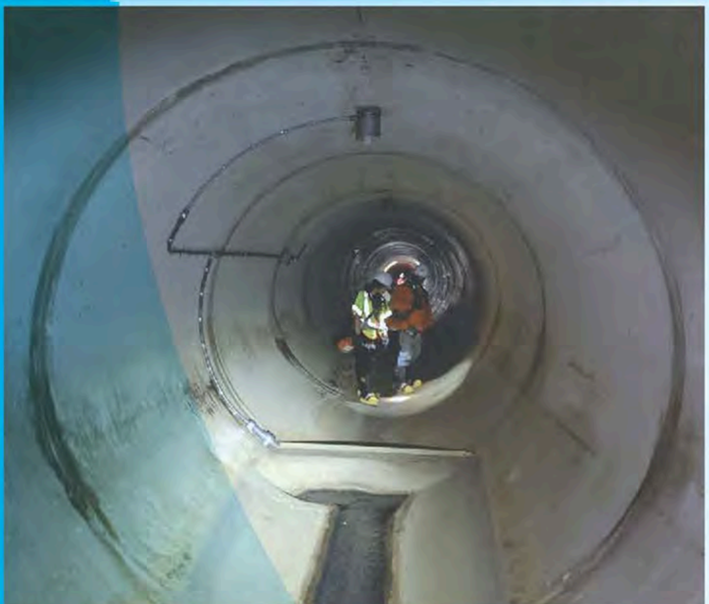
Final Report

Phase 2 White Paper: Tapping into Available Capacity in Existing Infrastructure to Create Water Supply and Water Quality Solutions



Prepared for
Las Virgenes MWD

LAS VIRGENES MUNICIPAL WATER DISTRICT EST. 1958

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Challenging today.
Reinventing tomorrow.

Funding Partners

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Steering Committee

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- **Co-Chair - Los Angeles County Sanitation Districts**
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  - Tony Zampiello
- **Three Valleys Municipal Water District**
  - Matthew Litchfield
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Executive Summary

Background

Key objectives for stormwater management in the Los Angeles Basin are to control dry and wet weather runoff, reduce pollutants entering receiving waters, maximize the beneficial use of waterbodies, develop new local water supplies, and provide tangible community benefits. Since 2018, with the passage of Measure W, there has been increased interest among agencies with responsibility for managing the region's water resources to collaborate on developing cost-effective approaches to manage stormwater, address existing and emerging regulatory challenges, capture polluted dry and wet weather runoff, maximize equitable multi-benefits, increase local water supply potential, and mitigate the effects of climate change and drought. The development of sustainable, reliable, and cost-effective solutions to manage dry and wet weather runoff requires a diversified approach, as no single solution is suitable or effective for countywide implementation. Alternative stormwater management approaches were sought, recognizing that only 28 percent of the Los Angeles Basin overlies a groundwater basin that can support the capture and infiltration of stormwater to supplement local water supplies.

Scope and Objectives of Phase 2 White Paper

To complement the current focus on dry and wet weather runoff capture and infiltration in Los Angeles County, Las Virgenes Municipal Water District (LVMWD) took the lead role on a White Paper study, "Tapping into Available Capacity in Existing Infrastructure to Create Water Supply and Water Quality Solutions." This effort evaluated the expanded use of low-flow diversions (LFDs), also referred to as dry weather diversions (DWDs), which provide a highly controlled means of diverting dry weather runoff to sanitary sewer systems with opportunities to capture and divert first-flush wet weather runoff and, potentially, additional wet weather flows. Two significant benefits from this approach include a new source of supply for water recycling and a reduction of pollutants discharged to receiving waters to support municipal separate storm sewer system (MS4) permit compliance. Figure ES-1 depicts the approach. Phase 1 of the White Paper study examined a strategic integration of the existing stormwater system with the sanitary sewer system to maximize the use of existing infrastructure by treating dry weather runoff through the 21 wastewater treatment plants (WWTPs) and water reclamation plants (WRPs) in Los Angeles County.

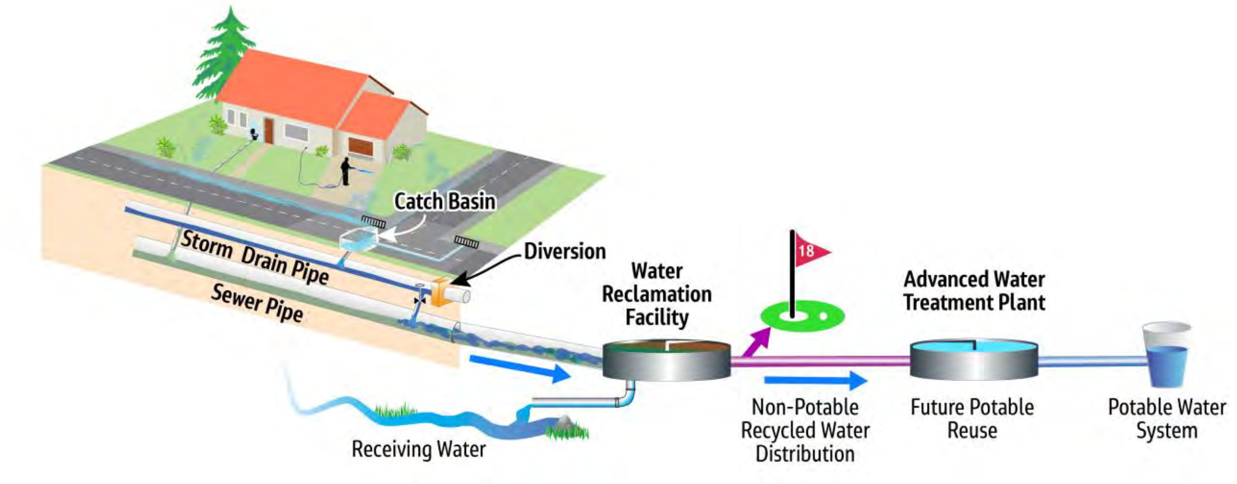

Figure ES-1. Illustration of DWD Approach

Beginning in 2019, following Phase 1 of the White Paper study, LVMWD collaborated with 12 other stakeholders in the Los Angeles Basin on Phase 2 of the study.

The goals of the Phase 2 study were to understand current operations of the existing DWDs and the sanitary sewer systems, explore the potential expansion of existing infrastructure for managing dry and wet weather runoff in the Los Angeles Basin, and develop a roadmap for MS4 permittees interested in developing and implementing a new DWD/wet weather diversion (WWD) or modifying an existing DWD to accept wet weather runoff.

Study Approach and Methodology

The stakeholder-led process for the Phase 2 White Paper provided guidance and review of the study's development and findings through two committees: (1) a Steering Committee to oversee the work's progress and provide strategic direction to ensure the project addressed each stakeholder's priorities, and (2) a Technical Review Committee to provide technical advice to the study team and feedback on the project deliverables. A series of workshops and meetings took place to provide project updates, obtain input, and discuss the study approach and results. The stakeholders reviewed and provided feedback on the technical memoranda developed throughout the effort. Figure ES-2 presents the study approach steps. The study methodology included gathering, compiling, and analyzing rainfall, DWD flow, and WRP influent flow data; analyzing DWD and sanitary sewer capacity data; and understanding the operations and configurations of the DWDs through field visits and discussions with the operators of the DWDs and WRPs as well as regular communications with stakeholders.

Figure ES-2. Study Approach Steps

Key Findings and Lessons Learned

A preliminary assessment was conducted to evaluate historical rainfall data from a few rain gauges in Los Angeles County; DWD pumping capacities and permitted capacities; influent flow data for the Hyperion WRP and Joint Water Pollution Control Plant (JWPCP); and the capacity of the associated collection systems to receive additional flows during wet weather diverted from storm drains. A more detailed, site-specific feasibility analysis with the relevant sanitary sewer system (that is, conveyance facilities and treatment plant) is recommended for proposed projects as they are developed. The Phase 2 study yielded the following key findings and lessons learned:

- **DWD Operations are Effective in Dry Weather**: DWDs have successfully diverted dry weather runoff from the storm drain system to the sanitary sewer system in coastal areas with the goal of improving the public health and safety of beach visitors by reducing the discharge of pollutants to the receiving waters. Exhibit ES-1 provides the locations of the existing DWDs.
- **DWDs have a Positive Effect on Permit Compliance**: DWDs support MS4 permit compliance for all the dry weather days (that is, on average about 92 percent of days with zero rainfall in a year) for pollutants of concern that have Total Maximum Daily Loads (TMDLs).

- **DWDs also have the Potential to Help Meet Compliance in the Inland Areas**: The existing DWDs constructed in the coastal areas represent less than 10 percent of the Los Angeles County. DWDs can be an effective tool to help achieve MS4 permit compliance for the uncaptured dry weather runoff in the inland areas as well.
- **Treatment Plants have Additional Capacity to Treat Dry Weather Runoff:** The amount of total dry weather runoff currently diverted by the DWDs is insignificant relative to the Hyperion WRP and the JWPCP's design capacities. Based on the preliminary analysis of WRP design capacities along with diminishing wastewater flows in the sewer systems due to recent water conservation practices, most of the WRPs/WWTPs (specifically the Hyperion WRP and JWPCP) are potentially capable of treating additional dry weather runoff.
- **The Sanitary Sewer Systems have Available Capacity to Convey Dry Weather Runoff:** The reduction in wastewater flows due to conservation translates to more available conveyance capacity in the sanitary sewer systems to convey additional dry weather runoff to the WRP/WWTPs without the risk of overflows. System-specific sanitary sewer analyses will be needed.
- **DWDs can be Improved to Potentially Capture Wet Weather Runoff:** The operations of DWDs can be modified to capture more runoff than is currently being diverted during dry weather, improve efficiency, reduce operational costs, and provide other regional benefits. There is also potential to divert wet weather flows, provided strategies (such as the development of storage facilities and real-time controls) can be adopted to mitigate the current limitations and risks.
- **The Roadmap Developed under this Study Provides a Step-by-step Approach to Implement Diversions:** The roadmap provides the steps for MS4 permittees that wish to implement a new DWD or a WWD or modify an existing DWD to divert additional dry weather and/or wet weather runoff (Figure ES-3).

Figure ES-3. Steps to Implement a New Diversion Project or Modify an Existing DWD to Capture Wet Weather Runoff

A key lesson from the discussions with various stakeholders was that issues encountered while developing stormwater management solutions can be more complex than anticipated. Early involvement and continuous participation of stakeholders during project planning can help resolve issues that, individually, may be viewed as insurmountable.

Recommendations

The results from this study were discussed in the monthly progress meetings with many of the project stakeholders. Various comments, input, and recommendations were received throughout the study. The project stakeholders found that the Steering and Technical Review Committees formed under this study ensured a collaborative approach to understand individual stakeholder/agency perspectives on diversion projects, the goals for stormwater capture, and diversion implementation challenges, as well as to elicit valuable feedback from a wide range of stakeholders to shape the outcome of the study. Stakeholder workshops provided a platform to discuss challenges and potential solutions for diversion implementation in the region. The stakeholders recommend the group stay engaged in some fashion to continue and sustain a dialogue in the following key areas:

★ **Conduct a Strategic Evaluation to Identify New Diversions**

a) Map storm drains with sanitary sewer infrastructure to prioritize areas for diversions.

b) Assess the cumulative impacts of existing and new diversions within each sanitary sewer system.

c) Use a long-term planning horizon for the entire sanitary sewer systems in Los Angeles County to identify the potential for generating additional regional water supplies.

d) Conduct climate change vulnerability assessment on proposed diversion projects, including the conveyance system and WRPs, in accordance with NPDES permit requirements.

e) Determine the cost-effectiveness of diversion projects to understand their costs and equitable full benefits.

★ **Conduct a Feasibility Study to Improve and Expand the Use of Existing Diversions**

a) Conduct site-by-site feasibility analyses to evaluate the potential for expanding existing DWDs.

b) Conduct case-by-case analyses to modify the DWDs' operations to restart following a rainfall event sooner than the current practice of waiting 24 or 72 hours after shutdown, depending on the availability of the sanitary sewer system and treatment plant capacities.

c) Conduct feasibility studies to implement DWDs at the existing LASAN- and LACFCD-owned pump plants.

d) Develop an inventory of the regional and distributed projects in various watersheds and conduct a feasibility study to assess which of these projects could include DWDs/WWDs.

e) Use an integrated, holistic approach to develop hybrid projects by combining nature-based solutions with diversion projects to achieve multiple benefits (for example, habitat restoration and community benefits, with water quality and water supply benefits).

★ **Develop a Pilot Project using "Smart" Technology for Proof of Concept for Diverting Wet Weather Runoff**

a) Develop a pilot project applying smart technology to gain confidence in diverting wet weather runoff on an incremental basis. Exhibit ES-2 shows the application of smart technology for real-time control of diversions.

b) Explore opportunities to develop storage facilities to capture wet weather runoff.

★ **Continue and Adapt the Engagement of the Existing Stakeholders**

a) Continue strengthening partnerships among sanitation agencies, water suppliers, MS4 permittees, the LACFCD, and if applicable, local watermasters to foster trust and commitment to the process of maintaining the multi-stakeholder dialogue and collaboration to develop runoff management solutions for the region.

b) Coordinate early among the MS4 permittees, water suppliers, sanitation agencies, the LACFCD, and if applicable, local watermasters to successfully implement diversions in the Los Angeles Basin.

c) Knowing the complexity of the issues, engage the stakeholders in Los Angeles County's watersheds on a continuous basis to discuss potential institutional issues or other issues (such as water rights) that may impede either the implementation of new DWDs/WWDs or the modification of the existing DWDs.

A collaborative approach is the most effective method of finding cost-effective solutions to manage dry and wet weather runoff to achieve water quality benefits and MS4 compliance, which can lead to the development of more reliable, robust, and sustainable local water supplies.

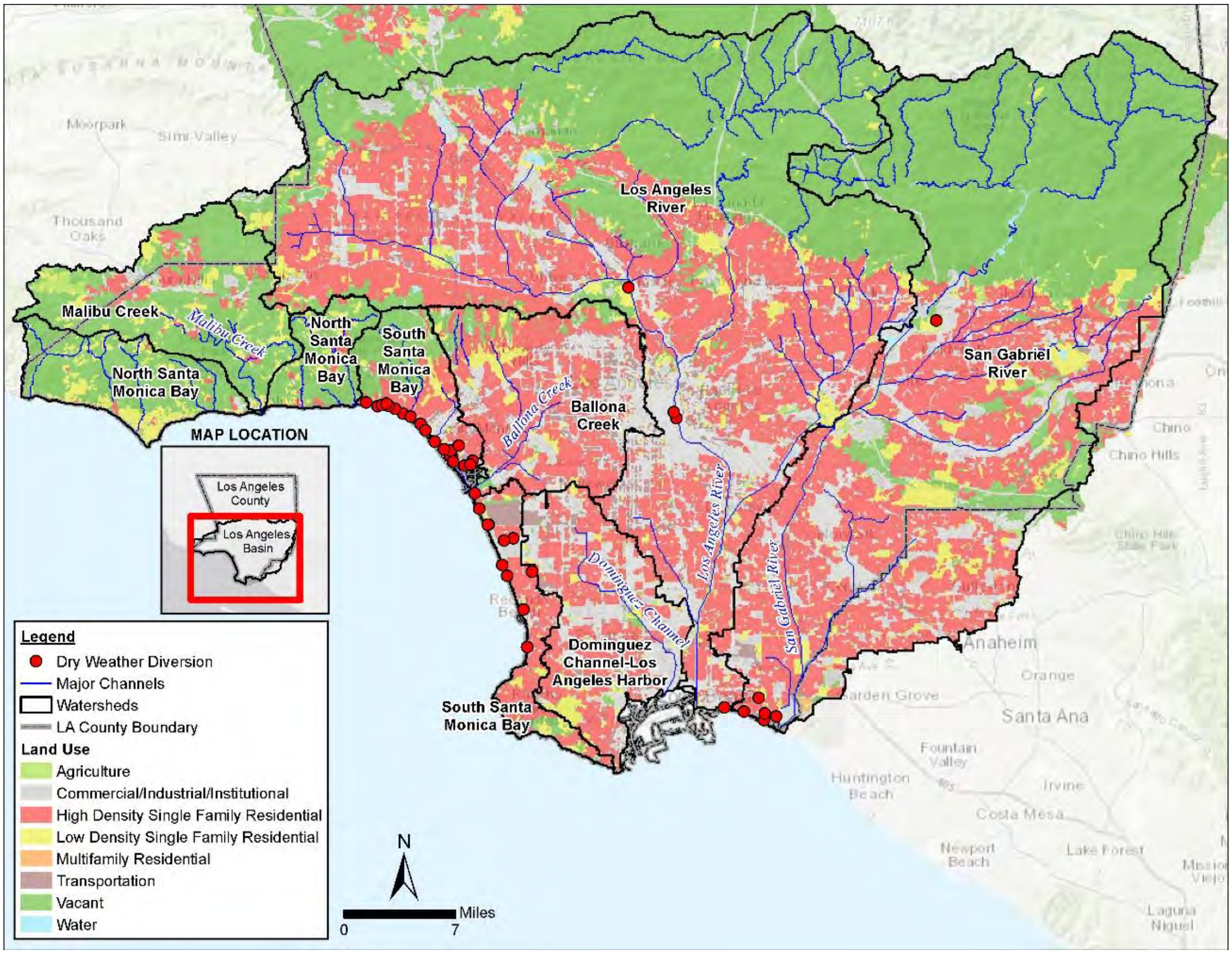

Exhibit ES-1. Locations of Existing DWDs

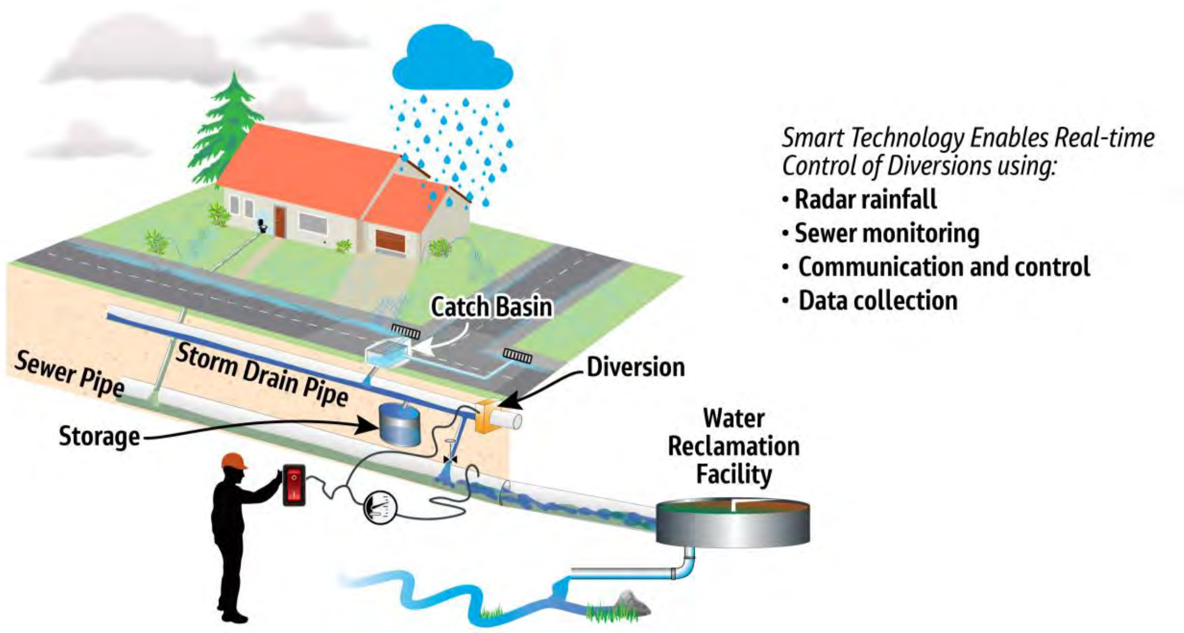

Exhibit ES-2. Application of "Smart" Technology for Management of Diverting Wet Weather Runoff

Report Organization and Content

As a part of the scope of work for this project, 9 technical memoranda (TM) were prepared and submitted to the stakeholders. These TMs are included as sections of this report, summarized here:

- ***Section 1 - Dry and Wet Weather Data Inventory***: This section provides an inventory of dry and wet weather data that were provided by stakeholders based on the original data request.
- ***Section 2 - Low Flow Diversion Inventory and Flow Analysis***: This section includes: (1) a revised inventory of 41 existing DWDs, (2) an analysis of dry and wet weather flows diverted by diversions from 2007 through 2018, (3) an analysis of influent flows of WRPs from 2013 through 2018, and (4) a comparison of DWD discharges with the available treatment capacity of WRPs.
- ***Section 3 - Dry Weather Diversion Efficacy Analysis and DWD Selection for Case Studies***: This section includes: (1) a discussion of the factors affecting DWD efficacy for potential conversion to WWD, and (2) the selection of DWDs for case studies.
- ***Section 4 - Case Studies of Dry Weather Diversions***: This section provides a high-level analysis of the four selected DWDs to determine their potential and feasibility of diverting wet weather flow under existing conditions. This section also presents the analysis of rainfall pattern in the DWD case-study watersheds, the effect of rainfall on the WRP influent, and the sanitary sewer system's ability to receive DWD discharge.
- ***Section 5 - Dry Weather Flow Estimates and Conceptual Approach for Diversions***: This section includes: (1) approaches to extract dry days from long-term data, (2) the amount of flow currently diverted by existing DWDs, (3) an estimate of remaining dry weather runoff that is currently not diverted by DWDs, and (4) a conceptual approach to divert remaining dry weather runoff in the Los Angeles Basin.
- ***Section 6 - Storage Considerations***: This section includes: (1) a discussion of the importance of water storage facilities, (2) examples of existing DWDs with storage facilities, (3) potential strategies for storage siting, (4) a summary of the existing DWDs with storage facilities, and (5) the operations and maintenance (O&M) requirements of storage facilities.

- ***Section 7 - Summary of Existing Regulations*:** This section includes a summary of: (1) the regulatory requirements regarding the installation and operations of DWDs and WWDs, and (2) outreach conducted with the Los Angeles Regional Water Quality Control Board (Los Angeles Regional Board or LARWQCB).
- ***Section 8 - Diversion Roadmap for MS4 Permittees*:** This section includes a roadmap for planning and implementing diversion projects under three scenarios: (1) use an existing DWD with modifications to divert additional flows than current operations allow, (2) develop a new DWD, and (3) develop a new WWD with storage. This section also discusses the regulatory requirements, permitting needs, costs, benefits, and limitations of diversion projects.
- ***Section 9 - Conclusions and Recommendations*:** This section includes a detailed summary of the conclusions and recommendations of the White Paper study.

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Appendices

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Acronyms and Abbreviations

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
AFY	acre-foot (feet) per year
ALERT	Automated Local Evaluation in Real Time
BMP	best management practice
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic foot (feet) per second
CIMP	Coordinated Integrated Monitoring Program
CIS	Coastal Interceptor Sewer
City	City of Los Angeles
COD	chemical oxygen demand
CWA	Clean Water Act
DCT WRP	Donald C. Tillman Water Reclamation Plant
d/D	flow depth/pipe diameter
DPW	Department of Public Works
DWD	dry weather diversion
EPA	U.S. Environmental Protection Agency
EWMP	Enhanced Watershed Management Program
GIS	geographic information system
gpd	gallon(s) per day
GPD/acre	gallon(s) per day per acre
gpm	gallon(s) per minute
ID	identification
IMP	integrated monitoring program
IRWD	Irvine Ranch Water District
JOS	Joint Outfall System
JWPCP	Joint Water Pollution Control Plant
LA County	Los Angeles County
LACFCD	Los Angeles County Flood Control District
LACSD (or Sanitation Districts)	Los Angeles County Sanitation Districts
LARWQCB (or Los Angeles Regional Board)	Los Angeles Regional Water Quality Control Board

LASAN	LA Sanitation & Environment
LAX	Los Angeles International Airport
LEL	lower explosive limit
LFD	low-flow diversion
LID	low-impact development
Los Angeles Basin Plan	Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties
Los Angeles Regional Board (or LARWQCB)	Los Angeles Regional Water Quality Control Board
LSA	Lake and Streambed Alteration
MG	million gallons
mg/L	milligram(s) per liter
MGD	million gallons per day
MH	maintenance hole
MRP	Monitoring and Reporting Program
MS4	municipal storm sewer system
MWDOC	Metropolitan Water District of Orange County
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRDC	National Resource Defense Council
O&M	operations and maintenance
PCB	polychlorinated biphenyl
PLC	programmable logic controller
PP	pump plant
QA/QC	quality assurance and quality control
RCB	reinforced-concrete box
RDI/I	rainfall-derived inflow and infiltration
Regional Water Board	Regional Water Quality Control Board
Sanitary Sewer Systems WDR	Statewide General WDRs for Sanitary Sewer Systems, Water Quality Order No. 2006-0003
SB	State Bill
SCADA	supervisory control and data acquisition
SCAR	sewer capacity availability review
SCCWRP	Southern California Coastal Water Research Project
SJC	San Jose Creek WRP
SMB	Santa Monica Bay

SMC	Santa Monica Canyon
SMURRF	Santa Monica Urban Runoff Recycling Facility
SS	suspended solids
SSMP	Sewer System Management Plan
SSO	sanitary sewer overflow
State Water Board	State Water Resources Control Board
SWMM	Storm Water Management Model
TMDL	Total Maximum Daily Load
USC	United States Code
VFD	variable-frequency drive
VPP	Venice Pumping Plant
WDR	Waste Discharge Requirement
WMMS	watershed management modeling system
WMP	watershed management program
WRP	water reclamation plant
WWTP	wastewater treatment plant

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Section 1. Dry and Wet Weather Data Inventory

1.1 Introduction

Low-flow diversions (LFDs) are commonly used in the Los Angeles region to describe the diversion of surface water from a channel or a storm drain during dry weather to treat and/or reuse. LFDs, also referred to as dry weather diversions (DWDs), can provide a highly controlled means of diverting dry weather runoff (or non-stormwater) to a sanitary sewer system, with opportunities to capture and divert first-flush wet weather runoff and, potentially, additional stormwater flows. Two significant benefits include a new source of recycled water and the potential reduction of pollutants discharged to receiving waters. The ultimate goal of this *Phase 2 of Tapping into Available Capacity in Existing Infrastructure to Create Water Supply and Water Quality Solutions White Paper* study is to assess the opportunity for the controlled and strategic integration of the existing stormwater and wastewater systems for regional water supply and water quality benefits in Los Angeles County (LA County). This study explores strategies to divert additional dry and wet weather runoff in the Los Angeles Basin using the existing and new DWDs by leveraging existing infrastructure in a cost-effective manner. This approach is intended to help agencies achieve municipal storm sewer system (MS4) compliance by managing dry and wet weather runoff to promote human health and safety and to generate a local water supply to decrease dependence on imported water supply in Southern California.

This section consists of the first two deliverables identified in Task 2 of the project scope of work. Based on the data collection effort and the compilation of dry and wet weather information, it seemed more appropriate to combine the information and data into a single deliverable, which is this document. Most of the information received from the data request was separated into dry and wet weather categories during the data analysis process, which is described in subsequent sections. The rainfall-impacted stormwater system and the sanitary sewersheds were the focus of the analysis of DWDs during wet weather periods. Subsequent sections also provide the flow data characterization for dry weather and wet weather and a more detailed inventory of DWDs.

The purpose of this section is to present the information/data gathered on existing infrastructure and projects for managing runoff within the study area. This section also includes the status of the data collection effort. In addition to raw data, metadata (such as the extent, type, format, and quality of data) were requested from the Stakeholder Group. A summary of reports and documents received from the Stakeholder Group is also presented. Geographical data relating to the physical attributes of various watersheds and sewersheds were collected from stakeholders to construct a geographic information system (GIS)-based data set for the study. Locations of DWDs and other stormwater management projects (including diversions that do not divert flows to the sanitary sewer system) and associated data were also collected. However, only the diversion projects that discharge flows to a sanitary sewer system (that is, DWDs), were considered for further analysis in this study. Finally, a summary table listing the status of the data collection task is presented.

The analysis presented in this section is confined to the information and data received in a readily usable electronic format, within 4 weeks of the data request. The information-gathering process continues and gathered information is reported and analyzed in subsequent deliverables.

This section is organized to include the following sections:

- Section 1.1 – Introduction
- Section 2.1 – Data Collection Approach
- Section 3.1 – Summary of Data Request
- Section 4.1 – Inventory of Data Received
- Section 5.1 – Data Collection and Integration Status and Next Steps
- Section 6.1 – References

1.2 Data Collection Approach

The goals of the data collection effort are to gather, understand, and synthesize the available data, and to generate an inventory of the data. This includes identifying and understanding existing studies related to the LFDs that have been either ongoing or completed for the various watersheds of LA County.

At the beginning of the project, it was recognized that the data collection task would need to evolve with the progress of the project tasks. The data collection approach was divided into three tiers to provide a focused data collection effort. This approach is necessitated by the following factors:

- The large study area comprising watersheds in LA County within various jurisdictions
- The large number of LFDs in each watershed within the stakeholders' geographical areas
- The involvement of agencies responsible for various components of LFDs

The tiered approach helps organize the level of information needed at various stages of the study, from developing an overview of the LFD projects, to preparing an inventory of data, and to evaluating detailed information on selected LFDs based on data availability for the study period (that is, 2002 through 2017). This three-tiered approach is depicted on Figure 1-1 and is described as follows with its status at this time:

- **Tier 1:** This step included a qualitative assessment of data availability to set the foundation for the follow-up data requests for this study. A data request was submitted to the stakeholders in the form of a questionnaire to identify the following: (1) the roles and responsibilities of the stakeholders related to the LFD operations, (2) the inventory of LFDs they are responsible for managing, (3) the types and formats of data and periods of records available, and (4) LFD operations and capacities. This section describes the results of data collected under Tier 1.

- **Tier 2:** This step is a follow-up of data needs based on the input received under Tier 1. During this stage, the data request focuses on LFDs in the LA County watersheds, and requests were issued to the relevant stakeholders for more detailed data and information. This information was used for analysis as presented in subsequent sections.

- **Tier 3:** This is the final stage of the data request step. More detailed information and data for up to four selected DWDs for case study analysis were requested. This information was compiled and presented in the subsequent sections.

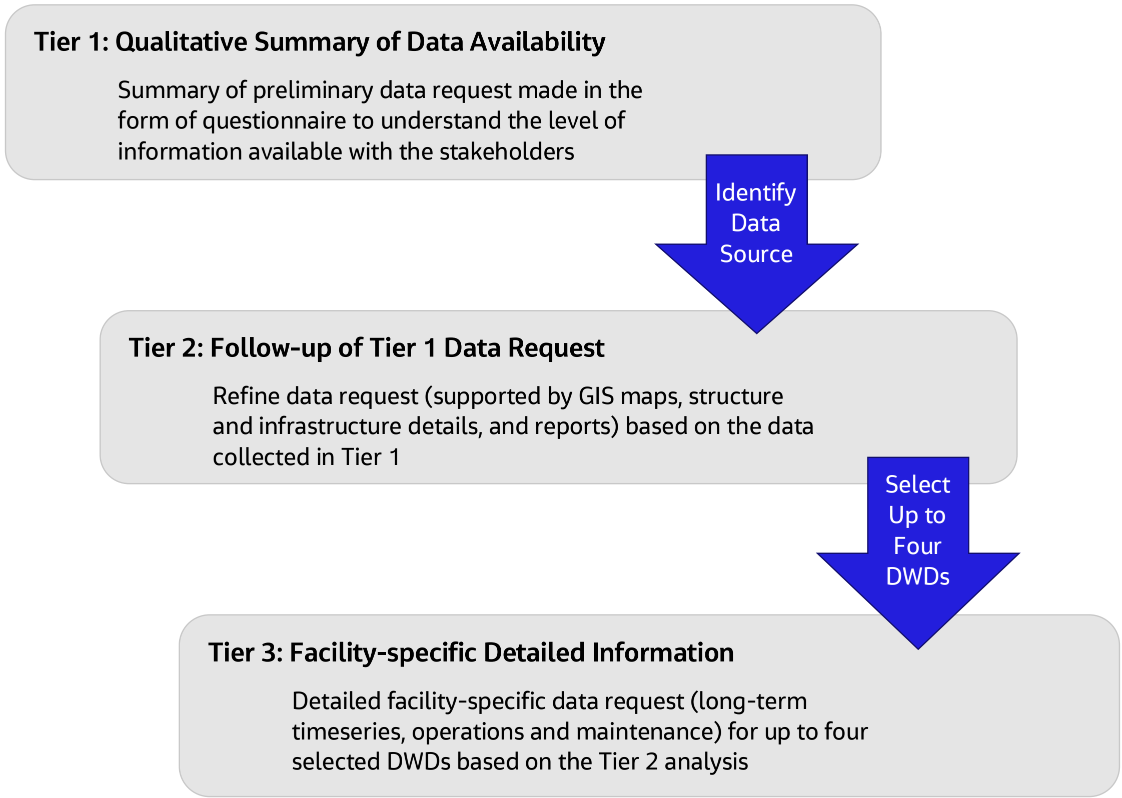

Figure 1-1. Data Collection Approach

1.2.1 Tasks Performed

Based on Tiers 1 and 2 of the data request, the following tasks were conducted:

- Prepared a data request and sent it to the stakeholders. With the identification of data sources through the Tier 1 data request, the project team worked with the stakeholders for the detailed data request to include in the Tier 2 data collection.
- Compiled, gathered, and mined a list of candidate documents for review.
- Gathered, formatted and analyzed data received from various agencies and sources. The data sets included function and operations of LFDs, the storm drain, the sanitary sewer system, and Water Reclamation Plants (WRPs). The project team collected geographical information pertaining to physical attributes of DWDs, storm drains, the sanitary sewer systems, and WRPs.
- Organized data sets obtained from various agencies to prepare a single (uniform) inventory of LFDs and related data. Two separate inventories were prepared: Excel spreadsheet that contains LFD related data and GIS data stored in a GIS format.
- Synthesized data to prepare the maps and figures presented in this section.

1.3 Summary of Data Request

This section explains the types of data requested and the response to the request.

1.3.1 Tier 1 Data Collection

The Tier 1 data request was sent to the stakeholders on March 18, 2019. The following categories of information were requested:

- LFD data (structures and operations)
- Storm drain data
- Wastewater collection system data and WRP data
- Rainfall and stream flow monitoring data
- GIS data
- Relevant studies and documents

The following information and data were requested for calendar years 2002 through 2017:

- GIS files containing information on the watershed and sewershed maps and the location of LFDs, sanitary sewer, WRPs and storm drain facilities, and gauges (such as rainfall, flow measurements)
- Information on water quality control programs, such as stormwater management programs, sewer system improvement activities, and other potentially related activities
- Data on existing infrastructure to control runoff water quality (such as best management practices [BMPs]), including the type, location, and delineation of the drainage area the infrastructure serves (point files with drainage attribute tables or polygon files)

The data request mentioned that data in any format, from hard copies of studies to spreadsheets or through GIS layers, were acceptable. In addition to sending the request letter with questionnaires to the stakeholders, follow-up contacts were made via telephone and email.

1.3.2 Summary of Data and Information Provided by Stakeholders under Tier 1

Table 1-1 lists stakeholders who responded to the data request. A checkmark under each data category indicates information was received from a stakeholder. Some agencies do not own or operate LFD, storm drain, sanitary sewer, or WRP, as Table 1-1 notes. Therefore, no further information was requested from these agencies.

Table 1-1. Type of Data Provided by Stakeholders/Agencies

Agency	LFD	Storm Drain System	Sanitary Sewer System	WRP
LVMWD	N/A	N/A	✓	✓
LACSD	N/A	N/A	✓	✓
LASAN	✓	✓	✓	✓
LACFCD	✓	✓	N/A	N/A
City of Torrance	N/A	✓	✓	N/A

Notes:

The following stakeholders do not own or operate infrastructure relevant to this study: LADWP, Three Valleys Municipal Water District, Upper San Gabriel Valley Municipal Water District, Pasadena Water and Power, Main San Gabrie Basin Watermaster, Metropolitan Water District of Southern California, WRD, and Central Basin Municipal Water District.

LACFCD = Los Angeles County Flood Control District
LACSD = Los Angeles County Sanitation Districts
LASAN = LA Sanitation & Environment
N/A = not applicable

1.4 Inventory of Data Received

This section presents the tables and figures comprising the data inventory when this section was developed.

1.4.1 Data Integration

Received data and information have been categorized into the following lists:

- List 1: LFD-specific Data
- List 2: Storm Drain Data
- List 3: Sanitary Sewer System Data
- List 4: WRP Data
- List 5: GIS Data
- List 6: Rainfall and Stream Flow Monitoring Data
- List 7: Relevant Studies and Documents

1.4.1.1 List 1: LFD-specific Data

Two stakeholders (LASAN and LACFCD) own, operate, and maintain LFDs in various watersheds. Other agencies, such as the Cities of Santa Monica and Long Beach, also own or operate LFD projects, but were not contacted for information because they are not a part of the study's Stakeholder Group. However, the inventory included information provided by the stakeholders on all LFDs, regardless of whether the owners or operators are outside the Stakeholder Group. Table 1-2 summarizes the LFD data inventory and the stakeholders' responses to the questionnaire. The inventory includes LFDs discharging to a sanitary sewer system, stormwater management projects (such as wetlands or stormwater capture project with reuse for irrigation), or pumping plants. Figure 1-2 shows the location of LFDs in each watershed based on the GIS shapefiles provided by the stakeholders. Figure 1-2 also shows the LFDs that discharge to sanitary sewer systems and the responsible agency, and LFDs that do not discharge to sanitary sewer systems. Table 1-3 summarizes the supporting information collected on the entire LFD inventory.

Note, during data collection, the data list included all types of LFDs including stormwater management projects that do not divert flows to a sanitary sewer system. However, only the LFDs that discharge flows to a sanitary sewer system, also referred to as DWDs herein, were considered for further analysis in this study.

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Table 1-2. Summary of LFD Information Received

Agency	Number of LFDs Operated and Maintained by the Agency	Number of LFDs Discharging to the Sanitary Sewer System	Flow Information for LFDs	LFDs with a Storage Component	Selection Criteria for LFDs	Planned LFDs	Any Poor Water Quality Areas Needing Additional LFDs	Type and Frequency of Maintenance	Lessons Learned from Operation of Existing LFDs and Other Information on the Operation and Maintenance of LFDs
LACFCD	21	19	In progress[a]	Storage at 28th/Strand, Marie Canyon, all LFDs have wet wells at the minimum.	Typically found near beach outlets with high bacteria loadings.	None led by LACFCD.	N/A	▪ Daily monitoring. ▪ Weekly in-person checks. ▪ Manual restart after every wet weather event. ▪ Vac truck removal of debris and sediment, pump replacement, flow meter replacement, etc.	▪ Storage is essential to manage episodic peak flows. ▪ LFDs require substantial maintenance effort. ▪ Telemetry is key for rapid response to issues (situational awareness) and demonstrating effectiveness for compliance purposes. ▪ Dry weather flow rates vary substantially on a daily, monthly, and yearly basis. ▪ Many other lessons have been learned over 15 years of operation. ▪ Over the last 2 years, annual LFD O&M costs averaged approximately $50,000 and ranged from $30,000 to $120,000, depending on the facilities.
LASAN	in progress[a]	Information is available.	Flow information determined by pump run time. N/A	They were placed in channels that led directly to water bodies, locations that coincided with compliance sampling locations, and that are within existing City property and facilities.	LFDs owned by stakeholders and discharging to sanitary sewer only[b].	This information is available under prioritization of subwatersheds per the EWMPs	N/A	N/A	N/A

[a] Some information was pending when this section was prepared. The information was later made available and is documented in subsequent sections.

[b] The full list is provided in Section 2.

Notes:

EWMP = Enhanced Watershed Management Program

O&M = operations and maintenance

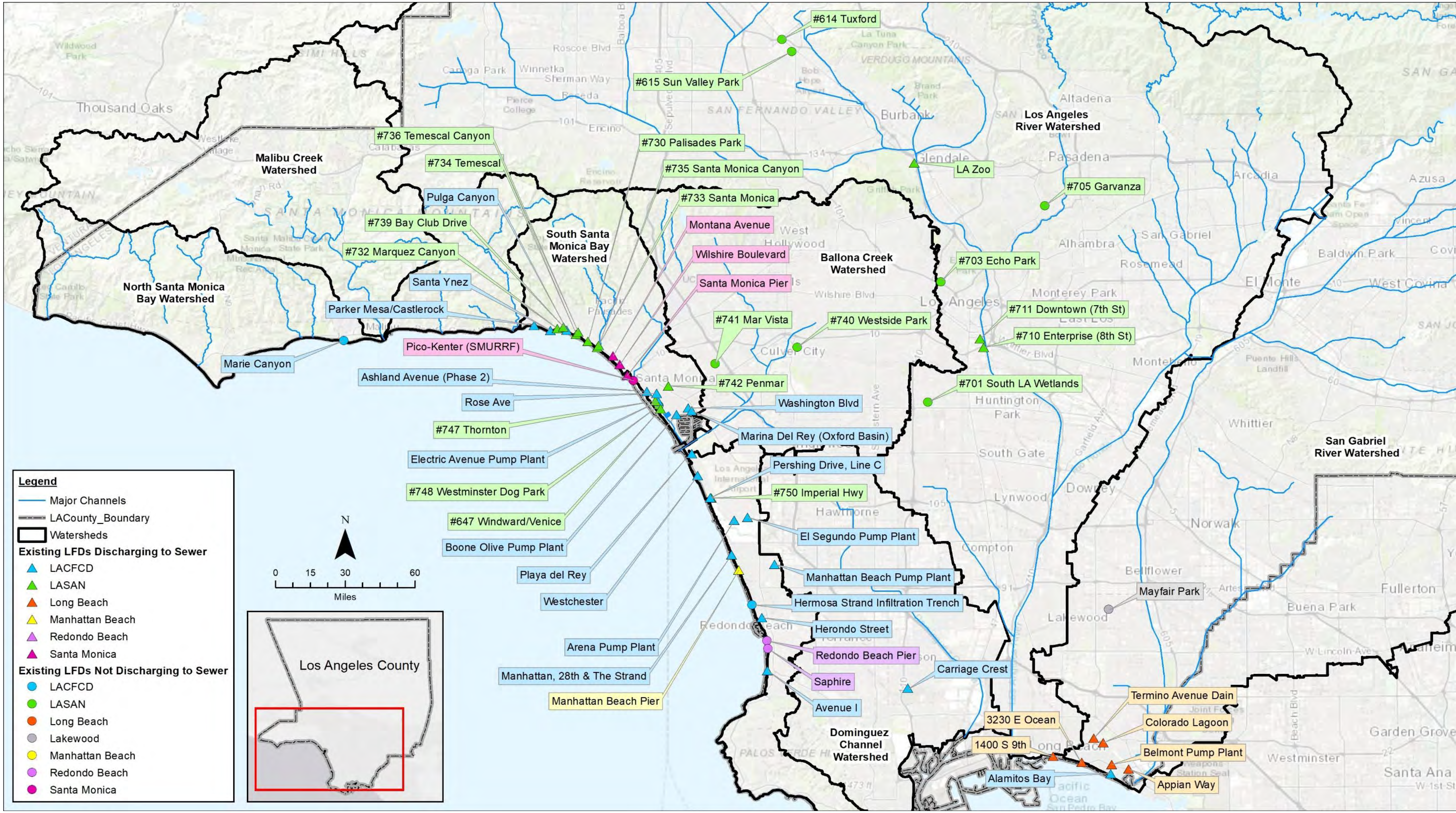

Figure 1-2. Location of Existing LFDs and Stormwater Diversion BMP Projects

Table 1-3. Summary of the Existing LFDs, including Stormwater Diversion BMP Projects

	Name	Owner	Discharge to Sewer	Watershed	Sewershed
1	Arena PP	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
2	Ashland Avenue (Phase 2)	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
3	Avenue I	LACFCD	Yes	South Santa Monica Bay	JWPCP
4	Boone Olive PP	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
5	El Segundo PP	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
6	Electric Avenue PP	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
7	Herondo Street	LACFCD	Yes	South Santa Monica Bay	JWPCP
8	Manhattan Beach PP	LACFCD	Yes	South Santa Monica Bay	JWPCP
9	Manhattan, 28th and The Strand	LACFCD	Yes	South Santa Monica Bay	JWPCP
10	Marie Canyon	LACFCD	No	North Santa Monica Bay	N/A
11	Marina Del Rey (Oxford Basin)	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
12	Parker Mesa/Castlerock	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
13	Pershing Drive, Line C	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
14	Playa del Rey	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
15	Pulga Canyon	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
16	Rose Avenue (Phase 2)	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
17	Santa Ynez	LACFCD	Yes	South Santa Monica Bay	N/A
18	Washington Blvd	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
19	Westchester	LACFCD	Yes	South Santa Monica Bay	Hyperion WRP
20	Carriage Crest	LACFCD and Carson	Yes	Dominguez Channel	JWPCP
21	Hermosa Strand Infiltration Trench	LACFCD and Hermosa Beach	No	South Santa Monica Bay	N/A
22	Alamitos Bay PP	LACFCD and Long Beach	Yes	San Gabriel River	JWPCP
23	Mayfair Park	Lakewood	No	San Gabriel River	N/A
24	No. 614 Tuxford	LASAN	No	Los Angeles River	N/A
25	No. 615 Sun Valley Park	LASAN	No	Los Angeles River	N/A
26	No. 647 Windward/Venice	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
27	No. 701 South LA Wetlands	LASAN	No	Los Angeles River	N/A
28	No. 703 Echo Park	LASAN	No	Los Angeles River	N/A
29	No. 705 Garvanza	LASAN	No	Los Angeles River	N/A
30	No. 710 Enterprise (8th Street)	LASAN	Yes	Los Angeles River	Hyperion WRP
31	No. 711 Downtown (7th Street)	LASAN	Yes	Los Angeles River	Hyperion WRP

Table 1-3. Summary of the Existing LFDs, including Stormwater Diversion BMP Projects

	Name	Owner	Discharge to Sewer	Watershed	Sewershed
32	No. 730 Palisades Park	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
33	No. 732 Marquez Canyon	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
34	No. 733 Santa Monica	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
35	No. 734 Temescal	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
36	No. 735 Santa Monica Canyon	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
37	No. 736 Temescal Canyon	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
38	No. 739 Bay Club Drive	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
39	No. 740 Westside Park	LASAN	No	Ballona Creek	N/A
40	No. 741 Mar Vista	LASAN	No	Ballona Creek	N/A
41	No. 742 Penmar	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
42	No. 747 Thornton	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
43	No. 748 Westminster Dog Park	LASAN	No	South Santa Monica Bay	N/A
44	No. 750 Imperial Hwy	LASAN	Yes	South Santa Monica Bay	Hyperion WRP
45	LA Zoo	LASAN	Yes	Los Angeles River	Hyperion WRP
46	1400 S 9th	Long Beach	Yes	San Gabriel River	JWPCP
47	3230 E Ocean	Long Beach	Yes	San Gabriel River	JWPCP
48	Appian Way	Long Beach	Yes	San Gabriel River	JWPCP
49	Belmont Pump Plant	Long Beach	Yes	San Gabriel River	JWPCP
50	Colorado Lagoon	Long Beach	Yes	San Gabriel River	JWPCP
51	Termino Avenue Dain	Long Beach	Yes	San Gabriel River	JWPCP
52	Manhattan Beach Pier	Manhattan Beach	Yes	South Santa Monica Bay	JWPCP
53	Redondo Beach Pier	Redondo Beach	No	South Santa Monica Bay	N/A
54	Saphire	Redondo Beach	No	South Santa Monica Bay	N/A
55	Montana Avenue	Santa Monica	Yes	South Santa Monica Bay	Hyperion WRP
56	Pico-Kenter (SMURRF)	Santa Monica	No	South Santa Monica Bay	N/A
57	Santa Monica Pier	Santa Monica	Yes	South Santa Monica Bay	Hyperion WRP
58	Wilshire Boulevard	Santa Monica	Yes	South Santa Monica Bay	Hyperion WRP

Notes:

JWPCP = Joint Water Pollution Control Plant
PP = pump plant
SMURRF = Santa Monica Urban Runoff Recycling Facility

1.4.1.2 List 2: Storm Drain Data

Table 1-4 summarizes storm drain data and information received.

Figure 1-3 presents a map showing the storm drain network for major channels and storm drains within the study area based on GIS shapefiles received from LA County Department of Public Works' (DPW's) online database.

1.4.1.3 List 3: Sanitary Sewer System Data

Table 1-5 provides a detailed summary of sanitary sewer system data and information received. This includes the wastewater collection system or sewershed, including pipelines, pumps, flow control structures, and WRPs.

Figure 1-4 presents a map showing the sanitary sewer network with flow monitoring locations and WRPs within the study area based on GIS shapefiles received from the stakeholders.

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Table 1-4. Summary of Storm Drain Data Received

Agency	Storm Drain Monitoring	Dry Weather Monitoring	Flooding in Storm Drain	Any Hydraulic and/or Hydrologic Models for Stormwater Management	Other Monitoring Agency Involved in the Subwatershed/Sewershed	Regional Stormwater Capture Systems, like Cisterns
LACFCD	Flow monitoring data are available from storm gauges. LA County Public Works operates 62 stream gaging stations throughout Los Angeles County. Mean daily and peak annual flow rate data are provided for each gauge in the annual Hydrologic Report (http://ladpw.org/wrd/report/index.cfm). Additional data can be obtained from the SWED-Hydrologic Records Unit. SWED currently has only one stream gauge (F130) in the Malibu Creek Watershed. F130 is along Malibu Creek just below Cold Creek.	All stream gaging stations throughout Los Angeles County record both dry weather and stormwater flows. EWMP/CIMP may provide some additional information.	Currently, LA County Stormwater Engineering Division is developing the Drainage Needs Assessment Program, which will report flooding. Previously, SWED used to track in the Unmet Drainage Needs database.	LA County uses several numerical models. Some examples include WMS, HEC-HMS, WSPG, XPSWMM, and HEC-RAS. These models are used to evaluate the adequacy or deficiency of our existing flood control infrastructure. These models are also used to evaluate proposed project alternatives to improve or enhance flood control.	Cities frequently maintain segments of the storm drain system within their jurisdictions. Many private developments have not transferred the storm drain system to the Flood Control District for maintenance. Reaches of some of the large channel drainage systems are maintained by the U.S. Army Corps of Engineers.	The Flood Control District storm drain system incorporates spreading grounds and detention for PPs that must be drained within 72 hours. Refer to EWMP/CIMP leads regarding cisterns.
LADWP	Flow monitoring data are not available.	For stormwater flows, refer to Stormwater Capture Master Plan: https://www.ladwp.com/ladwp/faces/wcnav_externalId/a-w-stormwatercapturemp.	The City of Los Angeles Department of Public Works Bureau of Engineering maintains flooding information	SWMM models have been developed to determine project-specific catchment area and volume.	Los Angeles Sanitation and Environment involved in monitoring of the subwatershed/sewershed.	Data are available from LASAN.
LASAN	Dry weather monitoring is done once every outfall assessment (during MS4 permit renewal). Wet weather monitoring is done for three events at the stormwater outfalls with autosamplers. Monitoring testing is done for analysis and not just for monitoring flow level. Data are available upon request. About 6 months of data can be obtained from the Regional Board, monthly bacteria reports, and annual reports to the LARWQCB.	Monitoring testing is done for analysis and not just flow level monitoring. The testing for non-stormwater is conducted once a week. There are permitted dewatering activities (e.g., Los Angeles County Metropolitan Transportation Authority dewatering), results of dry weather investigations, illicit discharges detected and reported in the watershed. Refer to sources: SCCWRP, in-house watershed investigations, One Water Los Angeles River Flow Study: One Water LA Vol 3 – Stormwater and Urban Runoff Facilities Plan.	Flooding information can be extracted from the flood complaints information in coordination with the City of Los Angeles Department of Public Works Bureau of Engineering.	On a project-by-project basis, HydroCalc is used for hydrologic modeling in-house. For the EWMPs, consultants used WMMS with SUSTAIN and SBPAT modeling for the Reasonable Assurance Analyses.	WCSD maintains a portion of storm drain catch basins. WCSD cleans the catch basins routinely. The storm drain system is self-cleaning.	Projects are evolved from the LID and Proposition O projects.
City of Torrance	For Machado Lake, flow monitoring is done for nutrients and toxics.	Machado Lake Annual Monitoring Report; Beach Cities SMB monitoring reports for Machado Lake watershed; Beach Cities source investigation studies	It is reported and monitored only after receiving resident requests and complaints.	Modeling information is available.	LACFCD is involved in monitoring tasks.	There are 14 retention and detention basins.

Notes:
CIMP = Coordinated Integrated Monitoring Program
LARWQCB = Los Angeles Regional Water Quality Control Board
LID = low-impact development
SCCWRP = Southern California Coastal Water Research Project
SMB = Santa Monica Bay
SWMM = Storm Water Management Model
Vol = volume

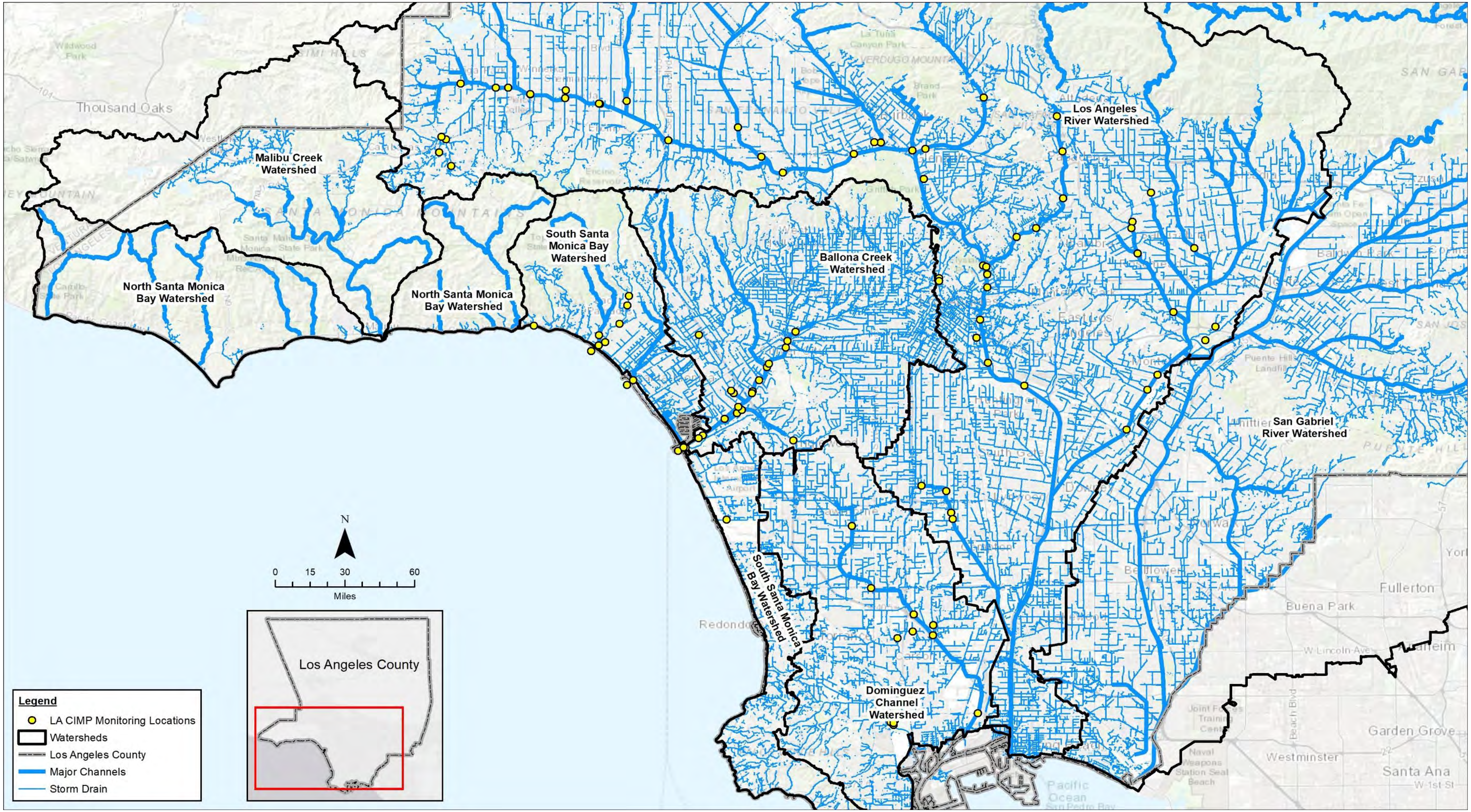

Figure 1-3. Map Showing the Storm Drain Network

Table 1-5. Summary of Sanitary Sewer System Data Received

Agency	Sanitary Sewer Flow Monitoring	Operational Condition of LFDs If Connected to the Sewer System	Data Collection Method	Areas with Excessive Infiltration and Inflow during Storms
LACSD	The dry weather flow monitoring program includes more than 2,600 gauging locations throughout the sewer network. These locations are monitored for a 1- to 2-week period in every 3 to 5 years, depending on the potential for growth within a tributary area of the sewer. Peak dry weather flow is measured at representative manholes in each trunk and joint outfall sewer and is plotted on clearance diagrams, which graphically present the clearance between the existing peak dry flow and pipe capacity under non-pressurized conditions. Clearance diagrams determine where capacity restrictions exist as part of the capacity assessment program. The wet weather flow monitoring program includes approximately 50 gauging locations where sewers are reaching capacity during wet weather or where sewers have overflowed or nearly overflowed in the past. These locations are continuously monitored from October to April every year.	LFDs are connected to the sanitary sewer system and currently go to LACSD's JWPCP. Systems are shut down during wet weather (rainfall in excess of 0.1 inch), sewer emergencies, and/or sewer construction/rehabilitation.	Remote alarm sensors are also used in various locations to notify personnel when the water surface rises above a predetermined level so that measures can be taken to prevent overflows. Approximately 50 wet weather flow monitoring locations provide real-time data via cellular signal. The sewer system currently has 20 smart cover level sensors that provide real-time data via satellite signal.	The LACSD sewer system is large and highly interconnected. Impacts from significant I&I can be experienced at locations throughout the system. Any particular location of inflow impact is dependent on the pattern and intensity of each storm. Intense storm cells can develop that cause an inflow-related overflow. No calibrated hydrodynamic sewer flow model exists.
LASAN	Three programs exist for the sanitary sewer flow monitoring: Near-time, periodic, and special. Near-time uses sensors to measure level and velocity. Periodic and special measure level only.	LFDs are controlled prior to substantial wet weather events.	Data are collected based on flow conditions in the watershed, in general, daily.	N/A A calibrated hydrologic and hydraulic sewer model exists.
LVMWD	Sewer flow monitoring is conducted at the Tapia WRP, and at the following manhole locations: MH365,299,280,265 @minute interval.	Not connected	Not provided	See I&I analysis reports. No calibrated hydrodynamic sewer flow model exists.
City of Torrance	Monitoring was planned to start in 2019 for the new Sewer System Model development. Frequency of measurement was planned to be determined at that time.	Not decided	Smart covers are used for monitoring sewer system overflows.	Unknown Modeling was planned to occur in 2019.

Notes:
@ = at
I&I = inflow and infiltration

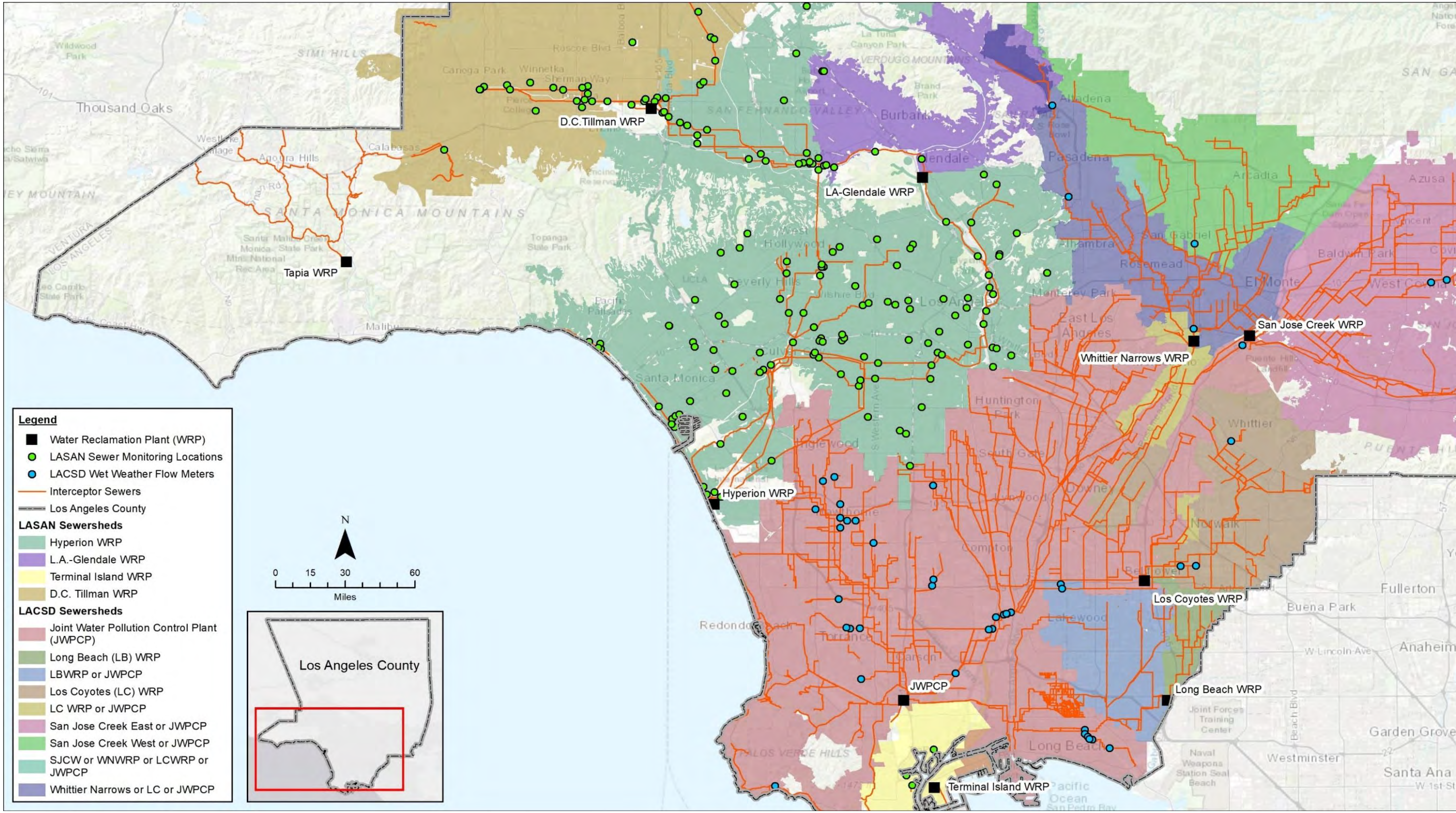

Figure 1-4. Map Showing Sanitary Sewer Network

1.4.1.4 List 4: WRP Data

Table 1-6 provides a detailed summary of water quality monitoring data and information received from the stakeholders. Table 1-7 summarizes the data for the WRPs. This table contains information about design capacities and average discharge flows, along with planned recycled water production and discharge locations for each WRP. Some WRPs have existing equalization basins and some are planned. Some of the information, such as average discharges and discharge locations for the Donald C. Tillman WRP and Los Angeles-Glendale WRP, was requested as a part of the Tier 2 data request.

Table 1-6. Summary of Water Quality Information at WRPs

Agency	Contaminants of Concern in Stormwater	Existing Water Quality Challenges at the WRPs?
LACSD	See Dry Weather Runoff Requirements for Sample Requirements. Also see the following NPDES permit requirements: ▪ JWPCP: CA00053813 ▪ Long Beach: CA0054119 ▪ Los Coyotes: CA0054011 ▪ Pomona: CA0053619 ▪ San Jose Creek: CA0053911 ▪ Saugus: CA0054313 ▪ Valencia: CA0054216 ▪ Whittier Narrows: CA0053716	While WRPs may have as many as 3 discharge permits (NPDES, Reuse and Groundwater Recharge), in evaluating DWDs, historically all have gone to the JWPCP, which only has NPDES ocean discharge requirements. As the project team considers diversions at the upstream WRPs, LACSD will have to assess potential impact to NPDES compliance with, reuse and groundwater recharge requirements. Flows produced at the Pomona, SJC, Los Coyotes, Long Beach, and Whittier Narrows WRPs are currently lower than design flows due to water conservation. In addition, the amount of flow treated at these WRPs varies based on the strength of the influent (which has increased with water conservation) and their nitrification/denitrification performance; any peak flows bypassed by these WRPs are treated at the JWPCP. Generally, the Pomona, SJC and Whittier Narrows WRPs have diverted more sewage to the JWPCP than the other plants to ensure compliance with nitrogen discharge limits and Title 22 disinfection requirements. Flow equalization at SJC WRP should help minimize the amount of peak flow bypassed, increase availability of recycled water at night when reuse demands are higher, and allow for optimal operation of the Sequential Chlorination disinfection process. Flow equalization is also being considered at the Pomona WRP. Construction of flow equalization at the Whittier Narrows WRP is not possible due to restrictions to increasing the plant footprint by the owner of the property but LACSD is looking at opportunities to increase the amount of recycled water produced at the facility. JWPCP and the Los Coyotes WRP may be able to treat additional flow during dry weather conditions. During wet weather, secondary clarifier performance at the WRPs can be adversely affected by the loss of activated sludge biomass because of hydraulic overloading of the secondary clarifier systems. The loss of biomass leads to loss in the nitrification capacity of the plant and in poorer settling sludge as the activated sludge system stabilizes. The intake of additional stormwater flows (beyond I&I) would likely lead to longer recovery times for the activated sludge process in post-storm flow situations. At SJC, this would also have an impact on recycled water customers, if it takes SJC longer to achieve the Title 22-compliant disinfection (because of persistent ammonia bleed-through caused by the loss of nitrifying biomass during storms). Also, the intake of additional stormwater (beyond I&I) for treatment would need to be carefully monitored and controlled in relation to available downstream sewer capacity to JWPCP.

Table 1-6. Summary of Water Quality Information at WRPs

Agency	Contaminants of Concern in Stormwater	Existing Water Quality Challenges at the WRPs?
LASAN	State Board Lists contaminants of emerging concern, pesticides, nutrients (see E-2 list of constituents, per the MS4 permit)	Sewer capacity (wet weather). Low influent flows (dry weather). Insufficient capacity to retain flows during wet weather before diverting to sewer.
LVMWD	See NPDES MRP in document link: NPDES No. CA0056014, Order R4-2017-0124	Wet Weather: Influent flow >32 MGD produces challenges with maintaining low turbidity and keeping up with disinfection. Average dry weather flow at Tapia is 7 MGD.

Notes:

MGD = million gallons per day
MRP = Monitoring and Reporting Program
NPDES = National Pollutant Discharge Elimination System
SJC = San Jose Creek WRP

Table 1-7. Summary of WRP Details

Stakeholder	WWTP/WRP Name	Current Design Capacity (MGD)	Equalization Basin Volume (MG)	Planned Recycled Water Production * (MGD)	Current Average Discharge * (MGD)+	Discharge Location/ Receiving Waterbody
LACSD	JWPCP	400	-	20 (in plant use; no reuse outside of plant)	261.08	Pacific Ocean
	Long Beach	25	-	9.75	4.76	Coyote Creek
	Los Coyotes	37.5	-	18.34	15.01	San Gabriel River
	Pomona	15	-	5.88	3.60	San Jose Creek
	San Jose Creek	100	8 (under construction)	48.84	20.06	San Jose Creek/ San Gabriel River
	Saugus	6.5	1.0	4.75	4.75	Santa Clara River
	Valencia	21.6	8.8	13.49	13.17	Santa Clara River
	Whittier Narrows	15	-	7.01	5.63	Los Angeles River/ Rio Hondo/San Gabriel River
LASAN	Hyperion WRP++	450	N/A	5 MGD to LAX, 20 MGD to West Basin, 20 MGD to Regional Recycled Water Project	208	Pacific Ocean
	DCT WRP	80	Existing 5 MG. Proposing 6.75 MG contingent upon East-West Interceptor Project.	20 MGD to GWR Project	TBD	N/A

Table 1-7. Summary of WRP Details

Stakeholder	WWTP/WRP Name	Current Design Capacity (MGD)	Equalization Basin Volume (MG)	Planned Recycled Water Production * (MGD)	Current Average Discharge * (MGD)+	Discharge Location/ Receiving Waterbody
	Los Angeles-Glendale WRP	20	Planning 5 MG with construction scheduled to be completed July 2022.	N/A	TBD	N/A
	Terminal Island WRP	30	N/A	N/A	8.5 MGD with 0.4 MGD as brine	Los Angeles Harbor
LVMWD	Tapia WRP	12	2.6	Remain the same: 5.5 MGD avg.	7.0	Malibu Creek

Notes:
- = no information provided
* = data for CY18
+ = for LACSD, this is the average flow discharged to receiving waters in 2018. It does not include any current reuse nor is it all the flow that is produced at the plants.
++ = Hyperion WRP will become 100% recycled water by 2035.
avg = average
DCT WRP = Donald C. Tillman Water Reclamation Plant
LAX = Los Angeles International Airport
MG = million gallons
WRP = water reclamation plant
WWTP = wastewater treatment plant

1.4.1.5 List 5: GIS Data

Geographical data layers were compiled into a single GIS database format to facilitate overlay and analysis. Table 1-8 summarizes the GIS data/layers. These data/GIS layers were used to generate Figures 1-2, 1-3, 1-4, and 1-5.

Table 1-8. Inventory of GIS Data Received and Collected

Shapefile/Geodatabase Name	Source	Description
City_LFDs	LACFCD Data Request	Points (21) of city-owned LFD locations
LACFCD_LFDs	LACFCD Data Request	Points (7) of County-owned LFD locations
PP_Layer	LACFCD Data Request	Points (136) of stormwater pumping plants
SewerSpills	LACSD Data Request	Points (235) of sanitary sewer spills
WetWeatherFlowMeterManholes	LACSD Data Request	Points (51) of wet weather flow meters
WRP_Trib	LACSD Data Request	Polygons (26) of LACSD sewersheds
WRPs	LACSD Data Request	Polygons (9) of LACSD WRPs
7MainSewersheds	LASAN Data Request	Polygons (12) of the LASAN sewersheds
LFD _DrainageAreas	LASAN Data Request	Polygons (26) of LFD drainage areas
LFDs_PointLocation_7thSt_8thSt	LASAN Data Request	Points (2) of LFD locations
Sewer MonitoringLocations	LASAN Data Request	Points (178) of LASAN sewer monitoring locations

Table 1-8. Inventory of GIS Data Received and Collected

Shapefile/Geodatabase Name	Source	Description
Stormwater_CIMP_CityLA_ Monitoring_Locations	LASAN Data Request	Points (126) of stormwater monitoring locations
LVMWD_Sewer.gdb	LVMWD Data Request	Geodatabase of sewer system. Point locations of sewer network junctions, cleanout vaults, control valves, discharge points, fittings, manholes, meters, structures, pumps, and system valves. Polylines for force mains, gravity mains, and lateral lines.
TSD_DD_PIPE.GDB	LVMWD Data Request	Geodatabase containing polylines of Triunfo Sanitation District sewer system.
Low_Flow_Diversions	City of Los Angeles GeoHub	Points (21) of LFD locations
Drainage_Basins	City of Los Angeles GeoHub	Polygons (12,046) of watershed sub-basins within Los Angeles.
Drainage_Subareas	City of Los Angeles GeoHub	Polygons (316) of watershed sub-basins within Los Angeles.
Storm_Pipes	City of Los Angeles GeoHub	Polylines of Los Angeles' storm drain pipes.
Sewer_Outfall_Pipes_by_Size	City of Los Angeles GeoHub	Polylines of Los Angeles' sewer outfall pipes.
SDN_Public.gdb	LA County GIS Data Portal	Geodatabase of LA County's storm drain system. Points for catch basins, manholes, and pump stations. Polylines for culverts, force mains, gravity mains, lateral lines, natural drainage, and open channels.
MS4_Outfall	LA County GIS Data Portal	Points (2,605) of MS4 outfalls
Sewers.gdb	LACSD Website	Geodatabase of LACSD facilities. Points for facilities and manholes. Polylines for sewers.

