberbauer 64122)

Quarried rip rap revetment is located along the Mission Bay Entrance and Main Channel and wrapping into Mariner's Basin at Mission Point. This stone is unvegetated within the upper supratidal margins and is considered urban/developed lands. Within the intertidal and subtidal zones, the rock supports a host of mobile and sessile invertebrates and macroalgae. Within the highest intertidal areas, mobile organisms consisting of amphipods (Family Talitridae) and lined shore crabs (*Pachygrapsus crassipes*) are the most common species. At lower elevations, barnacles (*Balanus*, *Chthamalus*, and others) are common. In subtidal environments, macroalgae dominates the rock. The introduced *Sargassum muticum* is the most common algae, however the rock also supports a host of folios, turf, and encrusting native algae. At deeper elevations, sessile invertebrates become more common as the algae begins to thin out due to light limitation and sand scour.

Birds present along the reveted shoreline include California brown pelican, double-crested cormorant, and western gulls.

2.2.1.8. Canopy Kelp – (Oberbauer 64122)

In addition to the marine algal community that dominates the subtidal revetment along the Mission Bay Entrance Channel, a short section of the revetment within the study area has a flatter relief and scattered rock that extends away from the shoreline. This area supports a small and relatively ephemeral giant kelp (*Macrocystis pyrifera*) bed that is attached to rocks at the base of the revement and those that have been dislodged and scattered into the channel at the toe of the revement. This kelp bed does not extend up the steeper revetment into the shallower portions of the subtidal or intertidal margin and thus is not directly within the WMP project area. In January 2019 this canopy kelp was not noted, however it was present in July 2018.

2.2.2. Jurisdictional Waters

Under federal standards, all three parameters must be present under normal circumstances to be determined a wetland. Because of the high degree of disturbance on the site and the presence of clean and well drained sands that tend not to support terrestrial vascular hydrophytic vegetation, the BSA lacks both hydrophytic vegetation and hydric soils. For this reason, no federal wetlands are present on site. The limits of jurisdictional waters are therefore defined by the HHT (Clean Water Act section 404 and 401), and the MHW (R&HA section 10) as defined by elevational metrics described previously.

2.2.3. Rare, Threatened, Endangered, Endemic and/or Sensitive Species or MSCP-Covered Species

Species identified as protected, rare, sensitive, threatened or endangered by the United States Fish & Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), or CDFW that may be expected in the project area at various times include three bird species, and two marine mammals (Table 5). All of these species are known in the area but the relative occurrence frequency varies.

Table 5. Special Status Species Observed or Expected to Occur within the Study Area

Common Name	Scientific Name	Status	Occurrence at Project Site
California Brown Pelican	*Pelecanus occidentalis californicus*	CDFG FP	Common
Double-crested Cormorant	*Phalacrocorax auritus*	CDFG WL	Common
California Least Tern	*Sternula antillarum browni*	SE, FE	Regular seasonal
Harbor Seal	*Phoca vitulina*	MMPA	Very uncommon
California Sea Lion	*Zalophus californianus*	MMPA	Uncommon
Bottlenose Dolphin	*Tursiops truncates*	MMPA	Very Uncommon
Green Sea Turtle	*Chelonia mydas*	FE	Rare

SE – State Endangered; **FE**- Federally Endangered; **FT** – Federally Threatened; **CDFW SSC**- CDFW Species of Special Concern; **CDFW-FP** – CDFW Fully Protected Species; **CDFW-WL**- CDFW Watch List; **MMPA** – species protected by the Marine Mammal Protection Act

*Least terns are a migratory species found in the area from April 1 through approximately September 1 of each year.

2.2.3.1. Sensitive Birds

California brown pelican (*Pelecanus occidentalis californicus*) and double crested cormorant (*Phalacrocorax auritus*) are protected at nesting locations and communal roosts. No nesting locations or roosts for these species are found within the BSA, however a communal roost is located on the Misson Bay Channel groin extending out from Hospitality Point, located about 1,000 feet across the channel from the BSA. As a result of the proximity of the roosting area and the presence of highly available forage resources near the mouth of the bay, both pelicans and cormorants are fairly common within the waters of the BSA.

California least terns (*Sternula antillarum browni*) do forage within the project area during summer months. The nearest least tern nesting colonies is located within the BSA at Mariner's Point. This species makes opportunistic use of the bay shallows to forage for small fish.

2.2.3.2. Sensitive Mammals

Other special status species that occur on the study area include marine mammals. Most specifically these are two pinniped species, California sea lion (*Zalophus californianus*) and the much less common harbor seal (*Phoca vitulina*) and one cetacean, the bottlenose dolphin (*Tursiops truncates*). Disturbance of these species is prohibited under the Marine Mammal Protection Act (MMPA).

California sea lion feed on squid and a variety of schooling fish. They are year round residents of Mission Bay and are regular residents in the outer bay with the highest aggregations of animals being found around the bait barge in Quivira Basin, along the south Mission Bay jetty, and following fishing boats into Dana Basin where they are fed bait and fish carcasses from boats using the Dana Landing ramp. Sea lions are more diffuse elsewhere in the westerly most portion of the bay up to about West Mission Bay Drive Bridge and along the Mission Bay Channel towards Dana Basin. Sea lions are rare elsewhere in the bay. Within proximity to the BSA, sea lions haul out on rocks at the Quivira Basin breakwater and on the Mission Bay entrance channel jetties. There are no rookeries or major haul-out locations within Mission Bay. While they do not have any habitual use areas within the BSA, sea lions numbering one or two individuals at a time do make foraging forays into Mariner's Basin on occasion. As such, they are considered to be uncommon visitors to the project area.

The harbor seal prefers sheltered coastal waters and feeds on schooling benthic and epibenthic fish in shallow waters. Being generally less disturbance tolerant than sea lions, harbor seals are far less common in Mission Bay. However, this species is rarely observed in the westerly portions of Mission Bay. Seal strandings have occurred in Mission Bay, but otherwise seals rarely leave the water in Mission Bay Park. There are no specific areas of the bay where seals are common and within in the project area, seals would be expected to be very uncommonly encountered and transitory in its occupancy of the area.

Bottlenose dolphins are commonly observed in the northern portion of San Diego Bay, particularly in the northern channels, however this species is much less common in Mission Bay. This species tends to stay within relatively deep channels where prey is most abundant and follows schools of bait fish. As a result, low dolphin occurrence in Mission Bay is somewhat driven by low entry of schooling pelagic fish into the bay. Bottlenose dolphins are considered to be rare visitors to inner Mission Bay, however due to the presence of a portion of the BSA extending over the Mission Bay Entrance Channel where dolphin occurrence may be more common.

2.2.3.3. Sensitive Turtles

The final sensitive species in the BSA is the green sea turtle (*Chelonia mydas*). The Mexican Pacific coast breeding population, to which the San Diego turtles belong, is federally listed as endangered. Green sea turtles are herbivores, feeding primarily on algae and eelgrass (*Zostera marina*). Mission Bay does not presently support an established resident population of turtles. Historically turtle were reported from Mission Bay in newspaper accounts from 1872 through 1903, but reports in the San Diego area disappeared until the 1960s when they were again reported in San Diego Bay (Stinson 1984). In recent years, green sea turtles have been observed more regularly in various southern California bays and estuaries than in the past several decades. While the increase in turtle presence is not fully understood, acoustic tracking of turtles has aided in the understanding of turtle movements along the southern California coast and tracking of turtle stranding events by NOAA has further enhanced understanding of turtle distribution, although stranding data can provide a biased picture of distribution patterns as it tends to track sick and injured animals that may not exhibit normal distribution patterns or behavior.

Within Mission Bay, NMFS has provided data for turtle strandings since 1950 (Dan Lawson, email transmittal 2017). These data indicate 8 reported strandings including 2 live turtles and 6 deceased turtles. In addition, a report of an additional turtle was made by a fisherman in 2016 (Alan Monji, RWQCB, pers. comm.). Of the turtle reports, three have been in the main Mission Bay channel near the inlet to Mariner's Point within the past several years. In addition, SeaWorld of San Diego has conducted green turtle rescue, rehabilitation, captive rearing, and releases through time. While SeaWorld's facilities are located on Mission Bay, none of the turtles released have been released into Mission Bay. Most recently SeaWorld released 15 turtles offshore in July 2016 from eggs hatched at SeaWorld in 2009. These turtles were identified by PIT tags and were fitted with satellite tags. While most of the released turtles never returned, Dan Lawson, NMFS, reported that he is "generally aware that at least 2 of the green turtles released by SeaWorld in 2016 with a satellite tag on it did appear to visit Mission Bay during the fall of 2016". Based on the information available, it is anticipated that turtles could occur within the BSA on rare occasions.

2.3. Wildlife Movement and Nursery Sites

The WMP project area within Mission Bay is not considered to be wildlife movement areas. While migratory birds make use of Mission Bay as part of their migration, the majority of the bird use by migratory birds is within areas around the Northern Wildlife Preserve at the north end of the bay and the Southern Wildlife Preserve in the San Diego River Flood Control Channel where animals are able to rest and forage with less harassment pressure than within the recreational areas of the bay where the project sites are centered.

Eelgrass is considered to be an important nursery habitat for several fish species and is considered to be Essential Fish Habitat (EFH) and a Habitat Area of Particular Concern (HAPC) under the Magnuson-Stevens Fisheries Conservation and Management Act, as well as a Special Aquatic Site under the Clean Water Act. While eelgrass habitat is considered to provide important nursery functions, there are no unique nursery functions believed to be associated with the eelgrass that may be impacted by the project over other eelgrass habitat in Mission Bay. This nursery function is one aspect of eelgrass beds that lead to the determination that impacts to eelgrass habitat would be significant without mitigation.

3.0 BIOLOGICAL IMPACT ANALYSIS

State CEQA Guidelines §15065 (a) (Title 14, Chapter 3, Article 5) states, "A project may have a significant effect on the environment" if:

- "The project has the potential to substantially degrade the quality of the environment; substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; substantially reduce the number or restrict the range of an endangered, rare or threatened species; or eliminate important examples of the major periods of California history or prehistory."
- "The project has possible environmental effects, which are individually limited but cumulatively considerable."

The following analysis identifies potential impacts to biological resources that could result from implementation of the proposed project, and addresses the significance of these impacts pursuant to CEQA, in accordance with the Issues listed under CEQA Guidelines Appendix G, Section IV.

3.1. <u>Impact Definitions</u>

Project impacts are categorized pursuant to CEQA as direct, indirect, or cumulative impacts.

- CEQA Guidelines §15358 (a) (1) and (b) (Title 14, Chapter 3, Article 20) defines a "direct impact or primary effect" as "effects, which are caused by the project and occur at the same time and place" and relate to a "physical change" in the environment.
- CEQA Guidelines §15358 (a) (2) and (b) (Title 14, Chapter 3, Article 20) defines an "indirect impact or secondary effect" as "effects, which are caused by the project and are later in time or farther removed in distance, but are still reasonably foreseeable" and relate to a "physical change" in the environment.
- CEQA Guidelines §15355 (Title 14, Chapter 3, Article 20) defines "cumulative impacts" as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts."

Direct, indirect, and cumulative impacts can be described as either permanent or temporary. Permanent impacts are generally defined as effects that would result in an irreversible loss of biological resources; temporary impacts can be defined as effects that could be restored, thus providing habitat and wildlife functions and values effectively equal to the functions and values that existed before the area was impacted.

3.2. <u>Mitigation Definitions</u>

CEQA Guidelines §15370 (Title 14, Chapter 3, Article 20) defines "mitigation" as:

- "Avoiding the impact altogether by not taking a certain action or parts of an action."
- "Minimizing impacts by limiting the degree or magnitude of the action and its implementation."
- "Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment."

- "Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action."
- "Compensating for the impact by replacing or providing substitute resources or environments."

3.3. Project Impacts, Significance, and Recommended Mitigation

Potential project impacts were evaluated based on examination of the proposed project within the context of the biological resources documented during the field survey and those biological resources assessed as having a likely potential to occur in the project area. Direct impacts were determined by overlaying the project plans on the mapped vegetation communities/habitats in GIS ESRI software platforms. Indirect impacts were determined based on the design, intended use, and location of the proposed project elements relative to biological resources.

3.3.1. Habitats/Vegetation Communities

Implementation of the proposed project would result in permanent and temporary direct impacts to terrestrial and submerged habitats identified within (Table 3; Figure 5).

3.3.1.1. Terrestrial Habitats

Within the terrestrial habitats of urban/developed and supratidal beach, the implementation of the WMP is anticipated to result in temporary impacts since the majority of the WMP facilities are subsurface. Impacts in these areas would also be to low sensitivity habitat types. As such, they are considered to not result in significant impacts.

3.3.1.2. Intertidal and Subtidal Habitats

Intertidal and subtidal habitat impacts are similarly anticipated to be principally temporary in nature; however storm drain systems outlet removals and replacements are expected to result in permanent features in the subsurface environment while eliminating similar features within the intertidal beach environment. Repairs and retrofit of existing outlets in the existing rip-rap revetment are expected to result in limited and temporary impacts around the drains themselves. Typically the fish and invertebrate communities in soft bottom bay environments recover rapidly following impacts from sediment disturbance (Merkel & Associates 2009).

The effects of extending drain outlets to lower discharge points would reduce the sand migration from intertidal to subtidal areas by elimination of the flow gradients across the intertidal beach. This would be expected to reduce the beach maintenance requirements within the intertidal areas and reduce infill of subtidal portions of Mariner's Basin. It would also result in a long-term reduction in impacts to eelgrass habitat as a result of sand overrun of eelgrass and raising of the shallows that typically support eelgrass to elevations that are too high to support continued eelgrass presence due to desiccation stress.

Notwithstanding long-term reduction in eelgrass impact anticipated as a result of extension of the drains to subtidal elevations, the initial construction of the drains is expected to result in temporary impacts to eelgrass within the construction corridor through which the drains are extended. Eelgrass impacts are regulated under federal, state, and local regulatory programs and mitigation of impacts are subject to the adopted California Eelgrass Mitigation Policy (CEMP) (National Marine Fisheries Service 2014). Except under particular unique circumstances, the CEMP requires in kind eelgrass mitigation in southern California to be implemented by planting at not less than 1.38:1 at a planting to impact ratio and that not less than 1.2:1 mitigation to impact be achieved from the restoration efforts. Impacts and mitigation needs are estimated during the environmental review and permitting phases of project development and authorization. However, the ultimate impact determination, and subsequent mitigation required is determined at the time of project implementation through the use of pre-construction and post-construction eelgrass surveys coupled with evaluation of natural variability by coincident assessment of change within an unaffected reference site(s).

Because the details of the drain extensions remain to be developed through engineering design, an assumption has been made that temporary coffer dams would be placed around the drain extension alignment into the Bay. For analysis purposes, a very conservative cofferdam work area of 100 feet in width has been applied for analysis purposes. By applying this assumption of eelgrass impacts, it has been determined that the project may result in impacts to approximately 0.22 acre of eelgrass as a result of construction activities. The areas within the construction zone would be restored to sandy intertidal and subtidal slopes suitable to support eelgrass. Subsequently, eelgrass would be restored within the impact area. Because eelgrass within the impact area is very limited, the flattening of the subtidal slope around the storm drains will allow for an expansion of suitable habitat to support eelgrass and mitigation in accordance with the CEMP is expected to be possible within Mariner's Basin in association with the project implementation. Impacts to eelgrass are considered to be significant and requiring of mitigation in accordance with preliminary mitigation measure BIO-1.

BIO-1: Mitigation of any unanticipated impacts to eelgrass would be conducted in accordance with the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014). Under this policy any eelgrass impacts would require successful mitigation at a 1.2:1 replacement ratio through transplant of a minimum ratio of 1.38:1. However, should mitigation be derived from existing established mitigation banks, the applicable ratio would be 1:1 for any impacts. At the present time, mitigation is anticipated to be achieved on-site within Mariner's Basin. A mitigation and monitoring plan to support this mitigation measure shall be prepared and made part of the site development permit and is anticipated to be incorporated into federal and state permitting as well.

The work on the revetment outlet storm drains (120003 and 120006) is limited to the repair of a broken pipe and replacement of the duck bill valve on drain 120003. This will require minor rock disturbance at the drain and replacement of the rock after the repairs are made. The activities will have a localized and temporary impact on intertidal algae and invertebrate communities at the repair location. The activities are to be performed shoreward of the existing kelp habitat and would not be expected to effect the kelp habitat. This impact is not considered to be biologically significant and would not require mitigation.

3.3.2. Jurisdictional Resources

The proposed work would extend storm drains that presently terminate within the intertidal zone within jurisdictional non-wetland waters further to subtidal elevations within the same jurisdictional waters. Some drains would be relocated and consolidated and one new drain would be added. These activities would impact existing jurisdictional waters through temporary cofferdam containment construction and dewatering.

Conversely, the repositioning of storm drain outfalls below the intertidal zone would result in a reduction of beach erosion and sediment transport into the basin. This would have the benefits of reducing the extent and frequency of eelgrass losses and it would reduce the infill of sand into the navigation areas of Mariner's Basin. As a result, the temporary impacts would be offset by permanent improvements and impacts would not be considered significant from a CEQA standpoint. However, regulatory approvals for work within waters are required from the Army Corps of Engineers, California Coastal Commission, Regional Water Quality Control Board, and the City itself. Therefore mitigation measure BIO-2 has been incorporated to ensure that applicable federal, state, and local permits are obtained for the work.

BIO-2: Prior to implementation of the project, the following permits and approvals shall be obtained, or it shall be demonstrated to the Development Services Department that such approvals are not required:

A) A R&HA Section 10 for work in traditionally navigable waters of the U.S.,

B) A CWA Section 404 for discharge of dredged or fill material within waters of the U.S.,

C) A CWA Section 401 state water quality certification for an action that may result in degradation of waters of the State, and

D) A CDP issued by the California Coastal Commission.

3.3.3. Special Status Species Impacts

There were no sensitive species observed within the project sites during the field surveys. The BSA is expected to potentially be intermittently and uncommonly used by marine mammals and rarely used by green sea turtles during the period of work. Marine mammals and turtles may be adversely affected by noise generated within the water as a result of pile driving activities.

For marine mammals, NMFS published technical guidance on sound characteristics that are likely to cause injury in the form of permanent hearing threshold shifts (PTS) and temporary threshold shifts (TTS) resulting in behavioral disruption which would be considered "take" in the context of the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) (NMFS 2018). Under the current guidance, bottlenose dolphin, a mid-frequency cetacean is expected to experience the onset of PTS with impulsive (e.g., impact hammering) is expected at peak sound pressure levels of 230 dB re: 1 µPa or 185 dB re: 1µPa^{2}s for cumulative sound exposure level (SEL$_{cum}$) over a 24 hour period. Exposure to non-impulsive sounds (e.g. vibratory pile driving) is expected to result in onset of PTS at 198 dB re: 1µPa^{2}s. For Phocid pinnipeds, including harbor seal, the onset of PTS is expected with impulsive peak sound pressure levels of 218 dB re: 1 µPa or 185 dB re: 1µPa^{2}s SEL$_{cum}$. Sound levels resulting in the onset of PTS from non-impulsive underwater noise are assumed to be 201 dB re: 1µPa^{2}s. For Otariid pinnipeds, including the California sea lion, the onset of PTS is expected with impulsive peak sound pressure levels of 232 dB re: 1 µPa or 203 dB re: 1µPa^{2}s. Sound levels resulting in the onset of PTS from non-impulsive underwater noise are assumed to be 219 dB re: 1µPa^{2}s (NMFS 2018). For non-impulsive sound the TTL onset for the bottlenose dolphin is taken to be 178 dB SEL$_{cum}$, that for the harbor seal is taken as 181 dB, and that for the sea lion is 199 dB (NMFS 2018). For in-water noise generation, the current acoustic thresholds of PTS have been applied for marine mammals harassment includes Level A take with the potential for injury and the TTS has been applied for Level B take that may result in behavioral disruption but not injury.

Other marine species of high concern may also be impacted by in water noise. These include green sea turtles. Green sea turtles would be rarely expected to occur near the project area; however, should they be present at any time, they may be potentially exposed to construction related hydroacoustic impact. NMFS has not established specific in-water acoustic thresholds for green sea turtles; however, the U.S. Navy, in coordination with NOAA, developed standards for assessment of sound impacts to turtles for purposes of the Hawaii-Southern California Training and Testing Final EIS/OEIS (U.S. Navy 2013). The document examined sound effects and sea turtle physiological literature in developing criteria for non-impulsive and impulsive noise sources. For sea turtles, the Navy established a threshold for injury from vibratory pile driving and impact driving at 190 dB_{rms}. Behavioral effects thresholds were noted to be more complex to establish than injury as there is limited data on turtle behavioral response to sound. In review of the literature, the lowest sound intensity stimulus that resulted in a behavioral response was 166 dB_{rms} that resulted in increased swimming activity in caged green and loggerhead sea turtles (McCay et al. 2000, as reported in U.S. Navy 2013). However, it also appears from the literature that turtles become habituated to repeated exposures to sound. Under such circumstances, noises even as high as 179 dB_{rms} were tolerated by turtles without behavioral response when exposure became regular (Moein Bartol et al. 1995, as reported in U.S. Navy 2013). Based on the available information, behavioral response by turtles to environmental ensonification is triggered at higher sound intensities than for marine mammals. Further, turtles exhibit a low frequency hearing range typically below 2kHz such that higher frequency sounds (such as from sonar) are generally omitted from audiologic sensors and thus would not be expected to result in behavioral response (U.S. Navy 2013). As a result, the potential for behavioral response to sound is further limited to sounds at both elevated intensity and low frequency. For the present analysis, the lower noise exposure level of 166 dB_{rms} has been adopted.

In 2008, NOAA Fisheries, USFWS, CDFW, and transportation agencies of California, Oregon, and Washington agreed to assess project effects using Interim Criteria for Injury to Fish from Pile Driving Activities (Fisheries Hydroacoustics Working Group 2008). The interim criteria for assessment included both peak noise levels and accumulated sound exposure levels for impulse noise. No exposure levels were developed for non-impulsive sound. The interim criteria for fish were generally developed for endangered salmonids and are considered to be conservative indicating that the criteria are based on a potential for effect rather than a likelihood of effect. It should be noted that while the current interim criteria have not been replaced and stand as the only adopted standards, they were widely criticized at the time of adoption for being too conservative and not based on the best available science at the time (Carlson et al. 2007). Presently, there is considerable quantitative study data that suggests that for physiological effects the cumulative exposure thresholds are lower than necessary to be protective. In studies of the effects of pile driving on the onset of physiologic injury to Chinook salmon (Halvorsen et al., 2011a, b) and other species (Casper et al. 2011a) studies, demonstrated that an SEL_{cum} below approximately 207 dB re $1\mu Pa^2 \cdot s$ do not result in the onset of injury and that SEL_{cum} as high as 210 dB re $1\mu Pa^2 \cdot s$ produced physiological effects that were considered by the researchers as inconsequential. While the interim criteria remain the standard against which the present project is analyzed, it is important to acknowledge the extremely conservative nature of the thresholds as relevant to their establishment in the context of the "may affect" standard of the Endangered Species Act and has principally been used as a standard for consultation when endangered fish species are involved. However there are no endangered fish in Mission Bay.

A multitude of noise metrics may apply to the assessment of significant effects to wildlife from in water sound generation depending upon the organism exposed and the nature of the sound to which the animal is exposed. It is anticipated that steel sheetpiles will be driven for cofferdam containment of the construction area. It is further anticipated that of the driving will be conducted using vibratory hammer. The in-water sound generation from temporary sheet piles driven into the sandy sediment environment in shallow water is expected to be relatively low. To estimate sound generation, data were derived from the Caltrans hydroacoustic compendium for a similar cofferdam at Ten Mile River Bridge in Fort Bragg. Here construction of the cofferdams consisted of driving four H-piles and a series of 2-foot-wide steel sheet piles using a vibratory pile driver with no sound attenuation. Underwater noise levels were measured during installation of sheet piles. The peak sound pressure levels in water at 10 meters from the sound source ranged from 170 dB (re: 1µPa) to 174 dB and the root mean squared (RMS) sound levels in water ranged from 140 dB_{rms} to 142 dB_{rms} (Caltrans 2015).

However, sound impacts are accumulated over time from non-impulsive sound sources. For this reason, it is necessary to estimate the duration of sound generation from vibratory pile driving during any given 24 hour period. For the present project, a high number of 40 interlocking 24-inch sheet piles has been assumed to be driven in a single day with an estimated 10 minute per pile drive time being employed. This results in an estimated pile driving of 6.7 hours during a single day. Given construction activities being limited to a period from 7am to 7 pm this would result in pile driving for 55.5% of the available work day. This is expected to be a very high estimate of driving time. With the noise level and duration of driving the accumulated SEL can be calculated and the distance from the noise source at which sound exposure thresholds considered to impact organisms can be determined. This has been done with the results expressed as isopleth distances from the pile sound sources at which thresholds will be exceeded (Table 6). Note that no thresholds for non-impulsive sound have been set for fish.

Table 6. Impact Distance from Vibratory Pile Driving for Mammals and Turtles

Species	Acute Exposure (peak sound)		Continuous Exposure (SEL)	
	Distance (m) Physical Impacts	Distance (m) Behavioral Impacts	Distance (m) Physical Impacts	Distance (m) Behavioral Impacts
Bottlenose Dolphin	NA	NA	0.1	2.2
Harbor Seal	NA	NA	0.8	4.3
California Sea Lion	NA	NA	0.1	1.3
Green Sea Turtle	NA	NA	0.1	6.4

From Table 6, it is clear that with the type of piles anticipated to be driven to support cofferdam construction assuming vibratory driving, there is no expection of acoustic impact from peak sound levels to any resource for either behavioral or physical injury type impacts. For continuous sound exposure, the distances to the piles at which sound impacts would occur from chronic exposure would be too short to expect animals to remain adjacent to the work for the entire duration of pile driving activities. For this reason, no significant hydroacoustic impacts are anticipated in association with the sheet pile cofferdam construction.

Sensitive bird species that occasionally occur in the project site are the California brown pelican, double-crested cormorant, and California least tern. As discussed above, no nesting sites or communal roosts for California brown pelican or double-crested cormorant occur within or adjacent to the project area. These two species are only occasional visitors to the project area. However, both species are fish foragers (California brown pelican forages from the air, and double-crested cormorant dives from the water). Work is expected to be short-term and localized, although mobile as work progresses. Work would affect only a small area of the bay at any given time. As a result, and based on these factors, impacts of the proposed project on California brown pelican and double-crested cormorant are not considered to be significant.

California least tern nests within Mission Bay (with the closest nesting sites being at Mariner's Point. The proposed work would include driving of sheetpiles via vibratory placement and then dewatering inside of the sheet pile cofferdam to allow work in the dry. This would result in minimal turbidity generation and no impact driving that may result in both sharp noise and vibration at the tern nest site. As a result of the use of vibratory driven cofferdams no significant impacts to least tern nesting activities are anticipated to occur from the proposed work.

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Appendix D. – Integrated Projects

Project Info			Existing Condition									Recommended Condition									Asset Cost				Projects	
			Dimensions									Dimensions														
FacilityID	InletFacID	OutletFacID	D' (diameter)	H' (height)	B' (width)	Barrels	Shape	Material	Q100 (cfs)	Q vs Qcap (100-yr)*	D' (diameter)	H' (height)	B' (width)	Barrels	Flapgate	Shape	Material	Q100 (cfs)	Q vs Qcap (100-yr)*	FacCosts	ConstCost	Length (ft)	RecStatus	ProjID	ProjCost
220001	90020	90001	1	0	0	1	CIRCULAR	RCP	3.18	0.75	2	0	0	2	NO	CIRCULAR	RCP	23.14	0.61	$ 27,767	$ 43,038	63	Replace	IP-120001	$ 10,096,391
220003	110004	120001	1.25	0	0	1	CIRCULAR	RCP	5.06	1.75	2.5	0	0	2	YES	CIRCULAR	RCP	49.3	0.39	$ 165,995	$ 257,292	415	Replace	IP-120001	$ 10,096,391
220012	90001	90025	1	0	0	1	CIRCULAR	RCP	3.83	1.35	2.5	0	0	2	NO	CIRCULAR	RCP	47.41	1.01	$ 138,906	$ 215,304	347	Replace	IP-120001	$ 10,096,391
220024	90021	110006	1	0	0	1	CIRCULAR	RCP	7.98	2	1.5	0	0	1	NO	CIRCULAR	RCP	3.4	0.44	$ 17,005	$ 26,357	94	Replace	IP-120001	$ 10,096,391
220025	110005	120005	1.25	0	0	1	CIRCULAR	RCP	4.45	0.75	1.5	0	0	1	YES	CIRCULAR	RCP	1.02	0.04	$ 50,343	$ 78,032	280	Replace	IP-120001	$ 10,096,391
220030	110006	120002	1.75	0	0	1	CIRCULAR	CMP	7.98	0.86	1.5	0	0	1	NO	CIRCULAR	RCP	3.31	0.68	$ 33,751	$ 52,315	188	Realigned	IP-120001	$ 10,096,391
220031	90008	120004	1.25	0	0	1	CIRCULAR	RCP	2.57	0.31	1.5	0	0	1	YES	CIRCULAR	RCP	2.57	0.12	$ 68,845	$ 106,710	382	Replace	IP-120001	$ 10,096,391
220034	90025	110004	1	0	0	1	CIRCULAR	RCP	5.39	0.58	2.5	0	0	2	NO	CIRCULAR	RCP	49.05	0.99	$ 7,606	$ 11,789	19	Replace	IP-120001	$ 10,096,391
220043	110010	120008									2.5	0	0	2	YES	CIRCULAR	RCP	40.6	0.23	$ 112,532	$ 174,425	281	New	IP-120001	$ 10,096,391
220044	110011	110010									2.5	0	0	2	NO	CIRCULAR	RCP	31.92	0.76	$ 41,763	$ 64,732	104	New	IP-120001	$ 10,096,391
220045	90015	110011									2	0	0	2	NO	CIRCULAR	RCP	31.86	1.44	$ 90,555	$ 140,360	206	New	IP-120001	$ 10,096,391
220046	110012	90015									2	0	0	2	NO	CIRCULAR	RCP	28.77	1.26	$ 37,745	$ 58,504	86	New	IP-120001	$ 10,096,391
220047	90030	110012									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	2.86	0.25	$ 6,321	$ 9,798	25	New	IP-120001	$ 10,096,391
220048	90007	110012									1.583	2.5	0	1	NO	HORIZ_ELLIPSE	RCP	10.44	0.87	$ 17,988	$ 27,882	60	New	IP-120001	$ 10,096,391
220049	160019	110013									1.5	0	0	1	NO	CIRCULAR	RCP	5.4	0.66	$ 16,817	$ 26,066	93	New	IP-120001	$ 10,096,391
220050	110013	110014									1.5	0	0	1	NO	CIRCULAR	RCP	5.4	0.66	$ 5,008	$ 7,762	28	New	IP-120001	$ 10,096,391
220051	110014	110010									1.5	0	0	1	NO	CIRCULAR	RCP	5.37	0.83	$ 31,347	$ 48,588	174	New	IP-120001	$ 10,096,391
220052	90014	110015									1.583	2.5	0	1	NO	HORIZ_ELLIPSE	RCP	10.69	1.05	$ 14,690	$ 22,769	49	New	IP-120001	$ 10,096,391
220053	110016	110017									2.5	0	0	2	NO	CIRCULAR	RCP	56.03	1.54	$ 101,889	$ 157,929	255	New	IP-120001	$ 10,096,391
220054	110017	160018									2.5	0	0	2	NO	CIRCULAR	RCP	56.05	1.54	$ 40,701	$ 63,086	102	New	IP-120001	$ 10,096,391
220055	160018	120009									2.5	0	0	2	YES	CIRCULAR	RCP	56.58	0.33	$ 107,350	$ 166,393	268	New	IP-120001	$ 10,096,391
220056	90013	110015									1.583	2.5	0	1	NO	HORIZ_ELLIPSE	RCP	10.96	1.08	$ 8,777	$ 13,604	29	New	IP-120001	$ 10,096,391
220057	110015	110018									2.5	0	0	2	NO	CIRCULAR	RCP	48.82	1.34	$ 72,983	$ 113,123	182	New	IP-120001	$ 10,096,391
220058	110018	110016									2.5	0	0	2	NO	CIRCULAR	RCP	56.18	1.54	$ 34,021	$ 52,733	85	New	IP-120001	$ 10,096,391
220059	160020	110018									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	3.29	0.21	$ 6,036	$ 9,356	24	New	IP-120001	$ 10,096,391
220060	160006	110018									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	5.85	0.8	$ 12,430	$ 19,267	50	New	IP-120001	$ 10,096,391
220061	160021	110019									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	5.17	0.67	$ 7,979	$ 12,367	32	New	IP-120001	$ 10,096,391
220062	110019	110015									2	0	0	2	NO	CIRCULAR	RCP	29.27	1.34	$ 83,569	$ 129,532	190	New	IP-120001	$ 10,096,391
220063	160005	110019									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	10.71	1.77	$ 12,603	$ 19,535	50	New	IP-120001	$ 10,096,391
220064	160001	110020									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	7.18	1.16	$ 12,918	$ 20,023	52	New	IP-120001	$ 10,096,391
220065	110020	110019									2	0	0	2	NO	CIRCULAR	RCP	18.27	0.8	$ 84,074	$ 130,315	191	New	IP-120001	$ 10,096,391
220066	160022	110020									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	4.75	0.51	$ 8,435	$ 13,074	34	New	IP-120001	$ 10,096,391
220067	160009	110021									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	5.08	0.48	$ 13,465	$ 20,870	54	New	IP-120001	$ 10,096,391
220068	160004	110021									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	4.97	0.45	$ 2,715	$ 4,209	11	New	IP-120001	$ 10,096,391
220069	110021	90001									2	0	0	1	NO	CIRCULAR	RCP	20.12	1.77	$ 20,474	$ 31,735	93	New	IP-120001	$ 10,096,391
220070	160003	110022									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	7.86	0.74	$ 14,667	$ 22,735	59	New	IP-120001	$ 10,096,391
220071	160008	110022									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	4.8	0.37	$ 4,493	$ 6,964	18	New	IP-120001	$ 10,096,391
220072	110022	110021									1.5	0	0	1	NO	CIRCULAR	RCP	11.43	1.88	$ 31,579	$ 48,947	175	New	IP-120001	$ 10,096,391
220073	160002	110023									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	4.77	0.55	$ 16,020	$ 24,832	64	New	IP-120001	$ 10,096,391
220074	110023	110022									1.5	0	0	1	NO	CIRCULAR	RCP	4.46	0.71	$ 32,468	$ 50,326	180	New	IP-120001	$ 10,096,391
220075	160013	110023									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	1.61	0.17	$ 6,602	$ 10,233	26	New	IP-120001	$ 10,096,391
220076	160012	110024									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	7.32	1.44	$ 13,815	$ 21,414	55	New	IP-120001	$ 10,096,391
220077	110024	110012									1.5	0	0	2	NO	CIRCULAR	RCP	16.1	1.65	$ 66,522	$ 103,109	185	New	IP-120001	$ 10,096,391
220078	160023	110024									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	3.16	0.27	$ 5,679	$ 8,803	23	New	IP-120001	$ 10,096,391
220079	160007	110025									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	5.04	0.93	$ 13,820	$ 21,421	55	New	IP-120001	$ 10,096,391
220080	110025	110024									1.5	0	0	2	NO	CIRCULAR	RCP	6.64	0.67	$ 66,594	$ 103,221	185	New	IP-120001	$ 10,096,391
220081	160024	110025									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	2.21	0.16	$ 6,198	$ 9,608	25	New	IP-120001	$ 10,096,391
220082	160010	110026									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	7.05	0.92	$ 12,647	$ 19,603	51	New	IP-120001	$ 10,096,391
220083	110026	110020									1.5	0	0	2	NO	CIRCULAR	RCP	8.28	0.87	$ 76,835	$ 119,094	213	New	IP-120001	$ 10,096,391
220084	160025	110026									1.167	1.917	0	1	NO	HORIZ_ELLIPSE	RCP	2.37	0.47	$ 10,674	$ 16,544	43	New	IP-120001	$ 10,096,391
220085	160016	160017									1.5	0	0	1	NO	CIRCULAR	RCP	2.44	0.34	$ 17,465	$ 27,070	97	New	IP-120001	$ 10,096,391
220086	160017	110027									1.5	0	0	1	NO	CIRCULAR	RCP	9.48	0.91	$ 9,066	$ 14,052	50	New	IP-120001	$ 10,096,391
220087	110027	110028									1.5	0	0	1	NO	CIRCULAR	RCP	9.21	0.78	$ 14,202	$ 22,013	79	New	IP-120001	$ 10,096,391
220088	110028	120010									1.5	0	0	1	YES	CIRCULAR	RCP	9.03	0.41	$ 53,048	$ 82,225	295	New	IP-120001	$ 10,096,391
230002	110002	90020	2	0	0	1	CIRCULAR	CMP	3.29	0.23	2	0	0	1	NO	CIRCULAR	RCP	14.32	0.63	$ 3,912	$ 6,064	18	Replace	IP-120001	$ 10,096,391