Sources:
City of Los Angeles GeoHub: http://geohub.lacity.org/
LA County GIS Data Portal: https://egis3.lacounty.gov/dataportal/
LACSD Website: https://www.lacsd.org/about/gis/default.asp

1.4.1.6 List 6: Rainfall and Stream Flow Monitoring Data

The LA County DPW provided rain gauge data in GIS shapefile format. Figure 1-5 shows the locations of rain gauge stations. Later, rainfall data were obtained for selected gauges in the tributary area or watershed of DWDs and WRP sewersheds to better understand the relationship between rain events and impacts of runoff on the drainage system and wastewater infrastructure.

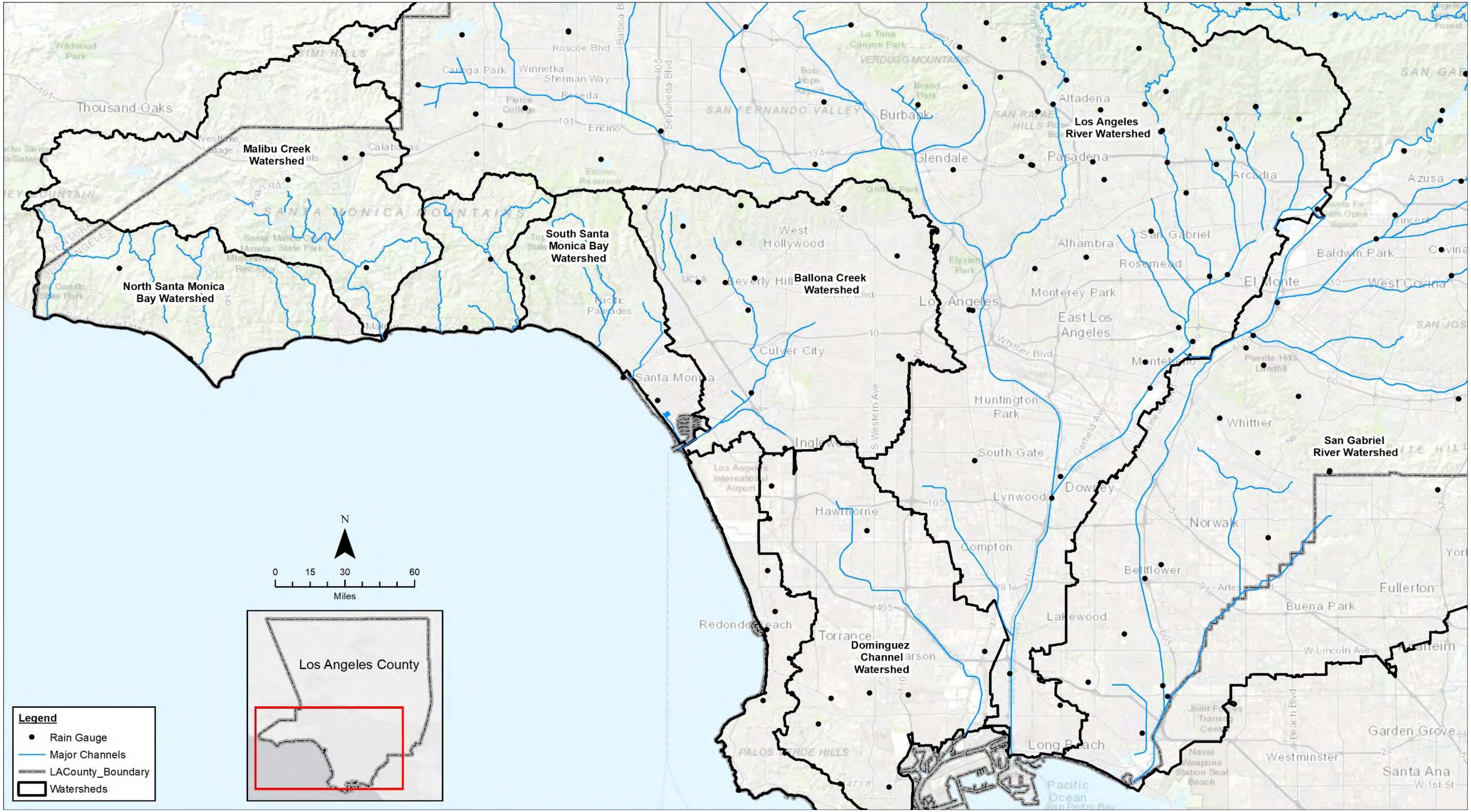

Figure 1-5. Map Showing Rain Gauge Stations

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1.4.1.7 List 7: Relevant Studies and Documents

Table 1-9 summarizes the documents and files received from the stakeholders. These documents were reviewed as a part of the data analysis task.

Table 1-9. Inventory of Reports and Documents Received

Report/Document Name	Type	Source	Description
2018-2019 CIMP Contacts	Word	LACFCD Data Request	Points of contact for LA County CIMPs.
Construction Bids	PDF	LACFCD Data Request	Construction bids for 12 LFDs.
Copy of DMS-#5051131-v2-Influent_Flows_2012-2017_LB-LC-POM-SJC-WN.xlsx	Excel	LACSD Data Request	WRP influent flows for Long Beach, Los Coyotes, Pomona, SJC, and Whittier Narrows WRPs from 2012 to 2017.
Industrial Wastewater Discharge Permit Requirement List	PDF	LACSD Data Request	Sample diversion permit; wastewater discharge permit for Long Beach LFD.
Dry Weather Diversions 20190401.xls	Excel	LACSD Data Request	Table of 15 LFDs (existing and proposed); information on agency, facility ID, facility name, physical location.
LACSD Sewer System Management Plan	PDF	LACSD Data Request	The document details how a specific sewer collection system is operated, maintained, repaired, and funded.
Manhole 02 1551 Arizona Avenue Trunk 2016.xlsx	Excel	LACSD Data Request	Example flow data collected in 2016 from Manhole 1551 on the Arizona Avenue Trunk.
Sample Clearance Diagram and Flow Data	Word	LACSD Data Request	Sample clearance diagram.
2013multipleannual.xls 2014multipleannual.xls 2015multipleannual.xls 2016multipleannual.xls 2017multipleannual.xls 2018multipleannual.xls	Excel	LASAN Data Request	Influent and effluent flows for LASAN WRPs from 2013 to 2018.
City of LA owned LFD Table (4-23-19).xlsx	Excel	LASAN Data Request	Table of 11 LASAN LFDs.
Penmar LFD As-Built Plans	PDF	LASAN Data Request	Penmar LFD As-Built Plans.
Santa Monica Bay LFD As-Built Plans	PDF	LASAN Data Request	SMB LFD As-Built Plans.
Santa Monica Canyon Channel LFD As-Built Plans	PDF	LASAN Data Request	Santa Monica Canyon Channel LFD As-Built Plans.
7th Street LFD As-Built Plans	Tif	LASAN Data Request	7th Street LFD As-Built Plans.
8th Street LFD As-Built Plans	Tif	LASAN Data Request	8th Street LFD As-Built Plans.
City of LA LFD Table (10-30-18) Marisol.xlsx	Excel	LASAN Data Request	Data of 10 LASAN LFDs.
SMBBB LFD (all)-6-10-08.xls	Excel	LASAN Data Request	SMB Beach 30 LFDs; LASAN/LA County.
Figure 1-LFDs (City of LA) (10-30-18) Marisol.pdf	PDF	LASAN Data Request	Map of City's 10 LFDs.

Table 1-9. Inventory of Reports and Documents Received

Report/Document Name	Type	Source	Description
LFD Upgrade Calculations 2006.pdf	PDF	LASAN Data Request	Document provides information on the four methods used for calculating flows from eight LFDs to use the LFDs during winter dry periods (i.e., November 1 through March 31 of each year). The report documents the recommended winter dry weather flows of design based on the four methods.
LFDs Design Capacity.pdf	PDF	LASAN Data Request	Winter dry weather flows for all LFDs (19 completed projects, 3 under construction, 2 under design).
LFDs.pdf	PDF	LASAN Data Request	Map showing the locations of LFDs in Jurisdictions 2 and 3.
Influent and Effluent Monitoring Frequencies at Tapia WRP	PDF and Excel	LVMWD Data Request	Daily influent and effluent flow data at Tapia WRP.
Sanitary Sewer Overflow Events	PDF	LVMWD Data Request	Sanitary sewer overflow events map.
Las Virgenes-Triunfo Joint Powers Authority Sewer System Management Plans	PDF	LVMWD Data Request	The plan includes the operation and maintenance program; overflow emergency response plan; fats, oils, and grease control program; system evaluation and capacity assurance plan; and sanitary sewer management plan program audits and other required elements to meet the State Water Resources Control Board's General Waste Discharge Requirements for Sanitary Sewer Systems – Sanitary Sewer Order 2006.
Las Virgenes-Triunfo Joint Powers Authority Sanitation Master Plan Update 2014	PDF	LVMWD Data Request	The 2014 Sanitation Master Plan covers the planning period through the year 2035; provides plan and schedule for construction of facilities to adequately serve growth projections within the service area and meet the permit requirements and includes a proposed capital improvement program.
Sanitary Sewer Overflow Export.xls	Excel	LVMWD Data Request	Sanitary sewer overflow events data.
Tapia WRP Infiltration-Inflow Data Analysis	PDF	LVMWD Data Request	I&I data analysis.
Tapia Influent Flow Data 2002-2018.xlsx	Excel	LVMWD Data Request	Tapia influent and effluent flow data from 2002 to 2018.
Special Study No. 3 Seventh Progress Report: 2017 Water Year Report – April 1, 2017 through March 31, 2018; Machado Lake Nutrient, Pesticides, and PCBs Total Maximum Daily Load Monitoring	PDF	Torrance Data Request	The purpose of this progress report is to provide a summary of the monthly and water year totals for total nitrogen and total phosphorus in stormwater; project progress for the 2017 water year; and summarize the collected analytical data, flow data, and quality assurance/quality control data.

Table 1-9. Inventory of Reports and Documents Received

Report/Document Name	Type	Source	Description
Coordinated Integrated Monitoring Program for the Beach Cities Watershed Management Group	PDF	Torrance Data Request	The Beach Cities Water Management Group CIMP describes an adaptive management process approach to satisfying the requirements and objectives of the MRP. The CIMP addresses the six required permit MRP elements: receiving water monitoring, stormwater outfall monitoring, non-stormwater outfall monitoring, new redevelopment effectiveness tracking, regional studies, and special studies.
Enhanced Watershed Management Program for the Beach Cities Watershed Management Area (SMB and Dominguez Channel watersheds)	PDF	Torrance Data Request	Summarizes watershed-specific water quality priorities identified by the Beach Cities Water Management Group, outlines the program plan, including specific strategies, control measures, and BMPs necessary to achieve water quality targets (water quality-based effluent limitations and receiving water limitations), and describes the quantitative analyses completed to support target achievement and permit compliance.
Wastewater Division High Frequency Cleaning List	Word	Torrance Data Request	List of high-frequency cleaning locations in the wastewater collection system.
Enhanced Watershed Management Program for the Machado Lake Watershed	PDF	Torrance Data Request	The goal of the EWMP is to address current TMDLs except trash, with consideration of future potential TMDLs. The Plan includes implementation methods, a schedule, and proposed milestones to achieve compliance of the TMDL waste load allocations.
Sewer System Management Plan for the City of Torrance	Word	Torrance Data Request	The Plan includes the operation and maintenance program; overflow emergency response plan; fats, oils, and grease control program; system evaluation and capacity assurance plan; and other required elements to meet the State Water Resources Control Board's General WDRs for Sanitary Sewer Systems – Sanitary Sewer Order 2006.
Torrance Standard Urban Stormwater Mitigation Plan Requirements by Receiving Waters	PDF	Torrance Data Request	Map of storm drain system, tributary areas, and detention and retention basins.

Notes:
ID = identification
PCB = polychlorinated biphenyl
PDF = portable document format
TMDL = Total Maximum Daily Load
WDR = Waste Discharge Requirements

1.5 Data Collection and Integration Status and Next Steps

Based on the initial set of information and documents received, Tier 1 of the data request was completed and Tier 2 was in progress when this section was developed. Using the data collected and feedback from the stakeholders, the following next steps were identified:

- Continue to identify and collect available data as identified in Tiers 2 and 3 of data request.
- Characterize and quantify dry and wet weather data collected to estimate the total amount of dry weather flow within the study area.
- Prepare an inventory of existing DWDs, including tables and maps of relevant data collected for each diversion.
- Understand the operational characteristics and efficacy of existing DWDs using the data collected.
- Select up to four DWDs for further analysis.

Table 1-10 summarizes the data collection status, gaps, and next steps for each tier.

Table 1-10. Summary of Status Summary of Data Request

Data Request Category	Status	Data Status and Ongoing Steps
Tier 1	**Complete**[a] The stakeholders/ divisions within each agency responsible for managing infrastructure have been identified.	▪ Information was received on LFDs, such as location, capacity, and maintenance practices. The following types of additional information was requested: the flow time series, storage and wet well volume and their operation in dry weather, and lessons learned from the facility operation staff who operate the LFDs. ▪ Information on storm drain networks in the watersheds was received. The stream gauge locations in various watersheds was requested. ▪ Information on WRPs and maps of the wastewater collection system/ sewershed was received. ▪ The locations of rain gauges were identified. Data from the rain gauges utilized for the operations of LFDs was requested.
Tier 2	**In progress**[b]	Stakeholders started providing Tier 2 information. Detailed information on LFDs was initiated based on the information gathered as a part of the Tier 1 request. Some of the Tier 2 information was included in this section. Further requests to the Stakeholders was made after the second set of data was obtained.
Tier 3	Request was made after selecting four case study DWDs.	Facility-specific data requests were made after reviewing the data received as a part of the Tier 1 and Tier 2 data requests.

[a] Completed in May 2019

[b] Task started in April 2019

1.6 References

CH2M HILL Engineers Inc. (CH2M). 2018. *Phase 1 White Paper: Tapping into Available Capacity in Existing Infrastructure to Create Water Supply and Water Quality Solutions*. Prepared for Las Virgenes Municipal Water District.

Section 2. Low Flow Diversion Inventory and Flow Analysis

2.1 Introduction

The first section of this report included an inventory of dry and wet weather data provided by stakeholders, based on the original data request. It also presented the approach for data gathering, compilation. As a part of the tiered data gathering approach, the data presented in Section 1 were further refined based on the stakeholder input and additional data gathered over time. The purpose of this section is to provide a refined inventory of DWD projects in the Los Angeles Basin, and develop an understanding of flows diverted by the DWDs and their operation under existing conditions.

Based on the information received during the Tier 2 data collection activities and review comments from stakeholders, it was noted that some of the projects included in Section 1 were not diversions to the sanitary sewer system; rather, they were other stormwater facilities and/or stormwater PPs. During a conference call held on June 19, 2019, the stakeholders suggested the following clarifications be added to this section:

- **LFD Definition**: LFDs or DWDs for this study are defined as permissible/controlled diversions from the storm drain system to the sanitary sewer system. DWDs were separated into two categories to indicate which facilities were designed to attenuate peak runoff for discharge during off-peak hours: (1) DWDs with Storage, and (2) DWDs without Storage. Section 2.2 provides details about these two categories of DWDs.
- **Stormwater Projects not Discharging to Sewer:** Apart from DWDs that discharge to a sanitary sewer system, there are other projects aiming to treat dry weather runoff and "first-flush" flows that do not discharge to a sanitary sewer system, such as wetlands or stormwater capture projects used for irrigation, infiltration, and other purposes. Any available information of stormwater management projects (that do not discharge to the sanitary sewer system) was not considered in this study. The further analysis or evaluation of these projects and facilities may be considered in subsequent phases, under a different scope of work.

Specifically, this section includes: (1) a completed/refined inventory of DWDs in the Los Angeles Basin, (2) an analysis of flows diverted by DWDs from 2007 through 2018, (3) an analysis of the Hyperion WRP and the JWPCP influent flows from 2013 through 2018, and (4) a comparison of DWD discharges with the available treatment capacity of the Hyperion WRP and the JWPCP determined from influent flows and the facility's design capacity.

This section is organized as follows:

- Section 2.1 – Introduction
- Section 2.2 – DWD Inventory
- Section 2.3 – Analysis of DWD Flows
- Section 2.4 – Analysis of WRP Influent Flows
- Section 2.5 – Conclusions and Recommendations
- Section 2.6 – References

2.2 DWD Inventory

While each DWD is unique, Figure 2-1 shows an example schematic of a typical DWD provided by LASAN. The dry weather runoff from the existing storm drain system is redirected to the diversion system while allowing high flows to bypass the system during storm events. Diverted runoff is directed through a pretreatment device, typically a trash screen or hydrodynamic separator, to remove trash and other debris. Accumulated debris is removed regularly (monthly or quarterly) by a vacuum truck. Next, water flows to a wet well that houses a submersible pump, which is triggered by float switches or a programmable logic controller (PLC) connected to a pressure transducer. Once there is adequate water accumulation in the wet well, the pump discharge flows into the sewer system.

Pumping the diverted flows is important to prevent potential backflow from the sanitary sewer into the storm drain system. Once comingled with the sewer system, flows are directed to the WRP for treatment and potential reuse as recycled water.

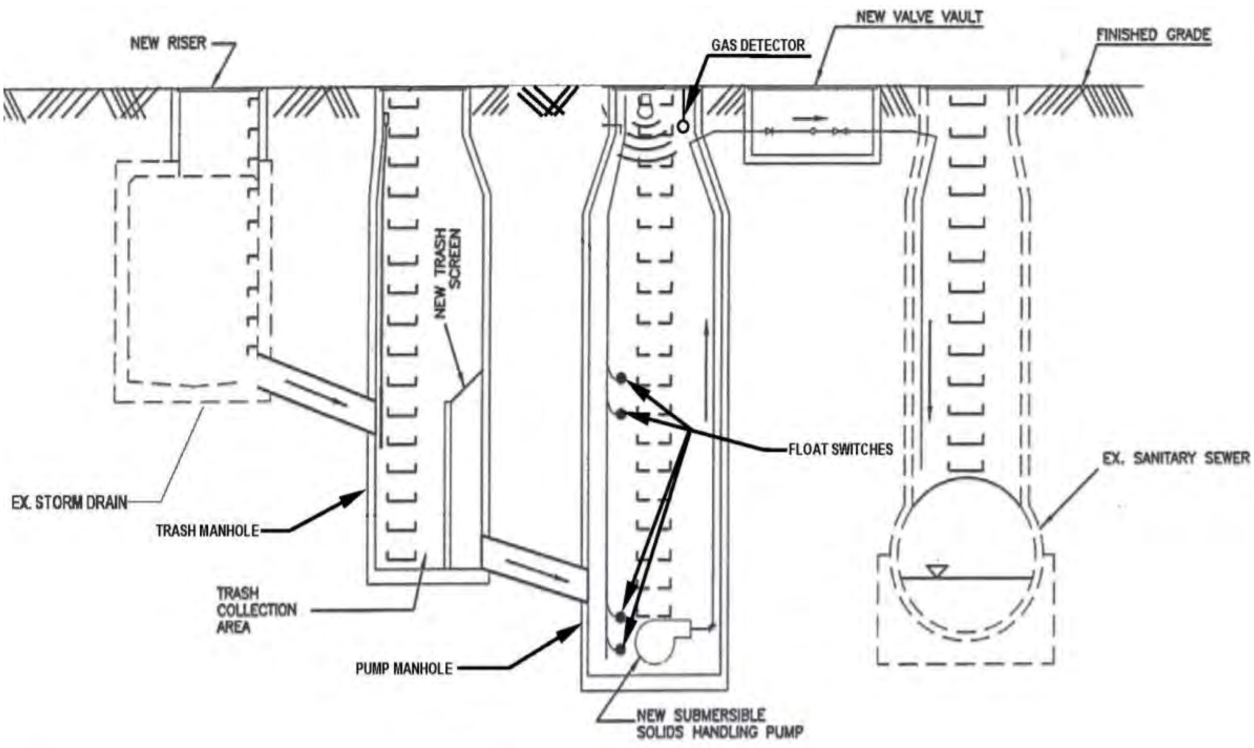

Figure 2-1. Typical DWD Cross Section Schematic

Source: LASAN, 2017

2.2.1 Existing DWDs

There are 41 DWDs identified within the Los Angeles Basin. Where multiple DWDs are used to divert dry weather runoff with only one connection to the sewer, only one DWD is counted (for example, Temescal and Temescal Canyon diversions). Table 2-1 provides an inventory of existing DWDs including respective names, addresses, tributary areas, receiving waters, shutoff mechanisms, storage, capacities, sanitary sewer system service areas, year of construction, and any additional notes about the facility. A general description of these facility characteristics is provided in this section below. As a part of the next task, up to four DWDs will be selected for a more in-depth analysis and description of system operations. This section is intended to summarize existing facilities and operations. Figure 2-2 shows an overview of the DWD locations.

DWDs are owned by the (LACFCD, LASAN, and the Cities of Irwindale, Long Beach, Manhattan Beach, and Santa Monica. Since LACFCD and LASAN own most of the DWDs and are part of the Stakeholder Group for this study, information and data collection was focused on the DWD projects owned by these stakeholders. The Cities of Irwindale, Long Beach, Manhattan Beach, and Santa Monica are grouped together as "Other Owners" for this study. Only publicly available information was used during information collection for DWD facilities owned by these other agencies.

DWDs have been further separated by the amount of storage available at the facility. A sanitary sewer system's capacity to receive dry weather runoff is impacted by seasonal, diurnal, and wet weather periods. DWDs that do not have storage are limited by the adjacent sanitary sewer capacity. DWDs with storage can be sized much larger, because they can store the flows and discharge during off-peak hours or during dry weather periods. Some of the DWDs divert flows from storm drains, while others divert flows from receiving waterbodies, such as Santa Monica Canyon (SMC). The following is a breakdown of DWDs by owner and storage:

- 19 DWDs owned by LACFCD
  - 11 DWDs without storage
  - 8 DWDs with storage
- 12 DWDs owned by LASAN
  - 8 DWDs without storage
  - 4 DWDs with storage
- 10 DWDs owned by other agencies
  - 1 owned by the City of Irwindale
  - 5 owned by the City of Long Beach
  - 1 owned by the City of Manhattan Beach
  - 3 owned by the City of Santa Monica

GIS shapefiles of the DWD subwatersheds were provided by LASAN and LACFCD for several facilities, including areas for LACFCD, LASAN, and Santa Monica DWDs. Where no subwatershed shapefile was provided, the subwatershed area was estimated based on storm drain system layout, topography, and sub-basin shapes. Figures 2-3 through 2-6 provide maps of these watershed areas. According to the National Oceanic and Atmospheric Administration (NOAA), 80 percent of pollution to the marine environment comes from land as small, non-point sources (NOAA, 2019). Most of the existing DWDs along the coast capture dry weather runoff before allowing it to reach receiving waterbodies, thereby improving water quality and reducing the potential for beach closures. SMB serves as an example of this effort, with 31 of the 41 DWDs identified within the South SMB watershed, capturing approximately 70 percent of the watershed. Inland DWDs, like the Enterprise (8th Street) and Downtown (7th Street) facilities, help to capture other high-priority areas, including downtown Los Angeles neighborhoods.

Figures 2-3 through 2-6 show subwatersheds only for DWDs with discharges to the sanitary sewer system. Additional stormwater and non-stormwater treatment take place using other mechanisms, including green infrastructure and structural treatment controls. However, those facilities are not identified or discussed in this section. Figure 2-7 shows the LASAN and LACFCD DWD construction timeline.

In addition to targeting areas with impaired water quality, existing stormwater pump stations provide opportunities to use existing infrastructure to divert flows. Storm drain systems are designed to direct stormwater to rivers and channels that ultimately drain to the ocean. However, low-lying areas can be subject to accumulation and localized flooding. Pump stations are used to mitigate this hazard and pump stormwater to where it can once again flow towards the ocean. To attenuate peak storm runoff, pump stations are typically designed with a storage component. As Table 2-1 indicates, several existing pump stations also have DWDs that discharge dry weather runoff to the sanitary sewer system during dry weather. Some DWDs are equipped with rain gauges that shut off the diversion at the start of a rain event. Other diversions are controlled using a high-water cutoff or are manually controlled.

Each DWD has three types of diversion capacity: (1) capacity of the storm drain diversion, (2) pumping capacity to the sanitary sewer, and (3) permitted capacity. Typically, only the pumping capacity or permitted capacity data were available; therefore, Table 2-1 identifies only one capacity that is used to indicate the size of the facility. Most DWDs divert dry weather runoff to the nearest available connection to the sanitary sewer system for treatment at either the JWPCP (owned by LACSD) or Hyperion WRP (owned by LASAN). To protect the sanitary sewer system from surcharging and spills, the sanitation agency has the ultimate authority on the amount of flow and time of discharge to the sanitary sewer system. LACSD has developed a Dry Weather Urban Runoff Diversion Policy (LACSD, 2014) and implemented a permitting system to dictate the capacity and operation of a DWD. Therefore, the capacity of facilities in the JWPCP service area is based on the permitted capacity. LASAN owns and operates both the stormwater and wastewater infrastructure for the City of Los Angeles (City; therefore, the design and construction of DWD facilities is conducted by the City's Bureau of Engineering in coordination with LASAN to size the facility, based on available capacity in the sanitary sewer system, including conveyance system and components, such as pump stations.

Table 2-1. Existing DWD (without Storage) Inventory

Owner	DWD Name	Address	Subwatershed Area[a] (acres)	Receiving Water/ Watershed	Diversion Shutoff Mechanism	Storage[b] (gal)	Capacity[c] (gpm)	WRP Service Area	Year Constructed	Notes
LFDs without Storage										
LACFCD	Ashland Avenue (Phase 2)	103 Ashland Ave. n\o Neilson Way, Santa Monica	200	South Santa Monica Bay	High water cut-off	N/A – wet well only	30	Hyperion WRP	2006	
	Avenue I	Esplanade and Avenue I, Redondo Beach	330	South Santa Monica Bay	Rain gauge	N/A – wet well only	60	JWPCP	2006	
	Marina Del Rey (Oxford Basin)	Berkley Dr. and Yale Ave. (near Lincoln), Marina Del Rey	190	South Santa Monica Bay	High water cut-off	N/A – wet well only	200	Hyperion WRP	2010	
	Parker Mesa/Castlerock	Pacific Coast Hwy. and Coastline Dr., Los Angeles	370	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	75	Hyperion WRP	2007	
	Pershing Drive, Line C	Imperial Hwy. w\o Pershing Dr., Playa del Rey	2,000	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	240	Hyperion WRP	2006	
	Playa del Rey	Culver Blvd. and Pershing Dr., Playa Del Rey	210	South Santa Monica Bay	Rain gauge	N/A – wet well only	180	Hyperion WRP	2001	
	Pulga Canyon	16510 Pacific Coast Hwy., Los Angeles	1,000	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	260	Hyperion WRP	2004	
	Rose Avenue (Phase 2)	300 Rose Ave., Venice	1,910	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	N/A	Hyperion WRP	2005	
	Santa Ynez	17310 Sunset Blvd., Pacific Palisades	4,490	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	826	Hyperion WRP	2006	
	Washington Blvd	Washington Blvd. and Thatcher Ave., Los Angeles	480	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	64	Hyperion WRP	2007	
	Westchester	8184 Vista del Mar, Playa del Rey	2,400	South Santa Monica Bay	Manual storm shutoff	N/A – wet well only	125	Hyperion WRP	2004	
LASAN	#710 Enterprise (8th St)	2460½ Enterprise, Los Angeles	587	Los Angeles River Reach 2	TBD	N/A – wet well only	700	Hyperion WRP	2003	Per LASAN staff
	#711 Downtown (7th St)	715 Santa Fe at 7th St., Los Angeles	426	Los Angeles River Reach 2	TBD	N/A – wet well only	2,250	Hyperion WRP	2011	Per UPRS (J7476)
	#730 Palisades Park	15100½ Pacific Coast Hwy., Will Rogers Beach	295	South Santa Monica Bay	TBD	N/A – wet well only	680	Hyperion WRP	2000	
	#732 Marquez Canyon	17302½ Pacific Coast Hwy., Palisades	53	South Santa Monica Bay	TBD	N/A – wet well only	630	Hyperion WRP	2006	
	#735 Santa Monica Canyon	156 W Channel Rd., Santa Monica	10,147	South Santa Monica Bay	TBD	N/A – wet well only	10,770	Hyperion WRP	2002	DWD uses rubber dam in channel to divert flows; one or the 3 pumps is standby
	#739 Bay Club Drive	230½ Arno Way, Palisades CA	91	South Santa Monica Bay	TBD	N/A – wet well only	220	Hyperion WRP	2001	
	#747 Thornton	713½ Main St., Venice	330	South Santa Monica Bay	TBD	N/A – wet well only	1,275	Hyperion WRP	1999	
	#750 Imperial Hwy	7600 Imperial Hwy., Vista Del Mar	1,958	South Santa Monica Bay	Ultrasonic level sensor	N/A – wet well only	960	Hyperion WRP	2002	Diversion shutoff mechanism per plans
Irwindale	Santa Fe Dam	15501 E. Arrow Hwy., Irwindale	N/A; see Notes column	San Gabriel River	Rain gauge	N/A – wet well only	50 gpd	JWPCP or SJC WRP	2005	DWD installed for vector control to alleviate ponding
Long Beach	1400 S 9th	1400 S. 9th Place, Long Beach	30	San Gabriel River	TBD	N/A – wet well only	TBD	JWPCP	TBD	
	3230 E Ocean	3230 E. Ocean Blvd., Long Beach	150	San Gabriel River	TBD	N/A – wet well only	TBD	JWPCP	TBD	
Manhattan Beach	Manhattan Beach Pier	1 N. The Strand, Manhattan Beach	70	South Santa Monica Bay	TBD	N/A – wet well only	50	JWPCP	2006	
Santa Monica	Montana Avenue	Montana Ave. and Ocean Ave., Santa Monica	600	South Santa Monica Bay	High water cut-off	N/A – wet well only	170	Hyperion WRP	2007	
	Wilshire Boulevard	Wilshire Blvd. and Ocean Ave., Santa Monica	580	South Santa Monica Bay	TBD	N/A – wet well only	TBD	Hyperion WRP	2007	

Table 2-1. Existing DWD (without Storage) Inventory

Owner	DWD Name	Address	Subwatershed Area[a] (acres)	Receiving Water/ Watershed	Diversion Shutoff Mechanism	Storage[b] (gal)	Capacity[c] (gpm)	WRP Service Area	Year Constructed	Notes
LFDs with Storage										
LACFCD	Alamitos Bay PP	5425 Ocean Blvd., Long Beach	270	Alamitos Bay	Rain gauge	146,000	120	JWPCP	1999	DWD integrated into stormwater pumping plant
	Arena PP	199 E. El Segundo Blvd., El Segundo	80	South Santa Monica Bay	Manual storm shutoff	1,507,968	60	Hyperion WRP	2006	DWD integrated into stormwater pumping plant
	Boone Olive PP	539 Washington St., Venice	70	South Santa Monica Bay	Manual storm shutoff	104,720	96	Hyperion WRP	2007	DWD integrated into stormwater pumping plant
	El Segundo PP	231 Center St., El Segundo	240	South Santa Monica Bay	Manual storm shutoff	4,675,000	60	Hyperion WRP	2006	DWD integrated into stormwater pumping plant
	Electric Avenue PP	314 Brooks Ave., Venice	230	South Santa Monica Bay	Rain gauge	405,131	76	Hyperion WRP	2001	DWD integrated into stormwater pumping plant
	Herondo Street	445½ Herondo St., Hermosa Beach	2,780	South Santa Monica Bay	Rain gauge	12,626	60 during peak hours 120 during off-peak hours	JWPCP	2005	
	Manhattan Beach PP	Polliwog Park, Manhattan Beach	300	South Santa Monica Bay	Rain gauge	68,068	50	JWPCP	2004	DWD integrated into stormwater pumping plant
	Manhattan, 28th & The Strand	Strand between 27th and 28th St., Manhattan Beach	1,190	South Santa Monica Bay	Rain gauge	42,298	130	JWPCP	2007	
LASAN	#647 Windward/Venice	1600 Main St., Venice	128	South Santa Monica Bay	TBD	TBD	900 – 2 low flow pumps 42,000 gpm (4 high flow pumps)	Hyperion WRP	2002	DWD integrated into stormwater pumping plant
	#734 Temescal	200 N Temescal Canyon Rd., Santa Monica	1,660	South Santa Monica Bay	High water cut-off	1,250,000	3,750	Hyperion WRP	2002	Stormwater is diverted at #736 Temescal Canyon for irrigation, excess flows sent to #734 Temescal for discharge to sewer
	#742 Penmar	901 Rose Ave., Venice	TBD	South Santa Monica Bay	Ultrasonic level sensor	TBD	1,125 – low flow 2,925 – high flow	Hyperion WRP	2013	Phase I diverts dry weather flows to sewer and stores wet weather. Phase II will use stormwater for irrigation
	LA Zoo	4700½ Western Heritage Dr., Los Angeles	153	Los Angeles River Reach 3	TBD	1,800,000	3,600	Los Angeles-Glendale WRP	1993	
Long Beach	Appian Way	5875 Appian Way, Long Beach	69	Alamitos Bay	TBD	TBD	30	JWPCP	2009	DWD integrated into stormwater pumping plant
	Belmont PP	222 Claremont Ave., Long Beach	99	Alamitos Bay	TBD	TBD	60	JWPCP	2010	DWD integrated into stormwater pumping plant
	Colorado Lagoon (2 LFDs)	4825 E. 6th St., Long Beach	750	Alamitos Bay	TBD	TBD	60	JWPCP	2010	Flows are stored and pumped to sewer at night.

Table 2-1. Existing DWD (without Storage) Inventory

Owner	DWD Name	Address	Subwatershed Area[a] (acres)	Receiving Water/ Watershed	Diversion Shutoff Mechanism	Storage[b] (gal)	Capacity[c] (gpm)	WRP Service Area	Year Constructed	Notes
Santa Monica	SMURRF/Santa Monica Pier	1623 Appian Way, Santa Monica	5,100	South Santa Monica Bay	TBD	300,000	Excess flows only	N/A	1993	Primary facility purpose is treatment and reuse. Connection to sewer for excess flows only.

[a] Where DWD subwatershed areas were not provided by stakeholders or existing reports, areas were estimated based on storm drain layout, topography, and sub-basins.

[b] Storage values are only provided for DWDs with storage components used to attenuate peak flows.

[c] Capacity is based on either the pumping capacity (for Hyperion or Los Angeles-Glendale WRP service areas) or permitted discharge flow (for JWPCP or SJC WRP sewersheds).

Notes:

gal = gallon(s)

gpd = gallon(s) per day

gpm = gallon(s) per minute

N/A = not applicable

TBD = to be determined; information was not available at the time of report development

Sources:

Correspondence with DWD owner

2014 Report on Treatment of Urban Runoff and Governance of Los Angeles County Sanitation Districts, Los Angeles County Department of Public Works available at http://file.lacounty.gov/SDSInter/bos/bc/210758_CleanWaterCleanBeaches3-17-14.pdf

Clean Beaches Initiative Final Reports available at https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/docs/summaries/

Figure 2-2. Existing DWDs

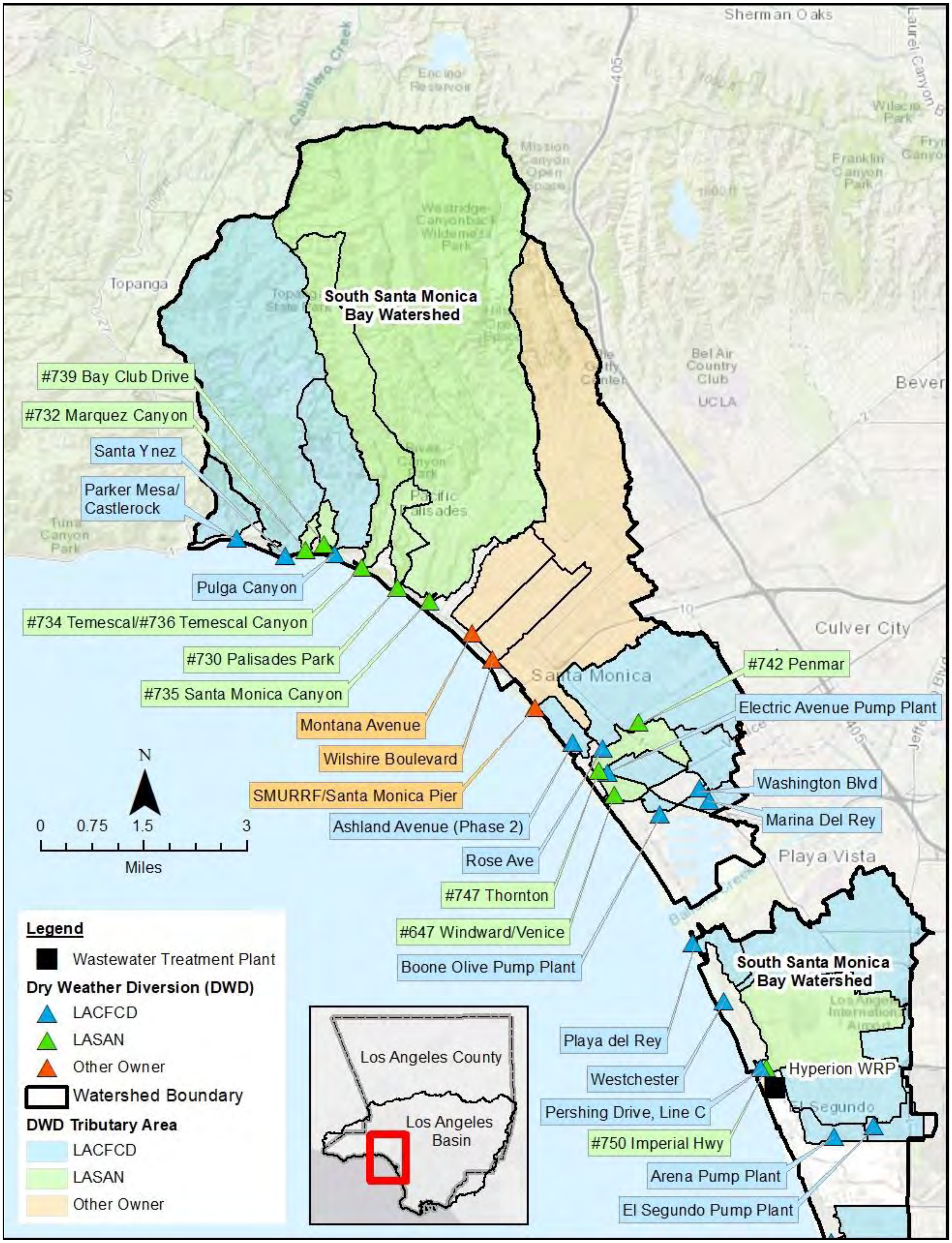

Figure 2-3. South Santa Monica Bay Watershed DWDs and Subwatershed Areas (1 of 2)

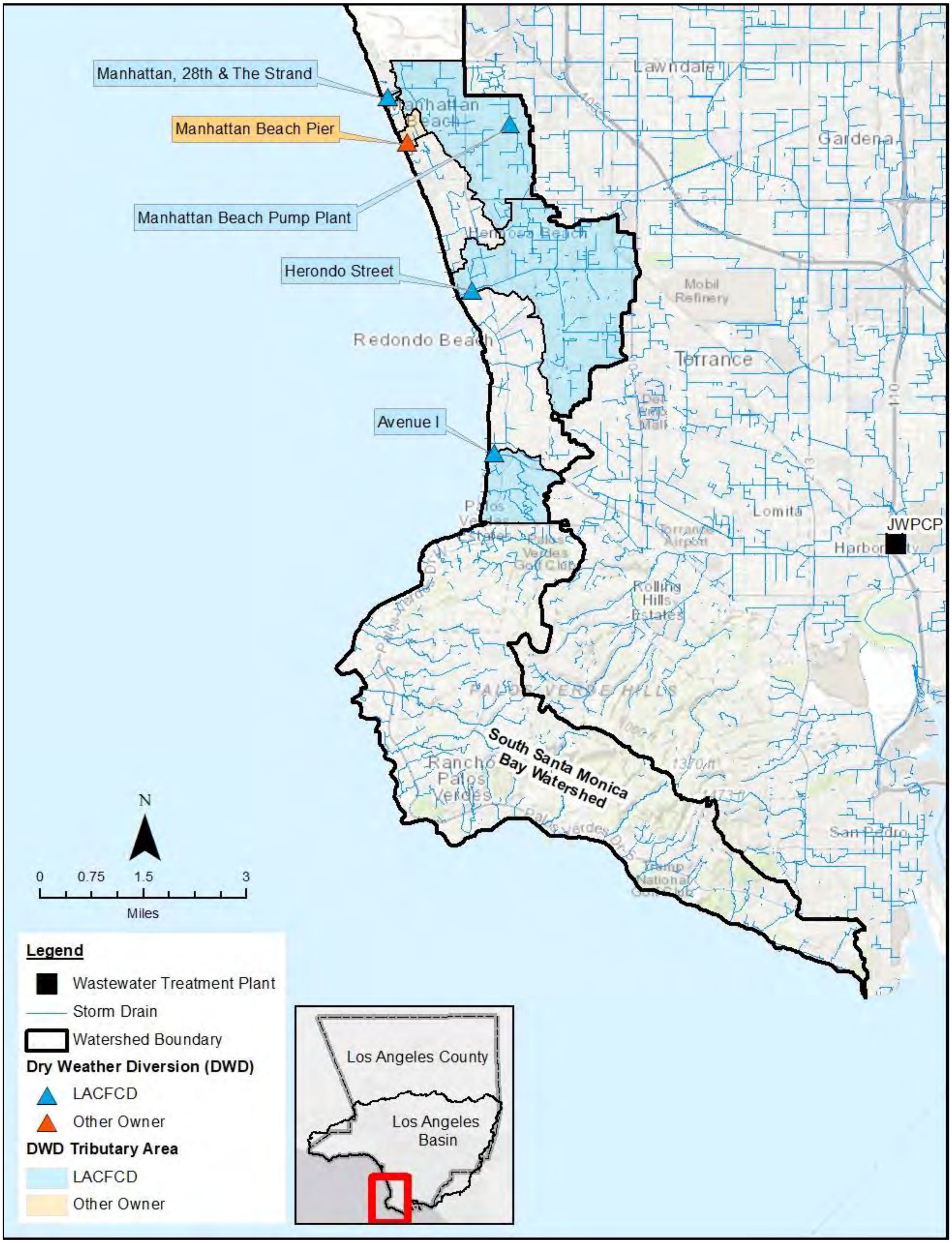

Figure 2-4. South Santa Monica Bay Watershed DWDs and Subwatershed Areas (2 of 2)

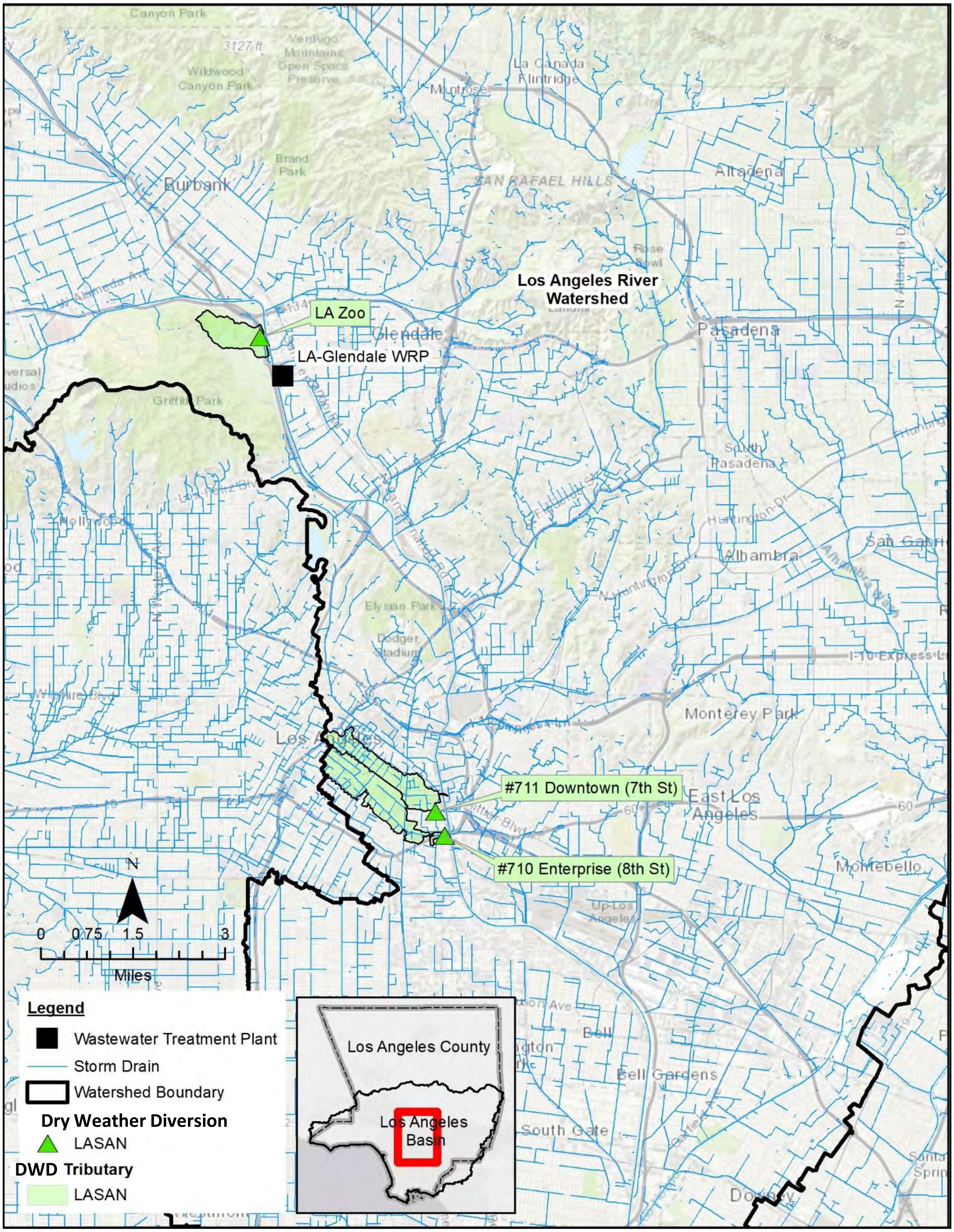

Figure 2-5. Los Angeles River Watershed DWDs and Subwatershed Areas

Figure 2-6. San Gabriel River Watershed and Los Angeles/Long Beach Harbor DWDs and Subwatershed Areas

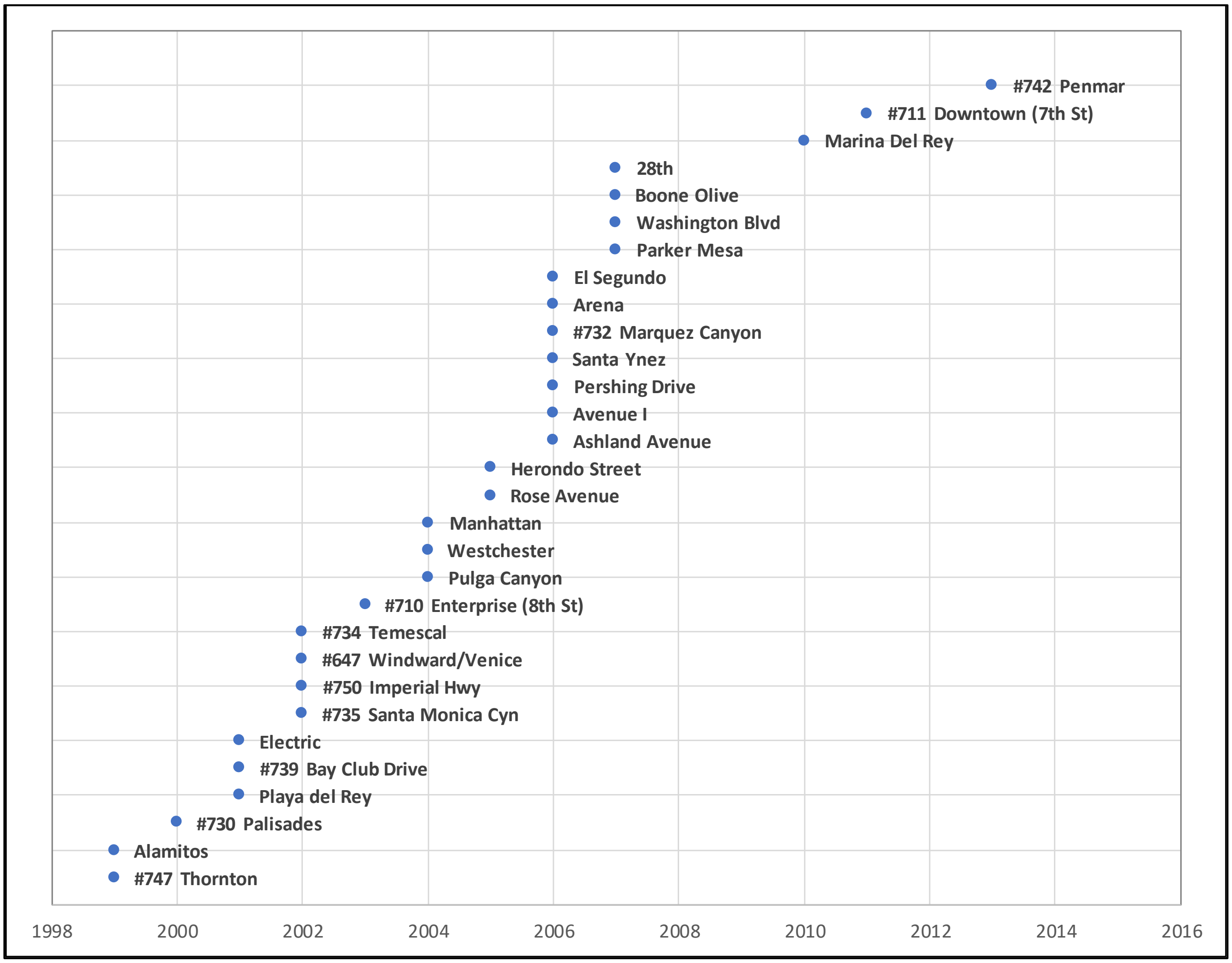

Figure 2-7. LASAN and LACFCD DWDs Construction Timeline

2.2.2 DWDs Planned, Designed, or in Construction

Several DWDs have been identified for implementation within the next 5 years. Both the Stakeholder Group and the respective LA County Enhanced Watershed Management Program Group were contacted to obtain information about future DWDs. Table 2-2 shows DWDs planned, in design, or in construction within the next 5 years.

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Table 2-2. DWDs Planned, Designed, or in Construction

Owner	DWD Name	Status	Address	Watershed	Subwatershed Area (acres)	WRP Service Area	DWD Type/Description
Stakeholder Owned							
LASAN	R2-G	Pre-design/Design	445 N Mission Rd., Los Angeles	Los Angeles River	2,490	Hyperion WRP	DWD without storage
	R2-J	Pre-design/Design	500 S. Santa Fe Ave., Los Angeles	Los Angeles River	169	Hyperion WRP	DWD without storage
	R2-02	Pre-design/ Design	100 S. Alameda St., Los Angeles	Los Angeles River	1,710	Hyperion WRP	DWD without storage
	AS-15	Pre-design/ Design	4702 N. Figueroa St., Los Angeles	Los Angeles River	1,135	Hyperion WRP	DWD without storage
	AS-21	Pre-design/Design	5526 E. Via Marisol, Los Angeles	Los Angeles River	267	Hyperion WRP	DWD without storage
	LAR-E-021	Planning	5353-6364 White Oak Ave., Los Angeles	Los Angeles River	1,020	DCT WRP	DWD, storage TBD
	LAR-E-048	Planning	6564 Reseda Blvd., Los Angeles	Los Angeles River	854	DCT WRP	DWD, storage TBD
	LAR-E-058	Planning	6500-6524 Wilbur Ave., Los Angeles	Los Angeles River	1,316	DCT WRP	DWD, storage TBD
	LAR-E-065	Planning	6448 Tampa Ave., Los Angeles	Los Angeles River	731	DCT WRP	DWD, storage TBD
	LAR-E-077	Planning	19945 Haynes St., Los Angeles	Los Angeles River	1,106	DCT WRP	DWD, storage TBD
	LAR-E-081	Planning	Los Angeles River Greenway, Canoga Park, Los Angeles	Los Angeles River	1,166	DCT WRP	DWD, storage TBD
	LAR-E-096	Planning	Los Angeles River Greenway, Canoga Park, Los Angeles	Los Angeles River	2,264	DCT WRP	DWD, storage TBD
	LAR-E-097	Planning	6880 De Soto Ave., Los Angeles	Los Angeles River	536	DCT WRP	DWD, storage TBD
	LAR-E-110	Planning	Canoga Park, Los Angeles	Los Angeles River	2,264	DCT WRP	DWD, storage TBD

Table 2-2. DWDs Planned, Designed, or in Construction

Owner	DWD Name	Status	Address	Watershed	Subwatershed Area (acres)	WRP Service Area	DWD Type/Description
	Ballona Creek Low Flow Treatment Facility (LFTF-1)	Design (50%)	10201 W. Jefferson Blvd., Los Angeles	Ballona Creek	54,808	Hyperion WRP	DWD without storage. A portion (6 MGD) of diverted flows will be treated and discharged back to receiving water. Remaining portion of diverted flows (23 MGD) discharged to sanitary sewer
LACFCD	La Brea	Planning					DWD with storage
Torrance	Torrance Airport Storm Water Infiltration	Design	3301 Airport Dr., Torrance	Dominguez Channel	3,481	JWPCP	DWD with storage
Non-Stakeholder Owned LFDs							
Carson	Carriage Crest	Construction	23800 S. Figueroa St., Carson	Dominguez Channel	1,100	JWPCP	DWD with storage
Culver City	Mesmer	Design	5586 Mesmer Avenue, Culver City	Ballona Creek	6,145	Hyperion WRP	DWD with storage, existing wastewater pump station will be repurposed as DWD
Lakewood	Mayfair Park	Construction	5720 Clark Ave., Lakewood	Los Cerritos Channel	2,301	JWPCP	Stormwater capture for irrigation project, excess flows discharged to the sewer
Long Beach	Termino Avenue Drain	Construction	700 Roswell Ave., Long Beach	San Gabriel River	569	JWPCP	DWD with storage

2.3 Analysis of DWD Flows

LASAN and LACFCD provided DWD flow data. The LASAN provided monthly total diverted volumes for the period of 2008 through 2017 for 12 LFDs. LACFCD provided flow data at 15-minute intervals for 15 DWDs for the period from 2008 through 2019. A total of 6,609 files with raw data containing the pump operational records, water level measurements, and flow measurements for most of the DWDs, were received from LACFCD.

DWDs are operated slightly differently by LASAN and LACFCD. In general, DWDs operated by LASAN are generally operated during dry period (no rain, whereas the DWDs discharging flows to the LACSD's sanitary sewer system are operated until up to 0.1 inch rainfall is measured at the diversion location. Although the DWDs were designed for dry weather improvements, the analysis presented in this section is based on the use of DWDs for stormwater management under existing conditions. This analysis aims to understand the feasibility to divert additional flows to the sanitary sewer system, beyond the dry weather runoff diverted under existing conditions.

The flow data analysis is provided only for DWDs; that is, diversions that which discharge to the sanitary sewer system. The diversions that do not discharge to the sanitary sewer system were excluded from the analysis. In addition, this analysis was only conducted for the DWDs owned and operated by stakeholders. DWDs owned and operated by other agencies (non-stakeholders) are acknowledged but no analysis was conducted. This analysis is based on flow data provided by the stakeholders for the runoff diverted by DWDs under existing conditions.

2.3.1 Diversion Capacity

To assess the feasibility of diverting additional flows by DWDs, it is important to identify the maximum discharge capacities of the DWDs under existing conditions. There are three types of discharge capacities that control the flow diverted by DWDs: (1) permitted/allowable capacity (2) pumping capacity, and (3) infrastructure capacity, including conveyance system and WRPs, as discussed below.

2.3.1.1 Permitted/Allowable Capacity

Permitted discharge capacity is the discharge from DWDs permitted by the downstream sewer management agency to discharge into their sanitary sewer system. The permit depends on sewer system capacity availability, water quality, and total proposed flow from the DWDs into the sanitary sewer system.

At the beginning of the DWD project, the developer or the project proponent submits an application to the sanitation agency with the total proposed flow rate for the DWD and the proposed connection location. The sanitation agency conducts a hydraulic analysis based on the provided information and approves or proposed modifications to the sanitary sewer capacity request or the location for the connection point(s), or approves with conditions to discharge during non-peak hours, to accommodate the total proposed flow requested.

Typically, a sewer capacity availability review (SCAR) is performed by the City of Los Angeles' Bureau of Engineering, and LASAN, when an applicant decides to connect to the City's sewer system. This SCAR evaluates the existing sewer system to determine whether there is adequate capacity to safely convey sewage from proposed development projects, proposed construction projects, proposed groundwater dewater projects, and proposed increase of sewage from existing facilities, based on flow gauging data, closed-circuit television, and other considerations. The hydraulic analysis serves to calculate sewer flows along the sewer flow path, until it reaches the downstream WRP. During this review, the limitations on approved or permitted capacity can happen when the depth to diameter ratio exceeds 50%. As the other 50% sewer capacity is needed to remain available in order to accommodate sewer gases and wet weather runoff infiltration that seeps into the sewer system during a rain event.

Under high-flow conditions, the DWD discharge permit issued by the sewer agency may control the maximum allowable flow from DWDs even though the pumps can deliver more flow than the permit limit. The goal of the permit is to prevent adverse effects to the sanitary sewer system and WRPs while enabling the treatment of the water discharged by the DWDs for potential reuse.

2.3.1.2 Pumping Capacity

The discharge capacity of diversion is controlled by the design flow of the pumps in operation. Pumping capacity is the maximum amount of flow that can be pumped to the downstream sanitary sewer system. Under the current conditions, pumps are turned on to pump dry weather runoff to the sanitary sewer system during dry weather only.

Generally, the design capacities of most of the DWD pumps are higher than the permitted discharge capacity to capture peak dry weather runoff flows that are generally highly variable. Under high-flow conditions, the DWD wastewater discharge permit issued by the sewer agency may control the maximum allowable flow from DWDs even though the pumps may deliver more flow than the permit limit.

2.3.1.3 Infrastructure Capacity

The optimum discharge capacity of DWDs can be limited by the infrastructure capacity. The infrastructure capacity includes the sizes of the DWD suction and discharge pipe connections with the pump and the wet well, volumetric capacity of wet well, connections to the sanitary sewer system. The discharge rate is limited to ensure the downstream sewer will not flow more than ½ to ¾ of the depth of the sanitary sewer pipe, depending on the design standard of the owning agency. It is important to ensure that the check valve in the force main between the pump and connection to the sanitary sewer is of sufficient capacity so it can prevent backflow from sanitary sewer system to the storm drain system.

The capacity of WRPs receiving the DWD flow is also an important factor of infrastructure capacity. The conveyance capacity lone can't fully satisfy the need of infrastructure capacity unless the WRP capacities become available.

2.3.2 Design Factors of Diversion Capacity

The determination of the three types of capacities is important to define the diversion capacity from both the permitted and operations perspectives (Figure 2-8). This is because any single capacity would not characterize how much a DWD could discharge to a sanitary sewer system if other diversion capacities do not synchronize under the variable flow conditions.

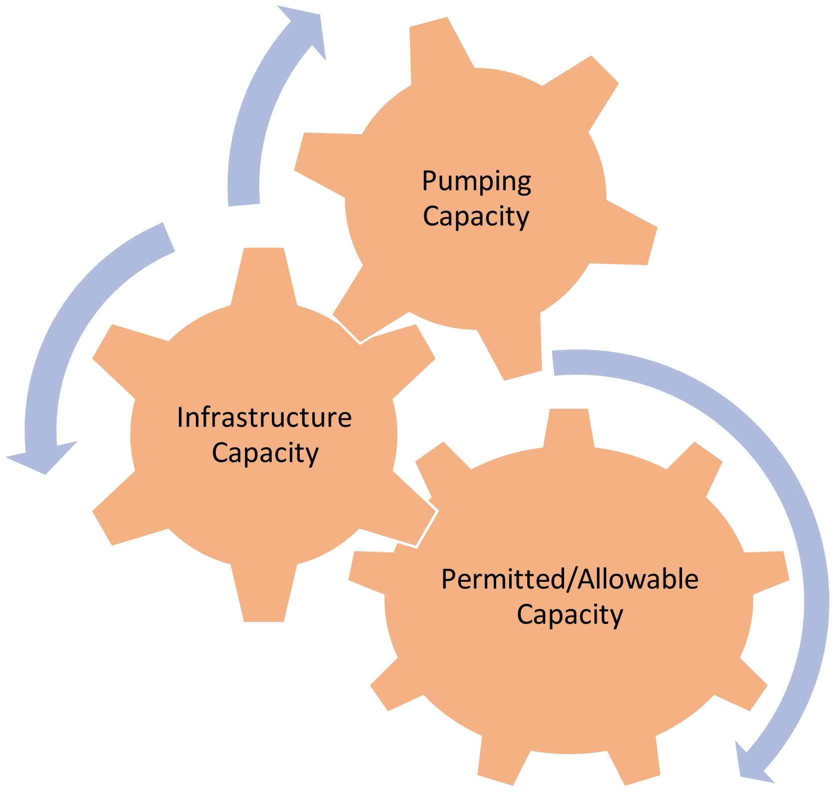

Figure 2-8. Diversion Capacity Concepts

Stakeholders provided the diversion capacity for each DWD considered for the analysis. For the LASAN DWDs, it is based on the pumping capacity or permitted capacity as provided by a SCAR, whereas, for the LACFCD DWDs, both permitted capacity and pumping capacity were considered to determine the diversion capacity.

This section first presents an analysis of flows from DWDs owned and operated by LASAN, followed by the DWDs owned and operated by LACFCD. The DWD data analysis was conducted based on:

- Annual flow timeseries analysis
- Monthly average and monthly maximum flow at DWDs
- Flow rate per day analysis
- Flow rate per subwatershed area of the DWD
- Average and maximum flow compared to the DWD’s discharge capacity

2.3.3 LASAN DWDs and Flow Analysis

Details of the DWDs were provided by LASAN in digital formats and reports. In case of data clarification, meetings with the City and Jacobs’ staff were held.

The City provided monthly total DWD diverted volumes for the period of 2008 through 2017 for 9 out of 12 LFDs (Table 2-3). Note, the flow estimates are based on the pump run times, which may not represent the real flow conditions.

Table 2-3. DWDs with Available Monthly Total Diverted Water Volume Data

DWD Name	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017
8th Street DWD	N/A	N/A	N/A	✓	✓	✓	✓	✓	✓
Palisades Park	✓	✓	10-M	6-M	✓	✓	✓	✓	✓
Marquez Canyon	11-M	✓	4-M	6-M	9-M	✓	✓	✓	7-M
Santa Monica Canyon	9-M	✓	✓	6-M	✓	✓	✓	✓	N/A
Temescal Canyon	✓	✓	1-M	3-M	11-M	✓	✓	✓	✓
Bay Club	✓	✓	4-M	6-M	11-M	✓	✓	✓	✓
Thornton Avenue	✓	7-M	2-M	6-M	✓	✓	✓	✓	✓
Imperial Hwy.	✓	8-M	3-M	5-M	9-M	6-M	10-M	✓	N/A
Venice Pavilion	9-M	✓	✓	6-M	9-M	✓	✓	✓	✓

Notes:
M = month(s) with volume data
N/A = not available – annual volume data
✓ = monthly total flow data available for the year

As applied in the Los Angeles area stormwater regulations and their associated TMDL requirements, summer dry weather covers the months of April through October. Winter dry weather covers the months of November through March. The SMB DWDs, owned and operated by the LASAN, were designed to manage summer dry-weather stormwater to meet the 2006 compliance deadline for summer dry-weather periods. The City upgraded the existing DWDs to manage higher, winter dry-weather runoff flows to meet the 2009 compliance deadline.

Figure 2-9 presents average flow for 9 out of 12 LASAN DWDs, based on data received from LASAN (Table 2-3). On average, the highest flow was recorded at the SMC DWD.

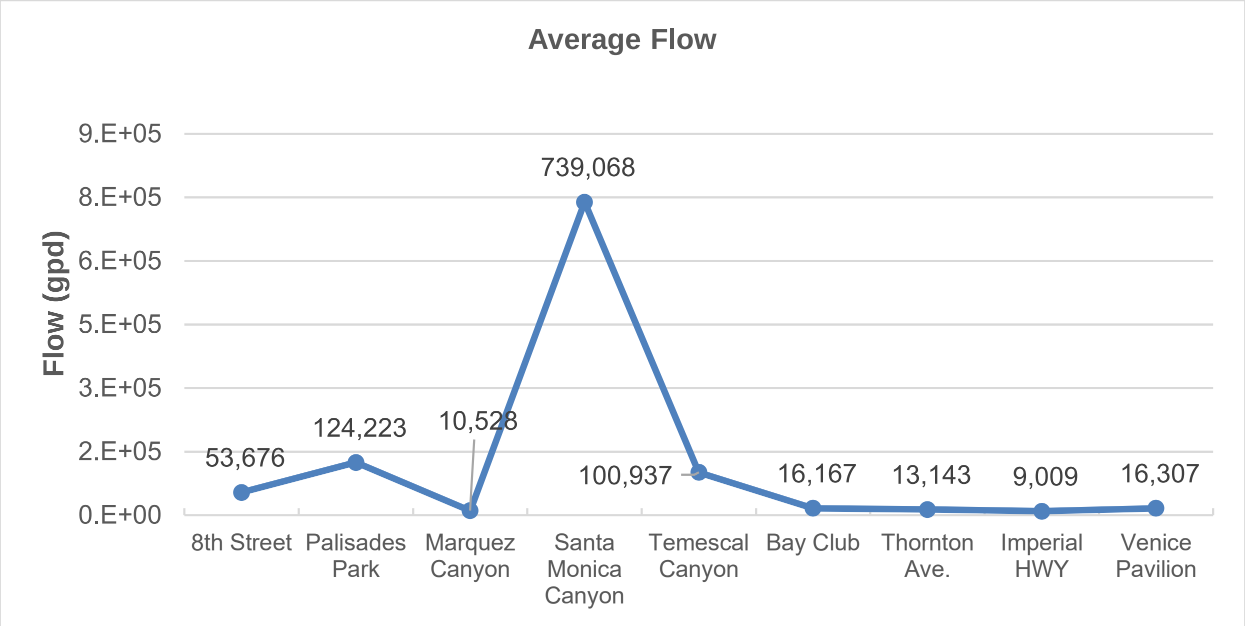

Figure 2-9. Historical Average Flow for LASAN DWDs

Figure 2-10 presents average flow per subwatershed area for LASAN DWDs based on available data (Table 2-3). The average flow per subwatershed area was the highest at the Palisades Park DWD.

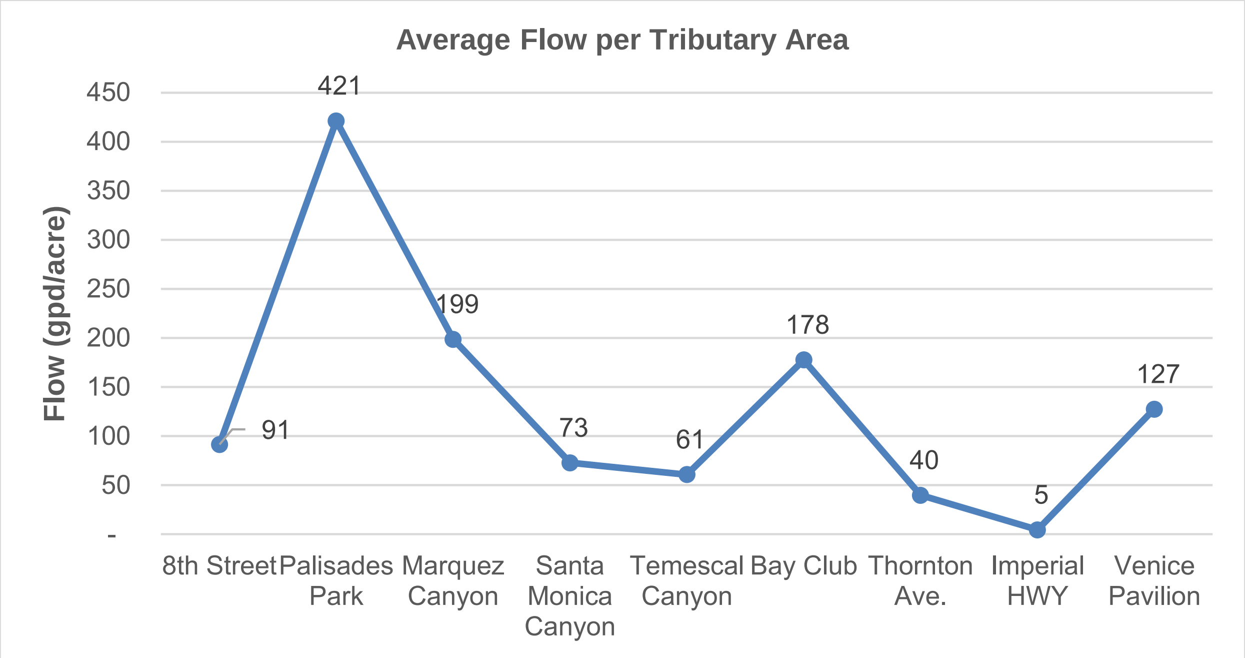

Figure 2-10. Average Diverted Flow per Subwatershed Area for LASAN DWDs

Appendix A provides a summary of the flows managed by each of these DWDs.

The purpose of the DWD is to divert dry weather runoff and prevent it from discharging to the SMB to improve water quality and meet the TMDL requirements. Although not the purpose of this study, the data collected in this exercise demonstrate the these DWDs are diverting dry weather runoff and preventing pollutants from being discharged to the SMB.

2.3.4 LACFCD DWDs and Flow Analysis

As presented in Table 2-4, 19 DWDs that are owned and operated by LACFCD discharge dry-weather runoff to the sanitary sewer system, which is treated at the JWPCP or the Hyperion WRP. LACFCD provided DWD flow data for 15-minute intervals in an electronic format. The time period for flow records varied for these DWDs. A total of 6,609 files with raw data containing the pump operation records, water level measurements, and flow measurements for most of the DWDs were received. Table 2-4 summarizes the data received. Flow data for the Arena, El Segundo, Playa del Rey, and Electric DWDs were not available.