CONVEYANCE SUMMARY TABLE

Project Info			Existing Condition								Recommended Condition									Asset Cost				Projects	
			Dimensions								Dimensions														
FacilityID	InletFacID	OutletFacID	D' (diameter)	H' (height)	B' (width)	Barrels	Shape	Material	Q100 (cfs)	Q vs Qcap (100-yr)*	D' (diameter)	H' (height)	B' (width)	Barrels	Flapgate	Shape	Material	Q100 (cfs)	Q vs Qcap (100-yr)*	FacCosts	ConstCost	Length (ft)	RecStatus	ProjID	ProjCost
230004	100005	110002	2	0	0	1	CIRCULAR	CMP	8.75	0.67	2	0	0	1	NO	CIRCULAR	RCP	14.57	1.12	$ 4,408	$ 6,833	20	Replace	IP-120001	$ 10,096,391
220004	90009	120003	1.5	0	0	1	CIRCULAR	RCP	21.21	0.8	1.5	0	0	1	YES	CIRCULAR	RCP	22.77	0.86	$ 9,026	$ 13,990	50	Replace	IP-120002	$ 2,440,536
220042	90029	120007	2	0	0	1	CIRCULAR	RCP	13.33	1.3	2	0	0	1	YES	CIRCULAR	RCP	13.33	1.3	$ 118,441	$ 183,584	538	Replace	IP-120002	$ 2,440,536
220002	90018	110001	0.667	0	0	2	CIRCULAR	RCP	6.95	0.88													Removed		
220005	90012	80001	0.25	0	0	2	CIRCULAR	PVCP	0.03	0.31	0.25	0	0	2	NO	CIRCULAR	PVCP	0	0	$ -	$ -	33	Existing		
220008	90012	100004	1.5	0	0	1	CIRCULAR	PVCP	5.57	1.1	1.5	0	0	1	NO	CIRCULAR	PVCP	7.26	1.44	$ -	$ -	152	Existing		
220009	100003	100005	2	0	0	1	CIRCULAR	ACP	8.84	0.65	2	0	0	1	NO	CIRCULAR	ACP	13.26	0.98	$ -	$ -	106	Existing		
220014	90006	100003	2	0	0	1	CIRCULAR	ACP	6.27	0.63	2	0	0	1	NO	CIRCULAR	ACP	10.67	1.07	$ -	$ -	249	Existing		
220015	90004	100003	1.5	0	0	1	CIRCULAR	PVCP	2.78	0.38	1.5	0	0	1	NO	CIRCULAR	PVCP	2.76	0.38	$ -	$ -	31	Existing		
220016	90007	90018	0.667	0	0	2	CIRCULAR	RCP	2.2	1.03													Removed		
220017	110003	90021	1	0	0	1	CIRCULAR	RCP	4.57	3.26													Removed		
220018	110001	110003	1	0	0	1	CIRCULAR	RCP	4.94	3.44													Removed		
220022	90014	90013	0.667	0	0	2	CIRCULAR	CIPCP	1.85	1.86													Removed		
220023	110008	90012	1.5	0	0	1	CIRCULAR	PVCP	2.66	0.35	1.5	0	0	1	NO	CIRCULAR	PVCP	3.49	0.46	$ -	$ -	193	Existing		
220026	90013	90005	1	0	0	1	CIRCULAR	RCP	2.83	1.76													Removed		
220027	90005	90016	1	0	0	1	CIRCULAR	RCP	3.86	2.54													Removed		
220028	90015	110001	1	0	0	1	CIRCULAR	RCP	2.74	0.7													Removed		
220029	90016	110005	1	0	0	1	CIRCULAR	RCP	4.45	1.85	1	0	0	1	NO	CIRCULAR	RCP	1.03	0.43	$ -	$ -	102	Existing		
220032	90022	110007	1.5	0	0	1	CIRCULAR	RCP	1.09	0.14	1.5	0	0	1	NO	CIRCULAR	RCP	1.48	0.19	$ -	$ -	72	Existing		
220033	110007	110008	1.5	0	0	1	CIRCULAR	RCP	1.14	0.16	1.5	0	0	1	NO	CIRCULAR	RCP	1.23	0.17	$ -	$ -	47	Existing		
220036	90026	110008	1.5	0	0	1	CIRCULAR	RCP	2.96	0.31	1.5	0	0	1	NO	CIRCULAR	RCP	2.93	0.31	$ -	$ -	230	Existing		
220037	90024	90023	1.5	0	0	1	CIRCULAR	RCP	1.75	0.45	1.5	0	0	1	NO	CIRCULAR	RCP	1.75	0.45	$ -	$ -	76	Existing		
220038	90023	120006	1.5	0	0	1	CIRCULAR	RCP	3.38	0.09	1.5	0	0	1	YES	CIRCULAR	RCP	3.38	0.09	$ -	$ -	44	Existing		
220039	90027	110009	1.5	0	0	1	CIRCULAR	RCP	6.39	1.05	1.5	0	0	1	NO	CIRCULAR	RCP	6.39	1.05	$ -	$ -	113	Existing		
220040	110009	90029	1.5	0	0	1	CIRCULAR	RCP	6.4	0.6	1.5	0	0	1	NO	CIRCULAR	RCP	6.4	0.6	$ -	$ -	57	Existing		
220041	90028	90029	1.5	0	0	1	CIRCULAR	RCP	3.28	0.34	1.5	0	0	1	NO	CIRCULAR	RCP	3.28	0.34	$ -	$ -	207	Existing		
230003	100004	90006	1.5	0	0	1	CIRCULAR	PVCP	5.58	1.08	1.5	0	0	1	NO	CIRCULAR	PVCP	7.3	1.41	$ -	$ -	53	Existing		

Appendix D-1

STRUCTURES SUMMARY TABLE

	Existing Condition			Proposed Condition			Asset Cost			Projects	
FacilityID*	Type	Q100 (cfs)	InvElev	Type	Q100 (cfs)	InvElev	Facility Cost	Total Cost	RecStatus	ProjID	ProjCost
80001	HEADWALL	0.03	6.76	HEADWALL	0	6.76	$ -	$ -	Existing		
90001	INLET	10.48	0.985	INLET	48.7	-0.829	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90004	INLET	2.77	2.87	INLET	2.77	2.87	$ -	$ -	Existing		
90005	INLET	16.92	1.399						Removed		
90006	INLET	7.98	2.72	INLET	10.62	2.72	$ -	$ -	Existing		
90007	INLET	12.59	2.76	INLET	10.45	0.76	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90008	INLET	2.58	3.521	INLET	2.58	1.25	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90009	INLET	21.21	2.005	INLET	22.77	2.005	$ -	$ -	Existing		
90012	INLET	6.78	3.14	INLET	7.25	3.14	$ -	$ -	Existing		
90013	INLET	22.64	0.11	INLET	11	0.33	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90014	INLET	19.83	1.326	INLET	10.63	0.37	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90015	INLET	19.78	2.76	INLET	31.93	0.369	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90016	INLET	4.51	0.851	INLET	1.04	0.851	$ -	$ -	Existing		
90018	INLET	12.62	2.28						Removed		
90020	INLET	10.34	1.866	INLET	23.27	-0.386	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90021	INLET	12.63	1.01	INLET	3.39	1.01	$ -	$ -	Existing		
90022	INLET	3.06	4.62	INLET	1.53	4.62	$ -	$ -	Existing		
90023	INLET	3.38	4.718	INLET	3.38	4.718	$ -	$ -	Existing		
90024	INLET	1.75	4.821	INLET	1.75	4.821	$ -	$ -	Existing		
90025	INLET	5.38	-1.217	INLET	49.09	-1.97	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
90026	INLET	2.94	5.91	INLET	2.94	5.91	$ -	$ -	Existing		
90027	INLET	6.44	-1.185	INLET	6.44	-1.185	$ -	$ -	Existing		
90028	INLET	3.56	-0.407	INLET	3.56	-0.407	$ -	$ -	Existing		
90029	INLET	13.7	-2.145	INLET	13.7	-2.145	$ -	$ -	Existing		
90030				INLET	2.89	0.93	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
100003	LUG	8.89	2.24	LUG	13.02	2.24	$ -	$ -	Existing		
100004	LUG	5.57	2.84	LUG	7.26	2.84	$ -	$ -	Existing		
100005	LUG	8.84	1.86	LUG	13.26	1.86	$ -	$ -	Existing		
110001	CLEANOUT	10.24	1.35						Removed		
110002	CLEANOUT	8.75	1.794	CLEANOUT	14.57	1.794	$ -	$ -	Existing		
110003	CLEANOUT	5.58	0.56						Removed		
110004	CLEANOUT	5.39	-2.518	CLEANOUT	49.23	-2.04	$ 8,000	$ 12,400	Replace	IP-120001	$ 10,096,391
110005	CLEANOUT	4.45	0.389	CLEANOUT	1.03	-0.111	$ 8,000	$ 12,400	Replace	IP-120001	$ 10,096,391
110006	CLEANOUT	7.98	-0.18	CLEANOUT	3.4	0.5	$ 8,000	$ 12,400	Replace	IP-120001	$ 10,096,391
110007	CLEANOUT	1.09	4.22	CLEANOUT	1.48	4.22	$ -	$ -	Existing		
110008	CLEANOUT	2.96	4	CLEANOUT	4.14	4	$ -	$ -	Existing		
110009	CLEANOUT	6.39	-1.564	CLEANOUT	6.39	-1.564	$ -	$ -	Existing		
110010				CLEANOUT	40.48	-0.399	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110011				CLEANOUT	31.86	-0.125	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110012				CLEANOUT	28.76	0.588	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110013				CLEANOUT	5.4	0.926	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110014				CLEANOUT	5.4	0.756	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110015				CLEANOUT	49.56	0.27	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110016				CLEANOUT	56.18	-0.26	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110017				CLEANOUT	56.03	-0.76	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110018				CLEANOUT	56.62	-0.091	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110019				CLEANOUT	31.31	0.714	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110020				CLEANOUT	19.79	1.2	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110021				CLEANOUT	20.96	-0.093	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110022				CLEANOUT	13.63	0.492	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110023				CLEANOUT	4.77	1.135	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110024				CLEANOUT	16.69	1.486	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110025				CLEANOUT	7.21	1.896	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110026				CLEANOUT	9.37	1.64	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110027				CLEANOUT	9.48	0.2	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
110028				CLEANOUT	9.21	-1	$ 8,000	$ 12,400	New	IP-120001	$ 10,096,391
160001	WP SUMP	13.03	3.031	INLET	7.59	0.4	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160002	WP SUMP	11.02	2.821	INLET	4.85	1.02	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160003	WP SUMP	11.01	4.326	INLET	12.6	0.56	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160004	WP SUMP	6.41	2.045	INLET	5.01	-0.56	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160005	WP SUMP	8.89	1.921	INLET	12.2	-0.1	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391

	Existing Condition			Proposed Condition			Asset Cost			Projects	
FacilityID*	Type	Q100 (cfs)	InvElev	Type	Q100 (cfs)	InvElev	Facility Cost	Total Cost	RecStatus	ProjID	ProjCost
160006	WP SUMP	7.67	2.686	INLET	5.94	-0.42	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160007	WP SUMP	5.33	3.58	INLET	5.16	1.06	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160008	WP SUMP	4.24	2.573	INLET	10.92	0.2	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160009	WP SUMP	6.29	3.416	INLET	5.16	-0.08	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160010	WP SUMP	11.94	3.343	INLET	7.26	0.94	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160011	WP SUMP	11.55	3.174	INLET	6.35	2.174	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160012	WP SUMP	6.72	3.33	INLET	7.41	0.63	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160013	WP SUMP	6.36	3.372	INLET	8.05	0.37	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160016	WP SUMP	3.39	3.667	INLET	2.69	1.16	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160017	WP SUMP	7.53	4.282	INLET	9.88	0.7	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160018	WP SUMP	0.81	-0.774	INLET	56.47	-1.96	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160019	WP SUMP	10.37	4.012	INLET	5.4	0.5	$ 7,000	$ 10,850	Replace	IP-120001	$ 10,096,391
160020				INLET	3.34	-0.1	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
160021				INLET	5.35	-0.094	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
160022				INLET	4.87	0.5	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
160023				INLET	3.2	0.79	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
160024				INLET	2.24	1.347	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391
160025				INLET	2.53	0.749	$ 7,000	$ 10,850	New	IP-120001	$ 10,096,391

OUTFALLS SUMMARY TABLE

		Existing Condition		Proposed Condition		Asset Cost			Projects	
FacilityID*	Type	Q100 (cfs)	InvElev	Q100 (cfs)	InvElev	Original FacilityID	Lump Sum Cost	RecStatus	ProjID	ProjCost
120001	Outfall	5.06	-3.3	49.3	-13.5		$ 232,500	Replace	IP-120001	$ 10,096,391
120002	Outfall	7.98	-1.06				$ -	Removed		
120003	Outfall	21.21	-1.198	22.77	-1.198		$ 232,500	Replace	IP-120002	$ 2,440,536
120004	Outfall	2.57	-1.198	2.57	-10		$ 232,500	Replace	IP-120001	$ 10,096,391
120005	Outfall	4.45	-1.198	1.02	-13.5		$ 232,500	Replace	IP-120001	$ 10,096,391
120006	Outfall	3.38	-1.136	3.38	-1.136		$ -	Existing		
120007	Outfall	13.33	-3.5	13.33	-3.5		$ 232,500	Replace	IP-120002	$ 2,440,536
120008	Outfall			40.6	-13.5	120002	$ 232,500	Realign	IP-120001	$ 10,096,391
120009	Outfall			56.58	-13.5		$ 232,500	New	IP-120001	$ 10,096,391
120010	Outfall			9.03	-13.5		$ 232,500	New	IP-120001	$ 10,096,391

Appendix D-1

BMP SUMMARY TABLE

		Contributing Area		BMP	Asset Cost			Projects	
FacilityID	Type	Area (ac)	Impervious Area (ac)	BMP Surface Area (sq. ft)	Facility Cost	Construction Cost	RecStatus	ProjID	ProjCost
BMP-090006-S	Biofiltration w/ Partial Retention	6.6	4.6	6,010	$ 95,088	$ 147,387	New	IP-120002	$ 2,440,536
BMP-090009_1-S	Bioretention	1.1	1.1	1,385	$ 23,862	$ 36,986	New	IP-120002	$ 2,440,536
BMP-090009_2-S	Bioretention	4.1	2.6	3,398	$ 51,659	$ 80,071	New	IP-120002	$ 2,440,536
BMP-090009_3-S	Bioretention	0.8	0.5	663	$ 11,674	$ 18,094	New	IP-120002	$ 2,440,536
BMP-090012-S	Biofiltration w/ Partial Retention	1.8	1.5	1,994	$ 31,128	$ 48,248	New	IP-120002	$ 2,440,536
BMP-090023-S	Biofiltration w/ Partial Retention	1.6	0.8	1,104	$ 17,367	$ 26,918	New	IP-120002	$ 2,440,536
BMP-090027-S	Biofiltration w/ Partial Retention	2.5	2.0	2,556	$ 38,903	$ 60,300	New	IP-120002	$ 2,440,536
BMP-090028-S	Biofiltration w/ Partial Retention	1.1	0.7	977	$ 15,225	$ 23,598	New	IP-120002	$ 2,440,536
BMP-090029-S	Biofiltration w/ Partial Retention	1.4	1.1	1,452	$ 26,460	$ 41,013	New	IP-120002	$2,440,536

Appendix D-1

LOW-FLOW SEWER DIVERSION SUMMARY TABLE

			Asset Cost		Projects	
FacilityID	Type	Description	Lump Sum Cost	RecStatus	ProjID	ProjCost
DV00015	Alternative 1	Low Flow Diversion Structure-DV 15	$ 199,350	Replace	IP-120002	$ 2,440,536
DV00030	Alternative 1	Low Flow Diversion Structure-DV 30	$ 199,350	Replace	IP-120001	$ 10,096,391
DV00032	Alternative 1	Low Flow Diversion Structure-DV 32	$ 199,350	Replace	IP-120001	$ 10,096,391
DV00033	Alternative 1	Low Flow Diversion Structure-DV 33	$ 199,350	Replace	IP-120001	$ 10,096,391
DV01001	Alternative 1	LFD Structure-DV To IPS 13	$ 199,350	Replace	IP-120002	$ 2,440,536
DV01002	Alternative 1	New Low Flow Diversion Structure-DV	$ 199,350	New	IP-120001	$ 10,096,391
DV01003	Alternative 2	New Low Flow Diversion Structure-DV	$ 205,650	New	IP-120001	$ 10,096,391
DV01004	Alternative 2	New Low Flow Diversion Structure-DV	$ 205,650	New	IP-120001	$ 10,096,391
DV01005	Alternative 1	New Low Flow Diversion Structure-DV	$ 199,350	New	IP-120001	$ 10,096,391
DV01006	Alternative 1	LFD Structure-DV To IPS 13	$ 199,350	Replace	IP-120002	$ 2,440,536

RICK
ENGINEERING COMPANY

Appendix D-1

SURFACE IMPROVEMENT SUMMARY TABLE

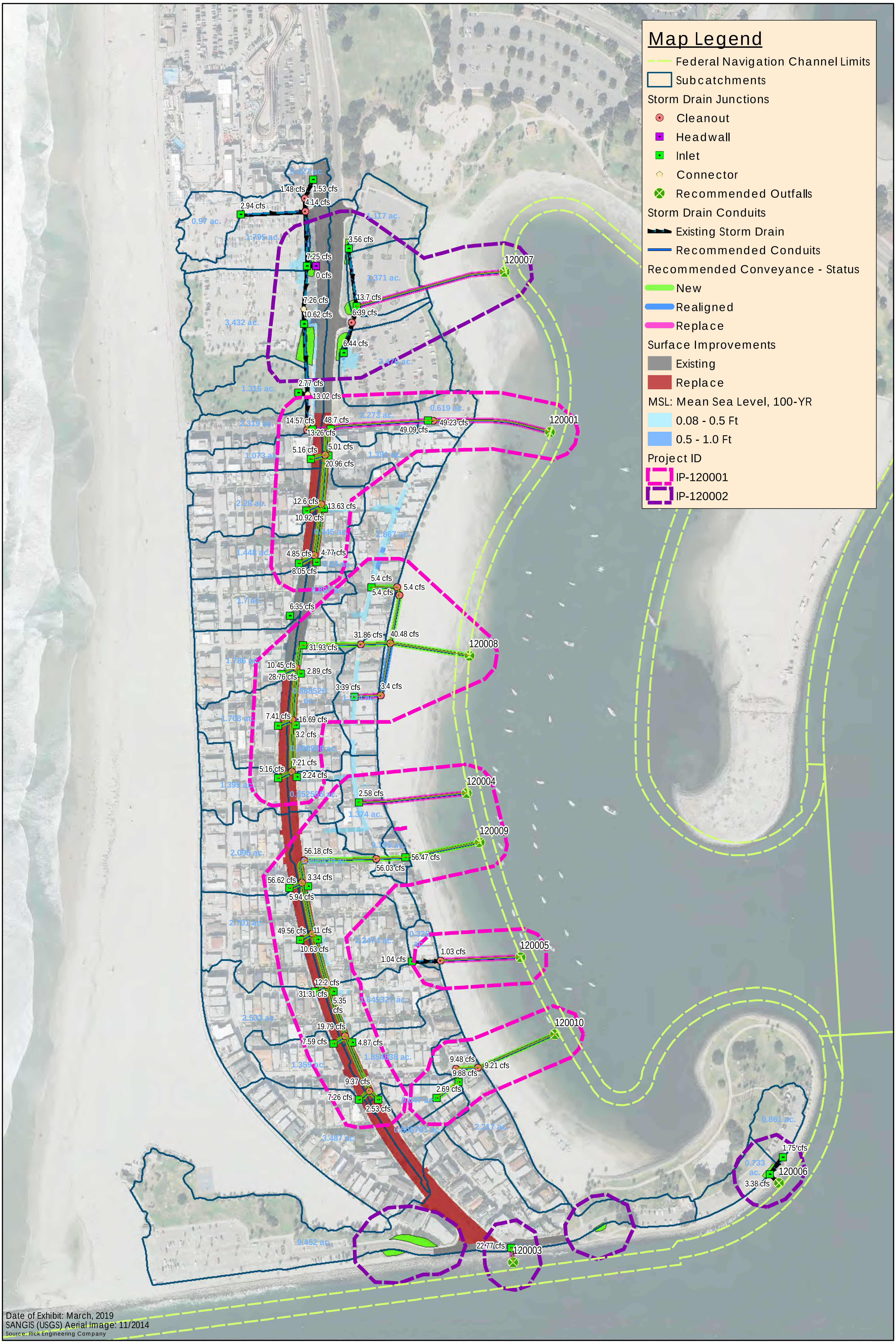
		Roadway				Projects	
FacilityID	**Type**	**Area (sf)**	**Curb Height (in)**	**Construction Cost**	**RecStatus**	**ProjID**	**ProjCost**
SURF-00235	Street Section	12,184	6.0		Existing		
SURF-00238	Street Section	35,981	6.0		Existing		
SURF-00250	Street Section	11,653	3.0	$ 46,610	Replace	IP-120001	$ 10,096,391
SURF-00251	Street Section	18,383	3.0	$ 73,532	Replace	IP-120001	$ 10,096,391
SURF-00252	Street Section	5,164	3.0	$ 20,656	Replace	IP-120001	$ 10,096,391
SURF-00253	Street Section	11,390	3.0	$ 45,562	Replace	IP-120001	$ 10,096,391
SURF-00254	Street Section	7,923	3.0	$ 31,692	Replace	IP-120001	$ 10,096,391
SURF-00255	Street Section	7,130	3.0	$ 28,520	Replace	IP-120001	$ 10,096,391
SURF-00256	Street Section	6,788	3.0	$ 27,153	Replace	IP-120001	$ 10,096,391
SURF-00257	Street Section	12,269	3.0	$ 49,078	Replace	IP-120001	$ 10,096,391
SURF-00259	Street Section	11,733	3.0	$ 46,931	Replace	IP-120001	$ 10,096,391
SURF-00260	Street Section	11,702	3.0	$ 46,809	Replace	IP-120001	$ 10,096,391
SURF-00261	Street Section	6,526	3.0	$ 26,104	Replace	IP-120001	$ 10,096,391
SURF-00262	Street Section	6,418	3.0	$ 25,672	Replace	IP-120001	$ 10,096,391
SURF-00263	Street Section	11,473	3.0	$ 45,891	Replace	IP-120001	$ 10,096,391
SURF-00264	Street Section	11,532	3.0	$ 46,127	Replace	IP-120001	$ 10,096,391
SURF-00265	Street Section	11,581	3.0	$ 46,323	Replace	IP-120001	$ 10,096,391
SURF-00266	Street Section	6,534	6.0		Existing		
SURF-00267	Street Section	6,496	6.0		Existing		
SURF-00268	Street Section	11,787	6.0		Existing		
SURF-00269	Street Section	11,742	3.0	$ 46,970	Replace	IP-120001	$ 10,096,391
SURF-00270	Street Section	10,261	3.0	$ 41,044	Replace	IP-120001	$ 10,096,391
SURF-00271	Street Section	21,611	6.0		Existing		
SURF-00272	Street Section	12,967	6.0		Existing		

PROJECT BUNDLING SUMMARY TABLE

Project Info			Prioritization			Project Costs		
FC_ProjectID	**FacilityID**	**Description**	**Facility Cost**	**Construction Cost**	**RecStatus**	**Project Construction Cost**	**Project Soft Cost**	**Total Project Cost**
IP-120001	220043	Storm Drain Pipe	$ 112,532	$ 174,425	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220044	Storm Drain Pipe	$ 41,763	$ 64,732	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220045	Storm Drain Pipe	$ 90,555	$ 140,360	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220046	Storm Drain Pipe	$ 37,745	$ 58,504	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220047	Storm Drain Pipe	$ 6,321	$ 9,798	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220048	Storm Drain Pipe	$ 17,988	$ 27,882	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220049	Storm Drain Pipe	$ 16,817	$ 26,066	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220050	Storm Drain Pipe	$ 5,008	$ 7,762	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220051	Storm Drain Pipe	$ 31,347	$ 48,588	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220052	Storm Drain Pipe	$ 14,690	$ 22,769	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220053	Storm Drain Pipe	$ 101,889	$ 157,929	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220054	Storm Drain Pipe	$ 40,701	$ 63,086	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220055	Storm Drain Pipe	$ 107,350	$ 166,393	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220056	Storm Drain Pipe	$ 8,777	$ 13,604	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220057	Storm Drain Pipe	$ 72,983	$ 113,123	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220058	Storm Drain Pipe	$ 34,021	$ 52,733	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220059	Storm Drain Pipe	$ 6,036	$ 9,356	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220060	Storm Drain Pipe	$ 12,430	$ 19,267	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220061	Storm Drain Pipe	$ 7,979	$ 12,367	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220062	Storm Drain Pipe	$ 83,569	$ 129,532	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220063	Storm Drain Pipe	$ 12,603	$ 19,535	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220064	Storm Drain Pipe	$ 12,918	$ 20,023	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220065	Storm Drain Pipe	$ 84,074	$ 130,315	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220066	Storm Drain Pipe	$ 8,435	$ 13,074	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220067	Storm Drain Pipe	$ 13,465	$ 20,870	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220068	Storm Drain Pipe	$ 2,715	$ 4,209	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220069	Storm Drain Pipe	$ 20,474	$ 31,735	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220070	Storm Drain Pipe	$ 14,667	$ 22,735	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220071	Storm Drain Pipe	$ 4,493	$ 6,964	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220072	Storm Drain Pipe	$ 31,579	$ 48,947	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220073	Storm Drain Pipe	$ 16,020	$ 24,832	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220074	Storm Drain Pipe	$ 32,468	$ 50,326	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220075	Storm Drain Pipe	$ 6,602	$ 10,233	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220076	Storm Drain Pipe	$ 13,815	$ 21,414	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220077	Storm Drain Pipe	$ 66,522	$ 103,109	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220078	Storm Drain Pipe	$ 5,679	$ 8,803	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220079	Storm Drain Pipe	$ 13,820	$ 21,421	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220080	Storm Drain Pipe	$ 66,594	$ 103,221	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220081	Storm Drain Pipe	$ 6,198	$ 9,608	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220082	Storm Drain Pipe	$ 12,647	$ 19,603	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220083	Storm Drain Pipe	$ 76,835	$ 119,094	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220084	Storm Drain Pipe	$ 10,674	$ 16,544	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220085	Storm Drain Pipe	$ 17,465	$ 27,070	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220086	Storm Drain Pipe	$ 9,066	$ 14,052	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220087	Storm Drain Pipe	$ 14,202	$ 22,013	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220088	Storm Drain Pipe	$ 53,048	$ 82,225	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220030	Storm Drain Pipe	$ 33,751	$ 52,315	Realigned	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220001	Storm Drain Pipe	$ 27,767	$ 43,038	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220003	Storm Drain Pipe	$ 165,995	$ 257,292	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220012	Storm Drain Pipe	$ 138,906	$ 215,304	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220024	Storm Drain Pipe	$ 17,005	$ 26,357	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220025	Storm Drain Pipe	$ 50,343	$ 78,032	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220031	Storm Drain Pipe	$ 68,845	$ 106,710	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	220034	Storm Drain Pipe	$ 7,606	$ 11,789	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	230002	Storm Drain Pipe	$ 3,912	$ 6,064	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	230004	Storm Drain Pipe	$ 4,408	$ 6,833	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120001	Outfall		$ 232,500	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120004	Outfall		$ 232,500	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120005	Outfall		$ 232,500	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120008	Outfall		$ 232,500	Realign	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120009	Outfall		$ 232,500	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	120010	Outfall		$ 232,500	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90001	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90007	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90008	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90013	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90014	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391

Project Info			Prioritization			Project Costs		
FC_ProjectID	FacilityID	Description	Facility Cost	Construction Cost	RecStatus	Project Construction Cost	Project Soft Cost	Total Project Cost
IP-120001	90015	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90020	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90025	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	90030	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160001	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160002	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160003	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160004	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160005	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160006	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160007	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160008	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160009	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160010	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160011	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160012	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160013	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160016	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160017	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160018	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160019	INLET	$ 7,000	$ 10,850	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160020	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160021	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160022	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160023	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160024	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	160025	INLET	$ 7,000	$ 10,850	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110004	CLEANOUT	$ 8,000	$ 12,400	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110005	CLEANOUT	$ 8,000	$ 12,400	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110006	CLEANOUT	$ 8,000	$ 12,400	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110010	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110011	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110012	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110013	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110014	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110015	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110016	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110017	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110018	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110019	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110020	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110021	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110022	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110023	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110024	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110025	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110026	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110027	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	110028	CLEANOUT	$ 8,000	$ 12,400	New	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00250	Street Section		$ 46,610	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00251	Street Section		$ 73,532	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00252	Street Section		$ 20,656	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00253	Street Section		$ 45,562	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00254	Street Section		$ 31,692	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00255	Street Section		$ 28,520	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00256	Street Section		$ 27,153	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00257	Street Section		$ 49,078	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00259	Street Section		$ 46,931	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00260	Street Section		$ 46,809	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00261	Street Section		$ 26,104	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00262	Street Section		$ 25,672	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00263	Street Section		$ 45,891	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00264	Street Section		$ 46,127	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00265	Street Section		$ 46,323	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00269	Street Section		$ 46,970	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391
IP-120001	SURF-00270	Street Section		$ 41,044	Replace	$ 7,211,708	$ 2,884,683	$ 10,096,391

Project Info			Prioritization			Project Costs		
FC_ProjectID	**FacilityID**	**Description**	**Facility Cost**	**Construction Cost**	**RecStatus**	**Project Construction Cost**	**Project Soft Cost**	**Total Project Cost**
IP-120002	220004	Storm Drain Pipe	$ 9,026	$ 13,990	Replace	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	220042	Storm Drain Pipe	$ 118,441	$ 183,584	Replace	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	120003	Outfall		$ 232,500	Replace	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	120007	Outfall		$ 232,500	Replace	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	BMP-090009_1-S	Bioretention	$ 23,862	$ 36,986	New	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	BMP-090009_2-S	Bioretention	$ 51,659	$ 80,071	New	$ 1,743,240	$ 697,296	$ 2,440,536
IP-120002	BMP-090006-S	Biofiltration w/ Partial Retention	$ 95,088	$ 147,387	New	$ 1,743,240	$ 697,296	$ 2,440,536



Map Legend

- Federal Navigation Channel Limits
- Subcatchments

Storm Drain Junctions
- ● Cleanout
- ■ Headwall
- ■ Inlet
- ○ Connector
- ⊗ Recommended Outfalls

Storm Drain Conduits
- Existing Storm Drain
- Recommended Conduits

Recommended Conveyance - Status
- New
- Realigned
- Replace

Surface Improvements
- ▨ Existing
- 🟥 Replace

MSL: Mean Sea Level, 100-YR
- 0.08 - 0.5 Ft
- 0.5 - 1.0 Ft

Project ID
- IP-120001
- IP-120002

Date of Exhibit: March, 2019
SANGIS (USGS) Aerial Image: 11/2014
Source: Rick Engineering Company

The City of SAN DIEGO

RICK ENGINEERING COMPANY

Scale in Feet
0 300 600

North

APPENDIX D - 2

DRAFT South Mission Beach WMP

Recommended Facilities Focus Map Projects

Appendix E. – Geotechnical Investigation

REPORT OF GEOTECHNICAL INVESTIGATION SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT CITY OF SAN DIEGO

Submitted to:

RICK ENGINEERING COMPANY
5620 Friars Road
San Diego, CA

Prepared By:

ALLIED GEOTECHNICAL ENGINEERS, INC.
9500 Cuyamaca Street, Suite 102
Santee, California 92071-2685

AGE Project No. 190 GS-18-D

March 8, 2019

AGE

Allied Geotechnical Engineers, Inc.