Table 2-4. LACFCD DWDs and Period of Flow Data Records

LFD Name	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
28th Street	N/A	1-M	✓	✓	✓	✓	✓	10-M	✓	✓	✓	✓	4-M
Alamitos	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8-M	4-M
Ashland	1-M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	4-M
Avenue I	1-M	✓	✓	✓	11-M	✓	11-M	✓	✓	✓	✓	✓	4-M
Boone-Olive	N/A	N/A	N/A	9-M	✓	✓	✓	✓	✓	✓	✓	✓	4-M
Herondo	1-M	10-M	9-M	8-M	4-M	✓	✓	✓	✓	✓	✓	✓	5-M
Manhattan	N/A	N/A	N/A	4-M	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Marina del Rey	N/A	N/A	N/A	9-M	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Parker Mesa	N/A	6-M	8-M	✓	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Pershing Drive	N/A	11-M	✓	✓	✓	✓	✓	9-M	7-M	✓	✓	✓	5-M
Pulga Canyon	1-M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Rose Avenue	1-M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Santa Ynez	1-M	✓	4-M	✓	✓	✓	✓	✓	✓	✓	✓	✓	5-M
Washington	N/A	8-M	9-M	✓	✓	✓	✓	✓	11-M	✓	✓	✓	5-M
Westchester	N/A	8-M	✓	✓	11-M	✓	✓	✓	✓	✓	11-M	✓	5-M

The data provided by LACFCD were extracted from the telemetry system but did not undergo quality checks by LACFCD. These data are considered provisional and are used to understand the operations of DWDs. For high-level planning and understanding purposes, this level of available flow data was cleaned for "bad quality" and negative values and used for preliminary analysis; however, a complete investigation of operation of each DWD will require a cleaned/validated flow dataset to draw conclusions.

For planning purposes, the operations of existing DWDs and their ability to accommodate additional flows was assessed, based on the available capacity at the Hyperion WRP and JWPCP. Appendix B provides a summary of the runoff managed by the DWDs. For all DWDs, the flows vary daily, monthly, and annually. Daily flows also show the spikiness and variability in data in short durations. However, to avoid any bias in data to understand the long-term trends in DWD operations, average monthly data were used. This was also an appropriate timescale, as the data obtained from the DWD projects owned and operated by LASAN were also monthly. Data with unreasonable values or long time periods of missing data were not used to compute the average flows diverted by DWDs.

Figure 2-11 presents monthly average flow for the LACFCD DWDs based on available data (Table 2-4). The average flow was the highest for the Santa Ynez DWD.

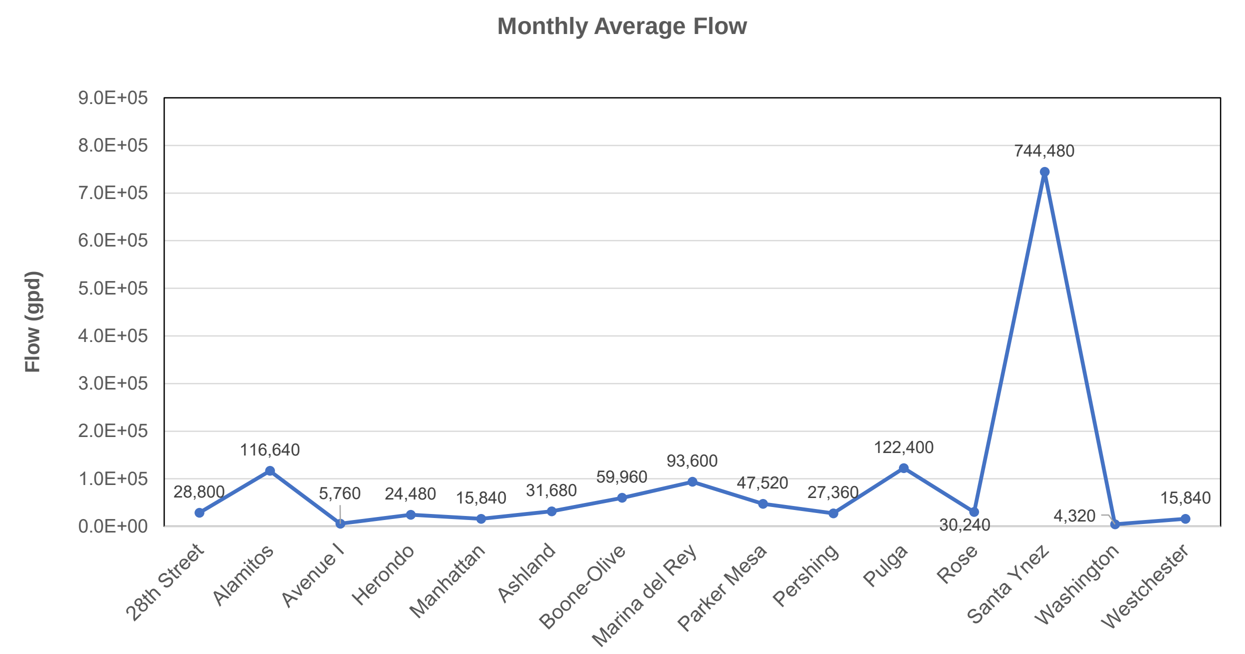

Figure 2-11. Average Flow for LACFCD DWDs during Winter Dry Weather Period

Although not the purpose of this study, the data collected in this exercise demonstrate the DWDs evaluated were highly effective at meeting their primary objective of improving water quality by preventing dry-weather discharges to the receiving waterbodies.

2.3.5 Limitations of Flow Analysis

The DWD flow analyses presented in this study are based on the raw data received from the stakeholders. Because there are no flow monitoring stations installed at many of the DWD discharge locations, stakeholders often used the pump operation characteristics to determine the flow discharged by the DWDs to the sanitary sewer systems, and provided raw data accordingly. Because the pumps are manually controlled and are not variable-frequency drive (VFD) pumps, dependence on pump data to evaluate flow discharged by DWDs is often misleading. Sudden, abrupt change in flow was observed in the data timeseries, which may not be representative of actual discharges. The spot jumps in peak discharges may have been a result of the data quality. Contributing factors may include:

- Pumps are constant-speed/constant-head pumps and they are controlled manually. Turning on a pump to a constant speed may cause instant higher flow, resulting in sudden peak in discharge. This would gradually recede to a discharge that is steadier and representative of actual flow conditions. The quality check of the raw volume or flow data was beyond the scope of current study.
- Pump runtime as an indication of volume delivered can be deceptive, because the pump shutoff is sometimes delayed due to the manual control of the pumps, as explained by LASAN operations personnel. The pumps might be running below the rated capacity, but the discharge volume estimates

assume maximum capacity operation. Therefore, the volume estimates used in the assessment could be higher than actual volumes diverted by the DWDs.

- A few peaks caused by pump shutoff/turn-on operations may affect the average flow estimates. Estimates for average flow for longer durations (such as monthly) may have dampened such sudden spikes in the flow data.
- Data received as monthly total volume may result in abnormally high calculations if any month's record is affected by manual pump operations.
- System operational changes and upgrades to the DWD (including the installation of new pumps, new pipes and operations of rubber dams or use of storage) may have contributed changes in performance when the analysis is performed over several years of data.
- When a larger record of evidence is available (such as system alarm data for the DWDs owned by LACFCD), a close review of abnormal peak values may resolve some of the issues pertaining to actual flow from a DWD.

Due to those drawbacks in volume and flow estimates, monthly average or average monthly calculations are considered for analysis, although data for finer timescales were available for the DWDs owned by LACFCD. However, persistent high diverted flows are also not to be ignored, because they could be accurately representing actual operating conditions. Qualitative judgement needs to be exercised for this analysis while investigating maximum potential discharges from the DWDs.

2.4 Analysis of WRP Influent Flows

Table 2-5 provides a summary of the influent flows to the WRPs owned by the stakeholders within the Los Angeles Basin. The annual average influent flow for the LACSD WRPs are for 2017 and those for the LASAN WRPs and Los Virgenes Municipal Water District WRP are for 2018. Based on a comparison of permitted capacity and average annual influent flow, the WRPs appear to have potentially available capacity to treat diverted flows. However, the available capacity of these facilities has not been calculated or verified.

Table 2-5. Summary of Influent Flows to WRPs Owned by the Stakeholders

WWTP/WRP Name	Permitted Capacity (MGD)	Equalization Basin Volume (MG)	Annual Average Influent Flow (MGD)[a]
LACSD WRPs			
JWPCP	400	-	294
Long Beach[b]	25	-	11
Los Coyotes[c]	37.5	-	-
Pomona[b]	15	-	7
San Jose Creek[b,d]	100	8 (F)	64
Whittier Narrows[b]	15	-	6
LASAN WRPs			
Hyperion	450	N/A	259
Donald C. Tillman	80	5 (E); 7 (F)[e]	43
Los Angeles-Glendale	20	5[f]	18
Terminal Island	30	N/A	12

Table 2-5. Summary of Influent Flows to WRPs Owned by the Stakeholders

WWTP/WRP Name	Permitted Capacity (MGD)	Equalization Basin Volume (MG)	Annual Average Influent Flow (MGD)[a]
Los Virgenes Municipal Water District WRP			
Tapia	12	-	7.5

[a] Based on annual average influent flow for 2017 for LACSD WRPs and for 2018 for LASAN WRPs and Tapia WRP.

[b] There is currently no available capacity to treat additional flow at this plant without WRP modifications. These WRPs occasionally bypass high flows that are then treated at JWPCP.

[c] There may be available capacity to treat additional flow at JWPCP, but the flow at Los Coyotes is unknown.

[d] Includes San Jose Creek East and San Jose Creek West

[e] Contingent upon East-West Interceptor Project.

[f] Construction scheduled to be completed July 2022.

Notes:

E = Existing

F = Future

MGD = million gallons per day

All existing DWDs are within either the Hyperion WRP or JWPCP service areas. The goal of the analysis presented below is to investigate historical influent flows to these plants and to examine the potential impact of additional DWD flows to the sanitary sewer system connected to these two treatment plants. This analysis is used to determine the average and peak influent flows that the JWPCP and Hyperion WRPs have received historically and to estimate available treatment capacity based on the WRP's design capacity. This analysis provides a high level screening analysis to determine whether treatment capacities at these plants are available to receive flows from additional DWDs and/or operating DWDs during wet weather. The following section compares the discharge from the existing DWDs to the influent flows of the WRPs. Influent WRP flows can be impacted by upstream sewer scalping and satellite treatment facilities. However, the location and quantity of flows treated by satellite facilities are not evaluated in this study.

2.4.1 Hyperion WRP Capacity Analysis

The Hyperion WRP treats dry weather runoff diverted by DWDs owned and operated by both LASAN and LACFCD. The following subsections present an analysis of influent flows at the Hyperion WRP to characterize the influent flows currently being treated compared to its design capacity of 450 MGD. The current dry-weather runoff flows diverted by the DWDs are then compared to the Hyperion WRP unused capacity. These analyses present current conditions and the unused capacity that may be available for diverting additional dry weather runoff and potentially wet weather runoff for treatment at the Hyperion WRP.

2.4.1.1 Hyperion WRP Influent Data Analysis

LASAN provided daily influent flows to the Hyperion WRP for the period 2013 through 2018 (Figure 2-12). The influent flow varied between 215 and 384 MGD, with the average flow of 264 MGD. The design capacity is also shown (Table 2-5)

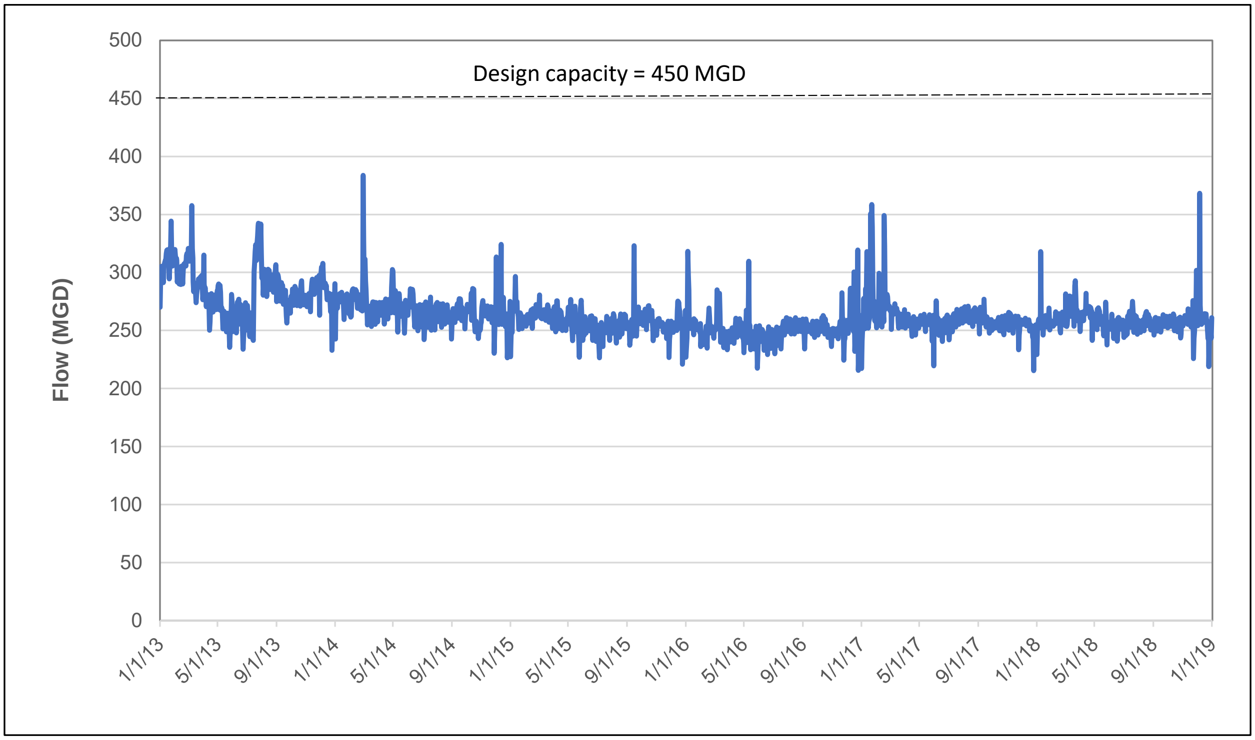

Figure 2-12. Influent Flow at the Hyperion WRP for the Period 2013 through 2018

Figures 2-13 and 2-14 present influent monthly average and monthly maximum flows, respectively. For comparison, the permitted capacity of the Hyperion WRP (450 MGD) is shown. Monthly average flows, as shown in red dotted line, have fewer variations over the months, except in 2013 when flows were relatively higher than other years. For the monthly maximum flows, relatively more variations are observed.

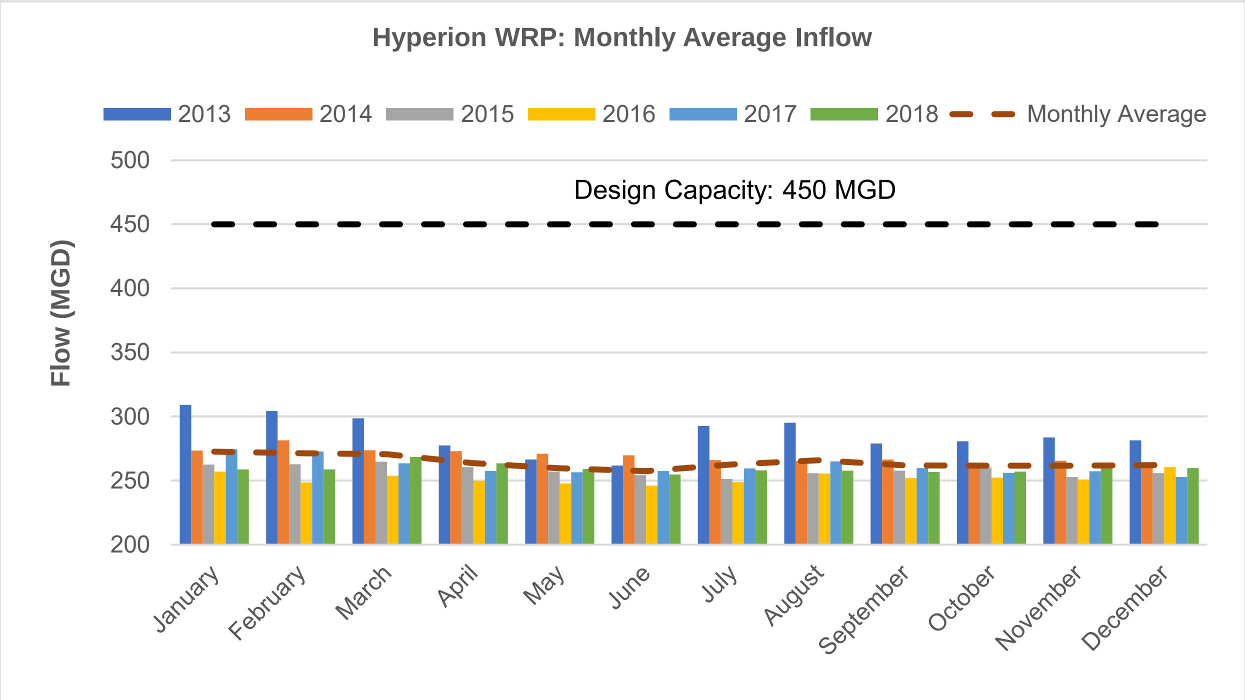

Figure 2-13. Monthly Average Influent Flow at the Hyperion WRP for the Period 2013 through 2018

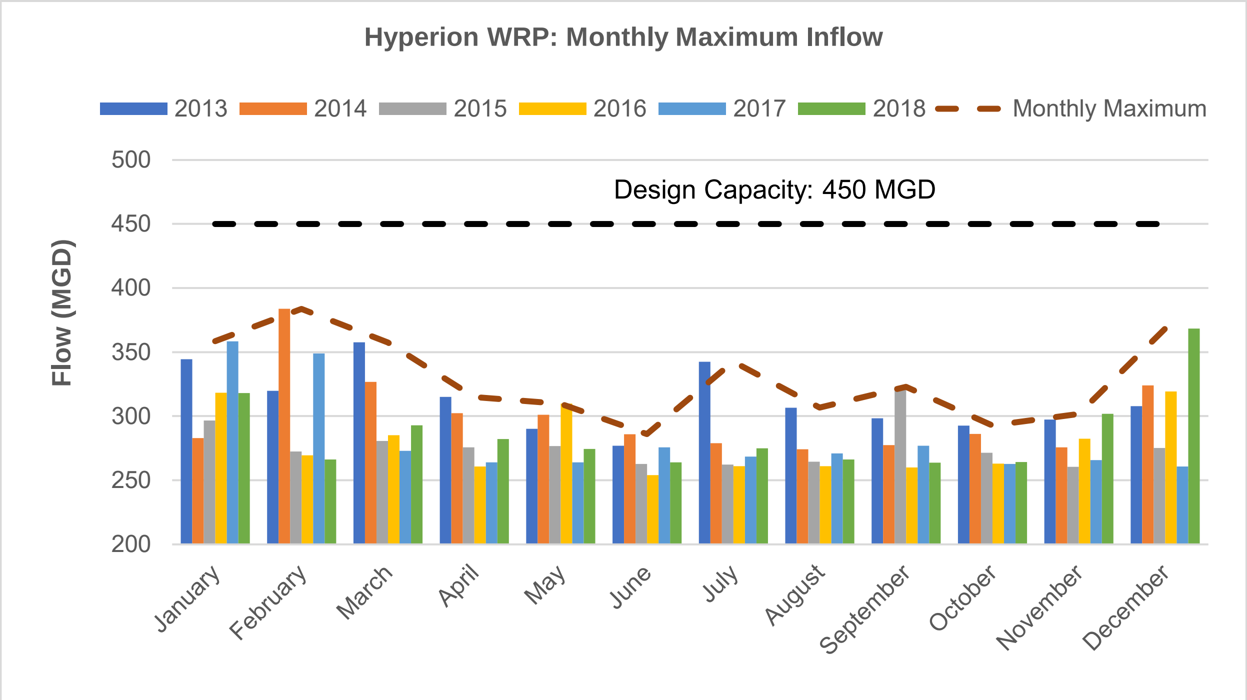

Figure 2-14. Monthly Maximum Influent Flow at the Hyperion WRP for the Period 2013 through 2018

Figure 2-15 presents annual maximum, average, and minimum inflows for the period 2013 through 2018. Figure 2-16 presents unused treatment capacity at Hyperion WRP compared to the maximum and average influent flow. Per annual average flow conditions, the unused treatment capacity varies between 217 to 235 MGD, and average is 228 MGD. Thus, on an annual average basis almost one-half of the design capacity is currently not used. The average flow is well below the design capacity as well. Per annual maximum flow conditions, the unused average treatment capacity is 98 MGD, varying from 66 to 131 MGD. Therefore, under the maximum flow regimes, the Hyperion WRP can receive at least 66 MGD of additional flow. Under average flow conditions, it could be a minimum of 217 MGD.

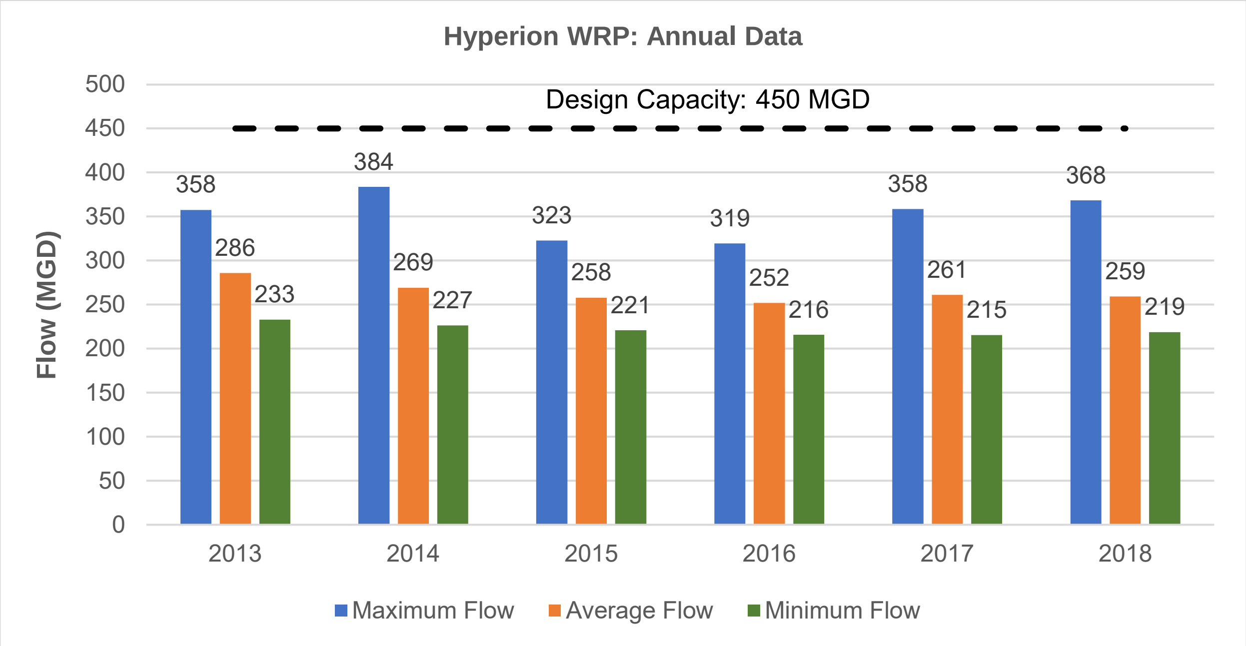

Figure 2-15. Annual Maximum, Annual Average, and Annual Minimum Influent Flow in Comparison to the Permitted Capacity at the Hyperion WRP

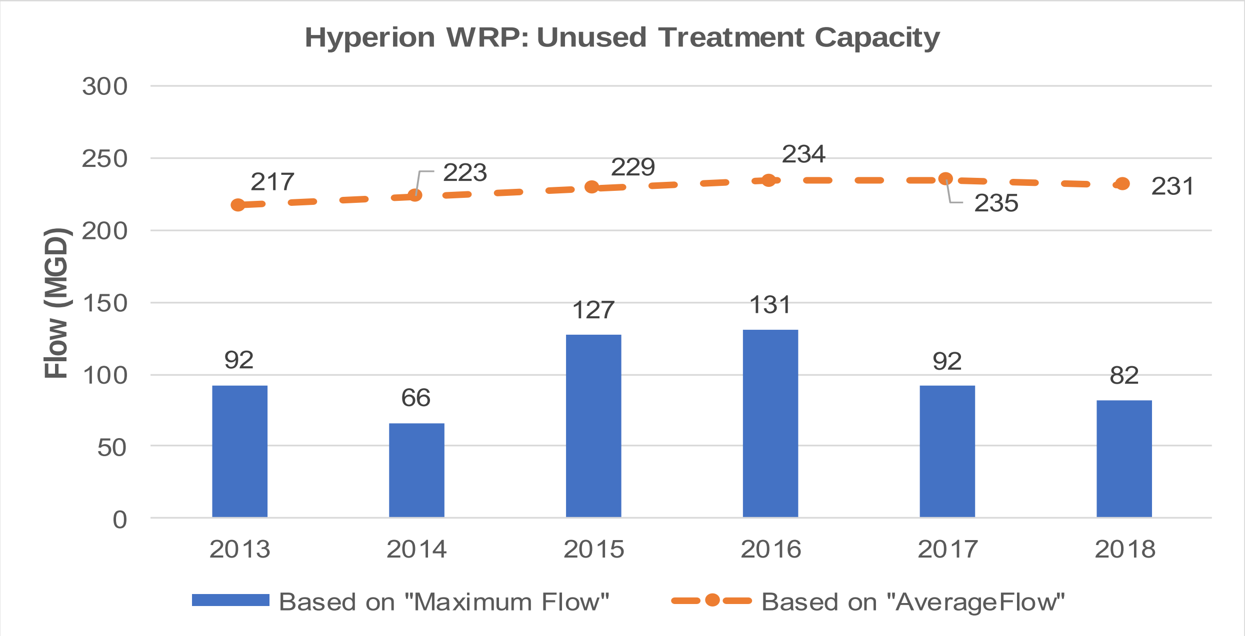

Figure 2-16. Annual Unused Treatment Capacity based on Maximum and Average Influent Flow at the Hyperion WRP

Tables 2-6, 2-7, and 2-8 present summaries of monthly influent flow at the Hyperion WRP for the period 2013 through 2018 for the peak, average, and minimum flows, respectively. Summary of monthly and annual data for the maximum, average, and minimum flows are also included in the respective tables. For this study, the maximum influent flow characteristics of the WRPs are a significant consideration, as it would be the worst-case scenario when more flows from DWDs could be added to the influent flows during the winter dry-weather period.

Table 2-6. Summary of Monthly Peak Influent Flows (MGD) at the Hyperion WRP

Months	2013	2014	2015	2016	2017	2018	Peak Monthly Flow
January	344	283	297	318	358	318	358
February	320	384	272	269	349	266	384
March	358	327	281	285	273	293	358
April	315	302	276	261	264	282	315
May	290	301	277	310	264	274	310
June	277	286	263	254	276	264	286
July	342	279	262	261	269	275	342
August	307	274	264	261	271	266	307
September	298	278	323	260	277	264	323
October	293	286	272	263	263	264	293
November	297	276	260	282	266	302	302
December	308	324	275	319	261	368	368
Peak Annual Flow	**358**	**384**	**323**	**319**	**358**	**368**	-

Table 2-7. Summary of Monthly Average Influent Flows (MGD) at the Hyperion WRP

Months	2013	2014	2015	2016	2017	2018	Average Monthly Flow
January	309	273	262	257	274	259	272
February	304	282	263	249	273	259	271
March	299	274	265	254	263	268	270
April	277	273	260	250	257	263	264
May	266	271	257	248	256	259	260
June	262	270	254	246	257	255	257
July	293	266	251	249	259	258	263
August	295	265	256	256	265	258	266
September	279	266	258	252	260	257	262
October	281	263	260	252	256	257	262
November	284	265	253	251	257	260	262
December	281	263	256	260	253	260	262
Average Annual Flow	**286**	**269**	**258**	**252**	**261**	**259**	**264**

Table 2-8. Summary of Monthly Minimum Influent Flows (MGD) at the Hyperion WRP

Months	2013	2014	2015	2016	2017	2018	Minimum Monthly Flow
January	270	243	228	227	217	229	217
February	290	262	252	235	252	248	235
March	274	253	252	233	251	254	233
April	250	256	249	239	245	241	239
May	236	248	227	217	219	238	217
June	234	250	240	229	240	241	229
July	241	242	226	230	242	244	226
August	279	243	239	247	253	248	239
September	256	251	237	234	247	246	234
October	271	243	241	236	246	243	236
November	263	230	227	224	233	226	224
December	233	227	221	216	215	219	215
Minimum Annual Flow	**233**	**227**	**221**	**216**	**215**	**219**	-

2.4.1.2 LASAN and LACFCD DWD Flows Treated at the Hyperion WRP

Figure 2-17 presents peak flows recorded at DWDs per data received from LASAN for all the data for the period 2008 through 2017. Among nine DWDs, maximum flow was recorded at #733 SMC, followed by #734 Temescal Canyon Park, and #730 Palisades Park and. The maximum flow from diversions was less than 1.0 MGD (Figure 2-17).

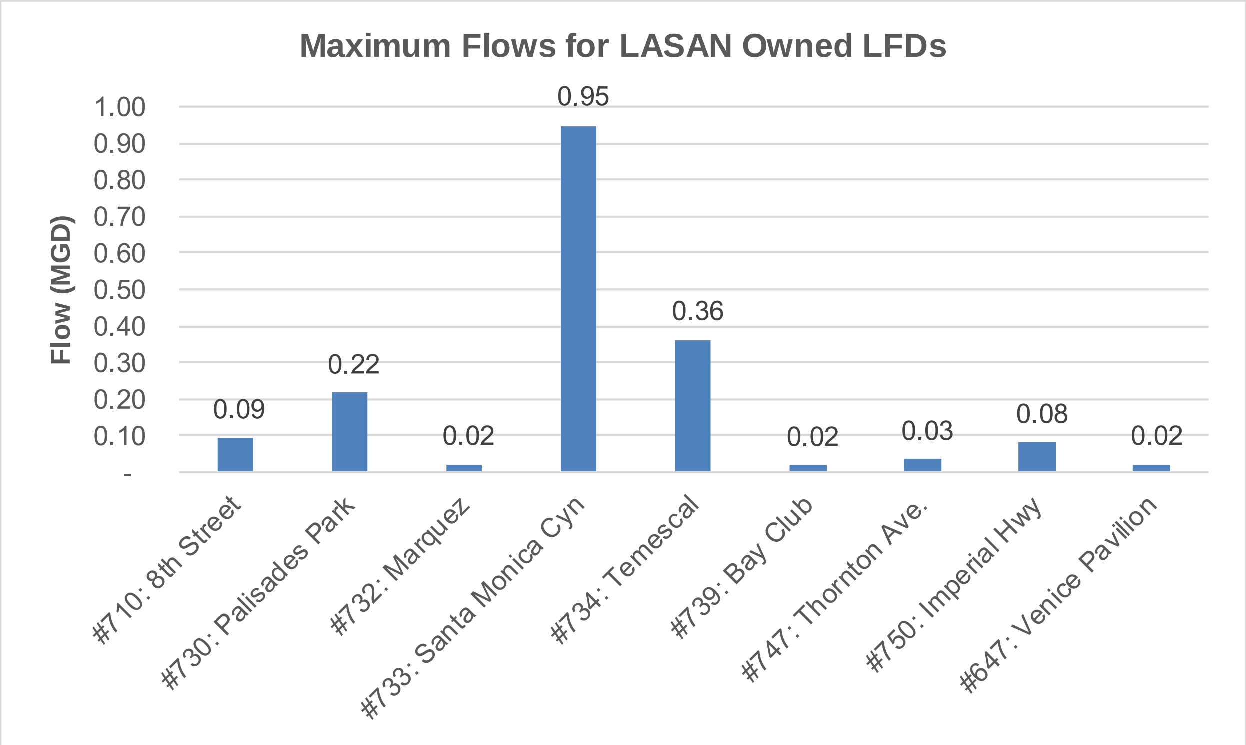

Figure 2-17. Maximum Flows Recorded in LASAN DWDs from 2008 through 2017

Figure 2-18 presents monthly average flow from the DWDs owned and maintained by LACFCD discharging to the sanitary sewer system connected to the Hyperion WRP. Most of these flows are less than 0.1 MGD, and they total approximately 1.5 MGD. This volume is well below the unused treatment capacity calculated for the Hyperion WRP.

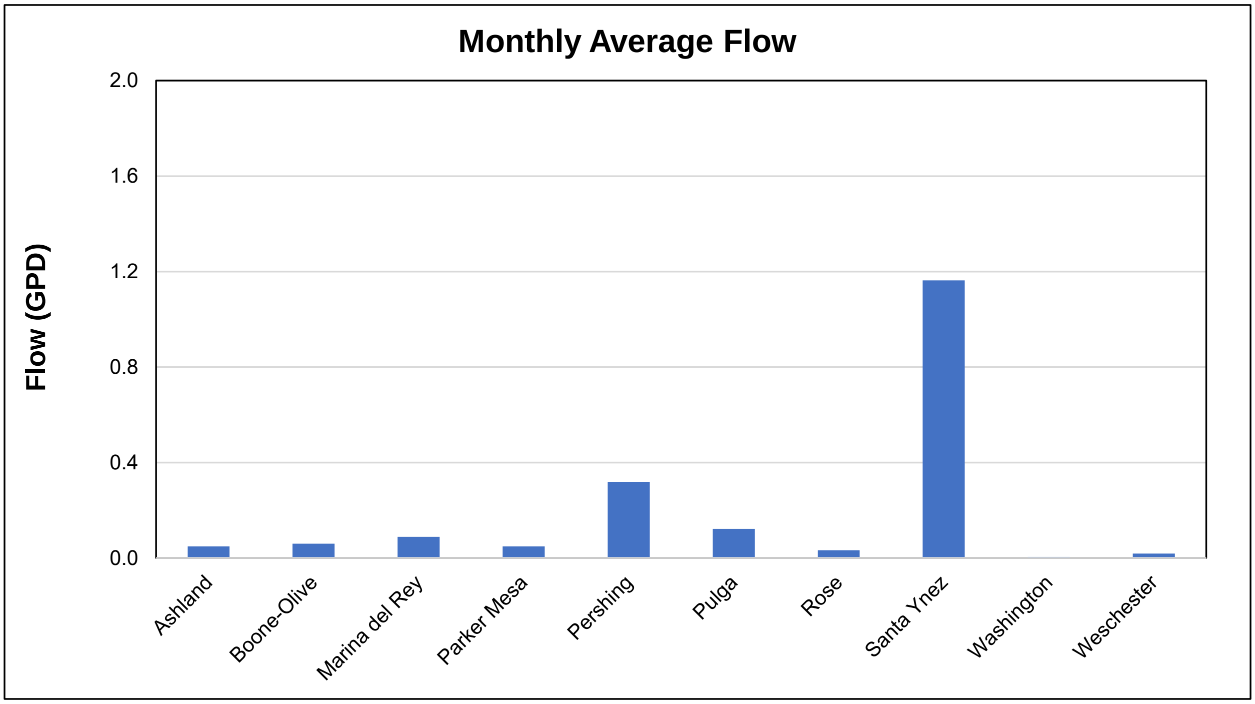

Figure 2-18. Monthly Average Flows Recorded in LACFCD DWDs from 2008 through 2019

As Figure 2-16 shows, the current minimum unused capacity at the Hyperion WRP is 66 MGD. Note, that this flow includes the dry weather runoff received from DWDs. Based on the calculated average available unused capacity at the Hyperion WRP, there is capacity to treat at least 217 MGD more flow than the historical average treatment (Figure 2-16). In summary, the Hyperion WRP can potentially capture, treat, and supply more recycled water during dry and wet weather. The existing DWDs could be modified for use during wet weather. This is because the additional flow to the WRPs will be insignificant to the total unused permitted capacity if diverted flows are increased from DWDs. Further analysis will be conducted under specific case studies to evaluate the potential of diverting more dry-weather and, potentially, wet-weather runoff to the Hyperion WRP along with the study of sanitary sewer system capacity to convey those flows from the DWDs to the plant.

2.4.2 JWPCP WRP Capacity Analysis

The JWPCP treats dry weather runoff diverted by DWDs owned and operated by the LACFCD. This section presents an analysis of influent flows at the JWPCP to characterize the influent flows currently being treated compared to its permitted capacity of 400 MGD. The current dry weather runoff flows diverted by the DWDs is then compared to the JWPCP capacity. These analyses present current conditions and the unused capacity that may be available for diverting additional dry-weather runoff and, potentially, wet-weather runoff for treatment at the JWPCP.

2.4.2.1 JWPCP WRP Influent Data Analysis

LACSD provided daily influent flows to the JWPCP for the period 2012 through 2017 (Figure 2-19). The flows varied between 200 and 400 MGD, with the annual average influent of 303 MGD. The design capacity of the plant (Table 2-5) is also shown.

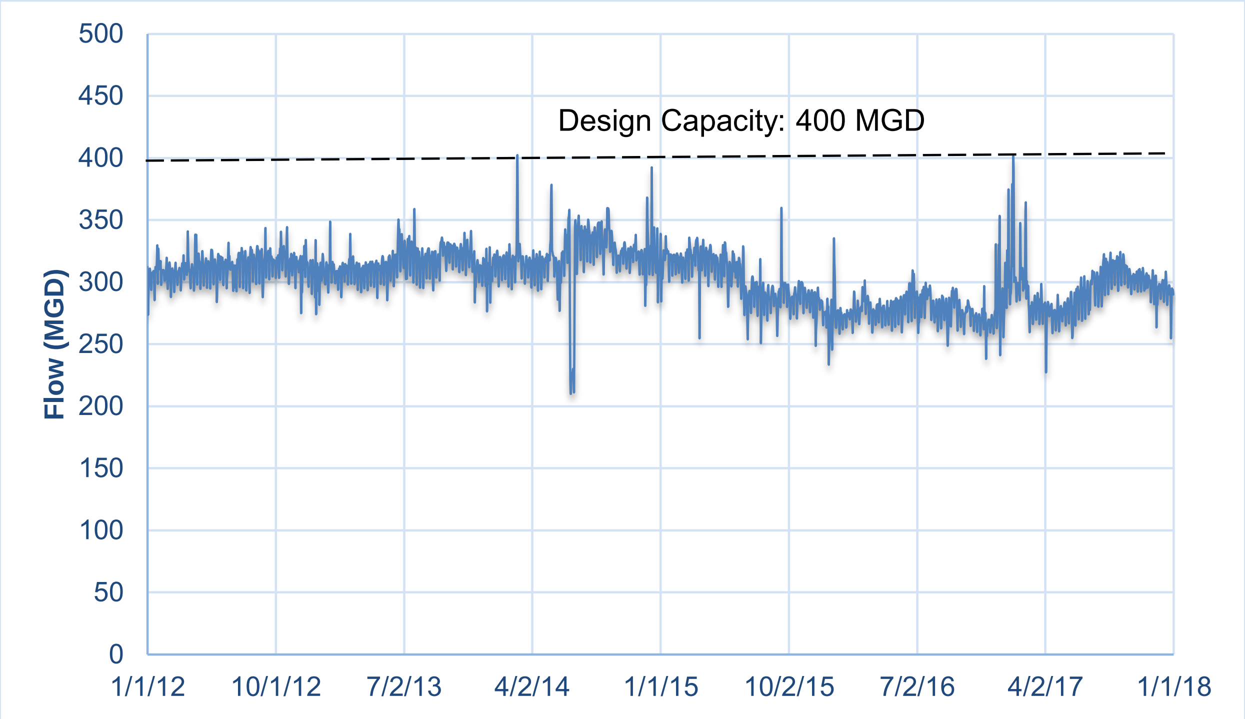

Figure 2-19. Daily Influent Flow to the JWPCP (2012–2017)

Figure 2-20 presents annual average, annual maximum, and annual minimum flow delivered by the DWDs and compared with the design capacity of the JWPCP for the available data between 2012 and 2017. Apart from 2017, the maximum flow was less than the design capacity (400 MGD) of the JWPCP.

Figure 2-21 presents monthly average, monthly maximum, and monthly minimum influent flow at JWPCP delivered by the DWDs for the period 2012 through 2017. For the monthly maximum flows, relatively more variation is observed. In a few instances, the maximum flows to the JWPCP peaked near the design capacity.

Figure 2-22 presents unused treatment capacity based on the design flow and compared with the maximum and average flow generated by DWDs. Per annual average DWD flow conditions and based on the JWPCP's design capacity, the unused average capacity is 97 MGD, varying from 80 to 122 MGD. Thus, based on average flow conditions, almost one-fourth of the design capacity of the JWPCP is unused. Based on the annual maximum flow conditions, the unused average capacity is 30 MGD. It is recognized that influent flows peaked several times to the design capacity during 2014 and 2017. On average, the JWPCP can receive between 30 MGD and 97 MGD of additional flow under current conditions.

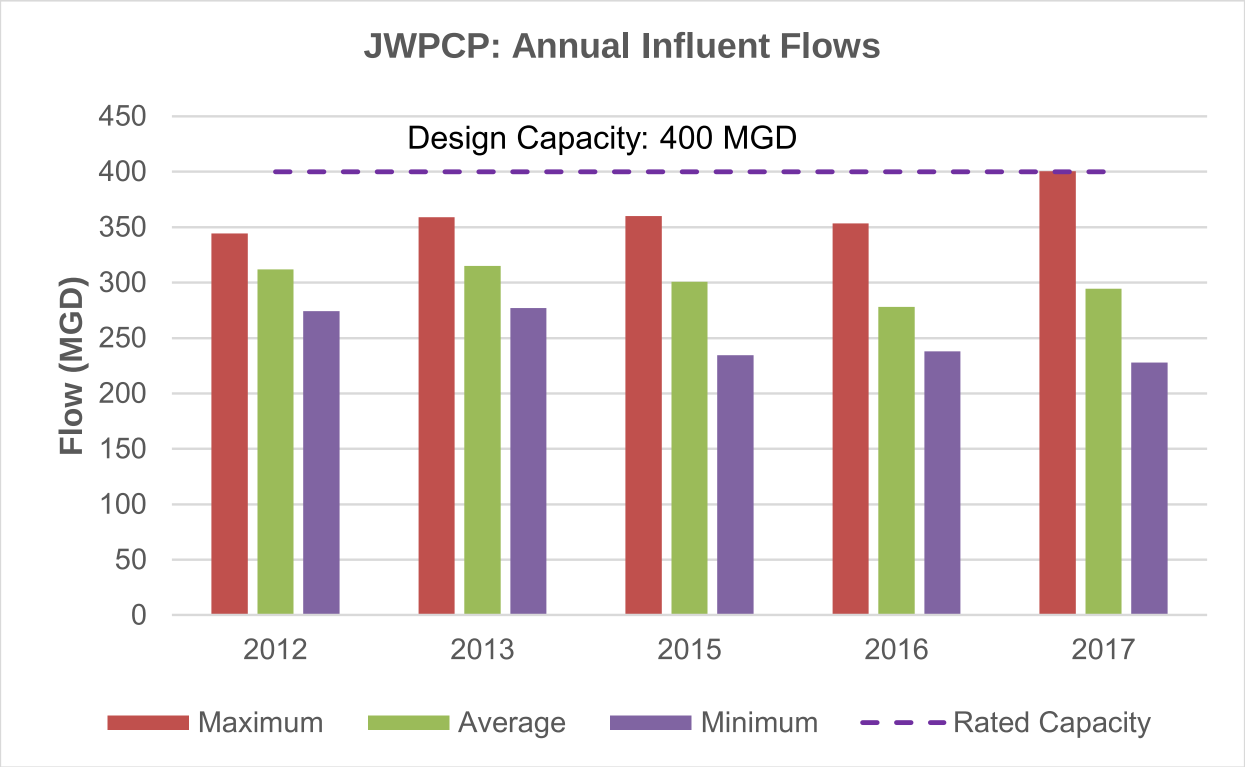

Figure 2-20. Annual Maximum, Annual Average, and Annual Minimum Influent Flow to the JWPCP

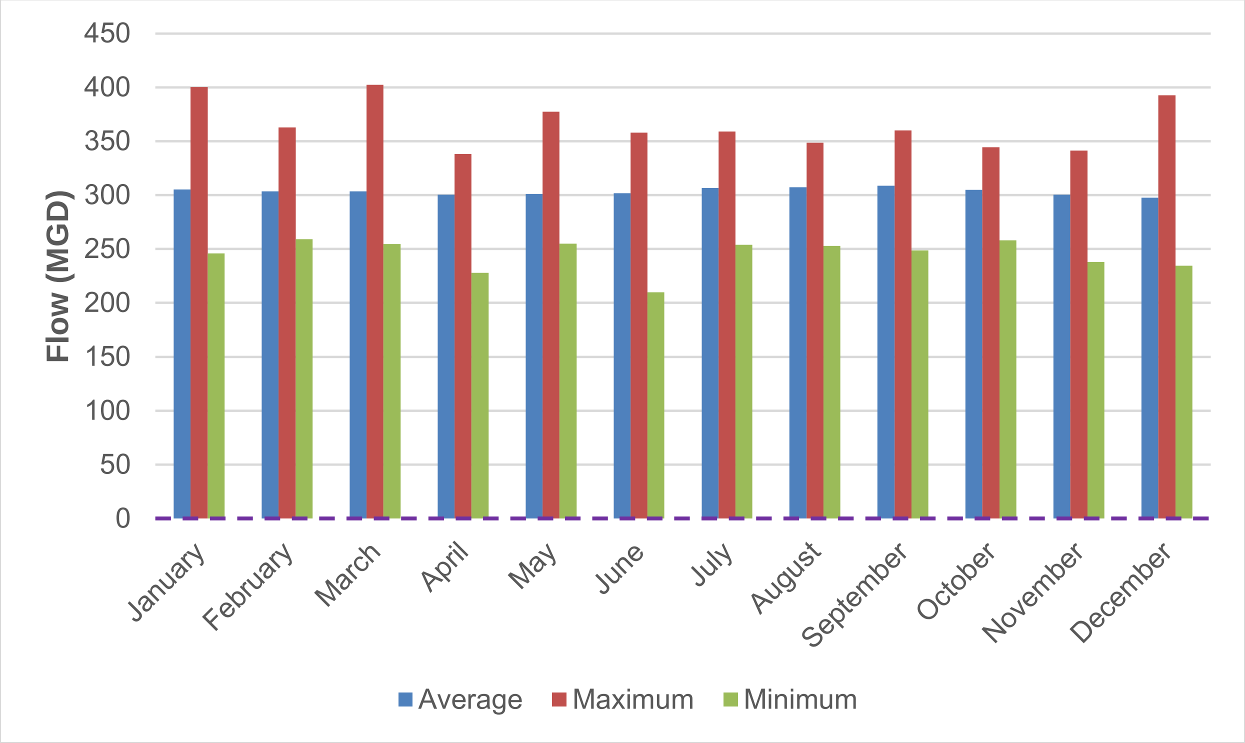

Figure 2-21. Monthly Average, Maximum, and Minimum Influent Flow to the JWPCP for the Period 2012 through 2017

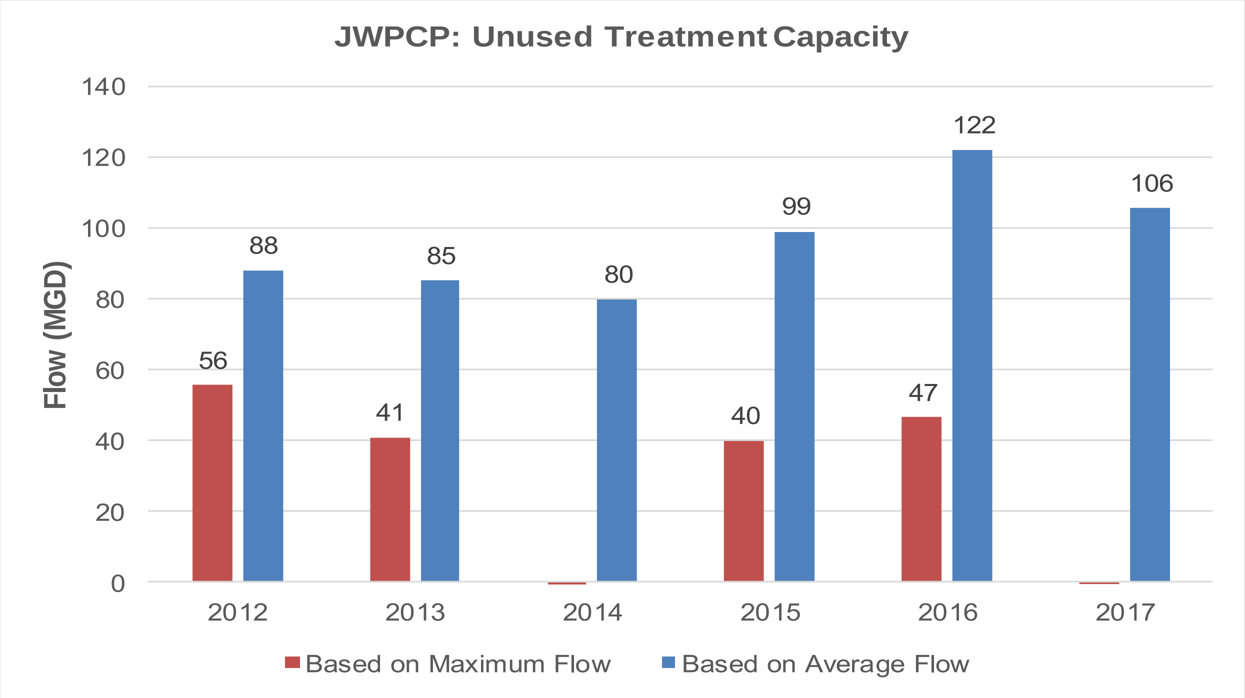

Figure 2-22. Annual Unused Treatment Capacity at the JWPCP based on Maximum and Average Influent Flow

Tables 2-9, 2-10, and 2-11 present summaries of monthly influent flow data for the period 2012 through 2017 for the maximum, average, and minimum flows, respectively. Summary of monthly and annual data for the maximum, average, and minimum flows are also included in the respective tables.

Table 2-9. Summary of Monthly Maximum Influent Flows (MGD) at the JWPCP

Months	2012	2013	2014	2015	2016	2017	Monthly Maximum
January	329	349	328	338	334	400	400
February	320	316	355	326	292	363	363
March	341	339	402	336	301	299	402
April	338	317	326	334	287	290	338
May	326	321	377	332	288	292	377
June	332	351	358	329	309	305	358
July	327	359	354	305	299	312	359
August	329	327	348	317	289	323	348
September	343	336	359	360	296	324	360
October	344	332	332	301	285	311	344
November	324	341	338	296	297	310	341
December	334	327	393	296	353	309	393
Annual Maximum	**344**	**359**	**402**	**360**	**353**	**400**	-

Table 2-10. Summary of Monthly Average Influent Flows (MGD) at the JWPCP

Months	2012	2013	2014	2015	2016	2017	Monthly Average
January	307	310	314	318	275	308	305
February	306	307	316	316	275	301	304
March	311	311	319	319	280	280	303
April	311	308	313	319	276	274	300
May	312	310	318	313	278	276	301
June	314	321	294	307	289	287	302
July	312	322	335	289	286	297	307
August	317	317	335	288	278	309	307
September	316	320	333	292	280	310	309
October	318	324	321	289	275	302	305
November	311	321	320	284	269	297	300
December	309	308	323	276	278	293	298
Annual Average	**312**	**315**	**320**	**301**	**278**	**294**	-

Table 2-11. Summary of Monthly Minimum Influent Flows (MGD) at the JWPCP

Months	2012	2013	2014	2015	2016	2017	Monthly Minimum
January	274	282	284	286	246	257	246
February	288	288	294	300	259	260	259
March	293	294	296	255	260	266	255
April	293	292	293	297	264	228	228
May	284	285	277	280	260	255	255
June	295	297	210	273	268	265	210
July	293	298	280	254	259	274	254
August	291	295	314	253	260	289	253
September	288	293	306	257	249	293	249
October	299	308	307	270	258	290	258
November	275	284	282	250	238	264	238
December	274	277	285	235	243	255	235
Annual Minimum	**274**	**277**	**210**	**235**	**238**	**228**	-

2.4.2.2 LACFCD DWD Flows Treated at the JWPCP

As shown in Table 2-1, the following DWDs are owned and maintained by LACFCD discharge dry-weather runoff to the sewer system connected to the JWPCP:

- Avenue I
- Herondo Street
- Manhattan Beach PP
- Manhattan, 28th and The Strand
- Alamitos Bay PP

Figure 2-23 presents monthly average flows recorded at DWDs per data received from LACFCD for the period from 2008 through 2019. The exception is the Alamitos DWD, for which flow data were available only for 2018 and 2019. The total flow from these five DWDs was 0.2 MGD, which is insignificant compared to the JWPCP's unused design capacity (Figure 2-23).

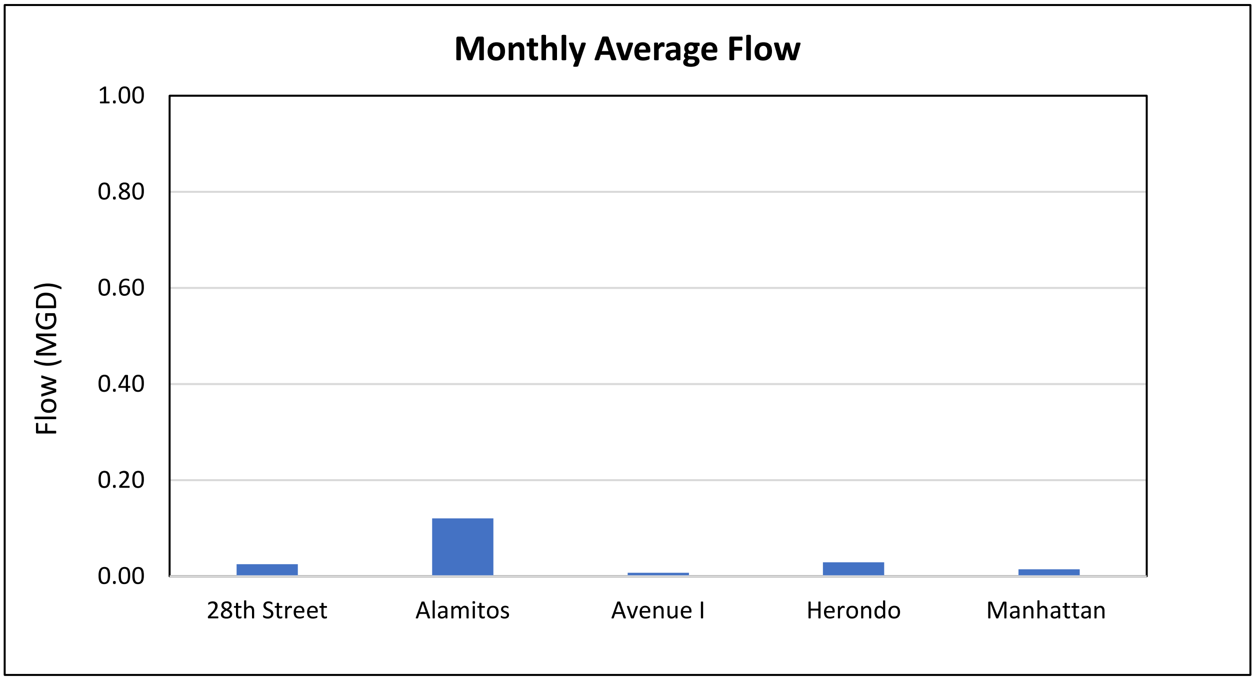

Figure 2-23. The Monthly Average Flows from DWDs discharging to the JWPCP during 2008 through 2019, except for Alamitos where Data for 1 year (2018-2019) were available.

2.5 Conclusions and Recommendations

This analysis found that the dry-weather runoff diverted by DWDs varies daily, monthly, and annually. The monthly flows diverted by the DWDs also varied over the years. Currently, most of the diversions are turned off during rain events. With a few exceptions at some diversions, generally, the winter dry-weather runoff is greater than summer dry-weather runoff. This could be attributed to the fact that the DWDs operated in LACSD's service area include runoff generated from up to the first 0.1 inch of rainfall. In addition, dry-weather runoff can also be impacted by the rainfall from previous day(s).

Based on the screening level analysis of DWD and WRP flows, the following conclusions were drawn:

- Because DWDs are sized to prevent bypass of highly variable peak flows, their average discharges are typically less than their design capacities.
- In most cases, the peak and average monthly DWD flows were less than the design capacities of the DWDs for the LASAN DWDs. For the LACFCD DWDs, the monthly average flows were less than the permitted discharge capacities of the DWDs. Occasional spikes in flow could be attributed to various reasons, including malfunctioning of pumps; issues with the manual control system, telemetry data, and data retrieved from the pump run time; and system clogging. The Regional Water Quality Control Board permitted stormwater discharges from construction dewatering activities and the groundwater dewatering related discharges to the storm drains could be substantial, but no analysis was conducted to separate out the sources of flow to the storm drains due to the unavailability of such data.
- Based on the flow data analysis for the period 2013 through 2018 and 2012 through 2017 for the Hyperion WRP and the JWPCP, respectively, it was inferred that the average inflow is significantly less than the WRPs' design capacities. It was estimated that significant unused permitted capacity can potentially be used to manage additional dry- and, potentially, wet-weather runoff at both WRPs.
- Compared with the potentially minimum available treatment capacity, the discharges from DWDs were found to be less than 1.5 percent of the influent flows at the Hyperion WRP and JWPCP.

- Based on the downstream WRP's available design capacity, it appears that DWDs could be operated during wet weather; however, the capacity of the sanitary sewer system and all its conveyance assets between the DWDs and the WRPs would need to be analyzed. Where sewer system capacity is limited during wet weather, stormwater can be stored until capacity is available during dry weather.
- The purposes of the DWDs are to divert dry-weather runoff and prevent it to discharge to the receiving waterbodies (such as the SMB and the Los Angeles River) to improve water quality of these waterbodies and meet the TMDL requirements. Although not the purpose of this study, the data collected in this exercise demonstrate the DWDs are diverting dry-weather runoff and preventing pollutants from being discharged to the receiving waterbodies.

The data provided by the LACFCD were extracted from the telemetry system but did not undergo quality checks by the LACFCD. These data are considered provisional and are used to understand the operations of DWDs. For high-level planning and understanding purposes, this level of available flow data was cleaned for poor quality and negative values, and was used for the preliminary analysis presented in this section. A complete investigation of the operation of each DWD will require a cleaned/validated flow dataset to draw conclusions.

Most of the DWD flow data provided by LASAN were the monthly total volumes pumped by the DWDs to the sanitary sewer system, which were estimated based on the pump runtime. It is recommended that flow meters be installed at these facilities to continuously obtain accurate data on diverted flows. The quality and temporal resolution of data need to be improved to better understand the operation of DWDs and the types of improvements needed for the infrastructure to potentially accommodate wet weather runoff.

Available flow data with higher resolution (such as daily, hourly or smaller time resolution data) are important. Accurate DWD subcatchment area and land use data for estimating the flow generated are needed. Adding flow monitoring devices on surface waters downstream of existing DWD locations can help track any new sources of flows downstream from the diversion location.

2.6 References

Los Angeles County Flood Control District (LACSD). 2014. Dry Weather Urban Runoff Diversion Policy. https://www.lacsd.org/civicax/filebank/blobdload.aspx?BlobID=2560

LA Sanitation and Environment (LASAN). 2017. *Final Project Report for Marquez Low Flow Diversion Project*. https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/docs/summaries/253_marquez_div.pdf

National Oceanic and Atmospheric Administration (NOAA). 2019. What is the Biggest Source of Pollution in the Ocean? https://oceanservice.noaa.gov/facts/pollution.html

Section 3. DWD Efficacy Analysis and DWD Selection for Case Studies

3.1 Introduction

The purpose of this section is twofold: (1) to identify and document an efficacy analysis that could potentially be used for DWDs to explore their potential for wet weather operations based on physical, operational, and regulatory factors: and (2) to apply the efficacy analysis to select four case-study DWDs for further evaluations. The four case-study DWDs were selected by LASAN and LACFCD based on the efficacy analysis, field visits, and selection criteria described here. Section 4 describes the case studies in more detail.

To understand the additional benefits of DWDs, a first step is to determine whether the DWDs, which are traditionally designed to divert dry weather flows, can also be operated during wet weather. To determine whether DWDs can divert flows during wet weather, it is necessary to investigate whether sufficient capacity exists within the wastewater collection system, as well as the WRP downstream from the point of diversion, to accommodate additional flows in a safe and controlled manner.

Based on an analysis of the previous deliverables of this study, the existing DWDs are successfully diverting dry weather flows to the sanitary sewer system and accomplishing their water quality objectives. A preliminary analysis suggested in most cases, the peak and average monthly flows diverted by the DWDs were less than their design capacities and permitted capacities, indicating the potential for additional water supply benefits. Occasional spikes in flow could be attributed to various reasons, including anomalous flows from malfunctioning irrigation, water line flushing, permitted discharges, or mechanical issues with the DWD system. The diversions can potentially be operated during the wet weather period based on the WRP's available treatment capacity. However, the collection system capacities, in addition to rainfall-impacted runoff volumes, will need to be analyzed on a case-by-case basis.

Specifically, this section is organized as follows:

- Section 3.1 - DWD Efficacy for Potential Conversion to WWD
- Section 3.2 - Selection of DWDs for Case Studies
- Section 3.3 - Conclusions and Next Steps
- Section 3.4 – References

3.2 DWD Efficacy for Potential Conversion to WWD

The efficacy of a DWD to accommodate additional flows beyond dry weather runoff depends on several physical, operational, and regulatory factors. The factors include the wet weather runoff generated from rainfall in the tributary area, the existing DWD and infrastructure capacity to successfully manage additional flows, land availability for expansion, and the location of the DWD relative to a WRP. As learned from the previous analysis, the existing DWDs have been operated successfully and have improved water quality by removing dry weather discharge of urban runoff from receiving waterbodies and diverting it to the sanitary sewer systems. Based on the analysis described in Section 2, DWDs can potentially accommodate additional flows, but need to be evaluated on a case-by-case basis.

Some DWDs may be easily modified for WWD operations, while others may require small or large retrofits to provide additional capacity to handle wet weather runoff. Also, as discussed here, the capacity to handle additional flows at a specific DWD will vary, depending on the magnitude and timing of flows generated in the watershed, available storage capacity, and associated infrastructure capacity to handle the additional flows. Therefore, the efficacy factors were developed in association with stakeholder input and experience gained in the previous task. The following section describes the efficacy factors, which are not presented in a particular order of importance.

3.2.1 Flow Data Availability and Data Quality

The availability of detailed flow data is key to the identification of DWDs that are suitable for WWD operations. Based on the Tiers 1 and 2 data gathering process described in Section 1, a preliminary understanding of the operations of DWDs and the capacities of the sanitary sewer systems was obtained in Section 2. “Good” data availability is defined as follows:

- Available complete database of flow records for the entire period of DWD operation
- Available flow data with higher resolution; for example, daily, hourly, or smaller time resolution data
- Available GIS data for the DWD tributary area
- Available reports/documents, including as-built drawings for the DWD project
- Additional information available on the DWD projects, such as lessons learned, any changes/modifications in the project over time, and operational successes/challenges

3.2.2 Availability and Permitted Discharge Capacity

Based on the analysis provided in Section 2, the available/permitted discharge capacities of the DWDs are documented. The assessment of diversion capacity depends on three types of capacities: (1) pumping capacity, (2) conveyance capacity, and (3) allowable/permitted discharge capacity to the sanitary sewer system. A DWD with available and permitted discharge capacity in its existing condition is a better candidate for handling additional flows under wet weather conditions without any modifications of the infrastructure.

3.2.3 Proximity to WRPs

Currently, DWDs discharge dry weather runoff to the sanitary sewer system, which flows to a WRP for treatment. Large sanitary sewer systems have thousands of branches each having capacity for a very small portion of the downstream treatment capacity. As such, the conveyance capacity of the sewer (including facilities like pumping plants, siphons, tunnels, control structures, and other critical infrastructure assets) is typically the controlling factor for a diversion project. Locating DWDs adjacent to WRPs and connecting to the WRPs directly or immediately upstream in the sanitary sewer system avoids downstream conveyance limitations in the sanitary sewer system.

3.2.4 WRPs with Available Treatment Capacity

Available WRP treatment capacity would be required for a DWD to divert additional flows during wet weather. Section 2 provided a preliminary analysis of available WRP treatment capacity, based on the monthly average and peak influent flows to the plants relative to their design capacities. A higher resolution of treatment plant influent flow data would provide additional information on the timing of the rainfall versus peak flows at the WRPs, as well as the recovery time.

3.2.5 System Controls

Currently, most of the diversions are turned off during, and for a period after, rain events. As identified in Section 2, some diversions have rain gauges and automatically shut off when rain is detected, while others are operated manually. During a forecasted rain event, a substantial amount of labor and expense is required for the O&M staff to visit each facility to turn off or adjust operations as the actual conditions require. Remote operations via supervisory control and data acquisition (SCADA) would allow for more precise timing for turning the diversions on and off and potentially increasing diversion volumes without compromising the integrity of the downstream sewer system. It would also enable operators to have real-time information on conditions at the diversion and in the sanitary sewer system via remote monitoring. Other system control modifications, such as installing VFD pumps for the diversions, would provide operational flexibility for the system to adjust pump speeds with flow variations, which would allow for an increase in water volume diverted and long-term operational cost savings.

3.2.6 DWD System Capacity

Each DWD's maximum flow rate is limited by several structural and mechanical factors, including the size of the diversion berm, size of the connector pipe, pump capacity, depth of wet well, pump discharge line size, and distance to the sanitary sewer. In general, peak flow rates are controlled by pump size; therefore, the pumps are the limiting factors. However, each of these elements must be considered when evaluating the potential for increasing discharge flows.

3.2.7 Conveyance Capacity

Identifying the existing sanitary sewer system capacities downstream of the diversions, including pipes, pump stations, siphons, control structures, and other conveyance assets, is also an important factor to determine whether the DWD can manage additional flows. In some cases, an expansion of a small portion of the sewer system could increase capacity for the entire system. It is critical to evaluate the capacities of the sanitary sewer systems from the DWD discharge locations to the inflow to the WRP and to account for other diversions in the sewershed. For example, flows from the Santa Monica sewersheds are routed to the Hyperion WRP via the Venice Pumping Plant (VPP). Therefore, it is necessary to understand the current and future capacity at the VPP to determine whether the plant can handle additional inflows. In this case, the available capacity at the VPP would be the governing/limiting factor, although the Hyperion WRP may have additional treatment capacity available.

3.2.8 Storage

When capacity of the sewer is the limiting factor, the addition of storage may be necessary to meet project objectives. For DWDs, storage allows discharge during off-peak hours (when more capacity is typically available and treatment costs may be lower). For stored wet weather diversions, stormwater can be held in storage until dry weather conditions are restored in the wastewater conveyance system and diversion is again permitted. For real-time wet weather diversions, the storage is sized by modeling the storm drain flow and sewer capacity during storms to determine the amount of storage necessary to meet the stormwater capture objectives.

3.2.9 Availability of Rainfall Gauges

Rain events are not uniform across watershed and sewershed areas or in time, intensity, or volume. Rainfall gauges located in the selected DWDs tributary areas' vicinity must be available to know when it begins raining in the watershed and report site-specific conditions. The rainfall-dependent runoff based on the data received from a local rain gauge provides necessary data for real-time operations and better data for post-event assessments of flows and volumes generated in the watershed than would those from a gauge located farther away.

3.2.10 Pretreatment of Dry and Wet Weather Runoff

DWDs are equipped with some form of pretreatment devices to remove trash and debris before diverting flows to the sanitary sewer system. Most of the diversions from storm drains to a pretreatment system are by gravity, but all the diversions from a DWD wet well to the sanitary sewer system are pumped diversions. As the water passes through the pretreatment system, debris and trash are retained. In addition, the systems have valves to control the maximum rate of flow and prevent backflow.

3.2.11 Available Land for Future Expansion of DWDs

It is important to investigate whether there is acquirable land available at the existing DWDs for potential future expansions. System improvements may require the expansion of many system components, such as the diversion structure, wet well, storage, control station, piping network, pumps, and pump station. Since the inflow to a DWD is gravity-driven, the wet well capacity could be increased, or additional storage could be built if land is available. Available land will enable the modification of existing facilities, including green areas for bioretention for detention of peak discharges. Also, it is highly desirable that the required improvements of DWDs to manage wet weather runoff be considered, along with currently planned DWD expansions or related projects.

3.3 Selection of DWDs for Case Studies

The efficacy factors described in Section 2 were used with a set of selection criteria, described here, to guide the DWD case study selection process. The selection process focused on a diverse group of DWDs with potential infrastructure capacity to divert additional dry and wet weather flows. To assist the stakeholders in the selection of four DWDs for case studies, the project team and stakeholders prepared a list of DWD selection criteria to guide the selection process. The case study DWD selection process used available data for the diversions, as described in the previous sections, as well as input from the stakeholders. As mentioned, Section 4 describes the four DWDs that were investigated as case studies.

3.3.1 Selection Criteria

While each DWD is a unique system, several DWDs are similar in type and operation. To select a variety of DWDs for case studies, the following selection criteria were used:

- At least one LASAN-owned DWD
- At least one LACFCD-owned DWD
- At least one DWD that discharges to the Hyperion WRP
- At least one DWD that discharges to the JWPCP
- At least one DWD with storage
- At least one DWD without storage
- One DWD located adjacent to a WRP

3.3.2 Existing DWD Attributes

There are 41 existing DWDs within the Los Angeles Basin. Section 2 provided a detailed inventory of the DWDs. Table 3-1 lists the attributes of the DWDs to guide the selection of the case study facilities. The DWD selection was limited to the facilities owned by the agencies participating in this study, including LACFCD and LASAN. Figure 3-1 provides the locations of all of the existing DWDs, the LA County rainfall gauges, and the WRPs.