March 8, 2019

Mr. Kevin Gibson, P.E.
Project Manager
Rick Engineering Company
5620 Friars Road
San Diego, CA

Subject: **REPORT OF GEOTECHNICAL INVESTIGATION**
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT
CITY OF SAN DIEGO
AGE Project No. 190 GS-18-D

Dear Mr. Gibson:

Allied Geotechnical Engineers, Inc. is pleased to submit the accompanying report to present the findings, opinions, and recommendations of a geotechnical investigation that was performed to assist Rick Engineering Company with their design of the subject project.

We appreciate the opportunity to be of service on this project. If you have any questions regarding the contents of this report or need further assistance, please feel free to contact our office.

Sincerely,

ALLIED GEOTECHNICAL ENGINEERS, INC.

Nicholas E. Barnes, P.G., C.E.G.
Senior Geologist

Sani Sutanto, P.E.
Project Manager

NEB/SS/TJL:cal
Distr. (1 electronic) Addressee

Professional Geologist No. 5383
Nicholas E. Barnes
No. 1893
Certified Engineering Geologist
Exp. 05/31/2020
State of California

Registered Professional Engineer
Sani Sutanto
No. 51873
Exp. 06/30/2020
Civil
State of California

REPORT OF GEOTECHNICAL INVESTIGATION
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT
CITY OF SAN DIEGO

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Tables

TABLE OF CONTENTS
(Continued)

1.0 INTRODUCTION

Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit this report to present the findings, opinions, and recommendations of a geotechnical investigation conducted to assist Rick Engineering Company (Rick Engineering) with their design of the South Mission Beach Green Infrastructure Project for the City of San Diego (City). The investigation was performed in conformance with AGE's proposal dated July 11, 2018 (revised July 24, 2018), and the subconsultant agreement entered into by and between Rick Engineering and AGE on November 1, 2018.

This report has been prepared for the exclusive use of Rick Engineering and its design team and the City in their design of the project as described herein. The information presented in this report is not sufficient for any other uses or the purposes of other parties.

2.0 SITE AND PROJECT DESCRIPTION

Based on a review of preliminary alignment plan prepared by Rick Engineering Company (see Figure 1 - Project Alignments Map), dated December 28, 2017, it is our understanding that the scope of the proposed project will include the following:

- design and construction of approximately 88 feet of concrete lined channel;
- design and construction of approximately 6,253 feet of storm drain pipelines;
- design and construction of approximately 142 feet of encased storm drain;
- design and construction of 16 feet of culvert; and
- design and construction of associated headwalls, inlets, connectors, cleanouts, outlets, tidegates and weep sumps.

The proposed project alignments extend along public right-of-ways in the South Mission Beach area of San Diego. It is anticipated that the proposed pipelines will be installed using conventional cut-and-cover construction method with invert depths on the order of 4 to 12 feet below the ground surface (bgs).

Existing improvements along the project alignments include a mix of residential and commercial developments as well as Mission Beach and Mission Bay Park. The topography along the project alignments varies from level to very gently sloping with elevations which vary from sea level to approximately 13 feet above mean sea level (msl).

3.0 OBJECTIVE AND SCOPE OF INVESTIGATION

The objectives of this investigation were to characterize the subsurface conditions along the project alignments and to develop geotechnical recommendations for use in the design of the currently proposed project. The scope of our investigation included several tasks which are described in more detail in the following sections.

3.1 Information Review

This task involved a review of readily available information pertaining to the project study area, including the preliminary project plans, as-built utility maps, topographic maps, published geologic literature and maps, and AGE's in-house references.

3.2 Geotechnical Field Exploration

The field exploration program for this project was performed on February 11 and 12, 2019. A total of four (4) soil borings, four (4) infiltration test holes, and two (2) pavement corings were performed at the approximate locations shown on Figures 2 through 5. In addition, AGE attempted to perform infiltration testing inside an existing weep sump located on the west side of Mission Boulevard, at the entrance of an alley located between Brighton Court and Capistrano Place. The soil borings were advanced to depths ranging from 15 feet to 16.5 feet below the existing ground surface (bgs). The infiltration test holes were hand-augured to depths ranging from 36 inches to 63 inches bgs. A brief description of the location and depth, pavement sections, groundwater level, and subsurface conditions encountered in the borings and infiltration test holes is presented in Table 1 on the next page. A more detailed description of the excavation and sampling activities, and logs of the soil borings are presented in Appendix A.

Table 1

Summary of Subsurface Conditions

Boring & Test Hole ID	Location	Depth (Feet)	Existing Pavement Section	Subsurface Conditions	Estimated Groundwater Depth/ Elevation (Feet bgs/feet msl)
B-1	Mission Bay beach, approximately 10 feet east of Bayside Walk at intersection with San Fernando Place.	16.5	N/A	Hydraulic fill to 10 feet and old paralic deposits to the maximum depth of exploration.	11/-3.7
B-2	Southbound Mission Boulevard, approximately 40 feet south of San Fernando Place and 4 feet west of the center median.	15	4" A.C. over 8" P.C.C. underlain by 6" miscellaneous base.	Old paralic deposits to the maximum depth of exploration.	4.25/+2.0
C-2	Southbound Mission Boulevard, approximately 40 feet south of San Fernando Place and 12 feet east of the curb.	N/A	4.5" A.C. over 9.5" P.C.C. Unable to differentiate base materials.	N/A	N/A
B-3	Mission Bay beach, approximately 20 feet east of Bayside Walk at intersection with Coronado Court.	16.5	N/A	Hydraulic fill to 10 feet and old paralic deposits to the maximum depth of exploration.	4/+1.2
B-4	Southbound Mission Boulevard, approximately 60 feet south of Brighton Court and 4 feet west of the center median.	15	4.5" A.C. over 7.5" P.C.C. underlain by 4" miscellaneous base.	Old paralic deposits to the maximum depth of exploration.	3.25/+1.75

Table 1 (continued)

Summary of Subsurface Conditions

Boring & Test Hole ID	Location	Depth (Feet)	Existing Pavement Section	Subsurface Conditions	Estimated Groundwater Depth/ Elevation (Feet bgs/feet msl)
C-4	Northbound Mission Boulevard, approximately 60 feet south of Brighton Court and 12 feet west of the curb.	N/A	6" A.C., 6" P.C.C., 2" miscellaneous base.	N/A	N/A
P-1	Lawn area approximately 30 feet east of Mission Boulevard and 240 feet north of San Fernando Place.	62"	N/A	Four inches of topsoil underlain by old paralic deposits to the maximum depth of exploration.	3'/+2.7'
P-2	Tree planter on east side of Mission Boulevard approximately 20 feet north of Deal Court.	36"	N/A	Twelve inches of topsoil underlain by old paralic deposits to the maximum depth of exploration.	3'/+1.9'
P-3	Tree planter on west side of Mission Boulevard approximately 15 feet north of Balboa Court.	48"	N/A	Twelve inches of topsoil underlain by old paralic deposits to the maximum depth of exploration.	3'/+1.5'
P-4	Lawn area approximately330 feet east of Mission Boulevard and 10 feet south of Bayside Lane.	63"	N/A	Three inches of topsoil underlain by old paralic deposits to the maximum depth of exploration.	Not encountered.

Prior to commencement of the field exploration activities, several site reconnaissance visits were performed to observe existing conditions and to select suitable locations for the soil borings and infiltration test holes. Subsequently, Underground Service Alert (USA) was contacted to coordinate clearance of the proposed boring and test hole locations with respect to existing buried utilities. The utility clearance effort revealed the presence of the following buried utilities: potable water and sanitary sewer pipelines; storm drains; natural gas and electrical transmission lines; and cable, telephone, and fiber optic lines.

Traffic control permits were obtained from the City of San Diego to perform the borings (B-2 and B-4) and pavement cores (C-2 and C-4) that are located within the public right-of-way. Borings B-1 and B-3, and percolation holes P-1 and P-4 which are located in Mission Bay Park were performed with prior verbal approval from the City of San Diego Parks & Recreation Department.

Due to the presence of shallow groundwater inside test holes P-1, P-2 and P-3, AGE was unable to perform infiltration testing inside these holes. The existing weep sump was installed on top of an existing City of San Diego sewer trench. Furthermore, when AGE attempted to perform the infiltration testing, AGE uncovered an 18-inch diameter green PVC pipe filled with 3/4-inch crushed rock (see photograph in Figure 6). Therefore, AGE was unable to perform infiltration testing inside the weep sump. Infiltration testing was only performed in test hole P-4.

3.3 Laboratory Testing

Selected soil samples obtained from the soil borings were tested in the laboratory to verify field classifications and evaluate certain engineering characteristics. The geotechnical laboratory tests were performed in general conformance with the American Society for Testing and Materials (ASTM) or other generally accepted testing procedures.

The laboratory tests included: in-place density and moisture content, maximum density and optimum moisture content, sieve (wash) analysis, consolidation, shear strength, and R-value. In addition, representative samples of the onsite soil materials were collected and delivered to Clarkson Laboratories and Supply, Inc. for chemical (analytical) testing to determine soil pH and resistivity, soluble sulfate and chloride concentrations, and bicarbonate content.

4.0 GEOLOGIC CONDITIONS

4.1 Geologic Setting and Site Physiography

The project alignments are located in Mission Beach, a narrow sandbar situated between the Pacific Ocean and Mission Bay. The sandbar is underlain by marine sediments which range from Pleistocene to Holocene in age. Hydraulically placed fill materials were added along the eastern and southern portions of the sandbar during development of Mission Bay from the 1940's into the 1950's. Shallow mechanically placed fill materials were also encountered in the study area.

4.2 Tectonic Setting

Tectonically, the San Diego region is situated in a broad zone of northwest-trending, predominantly right-slip faults that span the width of the Peninsular Ranges and extend offshore into the California Continental Borderland Province west of California and northern Baja California. At the latitude of San Diego, this zone extends from the San Clemente fault zone, located approximately 60 miles to the west, and the San Andreas fault located about 95 miles to the east.

Major active regional faults of tectonic significance include the Coronado Bank, San Diego Trough, San Clemente, and Newport Inglewood/Rose Canyon fault zones which are located offshore; the faults in Baja California, including the San Miguel-Vallecitos and Agua Blanca fault zones; and the faults located further to the east in Imperial Valley which include the Elsinore, San Jacinto and San Andreas fault zones.

4.3 Geologic Units

Based on their origin and compositional characteristics, the soil types encountered in the borings can be categorized into two geologic units which include (in order of increasing age) fill materials and old paralic deposits. A brief description of each unit is presented below.

4.3.1 Fill Materials

Hydraulically placed fill materials were encountered in borings B-1 and B-3 to depths of approximately 10 feet bgs. The hydraulic fill generally consists of fine to medium grained sand with silt and containing scattered sub-rounded gravel. During the field investigation we met refusal in boring B-3 on a large buried rock or concrete at a depth of 3 feet bgs. We moved approximately 10 feet to the east and re-drilled to the target depth.

Mechanically placed fill materials on the order of 12 inches or less in thickness were encountered in infiltration test holes P-1 thru P-4. These materials generally consist of silty sands and organic-rich topsoil for lawns and street trees. Documentation pertaining to the original placement of the fill materials is unavailable.

4.3.2 Old Paralic Deposits

Late to mid-Pleistocene age old paralic deposits (Kennedy and Tan, 2008) were encountered below fill materials in borings B-1 and B-3, and below paving in borings B-2 and B-4 to the maximum depth of exploration. These deposits are generally described as poorly sorted, moderately permeable, reddish brown interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate resting on a now emergent wave-cut platform preserved by regional uplift (Kennedy and Tan, 2008). The deposits can generally be excavated with conventional heavy duty construction equipment. Although not encountered during the field exploration, localized conglomerate layers may present difficult excavation conditions.

The old paralic deposits encountered in our test borings generally consisted of fine-to medium grained sands and silty sands with scattered to trace amounts of sub-rounded gravel and shell fragments. The soil deposits are generally uncemented, damp to wet, and in a medium dense to dense condition.

4.4 Groundwater

At the time of our field investigation, groundwater was measured in the soil borings and test holes at depths ranging from 3 feet to 11 feet bgs (approximate elevations -2 feet to +7 feet msl). Tidal coefficients in Mission Bay (Quivira Basin) on the days of the field exploration based on National Oceanic and Atmospheric Administration (NOAA) data are shown below.

Date	**Low Tide**		**High Tide**	
	Time	**Height (MLLW)** **Height (MSL)**	**Time**	**Height (MLLW)** **Height (MSL)**
02/11/2019	7:34 am	-1.7 feet -4.5 feet	1:03 pm	+3.0 feet + 0.2 feet
02/12/2019	9:15 am	-1.5 feet -4.3 feet	3:07 pm	+2.6 feet +0.2 feet
02/13/2019	10:47 am	-0.9 feet -3.7 feet	5:18 pm	+2.7 feet -0.1 feet

No groundwater was encountered in infiltration hole P-4. Fill and formational materials encountered in the soil borings and infiltration test holes are generally considered to possess very high permeability characteristics. Based on the anticipated depth of excavations, it is anticipated that groundwater will be encountered along the project alignments during construction.

5.0 DISCUSSIONS, OPINIONS AND RECOMMENDATIONS

5.1 Potential Geologic Hazards

The majority of the project study area is classified in the City of San Diego Seismic Safety Study (2008), as Hazard Category 52 - Other Terrain, defined as, "Other level areas, gently sloping to steep terrain, favorable geologic structure, Low Risk". The beach area in the eastern portion of the study area, as well as Mission Point Park in the southeast portion of the study area adjacent to the Mission Bay Channel is classified as Hazard Category 31 - Liquefaction, defined as, "High potential-Shallow groundwater, major drainages, hydraulic fills. Neither classifications are anticipated to affect the proposed project as described herein.

5.1.1 Faulting

The northwest trending Point Loma fault is mapped 2,000 feet east of the project study area (Kennedy, 1975; Kennedy and Tan, 2008), This fault is concealed below Mission Bay and Holocene age fill materials east of the project study area. To the southeast the mapped trace of the fault crosses the Point Loma peninsula, where it is concealed beneath Pleistocene age old paralic deposits. The Point Loma fault is classified in the City of San Diego Seismic Safety Study (2008) as "potentially active, inactive, presumed inactive, or activity unknown."

For the purpose of this project we consider the Rose Canyon fault zone (RCFZ) to represent the most significant seismic hazard. The RCFZ is a complex set of anastomosing and en-echelon, predominantly strike slip faults that extend from off the coast near Carlsbad to offshore south of downtown San Diego (Treiman, 1993). Previous geologic investigations on the RCFZ in the Rose

Creek area (Rockwell et. al., 1991) and in downtown San Diego (Patterson et. al., 1986) found evidence of multiple Holocene earthquakes. Based on these studies, several fault strands within the RCFZ have been classified as active faults, and are included in Alquist-Priolo Special Studies Zones. In San Diego Bay, this fault zone is believed to splay into multiple, subparallel strands; the most pronounced of which are the Silver Strand, Spanish Bight and Coronado Bank faults.

A study by Kleinfelder (2017) at the San Diego International Airport identified two zones of active faulting. One of these faults was named the East Bay fault and the second fault was determined to be a northward extension of the Spanish Bight fault. Recent study by Ninyo & Moore (2018) at Seaport Village found evidence of recent movement along a fault that was determined to be a northward extension of the active Coronado fault. The project alignments are not located within an Alquist-Priolo Earthquake Study Zone.

5.1.2 Fault Ground Rupture & Ground Lurching

There are no known (mapped) active or potentially active faults crossing the project alignments (Kennedy, 1975; Kennedy and Tan, 2008; City of San Diego, 2008). Therefore, the potential for fault ground rupture and ground lurching along the project alignments is considered insignificant.

5.1.3 Soil Liquefaction

Seismically-induced soil liquefaction is a phenomenon in which loose to medium dense, saturated granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength due to cyclic ground vibrations induced by earthquakes.

Hydraulically placed fill materials in the east and southerly portions of the project alignments are classified in the City of San Diego Seismic Safety Study (2008) as having a high liquefaction potential. The findings of our investigation determined that the hydraulic fill materials encountered in borings B-1 and B-3 are in a medium dense condition, and therefore are considered to have a low liquefaction potential. However, it is likely that liquefaction prone soil materials will be encountered during construction.

5.1.4 Landslides

A review of the published geologic maps indicates that there are no known (mapped) ancient landslides in the project study area (Kennedy, 1975; Kennedy and Tan, 2008; City of San Diego, 2008). Therefore, landsliding is not considered a significant risk.

5.1.5 Lateral Spread Displacement

The project alignments are located in an area that is flat, therefore, the risk of lateral spread displacement during a seismic event is considered remote.

5.1.6 Differential Seismic-Induced Settlement

Differential seismic settlement occurs when seismic shaking causes one type of soil to settle more than another type. It may also occur within a soil deposit with largely homogeneous properties if the seismic shaking is uneven due to variable geometry or thickness of the soil deposit. Based on the results of our investigation, it is our opinion that there is a slight potential of differential settlement in areas underlain by deep hydraulically placed man-made fills.

5.1.7 Secondary Hazards

The project alignments are located within the tsunami inundation zone (California Geological Survey, 2009). Therefore, there is a high potential of property damage from seismic-induced tsunamis. The project alignments are located within the Special Flood Hazard Areas, 100- and 500-year flood zone (FEMA Flood Insurance Rate Map, 2012). Therefore the potential for flooding along the project alignments is considered high to very high.

5.2 Soil Corrosivity

In accordance with the City of San Diego Water Facility Design Guidelines, Book 2, Chapter 7, soil is generally considered aggressive to concrete if its chloride concentration is greater than 300 parts per million (ppm) or sulfate concentration is greater than 1,000 ppm, or if the pH is 5.5 or less.

Analytical testing was performed on representative sample of the onsite soil materials to determine pH, resistivity, soluble sulfate, chlorides and bicarbonates content. The tests were performed in accordance with California Test Method Nos. 643, 417 and 422. A summary of the test results is presented in Table 2 below. Copies of the analytical laboratory test data reports are included in Appendix B.

Table 2

Summary of Corrosivity Test Results

	pH	Resistivity (ohm-cm)	Sulfate Conc. (ppm)	Chloride Conc. (ppm)	Bicarbonates Conc. (ppm)
B-1 Sample No. 4 @14'-15'	8.3	130	1,050	3,630	46
B-2 Sample No. 3 @8'-9'	9.3	3,200	70	50	66
B-3 Sample No.3 @9'-10'	9.3	7,700	30	30	66
B-4 Sample No. 4 @10'-11'	9.2	730	140	620	46

The test results indicate that some of the soils along the project alignments are considered aggressive to concrete. Therefore, Type 5 Portland Cement Concrete should be used for proposed facilities along the project alignments. It should be noted here that the most effective way to prevent sulfate attack is to keep the sulfate ions from entering the concrete in the first place. This can be done by using mix designs that give a low permeability (mainly by keeping the water/cement ratio low) and, if practical, by placing moisture barriers between the concrete and the soil.

AGE does not practice in the field of corrosion engineering. In the event that corrosion sensitive facilities are planned, we recommend that a corrosion engineer be retained to perform the necessary corrosion protection evaluation and design.

5.3 Expansive Soil

Based on visual observations and soil classifications, the soil materials encountered in the borings and test holes are considered to be non-expansive.

5.4 Fill Material

Fill material for trench backfill should be free of biodegradable material, hazardous substance contamination, other deleterious debris, and or rocks or hard lumps greater than 6 inches. If the fill material contains rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard $^3/_4$-inch sieve. Fill material should consists of predominantly granular soil (less than 40 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 50.

The majority of the onsite soil materials are considered suitable for use as compacted backfill materials. It is noted that since the majority of the excavations will extend below the groundwater level, the majority of the soil materials generated from excavations along the project alignments will be wet, and will require drying prior to use as trench backfill materials.

5.5 Cut-and-Cover Construction

Since no changes to the existing ground surface along the cut-and-cover segment of the proposed storm drain pipeline alignment are planned, the net stress change in the underlying soils is considered negligible. Furthermore, the soils at the proposed invert level along the storm drain pipeline alignment are expected to provide a stable trench bottom. In the event that loose or disturbed soils are encountered at the trench bottom, it is recommended that they be over-excavated and replaced with pipe bedding or other approved materials. The depth of the overexcavation should be determined during construction by the City's Resident Engineer.

5.5.1 Soil and Excavation Characteristics

The materials within the anticipated depths of the storm drain pipe trench excavation will likely be comprised of materials which can be readily excavated with conventional heavy-duty construction equipment.

5.5.2 Pipe Loads and Settlement

Pipes should be designed for all loads applied by surrounding soils including dead load from soils, loads applied at the ground surface, uplift loads, and earthquake loads. Soil loading above and below the groundwater level may be estimated assuming a density of 100 pcf and 130 pcf, respectively, for properly compacted backfill materials.

Where a pipe changes direction abruptly, resistance to thrust forces can be provided by means of thrust blocks. For design purposes, for the passive resistance against thrust blocks embedded in dense formational material and/or properly compacted filled ground, an equivalent fluid density of 200 pcf may be used. Thrust blocks should be embedded a minimum of 3 feet beneath the ground surface.

Buried flexible pipes are generally designed to limit deflections caused by applied loads. The deflections can be estimated using the Modified Spangler equation. A modulus of soil reaction, E', equal to 1,000 and 2,000 psi may be used to represent a minimum of 6 inches of compacted pipe bedding materials of low plasticity (LL < 50) with less than 12 percent fines passing the #200 standard sieve and crushed rock materials, respectively.

5.5.3 Trench Backfill

Pipe Bedding Zone and Pipe Zone

"Pipe Bedding Zone" is defined as the area below the bottom of the pipe and extending over the full trench width, and should be at least 6 inches thick in order to provide a uniform firm foundation material directly beneath the pipe.

The "Pipe Zone" is defined as the full width of a trench from the bottom of the pipe to a horizontal level about 6 inches above the top (crown) of the pipe. In order to provide uniform support and to minimize external loads, trench widths should be selected such that a minimum clear space of 6 inches is provided on each side of the pipe. During backfilling, it is recommended that the backfill materials be placed on each side of the pipe simultaneously to avoid unbalanced loads on the pipe.

Backfill materials placed in the "Pipe Bedding Zone" and "Pipe Zone" should consist of clean, free draining sand or crushed rock. Sand should be free of clay, organic matter, and other deleterious materials and conform to the gradation shown in the following table.

Sieve Size	**Percent Passing by Weight (percent)**
½ inch	100
#4	75-100
#16	35-75
#50	10-40
#200	0-10

Crushed rock should conform to Section 200-1.2 and 200-1.3 of the Standard Specifications for Public Works Construction (SSPWC) for 3/4-inch crushed rock gradation. It must be noted that, since the native soil materials do not meet these specifications, import backfill materials will be required for the "Pipe Bedding Zone" and "Pipe Zone". If crushed rock is to be used for pipe zone and bedding backfill materials, we recommend that the rock materials be wrapped in geotextile filter fabric such as Mirafi 140N or equivalent. The purpose of the filter fabric is to prevent migration of fine grained materials from the backfill materials, and the sides and bottom of the trench into the rock bedding materials.

Above Pipe Zone

The "Above Pipe Zone" is defined as the full width of the trench from the top of the "Pipe Zone" to the finish grade or bottom of the pavement section. Backfill material placed in this zone should meet or exceed the criteria presented in Section 5.4. for either flowable fill or soil backfill.

5.5.4 Placement and Compaction of Backfill

Prior to placement, all soil backfill material should be moisture-conditioned, spread and placed in lifts (layers) not-to-exceed 6 inches in loose (uncompacted) thickness, and uniformly compacted to at least 90 percent relative compaction. During backfilling, the soil moisture content should be maintained at or within 2 to 3 percent above the optimum moisture content of the backfill materials. The maximum dry density and optimum moisture content of the backfill materials should be determined in the laboratory in accordance with the ASTM D1557 testing procedures. Field density testing shall be performed in accordance with either the Sand Cone Method (ASTM D1556) or the Nuclear Gauge Method (ASTM D2922 and D3017).

Small hand-operated compacting equipment should be used for compaction of the backfill materials to an elevation of at least 4 feet above the top (crown) of the pipes. Flooding or jetting should not be used to densify the backfill.

5.6 Buried Structures

It is recommended that any proposed buried structures be founded on firm native soils or approved compacted materials. In areas where loose or soft soils are encountered at the bottom of any manhole/box structure excavations, it is recommended that the loose/soft materials be removed and replaced with 3/4-inch crushed rock materials wrapped in geotextile fabric which meets or exceeds the specifications shown below.

Fabric Property	**Min. Certified Values**	**Test Method**
Grab Tensile Strength	300 lb	ASTM D 4632
Grab Tensile Elongation	35% (MAX)	ASTM D 4632
Burst Strength	600 psi	ASTM D 3786
Trapezoid Tear Strength	120 lb	ASTM D 4533
Puncture Strength	130 lb	ASTM D 4833

The actual extent of over-excavation of any loose/soft soil materials should be evaluated and determined in the field by the City's Resident Engineer.

5.6.1 Placement and Compaction of Backfill

Placement and compaction of backfill materials around the buried structures should be performed in accordance with the recommendations presented in Section 5.5.4 of this report.

5.6.2 Foundations

Bearing Capacity

For design of the buried structures which are founded on firm native soils an allowable soil bearing capacity of 2,000 psf may be used. In the event that loose and compressible soils are encountered at the bottom of the excavation for the proposed structures, we recommend that the structures be supported on a minimum of 24 inches of 3/4-inch crushed rock wrapped in geofabric. This allowable soil bearing value is for total dead and live loads, and may be increased by one third when considering seismic loads.

Anticipated Settlement

Under static condition, total settlement of the slab foundation is estimated to be less than 0.25 inch. Differential settlement between the center and the edge of the slab foundation is expected not to exceed 0.25 inch. No permanent deformation and/or post-construction settlement is anticipated, provided that backfill around the structures is properly compacted in accordance with the project specifications.

Resistance to Lateral Loads

Resistance to lateral loads may be developed by a combination of friction acting at the base of the slab foundation and passive earth pressure developed against the sides of the foundations below grade. Passive pressure and friction may be used in combination, without reduction, in determining the total resistance to lateral loads.

An allowable passive earth pressure of 200 psf per foot of foundation embedment below grade may be used for the sides of foundations placed against competent native soils. A coefficient of friction of 0.4 may be used for foundation cast directly on competent native soils or crushed rock wrapped in geofabric.

5.6.3 Walls Below Grade

Lateral earth pressures for walls below grade for structures less than 48 inches in horizontal dimensions may be treated as a shaft structure. Walls below grade for structures larger than 48 inches in horizontal dimensions should be designed to resist the lateral earth pressures presented in Figures 7 and 8 provided that the wall backfill materials are properly placed and compacted in conformance with the recommendations presented in this report. Surcharge and foundation loads occurring within a horizontal distance equal to the wall height should be added to the lateral pressures as presented in Figures 9 and 10.

5.7 Infiltration Testing

AGE attempted to perform infiltration testing in test hole P-4, but was unable to maintain a consistent free head inside the test hole during the 24-hour pre-soak period. During the test on February 14, 2019, AGE personnel had to add water into the test hole 24 times over a period of four (4) hours. The infiltration rate based on the last reading was calculated to be 90 inch per hour. It is our understanding that Rick Engineering is planning to install biofiltration basins with partial retention along the project alignments. It is our opinion that the soil underlying the project alignments are suitable for installation of partial retention biofiltration basins.

6.0 CONSTRUCTION-RELATED CONSIDERATIONS

6.1 Construction Dewatering

Groundwater and flowing sand conditions are anticipated to be encountered at or above the proposed pipe invert elevations along the project alignments. Because of the anticipated high rate of transmissivity of the underlying soils along the project alignments and the potential for encountering flowing sand condition, we recommend that groundwater be kept out of the trenched excavations using sheet piles in combination with sump pumps. Sheet piles should be extended to a depth of at least 10 feet below the bottom of the proposed trenched excavations.