Table 3-1. Existing DWD Attributes and Efficacy Factors for DWDs owned by LASAN and LACFCD

Owner	DWD Name	LACFCD - owned	LASAN -owned	Hyperion Sewershed	JWPCP Sewershed	Long-term Flow Data	Rainfall Gauge in Tributary	As-builts Provided	WRP Adjacent	DWD without Storage	DWD with Storage	Available Capacity [a]
LACFCD	Alamitos Bay PP	✓			✓			✓			✓	
LACFCD	Arena PP	✓		✓							✓	
LACFCD	Ashland Avenue (Phase 2)	✓		✓		✓		✓		✓		
LACFCD	Avenue I	✓			✓	✓		✓		✓		✓
LACFCD	Boone Olive PP	✓		✓		✓		✓			✓	
LACFCD	El Segundo PP	✓		✓				✓			✓	
LACFCD	Electric Avenue PP	✓		✓			✓	✓			✓	
LACFCD	Herondo Street	✓			✓	✓	✓	✓			✓	
LACFCD	Manhattan Beach PP	✓			✓	✓	✓	✓			✓	
LACFCD	Manhattan, 28th & The Strand	✓			✓	✓		✓			✓	
LACFCD	Marina Del Rey (Oxford Basin)	✓		✓		✓		✓		✓		
LACFCD	Parker Mesa/Castlerock	✓		✓		✓		✓		✓		✓
LACFCD	Pershing Drive, Line C	✓		✓		✓		✓	✓	✓		✓
LACFCD	Playa del Rey	✓		✓						✓		
LACFCD	Pulga Canyon	✓		✓		✓		✓		✓		✓
LACFCD	Rose Avenue (Phase 2)	✓		✓		✓		✓		✓		
LACFCD	Santa Ynez	✓		✓		✓	✓	✓		✓		
LACFCD	Washington Blvd	✓		✓		✓		✓		✓		✓
LACFCD	Westchester	✓		✓		✓		✓		✓		

Table 3-1. Existing DWD Attributes and Efficacy Factors for DWDs owned by LASAN and LACFCD

Owner	DWD Name	LACFCD - owned	LASAN -owned	Hyperion Sewershed	JWPCP Sewershed	Long-term Flow Data	Rainfall Gauge in Tributary	As-builts Provided	WRP Adjacent	DWD without Storage	DWD with Storage	Available Capacity [a]
LASAN	#647 Windward/Venice		✓	✓		✓		✓			✓	✓
LASAN	#710 Enterprise (8th St)		✓	✓		✓		✓		✓		✓
LASAN	#711 Downtown (7th St)		✓	✓		N/A				✓		
LASAN	#730 Palisades Park		✓	✓		✓		✓		✓		
LASAN	#732 Marquez Canyon		✓	✓		✓		✓		✓		✓
LASAN	#734/736 Temescal/Temescal Canyon		✓	✓		✓		✓			✓	✓
LASAN	#735 Santa Monica Canyon		✓	✓		✓		✓		✓		✓
LASAN	#739 Bay Club Drive		✓	✓		✓				✓		✓
LASAN	#742 Penmar		✓	✓				✓			✓	
LASAN	#747 Thornton		✓	✓		✓		✓		✓		✓
LASAN	#750 Imperial Hwy		✓	✓		✓			✓	✓		✓
LASAN	LA Zoo		✓			N/A		✓			✓	

[a] Potentially available capacity based on long term trends

Notes:

✓ = data are available

N/A = data not available

Highlighted DWDs were selected by the stakeholders for case studies

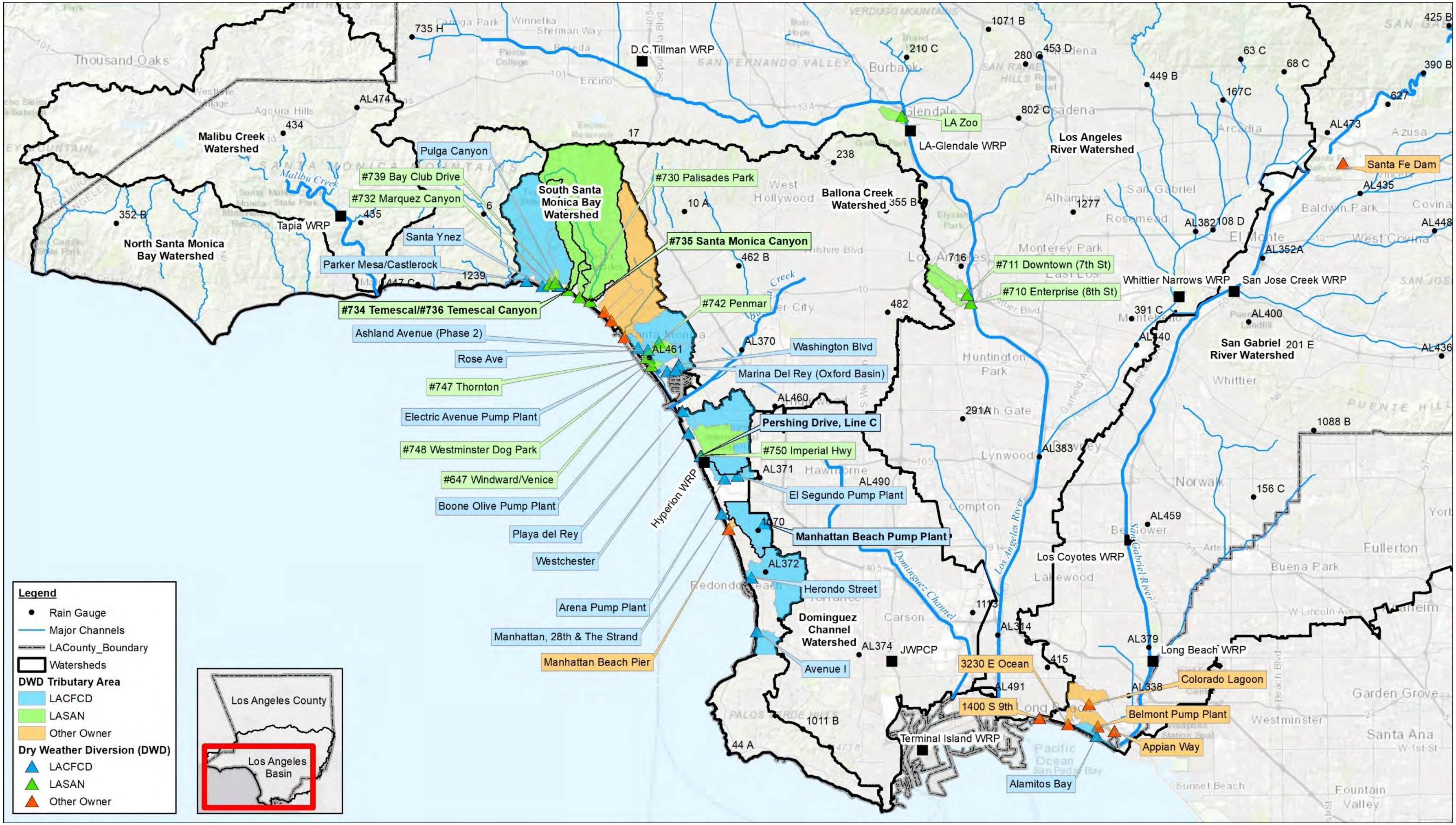

Figure 3-1. Existing DWDs, WRPs, and Rain Gauges

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3.3.3 Selected DWDs for Case Studies

Based on the efficacy factors, selection criteria, and knowledge and operations of these systems, LACFCD and LASAN proposed four DWDs for the case studies (Figure 3-2). The Jacobs team conducted field visits at the proposed four DWDs with LASAN and LACFCD staff and concurred with the proposals made by the two agencies. The following four DWDs were selected for the case studies; Figure 3-2 presents the location of the selected DWDs with their tributary areas:

- **LACFCD-owned DWDs**
  - **Pershing Drive DWD:** This DWD is unique because it is located directly adjacent to the Hyperion WRP. For planning of future facilities, identifying DWDs next to WRPs can be beneficial, as this avoids conveyance limitations of the sanitary sewer system between the DWD and the WRP. The short travel time from the DWD to the WRP can facilitate better flow control before the time of concentration of wet weather flow is experienced at the WRP. Photo 3-1 provides photographs of the Pershing Drive DWD.
  - **Manhattan Beach PP DWD:** This DWD primarily serves as a PP for a localized low point at Polliwog Park in Manhattan Beach. The park has a pond that is used for aesthetic purposes, as well as for stormwater retention during rain events. During dry weather, the pump station has a secondary pump that pumps non-stormwater flows into the sanitary sewer system, which flows to the JWPCP. Photo 3-2 provides photographs of the Manhattan Beach PP DWD.
- **LASAN-owned DWDs**
  - **Santa Monica Canyon DWD:** This DWD is unique because it is on an open channel that is a receiving waterbody. By comparison, most DWDs are diversions to underground storm drain systems before they discharge into receiving waterbodies. An inflatable rubber dam is used to redirect flows from the open channel to a diversion structure that flows to the Hyperion WRP. Photo 3-3 provides photographs of the SMC DWD.
  - **Temescal/Temescal Canyon DWD:** This DWD is a combination of two diversions: (1) the Temescal Canyon DWD, which diverts storm drain flows to an underground detention tank that is used to irrigate Temescal Canyon Park, and (2) the Temescal DWD, which pumps excess dry weather flow (from the same storm drain from where the first diversion is made) to the sanitary sewer conveying flows to the Hyperion WRP. Photo 3-4 provides photographs of the Temescal/Temescal Canyon DWD.

The selected DWDs provide a variety of examples of facilities and scenarios that will be considered while assessing the feasibility of potentially converting the DWDs to WWDs.

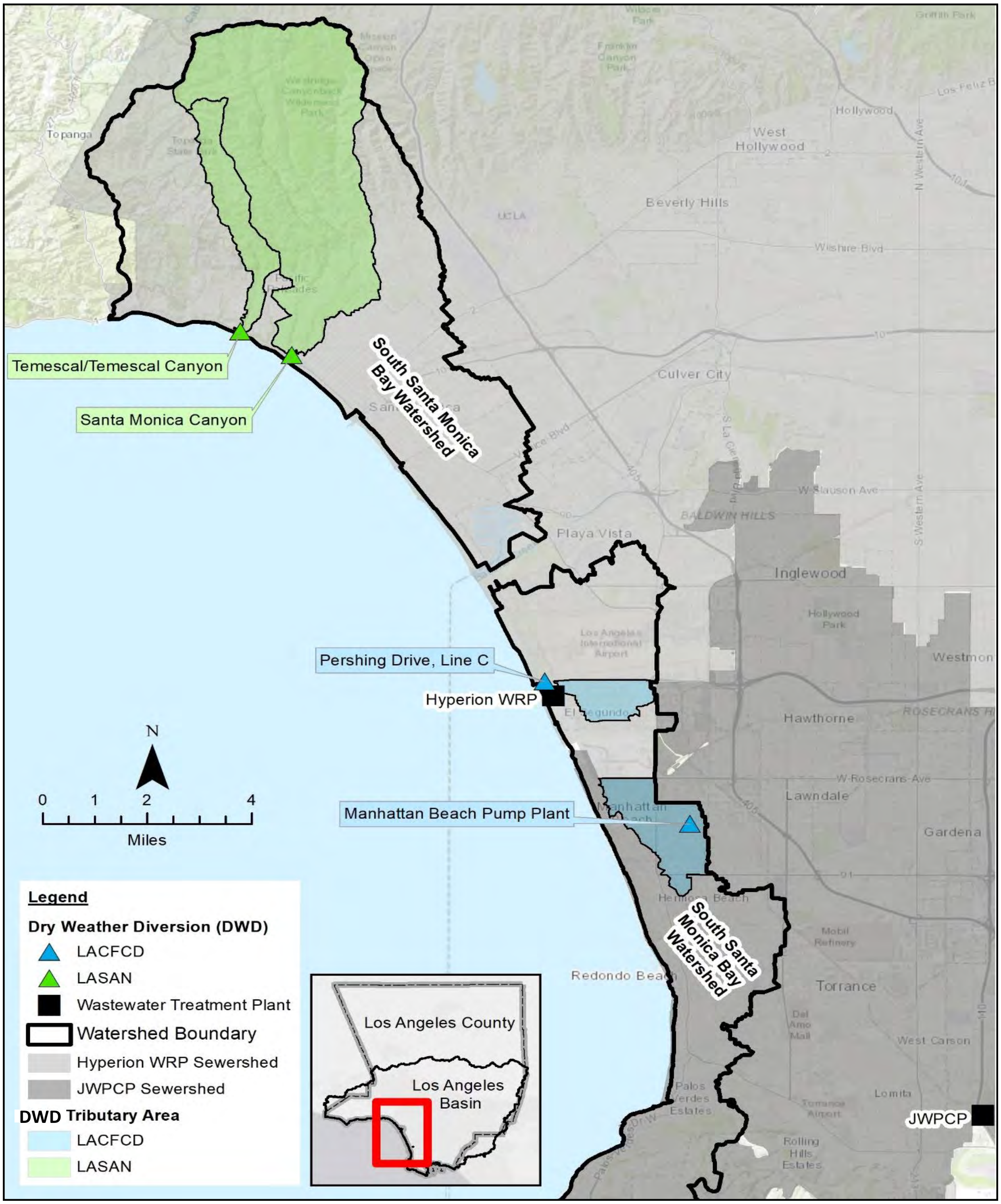


Figure 3-2. Subwatershed of DWDs Selected for Case Studies

Photo 3-1. Pershing Drive DWD; Photographs taken during October 22, 2019 Site Visit with LACFCD Staff

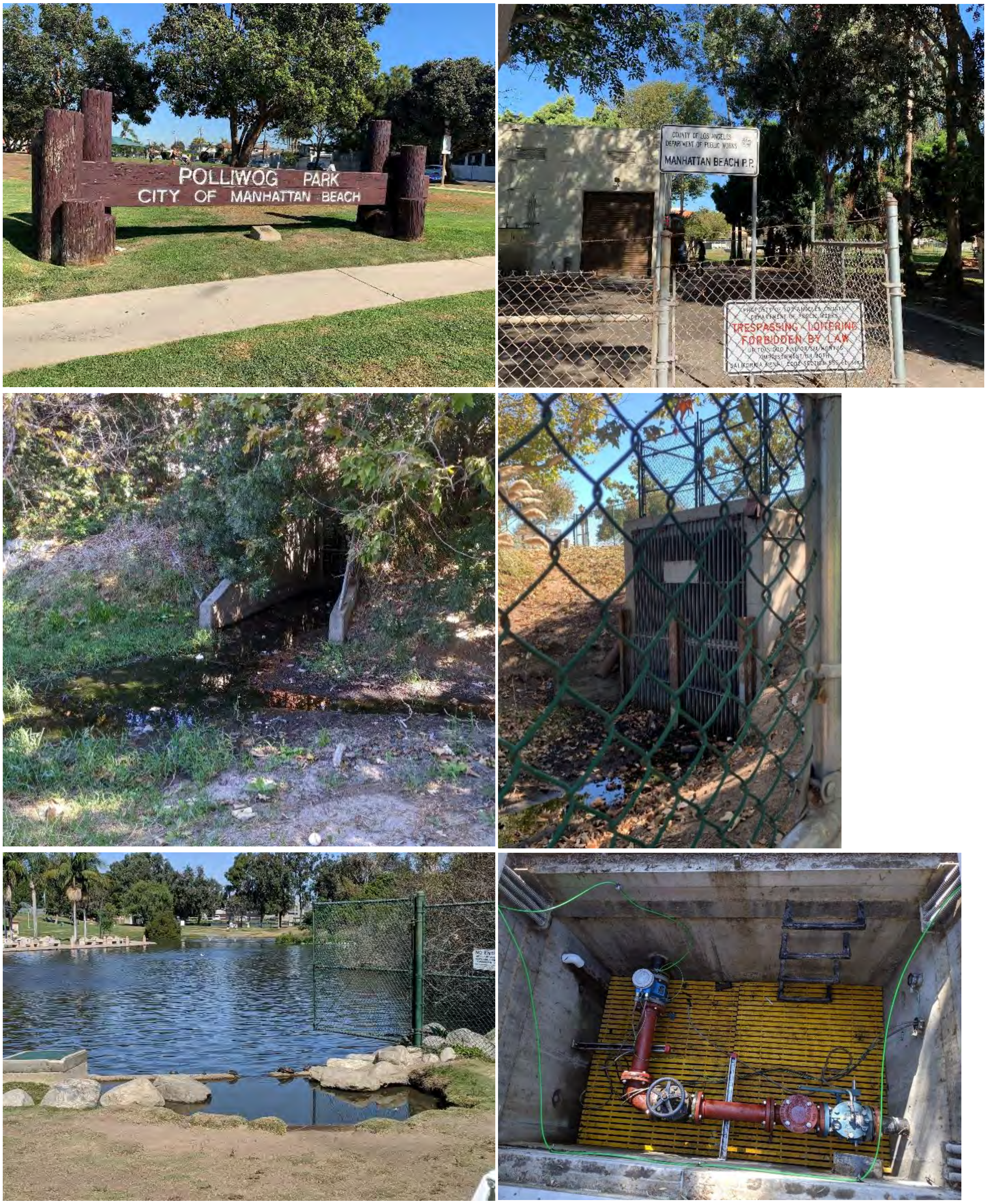


Photo 3-2. Manhattan Beach Pump Plant DWD and Storage at Polliwog Park Pond; Photographs taken during October 22, 2019 Site Visit with LACFCD Staff

Photo 3-3. Santa Monica Canyon DWD; Photographs taken during October 15, 2019 Site Visit with LASAN Staff

Photo 3-4. Temescal/Temescal Canyon DWD; Photographs taken during October 15, 2019 Site Visit with LASAN Staff

3.4 Conclusions and Next Steps

Based on the data collected and analysis described in Sections 1 and 2, factors used for considering the efficacy of DWDs for conversion to WWDs were developed and discussed. The efficacy factors include good data availability, the presence of a rainfall gauge in the tributary area, the DWD's storage area, DWDs with reasonable available discharge capacities, sanitary sewer system capacities, proximity to WRPs, available WRP treatment capacities, and DWD expansion potential. The efficacy factors and an additional set of selection criteria were used to guide the selection of four case studies for testing the efficacy of converting DWDs to WWDs.

Figure 3-3 presents the factors that were considered to select four DWDs case studies. These factors provided a process for screening which DWDs have the potential for conversion to WWDs.

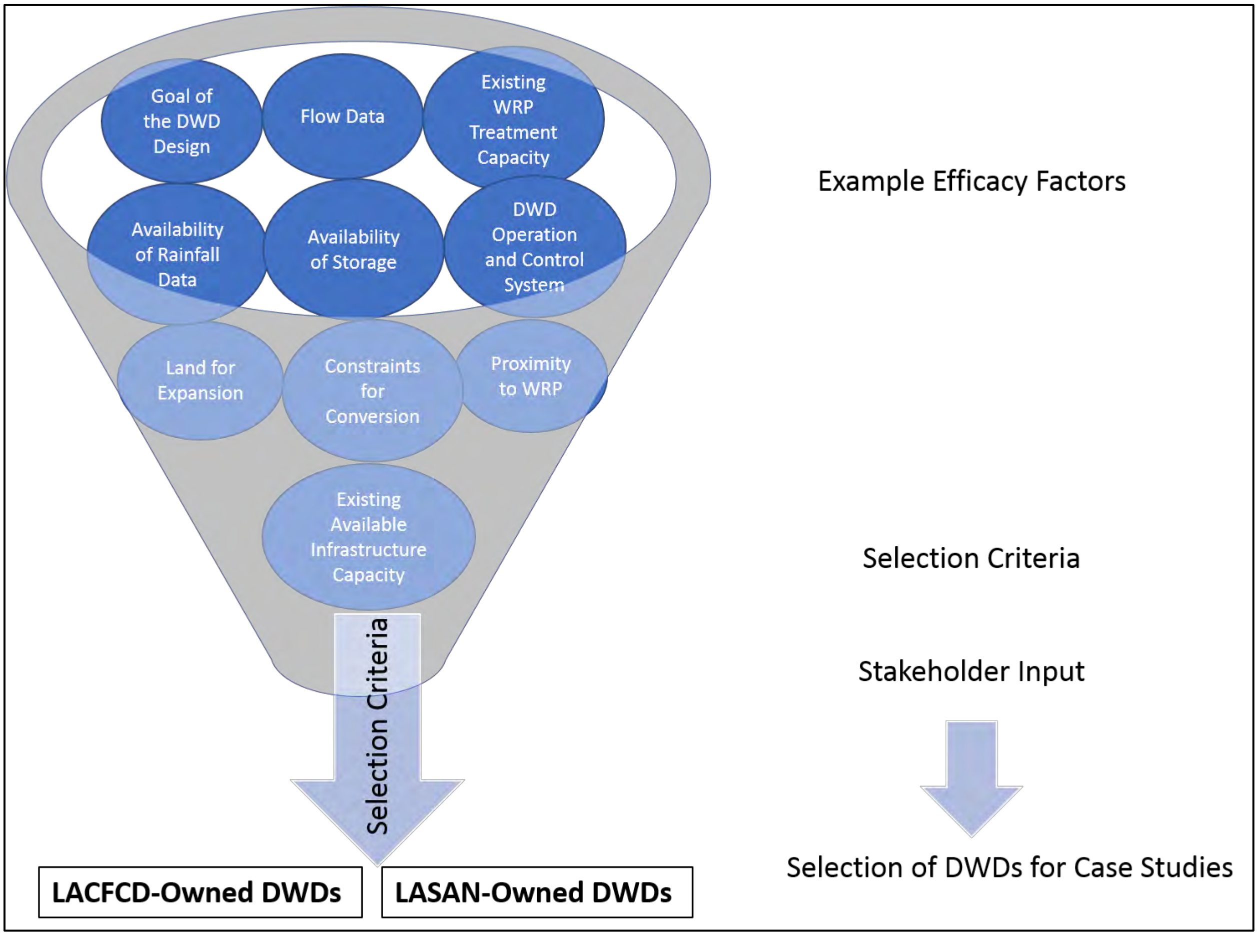


Figure 3-3. Steps for Selection of DWDs for Case Studies

The following four DWDs were selected by LACFCD and LASAN for case study analysis:

1. Pershing Drive (LACFCD)
2. Manhattan Beach PP (LACFCD)
3. Santa Monica Canyon (LASAN)
4. Temescal/Temescal Canyon (LASAN)

These DWDs represent the following variabilities:

- Four tributary locations with variable land uses along the SMB watersheds
- Discharge to different WRPs; for example, the SMC, Temescal Canyon, and Pershing Drive DWDs discharge to the Hyperion WRP, and the Manhattan Beach PP DWD discharges to the JWPCP
- Flow data available for long periods of time
- Location at an existing PP and with a storage component (Manhattan Beach PP)
- Location next to the Hyperion WRP (Pershing Drive DWD)

3.5 References

CH2M HILL Engineers, Inc. (CH2M). 2018. *Phase 1 White Paper: Tapping into Available Capacity in Existing Infrastructure to Create Water Supply and Water Quality Solutions*. Prepared for Las Virgenes Municipal Water District. https://www.lvmwd.com/your-water/water-supply-conditions/white-papers

Section 4. Case Studies of Dry Weather Diversions

4.1 Introduction

The stakeholders for this study selected four unique case-study DWDs representing various operational conditions, based on a range of selection criteria presented in Section 3. Two of the selected DWDs (Pershing Drive and the Manhattan Beach PP) are owned/operated by the LACFCD and the other two (SMC and Temescal Canyon) are owned and operated by the LASAN. All of the selected DWDs divert dry weather flows from the storm drain system to the sanitary sewer system leading to the Hyperion WRP, except the Manhattan Beach PP DWD, which discharges to the JWPCP.

The purpose of this section is to document the analysis performed for the selected four DWD case studies to examine the operations of DWDs during dry weather to help guide planning-level efforts for optimizing the use of existing DWDs and sanitary sewer system infrastructure to manage additional dry and wet weather runoff. The case studies are intended to serve as references or examples to assess the feasibility of each diversion to divert additional dry weather flows beyond the (existing) capacity to handle the year-round dry weather runoff, and to explore the potential to capture wet weather runoff.

Figure 4-1 shows the approach adopted for the analysis. Table 4-1 presents the steps used in this analysis approach, along with the tasks performed for the case-study DWDs (described in this section). Note, the high-level sanitary sewer system capacity analysis under wet weather was provided by the LASAN and LACSD for the DWDs discharging to their respective sanitary sewer system systems.

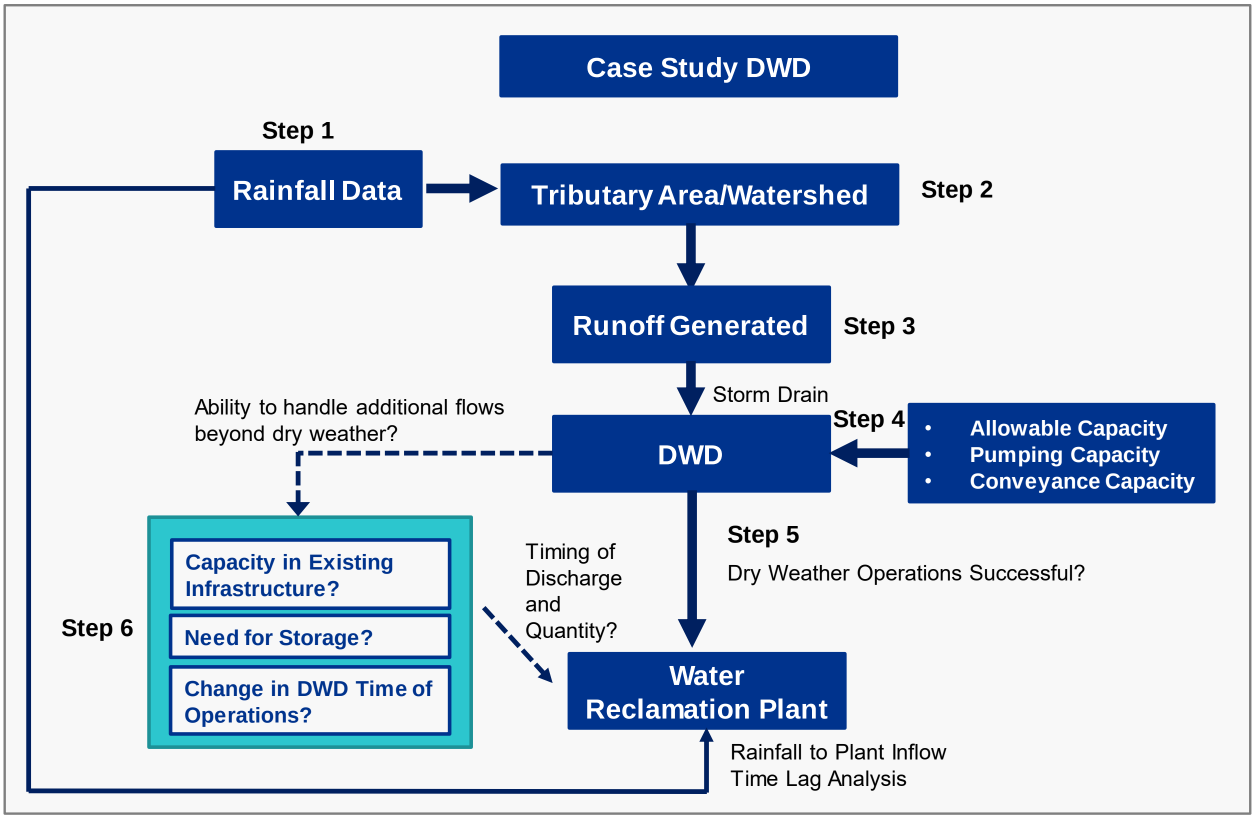


Figure 4-1. Conceptualization of the Analysis Steps used for the Case-study DWDs

Table 4-1. Summary of the Tasks Conducted for Performing Steps Identified in the Analysis Conceptualization

Step	Description	Tasks Performed
1. Rainfall analysis	Conduct rainfall data analysis for rain gauges in the tributary area of the DWD subwatershed and WRP sewershed	▪ Identify rain gauges in the tributary area of case-study DWD locations ▪ Evaluate the quality of available rainfall data ▪ Assess the validity of the rainfall gauge related to the WRP service area ▪ Conduct the rainfall data analysis (for example, intensity, frequency, and duration) ▪ Evaluate the 85^{th} percentile of the 24-hour rain event ▪ Evaluate rainfall intensity from the first flush/first storm event of a season
	Evaluate rainfall-impacted flow travel time from the DWD location to the WRP	▪ Understand the impact of temporal and spatial variability of rainfall on WRP inflows where the subwatershed and WRP service area overlaps ▪ Estimate the rainfall induced (stormwater/wastewater) flow travel time to the WRP
2. DWD tributary area analysis	Assess the DWD tributary area and land uses, and map the storm drain network	▪ Delineate the tributary subwatershed of the DWD ▪ Map land uses in the subwatershed ▪ Map the storm drain network in the DWD subwatershed
3. Rainfall-runoff analysis	Evaluate rainfall-induced runoff for the DWD drainage area	▪ Expand LA County's WMMS modeling timeframe to include the period from 2012 through 2019 ▪ Represent tributary areas of the case-study DWD under the WMMS modeling framework ▪ Calculate rainfall-induced runoff generated in the subwatershed
4. DWD capacity analysis	Evaluate the discharge capacity of the DWD	▪ Assess the capacity of the DWD with existing infrastructure, including the capacity of the sanitary sewer system to handle flows beyond dry weather flows ▪ Understand the operations of the DWD under various flow conditions ▪ Evaluate constraints and opportunities in delivering flow in the current conditions
	Pumping analysis at the VPP	▪ Assess the historical pumping at the VPP, which is the central pumping station that pumps sewer flow from SMB to the Hyperion WRP ▪ Identify constraints in the current conditions ▪ Develop a plan for increasing pumping capacity
	Sanitary sewer system analysis	▪ Evaluate sanitary sewer system capacity when the DWD under consideration is only discharging non-stormwater to the sanitary sewer system during a dry weather period (that is either no rainfall period) (for the LASAN systems) or up to 0.1 inch per day of rainfall (for the LACFCD systems). ▪ Identify limitations for conveying more flows during a wet weather period

Table 4-1. Summary of the Tasks Conducted for Performing Steps Identified in the Analysis Conceptualization

Step	Description	Tasks Performed
		▪ Determine potential solutions at high-flow conditions and provide recommendations
5. DWD performance analysis	Evaluate the performance of the DWD	▪ Determine DWD flows under dry weather operations ▪ Evaluate challenges and opportunities ▪ Identify lessons learned from the operation of the DWD
6. Potential wet weather flow capture analysis	Assess existing infrastructure capacity to deliver flows beyond dry weather to the WRP	▪ Evaluate the operations of the WRP from historical inflow data ▪ Determine rainfall in the WRP service area and response through inflow in the WRP ▪ Assess the capacity of the entire system (including the sanitary sewer) to deliver flows higher than the dry weather flows ▪ Identify the need for potential operational changes for DWDs ▪ Develop next steps

Note:
WMMS = Watershed Management Modeling System

This section is organized as follows:

- Section 4.1 – Introduction
- Section 4.2 – Rainfall Data Analysis
- Section 4.3 – Rainfall Impact on WRP Flow Analysis
- Section 4.4 – Dry Weather Case Studies
- Section 4.5 – Conclusions and Recommendations
- Section 4.6 – References

Earlier sections presented a high-level description of the operations of all DWDs in the Los Angeles Basin, based on the information collected and the feedback received from the stakeholders. This section provides a detailed analysis of the selected four case-study DWDs, including various components of the wastewater system, such as sanitary sewer system and treatment plant capacity, with a focus on understanding the feasibility of capturing wet weather runoff under various rainfall conditions.

4.2 Rainfall Data Analysis

This section provides the details of the rainfall variability near the DWD case study projects. It also includes a rainfall intensity-frequency analysis for two rain gauges to serve as a references and examples. These provide an understanding of the depth and frequency of the storm events that occurred in the last 10 years, to assess the possibility of managing wet weather runoff with the existing DWD infrastructure related to the capacity and operations of the sanitary sewer system and WRPs. This section also includes the first-flush analysis to understand the timing and the rainfall depth of the historical first-flush events of the season

4.2.1 Rainfall Gauges and the Dry Weather Diversion Case-study Locations

Rainfall influences flows in storm drains and DWDs. To conduct the assessment of stormwater generated from a subwatershed draining into the DWDs, data from suitable rainfall gauges (out of many gauges) were selected. Each gauge was selected based on its proximity to the DWD and the WRP service areas or sewersheds (that is, the Hyperion WRP and the JWPCP). Rainfall data from the Automated Local Evaluation in Real Time (ALERT) gauges operated and maintained by LA County were collected. To select an appropriate gauge for the flow analysis, rainfall depths at a few gauges were compared.

To understand the impact of variability in rainfall across the WRP service area, the Hyperion WRP influent flow data and rainfall data recorded at Gauges AL461 and 716 were compared.

Figure 4-2 shows the comparison of annual total rainfall depth at various gauges near the case-study DWDs from 2008/9 through 2018/19. This analysis was targeted to identify the variability of rainfall during various hydrologic conditions. The severe drought period in Southern California in recent years can be seen in the rainfall data. Generally, rainfall data for all gauges were complete for most of the 10-year period, with a few exceptions.

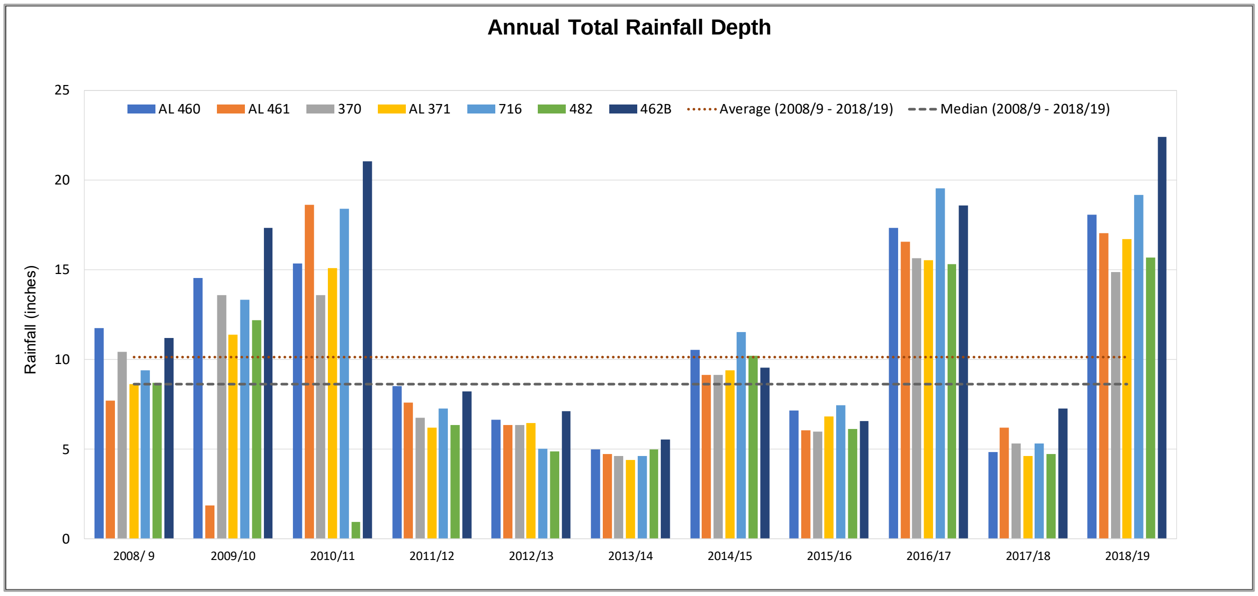


Figure 4-2. Annual Total Rainfall Depth at Selected Rain Gauges

As Figure 4-2 shows, the annual total rainfall depth was seldom close to the average annual depth of 10.1 inches for this period. Years 2011/12 through 2013/14, 2015/16, and 2017/18 were drier than wet years 2010/11, 2016/17, and 2018/19. The annual total rainfall depth in wet years for all gauges was greater than the median rainfall depth of 8.62 inches. Note, the median annual rainfall depth is less than the average annual rainfall depth for the period of analysis.

In this analysis, rain gauges in downtown Los Angeles (716) and at the University of Southern California were also included to understand the variability in rainfall across the WRP service areas, and the effect on the Hyperion WRP operations. Figure 4-3 shows the locations of these two gauges used for the analysis, as well as the other ALERT rainfall gauges.

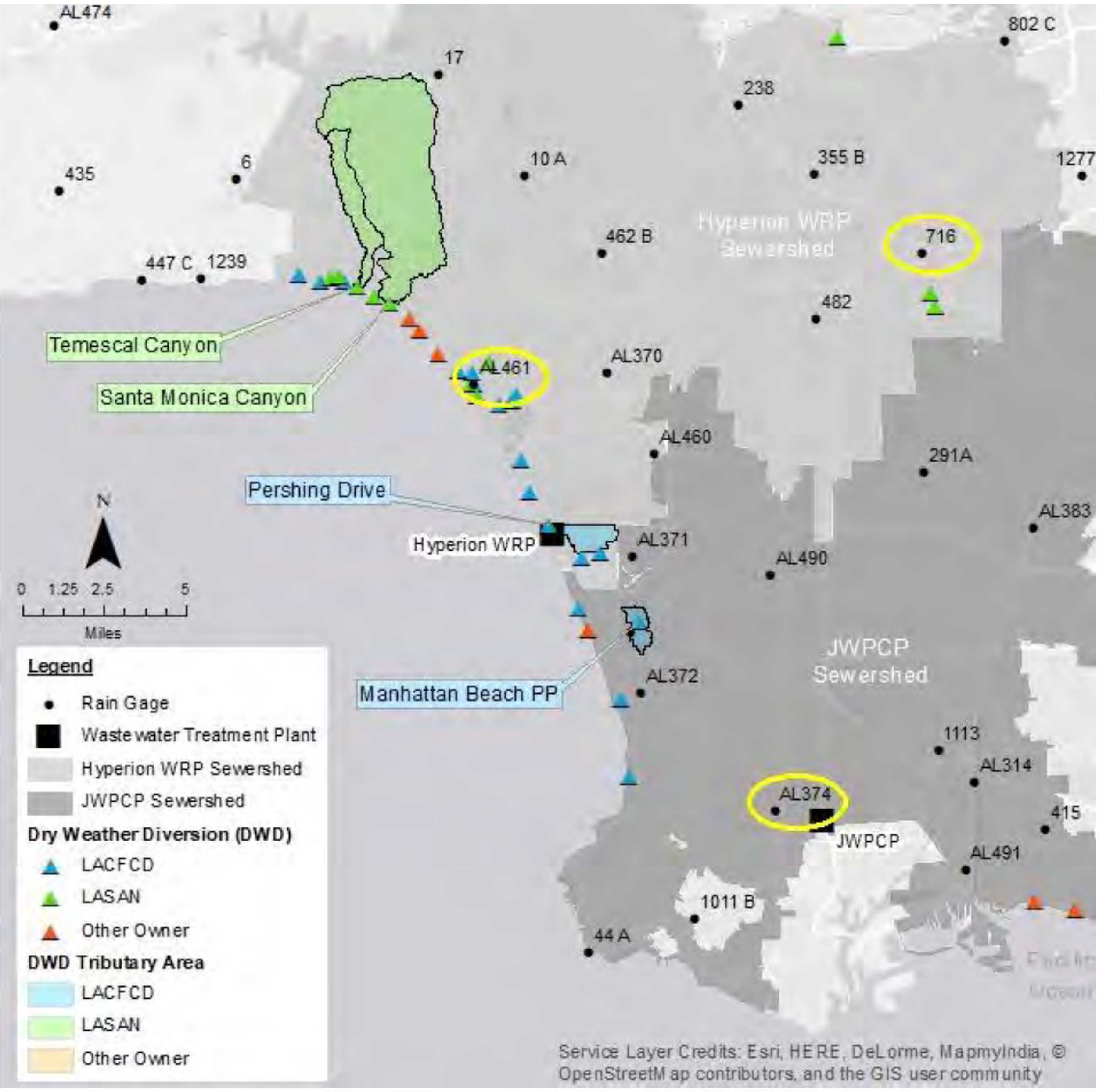


Figure 4-3. Rainfall Gauges, the Hyperion WRP and the JWPCP Service Areas, and the Location of Case-study DWDs

The rain gauges circled on Figure 4-3 were used to analyze flow travel time from the DWD subwatershed to the Hyperion WRP (as discussed in Section 4.3). Similarly, rainfall gauges in the JWPCP service area were used to determine the travel time of the wet weather runoff generated in the sanitary sewer system to the JWPCP via DWDs. Rainfall data were also used in the WMMS model to simulate runoff generated from the DWD subwatersheds.

4.2.2 Rainfall Data Pattern

The rainfall gauge data present the high-resolution spatial representation of meteorological patterns in the vicinity of the SMB subwatershed, where the case-study DWDs are located. Rainfall data from two gauges (that is, 716 and AL461) were further analyzed and used to evaluate rainfall-induced runoff from the DWD tributary subwatershed drainage area. The response of rainfall on the Hyperion WRP influent flows and the wet weather runoff travel time through the sanitary system to the inflow of the Hyperion WRP were also evaluated from these two rainfall gauges' data. Figure 4-4 shows an example of the variations in the total daily rainfall depth at these two gauges from 2010 through 2019. Maximum recorded daily rainfall depths at Gauges 716 and AL461 were 2.4 and 2.6 inches, respectively. These events occurred in 2010 and 2011. Note, daily rainfall is one of the primary criteria for this analysis, because the DWD flows and the WRP influent flows are analyzed on a daily scale.

The rainfall data obtained from a gauge suitably located in a service area can help optimize the DWD operation. In all practical applications, the watershed and sewershed overlap. For example, it can help to prioritize the areas for routing/handling of sewer flows in the sanitary sewer systems to the treatment plants. Historically, the daily rainfall peaked between 2.0 and 2.5 inches, with the maximum at 2.53 inches in January 2011. In January 2017, the rainfall peaked to 2.35 inches. Both of these peaks caused a considerable surge in the Hyperion WRP influent flows, which includes rainfall-derived inflow and infiltration (RDI/I). Within the past 10 years, these periods of peak events were the most stressful periods for the sanitary sewer system, along with the treatment plant operations. To understand the most stressful condition of the sanitary sewer system, the wet weather runoff along with flow caused by RDI/I in the subwatershed and the flow recorded at the WRPs during these two peak rainfall events are compared and presented in Section 4-3.

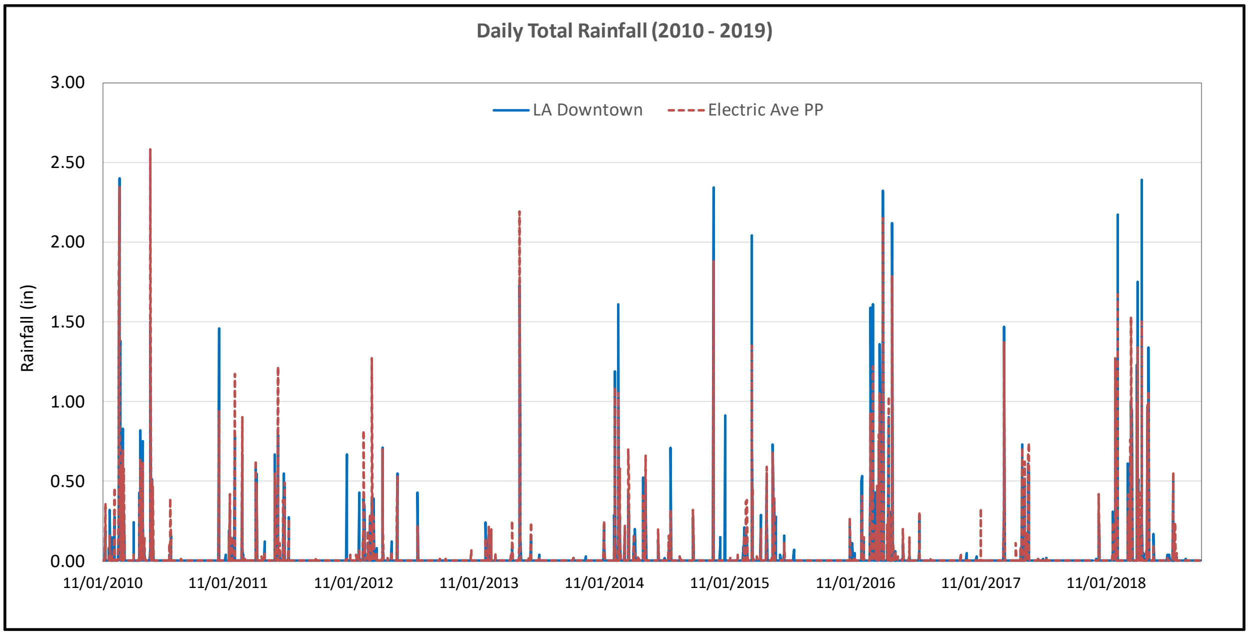


Figure 4-4. Daily Total Rainfall Depth at LA Downtown (Gauge 716) and Electric Ave PP (Gauge AL461)

The following sections discuss the rainfall data analysis for a few gauges that are applicable for the DWD case studies. The goal of this analysis is to understand the depth and frequency of the storm events that occurred in the last 10 years, to assess the possibility of managing wet weather runoff with the existing DWD infrastructure related to the capacity and operations of the sanitary sewer system and WRPs.

4.2.3 Rainfall Intensity Frequency Analysis for Gauge AL461

To determine the size of storm events, rainfall data were analyzed from Gauge AL461 for the period from October 1, 2008, through August 20, 2019. Figure 4-5 summarizes the rainfall depth and frequency analysis for the rainfall data collected at this gauge from 2008 through 2019. During this period, rainfall varied between 0.01 and 3 inches. Over the entire duration, 92 percent of days were dry days when no rain was detected, and 8 percent of days (that is, 327 days out of a total of 4,240 days) were days when rain was detected. In the context of this analysis, 327 days with rain are referred to as wet days for the LASAN-operated DWD systems. Out of 11 years of data, 154 days (that is, 47 percent) recorded 0.1 inch of rain or less. The LACFCD-owned DWDs discharged to the sewer system during 47 percent of the days with up to 0.1 inch of rainfall. Therefore, under existing conditions, the remaining days are 173 days (or 53 percent of total rainfall days during the 11-year period).

Figure 4-5 presents the rainfall frequency distribution under various sizes of rain events. This histogram captures the range of storm events, with varying rainfall magnitudes within the historical 11 years of rainfall records. Up to 80 percent of the recorded rainfall depth was less than 0.5 inch (Table 4-2). Also, 92 percent of days had 1 inch or less of rain, which is 301 days out of the total of 327 wet days. The maximum rainfall depth of approximately 3 inches was recorded for only 5 of the 327 wet days.

Table 4-2. Summary of Rainfall Depth and Frequency from 2008 to 2019 for Gauge AL461

Rainfall Depth (inch)	Occurrence (Days with Rainfall)	Percent of Total Wet Days	Cumulative Percent
0.01 – 0.1	154	47.1	47.1
0.1 – 0.3	73	22.3	69.4
0.3 – 0.5	36	11.0	80.4
0.5 – 0.7	22	6.7	87.2
0.7 – 1.0	16	4.9	92.1
1.0 – 1.5	16	4.9	96.9
1.5 – 2.0	5	1.5	98.5
2.0 – 3.0	5	1.5	100.0

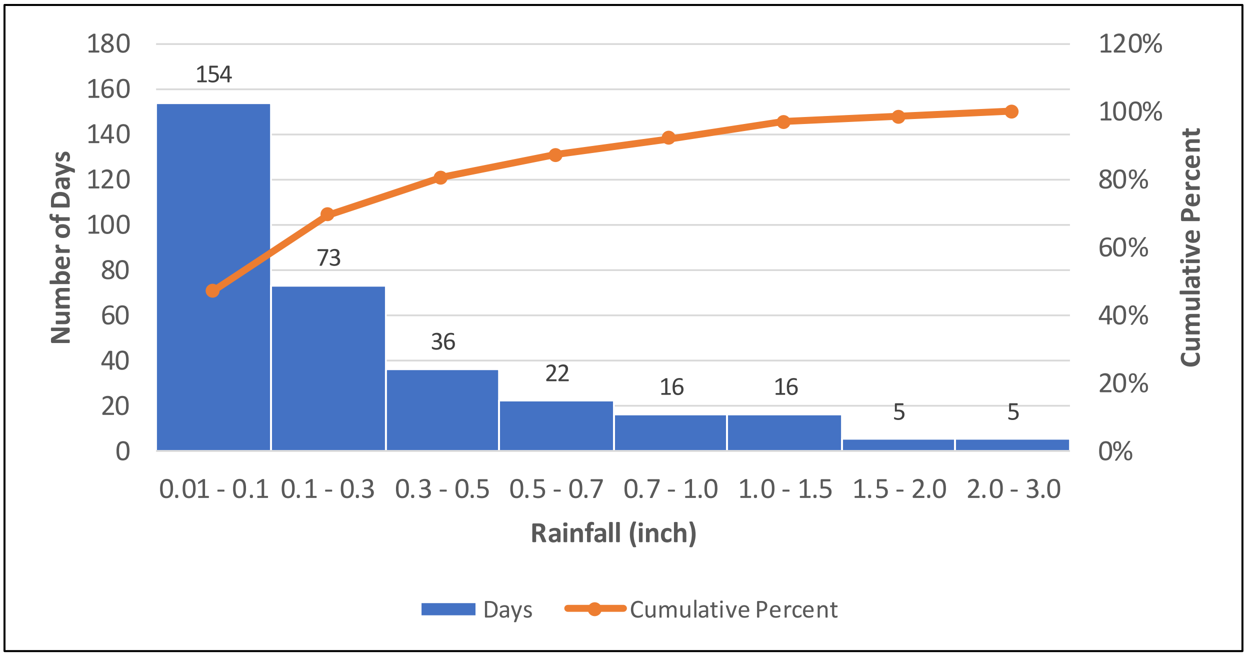


Figure 4-5. Daily Total Rainfall Depth Frequency Histogram for Gauge AL461

4.2.4 Rainfall Depth Frequency Analysis of Gauge AL374

To determine the depth of rainfall events in the SMB subwatershed and within the JWPCP service area, data from Gauge AL374 were analyzed for the period from January 23, 2009, through May 26, 2019 (Figure 4-3). Over the entire duration, 91 percent of days were dry days when no rain was detected, and 9 percent of days (that is, 343 days out of a total of 3,775 days) were wet days. Out of a total of 343 days with rainfall, 147 days or 43 percent of rainfall days had rainfall up to 0.1 inch. The wet days are the 196 days, or 57 percent of rainfall. Table 4-3 provides the rainfall intensity and frequency analysis for those wet weather days.

A total of 343 wet days had rainfall varying between 0.01 and 4 inches. Up to 93 percent of the recorded rainfall days had rainfall intensity up to 1.0 inch under various rainfall events (Table 4-3). Figure 4-6 shows the rainfall intensity frequency histogram with cumulative rainfall intensity under various rainfall-intensity bin sizes. The rainfall depth between 2.0 and 4.0 inches was recorded for 4 out of the 343 rainy days.

Table 4-3. Rainfall Intensity and Frequency Data from 2009 to 2019 for Gauge #374

Rainfall Depth (inch)	Occurrence (Days with Rainfall)	Percent of Total Wet Days	Cumulative Percent
0.01 – 0.1	147	42.9	42.9
0.1 – 0.2	62	18.1	60.9
0.2 – 0.5	59	17.2	78.1
0.5 – 1.0	50	14.6	92.7
1.0 – 1.5	15	4.4	97.1
1.5 – 2.0	6	1.7	98.8
2.0 – 4.0	4	1.2	100.0

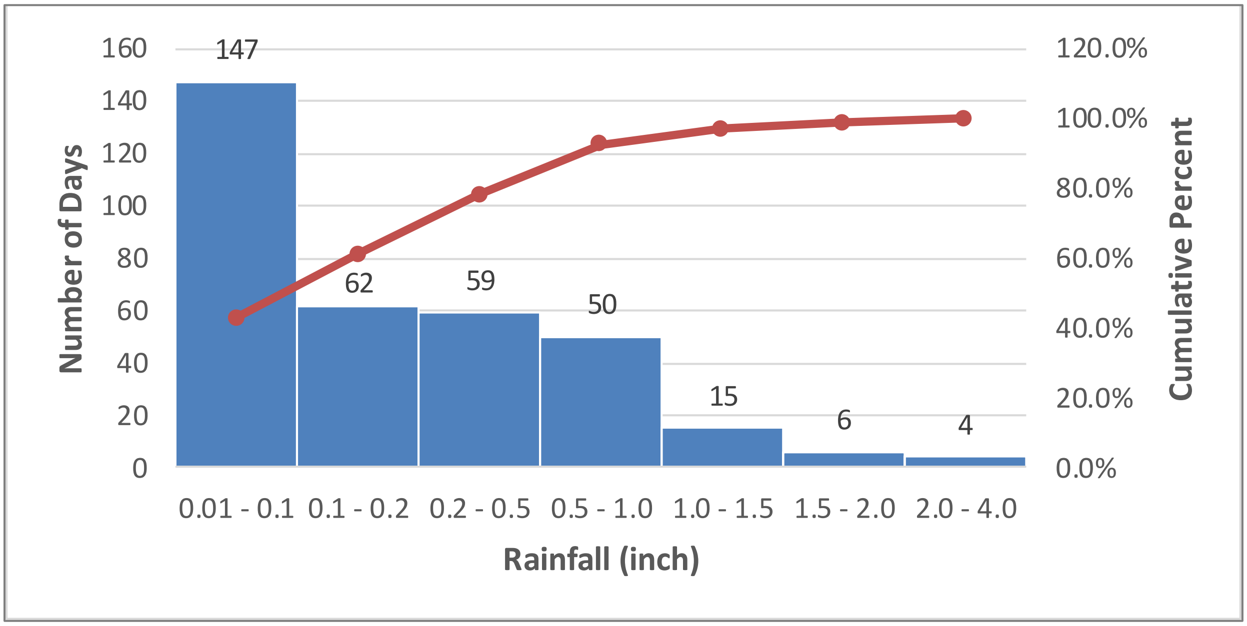


Figure 4-6. Histogram of Daily Total Rainfall Depth from 2009 to 2019 at Gauge AL 374

The rainfall intensity frequency analysis for these gauges suggests that the smaller rainfall events (for example, less than 0.5 inch of rainfall) are predominant in the DWD drainage area. The maximum rainfall depth was between 3 and 4 inches for the DWD subwatershed that discharge to the Hyperion WRP and the JWPCP, respectively.

4.2.5 First Flush/First Rainfall Event of the Season

For this analysis, the first-flush effect describes the initial part of a storm event, whereby buildup of constituents during dry periods are flushed by rain after a long, dry period. It is believed that the runoff generated in the beginning of a rainfall event is the most concentrated, because it collects pollutants through the washing of subwatershed and roads, and buildup of pollutants from impervious surfaces. The concentration of pollutants in the first flush varies by the size of the storm event and by pollutant. The amount of pollutants in the first flush varies by subwatershed and depends on the intensity and duration of the storm event, the size of the subwatershed, the amount of the impervious area, and the duration of the dry weather period. Studies conducted by the SCCWRP showed that the concentration of pollutants (for example, suspended solids [SS], total and dissolved metals, and polycyclic aromatic hydrocarbons) in urban runoff were consistently greater at the beginning of a storm event than later in the event (Tiefenthaler and Schiff, 2002).

Based on the rainfall dataset, the rainfall intensity of the first rainfall event of a season was evaluated from long-term historical rainfall data to understand the first-flush volume. The purpose of first-flush intensity analysis was to understand: (1) the timing (for example, the month) when the first rainfall event occurred after a long summer dry period, and (2) the depth of the first measurable rainfall event (greater than 0.1 inch) of the season.

4.2.5.1 First Flush Event Recorded by the Los Angeles Downtown (716) Rain Gauge

To identify the rainfall intensity of the first events of the season, rainfall data from the last decade were analyzed for Rainfall Gauge 716 for the period from 2010 to 2019. The example rainfall events with greater rainfall depths were selected from the following wet weather periods:

- Rain Event No. 1: October 2010 to June 2011
- Rain Event No. 2: October 2014 to June 2016
- Rain Event No. 3: October 2016 to June 2017
- Rain Event No. 4: October 2018 to June 2019

Rain Events No. 1 and 3 represent wet periods out of 10 years of data, and the other two events were randomly selected. Figure 4-7 presents the daily total rainfall intensity distribution of four selected rainfall events, which occurred between 2010 and 2019. Based on the rainfall data for these events, the rainfall depth of the first event of the season varied between 0.22 and 0.48 inches. In general, the first significant event of the season occurred in October. In general, 6 months (April through September) before the first flush event make up the prolonged dry period when there is little to no rain in the subwatershed.

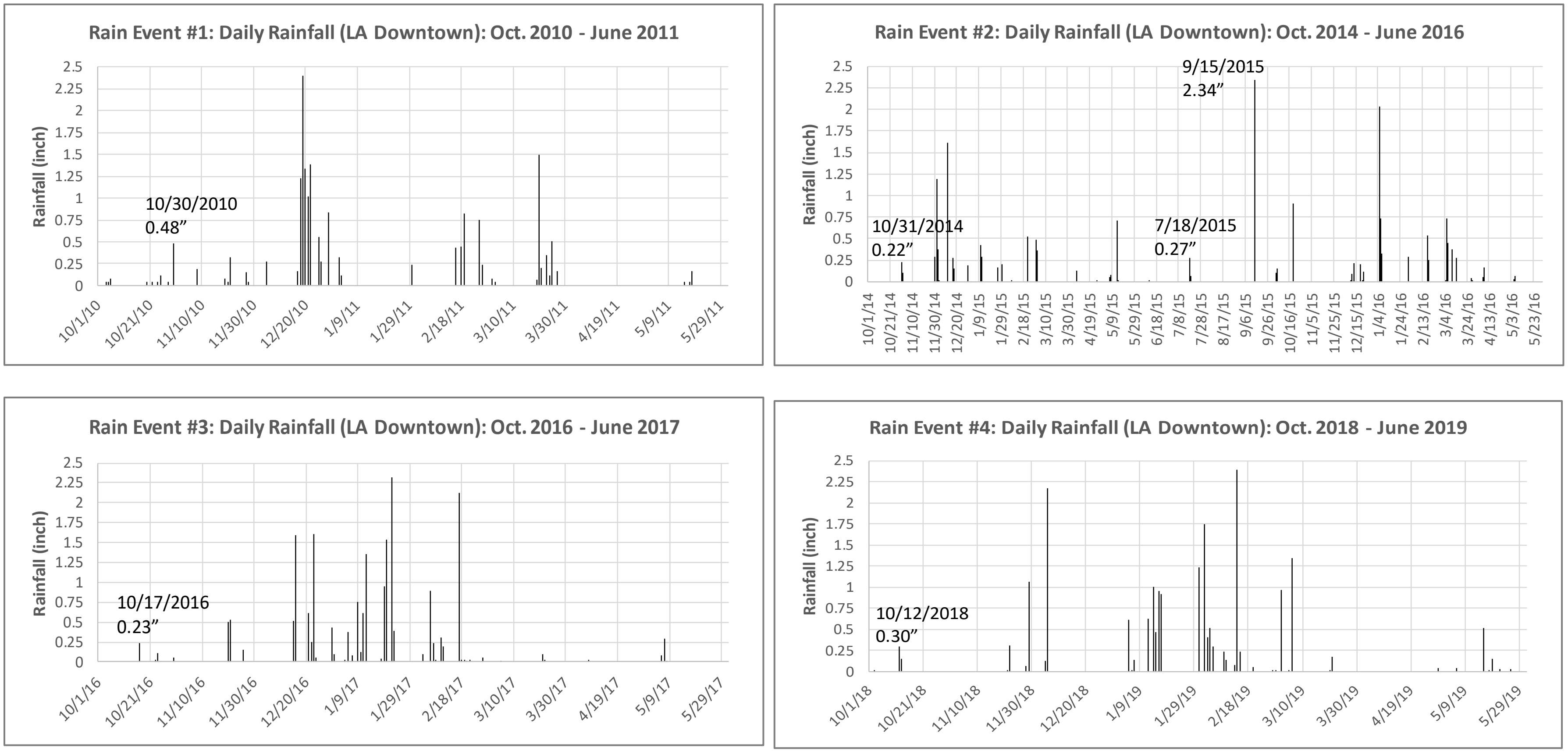


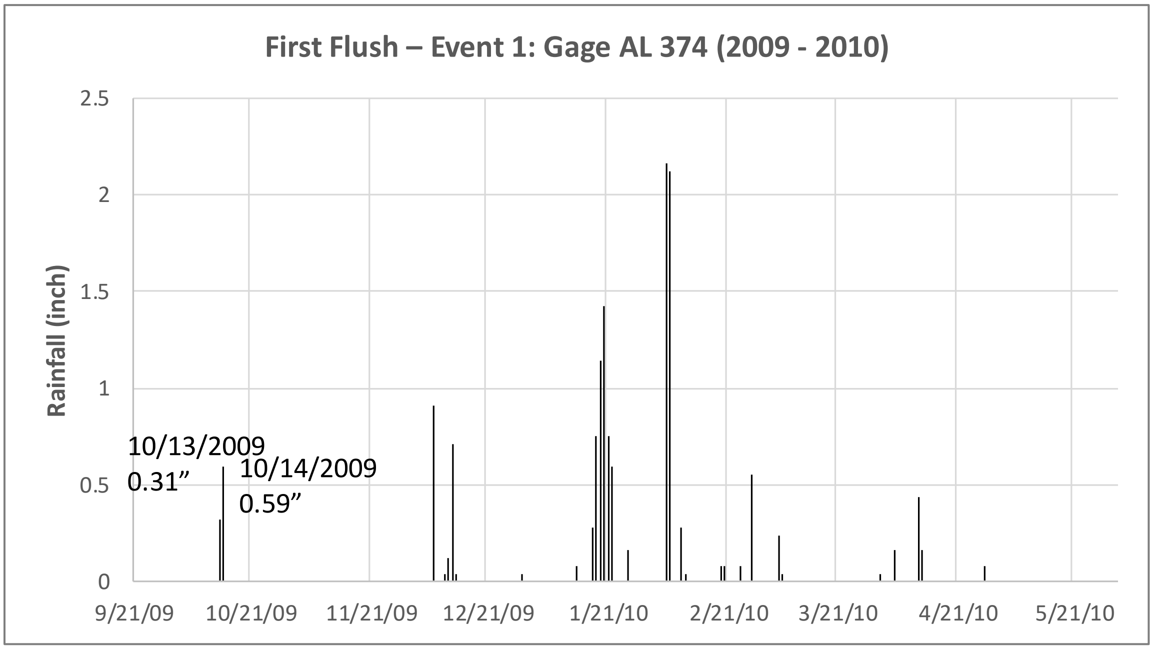
Figure 4-7. Rainfall Depth of Four Selected First Flush/Events at the Los Angeles Downtown Gauge 716

4.2.5.2 First Flush Event Recorded by the AL374 Rain Gauge

For Gauge AL374, which is in the JWPCP service area, a similar analysis took place for the first flush event of the season. Rainfall periods with rainfall depths greater than other years were analyzed for the period from 2009 to 2019. The example rainfall periods selected for the analysis are the following:

- Rain Event No. 1: October 2009 to June 2010
- Rain Event No. 2: October 2016 to June 2017

Figure 4-8 presents a rainfall depth distribution plot of the two selected rain events for Gauge AL374. The rainfall intensity of the first event of the season varied between 0.31 and 0.33 inch. In general, the first flush event occurred in October/November.



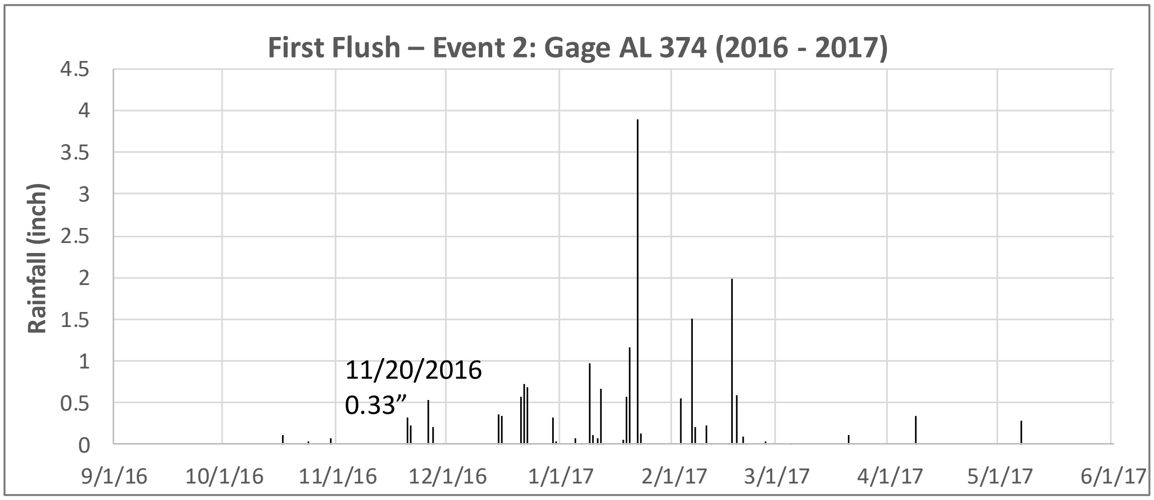


Figure 4-8. Rainfall Depth of the Two Selected First Flush/Events at Gauge AL374

4.2.6 85th Percentile 24-hour Rainfall in the Dry Weather Diversion Case-study Tributary Areas

The analysis conducted by LA County shows that the 85th percentile, 24-hour rainfall depths vary from 0.30 to 1.50 inches within Los Angeles County (Los Angeles County Public Works, 2004). The County's analysis was based on long-term rainfall data for over 90 rainfall gauges, and mapping of 85th percentile, 24-hour isohyets. More rainfall occurs over hills and mountain areas. The areas of higher elevations receive more rainfall due to changes in pressure and temperature.

The 85th percentile, 24-hour rainfall values in the subwatersheds of the four DWD case-study projects were evaluated. County mapping of the 85th percentile, 24-hour rainfall isohyets were overlaid with the DWD case-study subwatersheds. As Figure 4-9 shows, the rainfall depth varies between 0.9 and 1.2 inches in these case-study DWDs areas. For example, the 85th percentile, 24-hour rainfall in Temescal Canyon and SMC DWD subwatersheds varied between 0.9 and 1.1 inches, and between 0.9 and 1.2 inches, respectively. In smaller subwatershed areas like the Pershing Drive DWD and the Manhattan Beach PP DWD, the 85th percentile, 24-hour rainfall depths were 0.9 and 0.8 inch, respectively.

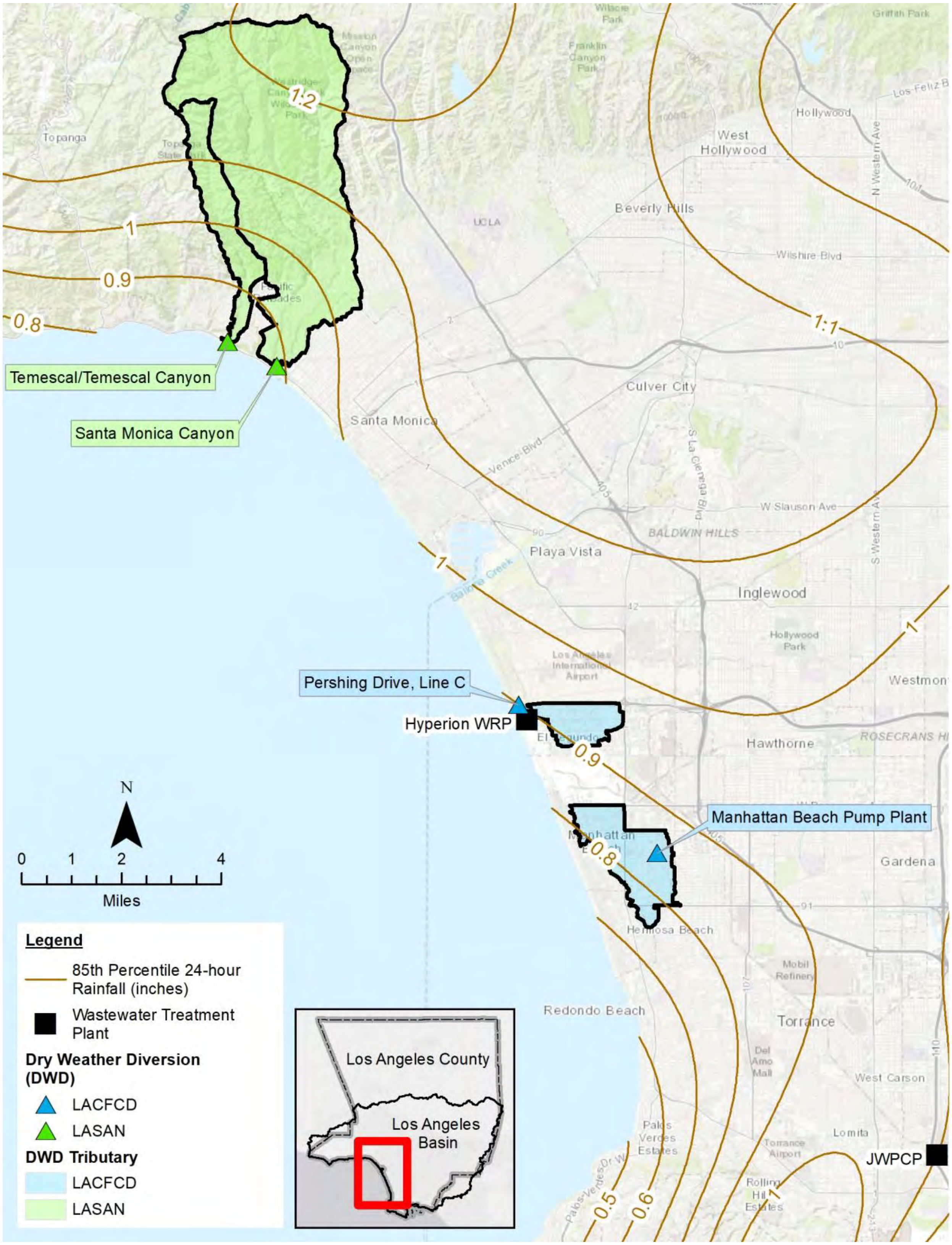


Figure 4-9. The 85th Percentile 24-hour Rainfall Depth Map (Los Angeles County) along with Subwatershed Boundaries of Four DWD Case-study Locations

Source: https://ladpw.org/wrd/publication/engineering/Final_Report-Probability_Analysis_of_85th_Percentile_24-hr_Rainfall1.pdf

4.3 Rainfall Impact on Water Reclamation Plant Flows

This section provides an overview of temporal variations between hourly and daily inflows to the Hyperion WRP and JWPCP. Based on the data availability, influent data were analyzed for the Hyperion WRP from 2010 to 2019, and for the JWPCP from 2012 to 2017. A few example rainfall events and the corresponding WRP influent flows were analyzed to identify: (1) the variability of flows in the service area, (2) the travel time of rainfall-induced flow from the DWD location to the WRP, (3) the sensitivity of the WRP influent flows to rainfall in the subwatersheds, (4) the rainfall intensity that causes flow exceeding the hydraulic capacity of the WRP, and (5) the duration of the flows that exceed the hydraulic capacity of the WRP. Note, this study did not consider the RDI/I. The analysis is presented for three case-study DWD discharges to the Hyperion WRP and one DWD discharge to the JWPCP. The effect of the service area's rainfall on the WRP influent was assessed using example historical rain events and corresponding WRP influent flows. A detailed feasibility for site-specific DWD analysis and the cumulative effect of DWDs on sanitary sewer system is recommended.

4.3.1 Hyperion WRP Influent Flows

Figure 4-10 shows the hourly influent flow recorded at the Hyperion WRP from 2010 to 2019. The dry weather flows show a declining trend in recent years. Generally, hourly influent flows at the Hyperion WRP varied between 107 MGD and 753 MGD, with an average of 265 MGD. Spikes in flows were observed during large rain events when hourly influent flows to the Hyperion WRP and exceeded its 450-MGD design capacity. For example, after the rainfall event of January 21 to 22, 2017, the influent flow to the plant peaked to 634.4 MGD.

The maximum hourly influent flow of 753.1 MGD at the Hyperion WRP was recorded during the rain event of March 20, 2011. The daily rainfall depth of 2.32 and 2.58 inches was recorded at Rainfall Gauges 716 and AL461, respectively, on that day.

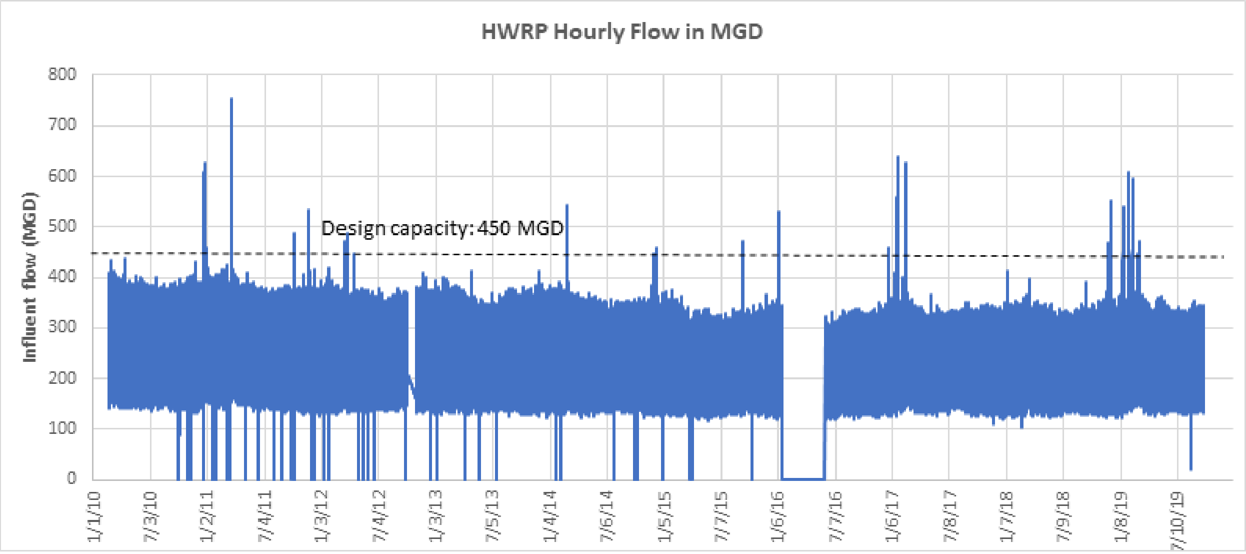


Figure 4-10. Hourly Influent Flows at the Hyperion WRP from 2010 to 2019

Figure 4-11 shows the influent flows at the Hyperion WRP and rainfall depth at Rain Gauge AL 461 for January 2017. The intensity and duration of the storm event affects the influent flows at the Hyperion WRP. The two significant storm events showed increased influent flows, which occurred from January 20 to 22, 2017 (Figure 4-12). On January 20 and 22, the influent flows exceeded the design capacity of 450 MGD for 5 and 9 hours, respectively. The peak hourly flows were 556.6 and 639.3 MGD on January 20 and 22, respectively. The corresponding daily rainfall depths were 1.18 and 2.15 inches, respectively, based on rainfall at Gauge AL461.

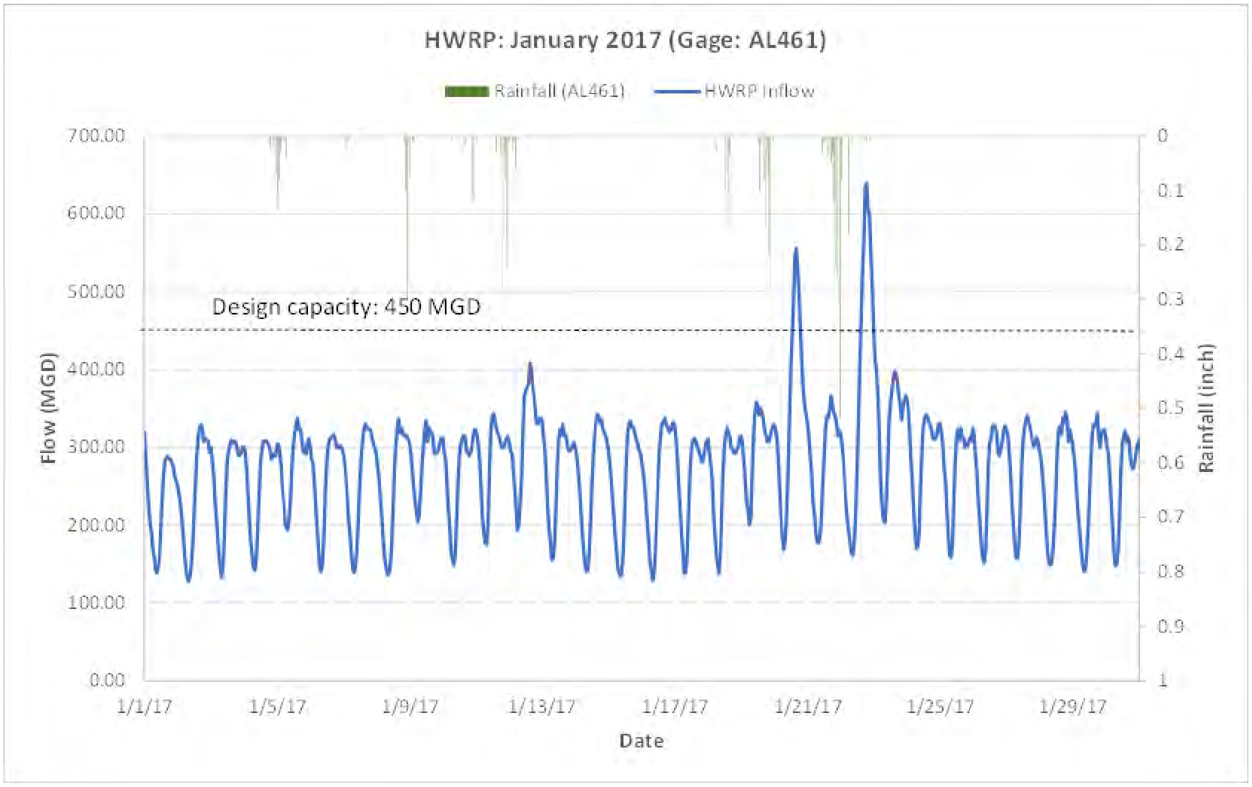


Figure 4-11. Hourly Influent Flow to the Hyperion WRP and Hourly Rainfall during January 2017

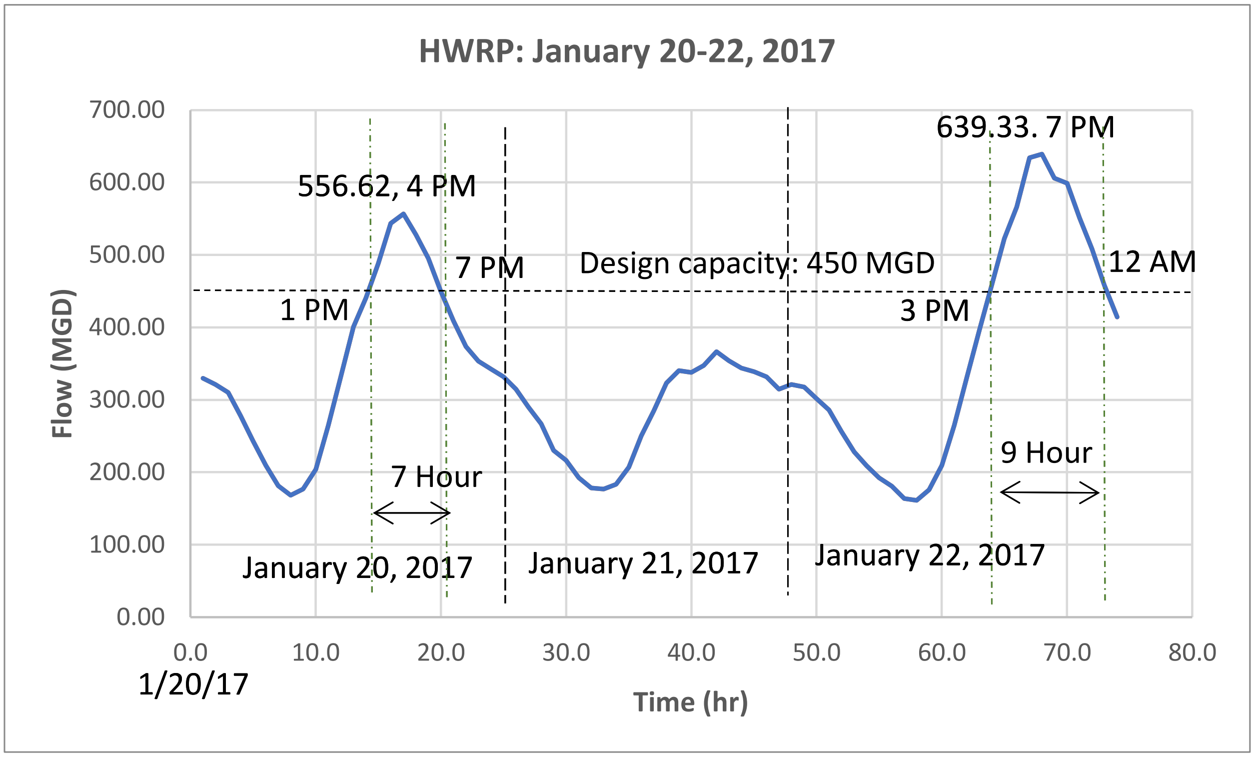


Figure 4-12. Hourly Inflow to the Hyperion WRP from January 20 through January 22, 2017

4.3.2 Influent Flow Sensitivity of the Hyperion WRP in Response to Rainfall

To identify the sensitivity of the influent flows at the Hyperion WRP in response to rainfall in its service area, a month's worth of hourly rainfall datasets was analyzed. Figure 4-13 shows the variability in hourly influent flows at the Hyperion WRP, and the rainfall depth in the month of January 2017. As discussed, the rainfall depth was found to vary across the Hyperion WRP service area. Back-to-back rainfall events in the service area had a significant impact on influent flows at the Hyperion WRP. As Figure 4-13 shows, rainfall events with smaller intensities in the beginning of the month (for example, January 4 to 7) did not show any noticeable impact to the influent flows at the Hyperion WRP. The rainfall event of January 9, 2017 (with 0.3 inch of rain at Gauge AL461) did not significantly impact the peak plant inflow. On January 12, 2017, a 0.36-inch rainfall caused a slight rise in the inflow to 400 MGD from 330 MGD. Here, the noticeable impact in the Hyperion WRP influent from the 0.36-inch rainfall is likely due to the antecedent rainfall on the 3 preceding days. Saturated ground may have increased the amount of RDI/I that reached the plant. The cumulative impact of back-to-rain rain events of the 4 days resulted in a significant increase in the plant inflow.

Similarly, the continuous large storm events of January 19 to 20 resulted in a substantial increase in Hyperion WRP influent flows. A rainfall depth of 0.52 inch produced a peak hourly influent flow of 639.33 MGD on January 22, 2017.

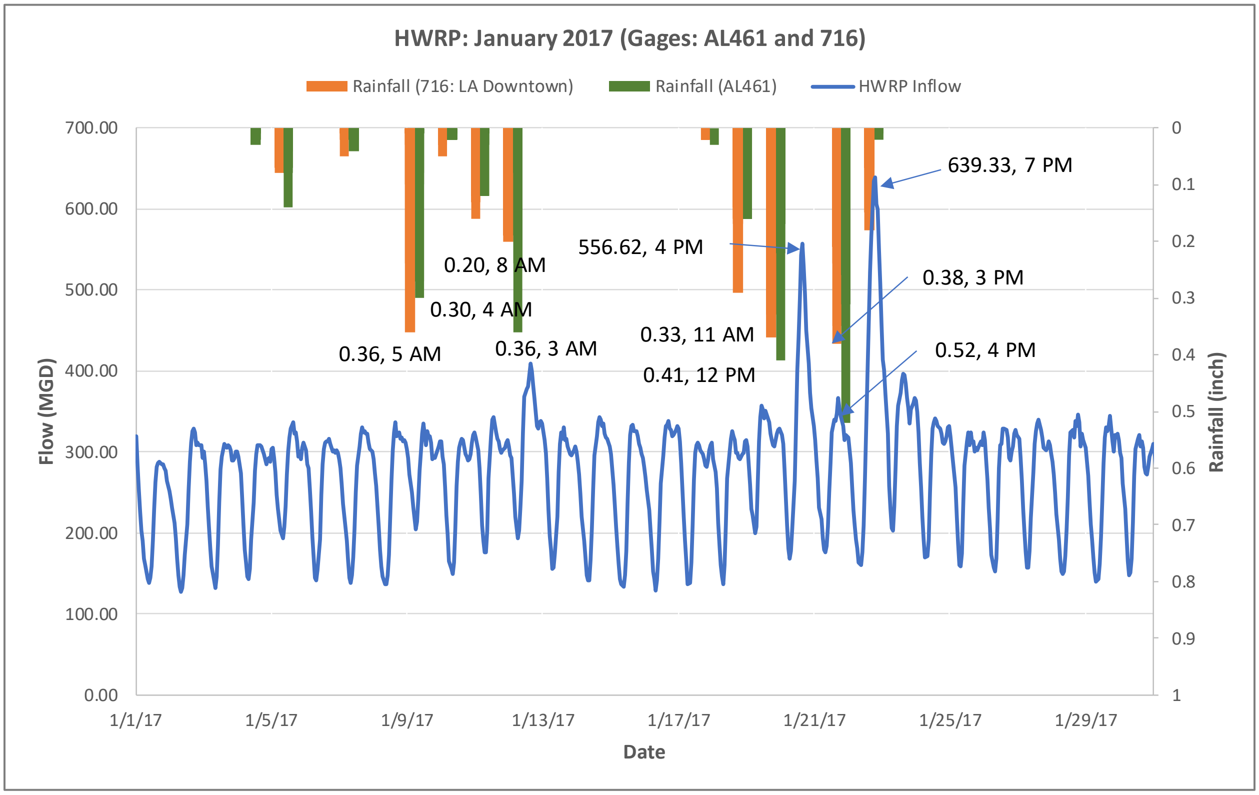


Figure 4-13. Hourly Inflow to the Hyperion WRP and Rainfall at Gauges AL461 and 716

4.3.3 Time Lag - Rainfall and Influent Flows at the Hyperion WRP

The time it takes for wet weather flow responses in the service area to affect WRP influent flows depends on several factors. These include the location, volume, length, and intensity of the rain event; the conveyance distance between the rain event location and the WRP and pump stations and other conveyance facilities along that path; and the local factors affecting RDI/I. Figure 4-13 shows hourly influent flows at the Hyperion WRP, and rainfall at Rain Gauges AL461 and 716 for January 2017. As Figure 4-13 shows, a time lag of 3 to 4 hours was observed from the rainfall peak in the service area to the peak influent flow at the Hyperion WRP. For example, Gauge AL461 recorded the larger peak in hourly rainfall (0.52 inch) at 4 p.m. on January 22, 2017, whereas the corresponding hourly influent flow peak at the Hyperion WRP (639.3 MGD) was observed at 7 p.m. on January 22, 2017. Both gauges shown on Figure 4-13 are in the Hyperion WRP service area (Figure 4-2), which implies that the cumulative impact of rainfall in the entire service area effects Hyperion WRP influent flows. Furthermore, the variability in the intensities of the rainfall events at various locations in the service area will also have an impact on the sanitary sewer system and the Hyperion WRP influent flows. The following observations can be drawn from the analysis:

- Based on the hourly influent flow data for the period of February 19, 2010, to September 30, 2019, the average influent flow to the Hyperion WRP was 265 MGD.
- During the 10-year period of record, the peak hourly influent flows exceeded the Hyperion WRP capacity 0.15 percent of the time.
- During large rainfall events (for example, on March 20, 2011, and January 22, 2017), the plant's hourly influent flows peaked to 753 and 634 MGD, respectively.
- Influent flows peaked with a time lag of 3 to 4 hours of rainfall peaks in the service area and in the case-study DWD subwatershed areas.

- Periods of high inflow (greater than 450 MGD) to the Hyperion WRP were recorded for a short period of time (that is, approximately 5 to 12 hours) before reducing to less than 450 MGD inflow (that is, the permitted design capacity).
- A noticeable impact was observed on the Hyperion WRP inflow when rainfall was greater than 0.3 inch in the sewershed.
- Based on this preliminary (example) data analysis, 1 day after a storm event appears to be a reasonable timeframe to resume the delivery of additional dry and/or wet weather runoff from DWDs to the Hyperion WRP. Storage facilities associated with the DWDs can assist DWD operations by detaining water during peak rainfall events and releasing stored water in a controlled way when the conveyance and treatment capacity becomes available, and thereby, attenuate peak stormwater flows from the drainage area.
- The Hyperion WRP has capacity under current conditions to treat more dry weather runoff. A detailed analysis would be needed to predict the amount of runoff that can be safely diverted.

4.3.4 Time Lag – Rainfall and Influent Flows at the JWPCP

Figure 4-14 presents the daily average influent flows to the JWPCP from 2012 to 2017. The flow varied between 210 and 402 MGD, with an average of 303 MGD. During this 5-year period, the daily flow for 2 days was slightly greater than its design capacity of 400 MGD.

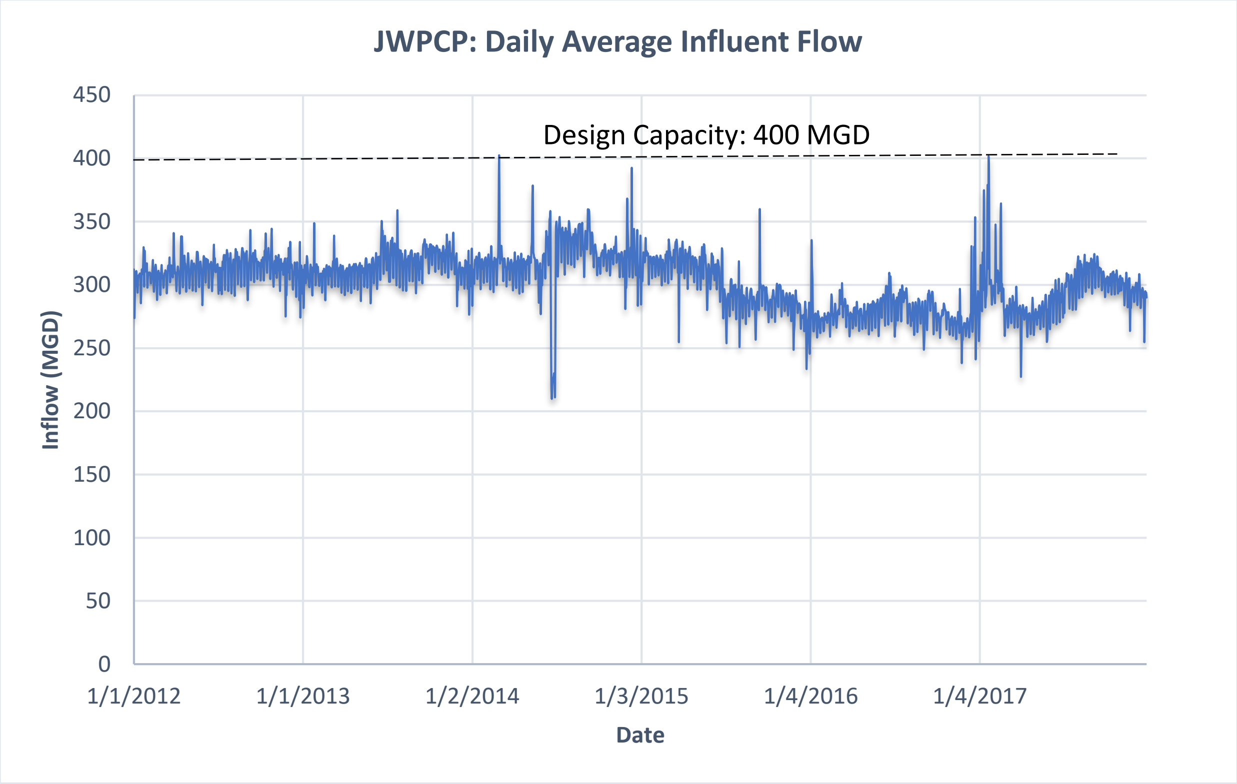


Figure 4-14. Daily Average Influent Flows at the JWPCP from 2012 through 2017

Based on the hourly influent flow data for January 2017, the hourly flows on January 20 and 22 peaked to 546 and 631 MGD, respectively (Figure 4-15). The durations of flows that exceeded the 400-MGD design capacity lasted for 12 and 16 hours, respectively. Rainfall intensity more than 0.6 inch resulted in greater-than-average influent flow at the JWPCP.

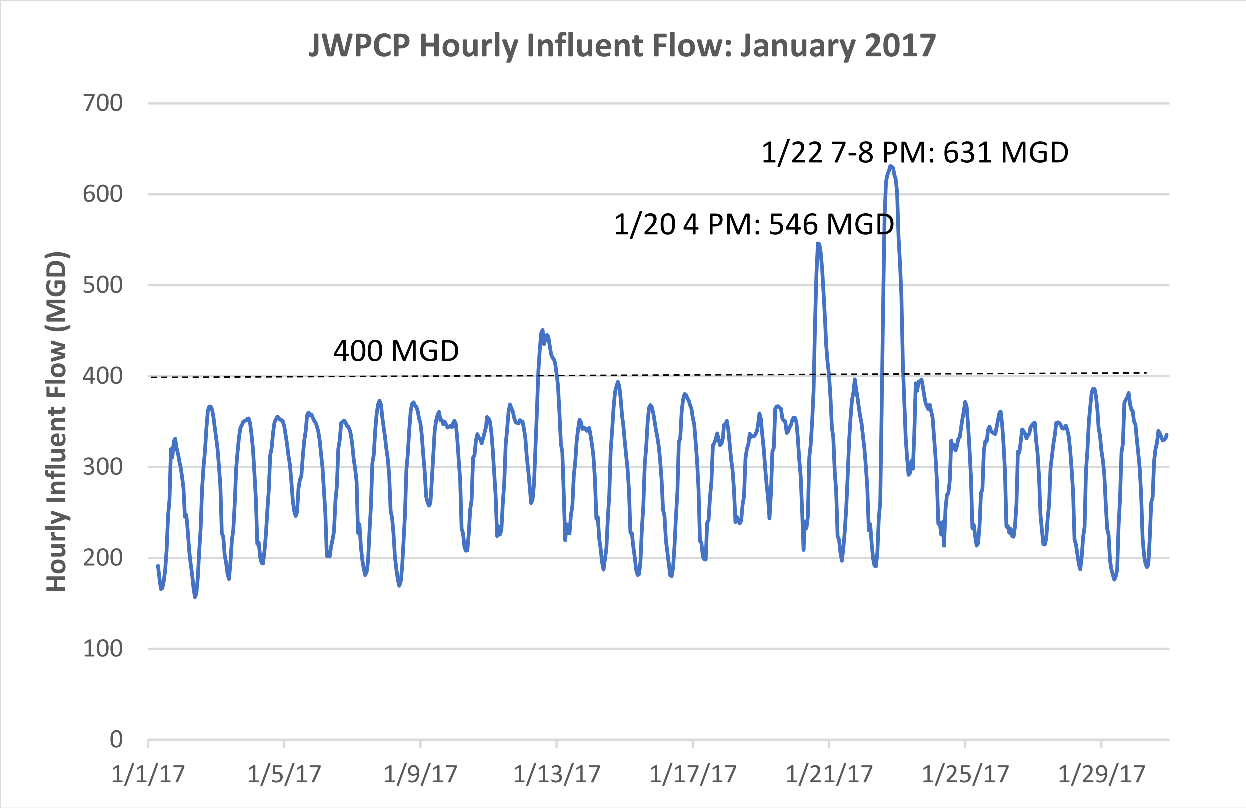


Figure 4-15. Hourly Influent Flows at the JWPCP for January 2017

Figure 4-16 shows the impact of rainfall across the JWPCP service area on JWPCP influent flows. The variations in rainfall pattern across the region and its impact on the JWPCP influent flow can vary, depending on the cumulative effect of rainfall from various areas and flow management at the upstream treatment plants. It was learned from the operator interviews that rain events farther away in the service area from the JWPCP have a lesser impact on JWPCP influent flows because the upstream WRPs take in and treat flows up to their plant capacities and bypass the excess flows, which are conveyed downstream to the JWPCP for treatment and discharge.

The following observations can be made from the JWPCP analysis:

- The effect of rainfall on JWPCP influent flows had a time lag of 3 to 4 hours.
- A single isolated rain event (0.40 inch) showed minimal impact on the influent flows when the event occurred after a long dry period.
- Periods of high inflow (greater than 400 MGD) occurred for a period of approximately 12 to 16 hours before reducing to less than 400 MGD inflow.
- Based in this preliminary example historical dataset, 1 day after peak rainfall could be a good estimate to deliver additional flows to the JWPCP under high inflow conditions due to a storm event.
- The JWPCP has capacity under current conditions to treat more flow, but a detailed analysis would be needed to calculate the amount of stormwater that can be safely diverted.

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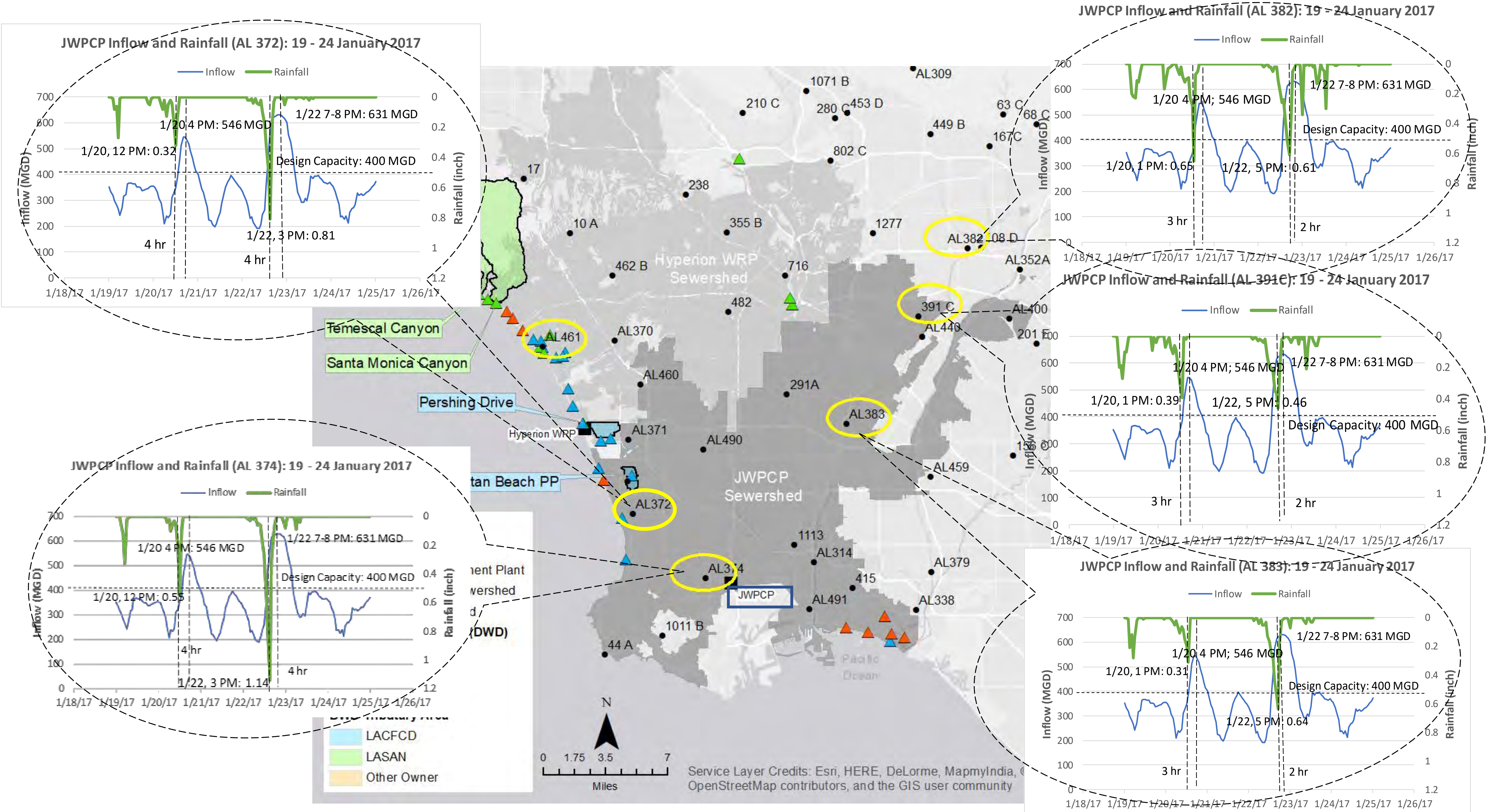

Figure 4-16. Hourly Influent Flows to the JWPCP and Hourly Rainfall at Gauges AL461, AL372, AL382, 391C, and AL383 for January 2017

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4.4 Dry Weather Diversion Case Studies

This section provides the details on the four case-study DWDs selected by the stakeholders. Two of the selected DWDs (Pershing Drive and the Manhattan Beach PP) are owned/operated by the LACFCD and the other two (SMC and Temescal Canyon) are owned and operated by LASAN. All case study DWDs diverts flows to the Hyperion WRP, except the Manhattan Beach PP DWD, which discharges to the JWPCP. For each DWD, this section provides an overview of the project, site conditions, rainfall-runoff analysis, conveyance capacity analysis, lessons learned, and conclusions and recommendations.

4.4.1 Case Study No. 1 - Santa Monica Canyon Dry Weather Diversion

4.4.1.1 Project Background

The SMC subwatershed drains to the SMC channel. Rustic Canyon Creek, Sullivan Canyon Creek, and Mandeville Canyon Creek are the three tributaries that drain into the SMC channel (Figure 4-17). The SMC channel, an open concrete-lined channel running between West Channel Road and Entrada Drive (Figure 4-17), is listed for lead and indicator bacteria on the State of California's 303(d) list for impaired and threatened waters. The SMC DWD's construction was completed in 2002, and it began to operate in April 2003. The diverted flows are discharged to the sewer system and eventually treated at the Hyperion WRP. The facility is located on West Channel Road, near the intersection with Short Street. Its subwatershed covers an area of 10,147 acres; 98 percent is within the City of Los Angeles and the remaining is within the City of Santa Monica. Some of the coastal subwatersheds like SMC have sporadic, but increasing, development centered along US Highway 101. The northern portion is hilly, while the southern portion is rugged mountain terrain.

As originally designed and constructed, the flow was diverted from the storm drain channel via a concrete berm constructed along the channel floor (LASAN, 2004). Diverted flow first enters a trash well for prescreening of trash and other floatables, then travels to the pump well. At the pump well, flow is pumped to the sanitary sewer, which in turn is conveyed to the Hyperion WRP. The diversion structure includes a trash well to collect trash and debris, a pump well to pump out diverted flow, a concrete valve box to control flow directions, and an instrumentation panel for control switches. A sluice gate was included in the trash well to control flow from the drain during maintenance. System controls are set to shut the entire system down on high and low water levels in the pump well. The vaults for the trash well and pumps are located on West Channel Road. Over time, a new DWD system was installed within the Will Rogers State Beach parking lot, east of the multiuse path bridge at the mouth of the SMC, for ease of O&M (Figure 4-18). The old DWD was left in place within West Channel Road for redundancy and system reliability.

The concrete diversion berm within the channel was replaced with a 3-foot-high-by-37-foot-wide air-inflatable rubber dam to divert flows into the DWD (Photo 4-1). The rubber dam, when inflated, causes dry weather runoff from streets and other non-vegetated areas to accumulate behind it and flow through an opening in the flood control channel wall, where it is pumped to a sewer main to be conveyed to the Hyperion WRP. A control building houses the rubber dam's air compressor and control panel at the downstream end of the channel. Based on the data provided by the City, this diversion is the largest of all diversions with a design capacity for diverting 5.04 MGD of dry weather runoff.

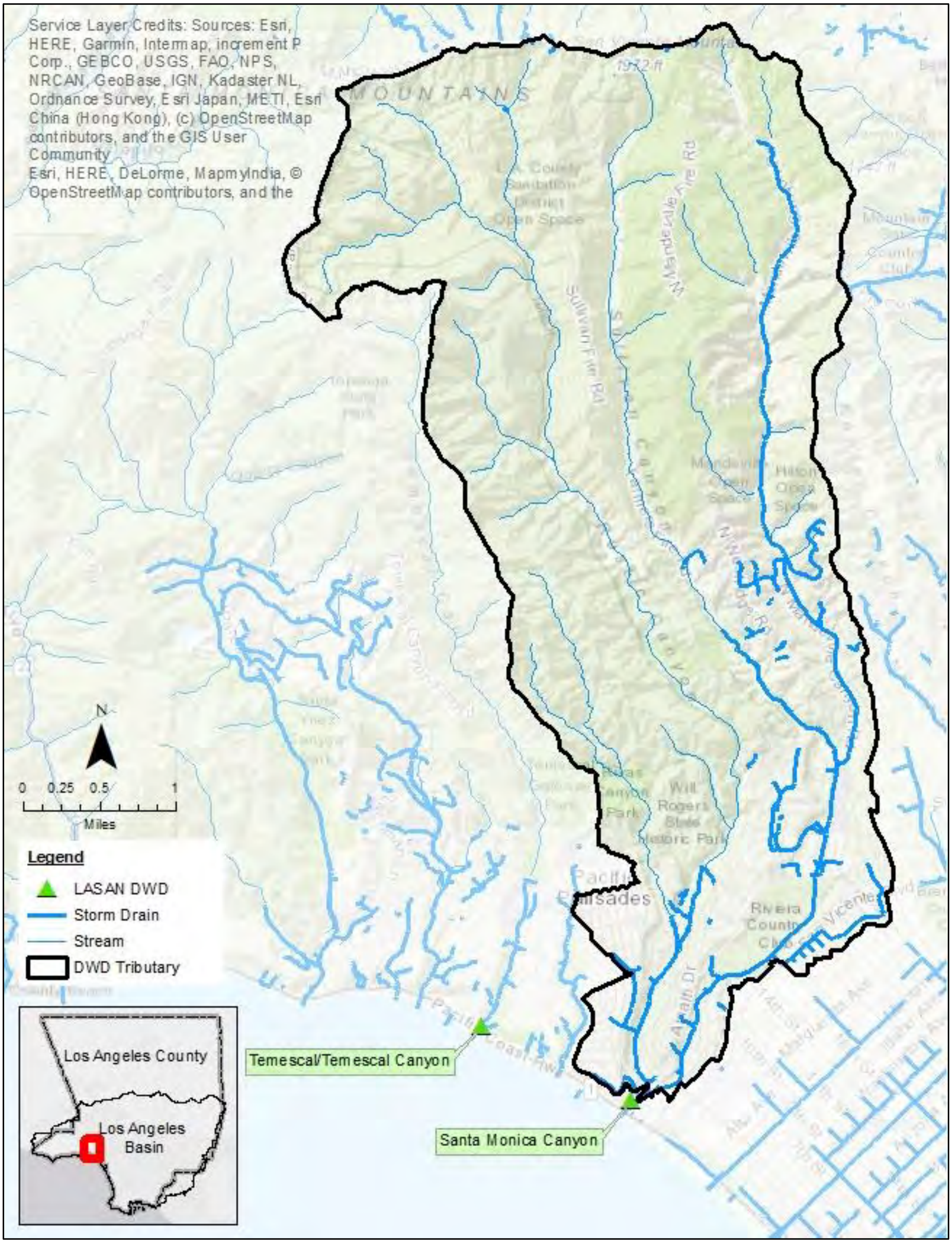


Figure 4-17. Santa Monica Canyon Subwatershed and the Storm Drain Network

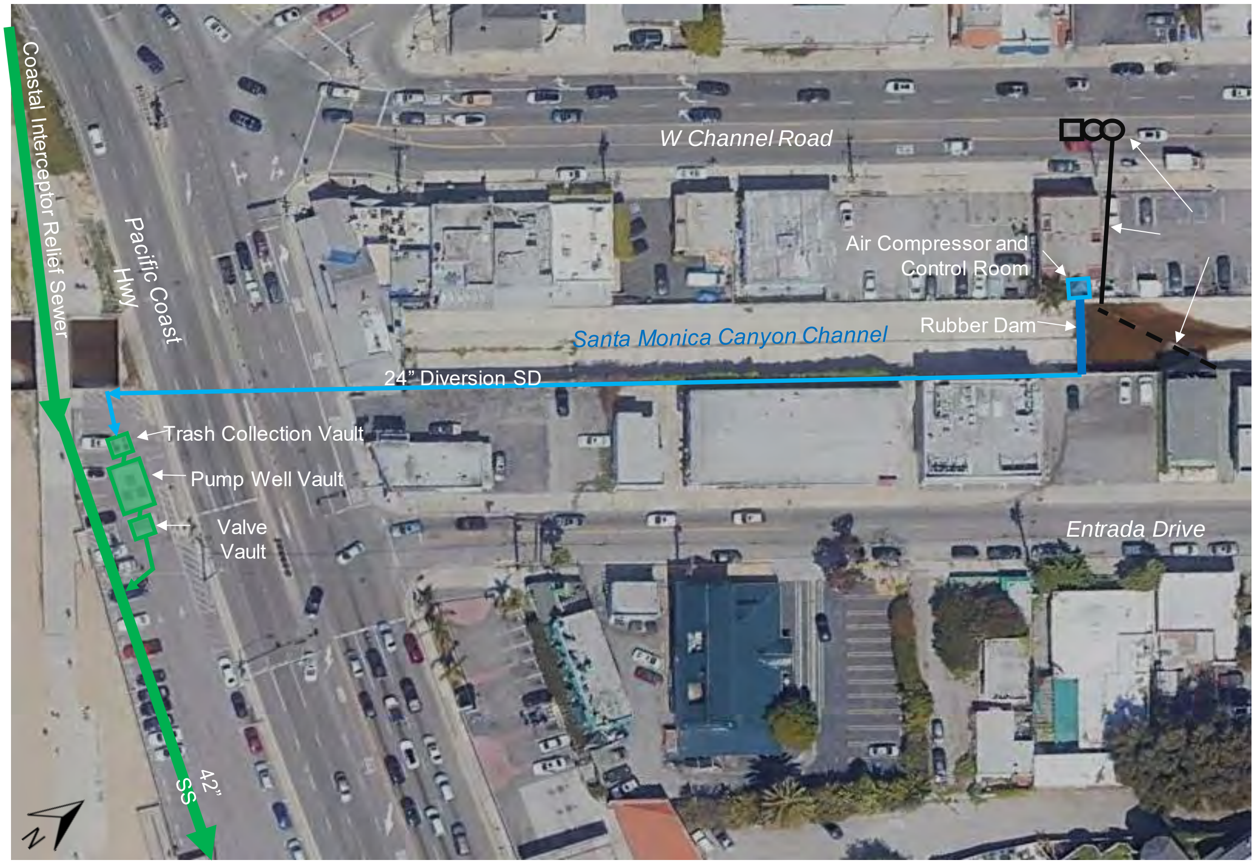


Figure 4-18. Conveyance Infrastructure of the New Location of the Santa Monica Canyon DWD

(a) Upstream of Diversion **(b) Diversion Dam and Downstream**

Photo 4-1. Santa Monica Canyon Dry Weather Diversion; (a) Upstream of Diversion, and (b) Downstream of Diversion Dam; Photographs Taken during the October 15, 2019 Site Visit with Los Angeles Sanitation and Environment Staff

4.4.1.2 Rainfall-runoff Analysis

Rainfall-induced runoff was simulated to estimate the potential runoff discharged to the storm drain network system during a rainfall event. For the SMC case study, the WMMS model developed by the LACFCD was used to simulate the runoff flow rates based on the rainfall in the DWD's subwatershed. While the model contains hydrological data from 1986 to 2012, the focus of this study is on the most recent 10-year period. Therefore, an extension of the model dataset was required. The WMMS model was extended from 2012 to 2019 using rainfall data from Gauge AL461.

Runoff from the subwatershed is governed by many factors, such as land use, soil type, slope, vegetation, and other conditions. The open and vacant subwatershed areas with steep canyons concentrate storm runoff quickly. The areas with increased imperviousness decrease runoff times of concentration, which results in increased runoff volumes and rates. Figure 4-19 shows the land uses in the subwatershed (SCAG, 2016).

The model represents various categories of land use, such as, urban, low-, and high-density single and multiple family residential, commercial, industrial, transportation, and vacant areas in the DWD subwatershed. The land use in the subwatershed is predominantly urban grass and vacant land.

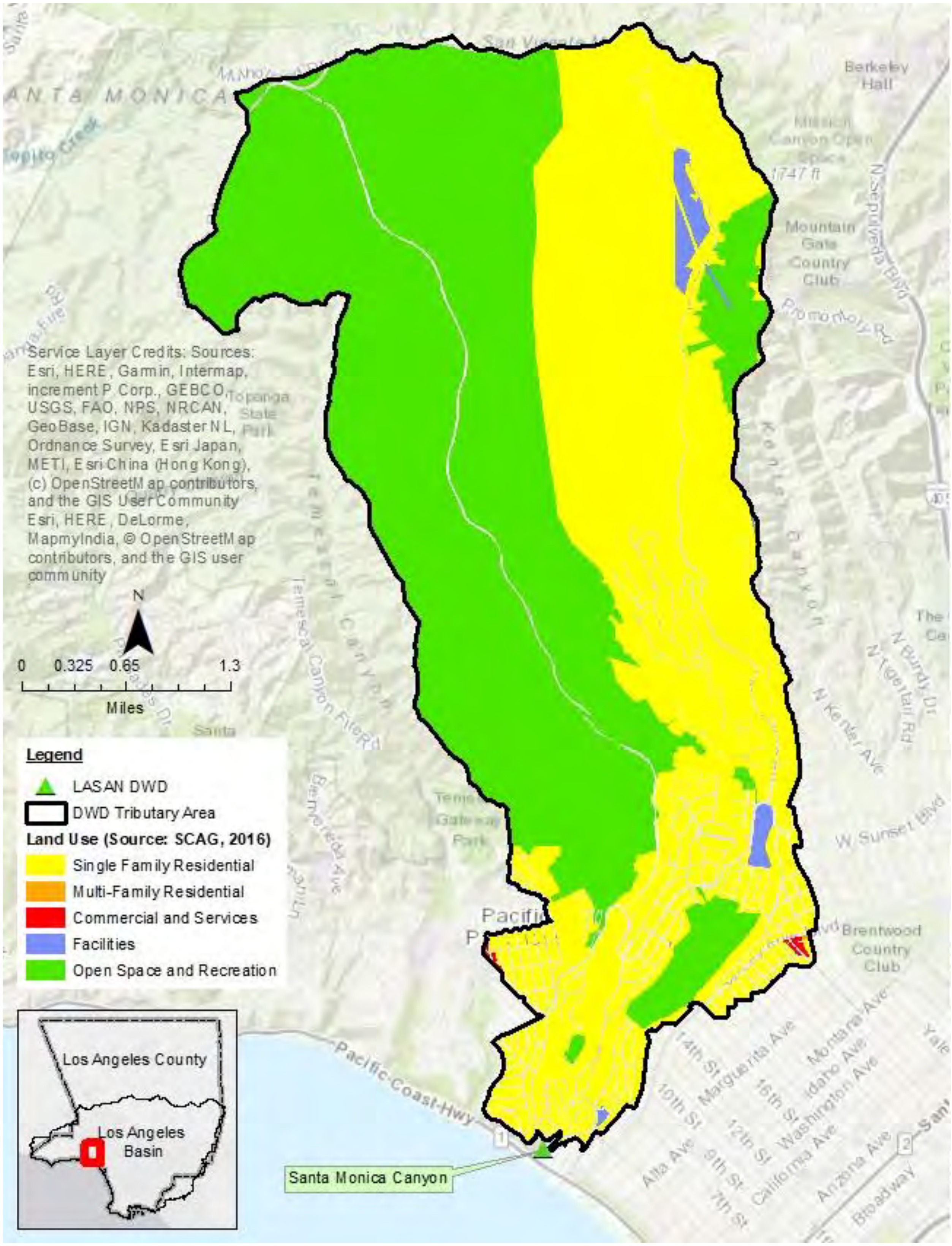


Figure 4-19. Land Use in the Tributary Area of the Santa Monica Canyon DWD Subwatershed

Figure 4-20 shows the model simulated runoff for the SMC DWD subwatershed from 2010 to 2019. The maximum simulated flow ranged between 16 cubic feet per second (cfs) (10 MGD) in 2013 and 149 cfs (96 MGD) in 2017. The average flows during dry year 2013 and wet year 2017 were 0.59 cfs (0.38 MGD) and 3.4 cfs (2.2 MGD), respectively. Flow duration data for daily mean modeled flows were analyzed to understand the exceedance probability.

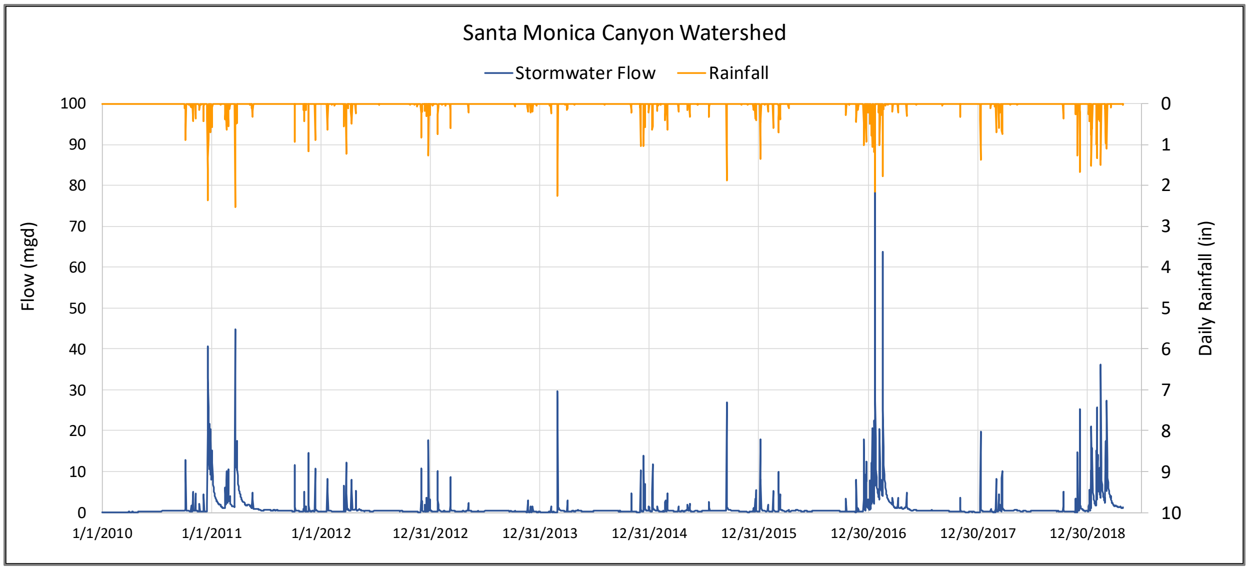


Figure 4-20. The Simulated Mean Daily Flow for the Santa Monica Canyon Subwatershed

Based on this analysis, the stormwater runoff is less than 5 MGD for approximately 67 percent of rainfall days from 2010 to 2019. Based on the model output, daily rainfall depths between 0.9 and 1.1 inches (the 85^{th} percentile of rainfall in 24 hours) resulted in flows ranging between 7.5 and 20.5 MGD, with an average of approximately 14.4 MGD.

4.4.1.3 Sanitary Sewer System

Collectively, the City's wastewater system includes over 6,500 miles of major interceptors and mainline sewers, 46 pumping plants, and various diversion structures and other support facilities, such as corporation yards. The wastewater system consists of two distinct WRP service areas: (1) the Hyperion WRP service area, and (2) the Terminal Island WRP service area. Figure 4-21 shows the Hyperion WRP service area and the sanitary sewer system between the SMC DWD and the Hyperion WRP, which comprises a network of underground pipes that convey wastewater through a sanitary sewer system to the Hyperion WRP. The Hyperion WRP service area covers approximately 515 square miles and serves the majority of the City's residents, businesses, and industries. In addition, the service area includes non-City agencies that contract with the City for wastewater service.

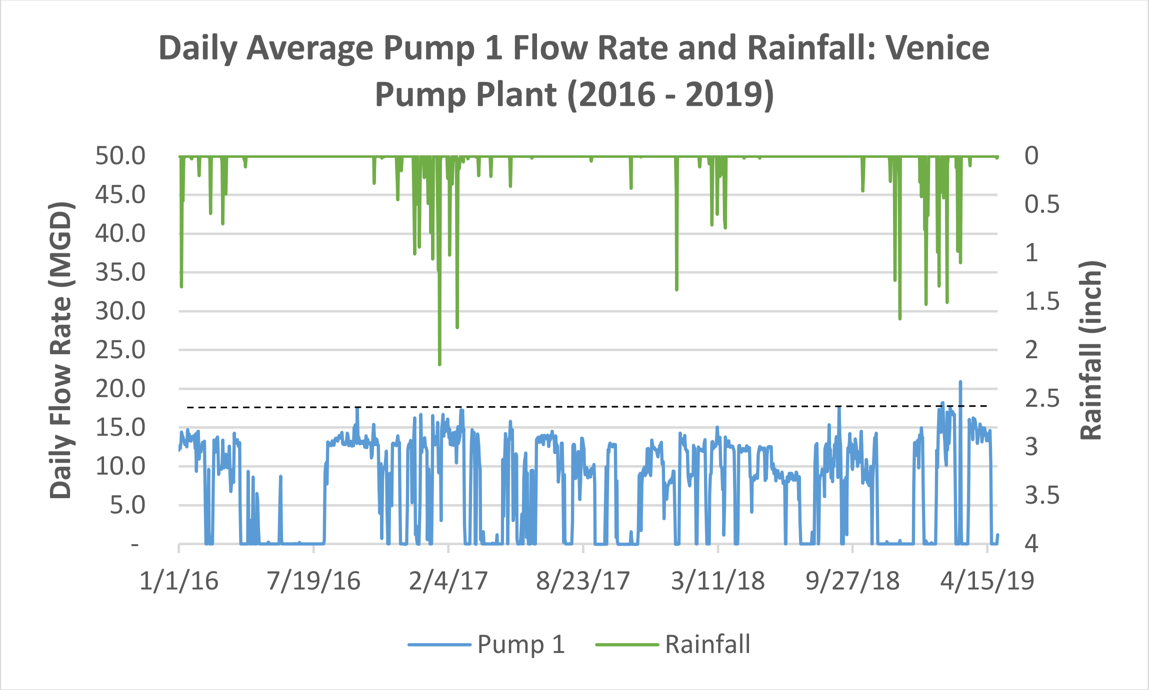
The sanitary sewer system conveys flows from the SMC DWD to the Hyperion WRP through the Coastal Interceptor Sewer (CIS) trunk line system. One of the critical components of the CIS sanitary sewer system is the VPP, located at 140 Hurricane Street in the Los Angeles community of Venice, adjacent to the Ballona Lagoon and the Grand Canal. The VPP is the City's largest pumping plant and is considered to be a critical facility for conveying sewage from its tributary areas to the Hyperion WRP. The City owns and operates the VPP. The facility was designed and built in 1957 and was upsized and upgraded in 1987. The VPP collects sewage from the City's CIS, which serves the communities of Topanga, Pacific Palisades, Brentwood, Venice, and Mar Vista. It also serves Santa Monica and parts of Los Angeles County. The potential for delivering more flow during the wet season to the Hyperion WRP depends on the pumping capacity of the VPP. More capacity is planned to be added to the VPP in a couple of years, which will enable it to pump more flow to the Hyperion WRP in the future.

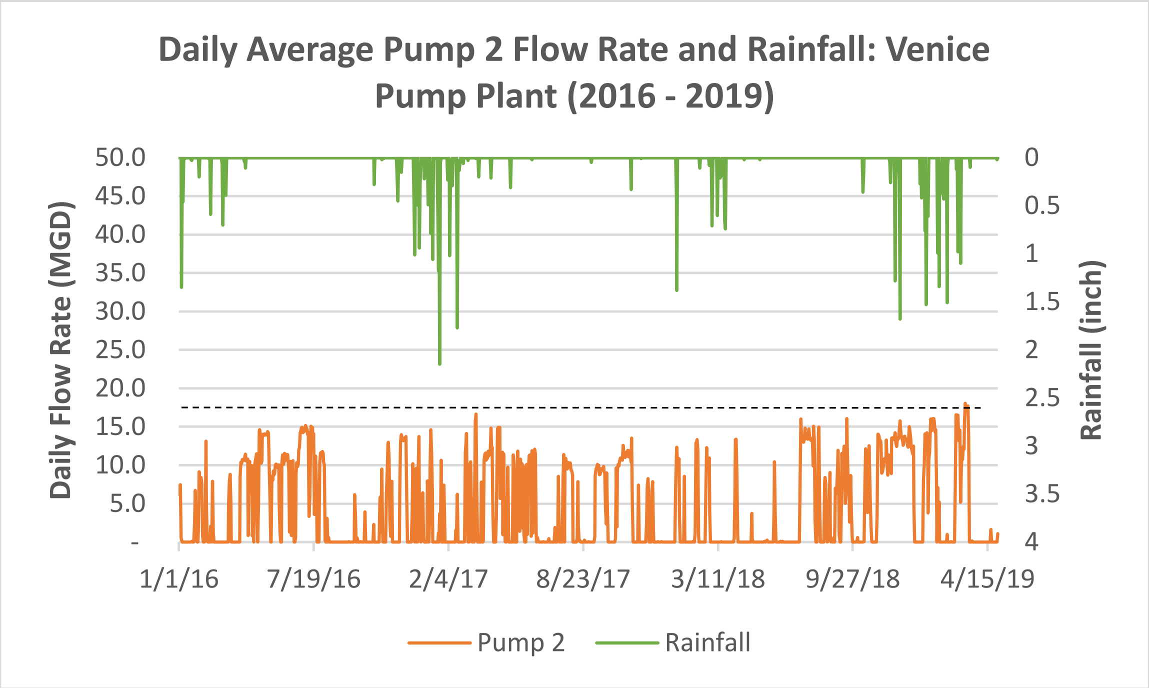
(Source: LASAN)

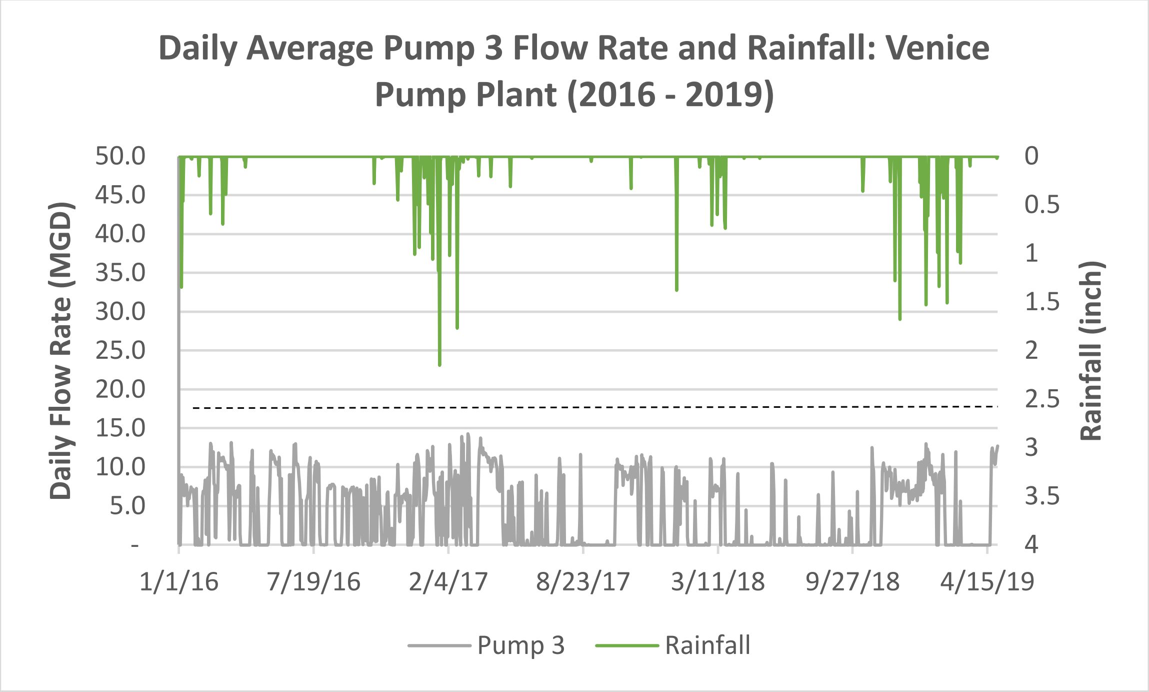
Figure 4-21. Conveyance System – The Hyperion WRP Service Area and the Sanitary Sewer System from Santa Monica Canyon to the Hyperion WRP

Venice Pumping Plant Flows

The flows generated from the DWDs in the Santa Monica area, north of the VPP, are conveyed via the CIS to the Hyperion WRP. Therefore, it was important to assess the capacity of the pumps at the VPP. The pumping data for the VPP were collected and analyzed. The data were derived from the pump run time. Currently, five pumps serve the facility. Figure 4-22 shows the daily flow rates delivered by four pumps from 2016 to 2019. The design capacity of each pump is also shown for comparison with the flows delivered. Flow data for the fifth pump were not available. As the figure panels show, the VPP has been operating close to the design capacity of each pump (18 MGD).


Daily Average Pump 1 Flow Rate and Rainfall: Venice Pump Plant (2016 - 2019)
Daily Flow Rate (MGD)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
-
Rainfall (inch)
0
0.5
1
1.5
2
2.5
3
3.5
4
1/1/16
7/19/16
2/4/17
8/23/17
3/11/18
9/27/18
4/15/19
Pump 1
Rainfall


Daily Average Pump 2 Flow Rate and Rainfall: Venice Pump Plant (2016 - 2019)
Daily Flow Rate (MGD)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
-
Rainfall (inch)
0
0.5
1
1.5
2
2.5
3
3.5
4
1/1/16
7/19/16
2/4/17
8/23/17
3/11/18
9/27/18
4/15/19
Pump 2
Rainfall



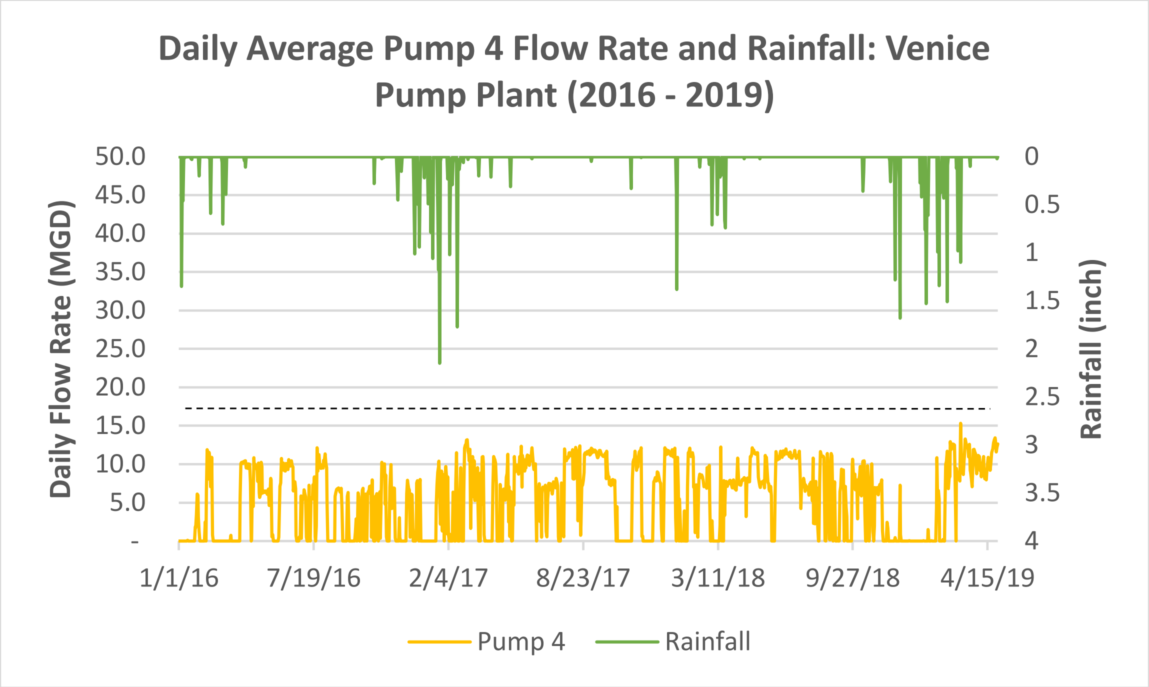


Figure 4-22. Daily Average Pumping Data from Four Pumps at the VPP

Note: The rainfall recorded at Gauge AL461 is also plotted. The dotted line shows the pumping capacity.

Other Sanitary Sewer System-Related Projects

The existing, aging, deteriorating sanitary sewer system in this area is more than 50 years old and is at risk of potentially overflowing during peak wet weather conditions. Therefore, the City has been working on installing a 54-inch-diameter force main sewer to supplement the 48-inch-diameter force main sewer built in the 1960s. The new force main is a new parallel force main sewer system that will, in conjunction with the existing sewer system, convey more flow from the VPP to the Hyperion WRP. The project upgrade objectives are to increase the sanitary sewer system capacity, create pipeline redundancy, and allow for maintenance of the system.

The City has been working on the construction of an auxiliary pumping plant next to the existing VPP to enhance reliability and supplement pumping capacity of the existing VPP for a combined peak capacity of 87 MGD, to manage wet weather runoff from a 10-year storm event.

While it appears that capacity at the DWD may be available to accommodate wet weather runoff in the future, a thorough investigation of the entire conveyance system is needed to determine whether the additional flows could be conveyed from the DWD to the Hyperion WRP successfully. The detailed analysis of the sanitary sewer system is needed because the conveyance system is complex, with a number of locations where pipe sizes change and several localized capacity constraints may exist. An assessment of the sections limiting the flows is recommended, with a detailed investigation of the cumulative effect of flows from all diversions to the Hyperion WRP.

Sanitary Sewer System Analysis

LASAN provided a preliminary assessment of sanitary sewer capacity for the DWD discharges under various flow conditions using the City's sanitary sewer system hydraulic model. The modeled sanitary sewer system from SMC and Temescal Canyon DWDs to the Hyperion WRP (Figure 4-23) were analyzed with the following assumptions.

- **85th Percentile 24 Hour Storm Event (Design storm)**: The storm events in January 2017 were captured for the design storm considerations. DWD discharge flows up to the 85th percentile storm volume were produced by the subwatershed at 1-inch rainfall in 24 hours (85th percentile of rainfall).
- **Storm event**: The 10-year design storm assumes accumulation of approximately 4 inches of rainfall in 24 hours and a peak rainfall intensity of approximately 1 inch per hour based on the 2016 to 2017 wet weather season.
- **Input - flow**: Multiple DWDs did not run concurrently in this analysis. It was modeled such that either Temescal Canyon DWD or SMC DWD could run at the flow rates provided. Cumulative effects of discharges from other DWDs to the sanitary sewer system were not considered.
- **Input – RDI/I**: The sanitary sewer system model under a wet weather scenario considers: (1) the general sanitary sewer network loads, (2) the effects of the DWD if it was turned on during a wet weather event, and (3) the effect of RDI/I.

(Source: LASAN)

Figure 4-23. Sanitary Sewer System between the Temescal Canyon DWD/Santa Monica Canyon DWD and the Hyperion WRP through the VPP

Table 4-4 presents the sanitary sewer system modeling results for the Temescal Canyon and SMC DWDs. Various flow rates were assumed to include runoff generated by variable rainfall depths in the respective watersheds. The design travel time of peak storm flow from DWDs to the Hyperion WRP is also provided.

Table 4-4. Sanitary Sewer System Model Results Summary

DWD	Flow Rates (gpm)	Flow Rates (MGD)	Design Storm	Location of Flow Limitations	Travel Time of Peak Storm to the Hyperion WRP
Temescal Canyon	1,775 2,000 2,220 2,600 3,000	2.56 2.88 3.17 3.74 4.32	The sanitary sewer system is unable to convey flow without exceeding a 0.75-d/D trigger level.	Modeled full pipe/ surcharge immediately downstream of VPP (MH 56204088 to the VPP)	90 – 120 minutes
SMC	11,600 13,000 20,000 25,000 37,000	16.7 18.7 28.8 36.0 53.3	The sanitary sewer system is unable to convey flow without exceeding a 0.75-d/D trigger level.	Modeled full pipe/ surcharge immediately downstream of VPP (MH 56204088 to the VPP)	45 – 60 minutes

Notes:
d/D = flow depth/pipe diameter
MH = maintenance hole

The effect of RDI/I is modeled in such a way that the expected volumetric contribution per catchment area is calculated during the application of the storm data provided. This volume is then applied to the sanitary sewer system network in the model at assigned nodes to model the RDI/I. Essentially, the whole system response is a sum of the typical daily wet weather runoff with the RDI/I component added.

The current permitted capacity of the DWD refers to the dry weather runoff, because the pumps are expected to be turned off during wet weather events. The following can be summarized from this analysis:

- Only dry weather runoff from the DWDs into the sanitary sewer system was reviewed when the DWDs were installed.
- Further detailed study is needed to investigate whether a spill will occur at a MH location for a storm event.
- The storage options should be considered to offset load on the sanitary sewer system and avoid any spills during the event of storm discharges. A detailed analysis should be conducted.
- The cumulative impact of flow from other DWDs to the sanitary sewer system up to the Hyperion WRP during wet weather should be included in the analysis, to evaluate the total storm volume produced under a storm event and compare it with the capacity of the existing sanitary sewer system.

Approximately 1 to 2 hours is the modeled travel time from the SMC DWD location to the Hyperion WRP under a scenario when DWD discharges are produced from a peak storm event.

4.4.1.4 Storage Potential

Based on the review of the land uses and vacant areas in the SMC watershed, it appears that storage for stormwater can be explored in some areas (for example, in the parking lot near Will Rogers State Beach). Other potential locations may include open/park spaces and public rights-of-way in the subwatershed. As a BMP, a storage facility to capture flow from the entire tributary area may be infeasible due to size of the watersheds; however, smaller storage facilities in the form of distributed projects throughout the watershed could be developed. While it would be desirable to have a storage facility to accommodate the entire stormwater runoff from the 85^{th} percentile, 24-hour storm event for MS4 permit compliance purposes, smaller storage facilities can retain smaller storm events and first flush flows to improve the water quality of releases to SMB. The relative cost of installing and operating multiple storage systems instead of a single storage facility would need to be evaluated prior to implementing a diversion project.

4.4.1.5 Lessons Learned

Based on the field visit and operator interviews, the following was learned:

- Regular maintenance is needed in front of the SMC DWD inflatable dam to remove accumulated sediment and debris.
- Better screening is needed on the inlet to the wet wells to remove debris. The wet wells are cleaned at least semiannually, if not more often, depending on wet weather season.
- Currently, the diversion cannot be remotely controlled. Being able to control pumps and valves via SCADA and through a smart control system would improve operations during wet weather.
- Flows were estimated based on the pump run time. The data collected are stored on servers and at the VPP and are backed up to servers at the Hyperion WRP.
- The quality of the discharged flows is not monitored.
- The stations are checked monthly by operations, mechanical, electrical, and instrumentation crews.
- An efficient data management system is needed to store the flow monitoring and pump data in one repository for the monitoring and system evaluation purposes.
- Dam operations need to be set up via a fully automated system, which can be controlled remotely.
- The DWD operates until the dam deflates. With the current system, it appears that the diversion may already be handling a portion of the first flush/first storm of the season. Real-time flow monitoring is needed to understand the flow diverted during storm events/first flush.
- The old diversion structure is still in place, although it is not used for operations and could be repurposed, if needed.

4.4.1.6 Conclusions and Recommendations

It was determined that the SMC DWD has the capacity to potentially deliver more flows beyond dry weather flows with the existing structure; however, availability of this DWD infrastructure capacity only occurs during dry weather periods, when the sewer system is able to convey flows to the Hyperion WRP. The sanitary sewer system analysis suggests that the diversions cannot deliver the runoff produced from the 85^{th} percentile 24-hour storm event due to limited sanitary sewer capacity. However, some modifications of the DWDs system components and operations could enable the diversion of more wet weather runoff. For example, the installation of storage facilities to retain runoff during storms and discharge the stored water once the sanitary system capacity, including the treatment capacity of the Hyperion WRP, becomes available.

The DWD is currently managing some wet weather runoff; however, the amount cannot be quantified because daily flow data were not available. Based on the flow data received from the City, it appears that the diversion may already be diverting a portion of the first-flush stormwater runoff from the subwatershed (generally, in the month of October). As discussed in Section 2, the first storm event of the season was recorded with daily rainfall intensity varying between 0.3 and 0.5 inch during the month of October. The sanitary sewer system capacity was not assessed for the first-flush scenario. With the existing DWD capacity of 5.04 MGD, it appears that much of that can be used during the storm event, provided the flow from the diversion can reach the Hyperion WRP without causing spills downstream in the sanitary sewer system. An investigation and analysis with refined flow data and potential storage in the channel of the SMC DWD would be required for an accurate assessment of this sanitary sewer capacity.

A telemetry system is recommended at the diversion structure. The telemetry system should include flow transducers and equipment to remotely control the flows at the diversion. Flow meters at key locations of the diversion would provide better control of flow during dry and wet weather periods.

A complete assessment and the optimization of the existing diversion are recommended, considering the diversion of additional stormwater during wet weather, along with proposed regional projects included in the SMB Jurisdiction 2 and Jurisdiction 3 EWMP Plan (for example, the Riviera Country Club project that includes storage, infiltration, and use, and the Rustic Canyon Recreation Center project that includes subsurface infiltration).

4.4.2 Case Study No. 2 – Temescal Canyon Dry Weather Diversion

4.4.2.1 Project Background

The Temescal Canyon subwatershed is located north of the SMC subwatershed (Figure 4-17). Following the epidemiology study of 1996, when the SMC DWD was constructed, the City assessed the Temescal Canyon subwatershed to understand the need to implement a DWD to reroute the flow from the storm drain to the sanitary sewer network. The Temescal Canyon DWD was constructed during the 2002 to 2003 period. It began to operate in April 2003.

The Temescal Canyon storm drain discharges into the SMB across the Pacific Coast Highway and Will Rogers Beach in a double-reinforced concrete box at Temescal Canyon Road (Photo 4-2). The subwatershed area covers approximately 1,660 acres, with 100 percent of the discharge from the City. Figure 4-24 shows the Temescal Canyon Subwatershed with the storm drain network.

The purpose of the DWD is to divert dry weather runoff from the storm drain channel before discharging into the SMB. The DWD facility is located at the east-south corner, where the Temescal Canyon Road intersects with the Pacific Coast Highway (Figure 4-25). Flow is diverted from the storm drain channel via a concrete berm constructed along the channel floor. The diversion structure includes a trash well to collect trash and debris, and a pump well to pump out diverted flow. A concrete valve box controls the flow directions and an instrumentation panel controls switches for flow passing through the diversion. A sluice gate is included in the trash well to control flow from the drain during maintenance. System controls are set out to shut the system down in case of high and low water levels in the pump well. The diverted flow enters a trash well that prescreens trash and other floatables, then travels to the pump well (Figure 4-26). At the pump well, flow is pumped to the sanitary sewer system, which in turn conveys the flow to the Hyperion WRP.