The design, installation, and operation of any construction dewatering measures necessary for the project shall be the sole responsibility of the contractor.

6.2 Temporary Shoring

Since the anticipated pipe invert depths will be more than 4 feet below the ground surface, prevailing Federal and Cal OSHA safety regulations require that the trenched excavation be either sloped (if sufficient construction space or easement is available), shored, braced, or protected with approved sliding trench shield. Limited construction space, the presence of other buried utilities, and the need to avoid excessive community disruption dictate that a shored excavation will be needed along the entire pipeline alignment. Design and construction of temporary shoring should be the sole responsibility of the contractor.

Settlement

Settlement of existing street improvements and/or utilties adjacent to the shoring may occur in proportion to both the distance between shoring system and adjacent structures or utilities and the amount of horizontal deflection of the shoring system. Vertical settlement will be maximum directly adjacent to the shoring system, and decreases as the distance from the shoring increases. At a distance equal to the height of the shoring, settlement is expected to be negligible. Maximum vertical settlement is estimated to be on the order of 75 percent of the horizontal deflection of the shoring system. It is recommended that shoring be designed to limit the maximum horizontal deflection to 1-inch or less where structures or utilities are to be supported.

It is recommended that pre- and post-construction surveys be conducted to document existing site conditions. Documentation should include photographic and video surveys of the existing facilities and site improvements, as well as field surveys of building floors and pavement structures. We further recommend that a weekly survey of existing utilities be performed during the construction phase.

Lateral Earth Pressures

Temporary shoring should be designed to resist the pressure exerted by the retained soils and any additional lateral forces due to loads placed near the top of the excavation. For design of braced shorings supporting fill materials and old paralic deposits, the recommended lateral earth pressure should be 32H psf, where H is equal to the height of the retained earth in feet. Any surcharge loads would impose uniform lateral pressure of 0.3q, where "q" equals the uniform surcharge pressure. The surcharge pressure should be applied starting at a depth equal to the distance of the surcharge load from the top of the excavation. In the event that the bottom of the excavation is located below the groundwater level, hydrostatic pressure should be added to the lateral loads.

The recommended lateral earth pressures have been prepared based on the assumptions that the shored earth is level at the surface and that the shoring system is temporary in nature.

Lateral Bearing Capacity

Resistance to lateral loads will be provided by passive soil resistance. The allowable passive pressure for the fill materials and old paralic deposits may be assumed to be equivalent to a fluid weighing 200 pcf.

6.3 Environmental Considerations

The scope of AGE's investigation did not include the performance of a Phase I Environmental Site Assessment (Phase I ESA) to evaluate the possible presence of soil and/or groundwater contamination beneath the project alignments. During our subsurface investigation soil samples were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The field screening did not reveal elevated levels of volatile organics in the samples.

In the event that hazardous or toxic materials are encountered during the construction phase, the contractor should immediately notify the City and be prepared to handle and dispose of such materials in accordance with current industry practices and applicable Local, State and Federal regulations.

7.0 GENERAL CONDITIONS

7.1 Post-Investigation Services

Post-investigation geotechnical services are an important continuation of this investigation, and we recommend that the City's Construction Inspection Division performs the necessary geotechnical observation and testing services during construction. In the event that the City is unable to perform said services, it is recommended that our firm be retained to provide the services.

Sufficient and timely observation and testing should be performed during excavation, pipeline installation, backfilling and other related earthwork operations. The purpose of the geotechnical observation and testing is to correlate findings of this investigation with the actual subsurface conditions encountered during construction and to provide supplemental recommendations, if necessary.

7.2 Uncertainties and Limitations

The information presented in this report is intended for the sole use of Rick engineering and other members of the project design team and the City for project design purposes only and may not provide sufficient data to prepare an accurate bid. The contractor should be required to perform an independent evaluation of the subsurface conditions at the project site prior to submitting his/her bid.

AGE has observed and investigated the subsurface conditions only at selected locations along the project alignments. The findings and recommendations presented in this report are based on the assumption that the subsurface conditions beneath all project alignments do not deviate substantially from those encountered in the exploratory test pits. Consequently, modifications or changes to the recommendations presented herein may be necessary based on the actual subsurface conditions encountered during construction.

California, including San Diego County, is in an area of high seismic risk. It is generally considered economically unfeasible to build a totally earthquake-resistant project and it is, therefore, possible that a nearby large magnitude earthquake could cause damage at the project site.

Geotechnical engineering and geologic sciences are characterized by uncertainty. Professional judgments and opinions presented in this report are based partly on our evaluation and analysis of the technical data gathered during our present study, partly on our understanding of the scope of the proposed project, and partly on our general experience in geotechnical engineering.

In the performance of our professional services, we have complied with that level of care and skill ordinarily exercised by other members of the geotechnical engineering profession currently practicing under similar circumstances in southern California. Our services consist of professional consultation only, and no warranty of any kind whatsoever, expressed or implied, is made or intended in connection with the work performed. Furthermore, our firm does not guarantee the performance of the project in any respect.

AGE does not practice or consult in the field of safety engineering. The contractor will be responsible for the health and safety of his/her personnel and all subcontractors at the construction site. The contractor should notify the City if he or she considers any of the recommendations presented in this report to be unsafe.

8.0 REFERENCES

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Rick Engineering Company, “South Mission Beach WMP, Geotechnical Investigation Locations Map”, dated 10/2/2018.

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FIGURES

Source: Rick Engineering Company

APPENDIX A - 9.1

The City of SAN DIEGO

RICK ENGINEERING COMPANY

Scale in Feet
0 300 600
North

Date of Exhibit: January, 2019
SANGIS (USGS) Aerial Image: 11/2014

South Mission Beach WMP
Rec. Improvements: Low SLR (3.6')

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT ALIGNMENTS MAP

PROJECT NO. 190 GS-18-D	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 1

LEGEND

● P-1	Approximate Infiltration Test Hole Location
B-2 ●	Approximate Boring Location
● C-2	Approximate Pavement Core Location

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

LOCATION MAP

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 2

LEGEND

● P-1	Approximate Infiltration Test Hole Location
B-2 ●	Approximate Boring Location
● C-2	Approximate Pavement Core Location

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT		**LOCATION MAP**
PROJECT NO. **190 GS-18-D**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 3**

LEGEND

● P-1	Approximate Infiltration Test Hole Location
B-2 ●	Approximate Boring Location
● C-2	Approximate Pavement Core Location

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

LOCATION MAP

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 4

LEGEND

● P-1	Approximate Infiltration Test Hole Location
B-2 ●	Approximate Boring Location
● C-2	Approximate Pavement Core Location

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

LOCATION MAP

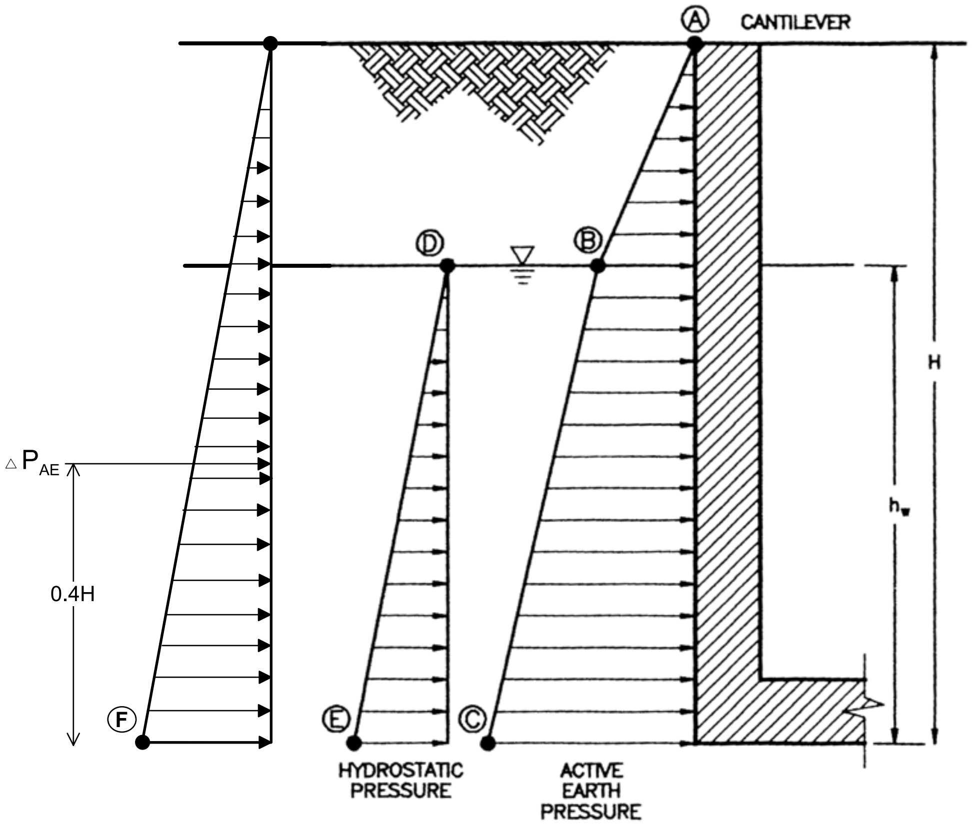
PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 5

SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT	WEEP SUMP PHOTOGRAPH

PROJECT NO. 190 GS-18-D	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 6



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

Earth Pressure
Ⓐ = 0
Ⓑ = 35 $(H-h_w)$, psf
Ⓒ = 35 $(H-h_w) + 20h_w$, psf

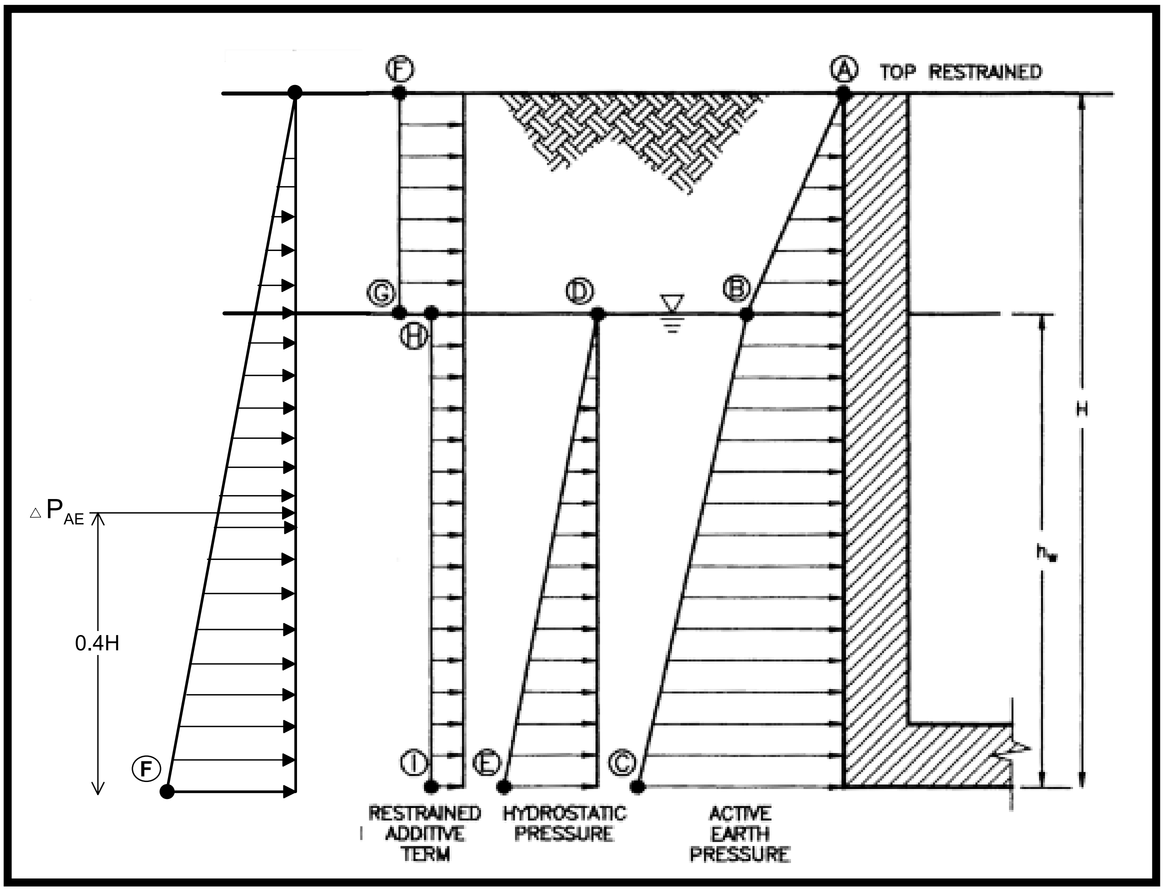
Hydrostatic Pressure
Ⓓ = 0
Ⓔ = $62.4h_w$

Dynamic Resultant Force

Ignored for shaft construction.

LATERAL PRESSURES FOR CANTILEVER WALLS
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

PROJECT NO. 190 GS-18-D	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 7**



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

Earth Pressure

Ⓐ = 0
Ⓑ = 35 (H-h_w), psf
Ⓒ = 35 (H-h_w) + 20h_w, psf

Hydrostatic Pressure

Ⓓ = 0
Ⓔ = 62.4h_w

Restrained Additive Term

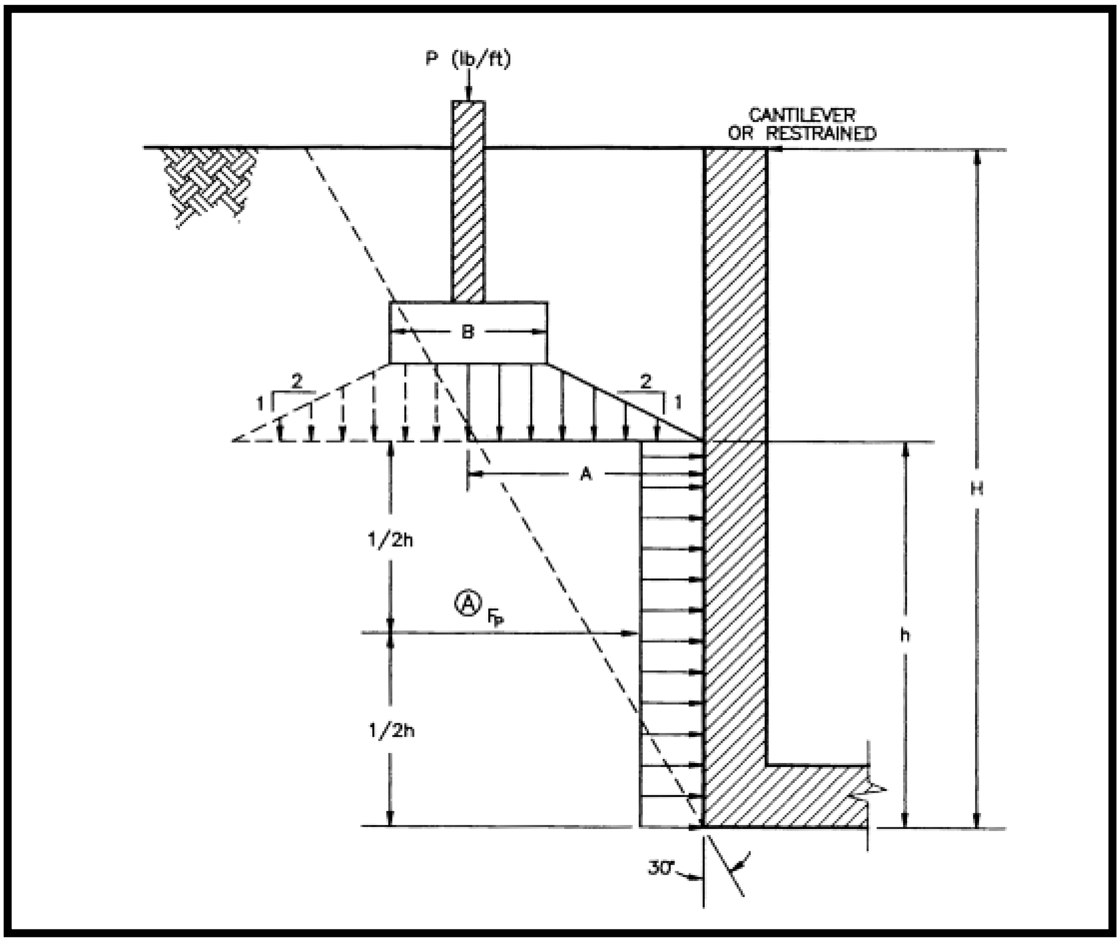
Ⓕ =Ⓖ= 10H, psf
Ⓗ=Ⓘ= 5H, psf

Dynamic Resultant Force

Ignored for shaft construction.

LATERAL PRESSURES FOR RESTRAINED WALLS
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

PROJECT NO. 190 GS-18-D	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 8**



NON-EXPANSIVE BACKFILL

F_p = M (A/B) P, lb/ft

A = h tan 30°, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall

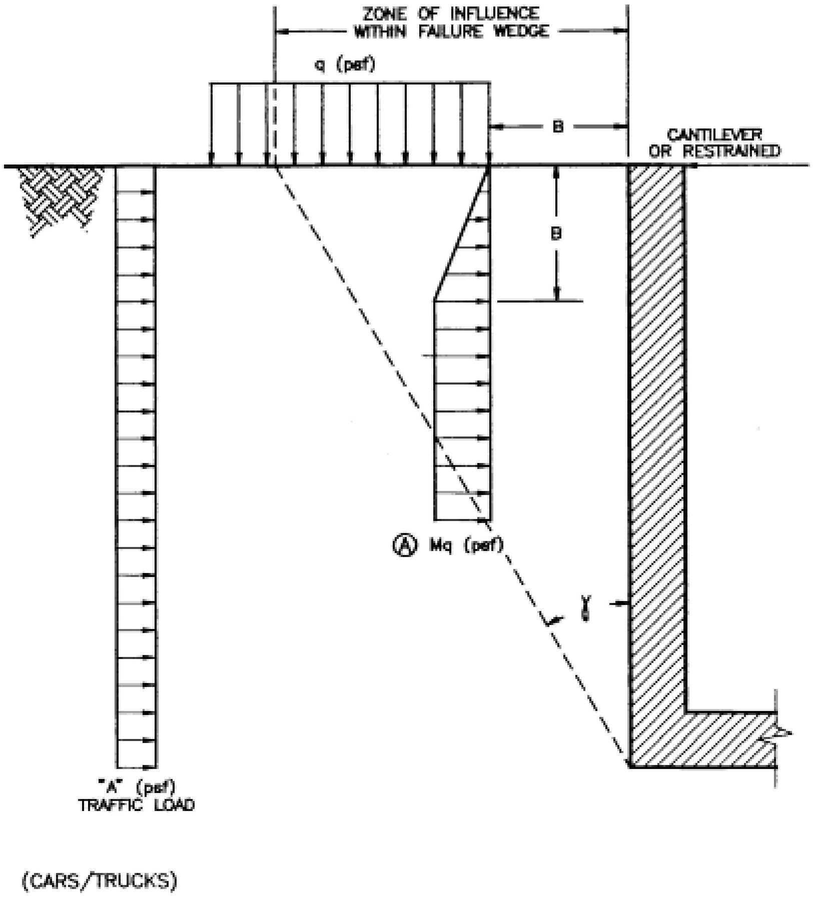
NOTES:

1. Surcharge pressure acting on wall is not affected by groundwater elevation.

2. Surcharge pressures shown are applicable for continuous footing only. Spread footings need to be evaluated individually.

FOUNDATION INDUCED WALL PRESSURE
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

PROJECT NO. **190 GS-18-D**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 9**



NON-EXPANSIVE BACKFILL

q = surcharge load (psf)
B = distance between wall and surcharge load, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall
Ⓐ = Mq, psf
"A" = 75 psf
γ = 30°

NOTE: Surcharge pressure acting on wall is not affected by groundwater elevation.

TRAFFIC INDUCED WALL PRESSURES
SOUTH MISSION BEACH GREEN INFRASTRUCTURE PROJECT

PROJECT NO. 190 GS-18-D	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 10**

APPENDIX A

FIELD EXPLORATION PROGRAM

APPENDIX A

FIELD EXPLORATION PROGRAM

The field exploration program for this project was performed on February 11 and 12, 2019. A total of four (4) soil borings, four (4) infiltration test holes, and two (2) pavement corings were performed at the approximate locations shown on Figures 2 through 5. In addition, AGE attempted to perform infiltration testing inside an existing weep sump located on the west side of Mission Boulevard, at the entrance of an alley located between Brighton Court and Capistrano Place. The soil borings were advanced to depths ranging from 15 feet to 16.5 feet below the existing ground surface (bgs). The infiltration test holes were hand-augured to depths ranging from 36 inches to 63 inches bgs. A brief description of the location and depth, pavement sections, groundwater level, and subsurface conditions encountered in the borings and infiltration test holes is presented in Table 1.

Borings B-2 and B-4 which were located in Mission Boulevard were performed with a CME-75 truck mounted drill rig. Borings B-1 and B-3 which were located on Mission Bay Park were performed with an all-terrain mounted drill rig. The soils encountered in the soil borings were visually classified and logged by an experienced engineering geologist from AGE. A Key to Logs is presented on Figures A-1 and A-2, and logs of the borings are presented on Figures A-3 thru A-6. The logs depict the various soil types encountered and indicate the depths at which samples were obtained for laboratory testing and analysis.

Prior to commencement of the field exploration activities, several site visits were performed to observe existing conditions and to select suitable locations for the soil borings and test holes. Subsequently, Underground Service Alert (USA) was contacted to coordinate clearance of the proposed boring and test hole locations with respect to existing buried utilities. The borings and test holes located in Mission Bay Park were performed in coordination with and with the approval from the City of San Diego Parks & Recreation Department.

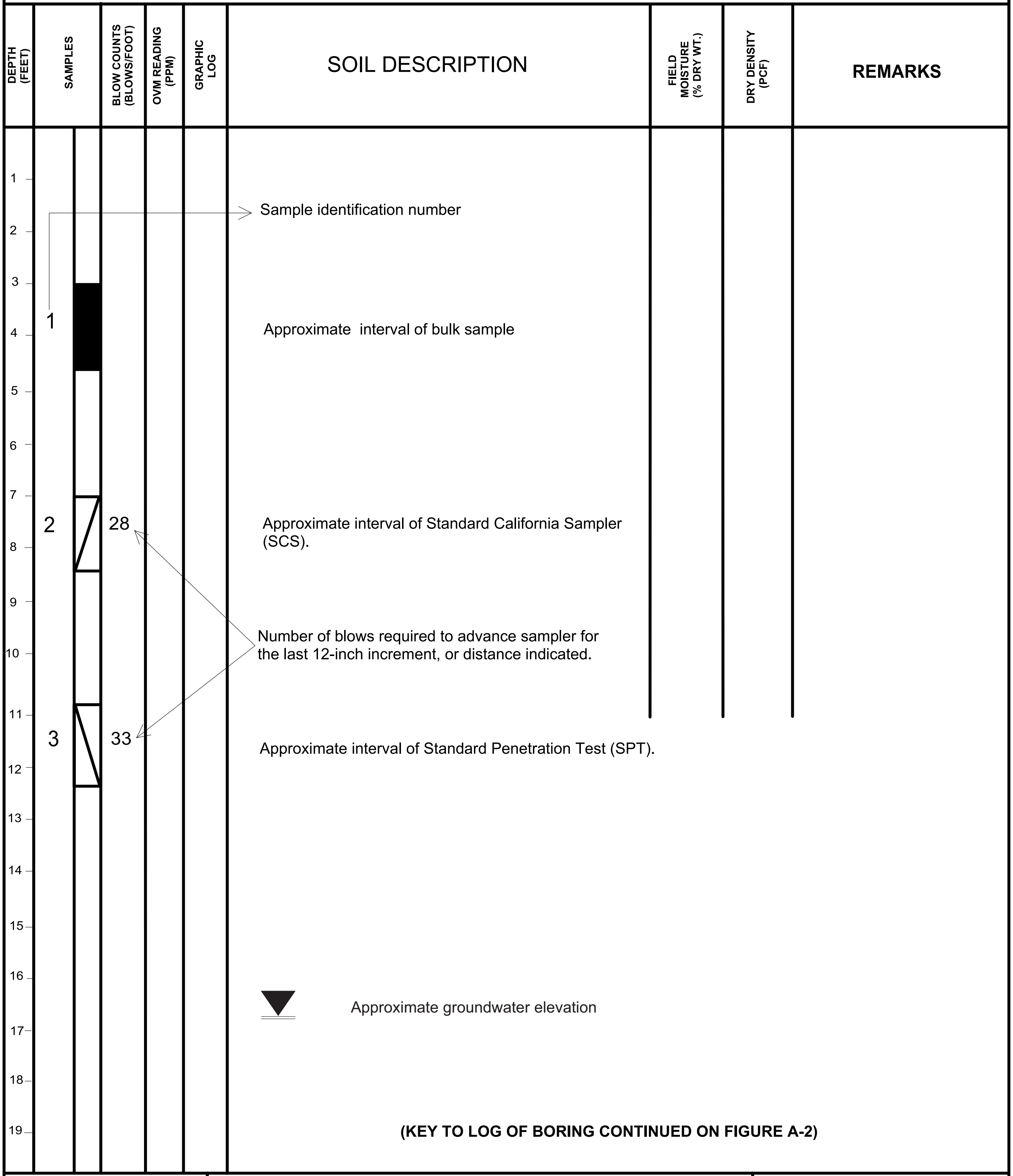
During drilling, Standard Penetration Tests (SPT) were performed at selected depth intervals. The SPT tests involve the use of a specially manufactured "split spoon" sampler which is driven a distance of approximately 18 inches into the soils at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. The number of blows required to penetrate each 6-inch increment was counted and recorded on the field logs, and have been used to evaluate the relative density and consistency of the materials. The blow counts were subsequently corrected for soil type, hammer model, groundwater and surcharge. The corrected blow counts are shown on the boring logs.

Relatively undisturbed samples were obtained by driving a 3-inch (OD) diameter standard California sampler with a special cutting tip and inside lining of thin brass rings into the soils at the bottom of the borehole. The sampler is driven a distance of approximately 18 inches into the soil at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. A 6-inch long section of soil sample that was retained in the brass rings was extracted from the sampling tube and transported to our laboratory in close-fitting, waterproof containers. The samples were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The OVM readings are indicated on the logs. In addition, loose bulk samples were also collected.

Infiltration testing inside test hole P-4 was performed using Borehole Percolation Test Methods described in Appendix F - Storm Water Infiltration/Percolation BMPs of the City of San Diego Guidelines for Geotechnical Report (2011) and Appendix D - Approved Infiltration Rate Assessment Methods of the San Diego Region Model BMP Design Manual (2018).

Upon completion of the drilling, sampling and testing activities, the borings were backfilled using bentonite grout and/or bentonite chips to approximately 12 inches below the ground surface. Borings B-1 and B-3 which were located at the beach were capped with on-site beach sand. Borings B-2 and B-4 which were performed in Mission Boulevard were capped with rapid-set concrete to match the adjacent pavement surface. Pavement coreholes C-2 and C-4 were also capped with rapid-set concrete to match the adjacent pavement surface. The infiltration test holes were backfilled with soil cuttings generated during excavation.

KEY TO LOG OF BORING



Sample identification number

Approximate interval of bulk sample

Approximate interval of Standard California Sampler (SCS).

Number of blows required to advance sampler for the last 12-inch increment, or distance indicated.

Approximate interval of Standard Penetration Test (SPT).

Approximate groundwater elevation

(KEY TO LOG OF BORING CONTINUED ON FIGURE A-2)

KEY TO LOG OF BORING (CONTINUED)

DEPTH (FEET)	SAMPLES	BLOW COUNTS (BLOWS/FOOT)	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE (% DRY WT.)	DRY DENSITY (PCF)	REMARKS
					—?— —— —?— APPROXIMATE GEOLOGIC CONTACT			
1								
2					**Strata symbols**			
3					▨ **Poorly graded sand with silt**			
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

GENERAL NOTES

1. Approximate elevations and locations of borings are based on the topographical maps provided by Rick Engineering Company, undated.
2. Soil descriptions are based on visual classification made during the field exploration and, where deemed appropriate, have been modified based on the results of laboratory tests.
3. Descriptions on the logs apply only at the specific locations and at the time the work was performed. They are not warranted to be representative of subsurface conditions at other locations or times.

BORING NO. B-1

DATE OF DRILLING: February 11, 2019 | TOTAL BORING DEPTH: 16.5’

GENERAL LOCATION: On the beach, 20' east of Bayside walk at San Fernando Place

APPROXIMATE SURFACE ELEV.: + 7.3' msl | DRILLING CONTRACTOR: Tri-County Drilling

DRILLING METHOD: Hollow-Stem Auger | LOGGED BY: Nicholas Barnes

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					HYDRAULIC FILL			
1								
2					Light gray, damp, medium grained poorly graded micaceous sand (SP-SM) with traces of broken shells.			
3								
4								
5								
6	1	25	1.6			6.2	105.6	
7								
8								
9								
10			?					?
11	2	17	0.1		**OLD PARALIC DEPOSITS** ▼	22.2		
12	3				Dark greenish gray, wet, medium grained poorly graded micaceous sand (SP-SM)			
13								
14								
15	4							
16	5	23				30.3	95.1	

17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

NOTES:

Boring terminated at depth of 16.5' bgs. No refusal.
Water level measured at depth of 11' bgs 10 minutes after completion of the drilling operations.

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-3

BORING NO. B-2

DATE OF DRILLING: February 12, 2019
TOTAL BORING DEPTH: 15’
GENERAL LOCATION: Southbound Mission Boulevard, approximately 40' south of San Fernando Place and 4' from median.
APPROXIMATE SURFACE ELEV.: +6.3' msl
DRILLING CONTRACTOR: Tri-County Drilling
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: Nicholas Barnes

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**PAVEMENT SECTION:** 4" A.C. over 8" P.C.C. underlain by 6" of miscellaneous base			
2					**OLD PARALIC DEPOSITS**			
3					Greenish gray, wet, medium grained poorly-graded micaceous sand with silt (SP-SM) with traces of broken shells.			
4					▼			
5								
6	1 2	34				26.0		
7								
8	3							
9								
10	4	26				26.3		
11								
12								
13								
14	5					24.7		
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								

NOTES:

Boring terminated at depth of 15' bgs. No refusal. Water level measured at depth of 4'-3" bgs at the completion of the drilling operation.

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-4

BORING NO. B-3

DATE OF DRILLING: February 11, 2019
TOTAL BORING DEPTH: 16.5
GENERAL LOCATION: On the beach, 20' east of Bayside walk at Coronado Court
APPROXIMATE SURFACE ELEV.: +5.2' msl
DRILLING CONTRACTOR: Tri-County Drilling
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: Nicholas Barnes

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**HYDRAULIC FILL**			
2					Greenish gray, wet, fine- to medium-grained poorly graded micaceous silty sand (SP-SM)			
3								
4					▼			
5								
6	1	27				25.5		
7								
8	2							
9	3					21.4		
10			?					?
11	4	26			**OLD PARALIC DEPOSITS**			Heaving sand. No sample recovery.
12					Greenish gray, wet, fine- to medium-grained poorly graded micaceous silty sand (SP-SM)			
13								
14								
15	5					24.9		
16								

NOTES:

First attempt encountered refusal at 3’ bgs and the boring location was moved 10 feet to the east.
Boring terminated at depth of 16.5' bgs. No refusal.
Water level measured at depth of 4' bgs at the completion of the drilling operation.

17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

BORING NO. B-4

DATE OF DRILLING: February 12, 2019
TOTAL BORING DEPTH: 15
GENERAL LOCATION: Southbound Mission Boulevard, approximately 60' south of Brighton Court
APPROXIMATE SURFACE ELEV.: +5' msl
DRILLING CONTRACTOR:
DRILLING METHOD:
LOGGED BY: Nicholas Barnes

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**PAVEMENT SECTION:**			
2					4.5" A.C. over 7.5" P.C.C. underlain by 4" of miscellaneous base			
3					▼ **OLD PARALIC DEPOSITS**			
4					Greenish gray, wet, medium grained poorly-graded micaceous sand with silt (SP-SM) with traces of broken shells and rounded gravels.			
5								
6	1 2	35						
7								
8	3		2.0			29.1		
9								
10	4		2.2			29.6		
11								
12								
13								
14	5		0.5			24.2		
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								

NOTES:

Boring terminated at depth of 15' bgs. No refusal. Water level measured at depth of 3'-3" bgs at the completion of the drilling operation.