Temescal Canyon Park is a 37.59-acre area located at 15900 West Pacific Coast Highway, upstream of the Temescal Canyon DWD (Figure 4-25). The park contains a children's play area, picnic tables, restrooms, and a native garden. Over the last few years, a stormwater BMP was installed at the park to provide onsite treatment and beneficial use of stormwater to irrigate the park (Figure 4-25). The project included diverting water from the storm drain to a buried detention tank in the park. The treated water is planned for irrigation purposes. The project was constructed in two phases. Phase 1 was designed to intercept and divert dry weather and wet weather stormwater flow from the Temescal Canyon storm drain. The diverted flows are conveyed to a hydrodynamic separator (for pretreatment) and stored in the buried detention tank. This project also includes a hydrodynamic separator, various pipelines (such as a dry-weather runoff return pipeline and an overflow pipeline), electrical enclosures (underground and aboveground electrical boxes, telephone ducts, and a vault), locked hatches, discharge pumps, and a discharge force main.

Phase 2 of the DWD project involved implementing onsite stormwater disinfection and the beneficial reuse of retained water in the buried detention tank to irrigate the park. It included the installation of a submersible pump inside the detention tank (constructed during Phase 1); a new stormwater treatment building; a 31-foot-by-13-foot treatment building with a 490-gallon double-contained tank for the treatment agent; 2,500 feet of treated stormwater line; 2,800 feet of new irrigation pipeline; and new onsite trees.

Photo 4-2. Temescal Canyon DWD

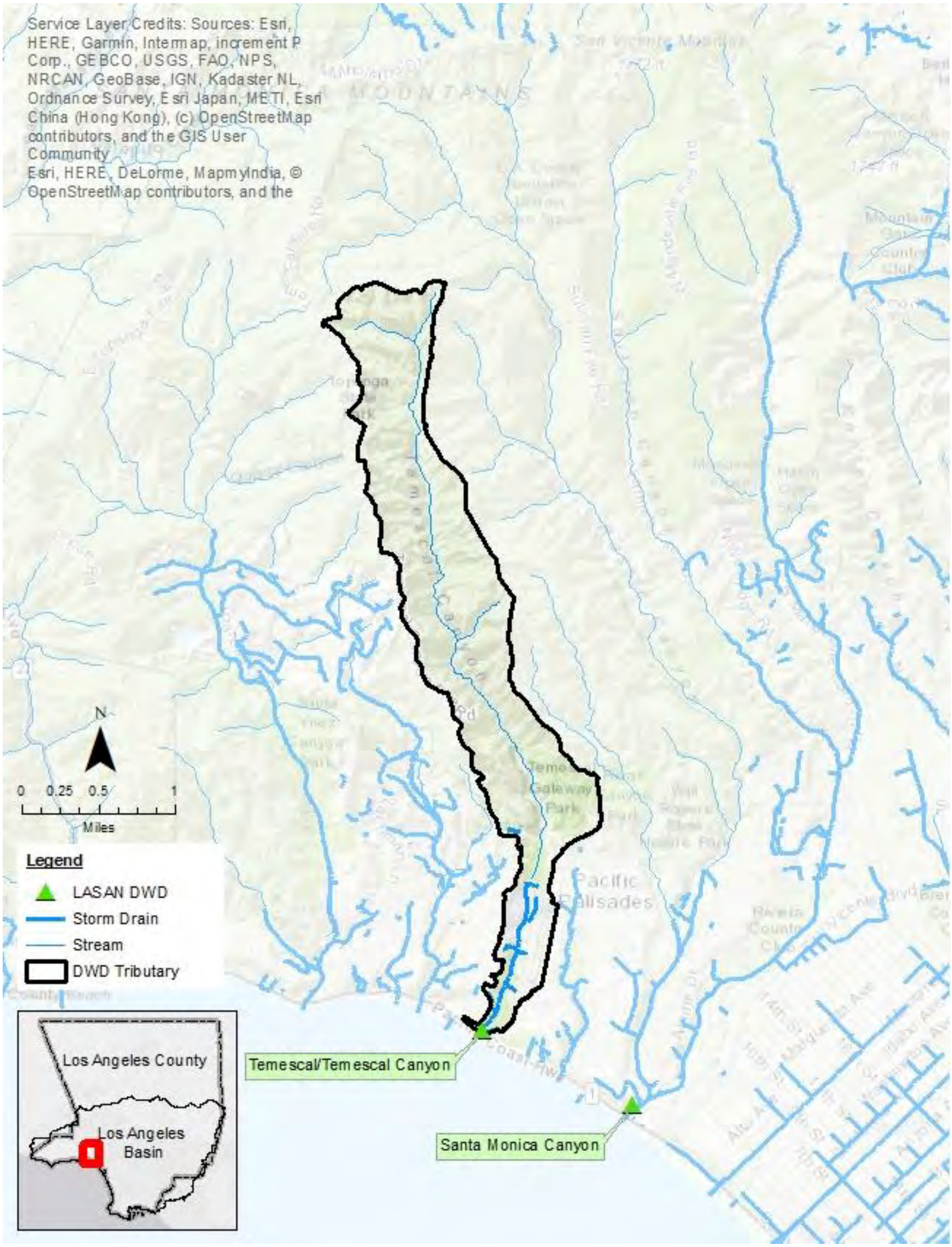


Figure 4-24. Temescal Canyon Subwatershed Showing the Drainage Area and the Storm Drain Network

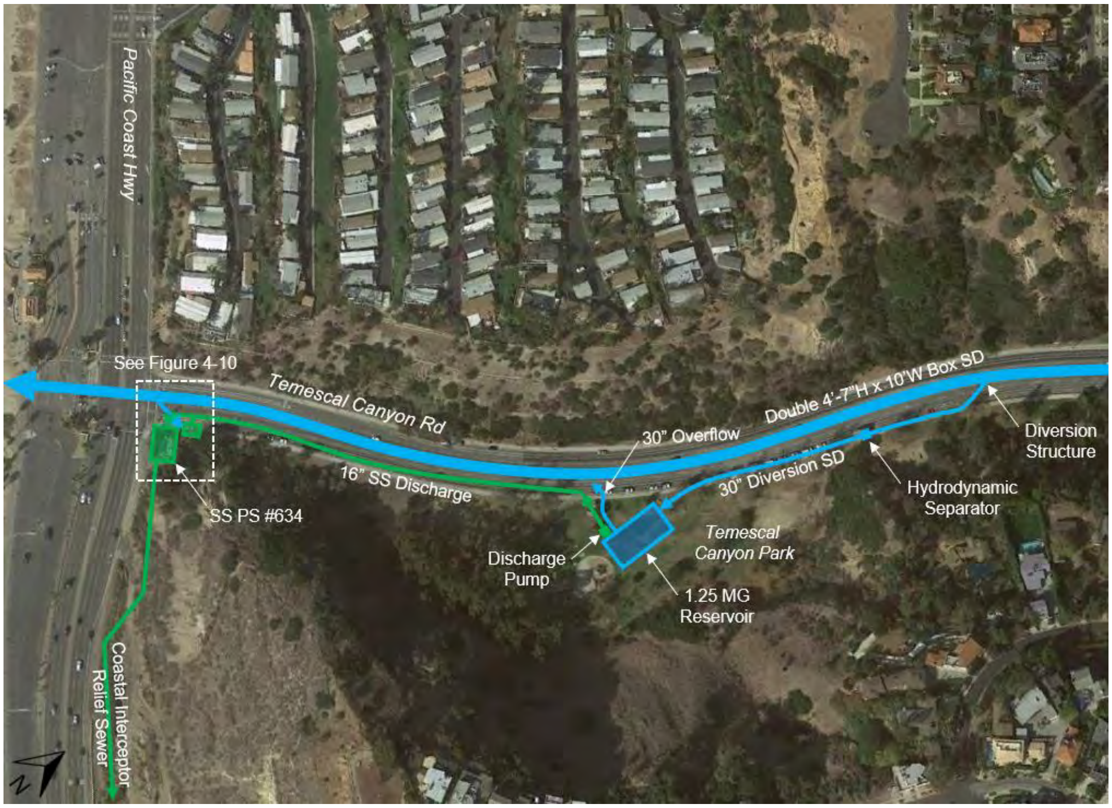


Figure 4-25. Temescal Canyon Park and the Location of the Temescal Canyon DWD

Figure 4-26. Temescal Canyon DWD Location and System Components

Stormwater is diverted at #736 Temescal Canyon (flow control) and sent to #734 Temescal Canyon DWD for treatment and reuse for irrigation, or for discharge to the sewer. Diverted flows are conveyed to a hydrodynamic separator (for pretreatment) and buried detention tank located within Temescal Canyon Park. Figure 4-27 shows the linkage between the two diversions and the buried detention tank, which stores water from the Temescal Canyon drain for beneficial onsite use after treatment.

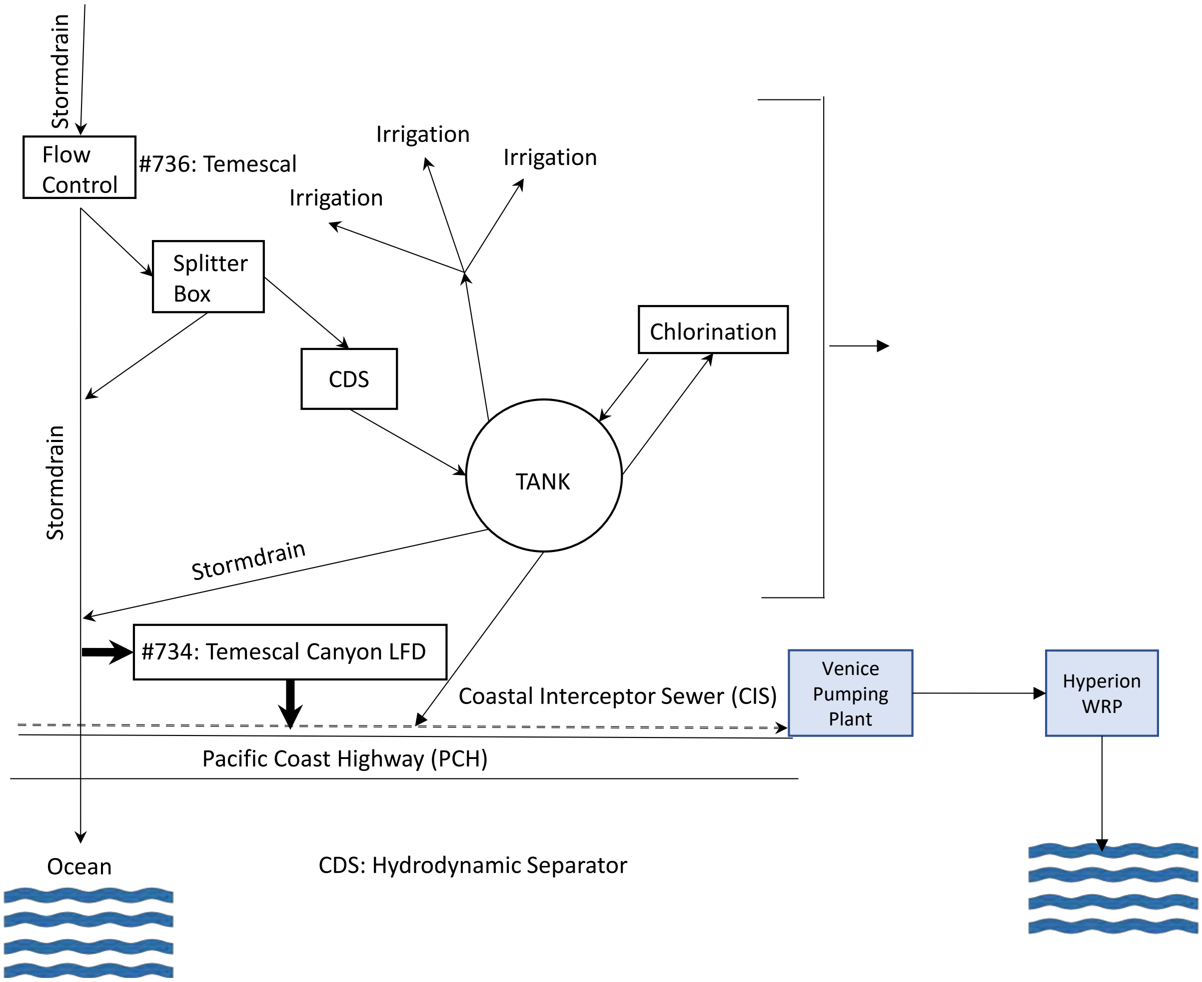


Figure 4-27. Conceptualization of the Temescal Canyon DWD (#734) and the Park Storage Facility

4.4.2.2 Rainfall-runoff Analysis

To create the application of the WMMS for the Temescal Canyon subwatershed, the rainfall data from Gauge AL461 were used. Similar to the application of the model for the SMC subwatershed, the hydrology data for the model were extended through the 2019 period from the original end point in 2012. The extension of the simulation period was necessary to: (1) represent more recent DWD data, which are often relatively more accurate with better quality control than data from an earlier period, (2) capture the changes in operations as a new DWD structure is either added to the original location or has altered its operation in the recent years, and (3) present the same Hyperion WRP flow analysis period as described in Section 3.

Runoff in the Temescal Canyon subwatershed is influenced by land use and soil type, slope, vegetation, and many other conditions. The open and vacant areas with steep canyons concentrate storm runoff. Due to increased imperviousness, the developed areas decrease runoff concentration times, which results in increased runoff volumes and rates. The WMMS model includes land uses representing different types of urban, residential, commercial, industrial, roads, and vacant areas (Figure 4-28). Approximately 89 percent of the subwatershed is an open-space recreation area. Therefore, a large portion of the tributary area is pervious, which would result in relatively less runoff volume than a similar impervious area.

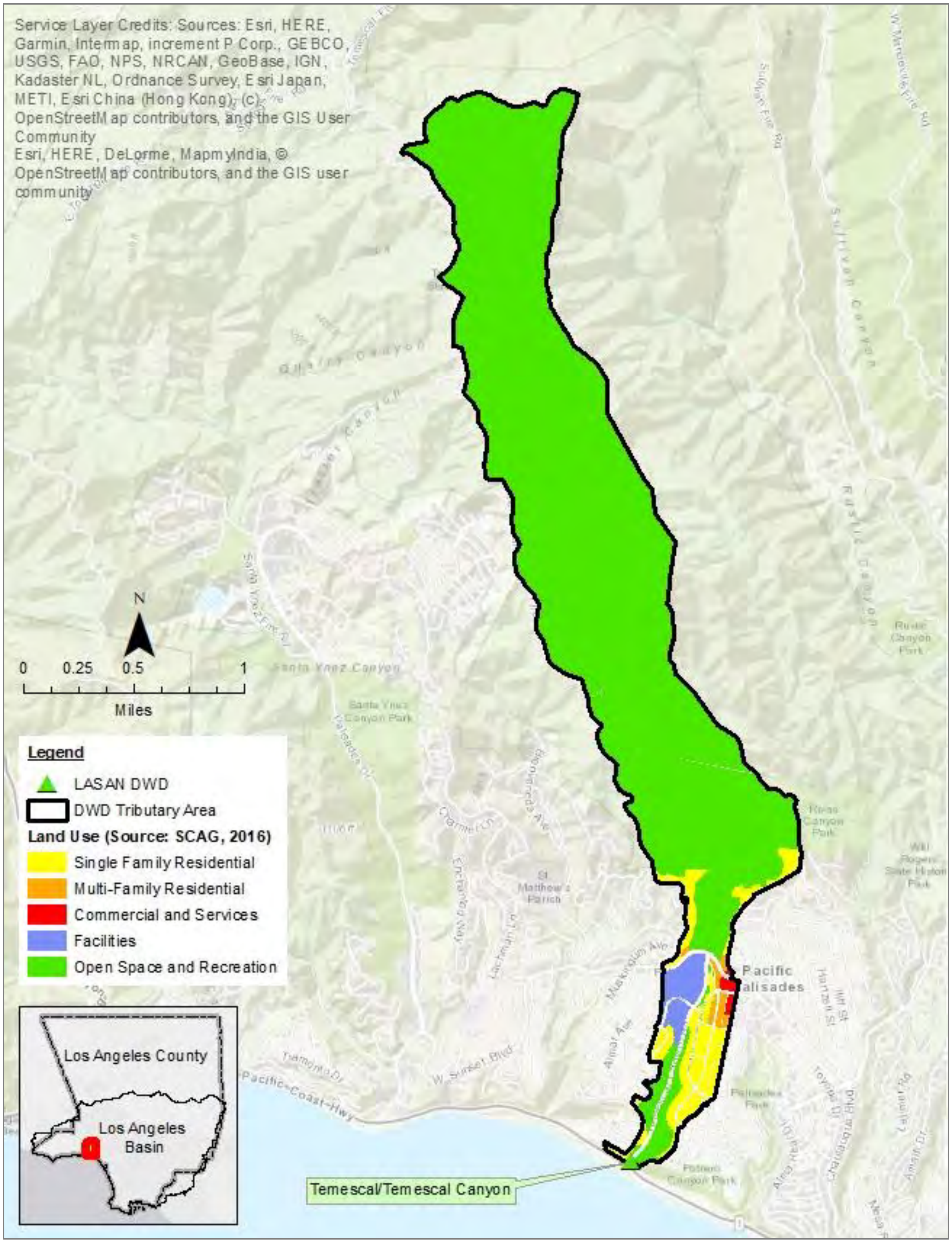


Figure 4-28. Temescal Canyon Subwatershed Showing Land Uses

Figure 4-29 shows the rainfall-runoff evaluation from 2010 to 2019, for the Temescal Canyon subwatershed. The maximum flow simulated by the WMMS model was approximately 1.7 MGD in 2013, and 15 MGD in 2017. The average flows during dry year 2013 and wet year 2017 were 0.03 and 0.29 MGD, respectively. Flow duration data for daily mean modeled flows were analyzed to understand the exceedance probability or the flow duration. Figure 4-30 shows the exceedance frequency of modeled flow. As this figure shows, only 10 percent of the simulation period flow exceeded 1.8 MGD. Note, the Temescal Canyon DWD is designed to divert a maximum flow of 5 MGD from the storm drain to the sanitary sewer system.

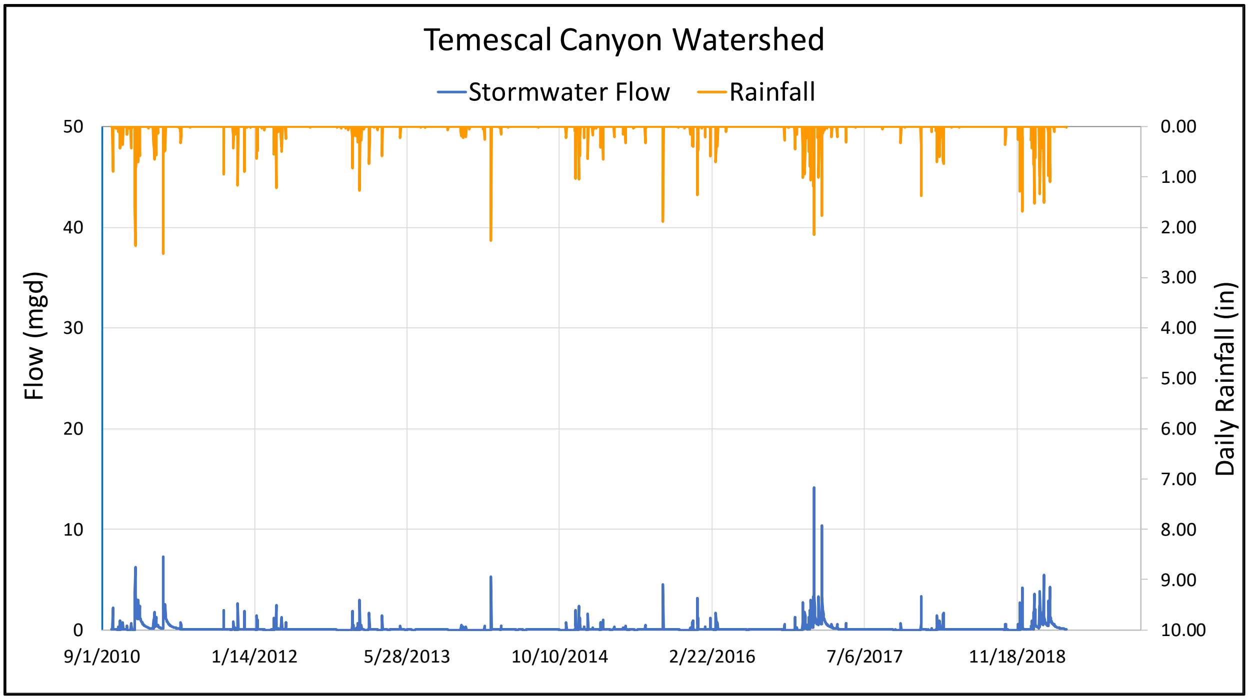


Figure 4-29. Mean Daily Simulated Flow: WMMS Model Output for the Temescal Canyon Subwatershed

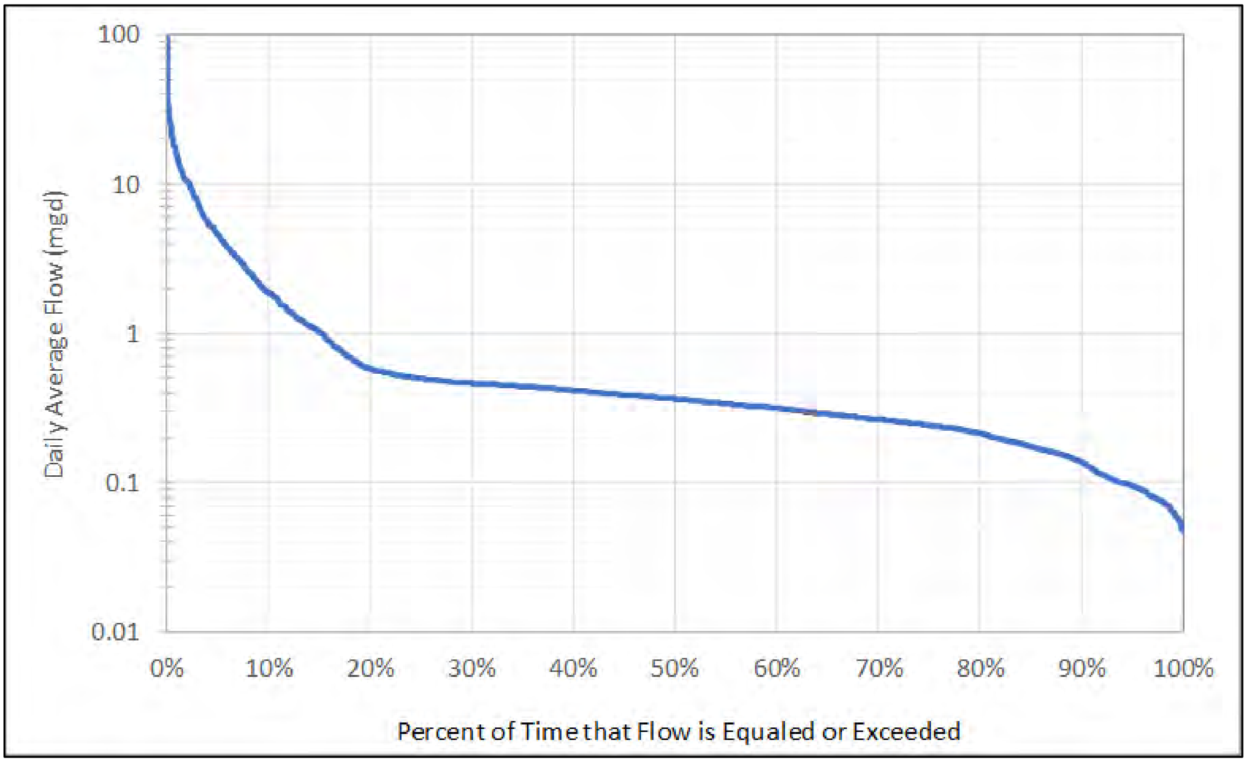


Figure 4-30. Flow Exceedance: Model Output for the Temescal Canyon Subwatershed from 2010 to 2019

From the preliminary analysis, it appears that the stormwater runoff is less than 2 MGD for approximately 86 percent of days with rainfall from 2010 to 2019. Approximately 0.9 inch of rainfall (85th percentile in 24-hour period) produced 2.6 MGD of runoff. The variability in flows depends on several factors, including rainfall intensity, storm duration, soil moisture content, days preceding a storm event, and single-day versus multiple-day storm events. Based on the DWD capacity analysis (Section 2), it appears that the Temescal Canyon DWD has allowable capacity to divert more flows than those generated during the dry weather period. Questions remain regarding how much flow the Temescal Canyon DWD can divert in wet weather without burdening the sanitary sewer system and when those flows can safely be delivered to the sanitary sewer system.

4.4.2.3 Sanitary Sewer System

The analysis of the sanitary sewer system's capacity to deliver stormwater by the Temescal Canyon DWD to the Hyperion WRP is similar to the SMC DWD, as described earlier, because both of these DWDs lie in the same segment of the CIS discharging to the Hyperion WRP, with one being slightly upstream from the other (Figure 4-17).

As noted, the sanitary sewer system capacity is currently insufficient to carry flows greater than those generated during the dry weather period. Some modifications in the sanitary sewer system would be required to manage flows diverted from storm events during wet weather. A thorough investigation of the entire sanitary sewer system from the DWD location to the Hyperion WRP is needed, and should consider the cumulative effects of all DWDs, upstream and downstream of the Temescal Canyon DWD to the Hyperion WRP. The sanitary sewer system is complex, with pipe sizes changes at a number of locations, and several localized capacity constraints may exist. The DWD could be optimized in conjunction with the sanitary sewer system to allow for the expansion of these diversions to accept additional wet weather runoff.

4.4.2.4 Storage Potential

Based on the capacity analysis (Section 2), it seems that the Temescal Canyon DWD can deliver flow to the sanitary sewer system during wet weather, provided additional storage facilities can be developed. In case of storm events, the storage tanks could detain water, which can be released to the sewer system through the DWD during the off-peak hours. Based on the review of the land uses and vacant areas in the Temescal Canyon DWD subwatershed, it appears that storage for stormwater can be explored in some areas (for example, in the parking lot near Will Rogers State Beach). Other potential locations may include open/park spaces in the subwatershed.

4.4.2.5 Lessons Learned

The following information about the Temescal Canyon DWD was obtained from the field visit and operator interviews:

- The pump start and shutoff operation at this DWD is operated manually. The SCADA-controlled pump operation, aided with automatic level sensors, would improve the operations and facilitate the diversion of more than dry weather flow.
- For this analysis, the DWD flow to the sanitary sewer system was derived from the pump run time, which is a rough approximation of actual operations (Section 2). The installation of flow meters is recommended to properly monitor flow. The installation and operation of a mag meter will improve monitoring capabilities by real-time flow data.
- An automated smart network would enable the DWD's operation from a central location.
- Regular maintenance is needed; specifically, during storm events to clear debris from the intake screen of the DWD and sediment from the channel. If the inlet sluice gates to the wet well are not closed during storm events, excessive amounts of debris may need to be removed to prevent damage to the pumps.
- The pumps need to be turned off in a timely manner during wet weather events to avoid impacts to the sewer system.

4.4.2.6 Conclusions and Recommendations

It was determined that the Temescal Canyon DWD has capacity to potentially deliver more flows beyond the dry weather flows with the existing structure; however, the DWD infrastructure available capacity is applicable only during dry weather periods when the sewer system is able to handle flows. The sanitary sewer system analysis suggests that the diversion cannot accommodate the entire runoff volume from the 85^{th} percentile storm event due to limited sanitary sewer capacity to the Hyperion WRP because the RDI/I uses the capacity of the sewer system during major storm events.

The diversion is currently managing some wet weather runoff, but the amount of diverted wet weather runoff is not clear. The storage facility upstream of the diversion is not yet fully operational for park irrigation purposes, but it is used to store stormwater and discharge to the diversion after the storm event. Accurate flow data are needed to identify the amount of stormwater runoff currently diverted by the diversion.

With the existing DWD capacity of 5 MGD, it appears that the diversion may already be diverting a portion of the first-flush stormwater runoff from the subwatershed. A proper investigation and analysis with refined flow data and storage in the park will be necessary to make an accurate assessment.

A telemetry system is recommended at the diversion structure. The telemetry system should include flow transducers and equipment to remotely control the flows at the diversion. Flow meters at key locations of the diversion would provide better control of flow during dry and wet weather periods.

A complete assessment and the optimization of the existing diversion are recommended, considering storage and the use of water for park irrigation.

4.4.3 Case Study No. 3 – Manhattan Beach Pump Plant Dry Weather Diversion

4.4.3.1 Dry Weather Diversion Background

In an effort to meet the requirements of the dry weather SMB Bacteria TMDL, the LACFCD constructed a DWD at the Manhattan Beach PP within Polliwog Park (Photo 4-3). This DWD was constructed to divert the upstream urban dry weather runoff to the sanitary sewer and reduce discharges to the receiving waterbody. However, this project only addresses the dry weather runoff from the uppermost portion of the subwatershed and it does not treat the additional dry weather runoff that enters the storm drain downstream of this DWD. To address this need, the LACFCD constructed a second diversion facility at the downstream end of the subwatershed (at 28th Street and the Strand).

The DWD operated by LACFCD at the Manhattan Beach PP is the case-study project. This facility primarily serves as a pumping plant for a localized low point at Polliwog Park in Manhattan Beach. The park has a pond, which is used for aesthetic purposes, as well as for stormwater retention during rain events (Photo 4-3). The DWD is located in a grassy area adjacent to a parking lot within the Manhattan Beach PP. It is located within Polliwog Park and is not within a Flood Control District channel right-of-way. The project site is adjacent to Manhattan Beach Boulevard.

The Manhattan Beach PP DWD project site is largely recreational and is within a largely suburban area. The construction of the DWD was completed in 2004; however, modifications to the sampling locations, diversion pump, and flow meter’s electrical system delayed the operation of the DWD until 2006. To alleviate a problem with pinecones clogging the diversion pump and causing it to fail, a trash screen was installed around the pump. Due to these problems, the DWD was offline until September 2006. After equipment was modified, a new pump was installed and electrical repairs were completed. The DWD became fully operational in September 2006. The DWD currently operates year-round during dry weather conditions and delivers flow to the JWPCP. Approximately 2.8 million gallons of flow were diverted to the sanitary sewer at the Manhattan Beach PP DWD between April 15 and November 5, 2007 (LACFCD, 2008). All dry weather runoff is stored in the PP sump.

The large pond makes Polliwog Park a wildlife refuge for ducks, geese, and other migratory birds. Polliwog Park becomes Polliwog Lake during storm events. The park was flooded on January 23, 2017 due to heavy rain events. The park functions as a retention basin for LA County and it is designed to store stormwater during rain events. LA County regulates the amount of water that flows through the pump station based on the capacity of the stormwater system at that time. During significant rain events, water at the lake is stored until it can enter the system without overwhelming it. Polliwog Lake is designated by the City of Manhattan Beach as a “hot spot,” which is assigned priority for attention during storm events.

This DWD diverts dry weather runoff generated from 400 acres of tributary area (Figure 4-31) and discharges to the JWPCP via an 18-inch local city sewer line. The LACSD sewers downstream are larger and vary in size down to the JWPCP. The system had approximately 68,000 gallons of storage beyond the wet well and is equipped with an automatic rain gauge shutoff mechanism. The sanitary sewer discharge capacity for this DWD is 50 gpm (0.07 MGD), which is the least among all the DWD case-study projects.

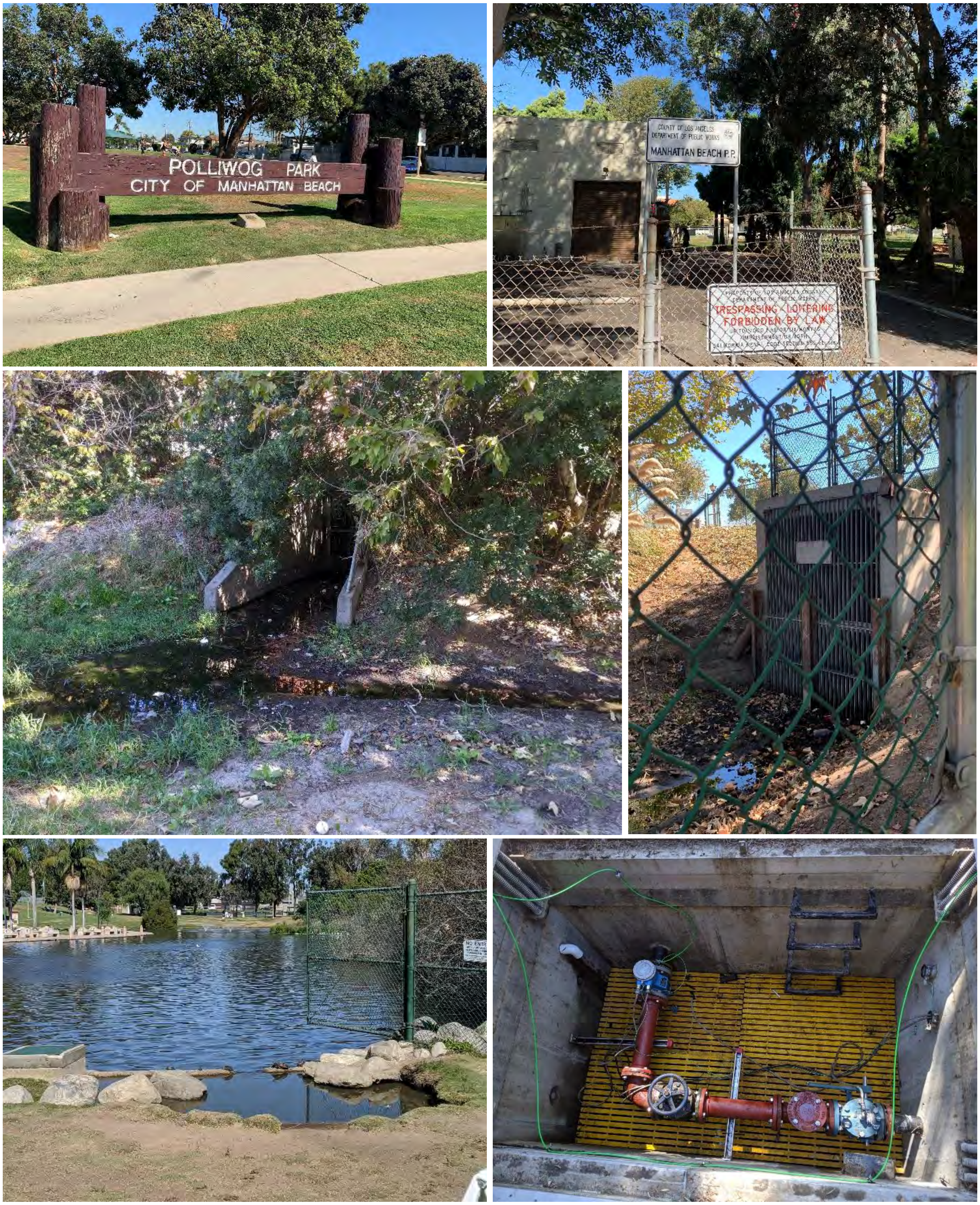


Photo 4-3. Manhattan Beach Pumping Plant and Storage at Polliwog Park Pond; Photographs Taken During the October 22, 2019 Site Visit with Los Angeles County Flood Control District Staff

The LACFCD conducts pre-storm maintenance activities, such as regular inspections of the facility, cleaning of catch basins and drains, cleaning of sumps at pump stations, and testing of main and backup pumps at the pump station at this location.

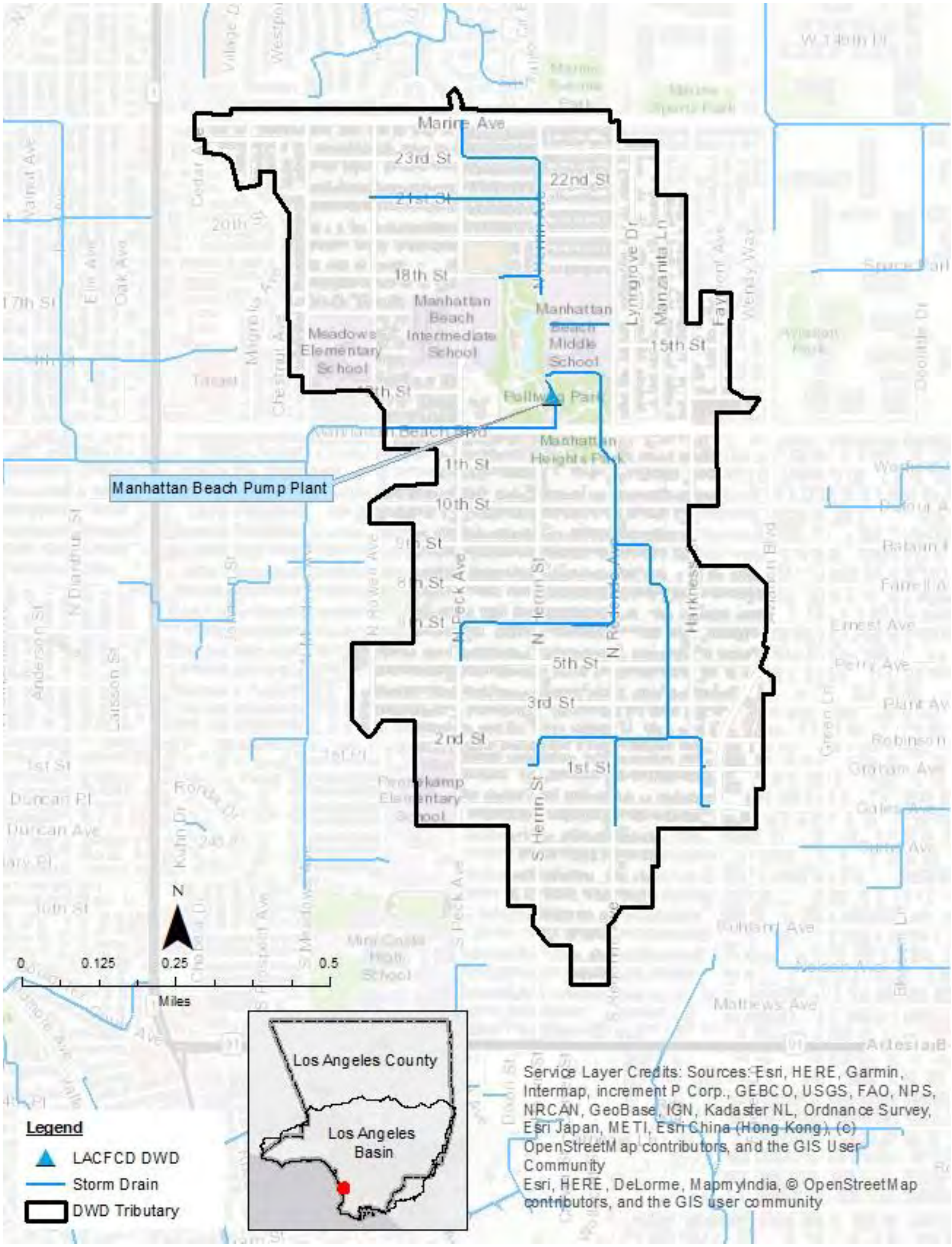


Figure 4-31. Manhattan Beach Pump Plant DWD Subwatershed Showing the Drainage Area and the Storm Drain Network

4.4.3.2 Rainfall-runoff Analysis

To create the application of the WMMS for the Manhattan Beach PP DWD subwatershed, rainfall data from Gauge AL461 were used. Similar to the application of the model for the other DWD case studies, the model hydrology data were extended through the 2019 period from the original end period of 2012 in the model. The data extension of the simulation period was needed to accommodate operational changes in recent years and to conduct analysis with a higher quality dataset for the DWD and the JWPCP inflows.

As noted, runoff from the subwatershed is influenced by many factors, such as land use and soil type, slope, vegetation, and many other conditions. The WMMS model includes a representation of various types of land uses (for example, different types of urban, residential, commercial, industrial, roads, and vacant areas) (Figure 4-32). Most of the subwatershed area is a built up area with a lot of imperviousness. Intuitively, the runoff per acre from this subwatershed would be higher than the other three case-study DWDs that have a substantially higher pervious area in their subwatersheds. Due to increased imperviousness, the developed areas decrease runoff concentration times, which results in increased runoff volumes and rates.

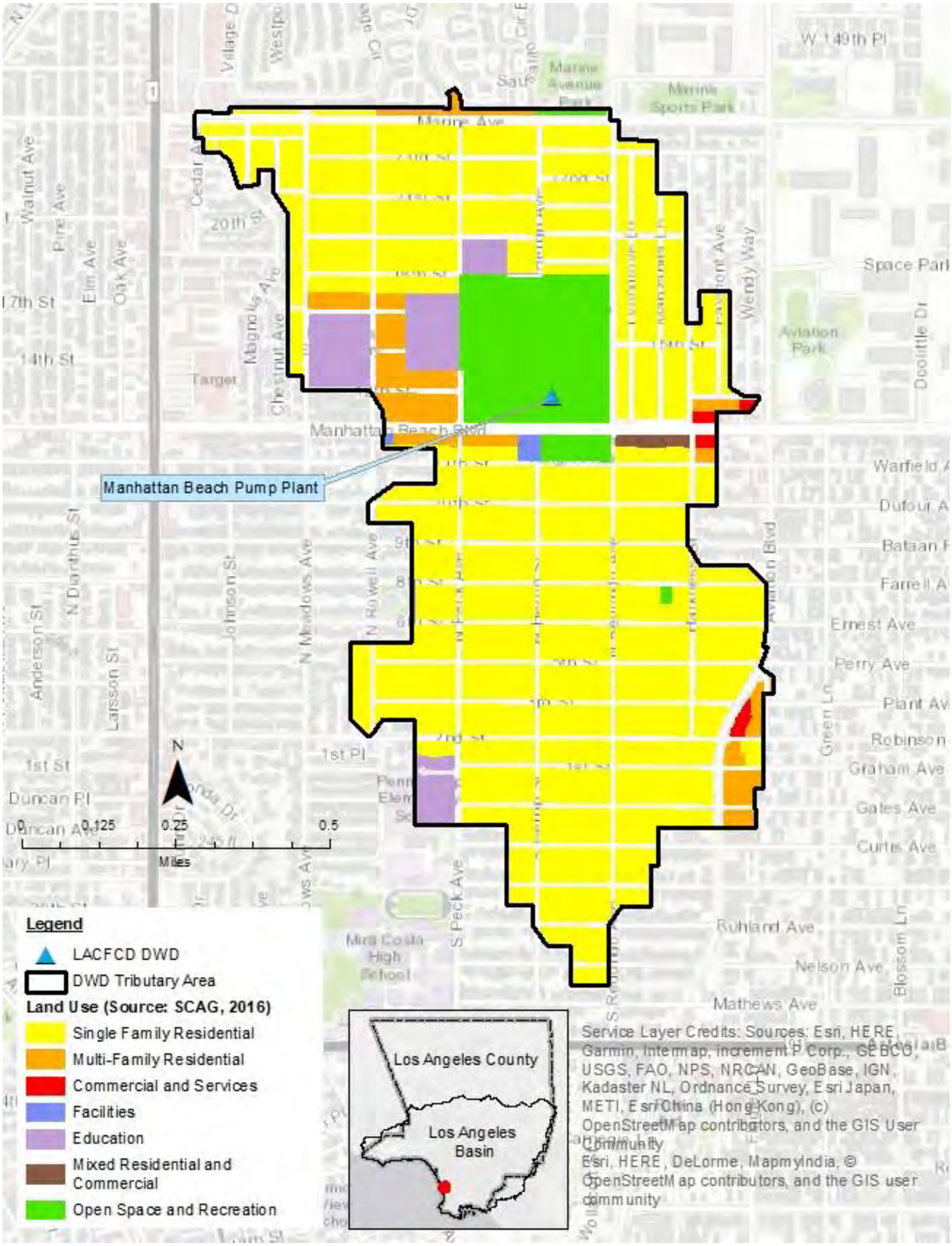


Figure 4-32. Manhattan Beach Pump Plant Dry Weather Diversion Subwatershed Showing Land Uses

Figure 4-33 shows the simulated rainfall-runoff calculation for the period from 2010 to 2019, for the Manhattan Beach PP DWD subwatershed. The WMMS model was used to simulate the runoff generated from the drainage area of the subwatershed. The maximum flow calculated by the model was approximately 4.5 MGD in dry year 2013 and 16.2 MGD in wet year 2017. The average daily flows in 2013 and 2017 were 0.1 and 0.3 MGD, respectively. Flow duration data for daily mean modeled flows were analyzed to understand the exceedance probability. Figure 4-34 shows the exceedance frequency of modeled flow. As the plot shows, only 10 percent of the simulation period flow exceeded 0.12 MGD.

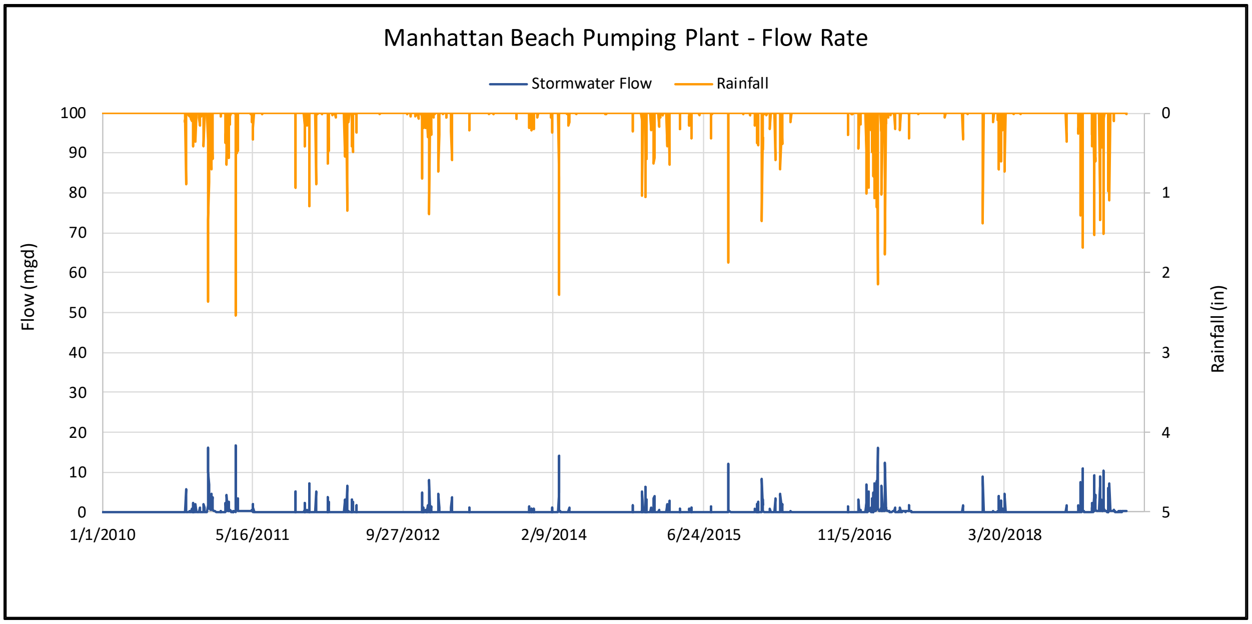


Figure 4-33. Mean Daily Flow: WMMS Model Output for the Manhattan Beach Pump Plant DWD Subwatershed

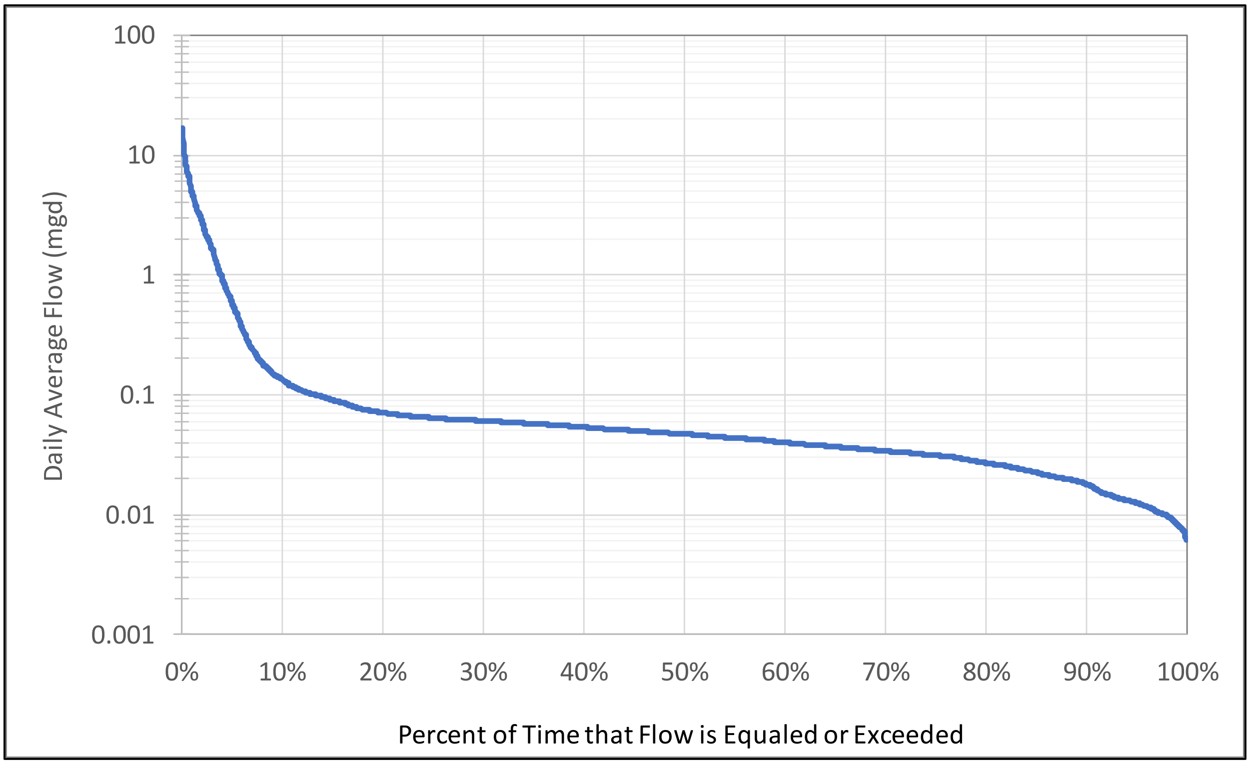


Figure 4-34. Flow Exceedance: Model Output for the Manhattan Beach Pump Plant Dry Weather Diversion Subwatershed from 2010 to 2019.

Based on the DWD capacity analysis (Section 2), it appears that the Manhattan Beach PP DWD has limited capacity to divert wet weather runoff. It is important to determine how much flow the Manhattan Beach PP DWD can divert in wet weather without causing any regulatory or operational concerns for the sanitary sewer system.

4.4.3.3 Sanitary Sewer System

The LACSD operates 10 WRPs and 1 ocean discharge facility, the JWPCP, which has capacity to treat approximately 510 MGD. Information on the Sanitation Districts' service area and WRPs can be found at: https://www.lacsd.org/services/wastewater/wwfacilities/wwtreatmentplant/default.asp.

Seventeen of the 24 independent districts in the Sanitation Districts' partnership have joined together to share a regional, interconnected sewerage system called the Joint Outfall System (JOS). The JOS covers approximately 660 square miles, from the foothills of the San Gabriel Mountains in the north to San Pedro Bay in the south, and from the Los Angeles City limits on the west to the Los Angeles County border on the east. The service area of the JOS encompasses 73 cities and unincorporated territory, and includes some areas within the City of Los Angeles. The JOS includes the JWPCP in Carson and six satellite WRPs, built near rivers to allow for the disposal of the treated water that is not reused. The six WRPs include:

1) La Cañada WRP (La Cañada- Flintridge)
2) Long Beach WRP (Long Beach)
3) Los Coyotes WRP (Cerritos)
4) Pomona WRP (Pomona)
5) San Jose Creek WRP (near the City of Whittier)
6) Whittier Narrows WRP (near South El Monte)

Large trunk sewers convey organic materials removed at the WRPs, along with certain industrial waste flows, to the JWPCP for treatment. Figure 4-35 shows a map of the JOS, including the 17 independent districts, large trunk sewers, 6 WRPs, and JWPCP.

The JOS provides the benefit of local control and the advantage of a shared regional sewerage system. Approximately two-thirds of the wastewater in the JOS is treated at the JWPCP. The system also includes trunk sewers and pumping plants that convey sewage from member cities' local sewers to the Sanitation Districts' treatment plants. Sanitation District No. 2 acts as the agent for the other signatory Sanitation Districts in administering the Joint Outfall Agreement.

(Source: LACSD 2020)

Figure 4-35. Joint Outfall System, Showing 17 Independent Districts, Large Trunk Sewers, 6 Water Reclamation Plants, and the Joint Water Pollution Control Plant

It was learned from the operator interviews that the influent flows to the JWPCP can increase by 50 to 100 percent during a 24-hour period of a rain event. Instantaneous peak flow can be much greater. Although RDI/I has been reduced, localized street flooding can still result in substantial water entering the sanitary sewer system through MHs. The location of the storm also affects influent flows to the JWPCP, and it is most likely affected by storms near the facility. Rain events farther away in the JWPCP service area have a lesser effect on the JWPCP influent flows because the upstream WRPs handle flows up to their capacities and the remaining flows are passed on to the JWPCP.

The Sanitation Districts provided a preliminary assessment of sanitary sewer system capacity for the Manhattan Beach PP DWD discharges under various flow conditions. The sanitary sewer system was analyzed from Polliwog Park, where the DWD is located, to the JWPCP. Figure 4-36 is a screen capture of the sanitary sewer network showing the flow trace from Polliwog Park to the JWPCP. As this figure shows, the Sanitation Districts' sewer system downstream of Polliwog Park is complex, with a number of locations where the flow splits and rejoins. The sewer network has several localized capacity constraints. In addition, the downstream sewers (downstream of Polliwog Park) will also receive post-storm flows from the Alondra Park Project and the Carriage Crest Park Project that are under design/construction; however, these projects are downstream of the controlling sewer segment.

To determine the sanitary sewer system capacity, the Sanitation Districts used Clearance Diagrams representing the available capacity in the sanitary sewer system based on sewer flow monitoring, hydraulic calculations, and best professional judgement.

(Source: LACSD 2020)

Figure 4-36. Flow Trace in the Sanitary Sewer System from Polliwog Park to the Joint Water Pollution Control Plant

Wet weather diversion potential - Currently, there is no modeling system that uses rainfall forecasts, real-time Los Angeles Countywide rainfall data, and real-time sewer level monitoring to optimize the sanitary sewer system, to understand when and where flow can be accepted during a storm. Based on the analysis provided by the Sanitation Districts, it was determined that the Manhattan Beach PP DWD cannot accept flows beyond 0.1-inch rainfall in its existing condition. The development and calibration of a robust wet weather model and/or storage will be needed to assess the capture flow beyond dry weather conditions.

Stored stormwater diversion potential - The sanitary sewer system analysis shows that a diversion that enters the Sanitation Districts' Joint Outfall D Unit 9 Trunk Sewer at MH D204 at a flow rate of 3 cfs (1.94 MGD or 1,350 gpm) can be safely conveyed to the JWPCP during dry weather. This allowable flow rate increases to 3.2 cfs (2.07 MGD or 1,436 gpm) between 10 p.m. and 8 a.m. Typically, diversions are prohibited from restarting until 24 hours after the end of a rainfall event. For this location, it was determined that the delay in restarting the flow after a storm event can be shortened to 12 hours. To make changes in the operations of the existing DWD to enhance stormwater diversion potential, a strategy will need to be developed to determine the storage potential at this location. The primary objective of the strategy would be to store water from the leading edge of the storm and release it following 12 hours of a storm event up to a total of 3 or 3.2 cfs. To deliver more wet weather runoff to the sewer system, the current Manhattan Beach PP DWD capacity of 50 gpm (0.07 MGD) needs to be increased. More data and analysis would be needed to determine how much capacity exists immediately after a storm event.

This high-level assessment suggests that the sanitary sewer can accommodate some wet weather runoff. The Sanitation Districts will continue to require controls and telemetry systems to shut off diversion pumps during storms and allow the Sanitation Districts to shut off diversions during emergency events where sewer system capacity and/or treatment plant capacity is becoming limited.

4.4.3.4 Storage Potential

Based on the high-level review of the land use in the Manhattan Beach PP DWD subwatershed, it appears that storage for stormwater can be challenging. Potential opportunities to store wet weather runoff and discharge during off-peak hours could include: (1) deepening or expanding the Polliwog Park pond, and (2) using of a number of baseball fields around the park for BMPs to store stormwater, such as constructing cisterns.

4.4.3.5 Lessons Learned

The following information about the Manhattan Beach PP DWD was obtained during a field visit and operator interviews:

- Wet weather runoff could not be stored in the existing storm drain/PP facility on a regular basis without substantial modifications to the detention pond/park area.
- As the DWD is located within Polliwog Park and is adjacent to Manhattan Beach Boulevard, which is a heavily travelled street, any project upgrades will require a lot of planning and public outreach.
- Regular maintenance is needed, specifically during storm events to clear debris and sediments from the intake screen of the DWD.
- Pumping capacity at the Manhattan Beach DWD will need to be increased to accommodate more flows during wet weather.
- An efficient data management system (for example, a comprehensive database) is needed to keep flow and pump data in one place.

4.4.3.6 Conclusions and Recommendations

To determine the capacity available in any section of the sewer during storm events, the following recommendations can be drawn from this analysis:

- The capacity of the Manhattan Beach PP DWD will need to be increased to accommodate wet weather flows. In addition, the conveyance system for the Manhattan Beach PP DWD has capacity constraints, and it will be difficult to accept wet weather runoff because the sanitary sewer system downstream of Polliwog Park is complex, with a number of locations where the flow splits and rejoins. Based on the conveyance capacity analysis provided by the LACSD for this DWD, it was determined that this DWD cannot accept upstream wet weather runoff generated from more than 0.1 inch of rainfall in 24 hours under existing conditions.
- Conduct sanitary sewer system analysis on a case-by-case basis from the point of diversion to the JWPCP using the historical flow data. It is also important to understand the design condition for the sanitary sewer system and evaluate whether more flows can be added without causing any overflows.
- Analyze the downstream sanitary sewer system along with any ongoing projects (for example, a new industrial wastewater discharge) to determine the constraining flow locations in the entire system given future flows.
- Determine the cumulative impact of flow from other DWDs in the same segment of the sanitary sewer system to the JWPCP during the post-storm period, to evaluate the entire sanitary sewer system's capacity to accept stormwater that has been stored until after the storm.
- Develop a smart modeling system that uses rainfall forecasts, real-time Los Angeles Countywide rainfall data, and real-time sewer level monitoring to allow for additional flow during the leading edge of smaller storms and to understand when and how the diversion system can be safely operated. Use this smart system to understand where, when, and how the sanitary sewer system can handle additional wet weather. A 12-hour lag of discharge from a storm event can be used as guidance for the storage volume evaluation.
- Develop mitigation strategies (for example, stormwater storage) to handle the sanitary sewer system capacity limitations with better flow control.

4.4.4 Case Study No. 4 – Pershing Drive Dry Weather Diversion

4.4.4.1 Project Background

The LACFCD-managed Pershing Drive DWD is located on Imperial Highway, adjacent to the Hyperion WRP (Figure 4-37, Photo 4-4). This facility is unique, because it is connected directly to the City's North Outfall Relief Sewer to discharge flows to the Hyperion WRP. This facility next to the Hyperion WRP can be beneficial because the direct connection avoids any limitations of the sanitary sewer system. Minimal travel time from the DWD to the Hyperion WRP may provide opportunities to operate the facility during wet weather.

This diversion is installed on an underground storm drain system to divert dry weather runoff generated from 2,000 acres of tributary area, and discharges to the Hyperion WRP via a 4-inch sewer line. The Pershing Drive DWD was constructed in 2006.

Figure 4-37. Location of the Pershing Drive Dry Weather Diversion Discharging to the Hyperion WRP

Inflow to the DWD is gravity-driven, and the diversion is equipped with valves to control the maximum flow rate and prevent backflow. Photo 4-4 shows the underground storm drain and the berm that diverts flows to the sanitary sewer system. This DWD is shut off manually before rain events projected to be 0.1 inch or greater. Figure 4-38 shows the storm drain network for the subwatershed.

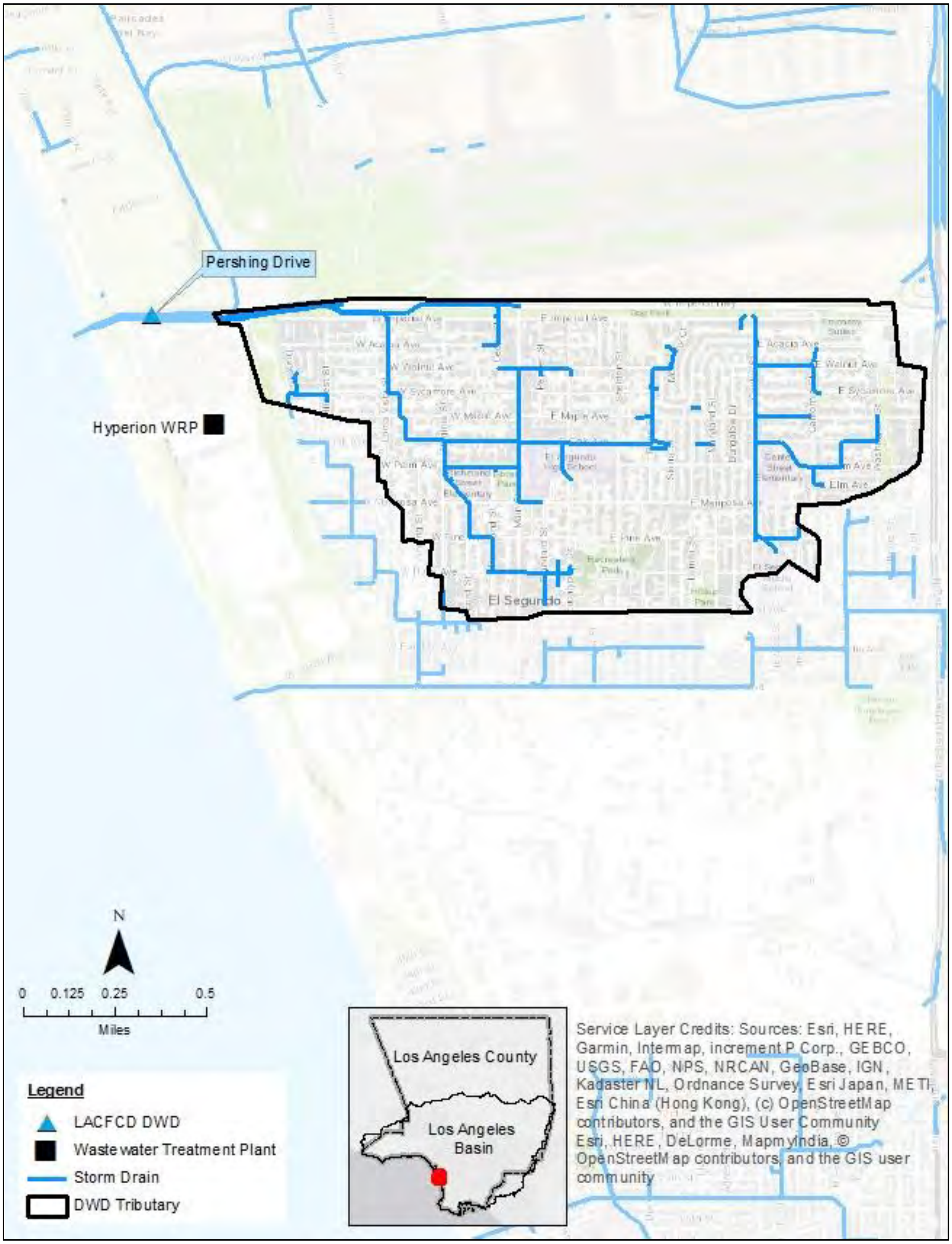


Figure 4-38. Pershing Drive DWD Subwatershed Showing the Drainage Area and the Storm Drain Network

Photo 4-4. Pershing Drive DWD; Photographs Taken during the October 22, 2019 Site Visit with Los Angeles County Flood Control District Staff

4.4.4.2 Rainfall-runoff Analysis

To create the application of the WMMS for the Pershing Drive DWD subwatershed, the rainfall data from Gauge AL461 were used. Similar to the application of the model for the other DWD case studies, the model was extended through the 2019 period from the original end period of 2012. As mentioned, the extension of the simulation period was needed to conduct analysis for a recent time period when the better dataset for the DWD and the Hyperion WRP flows was available.

As stated, the runoff from the subwatershed is influenced by land use and soil type, slope, vegetation, and many other conditions. The WMMS model includes a representation of various types of land uses (for example, different types of urban, residential, commercial, industrial, roads, and vacant areas) (Figure 4-39). Due to increased imperviousness, the developed areas decrease runoff concentration times, which results in increased runoff volumes and rates.

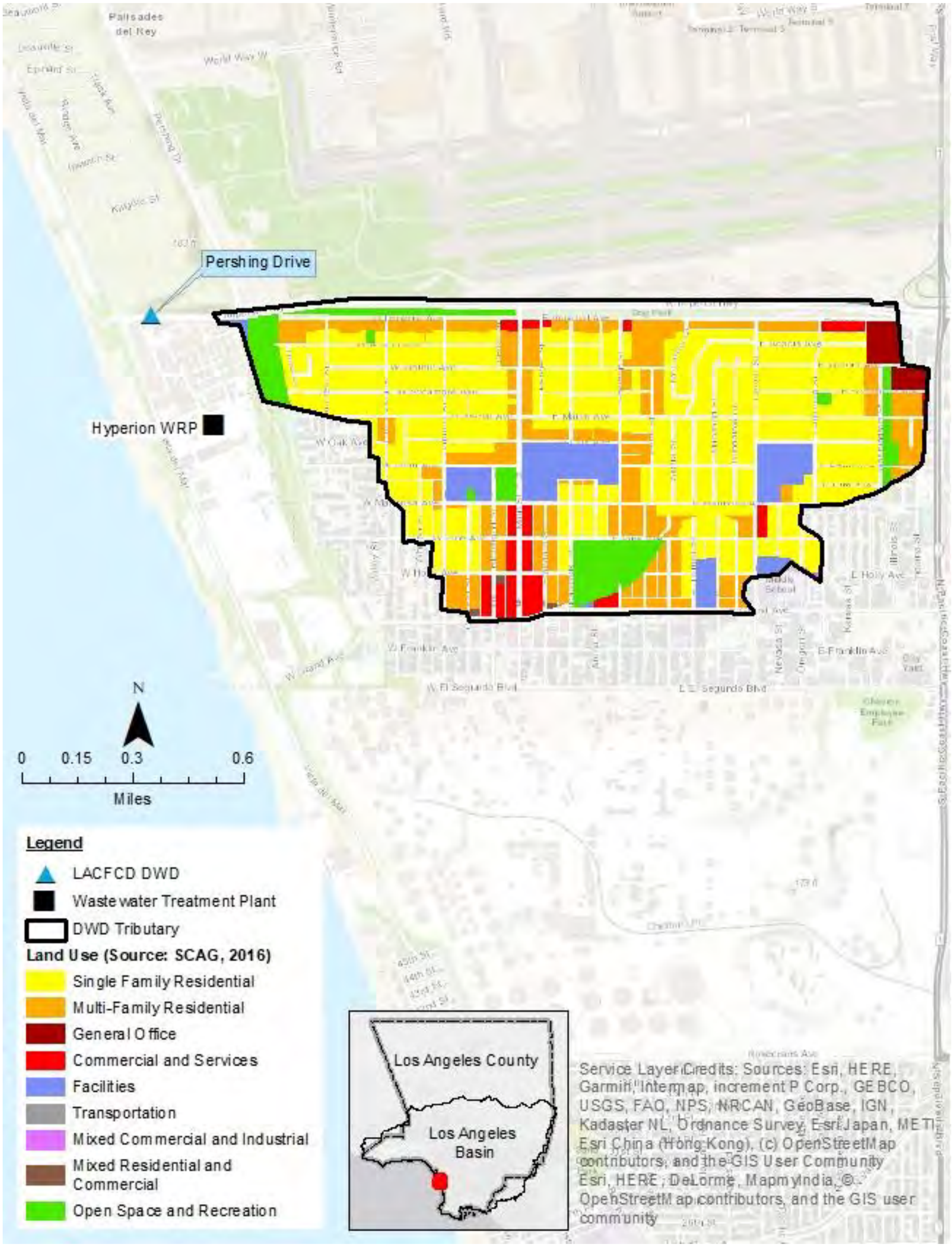


Figure 4-39. Pershing Drive DWD Subwatershed Land Uses

Figure 4-40 shows the rainfall-runoff plot for the period from 2010 to 2019, for the Pershing Drive DWD subwatershed. The WMMS model was used to simulate the runoff generated from the drainage area of the subwatershed. The maximum flow calculated by the model was approximately 8.6 MGD in dry year 2013 and 29.1 MGD in wet year 2017. The average flows in 2013 and 2017 were 0.12 and 0.50 MGD, respectively.

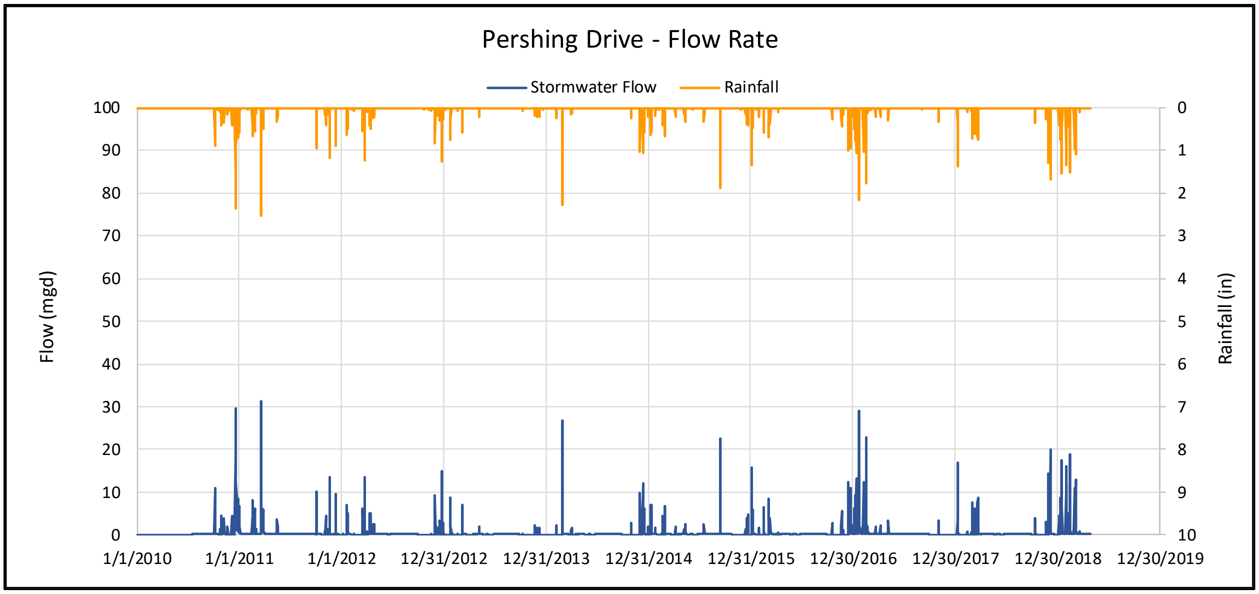


Figure 4-40. Mean Daily Flow: WMMS Model Output for the Pershing Drive Dry Weather Diversion Subwatershed

Flow duration data for daily mean modeled flows were analyzed to understand the exceedance probability. Figure 4-41 shows the exceedance frequency of modeled flow. As the plot shows, less than 5 percent of the simulation period flow exceeded 1 MGD. Approximately 80 percent of the simulated period flows were less than 0.1 MGD.