PROJECT NO.
190 GS-18-D

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-6

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

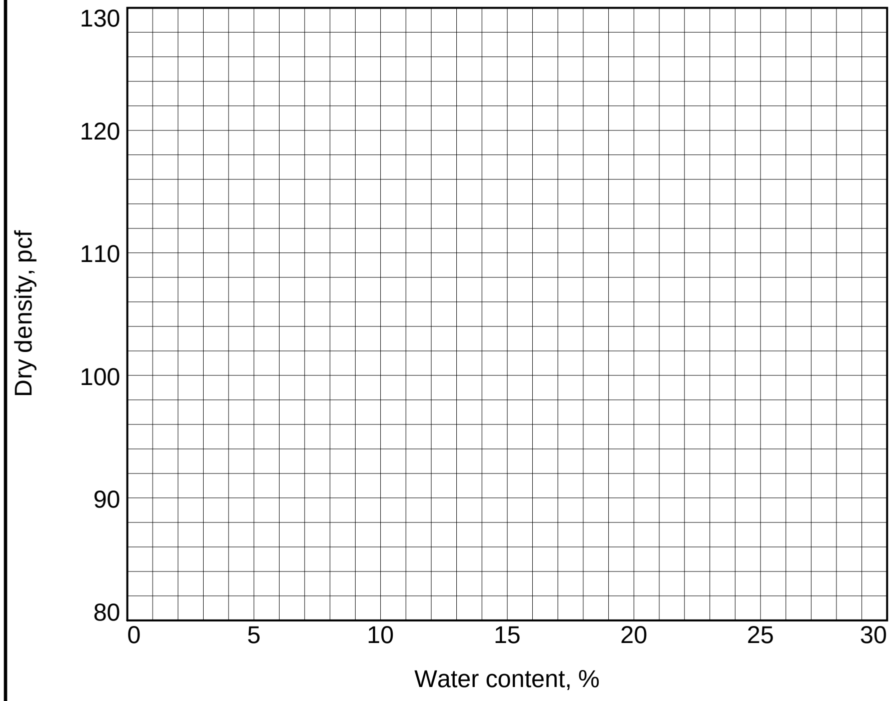
Selected soil samples were tested in the laboratory to verify visual field classifications and to evaluate certain engineering characteristics. The testing was performed in accordance with the American Society for Testing and Materials (ASTM) or other generally accepted test methods, and included the following:

- Determination of in-place moisture content (ASTM D2216). The final test results are presented on the test pit logs;
- Determination of in-place dry density and moisture content (ASTM D2937) based on relatively undisturbed drive samples. The final test results are presented on the test pit logs;
- Maximum density and optimum moisture content (ASTM D1557). The final test results are presented on Figures B-1 thru B-3;
- Sieve analyses (ASTM D422), and the final test results are plotted as gradation curves on Figures B-4 and B-5;
- Direct shear test (ASTM D3080). The test results are presented on Figures B-6 and B-7; and
- Consolidation (ASTM D2435). The test results are presented on Figure B-8.

In addition, representative samples of the onsite soil materials were delivered to Clarkson Laboratory and Supply, Inc. for analytical (chemical) testing to determine soil pH and resistivity, soluble sulfate and chloride concentrations, and bicarbonate content. Copies of Clarkson's laboratory test data reports are included herein.

Representative samples of the soil materials underlying Mission Boulevard were delivered to Southern California Soil & Testing (SCS&T) for R-Value testing. Copies of SCS&T's laboratory test data reports are included herein.

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-91 Procedure A Modified

Preparation Method
Hammer Wt. 10 lb.
Hammer Drop 18 in.
Number of Layers five
Blows per Layer 25
Mold Size 0.03333 cu. ft.

Test Performed on Material Passing #4 **Sieve**

NM 6.2 **LL** **PI**
Sp.G. (ASTM D 854) 2.6
%>#4 **%<No.200**
USCS **AASHTO**
Date Sampled
Date Tested
Tested By

TESTING DATA

	1	2	3	4	5	6
WM + WS						
WM						
WW + T #1						
WD + T #1						
TARE #1						
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE						
DRY DENSITY						

TEST RESULTS

Material Description

Dark greenish gray poorly-graded sand with silt (SP-SM)

Remarks:

Project No. 190 GS-18-D **Client:** Rick Engineering Company
Project: South Mission Beach Project

○ **Source of Sample:** B-1 **Depth:** 5 **Sample Number:** 1

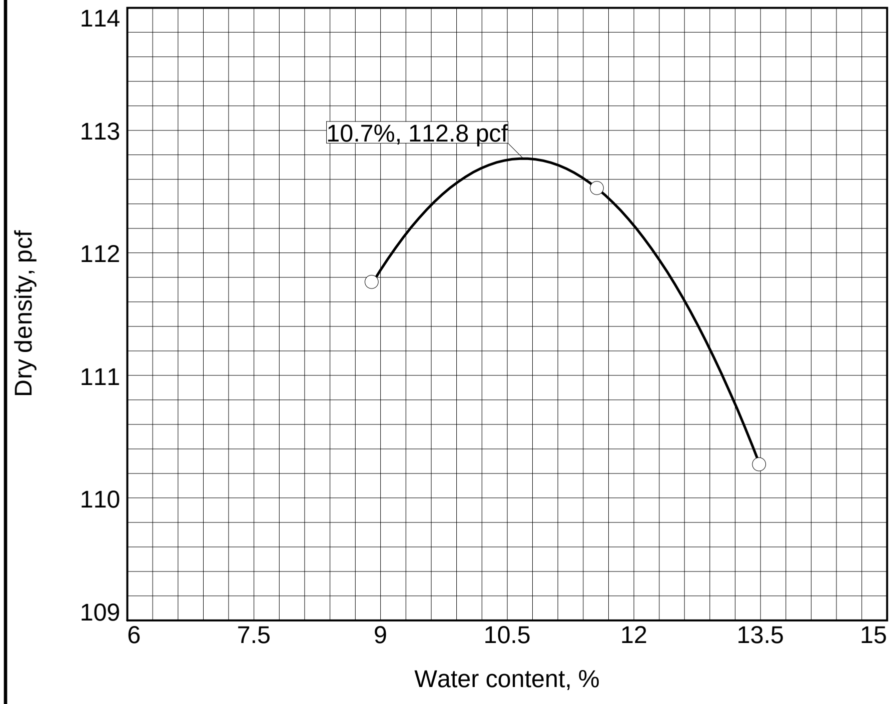
Allied Geotechnical Engineers, Inc.

Santee, CA

Checked by:
Title:

Figure B-1

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-91 Procedure A Modified

Preparation Method Wet
Hammer Wt. 10 lb.
Hammer Drop 18 in.
Number of Layers five
Blows per Layer 25
Mold Size 0.03333 cu. ft.

Test Performed on Material Passing #4 **Sieve**

NM 22.2 **LL** NV **PI**
Sp.G. (ASTM D 854)
%>#4 1.0 **%<No.200** 10.0
USCS SP-SM **AASHTO** A-3
Date Sampled 02/12/2019
Date Tested 02/21/2019
Tested By Nicholas Barnes

TESTING DATA

	1	2	3	4	5	6
WM + WS	5932.0	5926.0	5874.0			
WM	4034.0	4034.0	4034.0			
WW + T #1	531.6	520.0	493.9			
WD + T #1	482.6	466.7	459.5			
TARE #1	59.2	71.7	73.2			
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	11.6	13.5	8.9			
DRY DENSITY	112.5	110.3	111.8			

TEST RESULTS

Maximum dry density = 112.8 pcf

Optimum moisture = 10.7 %

Material Description

Dark greenish gray poorly-graded sand with silt (SP-SM)

Remarks:

Project No. 190 GS-18-D **Client:** Rick Engineering Company
Project: South Mission Beach Project

○ **Source of Sample:** B-1 **Depth:** 10 **Sample Number:** 2

Allied Geotechnical Engineers, Inc.

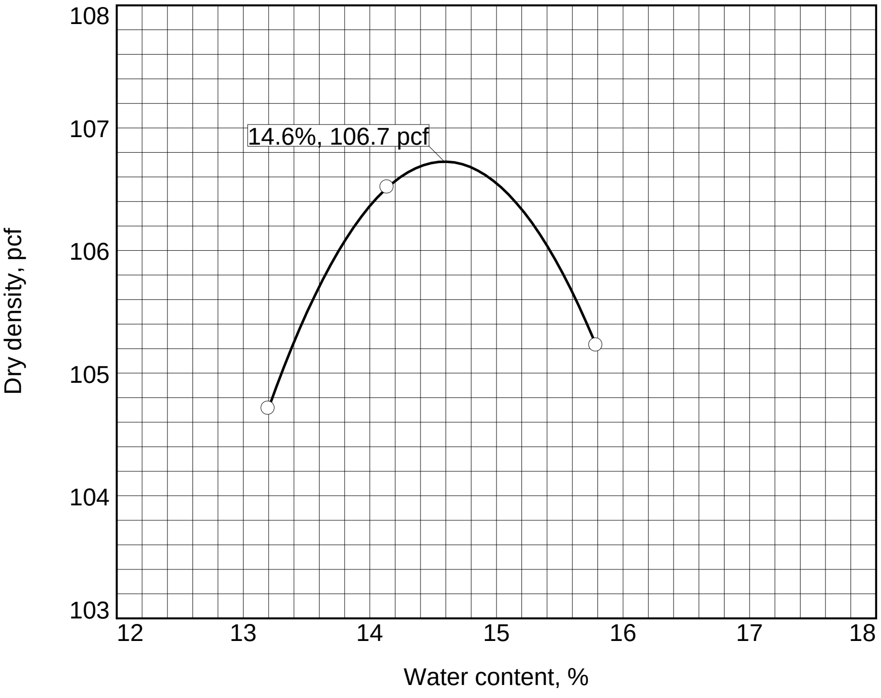
Santee, CA

Checked by: Sani Sutanto
Title: Project Manager

Figure B-2

COMPACTION TEST REPORT

Curve No.



Test Specification:
ASTM D 1557-91 Procedure A Modified

Preparation Method Wet
Hammer Wt. 10 lb.
Hammer Drop 18 in.
Number of Layers five
Blows per Layer 25
Mold Size 0.03333 cu. ft.
Test Performed on Material Passing #4 **Sieve**

NM ______ **LL** NV **PI** ______
Sp.G. (ASTM D 854) ______
%>#4 0.1 **%<No.200** 5.1
USCS SP-SM **AASHTO** A-3
Date Sampled 02/12/2019
Date Tested 02/21/2019
Tested By Nicholas Barnes

TESTING DATA

	1	2	3	4	5	6
WM + WS	5826.0	5872.0	5876.0			
WM	4034.0	4034.0	4034.0			
WW + T #1	491.0	475.3	486.0			
WD + T #1	440.0	424.2	428.2			
TARE #1	53.6	62.8	62.1			
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	13.2	14.1	15.8			
DRY DENSITY	104.7	106.5	105.2			

TEST RESULTS

Maximum dry density = 106.7 pcf

Optimum moisture = 14.6 %

Material Description

Greenish gray poorly graded sand with silt (SP-SM)

Remarks:

Project No. 190 GS-18-D **Client:** Rick Engineering Company
Project: South Mission Beach Project

○ **Source of Sample:** B-3 **Depth:** 6

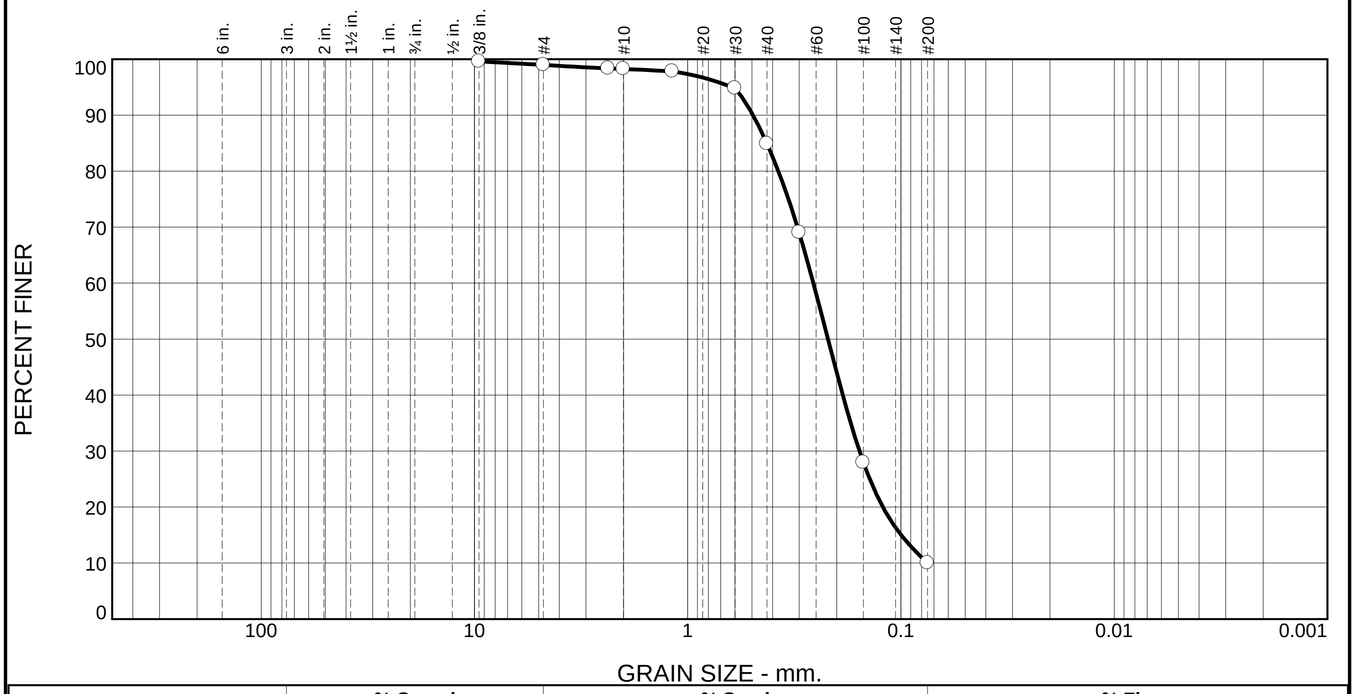
Allied Geotechnical Engineers, Inc.

Santee, CA

Checked by: Sani Sutanto
Title: Project Manager

Figure B-3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
			0.8	13.3	74.9	10.0	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375	99.6		
#4	99.0		
#8	98.4		
#10	98.2		
#16	97.8		
#30	94.8		
#40	84.9		
#50	69.0		
#100	27.9		
#200	10.0		

* (no specification provided)

Material Description

Dark greenish gray poorly-graded sand with silt (SP-SM)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.4940	D_{85}= 0.4263	D_{60}= 0.2575
D_{50}= 0.2199	D_{30}= 0.1566	D_{15}= 0.0998
D_{10}=	C_u=	C_c=

Remarks

Date Received: ____________ **Date Tested:** 02/21/2019

Tested By: Nicholas Barnes

Checked By: Sani Sutanto

Title: Project Manager

Source of Sample: B-1 **Depth:** 10 **Date Sampled:** 02/12/2019

Sample Number: 2

Allied Geotechnical Engineers, Inc.

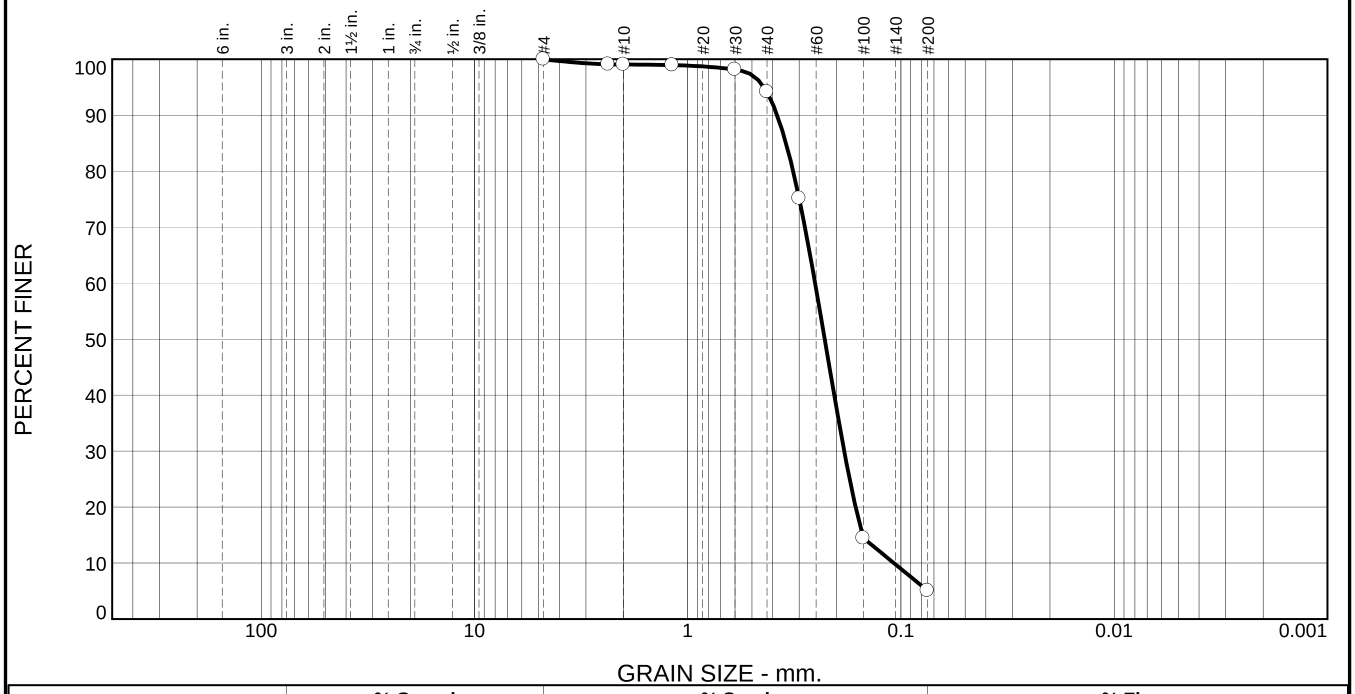
Santee, CA

Client: Rick Engineering Company

Project: South Mission Beach Project

Project No: 190 GS-18-D **Figure** B-4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
			0.9	4.9	89.0	5.1	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	99.9		
#8	99.1		
#10	99.0		
#16	98.9		
#30	98.1		
#40	94.1		
#50	75.1		
#100	14.5		
#200	5.1		

* (no specification provided)

Material Description

Greenish gray poorly graded sand with silt (SP-SM)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.3806 D_{85}= 0.3460 D_{60}= 0.2527
D_{50}= 0.2279 D_{30}= 0.1846 D_{15}= 0.1514
D_{10}= 0.1079 C_u= 2.34 C_c= 1.25

Remarks

Date Received: 02/12/2019 **Date Tested:** 02/21/2019

Tested By: Nicholas Barnes

Checked By: Sani Sutanto

Title: Project Manager

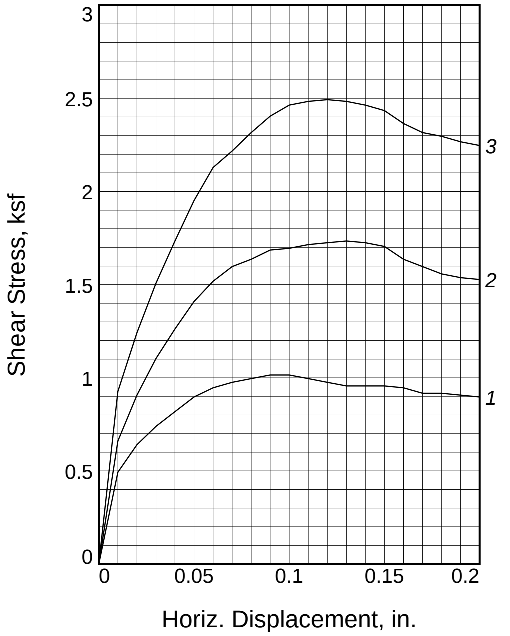
Source of Sample: B-3 **Depth:** 6 **Date Sampled:** 02/12/2019

Allied Geotechnical Engineers, Inc.

Santee, CA

Client: Rick Engineering Company
Project: South Mission Beach Project
Project No: 190 GS-18-D **Figure** B-5

	Results
C, ksf	0.27
ϕ, deg	36.5
Tan(ϕ)	0.74



	Sample No.	1	2	3
Initial	Water Content, %	31.5	31.0	30.7
	Dry Density, pcf	94.1	95.8	94.6
	Saturation, %	113.0	116.0	111.6
	Void Ratio	0.7253	0.6944	0.7159
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	0.0	0.0	0.0
	Dry Density, pcf	95.4	96.8	95.3
	Saturation, %	0.0	0.0	0.0
	Void Ratio	0.7012	0.6774	0.7039
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.99	0.99	0.99
Normal Stress, ksf		1.00	2.00	3.00
Fail. Stress, ksf		1.02	1.73	2.49
Displacement, in.		0.09	0.13	0.12
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.		0.008	0.008	0.008

Sample Type: Ring
Description:

Assumed Specific Gravity= 2.6
Remarks:

Figure B-6

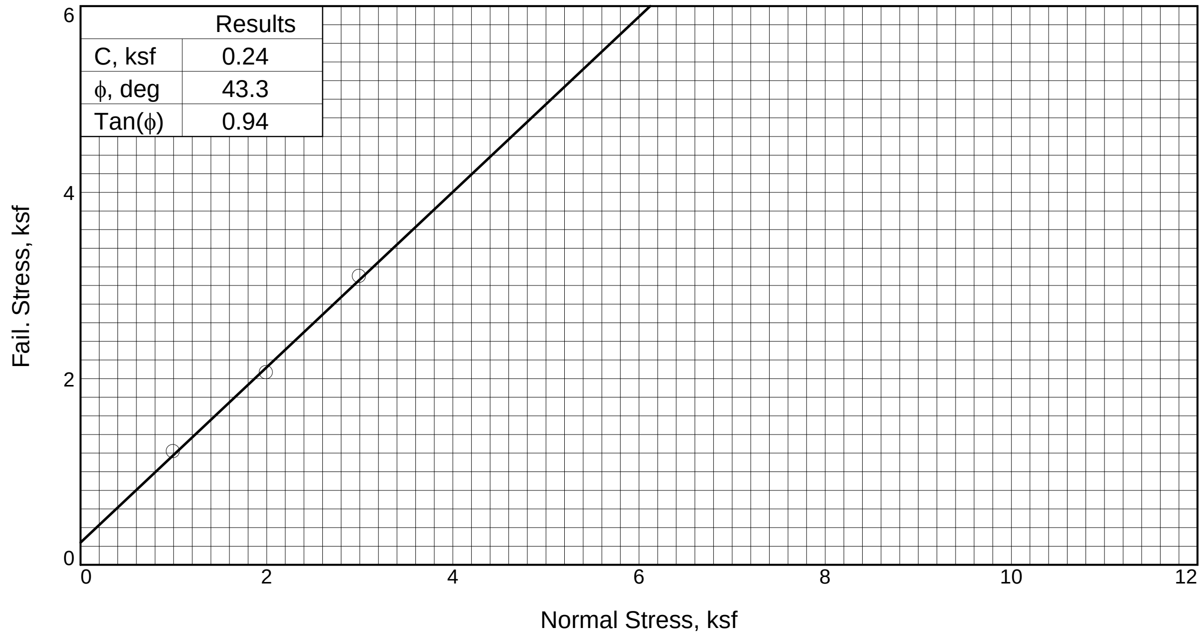
Client: Rick Engineering Company

Project: South Mission Beach Project

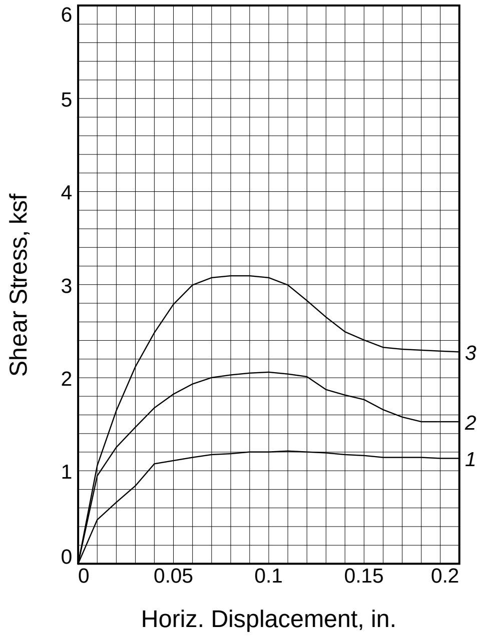
Source of Sample: B-1 **Depth:** 15
Sample Number: 5
Proj. No.: 190 GS-18-D **Date Sampled:** 02/12/2019

DIRECT SHEAR TEST REPORT
Allied Geotechnical Engineers, Inc.
Santee, CA

Tested By: Nicholas Barnes



	Results
C, ksf	0.24
ϕ, deg	43.3
Tan(ϕ)	0.94



	Sample No.	1	2	3
Initial	Water Content, %	22.0	22.1	23.1
	Dry Density, pcf	103.1	102.8	101.4
	Saturation, %	99.7	99.1	99.8
	Void Ratio	0.5742	0.5795	0.6010
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	22.5	22.8	23.2
	Dry Density, pcf	105.7	105.0	102.8
	Saturation, %	109.5	108.3	104.4
	Void Ratio	0.5349	0.5463	0.5785
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.97	0.98	0.99
	Normal Stress, ksf	1.00	2.00	3.00
	Fail. Stress, ksf	1.21	2.06	3.09
	Displacement, in.	0.11	0.10	0.08
	Ult. Stress, ksf			
	Displacement, in.			
	Strain rate, in./min.	0.008	0.008	0.008

Sample Type: Ring

Description:

Assumed Specific Gravity= 2.6

Remarks:

Figure B-7

Client: Rick Engineering Company

Project: South Mission Beach Project

Source of Sample: B-4 **Depth:** 5

Sample Number: 1

Proj. No.: 190 GS-18-D **Date Sampled:** 02/11/2019

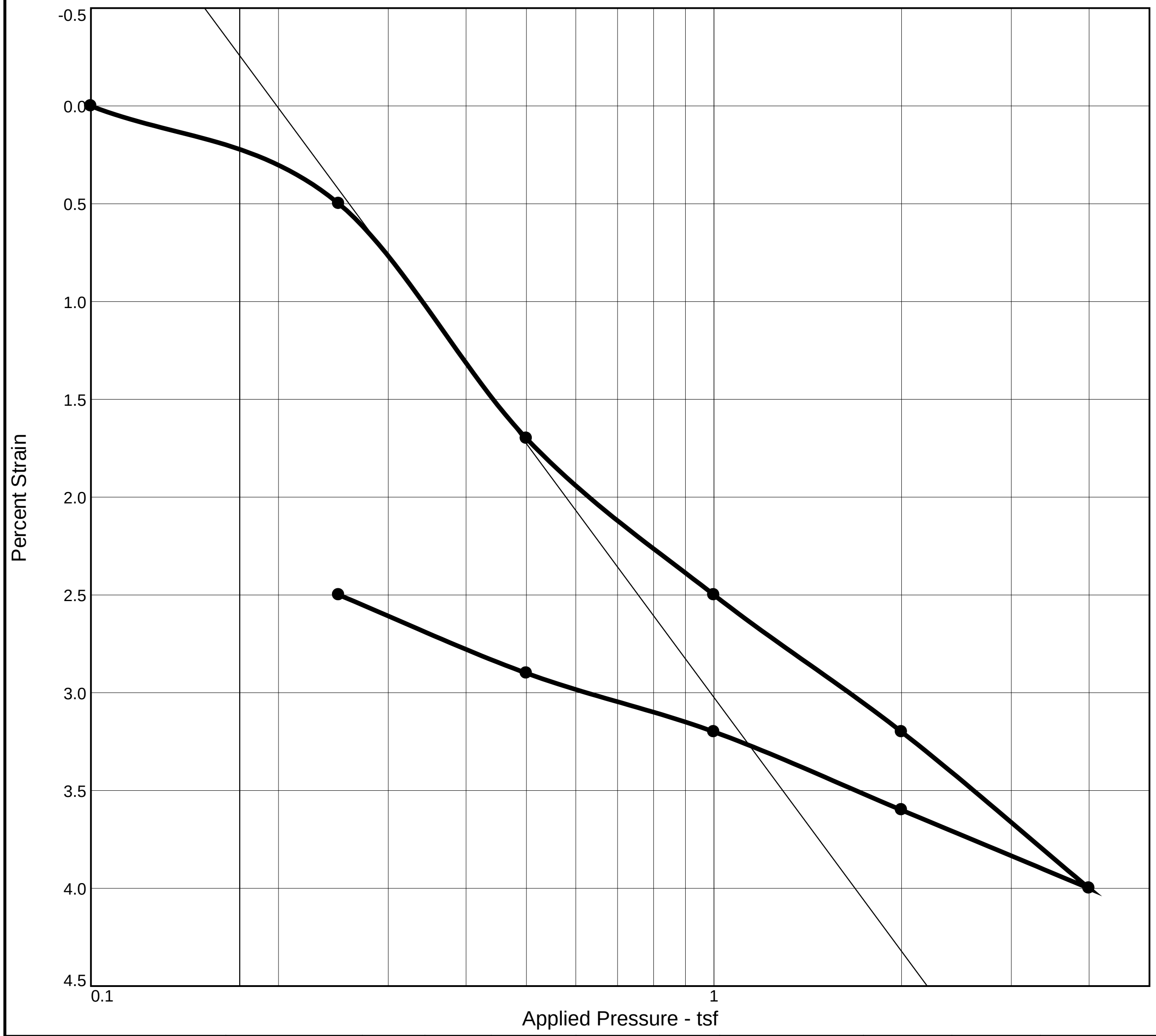
DIRECT SHEAR TEST REPORT

Allied Geotechnical Engineers, Inc.

Santee, CA

Tested By: Nicholas Barnes

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
34.0 %	7.1 %	98.2			2.6	0.1	0.2	0.07		0.543

MATERIAL DESCRIPTION	USCS	AASHTO
Dark greenish gray poorly-graded sand with silt (SP-SM)		

Project No. 190 GS-18-D **Client:** Rick Engineering Company

Project: South Mission Beach Project

Source of Sample: B-1 **Depth:** 5 **Sample Number:** 1

Allied Geotechnical Engineers, Inc.