Note, that the Pershing Drive DWD facility is designed to divert a maximum flow of 240 gpm (0.35 MGD) from the storm drain to the sanitary sewer system during a dry weather period.

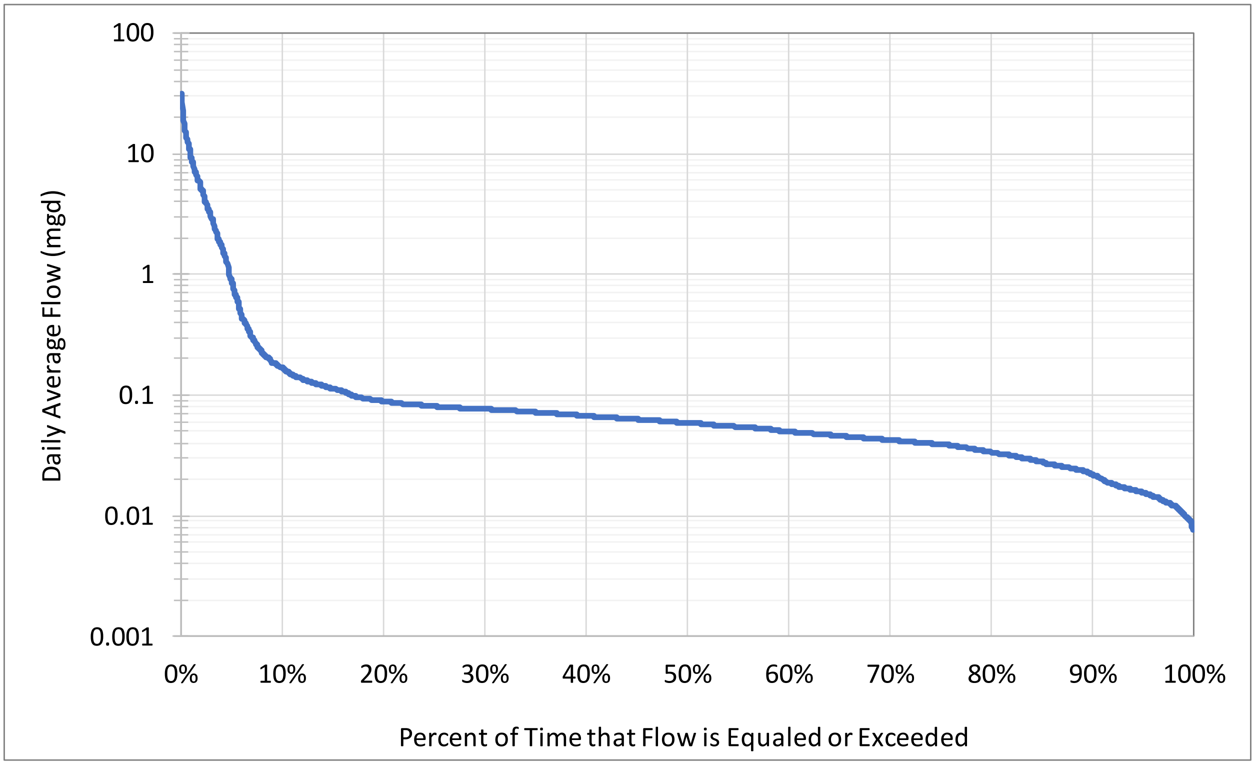


Figure 4-41. Flow Exceedance: Model Output for the Pershing Drive DWD Subwatershed from 2010 to 2019

4.4.4.3 Sanitary Sewer Capacity

LASAN staff assessed the sewer sanitary sewer capacity for the case-study DWDs that discharge to the Hyperion WRP. The Pershing Drive DWD was not included in this modeling analysis, because of how close it is to the Hyperion WRP (it is immediately upstream). The travel time of flow from this location to the Hyperion WRP is too short to conduct such analysis, as conducted for the Temescal Canyon and SMC DWDs. In addition, there is a direct connection of a 4-inch storm drain to the 150-inch CIRS, which may assist receiving storm discharges with direct delivery to the Hyperion WRP.

Further sanitary sewer system analysis is needed for the wet weather runoff. Like all other DWDs, the Pershing Drive DWD is designed to operate during dry weather. Flow exceeding the dry weather flow requires detailed analysis with the option of storage to offset the peak discharge during a storm event. The possible direct connection to the Hyperion WRP was not evaluated in this analysis.

4.4.4.4 Storage Potential

Based on the review of the land uses in the Pershing Drive DWD subwatershed, it appears that storage for stormwater can be challenging. Detailed options of above- and below-ground storage facilities can be investigated; these may include hardscape structures and elements (like walkways, parking lots, and parks) through the use of cisterns, rain storage tanks, or manufactured galleries or storage products, to store water during storm events and discharge to the sanitary sewer system after rain events.

4.4.4.5 Lessons Learned

The following information was obtained from the field visit to the DWD and operator interviews:

- The diversion is shut off manually before events projected to be 0.1 inch or greater.
- The diversion is on a telemetry system, which records whether the diversion is operational, and whether the pump is on.
- Regular maintenance is needed, specifically during storm events to clear debris and sediments from the intake screen of the diversion.
- An efficient data management system (for example, a comprehensive database) is needed to keep the flow and pump data in one place needed.
- The diversion structure is above the high tide and wave wash zone; however, it needs periodic maintenance to ensure performance.

4.4.4.6 Conclusions and Recommendations

The proximity of the Pershing Drive DWD to the Hyperion WRP offers a unique benefit for handing additional flows during wet weather, provided that DWD infrastructure changes, potential storage, and sanitary sewer capacity of the pipe from diversion to the sewer line that discharges to the Hyperion WRP can be accommodated. This DWD was selected as a case-study project because it may be connected to the inflow pipe to the Hyperion WRP without connecting to the CIS, which will already be stressed with flow from the sewershed during wet weather. This alternative connection needs to be evaluated for a wet weather scenario.

A refined telemetry system is recommended at the diversion structure. The telemetry system should include flow transducers and equipment to remotely control the flows at the diversion. Based on the flows at the headworks of the Hyperion WRP, a centrally located SCADA system will provide flexibility for better operational control of the diversion. In addition to the systems controls, installation of variable frequency drive pumps for the diversions can provide operational flexibility for the system to adjust pump speeds with flow variations.

4.5 Conclusions and Recommendations

The DWDs have been successful in preventing the dry weather runoff from entering the receiving waters by diverting it to the wastewater systems. All four-case study DWDs have unique characteristics since they do not have the same configurations, site and environmental conditions (such as land use, site settings, location), size and designs, and opportunities and constraints. As such, there is no generalized set of solution that can applied to all DWD projects for accepting the wet weather runoff. Table 4-5 summarizes the results of the four-case study projects. The following conclusions can be drawn:

- The proximity of the Pershing Drive DWD to the Hyperion WRP offers a unique opportunity to convey wet weather runoff directly to a WRP without using the sanitary sewer system. A detailed feasibility study would be necessary to expand the DWD to divert wet weather runoff. The current wait period for the restart of the DWD from a shutdown period of 24 hours after a rain event of 0.1 inch and more should be evaluated.
- The Temescal Canyon DWD can use existing storage and, potentially, a new storage system can be developed to store water during the leading edge of a storm event and discharge during off-peak hours when the capacity in the conveyance system becomes available. In addition, modifications to the conveyance system components and system operations will be needed. The current wait period for the restart of the DWD from a shutdown period of 72 hours after a rain event of 0.1 inch and more should be evaluated.

- The SMC DWD has the capacity to potentially deliver additional flows beyond dry weather runoff with its existing structure. It appears that the available DWD capacity can be used during wet weather, provided the flow from the diversion can reach the Hyperion WRP without causing spills downstream in the sanitary sewer system. A downstream sanitary sewer system analysis would be necessary. The current wait period for the restart of the DWD from a shutdown period of 72 hours after a rain event of 0.1 inch and more should be evaluated.
- The capacity of the Manhattan Beach PP DWD will need to be increased to accommodate wet weather runoff. In addition, the conveyance system for the Manhattan Beach PP DWD has capacity constraints, and it will be challenged to accept wet weather runoff because the sanitary sewer system downstream of Polliwog Park is complex, with a number of locations where the flow splits and rejoins. Based on the conveyance capacity analysis provided by the LACSD for this DWD, it was determined that this DWD cannot accept upstream wet weather runoff generated from more than 0.1 inch of rainfall in 24 hours under existing conditions. To overcome these challenges of diverting wet weather runoff with the DWD, a potential approach includes storing the wet weather runoff during storm events and discharging to the sanitary sewer system during off-peak hours. Two potential storage options are:
  - **WWD with Storage (also referred to as Stored Water WWD):** The diversion is operated to divert wet weather runoff generated from 0.1 inch of rain in 24 hours. Wet weather runoff from larger storms could be stored and discharged to the sanitary sewer system when the sewer conveyance capacity becomes available. An investigation and analysis with refined flow data and potential storage (for example, in the channel or beach parking lots, or in the watershed) would be required for an accurate assessment of the sewer conveyance capacity. In addition, the sanitary sewer system components and operations will require modifications.
  - **DWD Operational Time Change Potential:** For the DWDs that discharge to the LACSD sanitary sewer system, under current conditions, diversions are prohibited from restarting until 24 hours after the end of a rain event. Potential opportunities exist for the Manhattan Beach PP DWD, where the delay in restarting the DWD after a storm event can be shortened to 12 hours after the rainfall stops. A strategy would need to be developed to determine the storage potential at this location to store wet weather runoff and release it following 12 hours of a storm event up to an amount permissible for diversion.

Table 4-5. Summary of Case-study DWDs (Under Existing Conditions and Potential for Wet Weather Diversion)[a]

Parameters	Santa Monica Canyon		Temescal Canyon		Manhattan Beach PP		Pershing Drive	
	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather
DWD infrastructure available capacity	✓	Need sewer system analysis	✓	Need sewer system analysis	✓	Need sewer system analysis	✓	Need sewer system analysis
Conveyance capacity	✓	Investigate smart system	✓	Investigate smart system	✓	Investigate smart system	✓	Investigate smart system
Available capacity at WRP	✓	✓	✓	✓	[a]✓	[a]✓	✓	✓
First flush/First event	N/A	Need to investigate	N/A	Need to investigate	N/A	Expand DWD capacity	N/A	Need to investigate

Table 4-5. Summary of Case-study DWDs (Under Existing Conditions and Potential for Wet Weather Diversion)[a]

Parameters	Santa Monica Canyon		Temescal Canyon		Manhattan Beach PP		Pershing Drive	
	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather
Storage	N/A	needed	N/A	needed	N/A	needed	N/A	needed

[a] Manhattan Beach DWD discharges to the JWPCP; Other 3 DWDs discharge to the Hyperion WRP.

Notes:

The first flush of the season is the wet weather runoff from the first rain event, defined here as the first significant rain event of the season that occurred after a long, typically summer, dry period.

N/A = not applicable

Based on the DWD pumping capacity, it was found that the Manhattan Beach PP DWD does not have available capacity to capture the first-flush events, whereas the other three DWDs do appear to have partial or full capacity to handle the first-flush runoff. The pretreatment units would need to be expanded to remove debris and sediments carried with the first flush.

DWD facility operations are permitted by the sanitation agency receiving the diverted flow. LASAN is the permitting agency for the SMC, Temescal Canyon, and Pershing Drive DWDs. LACSD is permitting agency for the Manhattan Beach PP DWD. These facilities are permitted as industrial wastewater discharges to the sewer system and not specifically as a DWD. The permitting process and requirements depend on the sanitation agency, which typically requires initial monitoring for both flow rates and water quality. Based on the downstream wastewater system, the sanitation agency may place restrictions on the quantity and the timing of discharges, as well as limitations on water quality. Early coordination with the sanitation agency during project planning is highly recommended. Any modifications to an existing DWD or to convert a DWD into a WWD will require modification to the current permits and/or the issuance of new permits for industrial waste discharge.

DWDs operated by LASAN are operated manually during storm events. DWDs operated by LA County are operated manually before and after the storm events. A significant number of staff hours are required to go to all the DWDs, manually turn off the pumps, and close the inlet sluice. It was learned that the current resources (that is, personnel who operate and maintain the existing DWD facilities) are limited. In addition, to operate the diversions safely and on a permissible basis, better controls and telemetry systems are needed. A SCADA-enabled system would help shut off diversion pumps during storm events and allow the wastewater system operators to shut off diversions during emergency events where sewer system capacity or WRP, or both, capacity becomes limited. The DWDs to the LACSD already require SCADA-enabled pump control.

Based upon broad technical analysis conducted in the case-study DWDs, the further optimization of existing infrastructure presents an appropriate step for policy-level planning and next-step guidance. The analysis for the case studies provides a set of examples to develop a vision for MS4 compliance strategies. This analysis is not intended for design purposes; however, the detailed analysis of treatment plant flows, rainfall runoff, and rainfall intensity-duration-frequency lays a strong foundation for future studies. The analysis guides the process for evaluating the potential of DWDs to divert wet weather runoff, and highlights the system operations and challenges, system configurations, and sanitary sewer system capacity. It also identifies potential ways to optimize the existing DWDs to help solve water quality problems in the subwatershed and provide water supply benefits. It sets the stage for managers and stakeholders to encourage collaboration on the type of opportunities that might be available to help solve the water quality and water supply challenges in the Los Angeles Basin.

An important concept/option includes a direct connection of DWDs to the WRP influent to overcome the sanitary sewer system limitation. The Pershing Drive DWD, which is adjacent to the Hyperion WRP, is an example case study of this option. A detailed feasibility analysis is recommended to expand the current diversion infrastructure and conveyance pipe.

From the preliminary assessment and operator interviews, it was found that some of the DWDs may have been capturing a portion of the first flush of the season; however, refinements are needed with accurate flow data to assess the current status. The optimization of existing DWDs to manage some of the wet weather runoff, up to the runoff volume from the 85^{th} percentile storm event, provides another innovative approach to comply with the stringent wet weather MS4 permit compliance strategies. This strategy would complement the need for additional BMPs in the subwatersheds to comply with applicable TMDL requirements.

The first step in optimizing existing diversions would require upgrades and enhancements to flow data gathering and processing, the installation of necessary equipment, and the use of online sensors and system controls to address operational challenges and data quality. Along with technical feasibility, MS4 permittees and other agencies need to determine economic feasibility, regulatory acceptability, environmental impacts, and public acceptability. Upgrading and using existing infrastructure to manage runoff volumes up to the 85^{th} percentile storm should be determined on a case-by-case basis. Detailed investigations of each DWD, considering cumulative flow from all other DWDs under a storm event (for example, first flush), is needed due to their uniqueness of design, operations, challenges, sanitary sewer system limitations, and storage potential.

The coastal subwatersheds that outlet into SMB, such as Ballona Creek, SMC, and Temescal Canyon, have unique topographic and hydrologic characteristics ranging from undeveloped to highly urbanized areas. Each of the coastal subwatersheds are relatively small compared to the inland subwatersheds, such as the Los Angeles River, San Gabriel River, and Rio Hondo River subwatersheds. A comprehensive step-by-step approach for each DWD in the coastal region is recommended to achieve a broader goal, such as optimizing the use of existing infrastructure to solve water quality problems, along with balancing the need for additional BMPs in the subwatersheds to help save funding resources for other essential stormwater management projects in the region.

In summary, the analysis presented for the case-study projects provides a roadmap to analyze DWDs on a case-by-case basis. The high-level screening analysis process presented here can be applied to all DWDs to determine the potential for expansions of existing DWDs to handle additional wet weather runoff from current conditions.

For the case-study projects, the potential exists to divert wet weather runoff via DWDs, provided strategies can be adopted to mitigate the current limitations and risks. The potential strategies may include the following two options:

1) Continue more detailed technical evaluations and feasibility studies on a case-by-case basis:
   a) Conduct further hydrologic/rainfall evaluation after the release of the Version 2 WMMS tool, with refined/more current land uses and other upgrades (for example, inclusion of recent rainfall data). WMMS Version 1 was used for the rainfall-runoff analysis.
   b) Evaluate the feasibility of developing storage facilities based on the availability of potential locations in the subwatershed to store water during the leading edge of the storm, and to release water after the storm events, when the capacity in the sanitary sewer system and at the WRPs becomes available. The main idea of the storage is to hold the water until sanitary sewer system capacity is available.
   c) Understand technical challenges and issues that hinder the optimization and expansion of existing DWDs to handle additional dry and wet weather runoff.

d) Change the operational timing of DWD discharges following a 1-day rainfall event (for example, shortening the delay in bringing the DWD online after a storm event). Returning the DWDs back online within a 24-hour period versus the 72-hour normal practice may require additional staff to operate DWDs.

e) Evaluate or identify additional diversion projects in locations where the storm drain system and the sanitary sewer system are relatively near each other.

f) Conduct a detailed feasibility analysis to expand the current diversion infrastructure and conveyance pipe.

g) Modify the current permits and/or issue new permits for industrial waste discharge if the DWDs would discharge wet weather runoff to the sanitary sewer system.

h) Develop a smart modeling system that uses rainfall forecasts, real-time Countywide rainfall data, and real-time sewer level monitoring to allow additional flow into the sanitary sewer system during the leading edge of smaller storms, and to determine when and how the diversion systems can be safely operated.

2) Evaluate and continue building a framework for dialogue with stakeholders to achieve the following:

a) Determine whether the increased use of existing DWDs could result in potential cost savings to achieve TMDL compliance.

b) Identify major challenges or issues that influence the implementation of potential changes to existing DWDs, as identified in this section.

c) Discuss opportunities for participation and collaboration among stakeholders, especially during planning when project development can best be influenced.

d) Create a uniform framework that considers the strengths of existing conditions and builds on the collective efforts and advances of systems during the past few years to develop a consistent regional approach for the stakeholders.

e) Engage all stakeholders in LA County subwatersheds to discuss potential institutional issues or other issues that may either impede the implementation of new DWD projects or modification of the existing DWDs. A collaborative approach is the most effective method to achieve the goal of converting DWDs to WWDs.

f) Discuss and evaluate technical and economic feasibility, regulatory acceptability under federal and state laws, public acceptability, agency coordination, and environmental impacts.

g) Identify and work to resolve operational issues related to the interconnection of the stormwater and wastewater systems to maximize their utilization in achieving water quality improvements.

4.5.1 Uncertainties/Limitations

The following are the uncertainties and limitations of the data used and analysis conducted in this study:

- **Rainfall data -** For the three case-study DWDs, and for the fourth DWD, data from Rainfall Gauge AL461and rainfall data from Gauge 374 were used, respectively, to simulate runoff using the WMMS model. For the sanitary sewer system and flows to the Hyperion WRP, additional analysis with all rainfall gauges in the sewershed for longer period is needed. The impact of climate change on rainfall and the water resources could be included for future analysis.
- **GIS data and modeled subwatershed flows –** While performing the DWD analysis, a few discrepancies in the GIS data for the subwatershed areas were found and discussed with the stakeholders. For further evaluations, refinements for the GIS data for subwatershed areas and land use are recommended. It was learned from LA County that the WMMS model is currently being updated with recent land uses,

land cover, and rainfall data. Updates to the model will help provide refinements to the rainfall-runoff results.

- **Evaluation of sanitary sewer system from DWD location to WRPs –** The sanitary sewer system capacity analysis conducted by the agencies under this task was only conducted for a few storm events for discharge from one DWD at a time. In addition, this analysis did not consider the effect of storage with DWDs on the conveyance sanitary sewer system capacity.
- **Further investigations of other key assumptions –** The analysis of four case-study DWDs was completed separately for each DWD. The cumulative impact of all diversions on the sanitary sewer system, along with the WRPs, is needed to help develop the priority DWD areas with opportunities and constraints to manage the wet weather runoff.

4.6 References

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Section 5. Estimate of Dry Weather Flow and Conceptual Approach for Diversions

5.1 Introduction

Key objectives relating to diverting dry weather runoff are to reduce or eliminate non-stormwater runoff to reduce pollutants entering receiving waters and to maximize the beneficial use of stormwater runoff. A fundamental element of managing dry weather runoff is understanding the volume and quality of runoff generated in the watersheds. Runoff is associated with both dry and wet weather conditions. Dry weather runoff occurs in the absence of rainfall, which is generally associated with activities such as lawn watering, including landscape irrigation overspray; street cleaning; car washing; groundwater seepage; illegal connections; spring water; commercial activities; and intermittent sources, such as hydrant flushing and construction activities. Limited permitted discharges to storm drain channels may also contribute to dry weather runoff.

Dry weather runoff can be estimated using various approaches. The development of an accurate estimate of urban runoff is difficult and resource-intensive. It would require monitoring of thousands of storm drains in each watershed of the Los Angeles Basin. For broad planning purposes, a high-level estimate of dry weather runoff generated in the Los Angeles Basin was developed using a simple approach based on developed areas of watersheds.

The purpose of this section is to present the approach used for developing dry weather flow estimates for a reference watershed, Ballona Creek, and its use to provide a high-level runoff estimate in the Los Angeles Basin watersheds, as well as the amount of flow currently diverted by existing DWDs and potential approaches to divert some of the remaining runoff in the Los Angeles Basin.

Moreover, this section focuses on presenting the following information:

- Approaches to determine dry weather runoff
- The amount of flow currently diverted by existing DWDs
- An estimate of the remaining urban runoff currently not diverted by DWDs
- An approach to divert remaining runoff or uncaptured dry weather flow in the Los Angeles Basin.

This section is organized as follows:

- Section 5.1 – Introduction
- Section 5.2 – Dry Weather Flow Estimates
- Section 5.3 – Conceptual Approach for Diverting Remaining Dry Weather Flows
- Section 5.4 – Conclusions and Recommendations
- Section 5.5 – References

5.2 Dry Weather Flow Estimates

Dry weather runoff can be estimated using various approaches. The spectrum varies, depending on resources:

- Monitoring storm drains in the watersheds over an extended period to understand variability in runoff (CREST, 2006, 2008)
- Using mass balance approaches to estimate runoff based on the system inflows and outflows:
  - Studies have estimated dry weather runoff in the channel or river by equating the measured flows, the WRP flow releases, the rising groundwater flow, and evaporation, as well as other discharges, such as spring water and flows from dewatering activities (City of Los Angeles, 2004).

  - Other studies have used the partitioning of native (rainfall) and non-native (imported water) water sources to evaluate the impact of imported water on spatial and temporal hydrological cycling, and have developed models of the systems from predevelopment through to the time of the study (Liu et al., 2011).

- Using runoff per acre of pervious surface (landscaped area) or the impervious and developed area of the watershed (City of Los Angeles, 2004)

The following section summarizes the dry weather runoff estimated in previous studies.

5.2.1 Review of Dry Weather Runoff Estimate Studies

Several reports reference 100 MGD of dry weather flow produced in LA County, as identified in the following summaries. However, the source of this estimate has not been determined. In the Los Angeles Basin, studies have been conducted to estimate the dry weather runoff in various watersheds. The spectrum varies from monitoring storm drains, using population and urban residential areas to understand the runoff generated from outdoor water use activities, to estimating flows based on a water balance approach, as discussed in this section. The studies and reports reviewed under this task are summarized as follows:

- **LASAN One Water LA Plan:** On average, LASAN-owned LFDs divert approximately 1,500 acre-feet per year (AFY) of dry weather runoff to the Hyperion WRP. This type of runoff occurs as a result of nuisance flows, such as irrigation overspray, car washes, subsurface inflows to cracked storm drains, and dewatering activities that discharge to the storm drain system. Based on the LFD monitoring data from 2012 to 2016, the median value for incidental runoff is approximately 84 gpd per impervious acre of land (LASAN, 2018).

- **Council for Watershed Health State of the Los Angeles River Watershed:** Generally, urban runoff is the source of most of the dry season flow in many of the tributaries and channels of the lower watershed. Approximately 100 MG of runoff from landscape irrigation, car washing, and other inadvertent sources flow through LA County storm drain system daily and into the flood control channels, including the Los Angeles River and its tributaries (CWH, 2018).

- **National Resource Defense Council (NRDC) Stormwater Capture Potential in Urban and Suburban California:**

  - Even when it is not raining, water from excess landscape irrigation, car washing, industrial processes, and other uses flows into storm sewer systems - an estimated 10 to 25 MG of water discharges into SMB alone for each dry weather day (City of Los Angeles, 2009), and more than 100 MG to the ocean from across the county (NRDC, 2014).

  - On the basis of a 2004 study by the Metropolitan Water District of Orange County (MWDOC) and Irvine Ranch Water District (IRWD), it was assumed that dry weather runoff resulting from overirrigation and other processes for residential and commercial developments is 0.152 gallons of runoff per acre of pervious surface (landscaped area) per minute on days when it does not rain (MWDOC and IRWD, 2004).

- **SCCWRP Contemporary and Historical Hydrologic Analysis of the Ballona Creek Watershed:** The study investigated the partitioning of native (rainfall) and non-native (imported) water sources for the Ballona Creek Watershed. The conceptual model used precipitation and imported water (outdoor use) as inputs and evapotranspiration, runoff, and groundwater recharge as outputs. Land cover transition from pervious to impervious surfaces governed the water balance evolution and increased both dry and wet season runoff from predevelopment to the time of the study. The results of the study showed the changes in water budget after development saturation in the early 2000s and a shift in water budget with increased runoff that was attributed to changes in land uses (SCCWRP, 2011).

- **Characterization of Water Quality in the Los Angeles River:** The Los Angeles River is an effluent-dominated waterbody. Nearly 70 percent of the volume in the Los Angeles River arose from WRP tertiary-treated effluent discharged during this study. Although groundwater interactions existed (particularly in the Glendale Narrows and Arroyo Seco tributary), most storm drain discharges were assumed to arise from urban discharges. Less than 0.1 MGD of flow was measured at the mouth of the Los Angeles River during dry weather periods in 1930, when the population in the county was approximately 2 million. More than 100 MGD was measured at the mouth of the river during this study, when county population estimates exceeded 9.5 million (Ackerman, 2003).
- **Los Angeles Integrated Resource Plan:** The estimated dry weather runoff in the Los Angeles River, Ballona Creek, Urban SMB, and Dominguez Channel/Los Angeles Harbor was 59, 20, 15, and 16 MGD, respectively. Total runoff from these watersheds was estimated to be 110 MGD. Out of this estimate, about 58 MGD was in the City of Los Angeles. The water balance approach assumes the dry weather runoff equals the total measured flow, minus the WRP flows, and minus the rising groundwater flow, as these are the only flows in the river. The runoff rate for the developed areas was estimated by taking the estimated urban runoff reaching the Los Angeles River (26.6 MGD), divided by the developed area (140,300 acres), and then multiplied by 1 million to arrive at 190 gpd per developed acre (City of Los Angeles, 2004).

As the monitoring of dry weather runoff requires extensive resources, and with its inherent variability due to other known and unknown factors, several studies have estimated runoff using different methods. Regardless of the approach, there is inherent uncertainty in the runoff estimates.

5.2.2 Dry Weather Runoff Analysis Approach

An accurate estimate of dry weather runoff, if even possible, can be resource- and time-intensive and requires monitoring of all storm drains in the watersheds. For planning, a high-level estimate of dry weather runoff in the Los Angeles Basin watersheds was developed based on monitored flows and the impervious area of Ballona Creek, which is a highly urbanized watershed, and the approach is applied to other watersheds in the Los Angeles Basin to estimate basinwide dry weather runoff.

The approach to estimate dry weather runoff is based on the relationship of measured dry weather runoff to the impervious land area of the Ballona Creek Watershed and the application of that relationship to other watersheds to estimate dry weather runoff in Los Angeles Basin. Figure 2-1 illustrates this approach. After estimating the dry weather runoff in the Los Angeles Basin, the flows already diverted by the existing DWDs are subtracted out to understand the remaining dry weather runoff that is not diverted by the DWDs. Some portion of this estimated runoff may have been already diverted by other approaches, such as for groundwater recharge in the spreading basins. Therefore, caution may be exercised while discussing the remaining dry weather runoff in the Los Angeles Basin.

Figure 5-1 illustrates the steps of this approach including the estimates of the dry weather runoff into the Ballona Creek Watershed. Further, the application of this approach to determine the dry weather runoff into the Los Angeles River and other watersheds within the Los Angeles Basin are also described in the following text.

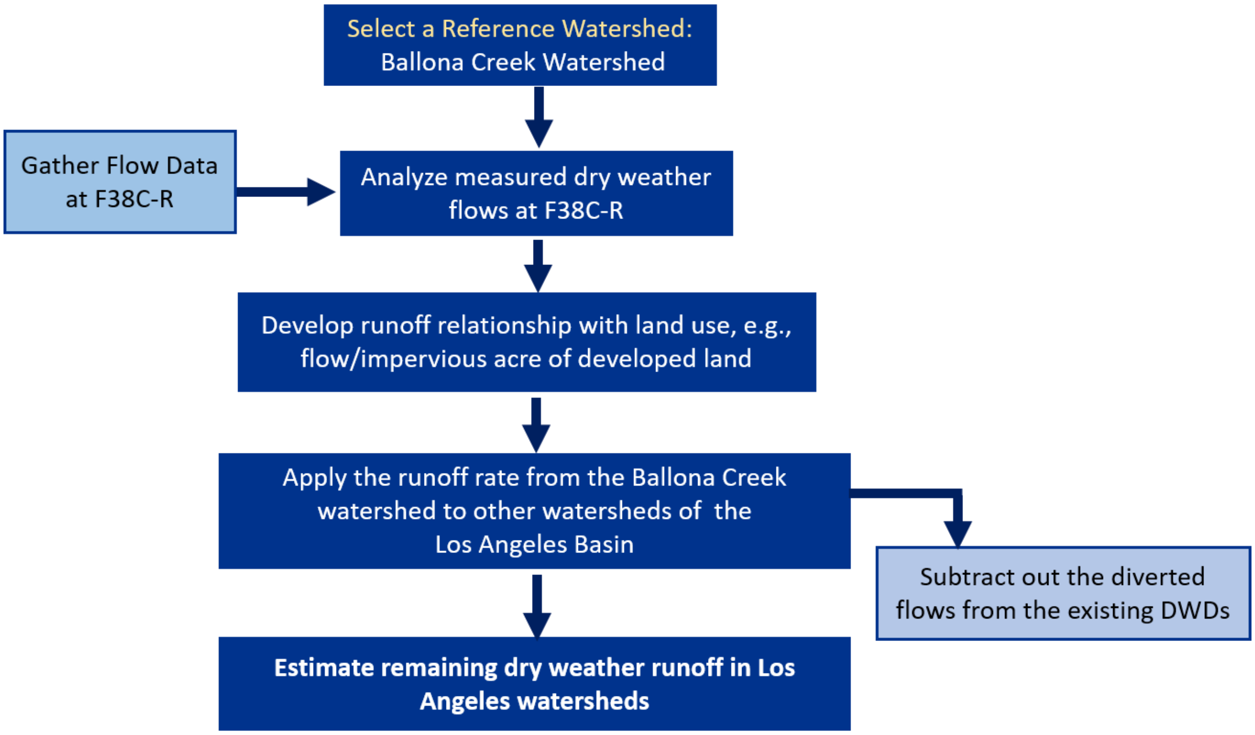

Figure 5-1. Estimating Dry Weather Runoff in the Los Angeles Basin
(Note: F38C-R is the LA County DPW flow monitoring gauge located in Ballona Creek Watershed)

Daily monitored flows in the Ballona Creek Watershed during the dry days from 2010 through 2019 were used to prepare the estimates of dry weather runoff volume per unit of impervious land area. For this analysis, the LA County land use and percent imperviousness GIS data layers from the WMMS 1.0 were used to calculate the percent impervious land area in each watershed.

Note: The data set used for the analysis was downloaded from the LA County website and is no longer available, as a newer model was released. The new model is available at https://portal.safecleanwaterla.org/wmms/home.

The calculated dry weather runoff rate from the Ballona Creek Watershed was applied to other watersheds in the Los Angeles Basin to estimate the dry weather runoff for the basin. The following steps were used for the analysis:

1) Estimate the dry weather runoff per impervious area (developed area) of the Ballona Creek Watershed.
2) Determine the total impervious area from the developed land uses in the watersheds of the Los Angeles Basin.
3) Estimate the total dry weather runoff volume from the Los Angeles Basin watersheds by multiplying the total impervious area with the runoff rate (that is, multiplying Step 1 and Step 2).
4) Estimate the total dry weather runoff diverted by the existing DWDs.
5) Determine the uncaptured dry weather runoff from the remaining watershed that is not currently being diverted by existing DWDs (that is, Step 3 minus Step 4).

5.2.3 Ballona Creek Watershed

The Ballona Creek Watershed extends north into the Santa Monica Mountains, west into Beverly Hills and Culver City, east into downtown Los Angeles, and south to the Westchester Bluffs. Ballona Creek drains to the SMB, with its outlet located adjacent to Marina del Rey. The upstream portions of Ballona Creek are natural channels; however, the lower portion features concrete-lined channels, either trapezoidal or rectangular shaped. Generally, the sources of dry weather runoff in the Ballona Creek Watershed may include street cleaning, car washing, lawn watering (including landscape irrigation overspray, intermittent sources, such as hydrant flushing and construction activities), and other commercial activities.

The Ballona Creek Watershed was chosen as the reference watershed for developing the urban developed land use-runoff relationship due to the following reasons:

1) It is a highly urbanized and developed watershed.
2) There are no WRP discharges to the storm drain system in this watershed.
3) There are no dams in the watershed.
4) The downstream end of the watershed has a flow monitoring station (F38C-R), where LA County has been collecting flow data for a long period. The monitoring station is assumed to be calibrated and accurate.
5) Runoff generation is known to be largely associated with developed impervious areas.
6) Large-scale diversion projects are in progress, which provide an extensive knowledge base.

To estimate dry weather urban runoff from the Ballona Creek Watershed, the measured Ballona Creek flow at Sawtelle Boulevard (LA County DPW gauge F38C-R) was used (Figure 5-2). This is the only flow metering station in the Ballona Creek Watershed. It is located above Sawtelle Boulevard, about 1.5 miles southeast of Culver City and about 2.5 miles upstream from where Ballona Creek enters the SMB. Based on analysis using the WMMS 1.0 model, the watershed area that drains from the total contributing area of the catchment above the F38C-R gauging station is approximately 57,000 acres in size, compared to the entire Ballona Creek Watershed management area of 86,000 acres. About 28,800 acres of land are impervious in the 57,000 acres of gauge watershed area. Note, about 29,000 acres of catchment area are further downstream of the gauge watershed - the flow from that area is not captured by F38C-R. Figure 5-2 is a map of the drainage area used for this analysis.

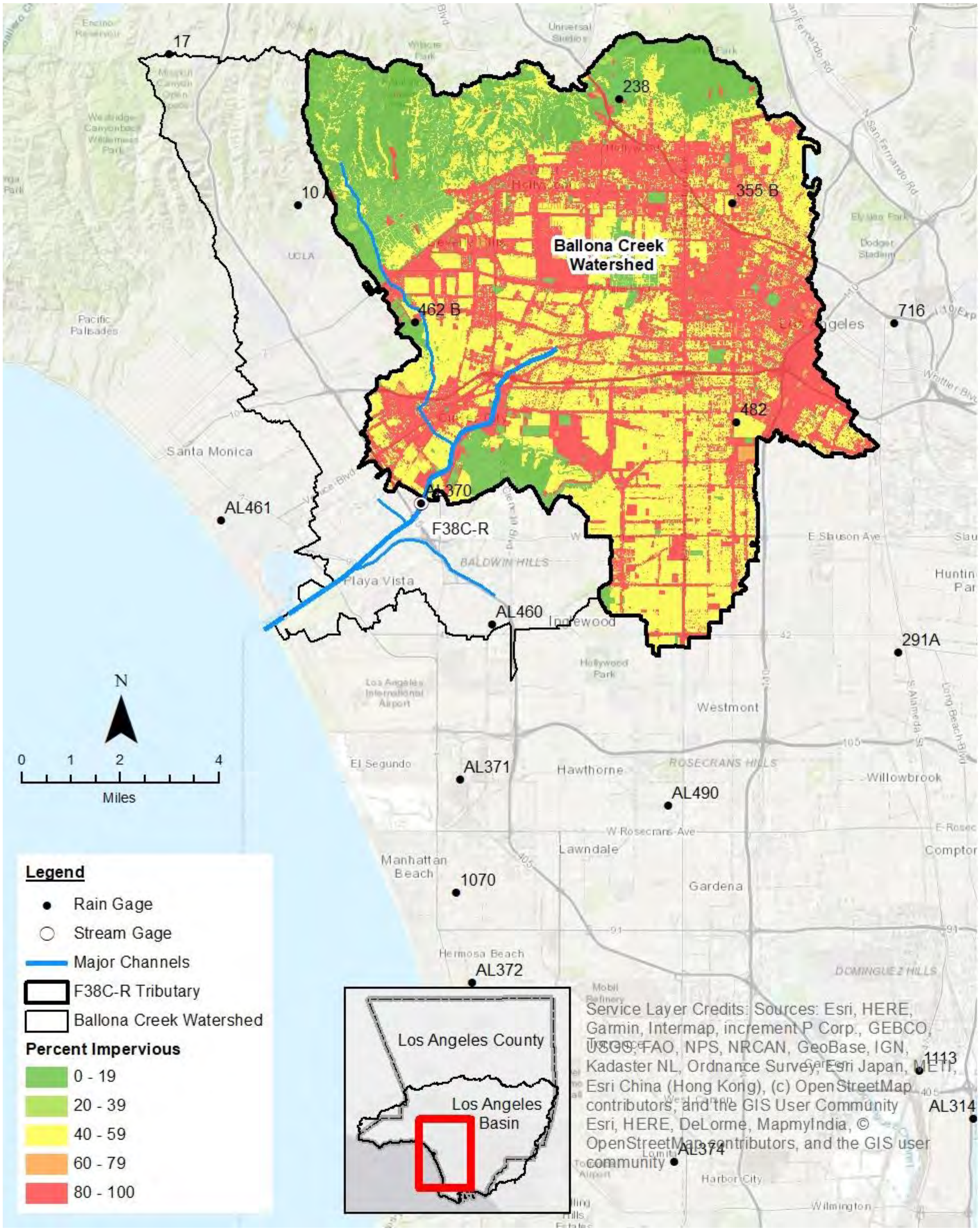

Figure 5-2. Drainage Area Used for the Ballona Creek Dry Weather Runoff Analysis

Based on the WMMS 1.0 model, the Ballona Creek Watershed has the following land uses:

- 50 percent residential
- 16 percent industrial/commercial/institutional
- 23 percent transportation and secondary roads
- 11 percent vacant, agriculture, and water

The watershed is about 89 percent developed, with corresponding impervious area that carries runoff. The impervious fractions for each land use type, provided in LA County's database, were used to calculate the impervious area for each land use type. It is assumed that the impervious area of the watershed results in urban runoff generation during dry weather.

Although there are no treatment plants or dams located in this watershed, discharges from construction permits or dewatering activities to storm drain channels contribute to dry weather runoff. Natural springs are also a known contributor to urban runoff in the Ballona Creek Watershed (SCCWRP, 2011), although the flow contribution from this source is relatively small compared to other sources.

5.2.4 Dry Day Classification

5.2.4.1 Flows at Station F38C-R

Average daily flow data from the Ballona Creek Watershed at gauge F38C-R from January 2010 through September 2019 were used to develop estimates of dry weather runoff. The flow data for this flow monitoring station were obtained from LA County. Although the dry weather flows do not depend on rainfall, a strong relationship between rainfall and wet weather runoff indicates the imperviousness of the watershed increases runoff in developed watersheds.

To determine dry weather runoff from the Ballona Creek Watershed, the first step was to determine the dry days. As an example, rainfall data at LAX for the same period as the flow data (that is, 2010 through 2019) were used to classify the days into dry or wet days. (Data from various rain gauges near the watershed can be used to refine this analysis.) Rainfall data collected at LAX were analyzed to identify the flows during both rainy days and dry days. To apply the rainfall data for a dry day determination, it was important to understand the number and type of rain events that occurred during this period. Figure 5-3 presents the rainfall frequency distribution under various depths of rain events. This histogram captures the range of storm events:

- About 91 percent of the days had zero recorded rainfall.
- About 46 percent of the recorded wet days had rainfall depths less than or equal to 0.1 inch.
- About 54 percent of the wet days had rainfall greater than 0.1 inch, which is 179 days out of the total of 333 wet days.
- A maximum rainfall depth of approximately 3 inches was recorded.

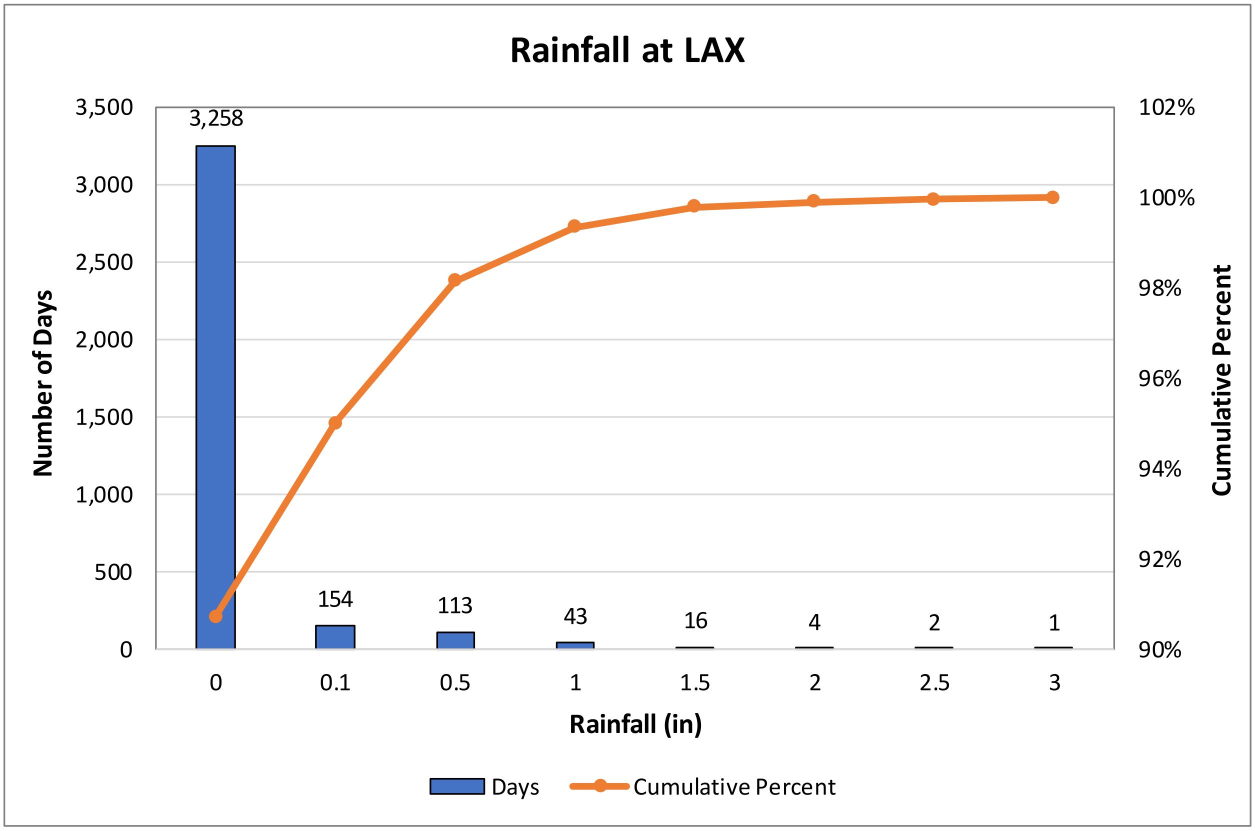

Figure 5-3. Daily Total Rainfall Depth (inches) at Los Angeles International Airport, Years 2010 to 2019

Per the bacteria TMDL, wet weather is defined as days with 0.1 inch of rain or greater, plus the 3 days following the rain event (LARWQCB, 2010). Three methods, as discussed in Table 5-1, were used to determine dry days for flow analysis.

Table 5-1. Methods Used for Dry Day Extraction from the Long Term Flow Data at F38C-R

Method	Dry Days	Approach
1	Days with no rainfall	Remove days with any recorded rain.
2	Method 1, plus days without influence of any prior rain event	Remove days with any rainfall. Also, remove 3 days following any rain event.
3	Method 2, plus days with up to 0.1 inch of rain	Remove days >0.1 inch of rainfall. Also, remove 3 days following a rain event with greater than 0.1 inch of rain.

Notes:

> = greater than

5.2.5 Dry Weather Runoff Estimate Based on Dry Days

Based on the three methods discussed, data from station F38C-R were extracted for dry days to estimate the dry weather flows in Ballona Creek recorded from 2010 through 2019. Figure 5-4 shows the variation in flows, as indicated with a box and whisker plot, based on the dry days as determined by the three methods. The median dry weather flow based on all three methods is about 6 MGD. The differences in flow among the three methods is in the higher flows (that is, above 90th percentile). For 99th percentile flows, the difference in flow between Methods 1 and 2 is about 2 MGD. However, the difference for the

99th percentile flow between Methods 2 and 3 is about 11 MGD. This is because in Method 3, the runoff generated from rain of up to 0.1 inch produce higher creek flows than the dry weather days, as determined by Methods 1 and 2. As the variability in dry weather flows between Methods 1 and 2 is not significant, based on discussion with stakeholders, flows estimated using Method 2 were used for further analysis.

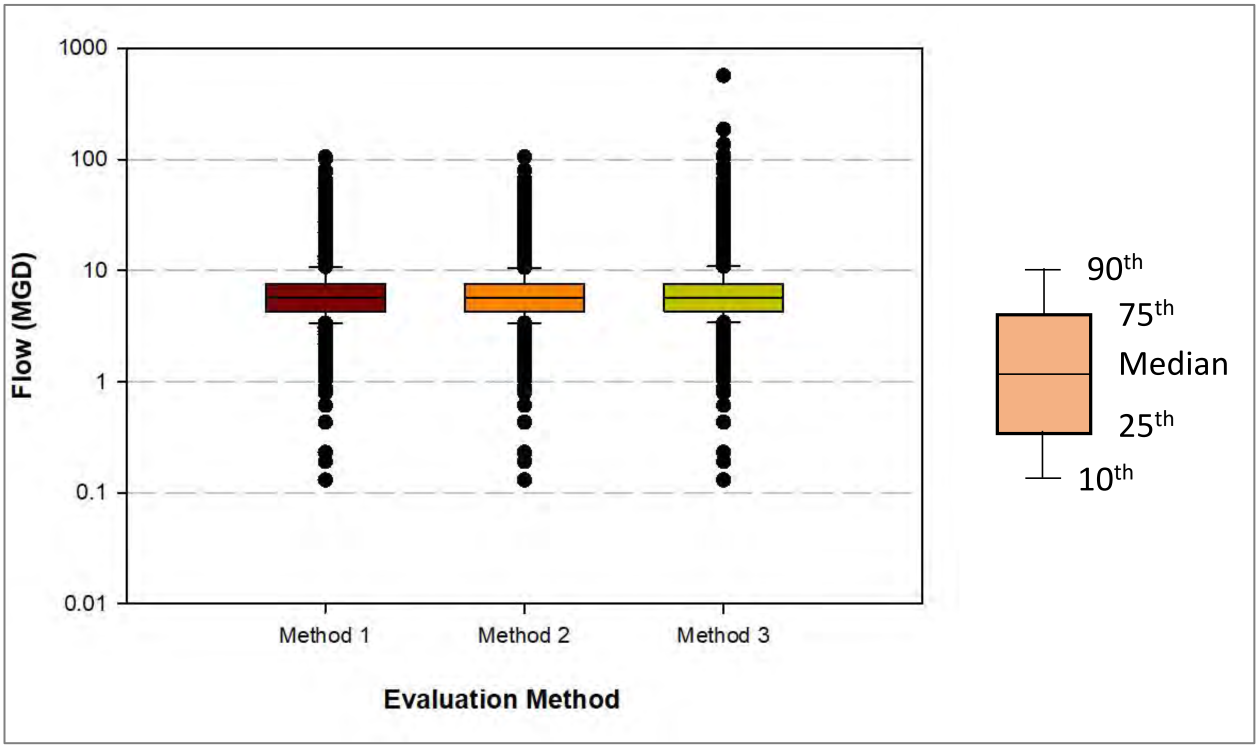

Figure 5-4. Daily Dry Weather Flows at F38C-R based on Methods 1, 2, and 3

Figure 5-5 presents the runoff frequency distribution under various flow rates under Method 2; the following observations should be noted:

- About 56 percent of days (with zero recorded rainfall) had runoff varying between 0.13 and 6 MGD.
- The remaining (about 44 percent) flows varied between more than 6 and 105 MGD.
- The maximum runoff recorded was 105 MGD.
- The 10th, 90th, and 99th percentile flows were about 3, 11, and 37 MGD, respectively.

Figure 5-6 shows the variations in dry weather flows from 2010 to 2019 based on Method 2.

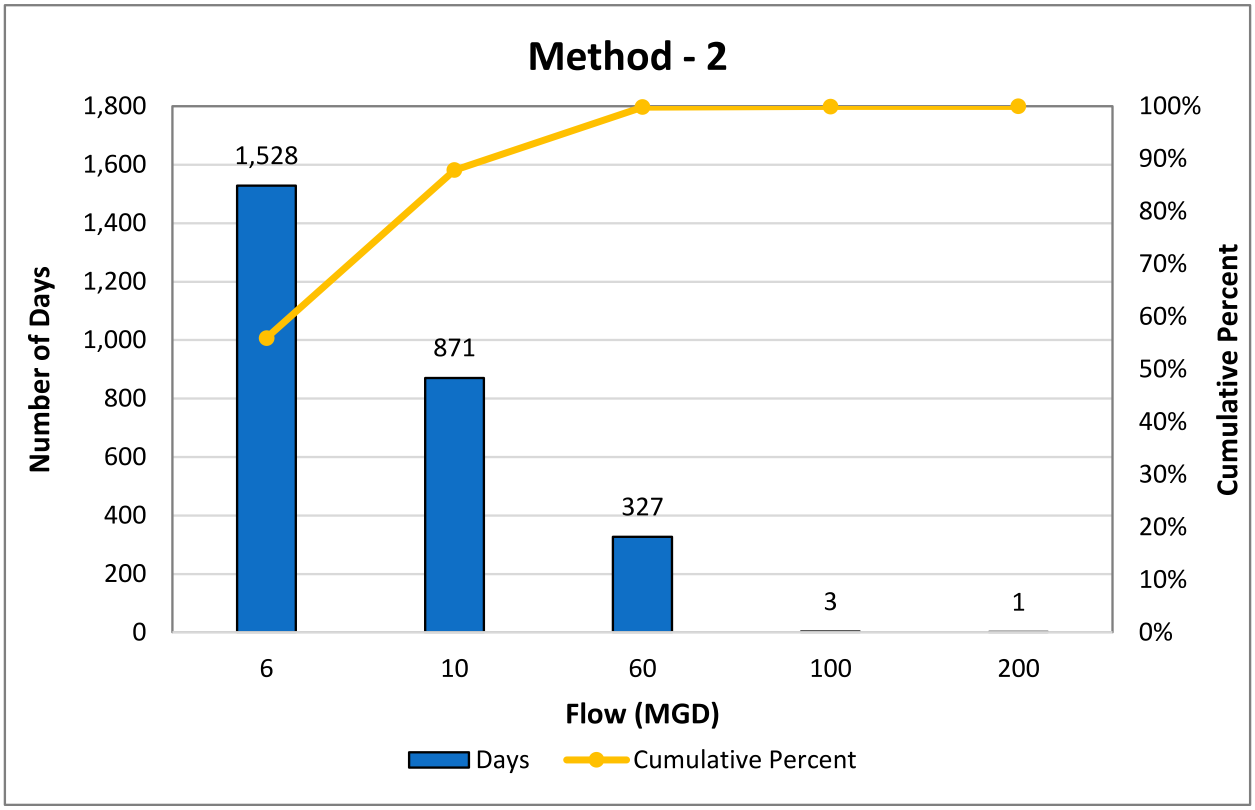

Figure 5-5. Daily Dry Weather Flows at F38C-R based on Method 2

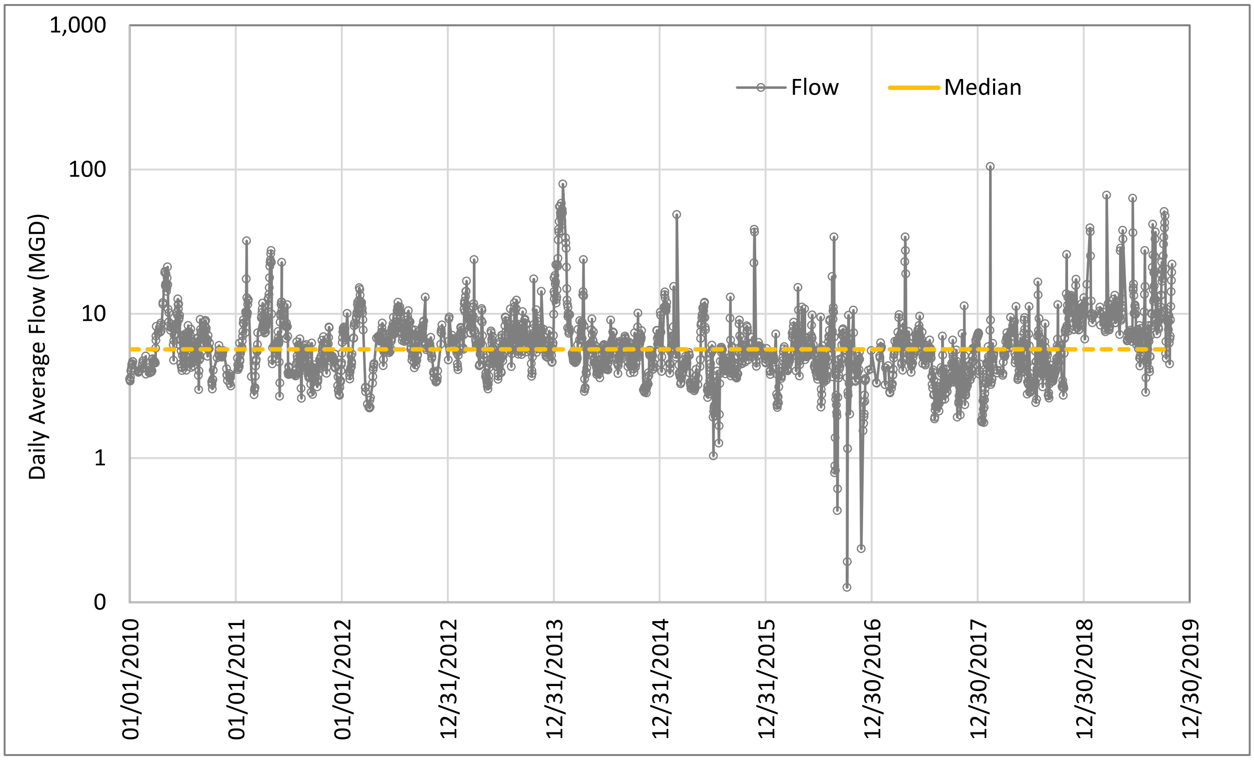

Figure 5-6. Variations in Dry Weather Flows from 2010 to 2019 at Station F38C-R based on Method 2

For the drainage area of 57,000 acres that contributes flows to the monitoring station F38C-R, a dry weather runoff rate was estimated by taking 6 MGD of estimated median runoff and dividing it by the 28,800 acres of impervious land, which results in 0.2 MGD per 1,000 impervious acre of land. This estimate includes impervious areas from transportation land use, as well. By subtracting the transportation land use of 3 percent, the median dry weather runoff estimate is 0.3 MGD per 1,000 impervious acres of land.

To estimate flows from other watersheds, the impervious area for each land use category in each of the LA County watersheds was determined and a dry weather runoff based on a median value of 0.3 MGD per 1,000 impervious acres was calculated. Similarly, the rate was applied to the impervious area of each watershed to estimate the 10^{th} and 90^{th} percentile dry weather runoff for each watershed.

For Steps 4 and 5 of the analysis, to estimate the remaining dry weather runoff that is not diverted by the existing diversions, the estimated flows from existing 41 DWDs were subtracted from the total dry weather runoff from the watersheds. For consistency, the estimates of the diverted flows by existing DWDs were calculated using the land use-based approach for the Ballona Creek Watershed, as used for other watersheds.

The impervious land area of existing DWD tributary watersheds was determined by overlaying the imperviousness layer from the developed area with exiting DWD tributary areas. With the existing 41 known DWDs largely in the coastal watersheds of the Los Angeles Basin, the estimated median diverted flow is 3 MGD. Based on the analysis of Ballona Creek and projecting to other watersheds, the estimated median dry weather runoff in the seven watersheds of LA County could be 73 MGD. The estimated remaining dry weather runoff ranged from 43 MGD for the 10^{th} percentile flows to 137 MGD for the 90^{th} percentile flows.

Note, the diverted flows due to existing LID, green infrastructure projects, runoff diverted to spreading grounds, and other BMPs used for managing stormwater were not estimated or subtracted from this estimate. Also, the estimates include flows diverted from all diversions, including the diversions that treat and reuse flows for onsite beneficial uses (for example, irrigation). The estimate does not separate out the flows diverted to the sanitary sewer system only. Nonetheless, based on this high-level analysis, there seems to be a substantial amount of uncaptured dry weather flow in the Los Angeles Basin.

The dry weather runoff estimates calculated by this method appear to be quite variable compared to the estimates provided in previous studies. This variability in the dry weather runoff estimates is due to a range of factors, as discussed in Section 5-4.

5.3 Conceptual Approach for Diverting Remaining Dry Weather Flows

The conceptual plan for diverting the uncaptured dry weather runoff requires a toolbox approach, as no single solution is suitable for Countywide implementation. The best dry weather runoff solution for each drainage area should be determined on a case by case basis. First, further refinements of dry weather runoff estimates and monitoring are needed to better calculate the true dry weather runoff generated in a watershed and subwatershed. Drainage area prioritization for diverting flows can be set based on flow estimates, EWMPs, and TMDLs of the receiving waters, and through the development of a dry weather runoff capture plan.

Where diversion to the sanitary sewer is deemed feasible by the MS4 permittee and sanitation agency, the following diversion approaches may be considered, as illustrated on Figure 5-7:

1) **Divert from a Surface Waterbody Directly to a Nearby WRP:** Most storm drains divert to a larger, channelized receiving waters; therefore, the ability to divert directly from the receiving water is the most efficient means of diverting dry weather runoff. Diverting from the channel allows for the potential to capture a much greater drainage area versus the smaller drainage area of an individual storm drain system. Where WRPs are located adjacent to a receiving water, this provides an opportunity to divert dry weather runoff from the channel for reuse or treatment and discharge with the WRP effluent. This strategy needs to consider the minimum stream flow requirements of the channel, potential for upstream permissible dry weather runoff (for example, groundwater infiltration, other permitted flows) and potential water rights issues.

2) **Divert Nearby Storm Drains to WRPs:** The diversion of existing storm drains near WRPs provides an opportunity to divert dry weather runoff without the constraints of the downstream collection system. The diversion can be operated if there is available capacity at the WRP, with minimal travel time from the diversion or reliance on available sewer capacity. It is recommended to review existing storm drain infrastructure near WRPs to identify potential locations for new DWDs. Existing examples include the Pershing Drive DWD, the Imperial Highway DWD, and the Carson Stormwater and Runoff Capture Project.

3) **Divert a Storm Drain to a Nearby Interceptor Sewer:** In general, existing sanitary sewer collection systems comprise laterals, main lines, and interceptor lines, ranging in size from smaller to larger sized pipes as they approach the WRP. For large systems, interceptor pipes form the backbone of the collection system with large-diameter pipes are used to convey the highest flows. Locating DWDs where storm drains cross interceptor sewers can help to alleviate some of the downstream conveyance constraints.

4) **Provide New Dedicated Conveyance from Multiple DWDs to a WRP:** Where there is not sufficient available conveyance capacity in the sanitary sewer system, constructing a dedicated pipe to the WRP can be an alternative solution. However, a dedicated pipe may significantly increase the cost of the project, and a cost-to-benefit analysis should be performed to understand this relationship.

5) **Divert Individual Storm Drains to Local Sanitary Sewers:** Examples of this strategy include most existing DWDs. Where the other strategies are not feasible or there is sufficient conveyance capacity in the existing sanitary sewer system, the continued implementation of DWDs provides an effective solution for managing dry weather runoff.

6) **Install DWDs at Existing Stormwater Pump Stations:** In addition to the five approaches discussed above, installation of DWDs at existing stormwater pump stations may be considered. More than 60 stormwater pump stations exist throughout the Los Angeles Basin, primarily concentrated in low-lying coastal areas to alleviate localized flooding and tidal impacts. Nine existing pump stations already have DWDs incorporated. Installing DWDs at the remaining pump stations would provide the dual purpose of the existing facility to capture dry weather flow.

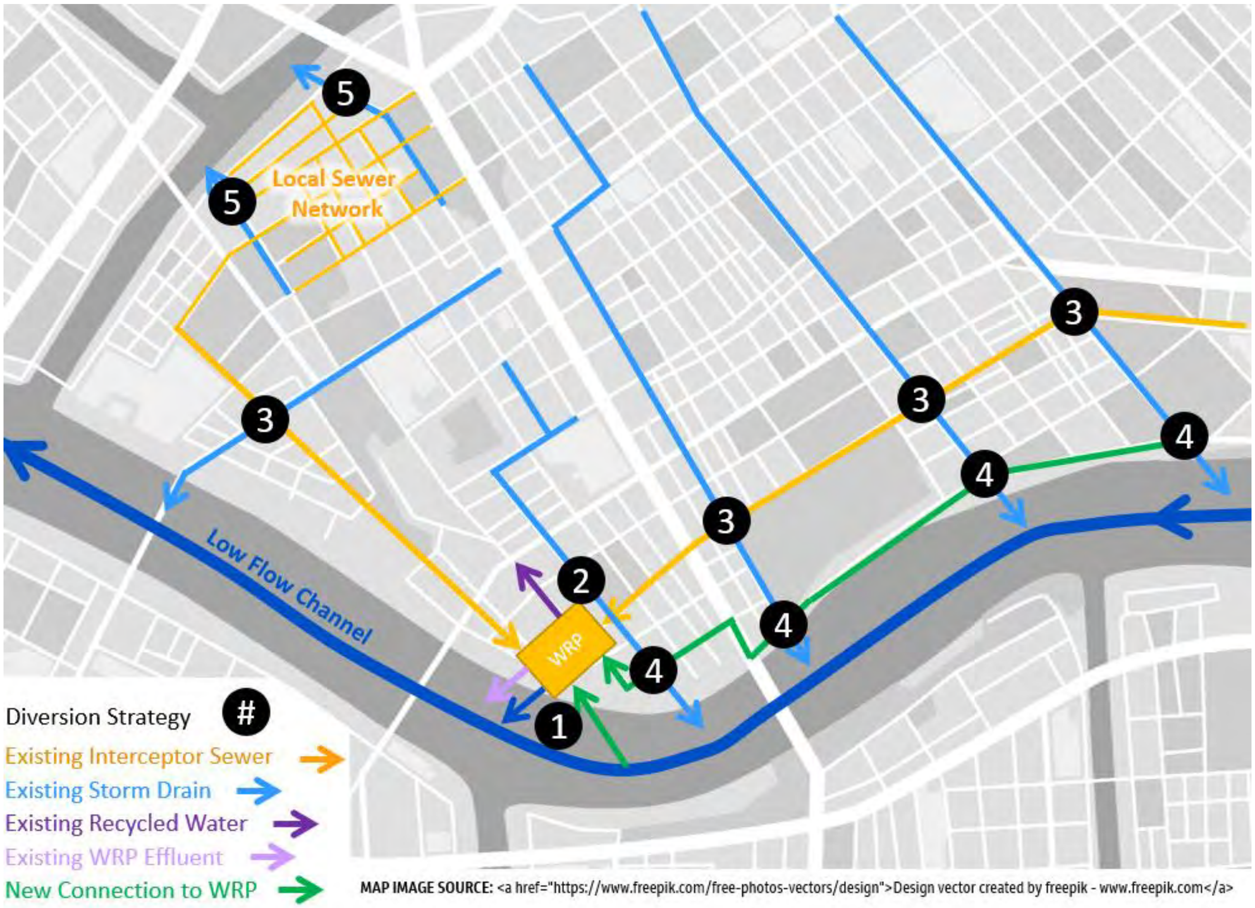

Figure 5-7. Potential Diversion Strategies

The feasibility of developing projects using any of these approaches will require investigations on a case by case basis. To manage dry and wet weather runoff, several approaches can be applied. In the toolbox approach, the strategies vary. They include smaller projects that treat runoff in the LID BMPs from areas such as streets and parking lots, specifically during wet weather. Other projects also include biofiltration and the use of pervious pavements to allow for infiltration. Many large-scale projects include diverting water to spreading basins for groundwater recharge. Each stormwater management project also presents opportunities to store and divert stormwater to the sanitary sewer system for treatment at WRPs and to produce recycled water, which can be used for various beneficial uses, such as groundwater recharge.

5.4 Conclusions and Recommendations

The goal of this section has been to better understand the magnitude of the uncaptured dry weather runoff in the Los Angeles Basin and guide planning level efforts to optimize the use of existing infrastructure to capture additional dry weather runoff. The conceptual approach to divert uncaptured dry weather runoff serves as a set of examples to identify feasible approaches to managing stormwater through diversion to the sanitary sewer.

The development of an accurate estimate of dry weather runoff is difficult and resource-intensive, and it would require monitoring of thousands of storm drains in all watersheds of the Los Angeles Basin, which would be a huge and expensive undertaking. The analysis presented in this section provides a high-level estimate of dry weather runoff in the Los Angeles Basin. Further investigations should be made to refine and update these dry weather runoff estimates. In addition, the separation between the type of stormwater management practices and potential for use of water supply generated from them can help provide an understanding of the constraints and opportunities to implement various types of projects, such as LID, green infrastructure, and DWDs.

Based on the seven watersheds in the Los Angeles Basin, the estimated median dry weather runoff is 73 MGD, ranging from 43 to 137 MGD, for the 10th and 90th percentile flows, respectively. The range of dry weather runoff estimates within a watershed and among watersheds is highly variable due to several factors, including the sources and frequency of water releases to the storm drains or receiving water bodies. The range of dry weather runoff estimates also vary among studies, due to the variability in approaches used for dry weather runoff estimations and the time period used for the analysis. Robust methods, including flow balance approaches, can help refine these estimates.

Based on the findings presented in Section 3, the DWDs have been successfully operated to prevent dry weather runoff from discharging to receiving waters. Across the Los Angeles Basin, 41 DWD projects have been successfully diverting dry weather runoff either to WRPs and WWTPs (such as the JWPCP), or used for beneficial purposes. Many more DWD projects are in the construction, design, and planning phases. Reducing or eliminating dry weather runoff from various sources not only provides a water quality benefit to the receiving waters, but also reduces the demand for potable water.

While this section is focused on estimating the remaining dry weather runoff in the Los Angeles Basin, wet weather runoff can be captured on a case-by-case basis, depending on the runoff volume, storage provided, and locations of storm drains, as well as the sanitary sewer system and WRPs. It is important to recognize the limitations associated with the dry weather runoff estimates and approach to developing strategies for managing stormwater. In summary, the dry weather runoff estimates in this current analysis:

- Do not fully capture each watershed-specific runoff source and condition
- Are based on the assumption that only the imperviousness derived from land use areas contributes to dry weather runoff estimates
- Do not differentiate the impact of structures (for example, dams and their operations on flows in the river or creek)
- Do not fully consider the impact of groundwater infiltration or rising groundwater flow
- Are not intended for developing feasibility studies; however, a detailed study with a high degree of resolution for each contributing dry weather runoff source in each watershed is recommended
- Are reasonable high-level dry weather runoff estimates for planning purposes

The variabilities in dry weather runoff estimates and the differences between this study and the earlier studies cited (for example, City of Los Angeles, 2004) could be attributed to several confounding factors for the Ballona Creek and other watersheds, including the following:

- ***Effect of conservation and drought on runoff***: Dry weather runoff generated from landscape irrigation may have been impacted due to conservation practices and recent droughts. Studies have shown that approximately 58 percent of residential water demand, primarily for home landscape irrigation is used for outdoor purposes (AWWARF and AWWA, 1998). Excess irrigation results in increased dry weather runoff generation. However, recent water conservation practices and changes in landscaping during- and post-drought have caused a shift in outdoor water use. Further analysis is recommended to understand the current changes in dry weather runoff due to water conservation and landscape water management practices.
- ***Change in land use over time***: The urbanization and changes in land cover or land use over the last few decades may have impacted the generation of dry weather runoff in various watersheds.

- ***Use of BMPs and ordinances and other approaches to capture stormwater*:** Agencies have implemented source control methods in the last few decades, including the implementation of ordinances and BMPs involving structural and nonstructural approaches, such as public education in various watersheds to reduce dry weather runoff generation and retain or reuse water onsite. The increasing implementation of these BMPs will continue to reduce the conveyance of dry weather runoff to the storm drain system.
- ***Watershed-specific effects (for example, dewatering operations and natural springs)***: Although the watersheds in the Los Angeles Basin have similarities contributing to dry weather runoff generation, there are watershed-specific conditions or sources, such as natural springs and groundwater activities, that may vary among the watersheds and can influence dry weather runoff estimates. The effect of this change is variable in different watersheds due to variations in land uses, and operations and activities (for example, dewatering and construction-related releases). It is difficult to assess a trend for such intermittent activities.

The estimates of dry weather runoff from the Ballona Creek Watershed and the application of the runoff rate based on the impervious area from the developed land use area approach to other watersheds in the Los Angeles Basin may have contributed to variability due to watershed-specific confounding factors. It is recommended that these estimates be updated or refined with measured flows. Furthermore, the different sources of dry weather runoff can be monitored to distinguish the relative contribution and variability of each source over time.

Specific recommendations for understanding the amount of valuable water resource that can be captured by stormwater management include:

- Continue detailed studies to understand the quantity of dry and wet weather runoff generated in various watersheds and with varying management strategies.
- Monitor the effect of changes in land use and imperviousness and evaluate their impact on dry weather runoff generation.
- Understand technical challenges and watershed-specific issues that affect the estimates and measurement of flows in storm drain systems (such as, dewatering activities and infiltration and exfiltration of groundwater water, natural springs, WRP discharges).
- Develop a water balance model for individual watersheds to understand the dry weather runoff sources, uses, and losses (for example, groundwater infiltration and evaporation) and their impact on runoff generation.
- Communicate with stakeholders regarding the change in regional hydrologic regimes and optimized use of existing infrastructure to develop water quality and water supply benefits.

5.5 References

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Section 6. Storage Considerations

6.1 Introduction

Stormwater storage facilities are typically developed either to retain dry weather runoff for onsite beneficial use purposes, such as onsite landscape irrigation, or to hold urban runoff generated during the day until additional capacity and lower sewer flow rates are available at night. Similarly, adding storage to DWDs enables agencies to retain additional dry and wet weather runoff and discharge when sanitary sewer capacity becomes available. During wet weather, runoff can be retained in storage until dry weather conditions are restored in the wastewater conveyance system and diversion is again permitted.