Santee, CA

Remarks:

Figure B-8

Tested By: Nicholas Barnes **Checked By:** Sani Sutanto

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: February 19, 2019
Purchase Order Number: 190GS18-D
Sales Order Number: 43345
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO7200-4 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 02/15/19 at 9:00am,
from South Mission Beach Green Infrastructure Project marked as B-4#4@10'-11'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 9.2

Water Added (ml)	Resistivity (ohm-cm)
10	2200
5	1500
5	1100
5	930
5	880
5	750
5	730
5	830
5	840

27 years to perforation for a 16 gauge metal culvert.
35 years to perforation for a 14 gauge metal culvert.
48 years to perforation for a 12 gauge metal culvert.
62 years to perforation for a 10 gauge metal culvert.
75 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140 ppm)
Water Soluble Chloride Calif. Test 422	0.062% (620 ppm)
Bicarbonate (as $CaCO_3$) (on a saturated soil paste extract)	46 ppm

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: February 19, 2019
Purchase Order Number: 190GS18-D
Sales Order Number: 43345
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO7200-3 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:
--
One soil sample received on 02/15/19 at 9:00am,
from South Mission Beach Green Infrastructure Project marked as B-3#3@9'-10'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 9.3

Water Added (ml)	Resistivity (ohm-cm)
10	39000
5	29000
5	19000
5	14000
5	10000
5	8800
5	7700
5	8300
5	9300

71 years to perforation for a 16 gauge metal culvert.
92 years to perforation for a 14 gauge metal culvert.
127 years to perforation for a 12 gauge metal culvert.
162 years to perforation for a 10 gauge metal culvert.
198 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.003% (30 ppm)

Water Soluble Chloride Calif. Test 422 0.003% (30 ppm)

Bicarbonate (as CaCO$_3$) 66 ppm
(on a saturated soil paste extract)

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: February 19, 2019
Purchase Order Number: 190GS18-D
Sales Order Number: 43345
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO7200-2 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 02/15/19 at 9:00am,
from South Mission Beach Green Infrastructure Project marked as B-2#3@8'-9'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 9.3

Water Added (ml)	Resistivity (ohm-cm)
10	13000
5	9500
5	6900
5	5100
5	4000
5	3500
5	3200
5	3500
5	3600

49 years to perforation for a 16 gauge metal culvert.
64 years to perforation for a 14 gauge metal culvert.
89 years to perforation for a 12 gauge metal culvert.
113 years to perforation for a 10 gauge metal culvert.
138 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.007% (70 ppm)

Water Soluble Chloride Calif. Test 422 0.005% (50 ppm)

Bicarbonate (as $CaCO_3$) 66 ppm
(on a saturated soil paste extract)

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: February 19, 2019
Purchase Order Number: 190GS18-D
Sales Order Number: 43345
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO7200-1 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 02/15/19 at 9:00am, from South Mission Beach Green Infrastructure Project marked as B-1#4@14'-15'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
20	270
5	220
5	140
5	130
5	130
5	130
5	130
5	140
5	160

13 years to perforation for a 16 gauge metal culvert.
17 years to perforation for a 14 gauge metal culvert.
24 years to perforation for a 12 gauge metal culvert.
30 years to perforation for a 10 gauge metal culvert.
37 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.105% (1050 ppm)

Water Soluble Chloride Calif. Test 422 0.363% (3630 ppm)

Bicarbonate (as $CaCO_3$) 46 ppm
(on a saturated soil paste extract)

Laura Torres

Laura Torres
LT/dbb

R-Value

Cal 301, ASTM D2844

Report Date: 3/11/2019

SCST, LLC - San Diego
LEA: 47, Exp: 04/25/2021
6280 Riverdale Street
San Diego, CA 92120
Phone: (619) 280-4321
Fax: (619) 280-4717

Client:	**Project:**
Allied Geotechnical Engineering 9500 Cuyamaca Street #102 Santee, CA 92071-2685	180035L Allied Geotechnical 2018 Lab Testing 9500 Cuyamaca Street Suite 102 Santee CA 9207...

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report. See R-Value 37891.pdf in the documents section at the end of this report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

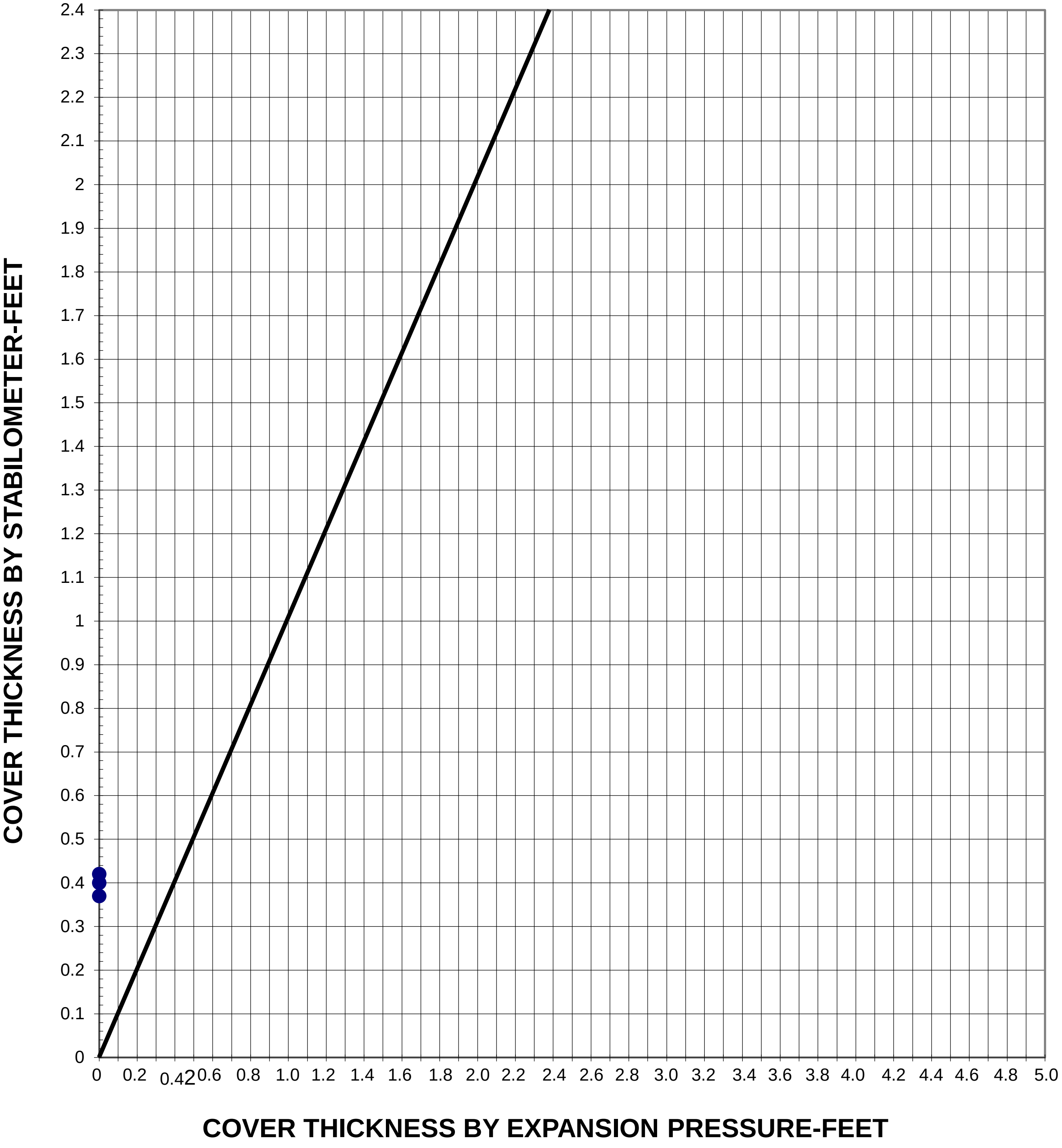
SCST, LLC
Corporate Headquarters
6280 Riverdale Street
San Diego, CA 92120
T 877.215.4321
P 619.280.4321
F 619.280.4717
W www.scst.com

Job Name: Allied Geotechnical 2018 Lab Testing **Job Number:** 180035L
Client: Allied Geotechnical Engineering **Sample No.:** 37891
Date: 3/5/2019 **By:** DRB
Location: B-4-2 @ 5'-8'
Description: Light Tan Sand

CTM 301 Resistance Value of Treated and Untreated Bases, Subbases and Basement Soils

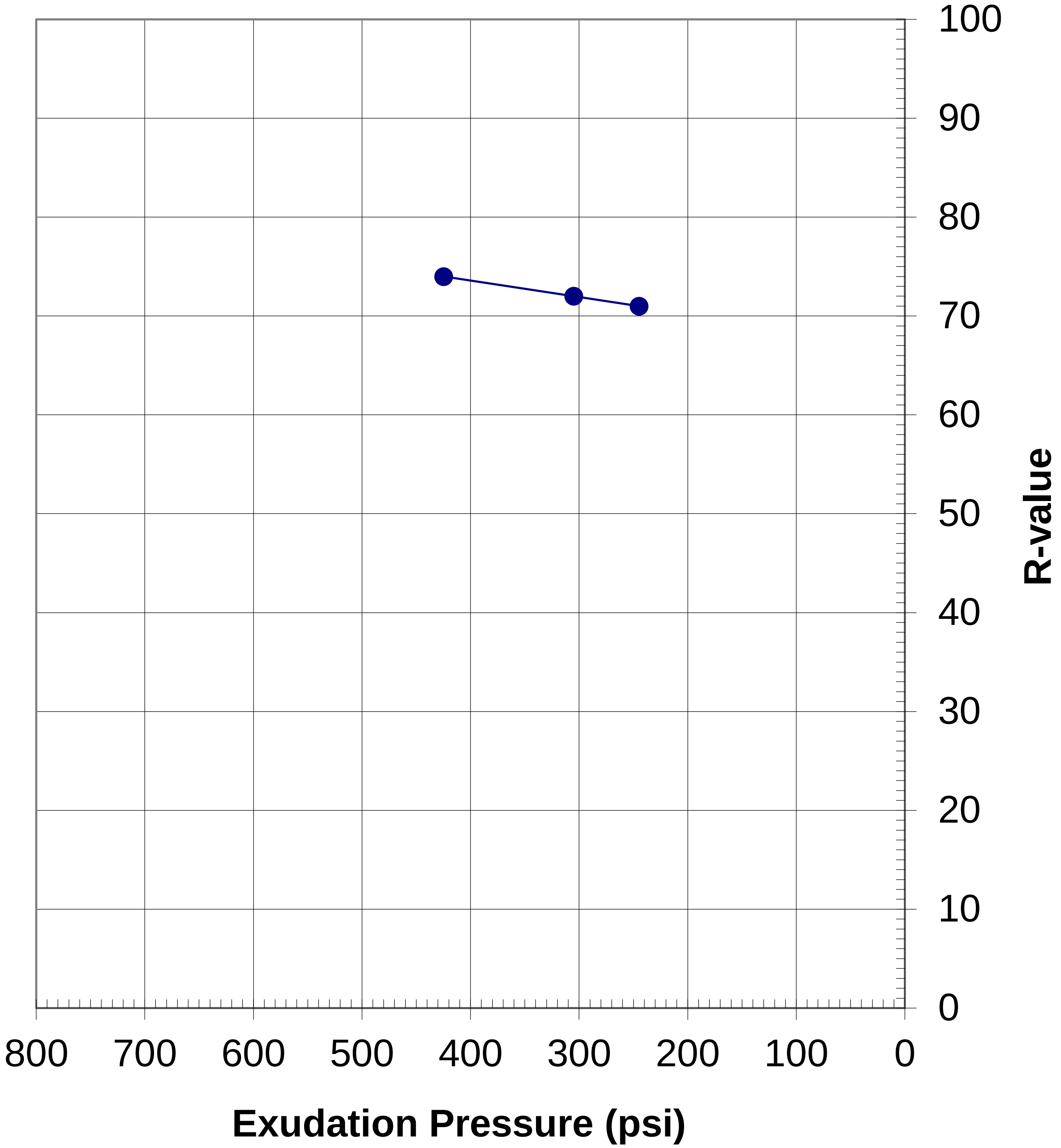
Test Specimen		**A**	**B**	**C**	**D**
Date Tested		3/5/2019	3/5/2019	3/5/2019	
Compactor Air Pressure	**PSI**	350	350	350	
Initial Moisture	**%**	0.4	0.4	0.4	
Soil Wt. Added	**GRAMS**	850	850	850	
Water Added	**ML**	90	103	84	
Water Added	**%**	10.6	12.2	9.9	
Moisture At Compaction	**%**	11	12.6	10.3	
Weight of Briquette & Tare	**GRAMS**	2983	2985	2979	
Net Weight of Briquette	**GRAMS**	929	944	924	
Briquette Height	**IN**	2.49	2.52	2.52	
Density	**PCF**	101.8	100.8	100.7	
Exudation Pressure	**PSI**	305	245	425	
Expansion Pressure	**PSF**	0	0	0	
PH at 1000 Pounds	**PSI**	13	13	12	
PH at 2000 Pounds	**PSI**	23	24	22	
Displacement	**Turns**	5.65	5.70	5.60	
R' Value		72	71	74	
Stabilometer Thickness	**FT**	0.4	0.42	0.37	
Expansion Thickness	**FT**	0	0	0	
Expansion Dial Reading		0000	0000	0000	
R' Value Modifier		0	0	0	
Corrected R-Value		72	71	74	
R-Value by Exudation Pressure		72			
Gravel Equivalent		0	0	0	
Traffic Index		4.5	4.5	4.5	
R-Value by Expansion Pressure		N/A			
R-Value at Equivalent		**72**			

EXPANSION PRESSURE CHART



Job Name:	**Allied Geotechnical 2018 Lab Testing**		
By:	**DRB**	**Date:**	**3/5/2019**
Job No.:	**180035L**	**Sample No.:**	**B-4-2 @ 5'-8'**
Gravel Equ:	**0**	**Plate No.:**	

R-value By Exudation Pressure



Job Name:	**Allied Geotechnical 2018 Lab Testing**		
By:	**DRB**	**Date:**	**3/5/2019**
Job No.:	**180035L**	**Sample No.:**	**B-4-2 @ 5'-8'**
R-Value by Ex.:	**72**	**Plate No.:**	

R-Value

Cal 301, ASTM D2844

Report Date: 3/11/2019

SCST, LLC - San Diego
LEA: 47, Exp: 04/25/2021
6280 Riverdale Street
San Diego, CA 92120
Phone: (619) 280-4321
Fax: (619) 280-4717

Client:

Allied Geotechnical Engineering
9500 Cuyamaca Street #102
Santee, CA 92071-2685

Project:

180035L
Allied Geotechnical 2018 Lab Testing
9500 Cuyamaca Street Suite 102 Santee CA 9207...

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

In accordance with your request, SCST has performed the subject laboratory testing. Test results are presented in the attached report. See R-Value 37892.pdf in the documents section at the end of this report.

If you have any additional questions or concerns, please contact us at 619.280.4321

Respectfully Submitted,
SCST, Inc.

SCST, LLC
Corporate Headquarters
6280 Riverdale Street
San Diego, CA 92120
T 877.215.4321
P 619.280.4321
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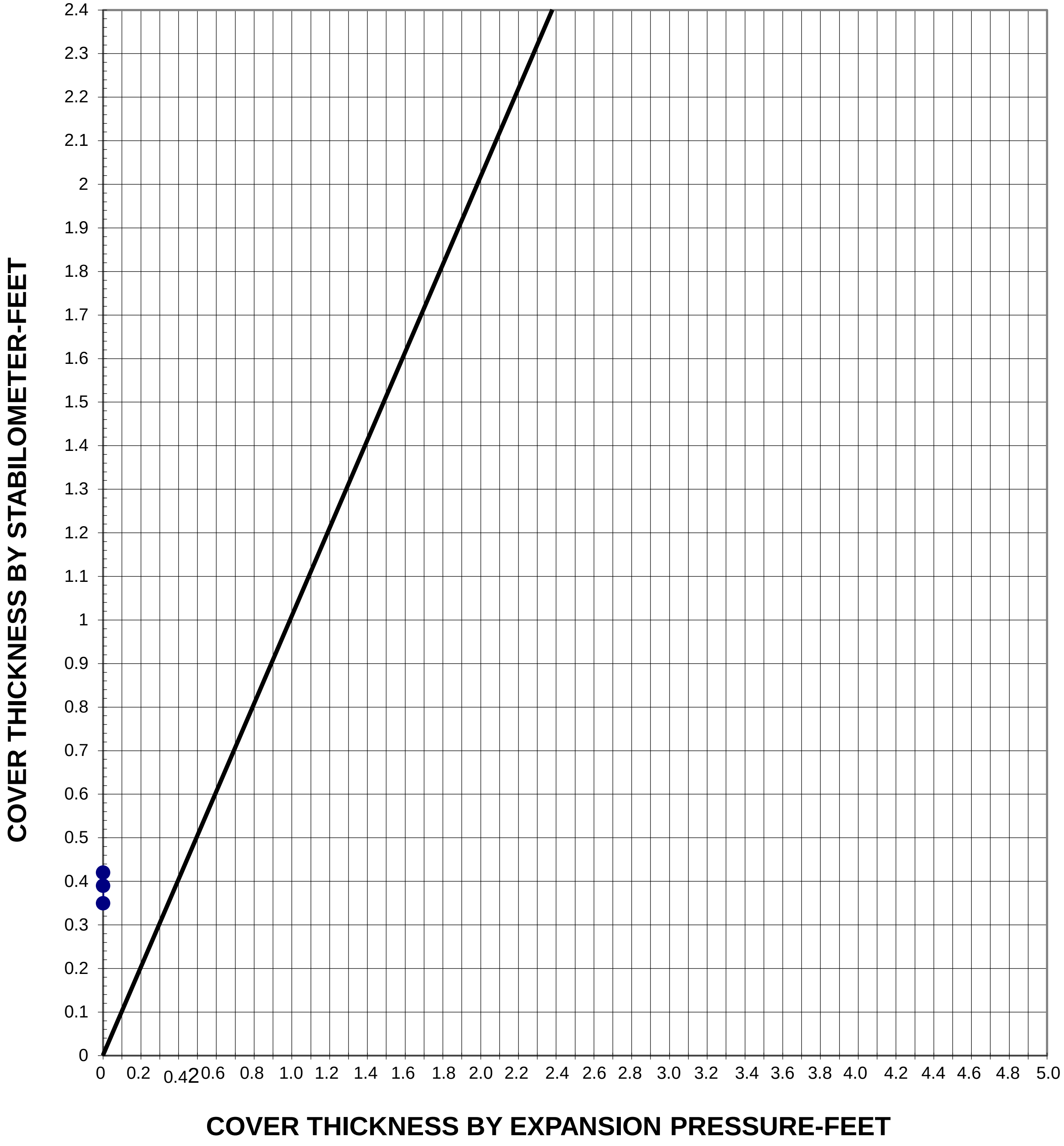
Job Name: Allied Geotechnical 2018 Lab Testing **Job Number:** 180035L
Client: Allied Geotechnical Engineering **Sample No.:** 37892
Date: 3/5/2019 **By:** DRB
Location: B-2-2 @ 5'-8'
Description: Light Grey Brown Silty Sand

CTM 301 Resistance Value of Treated and Untreated Bases, Subbases and Basement Soils

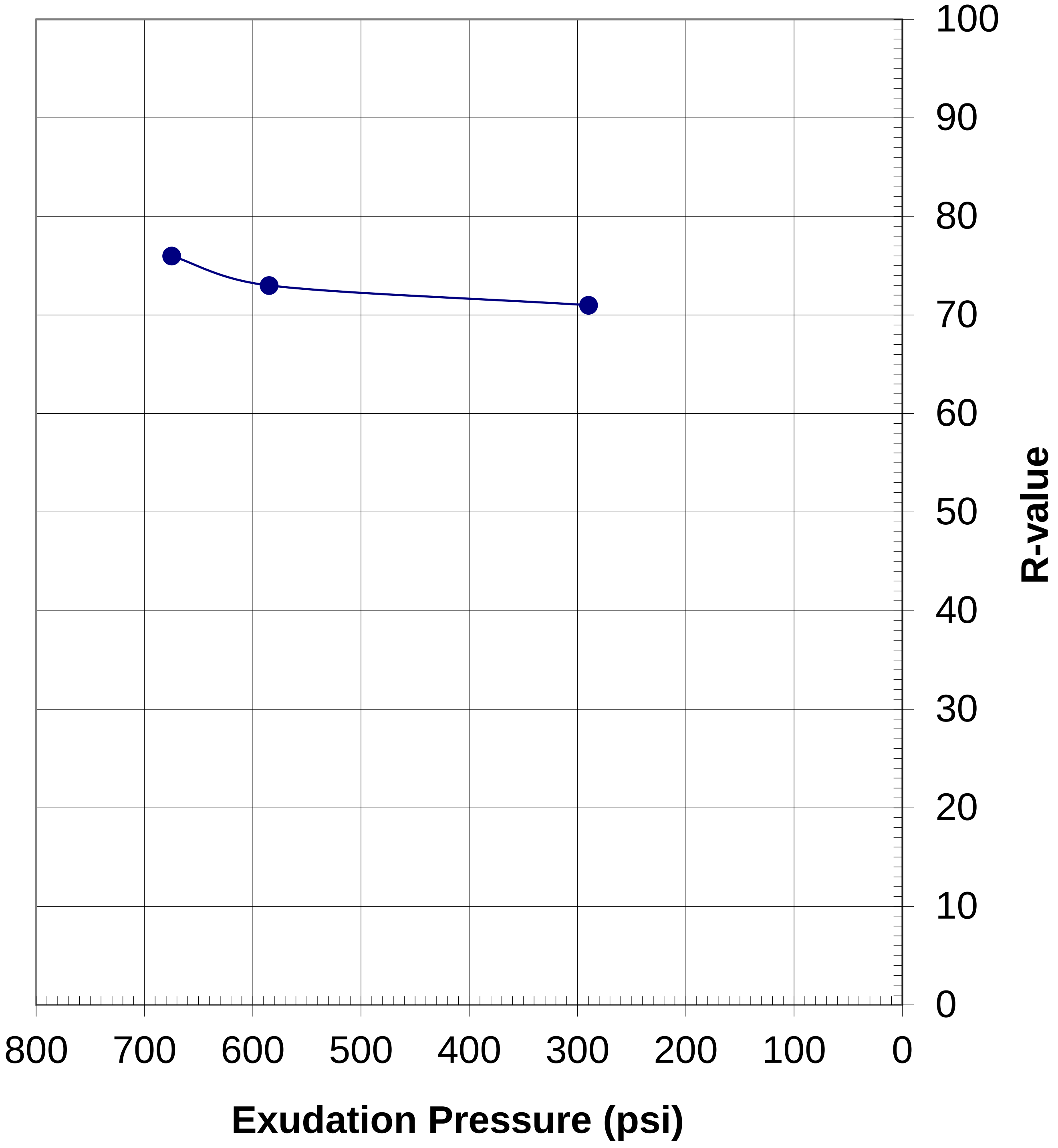
Test Specimen		**A**	**B**	**C**	**D**
Date Tested		3/5/2019	3/5/2019	3/5/2019	
Compactor Air Pressure	**PSI**	350	350	350	
Initial Moisture	**%**	0.7	0.7	0.7	
Soil Wt. Added	**GRAMS**	910	900	890	
Water Added	**ML**	85	95	108	
Water Added	**%**	9.4	10.6	12.2	
Moisture At Compaction	**%**	10.1	11.3	12.9	
Weight of Briquette & Tare	**GRAMS**	3100	3097	3101	
Net Weight of Briquette	**GRAMS**	986	985	989	
Briquette Height	**IN**	2.56	2.53	2.49	
Density	**PCF**	106.0	106.0	106.6	
Exudation Pressure	**PSI**	675	585	290	
Expansion Pressure	**PSF**	0	0	0	
PH at 1000 Pounds	**PSI**	14	14	15	
PH at 2000 Pounds	**PSI**	24	25	26	
Displacement	**Turns**	5.00	5.10	5.20	
R' Value		74	73	71	
Stabilometer Thickness	**FT**	0.35	0.39	0.42	
Expansion Thickness	**FT**	0	0	0	
Expansion Dial Reading		0000	0000	0000	
R' Value Modifier		2	0	0	
Corrected R-Value		76	73	71	
R-Value by Exudation Pressure			71		
Gravel Equivalent		0	0	0	
Traffic Index		4.5	4.5	4.5	
R-Value by Expansion Pressure			N/A		
R-Value at Equivalent			**71**		

EXPANSION PRESSURE CHART



Job Name:	**Allied Geotechnical 2018 Lab Testing**		
By:	**DRB**	**Date:**	**3/5/2019**
Job No.:	**180035L**	**Sample No.:**	**B-2-2 @ 5'-8'**
Gravel Equ:	**0**	**Plate No.:**	

R-value By Exudation Pressure



Job Name:	Allied Geotechnical 2018 Lab Testing		
By:	DRB	**Date:**	3/5/2019
Job No.:	180035L	**Sample No.:**	B-2-2 @ 5'-8'
R-Value by Ex.:	71	**Plate No.:**	

Appendix F. – Storm Drain Outfall Assessment

Merkel & Associates, Inc.
5434 Ruffin Road, San Diego, CA 92123
Tel: 858/560-5465 • Fax: 858/560-7779
San Diego • San Rafael • Arcata • Nehalem • Tacoma

March 29, 2019
M&A #18-049-02

Mr. Andrew Thies
Rick Engineering Company
5620 Friars Road
San Diego, CA 92110

RE: South Mission Beach Watershed Master Plan
Investigation of Sail Bay Subtidal Storm Drain Outlets

Dear Andrew,

In order to support the design of subsurface outfalls within Mariner's Basin from the South Mission Beach Watershed Master Plan (WMP), Merkel & Associates (M&A) was contracted by Rick Engineering Company (REC) to examine the existing storm drain outfalls of a similar design that were constructed within Sail Bay as part of the Sail Bay Improvements Project completed in 1986 (33 years ago). These outfalls were extensions of much shorter storm drains that originally discharged at higher elevations onto a narrow beach fringe. With the widening of the Sail Bay beaches, the drains were extended outward and into subtidal elevations. The drains were construction on gravel bedding pads consisting of coarse gravel of approximately 3-inch minus aggregate. No headwalls were used for these drains. Following the 1986 Sail Bay project, the Santa Clara Sewer Interceptor was constructed in approximately 1994 (approximately 25 years ago). This facility included a large submerged headwall and energy dissipater outlet box with four storm drains entering the structure. In total, nine drains were examined in Sail Bay, Drains #1 through #8, including two extending bayward from the Catamaran Hotel (Drain #2a and #2b). These drains are located on Figure 1.

M&A was requested to similarly examine the storm drains entering Mariner's Basin at intertidal elevations from the South Mission Beach WMP area. These drains are from various differing and unknown vintage. Five drains were examined in Mariner's Basin. These follow the numbering system assigned by REC within the WMP and include Drain #120001, 120002, 120004, 120005, and 120007 (Figure 2).

The purpose of the investigation was to examine these outfalls to determine the condition of the drain ends, evaluate the extent of occlusion of the outfall end by sediment or marine fouling, and collect photographs, to the extent practical, of the drain ends and construction detail. While the ends of the pipes and the outermost drain segments were examined, the work was not an interior inspection of the drains much beyond the first drain segment. Typically, marine fouling is greatest at the most tidally influenced end of the pipe; and as such, it was generally expected that any degradation of cross sectional area would be observed during the inspection of the outer end of the pipe and the interior of the terminal drain segments.

Figure 1. Location of eight subsurface storm drain outlets inspected within Sail Bay

Figure 2. Storm drains investigated within Mariner's Basin

METHODS

M&A Principal Ecologist, Keith Merkel, and Associate Scientist, Jordan Volker, conducted the storm drain outlet inspection on March 5 and 6, 2019. Work included a location of the drain ends via interferometric sidescan sonar (ISS). The drains were then investigated by ROV. Photographs of the drain ends and the exterior of the pipes and gravel beds were collected and are included as Appendix A.

From the collected ISS data string, bathymetric topology was processed and partially cleaned from dense point cloud data. The ISS data were collected with the initial intent of using the sidescan backscatter data simply to facilitate locating the drains. As such, no effort was made to calibrate the system for bathymetric data collection. However, on inspection of the drains during ISS survey, it was noted that some of the drains had modified the bay floor and it was determined beneficial to process the bathymetric data string to generate a topologic mapping of the bay floor around the drains to evaluate scour and accretion related to drains. Data were processed to 0.5-foot contours of an undefined vertical datum in order to evaluate the magnitude of influence of the drains on the bottom.

RESULTS

The results of the investigations are presented in Appendix A for each of the investigated drains. Most relevant conclusions that may be drawn from the surveys are as follows:

Santa Clara Cove Subtidal Outfalls (Drain #1)

1) The multiple storm drains discharging into the cast-in-place dissipater box remain open with limited and similar levels of biogenic fouling as the Sail Bay subtidal outfalls.

2) The box receives some sand inflow from around the box; however, scouring flows from the four drain pipes keep the box clear near the drain outlets.

3) This structure appears to be in good shape overall, although most of the floor of the box is buried and not visible for inspection.

Sail Bay Subtidal Outfalls (Drain #2-8)

1) The reinforced concrete pipe (RCP) used in the Sail Bay Improvements Project was a socket and spigot bell end design placed on gravel pads comprised of material that appears as coarse as 3-inch minus, with limited fine fraction being readily apparent.

2) No storm drain pipe slumping or joint failures were noted, although a few joints did show evidence of minor freshwater seepage into the water column.

3) Nearly all of the storm drains placed in Sail Bay are higher in elevation than would be desirable from the standpoints of navigational safety, habitat development, and physical shoreline processes. Most explicitly it appears that the inverts of the pipes were held at

approximately -10 feet NGVD29 without accounting for how the pipe diameter would affect proximity of top of pipe to the surface. As a result, a 48-inch pipe is very shallow at low tide.

4) The orientation of the pipe relative to the bottom, the size of the pipe, and the invert relationship to natural grade effect the extent of scour a pipe has on the bottom topology. While some drains showed evidence of scour both due to flows from the drains and due to hydrodynamics around the pipe, none of the drains appeared to be at risk from the level of scour noted.

5) None of the subtidal pipes suffered from substantive marine organism fouling on the inside of the pipes. What fouling was observed was generally limited to an average of less than 1 inch in thickness.

6) None of the subtidal pipes were well buried in the bottom over a broad length of the pipe. This relates to the initial design of the Sail Bay beach and subtidal to slope outward at a 15:1 slope to accommodate eelgrass restoration. This shallow slope did not fit well with pipeline burial.

7) Eelgrass has grown up against most drains and has even recruited onto the top of some of the drains. Conversely, larger drains protruding higher above the bay bottom tend the have scoured troughs along the pipe margins due to exacerbation of wave energy around the pipes.

Mariner's Basin Intertidal Outfalls (Drain #120001-2, 120004-5, 120007)

1) The intertidal Mariner's Basin drains are all different and appear to be of varying vintages, with the earliest pipes being of a corrugated metal, concrete, or asbestos concrete nature and the latest pipe being HDPE.

2) None of the intertidal drains appear to be in exceptionally functional condition. The status of the five pipes investigated are as follows:

    a) Drain #120001 – RCP or asbestos concrete failed at back beach intertidal elevations;
    b) Drain #120002 – HDPE impaired outlet by marine growth and sand, but intact drain;
    c) Drain #120004 – RCP or asbestos concrete failed at multiple joints;
    d) Drain #120005 – CMP failed at multiple points within the intertidal zone;
    e) Drain #120007 – Reportedly an RCP pipe, but fully buried in the sand beach.

3) The shifting sands, wave environment, and potentially vessel or beach maintenance equipment impacts have been hard on the drain infrastructure in Mariner's Basin, and every one of the pipes in this area can be considered to be in need of replacement.

4) Changing beach profiles have been a primary issue in maintaining stability of the drains with at least three of the five pipes having clearly suffered significant damage or functionality impacts from changing sand elevations within the intertidal zone.

CONCLUSIONS

The inspections completed under this request provide compelling information suggesting that subtidal drain location would provide a superior solution to the pipe locations over construction of intertidal outfalls. This conclusion is supportable purely on the basis of infrastructure protection and longevity. However, other factors also support such a design. These include enhancement of beach aesthetics and safety, reduction in beach erosion, improvement of habitat suitability for development of eelgrass, reduction in potential water quality concerns for water contact recreation (REC-1 beneficial uses) by separation of discharge points from direct proximity to users.

Negative conditions observed from subtidal discharges appear to be principally related to:

1) Drains being located too high and thus influencing shallow water littoral energy conditions and sediment transport and thus promoting scour and deposition changes;

2) Drains being too shallow and promoting invasive species growth, principally *Sargassum* and tunicates, while limiting eelgrass habitat development over the pipeline corridor;

3) Drains being too close to the bottom and thus resulting in scour damage and potential for undermining of the drains.

Subtidal discharges will result in increased construction costs but will likely reduce costs of pipe replacement and beach maintenance. Further, subtidal discharges may provide a good means for avoiding need for elaborate trestle supports that would cradle the pipes in the event of rising and falling beach profiles.

Please let me know if you need any additional information to support this effort. We appreciate the opportunity to assist you.

Sincerely,

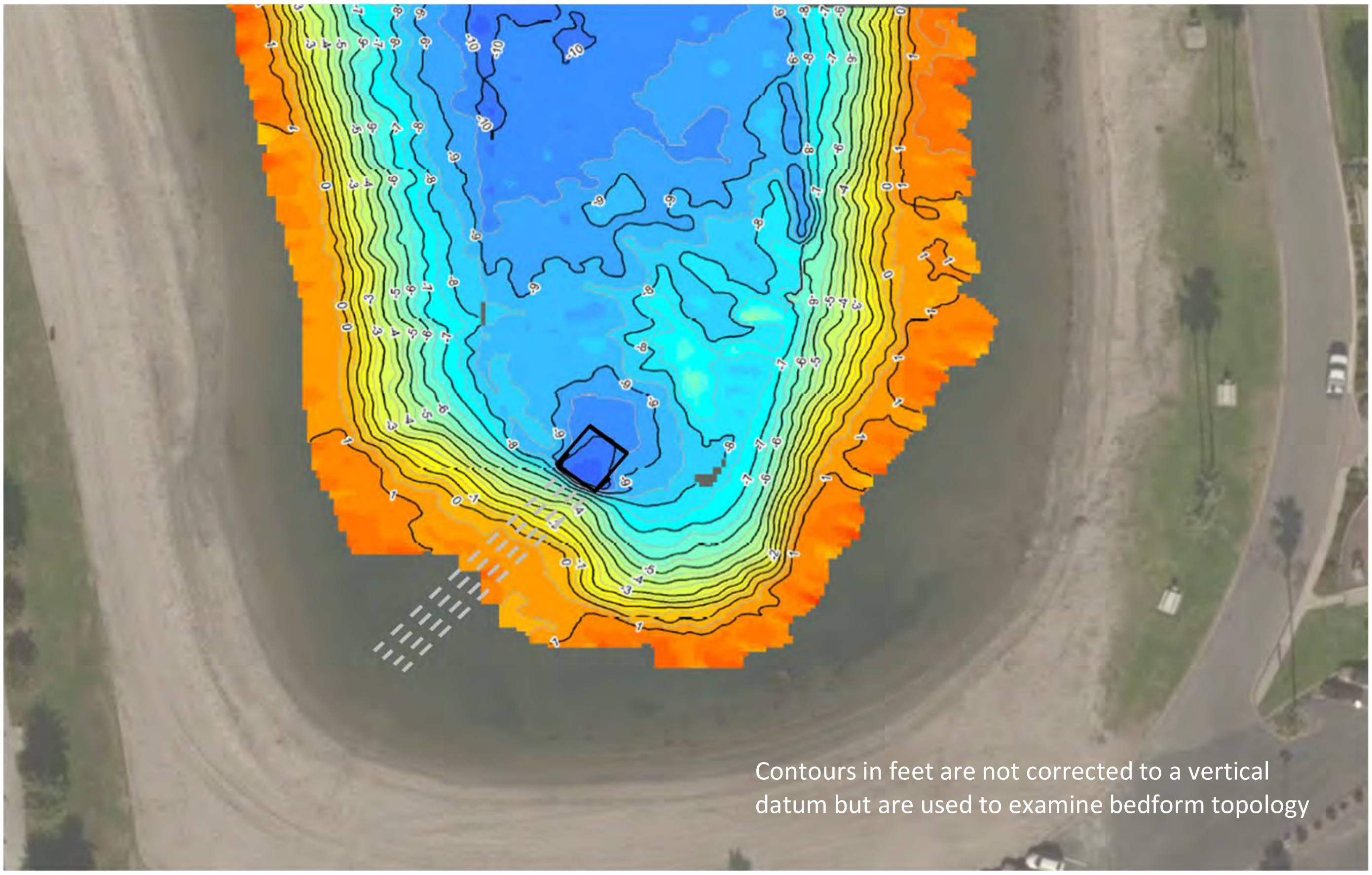
Keith W. Merkel

Keith W. Merkel
Principal Consultant

APPENDIX A. DRAIN REVIEW SUMMARIES

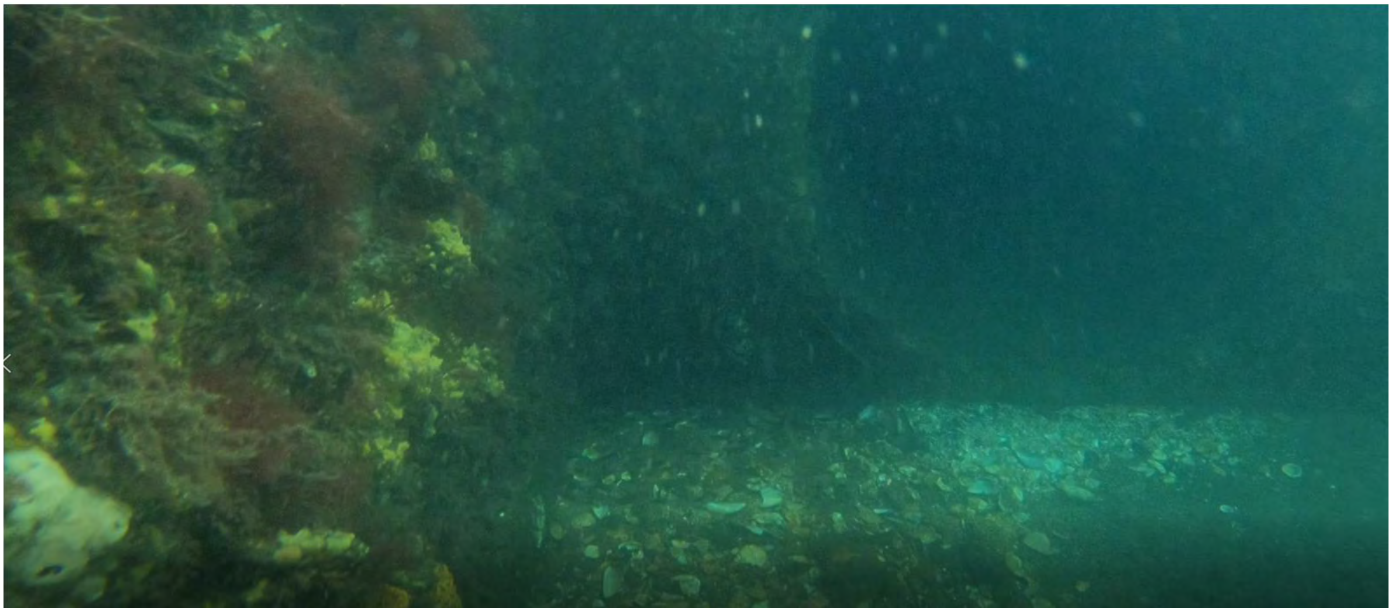
Drain #1: Santa Clara Cove

Four outfalls (approximately 30"-48") into cast box with terminal energy dissipation wall



Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

Santa Clara Cove is the only drain outlet with energy dissapation box cast in place at terminal end of drains.
Outlet inverts is approximately -12 feet NGVD29



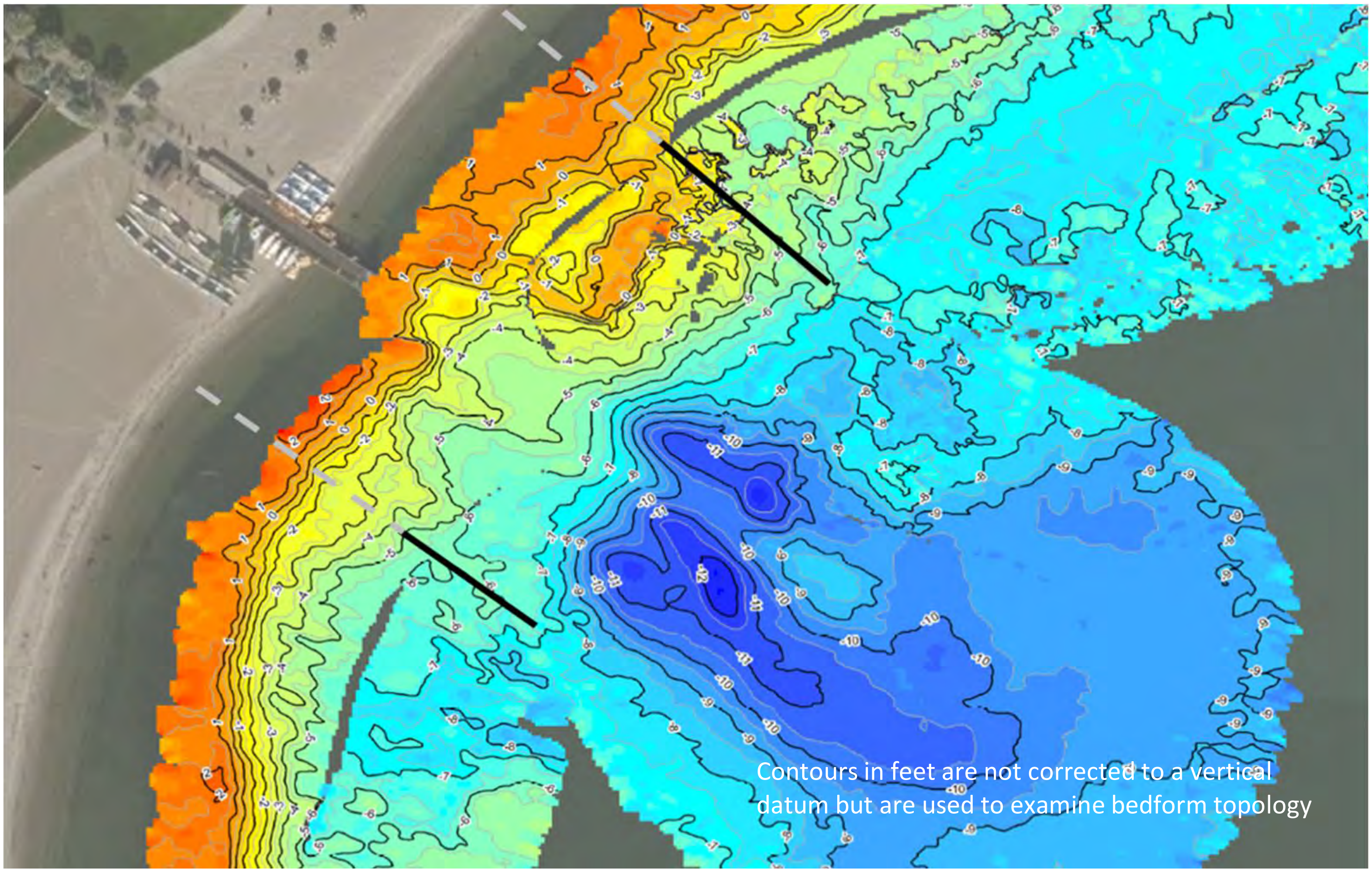
Inside outlet box at easterly most drain outlet. No obstruction of outlets was noted.

Eastern wing wall to receiver box. Note accumulation of terrestrial street debris (leaves in bottom of the box.
Lobster molts in this box are common due to extensive use of the pipes by spiny lobster.
Sediment accumulation from the uplands and sand from the beach accumulates at the north end of the box.

Terminal energy dissapation wall of box is now nearly flush with bottom due to infill of the box by sediment
and the redistribution of the sediment away from the storm drain discharge points.

Drain #2: Catamaran West and Catamaran East

Catamaran West (approximately 30") and Catamaran East (approximately 24") are RCP pipe on gravel beds

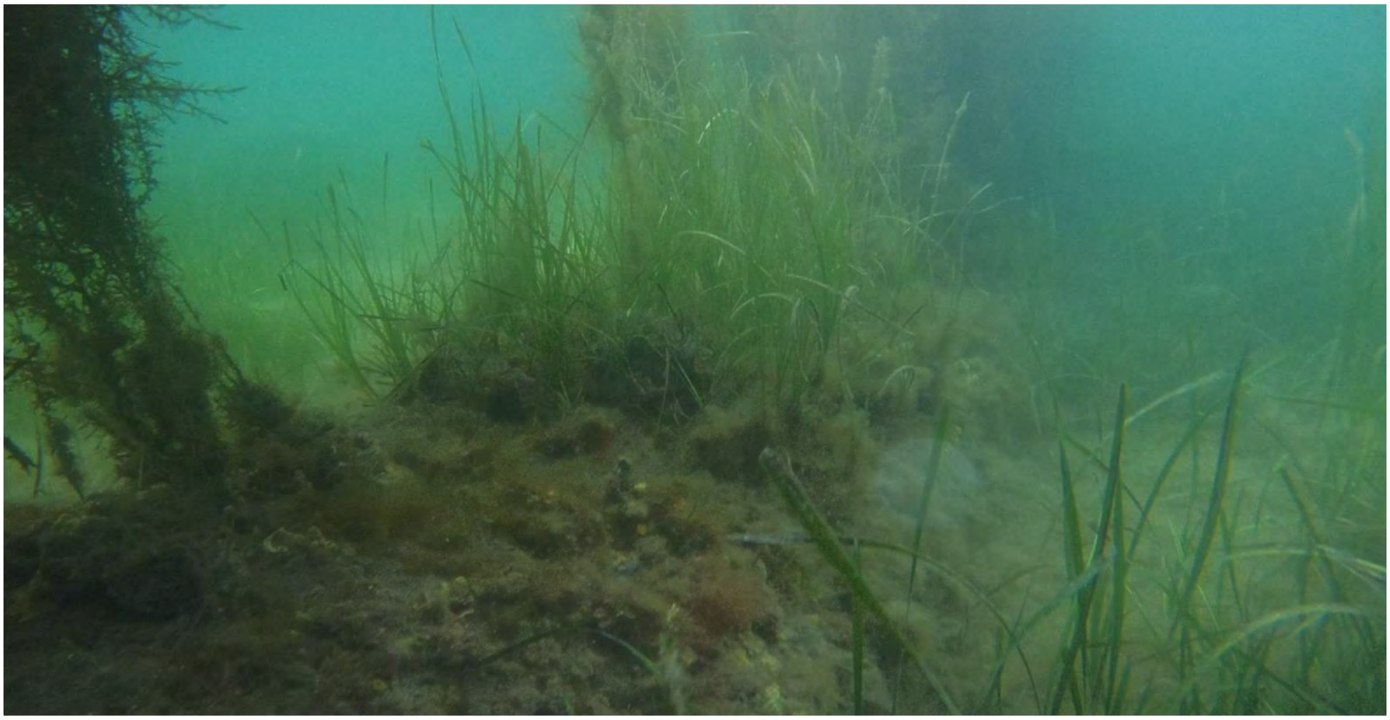


Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

Catamaran drain outfalls are shallow subtidal outfalls
Outlet inverts are approximately -9.5 feet NGVD29

Terminal end of outfall showing coarse grained sand due to energetic sorting of beach sand and 2-3" bedding gravel off the side margins of the outfall. No headwalls or energy dissapation beyond gravel has been included.

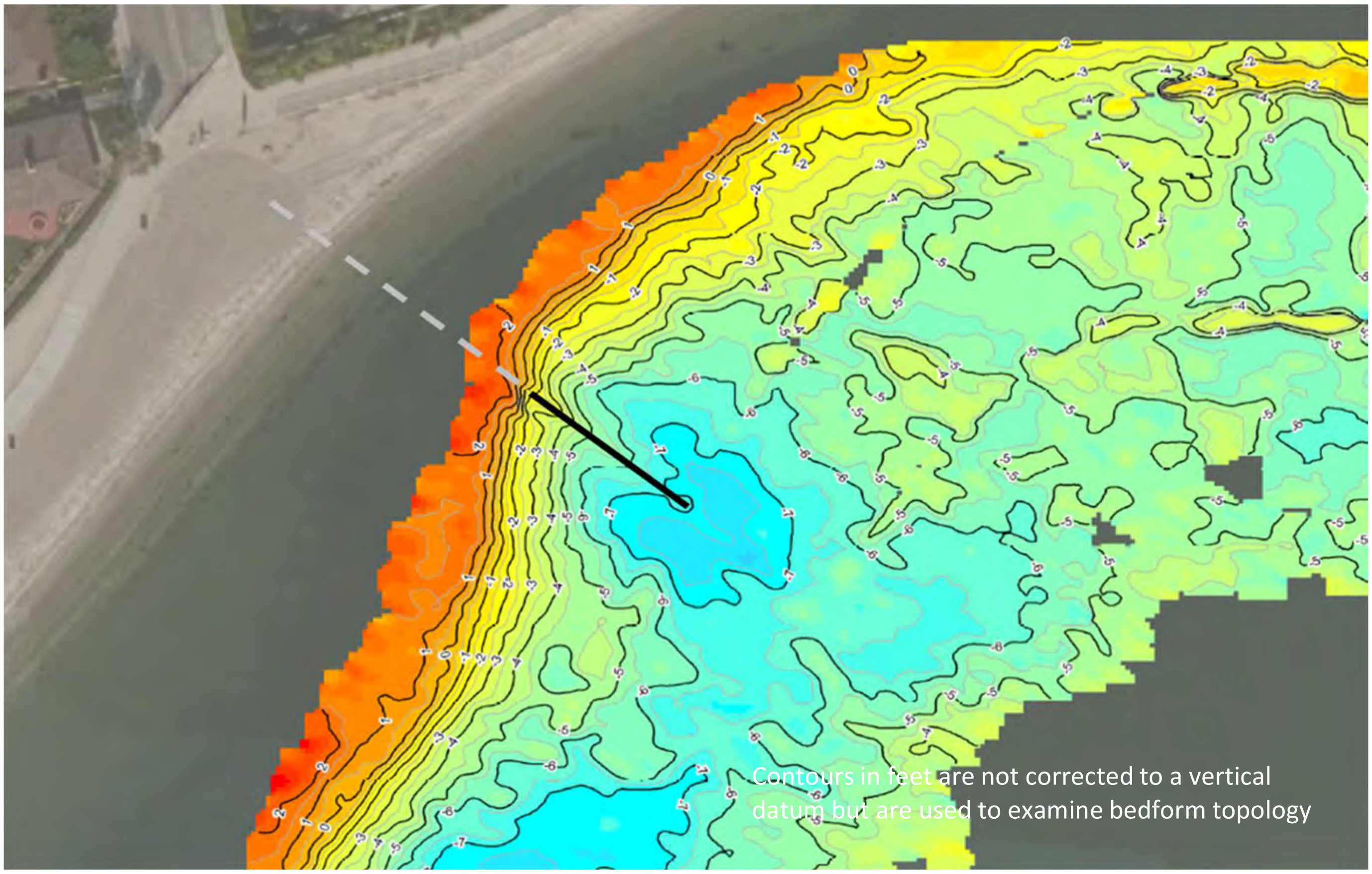
Typical spigot and socket joint. Note slight blur in the water above the pipe due to freshwater exfiltration.
The kelp like algae is a ubiquitous invasive species, *Sargassum muticum,* present on hard bottom.



Eelgrass and invasive Sargassum on the top of Catamaran West outfall pipe.

Drain #3: West Briarfield Drive

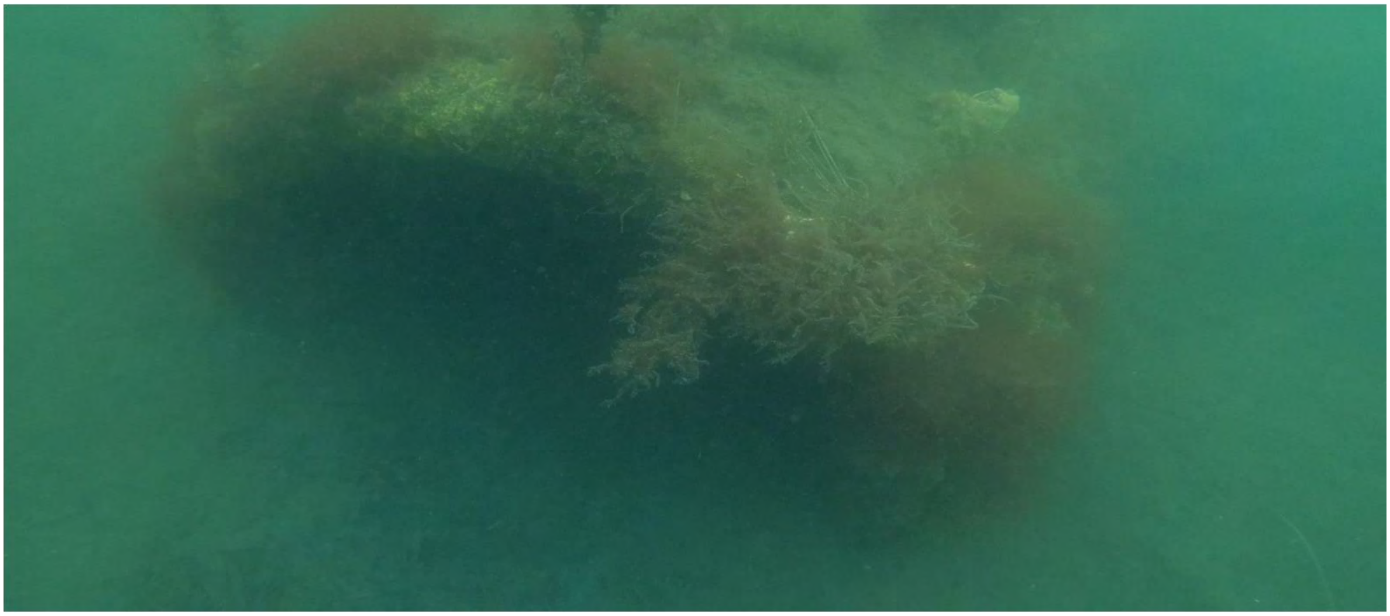
West Briarfield Drive (approximately 30") RCP pipe on gravel bed without headwall.



Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

The Briarfield Drive drain has slightly scoured the bottom and identifies a risk of a high energy drain located too close to the bottom or angled too steeply towards the bottom.

The outlet invert is approximately -10 feet NGVD29



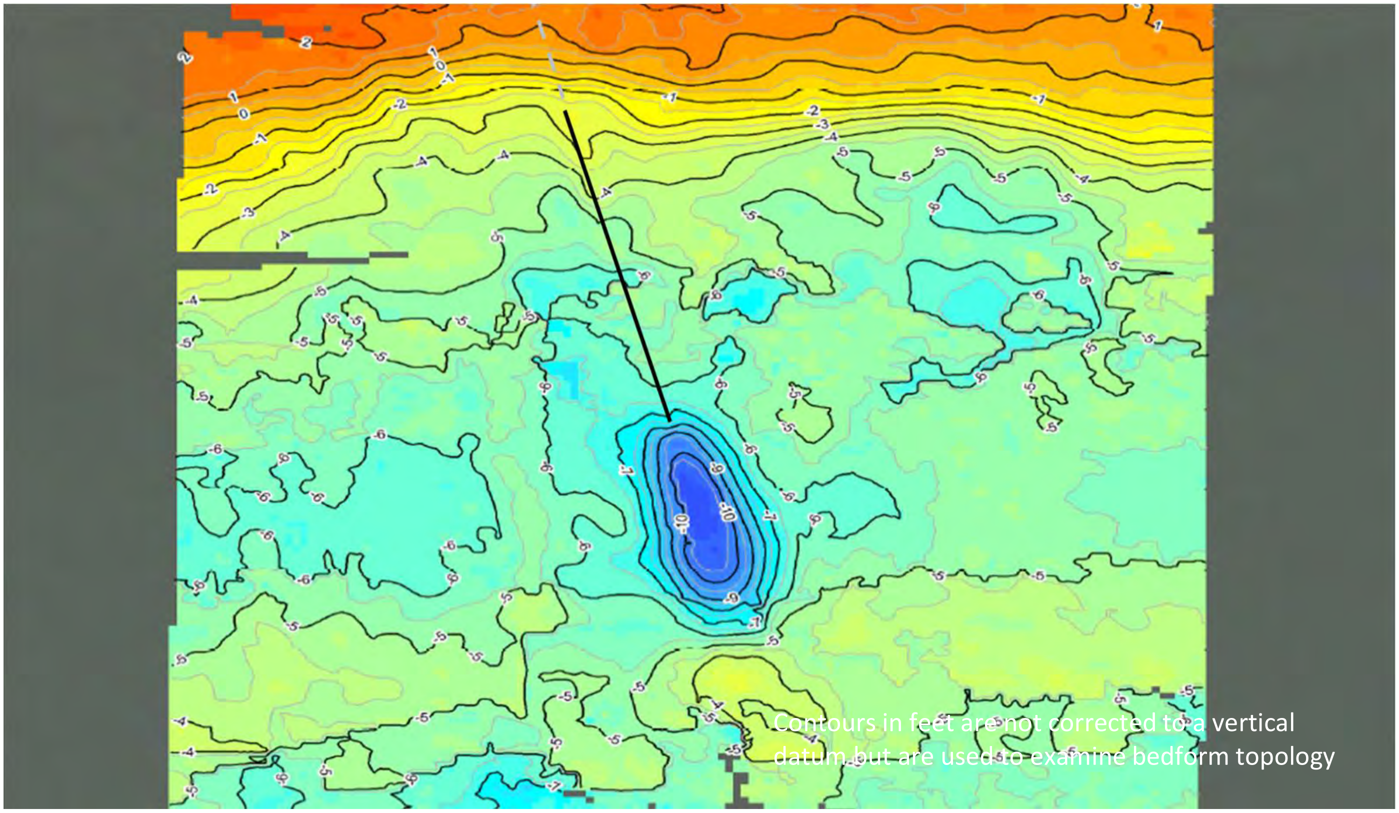
Terminal end of outfall showing proximity to sand floor not armored by gravel. It is not clear if gravel has been moved or was not placed at the terminal end of the pipe and thus allowed scour of the bottom.

Note slight undermining of the storm drain. Eelgrass occurs on the sand adjacent to the pipe.

Good example of bedding gravel on which storm drain pipe has been placed. Note that this gravel is clean. The clean gravel and slight undermining of the pipe on one side and build up on the other suggests localized scour conditions. The source is not certain but is likely wind wave driven scour and transport in shallow waters.

Drain #4: Dawes Street

Dawes Street (approximately 48") RCP pipe on gravel bed without headwall.



Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

The Dawes Street drain has deeply scoured the bottom due to an apperant invert elevation below grade and high flow volume and velocity of discharge.

The outlet invert is approximately -11 feet NGVD29 with a surrounding grade of -9 to -10 feet NGVD29

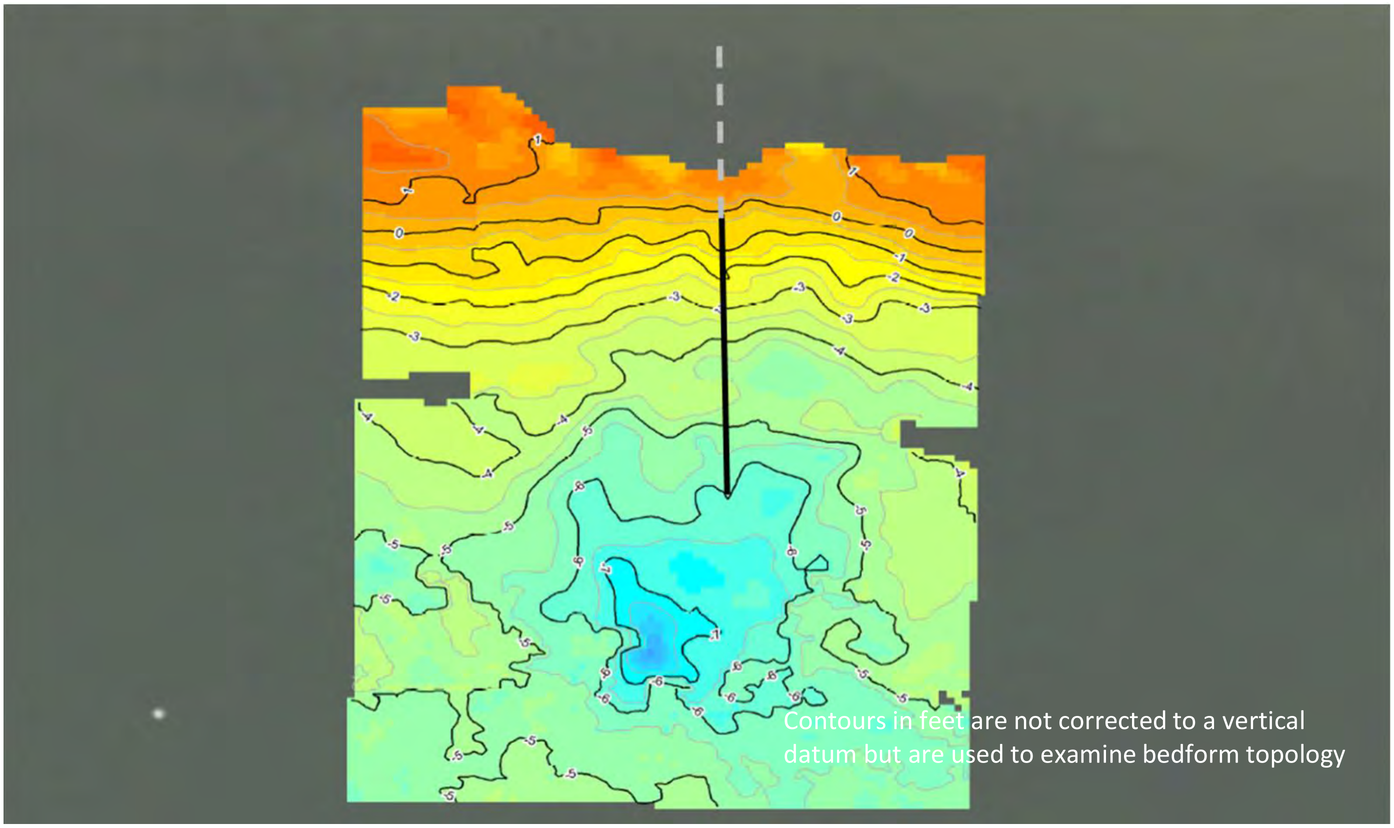
Terminal end of outfall showing deep scour pit in front of drain and mat of bacterium *Beggiatoa* typical of high sulfide, low oxygen environments.

Spigot and socket joint observed on Dawes Street drain. Note a slight white residue at the zenith of the bell. This residue is the result of a minor freshwater seepage through the joint.

A large concrete collar is found on one segment of the 48-inch pipe. The purpose of this color is not known but could be a thrust block. There is no detectible pipe inflection at or near this collar.

Drain #5: Everts Street

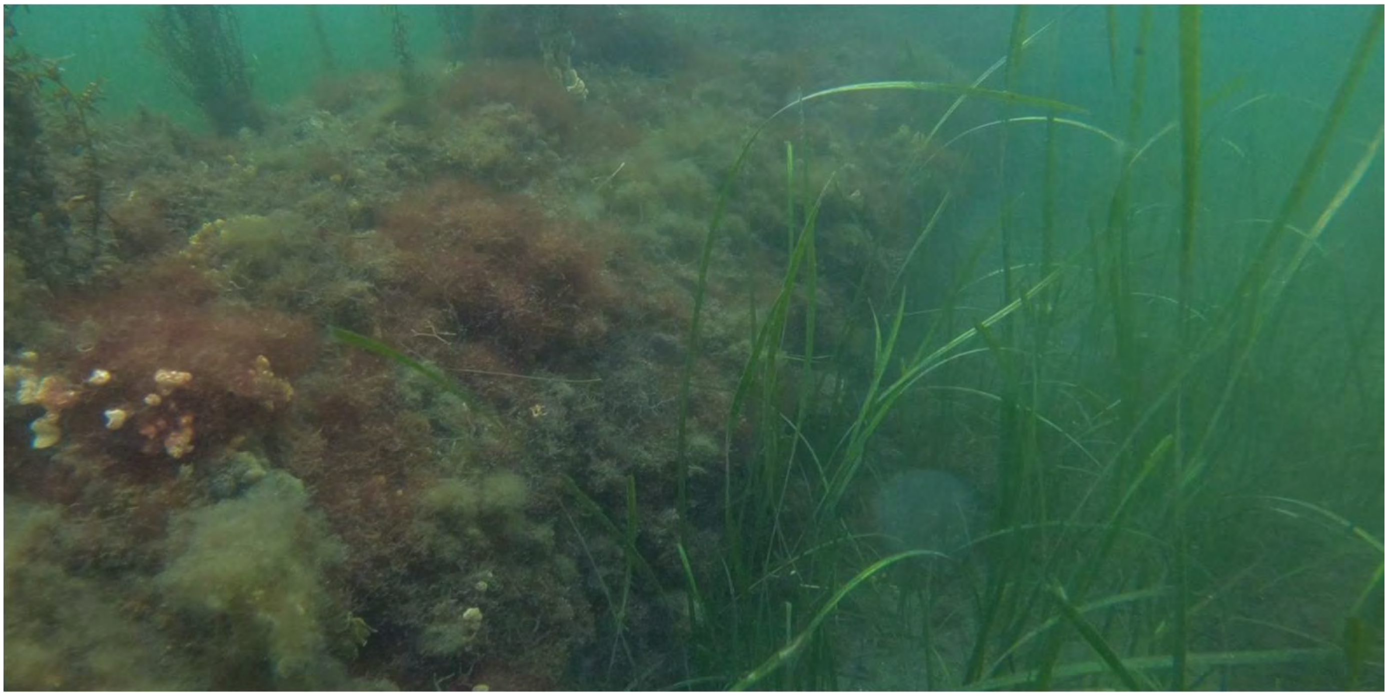
Everts Street (approximately24") RCP pipe on gravel bed without headwall.



Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

The Everts Street drain has limited scouring at the terminus of the drain but sits on an elevated gravel bed. Eelgrass surrounds a very small bare area at the end of the drain and terrestrial organic accumulation is absent.

The terminus of the pipe is positioned on a small gravel pedestal.

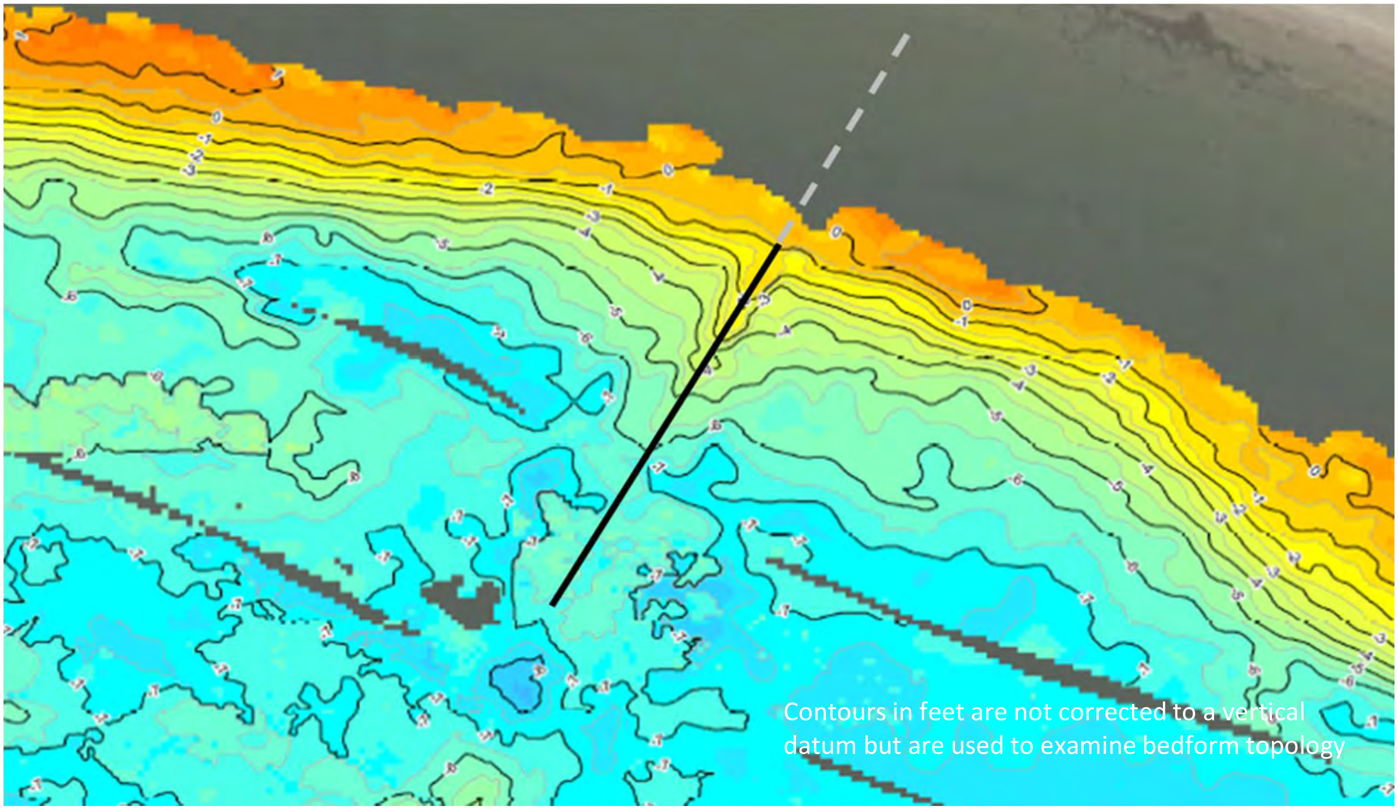


This storm drain shows eelgrass growth into the silts that have deposited within the bedding gravels allowing eelgrass to grow up to the margins of the pipe.

The pipe outlet is generally free of debris and only has a slight amount of coarse sand accumulated on the floor of the pipe. Marine growth does not substantially narrow the pipe diameter.

Drain #6: Fanuel Street

Fanuel Street (approximately48") RCP pipe on gravel bed without headwall.



The Fanuel Street drain has limited scouring at the terminus of the drain but sits on an elevated gravel bed. Eelgrass surrounds a very small bare area at the end of the drain and terrestrial organic accumulation is absent.

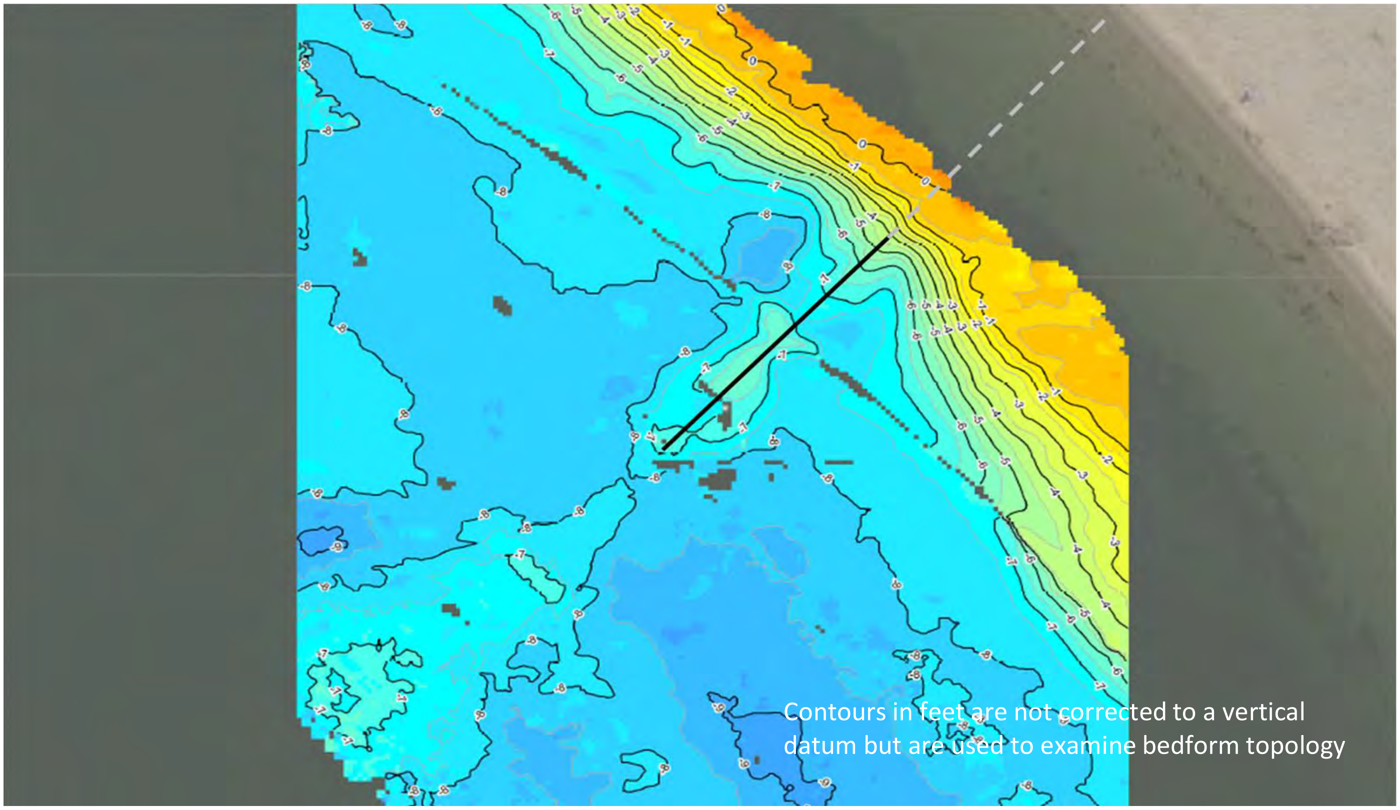
The terminus of the pipe shows bedding gravel floor adjacent and limited interior biogenic wall thickening.

The large diameter pipe extends well up into the water column and host considerable biotic growth on the pipe exterior.

Terrestrial organics have been deposited in proximity to the outlet of the Fanuel Street storm drain.

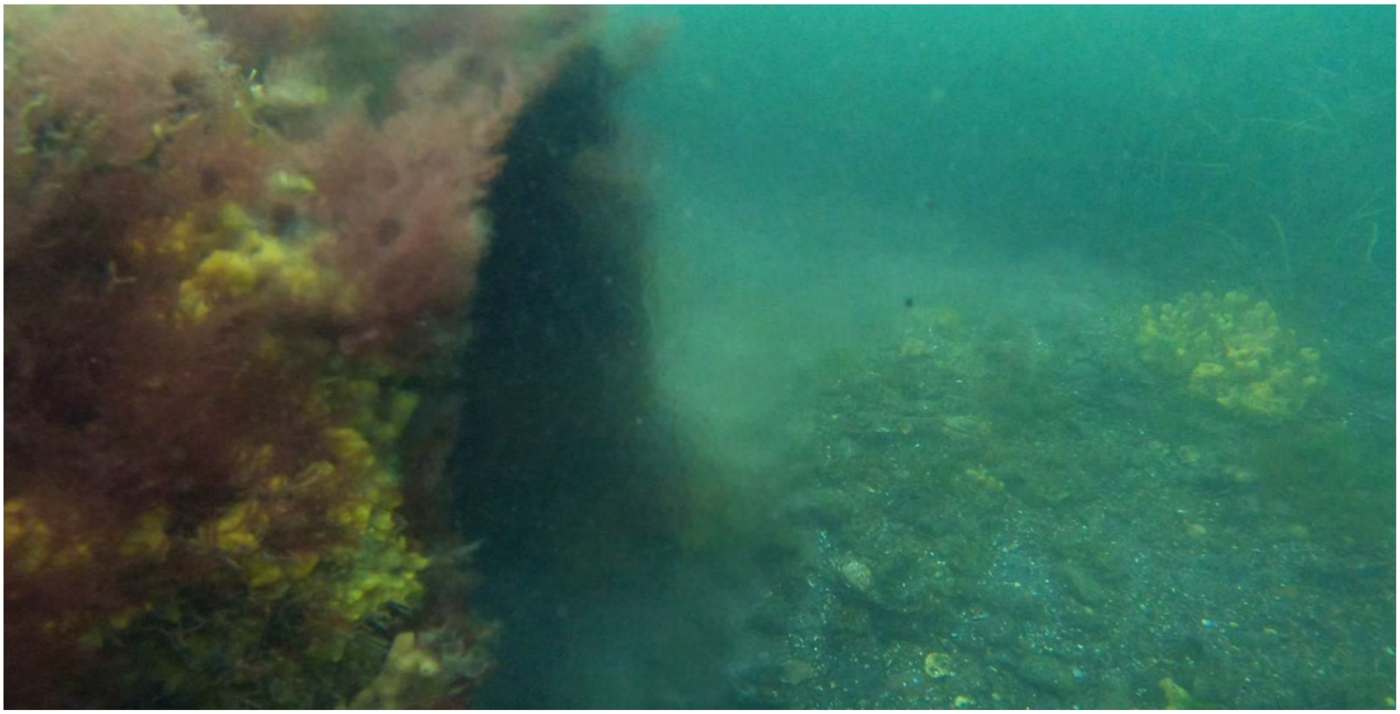
Drain #7: 3916/3920 Riviera Drive Alley

The 3916/3920 Riviera Drive Alley drain is an approximately 30" RCP pipe on gravel bed without headwall.



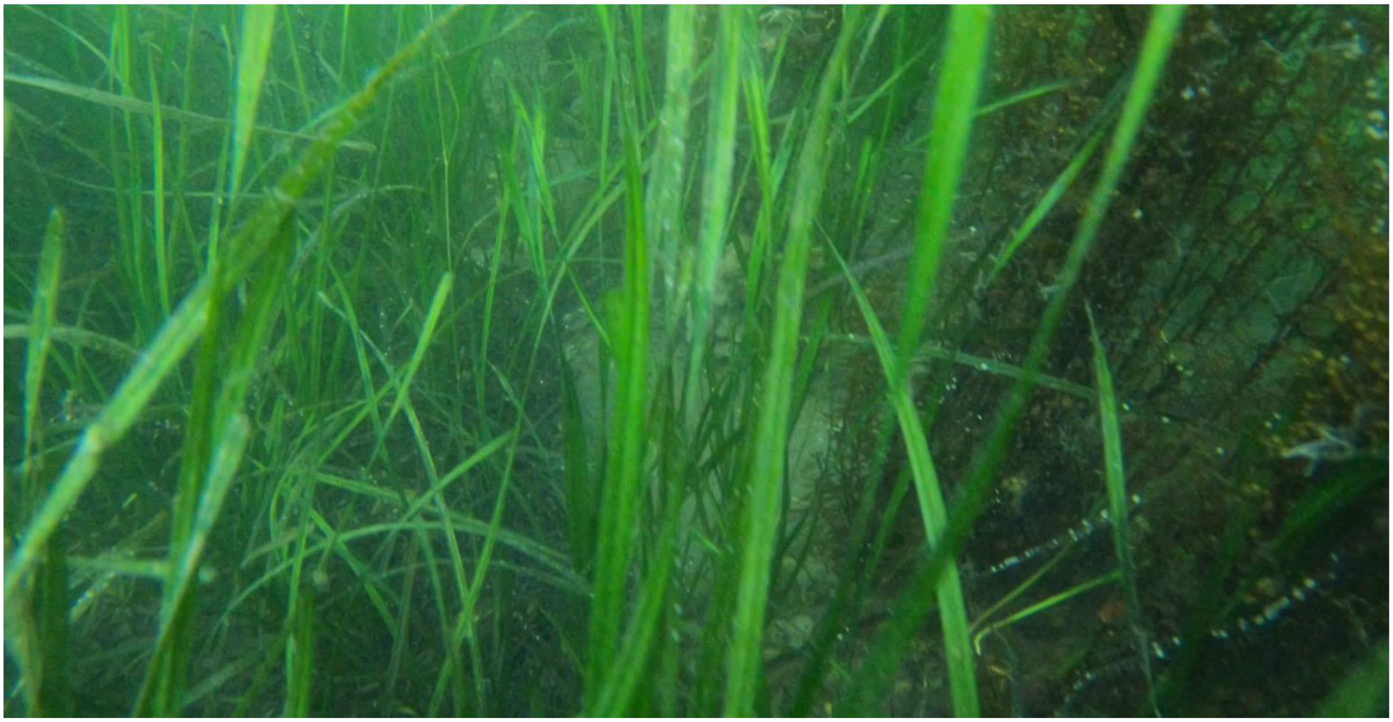
Contours in feet are not corrected to a vertical datum but are used to examine bedform topology

The discharge from this pipe has deposited a subtle deltaic feature over the bottom extending bayward from the pipe. In additon, the exposed pipe has resulted in littoral erosion on both sides of the pipe.



The terminus of the pipe shows bedding gravel floor mixed with sand and active freshwater flow from the pipe.

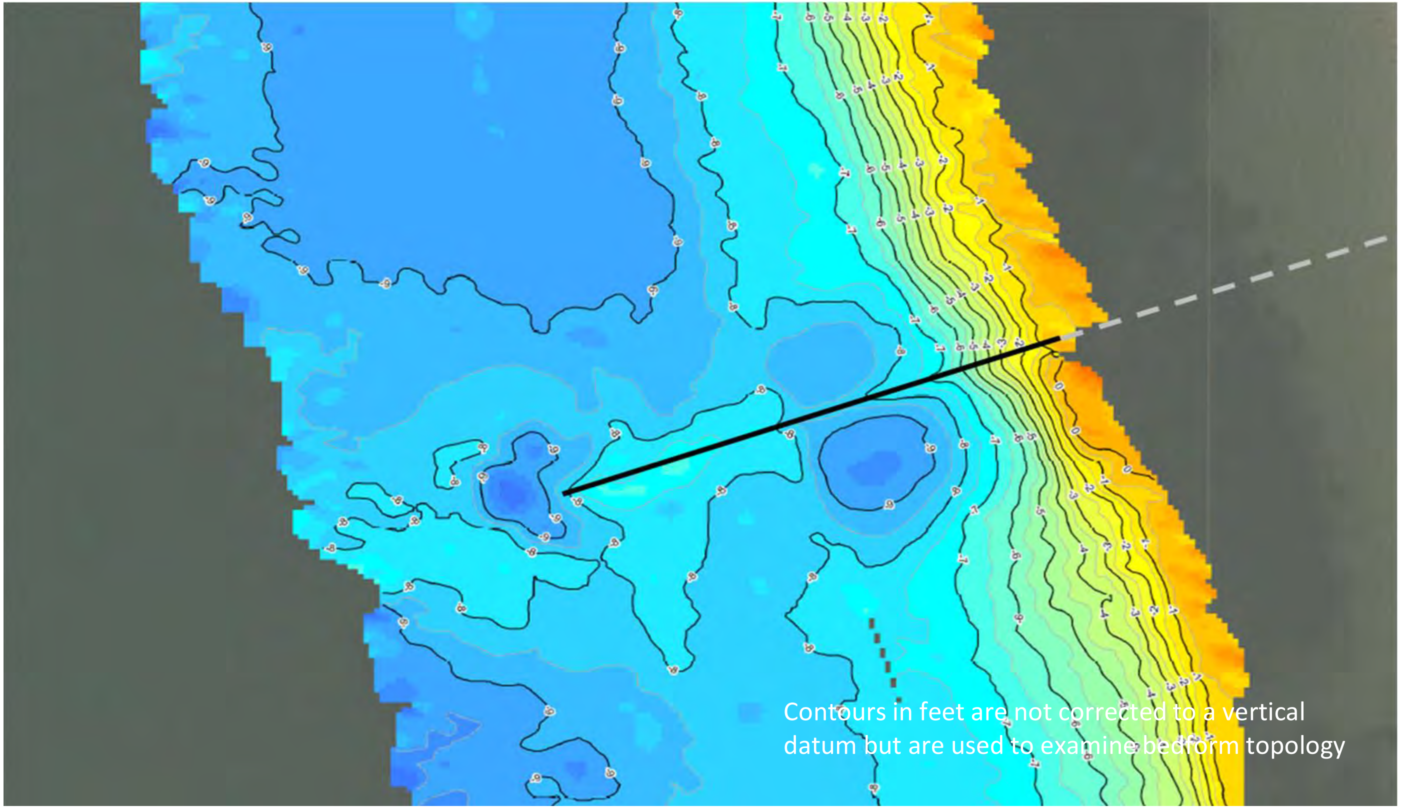
The pipe extends through an eelgrass bed that continues to the end of the pipe and eelgrass is absent in proximity to the terminus of the pipe.



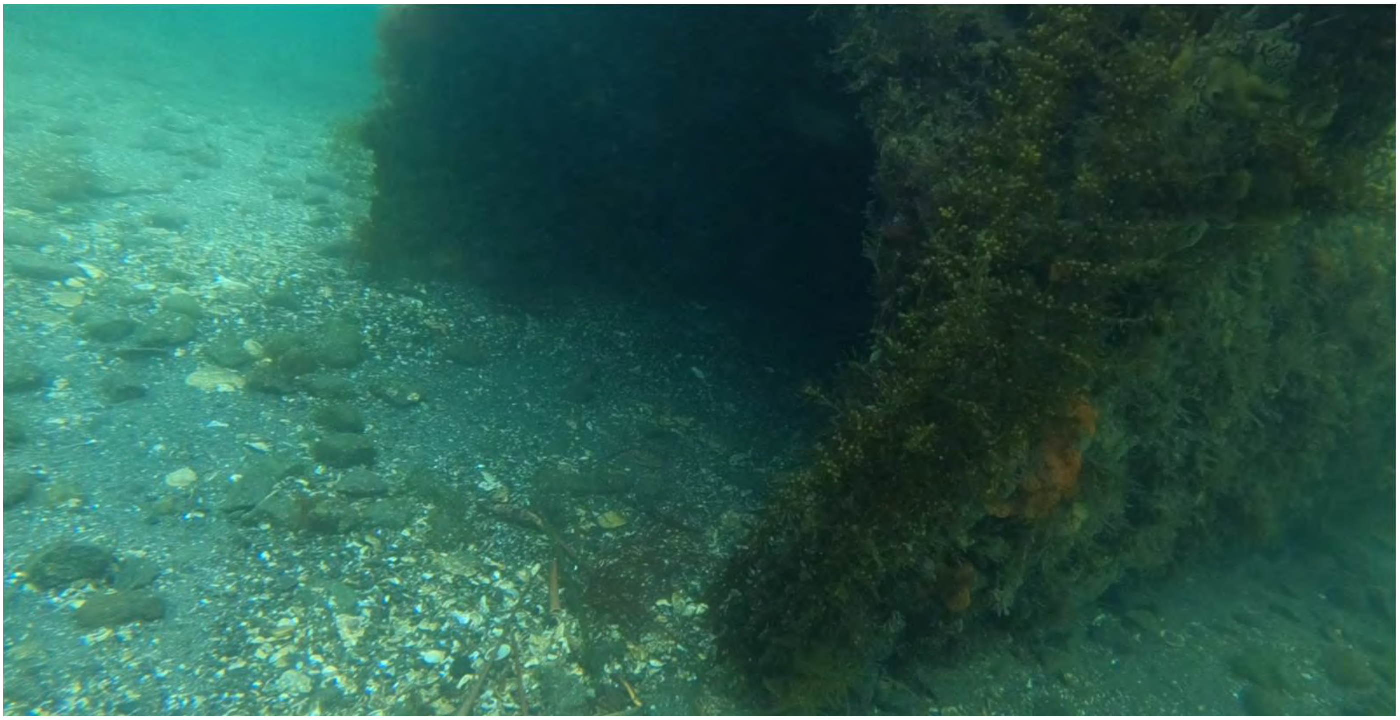
Over much of the drain length the pipe is barely exposed and would not be detected through the eelgrasss except for the presence of the brown alga, Sargassum muticum growing on the exposed pipe.

Drain #8: Moorland Drive

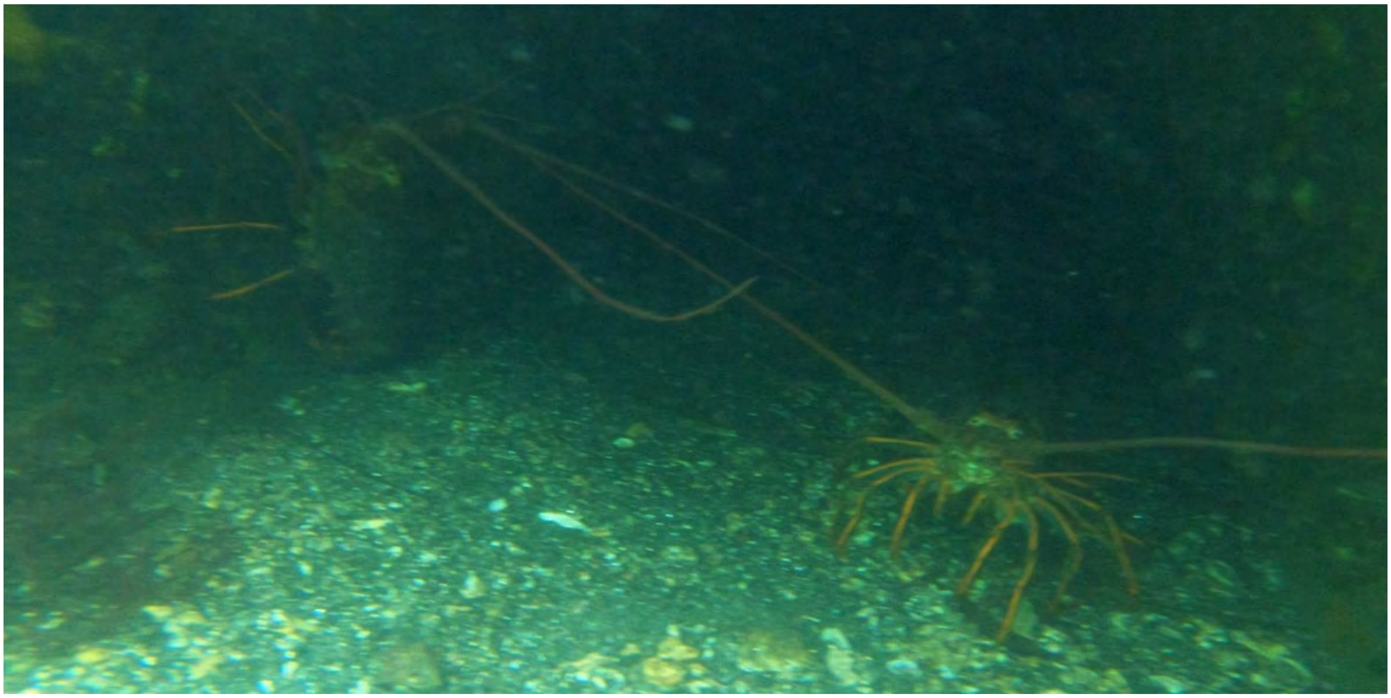
The Moorland Drive drain is an approximately 30" RCP pipe on gravel bed without headwall.



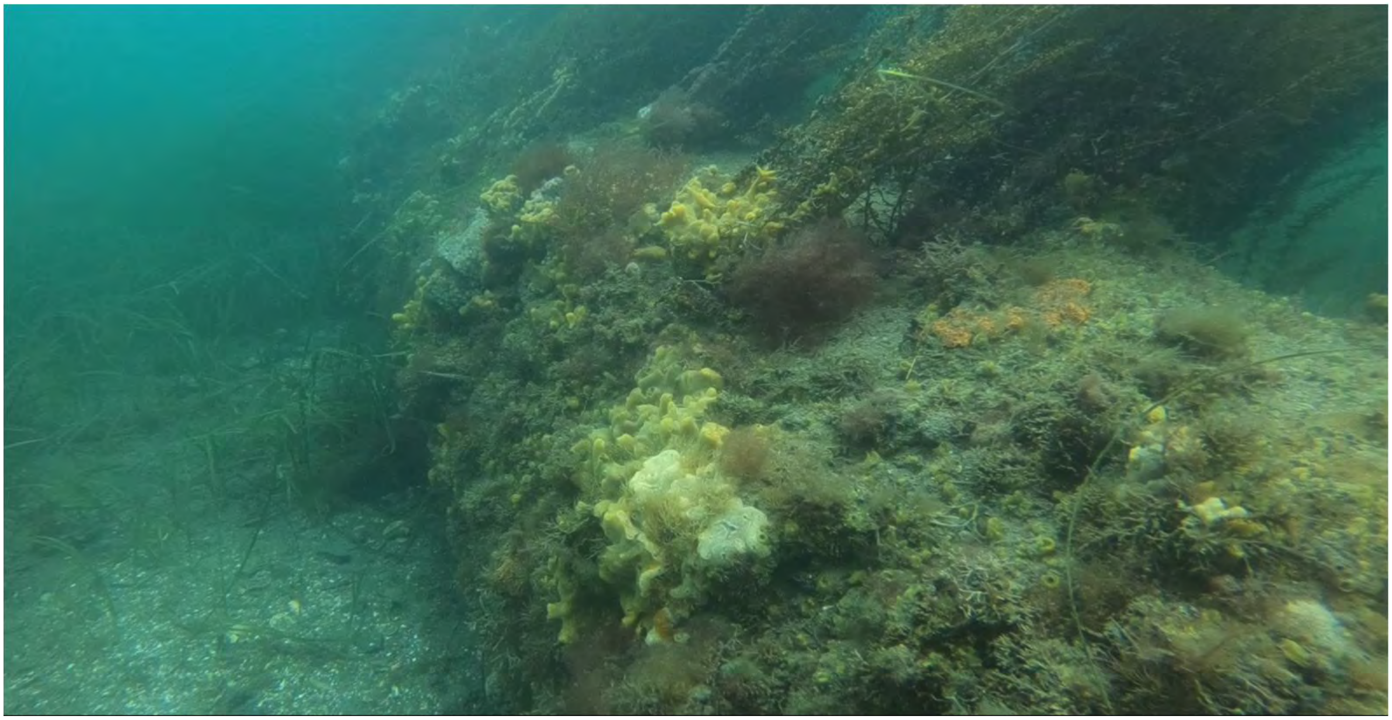
The discharge from this pipe has resulted in local scour and distributin of sediment around the scour hole. The pipe has also exacerbated erosion and generated a slight sediment shoal south of the pipe end.



The terminus of the pipe shows bedding gravel floor mixed with sand and active freshwater flow from the pipe. Some capacity has been lost to sand infill at the outlet. This appears due to sand transport across the outlet.



Spiny lobster occupy the pipe end. Biogenic growth has resutled in little change in cross sectional area.
The accumulation of sand diminishes in burial thickness with distance into the pipe.



Biotic growth on the pipe is diverse, but includes both native and non-native species. Eelgrass grows up to the margins of the storm drain on both sides of the pipe.

Drain #120001: San Fernando Place

The San Fernando Place drain is a 15" intertidal storm drain pipe that is anchored on beach but broken at the present beach scarp and no longer conveys storm drain flows. Flows now discharge at the back beach.

Current discharge point on back beach where the storm drain has developed a delta near the high tide line.

Remnants of the lower cross beach storm drain. This pipe no longer conveys flows having been broken off the drain at the back beach. Large pipe anchors retain the pipe and stabilize its position on the sand.

Bay mussels and Pacific oysters grow on the pipe through the intertidal reaches. At the lower end of the pipe common eelgrass occurs in the pools along the pipe.

Drain #120002: Deal Ct.

The Deal Court drain is a 21" HDPE pipe held in position by steel trestle segements.

Current discharge point on back beach where the storm drain has developed a delta near the high tide line.

The end of the HDPE pipe is substantially blocked by heavy mussel development on the upper portions of the pipe and sand infill on the bottom portion of the pipe.

Bay mussels dominate the cover on the HDPE outfall pipe, however green algae, and oysters are also common. The pipe appears intact along its exposed length. It is presumed intacted through the buried length.

Drain #120004: Cohasset Ct.

TheCohasset Court drain is a 15" RCP with a large terminal cast concrete lug supporting the final section of pipe. The pipe is fully within the intertidal sand beach environment to the back beach.

The final segment of the pipe is suspended in a large concrete anchor with the remaining pipe extending across the sandy beach to the point at which it extends into the sand near the middle intertidal.

The pipe segments are separated in many areas along the beach such that the outfall no longer conveys flow.

This pipe may be asbestos cement and should be investigated prior to removal.

Drain #120005: Balboa Ct.

The Balboa Court drain is a 15" CMP anchored by a steel trestle.

The pipe is within the intertidal environment and has failed in lower portions of the pipe due to corrosion.

The pipe has failed due to metal corrosion and presently discharges at multiple locations along its length.

The terminal end of the pipe is demarcated by a danger sign noting the location of the drain outlet. The sign is mounted on one of the steet trestles anchoring the pipe. At this location, the pipe is now mostly twisted steel.

The pipe crosses through the low intertidal in a seemingly intact condition, however it has failed both above and below this segment of pipe.

Drain #120007: Bonita Cove Park

The Bonita Cove Park drain is completely buried but reported to be a 24" pipe.

This pipe is completely buried in shoal sand.

The terminus of the pipe is in the broad low beach. While the extent of the pipe infill by sand is unknown, the drain does appear to continue to hold water based on drainage patterns exhibited at low tide.

Drainage from buried pipe faciliates transfer of sand down the beach below the drain to expand delta feature.