The purpose of this section is to explore the role of storage in DWDs and WWDs to convey flows either to the sanitary sewer system leading to the WRPs or directly to WRPs. The remainder of this section includes the following topics: the importance of storage for stormwater management, components of a diversion system with storage, existing DWDs with storage facilities, example WWDs with treatment, potential considerations for storage sizing and siting, O&M of a storage facility, and storage feasibility and limitations.

The existing DWDs divert dry weather runoff and nominal wet weather runoff year-round. For DWDs to operate under dry weather conditions, storage may not be necessary unless collected water is planned for beneficial uses or the timing of diversion is shifted to access higher capacity or lower sewer flow rates. For example, the Temescal Canyon DWD has a storage facility that is intended to capture dry weather runoff to meet Temescal Canyon Park's irrigation water demands and divert excess dry weather runoff to the Hyperion WRP. Dry weather runoff is currently diverted to the sanitary sewer system. A treatment unit has been added and when it becomes operational, the stored water will be treated and used for irrigation (Section 2). Due to the variability in the storm drain flows, a storage unit provides detention to meet the irrigation water demand, which can vary over the course of the day and the season.

A recent DWD installation, the Carson Stormwater and Runoff Capture Project at Carriage Crest Park (also known as the Carriage Crest Park Diversion Project), will be the first of its kind that includes control mechanisms to divert wet weather runoff from smaller storms while using an underground storage system to store water during heavy rain events. The diversion is to the LACSD's sanitary sewer conveyance system and the JWPCP when capacity is available during periods of lighter rainfall. In addition, this facility diverts flow to the sewer at night to significantly lower the annual sewer service charges.

The Watershed Management Programs (WMPs) for various Los Angeles Basin watersheds include both regional projects and distributed projects. BMPs are proven infrastructure to manage runoff from a contributing area. Regional BMPs are typically associated with the runoff of multiple land parcels making up a large area. They include infiltration facilities that promote groundwater recharge, and detention facilities that facilitate the settling of solids and associated pollutants. Storage facilities can either be constructed as open-surface basin BMPs (for example, infiltration, spreading and detention basins, or subsurface storage and infiltration facilities/galleries). Distributed BMPs include site-scale detention facilities, which could also incorporate a groundwater recharge component, green infrastructure, flow-through treatment BMPs, and source control structural BMPs, which are intended to treat runoff relatively close to the source and are typically implemented at a single- or few-parcel level (normally on less than 1 acre).

Historically, DWDs were designed to divert dry weather runoff to the sanitary sewer system. The main objective of the installation of most of the DWDs was to operate diversions during dry weather only. The capacity of a DWD depends on the location, tributary area of the watershed, DWD pumping capacity, sanitary sewer system capacity, WRP treatment capacity, and other factors. Some of the existing DWDs (specifically those diverting flows to the LACSD's sanitary sewer system) also divert a nominal amount of wet weather runoff. In the WMPs, DWDs are integrated with other BMPs to manage non-stormwater and some portion of stormwater runoff.

To maximize the potential of existing and new DWDs, a large storage facility could be developed to capture flow from the entire tributary area or smaller storage facilities in the form of distributed projects throughout the watershed. In watersheds where existing DWDs are in operation, the goals of a storage facility can be to: (1) capture additional dry weather runoff that cannot be delivered by the existing DWDs, and (2) capture wet weather runoff and discharge it as sanitary sewer system capacity and WRP treatment capacity become available. While it would be desirable to have a storage facility to accommodate stormwater runoff from the 85th percentile, 24-hour storm event for MS4 compliance purposes, smaller storage facilities can retain smaller rain events and first-flush wet weather runoff to improve the water quality of releases to downstream water bodies. The cost-effectiveness of installing and operating multiple small storage facilities instead of a single large storage facility would need to be evaluated before a project can be implemented.

A few critical key questions need to be answered while planning for a storage facility:

- How much space is available to develop a storage facility in a watershed?
- How much flow is generated from wet weather, and how much volume can be stored near diversions?
- When and how can the flow from a storage facility be routed to the conveyance system?
- What will be the cost and cost-effectiveness of the storage project?

6.2 Storage for Dry and Wet Weather Runoff Management

Typically, storage facilities are developed to retain dry weather runoff for onsite beneficial use purposes, such as onsite landscape irrigation or to hold flow for nighttime discharge at lower flow rates. Storage facilities can include single or multiple retention and detention basins and can be located throughout the watersheds. They can include above- or below-ground systems, and other large regional projects to store substantial amounts of stormwater.

In the Los Angeles Basin, rainfall usually occurs in winter months when irrigation demand is the lowest. In some parts of the Los Angeles Basin, stormwater is captured where the soils and slopes are conducive to stormwater infiltration, such as in the Rio Hondo and San Gabriel River spreading basins. In many places, where soil conditions prevent groundwater recharge, storage facilities can help capture additional dry weather and wet weather runoff up to the 85th percentile 24-hour storm event from the contributing drainage area to comply with MS4 requirements for water quality. The water retained in storage facilities can potentially be diverted to the WRPs to generate local water supplies by tapping into available treatment capacity at the WRPs.

Depending on the intensity, duration, and location of the rain event, the sanitary sewer system capacity can be a limiting factor to capture additional wet weather runoff with the existing DWDs (refer to Section 4). Storage facilities associated with the DWDs can assist DWD operation by retaining water during rain events and releasing stored water in a controlled way when conveyance and treatment capacity becomes available, and thereby attenuating flows from the DWD drainage area. Storing additional wet weather runoff has the important benefit of assured high-level treatment for discharge to receiving water bodies to meet MS4 compliance and delivery to a recycled water system.

Therefore, in addition to the current use of existing DWDs to capture dry weather runoff, storage facilities can help provide the following benefits:

- Capture of additional dry weather runoff that is not captured by existing DWDs with no or insufficient storage capacity.
- Potential capture of first-flush wet weather runoff, which is normally the highest in pollutant loadings. Storage designed for the 85th percentile storm can provide for complete diversion of smaller storms assuming there is adequate time between storms to draw down the storage.
- Flexibility to enable wastewater system operators to control the release of flow from DWDs to the WRP when sanitary sewer system conveyance and WRP treatment capacity is available.

6.2.1 Planning for Storage

Flow in the sanitary sewer system can increase during rain events due to RDI/I, which uses conveyance and treatment capacity and reduces the availability of capacity to accept additional wet weather runoff from a DWD facility. Storage can be implemented so DWD discharges can be delayed until after wet weather flows in the sanitary sewer system and at the WRP subside to accept stored volumes.

Figure 6-1 presents a hypothetical application of storage and shows a generalized flow scenario during and after a rain event at a DWD. The blue line represents the wet weather runoff flow rate in the DWD tributary area. The green line represents how a DWD with storage can be operated - the DWD discharges up to its pumping and permitted capacity, shuts off during the rain event (depicted by the gap in green line), and resumes operation, releasing the stored volume. During a rain event, storage can help attenuate peak flow discharges to the sanitary sewer system by delaying the discharge from the DWD to the sanitary sewer system and the WRP for treatment.

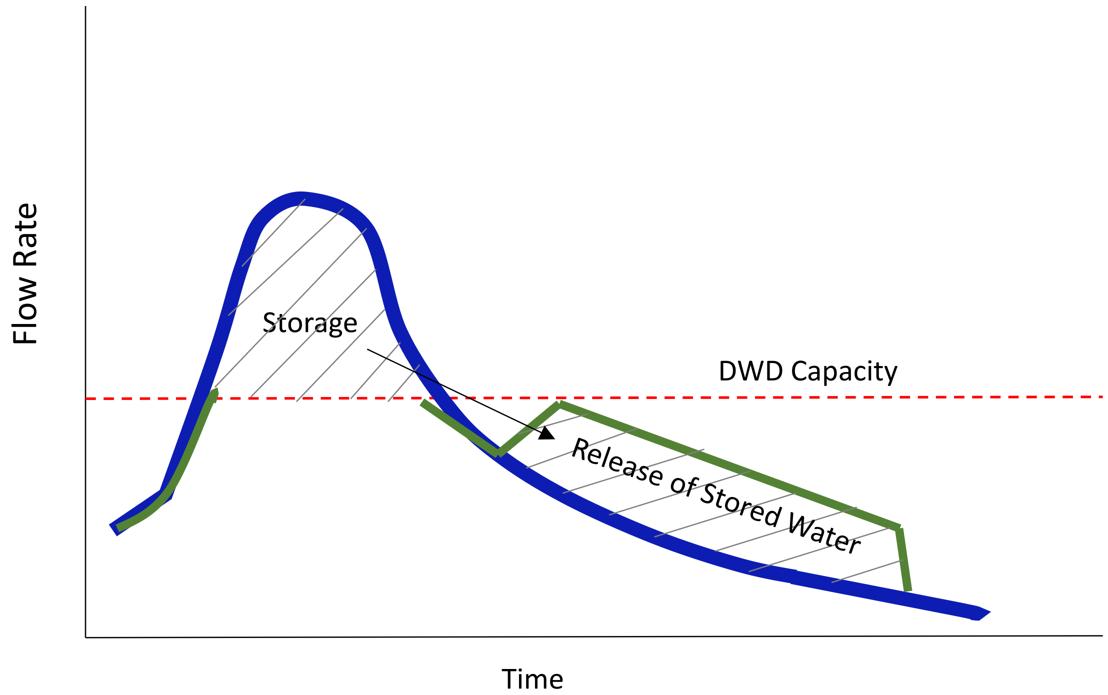

Figure 6-1. Conceptual Representation of Operating a DWD with Storage

The merit of integrating a storage facility with a DWD is the ability to hold dry and potentially wet weather runoff that exceeds the pumping and/or permitted DWD discharge capacity and release it to the sanitary sewer system when conveyance and treatment capacity becomes available. Water is released from the storage facility to the sanitary sewer system during the receding hydrograph. The release of stored water to the sanitary sewer system can be coordinated with WRP operations. The flow hydrograph's recession curve could be long, and depending on the available conveyance and treatment capacity, the storage volume would be held longer and/or released gradually over time as sanitary sewer system flows return to dry weather conditions.

6.2.2 Cost Considerations for Building a Storage Facility

Cost is often the determining factor for developing a DWD with a storage facility. Conceptual or engineer's estimates are often used for long-term planning and construction bidding purposes. Storage facilities, like other BMPs, require capital investment and continued O&M. During planning phases, O&M costs for storage must be included because those are recurring costs for a project's lifespan.

Generally, surface or aboveground storage facilities are less expensive than underground storage facilities because they are easier to construct. An aboveground storage facility may not require deep excavation and reinforcement. However, these facilities may present neighborhood compatibility issues and the need for managed access for safety reasons.

Installing an underground storage facility requires expenditures on excavation and earth-moving activities. After installing the storage tank and a pumping system, there is a cost to backfill the space and pave some areas. It is simpler to maintain an aboveground storage facility, specifically for troubleshooting and repairing cracks or other damage that may develop. But there are other costs associated with developing the overlying facilities.

To develop a storage facility within a watershed, a feasibility analysis needs to be conducted in a collaborative process with the project stakeholders to understand the opportunities and limitations. Based on the space availability for storage and the goals of the project, the storage sizing and costs can be determined.

6.3 Components of a Diversion System with Storage

The components of a DWD or WWD system with storage can include a diversion structure, pretreatment units, storage facilities, and a pump station. The following subsections provide a brief description of these components.

6.3.1 Diversion Structure

Diverting flows from a storm drain to a DWD storage facility would require a diversion structure. A concrete berm, diversion channel, or inflated dam are potential options for this purpose. Photos 3-1 and 3-2 show an example of a concrete berm and an inflated dam diversion structure, respectively. The diversion structure could be located at the upstream side or near the existing DWD.

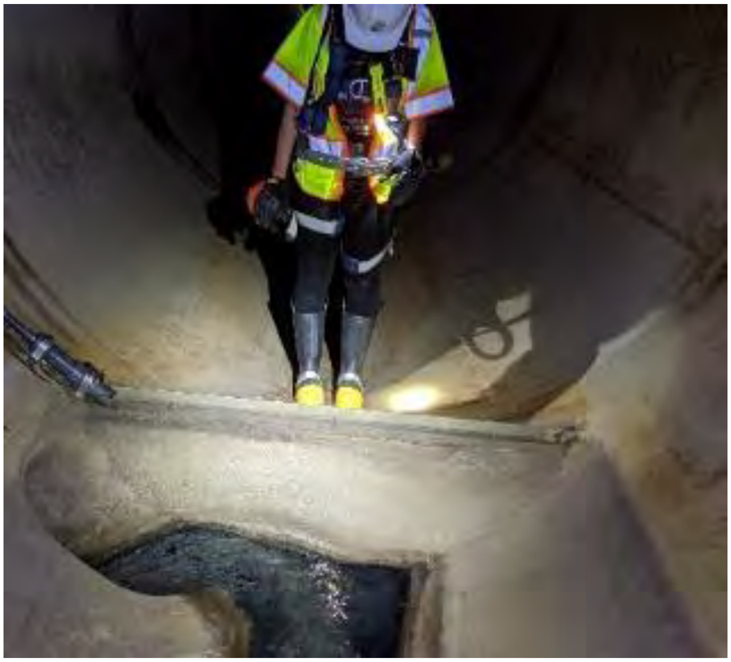

Photo 6-1. Example Diversion Structure with a Concrete Berm

Photograph Taken During the October 22, 2019 Site Visit with Los Angeles County Flood Control District Staff

Photo 6-2. Example Diversion Structure with an Inflated Rubber Dam

Photograph Taken during the October 15, 2019 Site Visit with Los Angeles Sanitation and Environment Staff

6.3.2 Pretreatment Unit

Pretreatment units (for example, trash wells with screens or commercially available, prefabricated units) can be designed and built into the system to prevent debris from entering the storage facility. The pretreatment units for the storage facility can also facilitate improvements to the treatability of flows at WRPs by removing floatables, skimming oils and grease, and trapping some of the sediments through deposition or separation. The proper design of pretreatment devices (for example, trash and debris interceptors, sedimentation basin, prefabricated units) upstream of DWDs can significantly improve the lifespan of DWDs.

6.3.3 Storage Facilities

In a built-out, urban environment, underground storage facilities typically act as retention or detention basins to harvest and store water. For diversion projects, the storage facilities are designed to retain a specified design volume from a storm event, which can be discharged to the sanitary sewer system. Depending on the soil conditions, the storage facility may provide some benefit of infiltration for groundwater recharge. However, for some locations (for example, for the Carson Stormwater Runoff and Capture Project), infiltration is not possible due to potential soil contamination, so discharge to the sanitary sewer system was determined be the primary mechanism for treatment (Tetra Tech, 2017).

Photo 6-3 shows examples of storage facilities, both below and above ground. The selection of a type of storage facility depends on many factors, such as location, hydraulics, and construction and operations costs. The availability of land near the DWD is a key component in selecting the type of storage. Peak inflow and outflow, water-holding volume during the peak discharge hour relative to the DWD's dry weather capacity, and water retention time and volume are the governing hydraulic considerations for the selection of storage type. Construction and operations costs are primarily related to the volume of excavation, possibility of remote access, available cleaning options, site access and security, and access for basin and tank entry.

Belowgrade Open Earthen Basin

Abovegrade Tank

Underground Storage – Carriage Crest Park Diversion Project in Construction
(Moon and Passanisi 2020)

Photo 6-3. Types of Storage Facilities

Stormwater can be stored under hardscape structures and elements (such as walkways, parking lots, and parks) through the use of cisterns, rain storage tanks, or manufactured galleries or storage products, and can provide for onsite irrigation needs. In institutional, commercial, and industrial settings, these types of units can provide capture-reuse systems because the areas available for capture and storage are larger, and the potable water need for irrigation demand in the landscaped areas can be minimized or eliminated by switching to stormwater use. Underground storage facilities are low-profile facilities and provide opportunities for additional benefits. The overlying surface can be used for other purposes; for example, the area above ground can be used for a parking lot, park, or playground. These opportunities provide a better blend with existing environmental conditions, as well as community benefits, and they protect the originally designed use of the facilities.

In addition, underground facilities help avoid water ponding scenarios susceptible to mosquitoes or pest problems if inlets to the storage are properly screened. Typically, diversions to the sanitary sewer system are required to be pumped to avoid the potential for an uncontrolled discharge causing a sanitary sewer overflow (SSO). Pumped discharge with telemetric monitoring and control is a requirement in LACSD's service area.

A DWD project with storage may include components to minimize the impact of storage on the local environment in terms of health and safety, odor, noise, project footprint, and other disturbances. Depending on the location of the storage facility, as well as the source and quality of the runoff, additional components may be required (for example, an air management system).

Figure 6-2 provides an example of the Carriage Crest Park Diversion Project system components, including treatment units for pretreatment for trash and debris, sediments, oil and grease, and other pollutants to reduce the cleaning load within the storage facility.

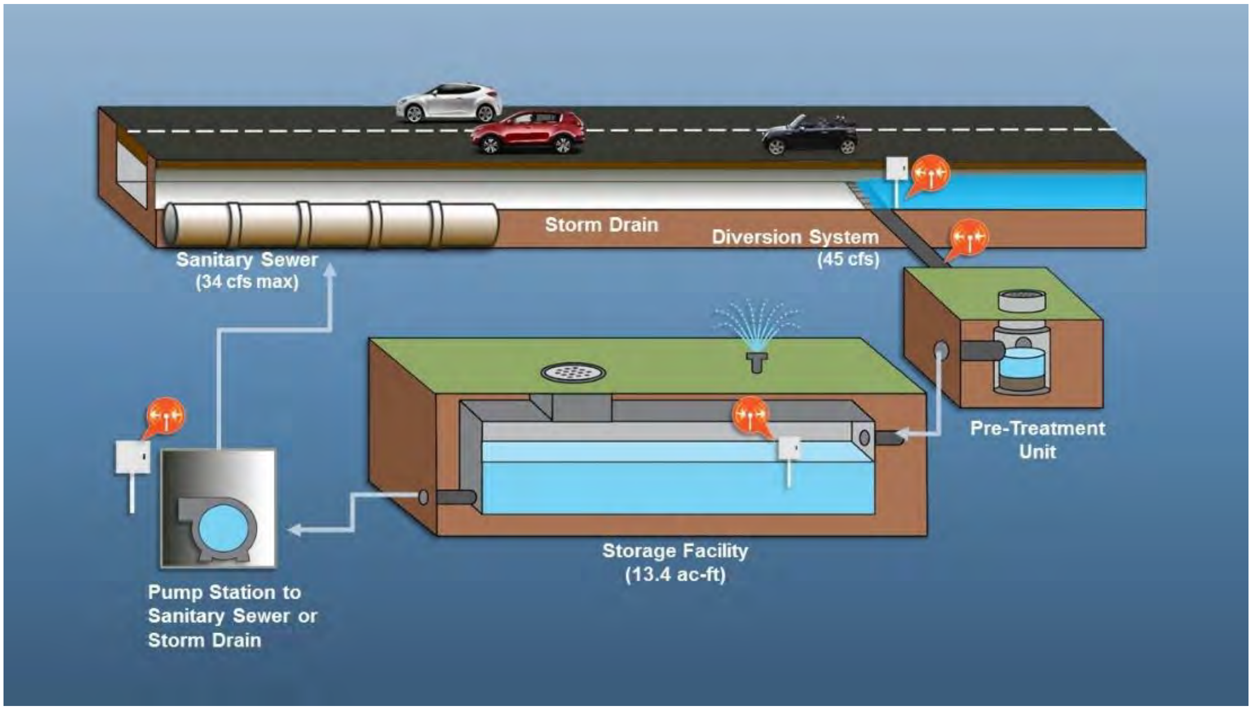

Figure 6-2. Example DWD Project System Components – Schematic Diagram of the Carriage Crest Park Diversion Project (Moon and Passanisi 2020)

6.3.4 Pump Station

It was observed during the field visits to all the case-study DWDs (SMC, Temescal Canyon, Manhattan Beach PP, and Pershing Drive) that the DWD pumps are constant-speed/constant-head pumps and they are controlled manually. For recent DWD/WWD projects, such as the Carriage Crest Park Diversion Project, pumps with VFDs are used (refer to Section 4). VFD-equipped pumps are more efficient than constant-speed pumps because they adjust the flow rate based on the requirement of flow diversion system, including available capacity. Most of the time, a constant-speed pump runs at a rate that does not match with the load/demand profile and uses much more power than required (Carrier and Stickney, 2007). VFD-equipped pumps often run at a lower speed based on the changing nature of flow and head, and consume less power than a constant-speed pump. In addition, VFD-equipped pumps can be integrated conveniently in an automatically controlled system.

6.4 Existing Dry Weather Diversions with Storage Facilities

6.4.1 Dry Weather Diversion Existing Inventory

Section 2 provided an inventory of existing DWDs, separated into two categories: (1) DWDs with storage and (2) DWDs without storage. The following summary of existing DWDs provides a breakdown of DWD by owner and storage:

- 19 DWDs owned by LACFCD
  - 11 LFDs without storage
  - 8 LFDs with storage
- 12 DWDs owned by LASAN
  - 8 LFDs without storage
  - 4 LFDs with storage
- 10 DWDs with and without storage owned by other agencies

Figure 6-3 shows the locations of the existing DWDs with storage facilities. Some of these divert nominal wet weather flows and use the storage for onsite beneficial uses. Currently, there are no operational WWDs with a storage facility in the Los Angeles Basin to capture runoff volumes from the 85th percentile 24-hour storm event to comply with the wet weather requirements of the MS4 permit. The Carriage Crest Park Diversion Project will be the first WWD, with operations beginning in 2021. The details of this diversion project are presented in the following section. Several other wet-weather storage projects are in development or were recently completed; specifically, the Alondra Park Regional Stormwater Capture Project, the Adventure Park Regional Stormwater Capture Project, and the Lakewood Stormwater and Runoff Capture Project at Mayfair Park.

Based on conversations with LASAN and LACSD, storage will likely be a component of any future WWD facilities (Rademacher and Kim, pers. comm., 2019).

6.4.2 Dry Weather Diversion Case Studies

Of the four-case study DWDs analyzed and discussed in Section 4, the Temescal Canyon DWD and Manhattan Beach PP both have storage components. These storage facilities are not specifically designed for MS4 compliance but are used for other beneficial purposes. The storage upstream of the Temescal Canyon DWD will detain dry weather and wet weather runoff from the Temescal Canyon storm drain, and treated water will be used for irrigation purposes. The Manhattan Beach PP storage has approximately 68,000 gallons of storage in addition to the wet well. This storage unit helps with mitigating flooding in the area.

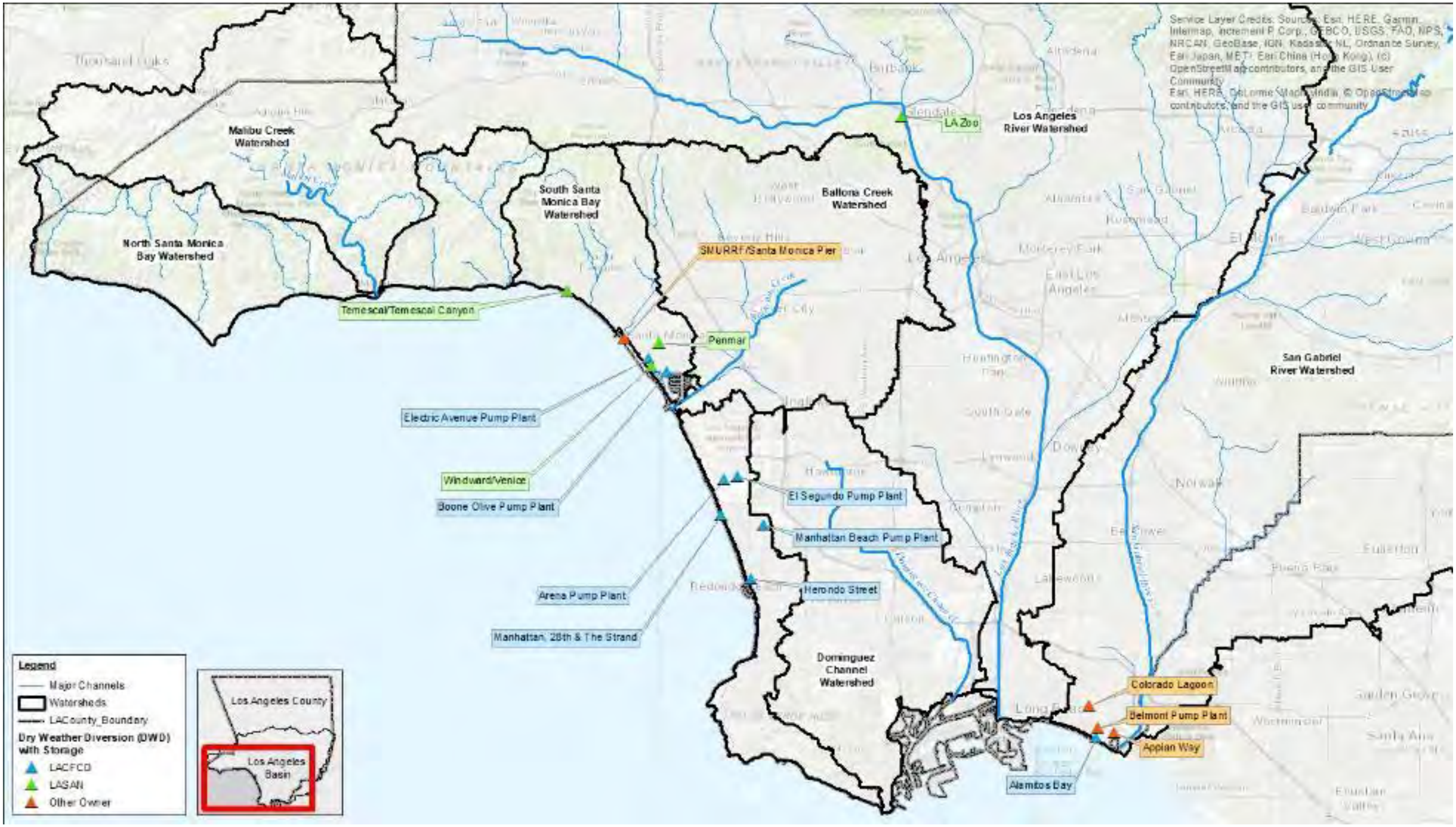

Figure 6-3. Dry Weather Diversions with Storage Facilities in the Los Angeles Basin

6.5 Example Wet Weather Diversion with Treatment

Now in construction, the Carriage Crest Park Diversion Project will become one of the first WWDs within the Los Angeles Basin. This project is a collaborative effort between the City of Carson, LACFCD, and LACSD, with funding by California Department of Transportation and LA County, and is the City of Carson's contribution to the Dominguez Channel Watershed Management Area Group WMP (Tetra Tech, 2017).

Carriage Crest Park is a 4.8-acre parcel owned by the City of Carson at the intersection of Figueroa Street and West Sepulveda Boulevard, and is immediately north of the JWPCP (Figure 6-4). Carriage Crest Park was identified in the Dominguez Channel EWMP as a high-priority site for a regional stormwater capture project due to its proximity to two large storm drains, with a total drainage area of 1,146 acres. This area discharges into Wilmington Drain, which subsequently discharges into Machado Lake. The overarching objective of the project is to improve the quality of Machado Lake by eliminating dry weather runoff and reducing wet weather pollutant loading (Tetra Tech, 2017).

(Source: Department of Public Works Los Angeles 2020)

Figure 6-4. Diversion and Storage Features of the Carriage Crest Park Diversion Project

The project will divert runoff from the LACFCD reinforced-concrete box (RCB) storm drain, as well as from two City of Carson catch basins, through a pretreatment structure and into an underground stormwater storage system, where the runoff is temporarily detained before diversion to the JWPCP. The diversion flow rate from the existing RCB has been designed for 45 cfs. Approximately another 5 cfs will be diverted from the local catch basins, based on the 85th percentile 24-hour design storm. Stormwater that is not diverted out of the LACFCD box culvert will continue to be conveyed in the existing storm drains leading to Machado Lake, as it currently does. The system uses VFD-equipped pumps to discharge to the sewer. The variable pumping rate allows the project to match the diversion rate to the available capacity in real time.

This project is an example of a diversion that will divert stormwater runoff into a detention basin underneath the park fields. Other projects, such as those in the Ballona Creek watershed, also use hybrid approaches to manage stormwater. The hybrid approaches include partial treatment of the runoff and release of treated water back to Ballona Creek to meet the environmental flow requirements, and diversions of the other portion of flow to the Hyperion WRP for beneficial reuse to offset potable water demand. Note, permission for any diversion of flow to the Hyperion WRP involves water rights permitting via the State Water Resources Control Board (State Water Board) (Clean Water Act [CWA], Section 401 water quality certification) and consultations and approvals by resource agencies regarding sensitive species (LASAN, 2016).

6.6 Potential Strategies for Storage Siting

Storage is generally possible, but it may be expensive to develop water storage facilities in the Los Angeles Basin, specifically in developed (built-out) areas. One of the inexpensive options is to develop surface water storage with recharge basins, such as spreading basins. In developed areas with limited vacant, open space, underground structures that are commonly constructed under parks and parking lots are used as storage facilities, as discussed in Section 6.3. This section discusses potential approaches for diverting wet weather runoff to DWDs with storage facilities.

6.6.1 Co-locating Storage with Diversion

Some of the existing DWDs have substantial storage facilities located at or near the diversions. As an alternative to infiltration, these facilities include underground storage in engineered cisterns. Co-locating storage facilities near DWDs allows easy operation of both the storage and the diversion. Stored dry and wet weather runoff can be used for beneficial purposes; however, unused excess water is typically discharged back to the original storm drain or the DWD. Potential opportunities for developing storage facilities in various land use areas in the Los Angeles Basin can be examined to determine the full potential of existing DWDs.

6.6.2 Storage Beneath Parks and Parking Lots

Stormwater cisterns provide an opportunity for using existing storage. Stormwater cisterns have been installed as BMPs throughout LA County to capture stormwater for reuse, like irrigation systems (landscaping, golf courses), or toilet flushing. With some capital improvements, existing cisterns can be modified to be used in combination with DWDs. The Temescal Canyon DWD has a storage facility that is intended to capture dry weather runoff to meet Temescal Canyon Park’s irrigation water demands and divert excess dry weather runoff to the Hyperion WRP. Dry weather runoff is currently diverted to the sanitary sewer system. A treatment unit has been added and when it becomes operational, the stored water will be treated and used for irrigation (refer to Section 4). Due to the variability in the storm drain flows, a storage unit provides detention to meet the irrigation water demand, which can vary over the course of the day and the season. The Penmar DWD is also an example of a system that includes cisterns as storage facilities.

Parking areas on developed land are generally asphalt or concrete paved (impervious surfaces) or unpaved and either directly connected or drained to adjacent pervious areas. The unpaved area beside a paved surface also acts like another impervious area, with little or no infiltration due to the effects of compaction, unless otherwise designed to enhance drainage. Stormwater can be stored under hardscape structures and elements (such as walkways, parking lots, parks). In commercial and industrial land use areas, these types of units can provide capture-reuse systems that can be installed under the parking lots to satisfy irrigation water demands for landscaped areas that are currently using potable water supply.

6.6.3 Storage Facilities within Proximity to Water Reclamation Plants

Locating both DWDs or storage (or both) adjacent to WRPs is advantageous because it eliminates or reduces the downstream conveyance constraints to convey water from the DWD location to the WRP via a sanitary sewer system. The Carriage Crest Park Diversion Project is an example of a WRP-adjacent storage system (Tetra Tech, 2017).

6.6.4 Standalone or Integrated Storage Facilities with Other Best Management Practices

In the context of WWDs, the goal is to identify the most practical areas to develop a storage facility to retain wet weather runoff from the 85th percentile, 24-hour storm event from the contributing drainage area, while achieving other benefits, such as water quality, water supply, and flood control. Storage could be designed as a standalone project for a WWD project; however, if the land availability, land cost, and project costs prevent the development of a storage facility, an integrated approach can be developed to accommodate additional dry and wet weather runoff with other smaller storage facilities and BMPs in the watersheds.

Although the diversions are included as Regional Projects in EWMPs, these projects can also work in combination with other distributed and regional Projects to collectively offer the benefits of peak flow attenuation during a storm event and treatment. Taking advantage of multi-benefit projects with storage allows the potential to maximize the water quality and water supply benefits of diverting and storing wet weather runoff.

6.6.5 Modification of Existing Stormwater Pump Stations

There are more than 60 LASAN- and LACFCD-owned stormwater pump stations to alleviate localized flooding at hydraulic low points in the storm drain systems in various watersheds. Several existing pump stations have DWDs installed to divert flows to the sanitary sewer system during dry weather (Figure 6-5). In general, pump stations typically have a storage component to mitigate peak wet weather runoff. This existing storage can be used to capture and discharge both dry and wet weather runoff to the sanitary sewer system. Therefore, it is proposed that existing pump stations without DWDs be considered for installation of diversion infrastructure. The controls for discharge to the sanitary sewer system would need to be re-examined and upgraded as necessary to assure the sanitary sewer system and WRP have sufficient capacity to accommodate the diverted flow. Pumps used in these upgrades would optimally be VFD-equipped pumps that can match the discharge to the available capacity in real time.

Existing pump stations with DWDs include:

- Alamitos Bay PP (LACFCD)
- Arena PP (LACFCD)
- Boone Olive PP (LACFCD)
- El Segundo PP (LACFCD)
- Electric Avenue PP (LACFCD)
- Manhattan Beach PP (LACFCD)
- Windward and Venice PP (LASAN)
- Appian Way PP (Long Beach)
- Belmont PP (Long Beach)

It is recommended that the feasibility of upgrading the DWDs at these pump stations to WWDs with storage be investigated.

Figure 6-5. Existing Pump Stations with Dry Weather Diversions

6.7 Considerations for Storage Facility

6.7.1 Storage Siting and Sizing

Assessing a site's potential for developing a storage facility requires a review of existing data and the collection of site-specific information. Information regarding site layout, land use and existing development, topography, soil type and geology, geotechnical conditions, hydrology, and local groundwater conditions should be reviewed. Other factors for consideration include: existing utilities, investigations for environmentally sensitive or restricted areas and contamination areas, and the management of flows from the potential construction site.

The technical feasibility of the storage project requires an assessment of the maximum volume that can be feasibly retained by the storage facility when all factors are considered. The water quality, including sediments and pollutant profile, is also important to understand impacts on downstream WRPs and needs for pretreatment devices.

For capturing additional dry and wet weather runoff, two potential strategies for planning DWDs with storage include:

1) Stored water diversion: Runoff is stored during and after a storm event and discharged to the sanitary sewer system when the conveyance capacity becomes available.
2) Real-time control of a diversion with storage: Runoff is stored and is discharged to the collection system based on real-time rainfall intensity observation (which can be used to estimate responses in the sanitary sewer), the real-time sewer level in the conveyance system and available treatment capacity.

The sizing of capture and reuse systems depends on the volume of water available during dry and wet periods, total tributary area and volume of water generated from the area based on rainfall, demand for local use, and space available for a storage facility. The available lot or space may determine the allowable dimensions of the storage facility and the provided storage volume. An analysis of rainfall and demand (infiltration or reuse) and the storage drawdown rate acceptable for DWD and the target conveyance system is required when trying to optimize the sizing of storage. Historical long-term rainfall records, including dry and wet periods, should be examined to determine the amount, frequency, and seasonal variability of rainfall. The storage drawdown rate and predicted fill rate will determine the proper storage capacity. The sanitary sewer diversion pumps should be VFD-equipped pumps that can match the discharge to the available capacity in real-time.

Standard design manuals and practices, along with local codes and ordinances for urban runoff and stormwater capture, should be followed while developing a storage project. In DWDs, backflow prevention assemblies must be included to prevent wastewater from flowing back into the storm drain system. Local water and sanitation agencies should be contacted to determine specific requirements. The designated separate piping systems prevent cross-contamination.

6.7.2 Climate Change Risk and Resiliency

Climate change is projected to impact Los Angeles wastewater and stormwater systems in a variety of ways. The wastewater systems consist of sewer systems, sewage pumping facilities, wastewater treatment facilities, and water reclamation facilities. The stormwater systems consist of collection systems, stormwater pumping plants, watershed protection, and Proposition O projects. Changes in temperature, precipitation, and sea levels will affect the physical plant and operational vulnerabilities of these facilities and operations.

Climate change predictions indicate the intensity and duration of climatic events, such as precipitation in California, will become more extreme in the future. More extreme precipitation events are expected to occur with climate change, creating added flood risk. Extreme rain events should be factored into the design of new projects or the retrofit of existing DWDs. A climate change risk assessment can help assess various scenarios of threats and risks to the infrastructure, assets, and communities to plan for mitigation and adaptation strategies.

The prediction for changes in the intensity and frequency of storm events with climate change have implications for DWD storage considerations. The existing and new DWDs, along with storage, need to be designed properly, based on predicted trends in increased rainfall. The design standards related to or reliant on precipitation conditions are based on historical data. The characteristics of the design storm (for example, depth-duration-frequency relationships) will likely need to be updated. In addition, existing DWD designs based on older standards may need to be revisited in the future.

The One Water LA 2040 Plan describes future changes to the global climate system that are expected to cause changes in the Los Angeles hydroclimate over the next century (LASAN, 2018). By continuing existing emission patterns, average temperatures will rise outside of normal variability to create a new regional climate by the end of the century. Average air temperature is projected to increase from 3.2 degrees Fahrenheit (°F) (1.8 degrees Celsius [°C]) to 3.6°F (2.0°C) by 2050. These changes will result in increasing the frequency of extremely hot days (warmer than 95°F or 35°C) from 6 to 22 days by 2050. While it is difficult to discern strong trends from the full range of climate projections, the median of the projections suggests no change in the future annual precipitation. Despite the relative uncertainty in annual precipitation changes, about two-thirds of the projections suggest increases in 3-day annual maximum precipitation by end of century. The median 3-day annual maximum precipitation for the Los Angeles downtown area by the end of the century is projected to increase by about 10 percent. The wetter projections also suggest an increase in the daily extreme precipitation events, such as the 100-year/24-hour storm that would occur approximately 1 percent of the time on an annual basis, and the 10-year/24-hour storm used for stormwater and sewer design. The 10-year/24-hour storm is projected to have a 17-percent increase in volume and a higher hourly peak intensity by the year 2050. The frequency and severity of droughts are expected to increase under future climate.

The siting and design of facilities should also consider current and future hazards and threats to assure their long-term resiliency. Facilities in or adjacent to floodplains should be designed following local, state, and federal design requirements for flood protection. Due to thermal expansion, ice melt, and local vertical land movement, the mean sea level at Los Angeles is projected to increase by a range of 0.43 to 1.97 feet (0.13 to 0.6 meter) by 2050 and 1.44 to 5.45 feet (0.44 to 1.66 meter) by 2100 relative to 2000. Sea level rise may expand low-lying coastal floodplains and raise flood elevations in the future and therefore the siting ad design of facilities should take this into account as well.

6.8 Storage Operations, Maintenance, and Controls

O&M is a critical component to support the proper performance of a storage facility over its designed service life. O&M requirements and corresponding resource allocations must be considered during the project planning phase, through design, construction, and optimization. The neglect of O&M planning and sufficient allocation of resources, such as budget, staff, tools and equipment, and training, can result in inadequate O&M activity, which can affect the performance of the system, thereby reducing the overall project benefits.

Every storage facility should include an O&M plan. The elements of the O&M plan can include:

- Site and location details – a map showing the boundaries of the storage and the flow path
- Baseline description of the storage facility – a list of the owner and agency responsible for O&M, including contact information of personnel responsible for the operations

- O&M procedures – including details of electrical and mechanical component maintenance requirements, with a frequency and maintenance performance matrix
- Documentation system – with a description of the inspection procedures, and recordkeeping and record retention requirements
- List of equipment, materials, and tools needed for O&M activities
- List of housekeeping procedures for proper maintenance and to prohibit failures to perform the O&M activities
- Resources required, specifically staff and training needs
- Safety practices and personnel protective equipment needs
- Mosquito and pest control plans

For aboveground storage systems, such as cisterns, the foundation housing the facility must be adequate to support the weight of the cistern with the stored water. For both aboveground and underground cisterns, O&M practices typically include:

- Inspecting and regularly cleaning pretreatment units
- Inspecting cisterns or storage facilities, associated piping, and pump and valve connections for leaks
- Inspecting inlet and outlet control structures or components
- Cleaning storage facilities regularly to remove accumulated sediment and debris annually or as needed
- For aboveground storage, checking cistern stability regularly
- For underground storage, checking that the manhole or the vault is accessible and in good condition
- Good housekeeping – keeping the areas around the storage facility clean and accessible
- Testing mechanical and electrical components and devices regularly
- Inspecting flow control system to verify that the stored water is partially or fully used or emptied between storms
- Testing functionality of control systems (for example controllers, flow depth measurements)

The frequency for inspecting and cleaning storage facilities should be determined based on local watershed conditions.

Storage systems for diversions may require additional monitoring, controls, and sampling to ensure the safe operations of the downstream conveyance systems. For example, the Carson Stormwater and Runoff Capture Project uses several sets of controls to ensure proper function of the facility and protection of existing infrastructure. The following elements are key components of the control system:

- ***Sewer Monitoring***: The flow depth in the sanitary sewer is continuously monitored. Flow depth is used to control the discharge pumping to optimize the diverted flow. VFD-equipped pumps are used to match the pumping rate to the available capacity.
- ***Communications and Controls***: Two PLCs are used to provide control for both LACSD and the City of Carson. The primary PLC will communicate with the existing telemetry system at LACSD's Long Beach Main Alarm Center to avoid impacts to the sanitary sewer collection system. The second PLC communicates with the City of Carson's telemetry system to provide remote control and monitoring of the stormwater runoff and capture project. Data are exchanged between the two PLCs such that both have control of the stormwater capture facilities, but at the same time, maintain isolation of the two SCADA networks.

- ***Sampling***: In addition to instrumentation and controls required to operate the diversion system, the project includes the construction of a sampling system for periodic composite and grab sampling of discharges to the sanitary sewer. That sampling system includes control elements, such as a pressure-reducing valves, various control valves, and flow recorders. The flow sampling system should be flow-paced with the effluent flow and interconnected with the effluent flow meter and other instrumentation.
- ***WRP Monitoring***: For DWDs where direct connection to the WRP may be possible, WRP flow monitoring can be used to control the discharge from the diversions to the WRP.

6.9 Storage Feasibility and Limitations

Infiltration projects implemented as part of regional projects have the capacity to capture large volumes of water during rain events. These types of projects can help divert water to large-scale spreading basins; however, where soils and geology inhibit the ability of water to percolate sufficiently deep to reach groundwater to increase groundwater supplies, the diversions, along with storage, can provide the potential to divert stormwater to WRPs to develop recycled water supplies. The recycled water can be used for groundwater recharge or other beneficial uses, including the augmentation of drinking water supplies and landscape irrigation.

Opportunities to develop storage facilities in the form of cisterns and detention basins include parks or other open spaces to capture runoff, which could be used for onsite irrigation (for example, the Temescal Canyon storage project) or as a part of WWD project (for example, the Carriage Crest Project).

Limitations for storage facilities include:

- Space must be available to develop a storage facility that will accommodate desired runoff and stormwater volume.
- For belowground detention basins, a high water table elevation can preclude the design of a storage facility.
- Steep slopes may not allow the placement of a storage facility close to a DWD structure.
- Any interference with existing flood control systems and structures may impede the feasibility of a storage facility.
- Extreme, back-to-back rainfall events may not benefit from full capture by the storage facility. The stored water must be used or diverted to the sanitary sewer system before the next storm event. This is a design consideration when assessing the volume of water that could be diverted to the storage facility based on the available storage volume. The back-to-back storms could be handled by the storage facility if the storage volume was estimated as a few multiples of the volume produced from a single storm with an 85^{th} percentile 24-hour rainfall event.

6.10 Summary and Conclusions

The sewer and treatment capacity at a WRP available to receive stormwater flows is impacted by seasonal, diurnal, and wet weather periods. The existing DWDs are limited by the discharge capacity that was established based on dry weather runoff from drainage areas. The conveyance system can be limited in its ability to accept wet weather runoff diversions. For this reason, storage is a key component for converting DWDs to WWDs by capturing wet weather flows in addition to the existing dry weather capacities. DWDs that do not have storage are limited by the worst-case scenario for sewer capacity and cannot be used during wet weather.

Currently, DWDs are either standalone systems that divert flows to the sanitary system or are treatment facilities that treat flows onsite (for example, by infiltration or with chemical or disinfection systems for onsite water use, such as irrigation). During wet weather, the irrigation demand drops significantly. Therefore, to achieve MS4 compliance and develop additional recycled water from storm events, storage is an important component of the overall strategy. The effectiveness of a storage facility is a function of tributary area, storage volume, onsite demand patterns and magnitude, and operational regime. The sizing of the storage depends on current and future climate conditions. In watersheds where a large storage facility cannot be developed due to space constraints, the development of small and large size storage facilities in institutional, commercial, and industrial settings and in parking lots and parks can help manage large volumes of stormwater. The proper sizing of storage within available space can help achieve the desired goals. Climate change, including changes in temperatures, precipitation patterns, and extreme rain events, should be factored into the design of new projects or the retrofit of existing DWDs. A climate change risk assessment can help assess various scenarios of threats and risks to the infrastructure, assets, and communities to plan for mitigation and adaptation strategies.

Specifically, in watersheds where a large storage facility can be implemented, DWDs with storage can store the flows during wet weather and discharge to sanitary sewer systems during off-peak hours. Therefore, a DWD that is enhanced to capture wet weather flows with storage facilities can have a greater potential benefit on water supply and water quality. The feasibility of diverting flows to a WRP during wet weather needs to be evaluated on a case-by-case basis.

To maximize the potential for diverting dry and wet weather runoff to the sanitary sewer system with storage, the following unique strategies should be considered:

- Use innovative approaches for co-locating storage with existing DWDs.
- Develop new diversion projects to capture both dry and wet weather runoff with onsite storage.
- Strategically develop storage facilities close to WRPs to avoid constraints of conveyance capacity, to allow for a direct connection for diverting flows at the start and end of storm events to avoid stressing WRP operations.
- Retrofit existing PPs where the diversion facility can serve to divert dry and wet weather runoff entering a flood control lift station. The pump stations could be modified to include DWDs to divert water to a sanitary sewer system, where feasible.
- Take advantage of regional and distributed BMPs in the watershed to provide multi-benefits for water supply augmentation and water quality improvements.
- Assess land availability in the DWD tributary area (for example, parking space, parking areas), specifically in commercial, institutional, and industrial land uses to develop large storage facilities.
- Provide site storage facilities with flexible design options (for example, beneath lawns, recreational areas, and parking lots where there are space constraints).
- Forge relationships for public-private partnerships to develop opportunistic widespread storage facilities in the watershed to gain maximum benefits.

For optimal control of a storage operation linked with a diversion structure and a WRP through the conveyance system or directly to a WRP, real-time control of the entire system by tracking weather and adopting a digitally managed watershed approach would be beneficial, if not essential. The digital watershed will be a schematic replica of key elements of the sanitary sewer system, WRP, storm drain, and diversion system. The storage unit should be equipped with such options so the automatic control of the facility under both dry and wet weather can be implemented, with safeguards in the control of the wastewater system operator.

6.11 References

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Section 7. Summary of Existing Regulations

7.1 Introduction

The planning, design, construction, and operation of DWDs requires permitting and coordination with federal, state, and local regulators; agencies; utilities; and watershed and surface water management programs. Knowing the relative rules, laws, and regulations is necessary to identify the planning, permitting, and operational requirements that must be satisfied to successfully implement projects. Achieving sustainable solutions with mutually beneficial results can be assured by identifying and understanding source/reuse water and receiving water quality goals at the beginning of projects and programs. Therefore, a compendium of relative information will prove valuable to this effort.

The purposes of this section is to:

- Summarize the current regulatory requirements regarding the installation and operation of DWDs and wet weather diversions (WWDs).
- Summarize the outreach conducted to date with the Los Angeles Regional Water Quality Control Board (Los Angeles Regional Board, LARWQCB).

7.2 Existing Regulatory Setting

This section provides an overview of the current regulatory setting and summarizes existing regulations, permits, and policies to divert flow from the storm drain system to the wastewater system. The actual permitting requirements should be determined during planning phases of future DWDs and WWDs. A rain event is defined by the Regional MS4 Permit as an event greater than 0.1 inch in 24 hours. Wet weather is also defined in the Bacteria TMDLs as a day with 0.1 inch or more of rain and 3 days following the rain event (State of California, 2020).

The language in this section has been copied from the cited permits or guidance documents from the associated regulatory agency.

7.2.1 Clean Water Act (33 United States Code 1251 et seq.)

"*The Federal Water Pollution Control Act, known as the Clean Water Act (CWA) (33 United States Code [USC] Sections 1251 et seq.), is the principal federal statute for water quality protection. In California, the State Water Resources Control Board (State Water Board) and the nine Regional Water Quality Control Boards (Regional Water Boards) implement many of the CWA's provisions. The CWA requires the State to adopt water quality standards and to submit those standards for approval by the U.S. Environmental Protection Agency (EPA). For point source discharges to surface water, the CWA authorizes the EPA and/or approved states (such as California) to administer the National Pollutant Discharge Elimination System (NPDES) program. CWA Section 303(d) requires states to list surface waters not attaining (or not expected to attain) water quality standards after the application of technology-based effluent limits; and, states normally must prepare and implement a total maximum daily load (TMDL) for all waters on the CWA Section 303(d) impaired waters …*" -State of California (2018a)

7.2.1.1 Section 303 Federal and State Antidegradation Policy

Each state must develop, adopt, and retain a statewide antidegradation policy regarding water quality standards and establish procedures for its implementation through the water quality management process (EPA, 2014).

A key policy of California's water quality program is the state's Antidegradation Policy. This policy, formally known as the Statement of Policy with Respect to Maintaining High Quality Waters in California (State Water Board Resolution No. 68-16), restricts the degradation of surface and ground waters. In particular, this policy protects water bodies where their existing quality is greater than necessary for the protection of beneficial uses. Under the Antidegradation Policy, any actions that can adversely affect water quality in all surface and groundwaters must be consistent with maximum benefit to the people of the State, not unreasonably affect present and anticipated beneficial use of the water, and not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the Federal Antidegradation Policy (40 Code of Federal Regulations [CFR] 131.12) developed under the CWA (State of California, 2018b).

7.2.1.2 Section 303(d) and Total Maximum Daily Loads

The CWA contains two strategies for managing water quality: (1) a technology-based approach, and (2) a water quality-based approach. Section 303(d) of the CWA bridges these two strategies. Section 303(d) requires that the states make a list of waters that are not attaining standards after the technology-based limits are implemented. The states are to develop TMDLs for waters on this list. A TMDL must account for all sources of the pollutants that caused the water to be listed. In California, the TMDLs are typically developed by the Regional Water Board and implemented through water quality control plans (basin plans) (State of California, 2018a).

7.2.1.3 Section 402(o) Anti-backsliding

Section 402(o) of the CWA sets forth the general rule prohibiting backsliding from effluent limitations contained in previously issued permits. Generally, the anti-backsliding regulations prohibit the reissuance of NPDES permits containing interim effluent limitations, standards or conditions less stringent than the final limits contained in the previous permit (Thorne, 2001).

7.2.2 Porter-Cologne Water Quality Control Act (California Water Code Section 13000 et seq.)

The Porter-Cologne Act is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater, and to both point and nonpoint sources (NPSs) of pollution. The Porter-Cologne Act established nine Regional Water Boards and the State Water Board, which are charged with implementing its provisions and which have primary responsibility for protecting water quality in California. The State Water Board provides program guidance and oversight, allocates funds, and reviews Regional Water Boards decisions. In addition, the State Water Board allocates rights to the use of surface water. The Regional Water Boards have primary responsibility for individual permitting, inspection, and enforcement actions within each of nine hydrologic regions (State of California, 2018a). The LARWQCB has jurisdiction over the coastal drainages between Rincon Point (on the coast of western Ventura County) and the eastern County of Los Angeles line.

The Porter-Cologne Act requires the adoption of water quality control plans that contain the guiding policies of water pollution management in California. The State Water Board has adopted a number of statewide water quality control plans, including the California Ocean Plan. Each of the Regional Water Boards have also adopted regional water quality control plans (basin plans), which are updated as necessary and practical.

The LARWQCB has prepared the *Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (Los Angeles Basin Plan) (LARWQCB, 2020). This plan identifies beneficial uses for surface and ground waters, and includes the narrative and numerical water quality objectives that must be attained or maintained to protect the designated beneficial uses and conform to the State's anti-degradation policy. It also describes implementation programs and other actions that are necessary to achieve the water quality objectives established in the Los Angeles Basin Plan.

The LARWQCB implements the Los Angeles Basin Plan by issuing and enforcing WDRs to individuals, municipalities, or businesses whose waste discharges can affect water quality, through the issuance of NPDES permits.

7.2.3 National Pollutant Discharge Elimination System Permits

The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States. Created in 1972 by the CWA, the NPDES permit program is authorized to state governments by EPA to perform many permitting, administrative, and enforcement aspects of the program (https://www.epa.gov/npdes). The NPDES permit program has been delegated to the State of California for implementation through the State Water Board and the nine Regional Water Boards, collectively the Water Boards. In California, NPDES permits are also referred to as WDRs that regulate discharges to waters of the United States (https://www.waterboards.ca.gov/water_issues/programs/npdes/).

7.2.3.1 Municipal Separate Storm Sewer System Permits

The WDRs for storm drain system (MS4) discharges within the coastal watersheds of LA County regulate discharges of stormwater and non-stormwater from the following MS4s:

- LACFCD
- County of Los Angeles
- Eighty-four incorporated cities within the LACFCD with the exception of the City of Long Beach)

The exceptions are discharges originating from the City of Long Beach MS4 (Order No. R4-2012-0175, as amended by Order WQ 2015-0075) (County MS4 Permit). Similarly, discharges from the City of Long Beach MS4 system are regulated by the WDRs for MS4 discharges from the City of Long Beach (Order No. R4-2014-0024) (Long Beach MS4 Permit).

As of the writing of this section, the LARWQCB has released a Draft Regional Phase 1 MS4 NPDES Permit (Tentative Regional MS4 Permit), which includes the following areas (State of California, 2020):

- LACFCD
- County of Los Angeles
- Eighty-five incorporated cities within the coastal watersheds of the County of Los Angeles
- Ventura County Watershed Protection District
- Ventura County
- Ten incorporated cities within Ventura County

If adopted, the Tentative Regional MS4 Permit (State of California, 2020) would supersede the existing permits, except for enforcement. The Tentative Regional MS4 Permit reflects the federal Phase I NPDES Storm Water Program requirements. These federal requirements include three fundamental elements (40 CFR 122.26):

1) A requirement to effectively prohibit non-stormwater discharges through the MS4
2) Requirements to implement controls to reduce the discharge of pollutants in stormwater to the maximum extent practicable
3) Other provisions the LARWQCB has determined appropriate for the control of such pollutants

The definitions, provisions, and requirements of the new Regional MS4 Permit are expected to mirror the existing MS4 permits, described here.

Stormwater discharges consist of those originating from rain events requiring MS4 permit for discharges at a rainfall event greater than 0.1 inch a day.

Non-stormwater discharges (dry weather runoff) consist of all discharges through an MS4 that do not originate from rain events. Non-stormwater discharges through an MS4 are prohibited unless they are subject to one of the following exceptions (State of California, 2020):

- Authorized under a separate NPDES permit
- Authorized by EPA
- Composed of natural flows
- The result of emergency firefighting activities
- Conditionally exempted (discharges from drinking water supplier distribution system releases and non-emergency firefighting activities)

To implement the permit requirements, LA County's MS4 Permit allows permittees to develop a WMP to implement the requirements on a watershed scale through customized strategies, control measures, and BMPs. Permittees can also elect to develop an EWMP.

An EWMP is defined as follows (LARWQCB 2015): *"…one that comprehensively evaluates opportunities, within the participating permittees' collective jurisdictional area in a Watershed Management Area, for collaboration among Permittees and other partners on multi-benefit regional projects that, wherever feasible, retain (i) all non-storm water runoff and (ii) all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, while also achieving other benefits including flood control and water supply, among others. In drainage areas within the EWMP area where retention of the 85th percentile, 24-hour storm event is not feasible, the EWMP shall include a Reasonable Assurance Analysis to demonstrate that applicable water quality based effluent limitations and receiving water limitations shall be achieved through implementation of other watershed control measures*."

As part of the WMP or EWMP, the permit also provides the option for the permittees to individually develop and implement an integrated monitoring program (IMP) or coordinate with other permittees to develop a CIMP. Both the IMP and CIMP are intended to facilitate the effective and collaborative monitoring of receiving waters, stormwater discharges, and non-stormwater discharges, and to report the results of monitoring to the LARWQCB. At a minimum, the IMP or CIMP must address all TMDL and non-TMDL monitoring requirements of the permit, including receiving water monitoring, stormwater outfall-based monitoring, non-stormwater outfall based monitoring, and regional water monitoring studies (LARWQCB, 2015).

7.2.3.2 Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (Order No. 2006-0003)

To provide a consistent, statewide regulatory approach to address SSOs, the State Water Board adopted Statewide General WDRs for Sanitary Sewer Systems, Water Quality Order No. 2006-0003 (Sanitary Sewer Systems WDR). The Sanitary Sewer Systems WDR requires public agencies that own or operate sanitary sewer systems to develop and implement sewer system management plans (SSMPs) and report all SSOs to the State Water Board's online SSO database. Public agencies that own or operate a sanitary sewer system composed of more than 1 mile of pipes or sewer lines conveying wastewater to a publicly owned treatment facility must apply for coverage under the Sanitary Sewer Systems WDR.

SSOs are overflows from sanitary sewer systems of domestic wastewater, as well as industrial and commercial wastewater, depending on the pattern of land uses in the area served by the sanitary sewer system. Sanitary sewer systems experience periodic failures resulting in discharges that may affect waters of the State. There are many factors that affect the likelihood of an SSO (including factors related to geology, design, construction methods and materials, age of the system, population growth, and system O&M). Major causes of SSOs include: grease blockages, root blockages, sewer line flood damage, manhole structure failures, vandalism, pump station mechanical failures, power outages, excessive storm or ground water inflow/infiltration, debris blockages, sanitary sewer system age and construction material failures, lack of proper operation and maintenance, insufficient capacity, and contractor- caused damages. Many SSOs are preventable with adequate and appropriate facilities, source control measures, and O&M of the sanitary sewer system.

To facilitate the proper funding and management of sanitary sewer systems, each Enrollee must develop and implement a system-specific SSMP. To be effective, SSMPs must include provisions for proper and efficient management, operations, and maintenance of sanitary sewer systems, while considering risk management and cost benefit analysis. An SSMP must also contain a spill response plan that establishes standard procedures for immediate response to an SSO in a manner designed to minimize water quality impacts and potential nuisance conditions (SWRCB, 2006).

7.2.3.3 Facility-specific Permits for Water Reclamation Plants

Discharges of treated wastewater by WWTPs and WRPs are subject to WDRs set forth by facility-specific NPDES permits. For example, the Hyperion WRP is regulated by NPDES Permit No. CA0109991, and the JWPCP is regulated by NPDES No. CA0053813. These facility-specific permits outline discharge prohibitions, effluent limitations and discharge specifications, mass emission benchmarks, receiving water limitations, and requirements for an MRP.

7.2.4 California Nonpoint Source Pollution Control Program

"*Nonpoint source (NPS) pollution does not originate from regulated point sources and comes from many diffuse sources. NPS pollution occurs when rainfall flows off the land, roads, buildings, and other features of the landscape."* (SWRCB, 2020).

CWA Section 319 requires all states to have an approved management program for controlling NPS pollution to waters of the state and for improving the quality of such waters. In addition, the Coastal Zone Act Reauthorization Amendments of 1990 require coastal states to have a Coastal Nonpoint Pollution Control Program. To satisfy these requirements, the State Water Board, the Regional Water Boards, and the California Coastal Commission have prepared the *California 2020 – 2025 Nonpoint Source Program Implementation Plan* (California Water Boards and the California Coastal Commission, 2020).

The general goals of the NPS Program are to:

- Implement and enforce WDRs, WDR waivers, and waste discharge prohibitions to control and reduce NPS pollution to waters of the State.
- Collaborate with state, local, and federal agencies on initiatives to control and reduce NPS pollution to waters of the State.
- Administer a grant program that focuses on controlling and reducing NPS pollution to targeted water bodies in this plan.
- Research and investigate traditional and nontraditional mechanisms for reducing, regulating, or otherwise decreasing NPS pollution to waters of the State.
- Evaluate the success of the NPS Program by tracking program activities, NPS pollutant load reductions, and water quality improvements.

7.2.5 California Environmental Quality Act

California is one of 20 states with an environmental impact assessment law, called the California Environmental Quality Act (CEQA), which is modeled after the National Environmental Policy Act. The State Water Board, Regional Water Boards, and all state and local government agencies must comply with

CEQA. The CEQA applies to discretionary activities proposed to be carried out by government agencies, including approval of permits and other entitlements. The CEQA has six objectives:

1) To disclose to decision-makers and the public the significant environmental effects of proposed activities
2) To identify ways to avoid or reduce environmental damage
3) To prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures
4) To disclose to the public reasons for agency approvals of projects with significant environmental effects
5) To foster interagency coordination
6) To enhance public participation

CEQA sets forth procedural requirements to ensure the objectives are accomplished. It also contains substantive provisions requiring agencies to avoid or mitigate, when feasible, impacts disclosed in an Environmental Impact Report. In addition, CEQA sets forth a series of broad policy statements encouraging environmental protection. These policies have led the courts to interpret CEQA "…so as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language…" (SWRCB, 2014.).

7.2.6 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires that federal agencies consult with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water to minimize the adverse effects of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the environmental review requirements (DAARP, 2020.).

7.2.7 California Fish and Game Code Section 1602

The Fish and Game Code Section 1602 requires any person, state or local governmental agency, or public utility to notify California Department of Fish and Wildlife (CDFW) before beginning any activity that may do one or more of the following:

- Divert or obstruct the natural flow of any river, stream, or lake.
- Change the bed, channel, or bank of any river, stream, or lake.
- Use material from any river, stream, or lake.
- Deposit or dispose of material into any river, stream, or lake.

CDFW requires a Lake and Streambed Alteration (LSA) Agreement when it determines the activity, as described in an LSA notification, will substantially alter a river, stream, or lake, and may substantially adversely affect existing fish or wildlife resources. An LSA Agreement is a type of permit that includes measures necessary to protect existing fish and wildlife resources. Common activities that are permitted by LSA Agreements include the installation, repair, or maintenance of water diversions, culverts, stream crossings (e.g., bridges, rock fords); or any other modification of a lake or stream's bed, bank, or channel including extraction of material from them (i.e., sand, rock, or gravel) or deposition of material into them (CDFW, 2020).

MS4 permittees should get approval from the State Water Boards, CDFW, and other regulatory agencies on water rights before diverting storm drain flow. Water Code section 1605 requires the State Water Board to conduct a water right licensing inspection of the project and the water use as soon as practicable after being notified that a permitted project is complete and ready for licensing. A permit is issued when the beneficial use of water is established and compliance to the permit's terms and conditions are confirmed (https://www.waterboards.ca.gov/waterrights/board_info/faqs.html#toc178761080).

7.2.8 Adjudicated Basins and Water Rights

Within the Los Angeles Basin, most of the groundwater basins are adjudicated (via a court decision), and producers within these basins follow management guidelines established by their respective adjudications. Currently, eight groundwater basins are adjudicated. These basins include the Central Basin, West Coast Basin, Main San Gabriel Basin, Raymond Basin, and Upper Los Angeles River Basin (comprising the San Fernando, Sylmar, Verdugo and Eagle Rock Basins) (Figure 7-1). For those adjudicated basins, the rights of usage have been established by court judgements. For each basin, the court appoints a Watermaster (an agency, individual, or groups of individuals) to carry out the terms of the court order by administering the adjudicated water rights in a basin and managing and protecting the groundwater resources.

Before beginning a diversion project, project proponents should evaluate whether they are in an adjudicated basin and whether they have any water rights issues. Project proponents should consult with the respective Watermasters at the beginning of the project.

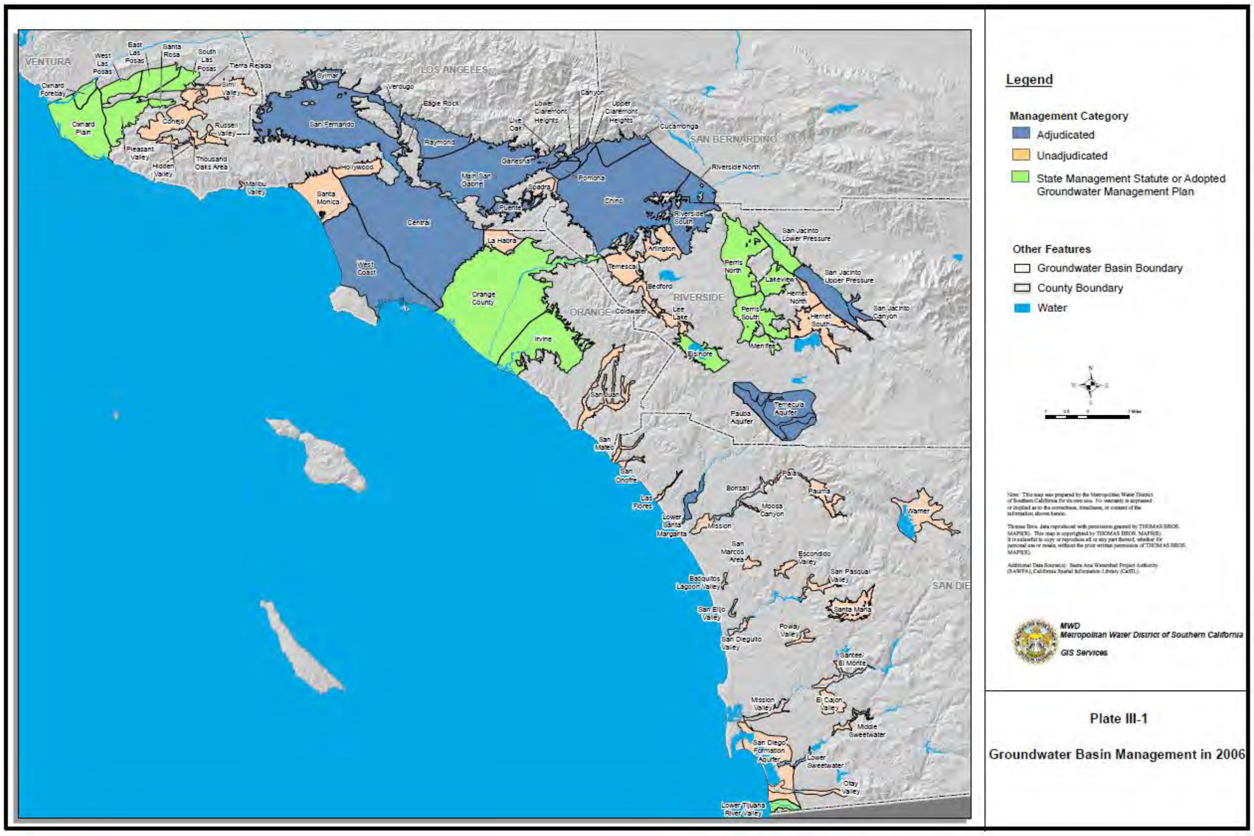

Figure 7-1. Groundwater Basins (Source: Groundwater Assessment Study; MWD, 2007)

7.2.9 Local Dry Weather Diversion Permits and Policies

7.2.9.1 Industrial Wastewater Permit

DWD facility operations are permitted by the sanitation agency receiving the diverted flow. However, these facilities are permitted as industrial wastewater discharges to the sewer system and not specifically as a DWD. The permitting process and requirements depend on the sanitation agency, which typically requires initial monitoring for both flow rates and water quality. Based on the downstream wastewater system, the sanitation agency may place restrictions on the quantity and the timing of discharges, as well as limitations on water quality. Early coordination with the sanitation agency during project planning is highly recommended.

7.2.9.2 State Bill 485 Hernandez – County Sanitation District Act

State Bill (SB) 485, Hernandez - County Sanitation District Act, was enacted in 2015 and gives LACSD the authority to assist local jurisdictions with stormwater and urban runoff projects. The County Sanitation District Act authorizes a sanitation district to acquire, construct, and complete certain works, property, or structures necessary or convenient for sewage collection, treatment, and disposal. This bill authorizes specified sanitation districts in Los Angeles County to acquire, construct, operate, maintain, and furnish facilities for the diversion, management, and treatment of stormwater and dry weather runoff, the discharge of the water to the stormwater drainage system, and the beneficial use of the water. The law requires a district to consult with the LACFCD and the relevant watermaster or water replenishment district before initiating a stormwater or dry weather runoff program within the boundaries of an adjudicated groundwater basin or within the service area of a water replenishment district, as applicable.

7.2.9.3 Los Angeles County Sanitation Districts Dry Weather Urban Runoff Diversion Policy

In 2014, LACSD enacted guidance that provides procedures for the diversion of dry weather flows into its collection system. The policy requires the owner of the stormwater collection system to obtain an Industrial Wastewater Discharge Permit, install pretreatment to remove large solids, provide a means for measuring flow, provide necessary monitoring and control systems, and pay appropriate fees (LACSD, 2014).

The policy also includes the following requirements:

- Limits to the discharge rate so the downstream sewer will not flow more than ¾ depth.
- Discharge to the sewer must be pumped with a check value between the pump and connecting sewer so wastewater does not backflow into the storm drain system.
- A rain collector must be installed to automatically shut off diversion upon sensing 0.1 inch of rainwater.
- Diversions are not allowed where incompatible pollutants have been detected in quantities that may impact the downstream treatment.

Diversions made pursuant to the 2014 policy were primarily limited to coastal dry weather flows.

Since the implementation of SB 485, LACSD has been open to accepting stormwater from controlled systems. They have reported the following steps for developing a new DWD or controlled stormwater diversion:

1) Set up a Stormwater Services Agreement to reimburse staff effort (a requirement of their SB485 authority).
2) Conduct a consultation with the Watermaster, Water Replenishment District, and Flood Control District (a requirement of their SB485 authority).

3) Submit requested sewer diversion flow rate(s), planned hours of operation, flow monitoring, and modeling (if applicable). Consider operational scenarios that will reduce long-term operational costs by avoiding the peak flow component of the sewer service charge. Specifically, to be cost-effective, daytime flow rates (between 8 am and 10 pm) should be no greater than the anticipated annual average flow. Excess flow should be diverted to the sewer between 10 pm and 8 am in a manner that uses the smallest flow rate that will reliably drawdown the storage component of the project. The proponents flow monitoring and modeling (if applicable) will be reviewed to evaluate the sewer capacity usage. LACSD's staff will perform the sewer capacity studies to determine whether capacity is available at the requested times and provide the lag time between rainfall and reinitiating of the diversion.

4) Submit water quality data, which should include one sample for all the parameters, with two additional samples for the salts, pH, chemical oxygen demand (COD), SS, and turbidity. LACSD's staff will determine the diversions impacts on downstream processes. Table 7-1 shows a list of required analytes for water quality information of the stormwater. This list often changes as the new chemicals appear to be monitored.

Table 7-1. Analytes Required for Submission

Metals	Organics	Pesticides	Salts	Other
Antimony	1,2,3-TCP	2,4-D	Conductivity	pH
Arsenic	1,4-dioxane	Fipronil	TDS	COD
Barium	Perchlorate	Fipronil desulfinyl	Chloride	SS
Cadmium	Tert-butyl alcohol	Fipronil sulfide	Sulfate	Turbidity
Chromium	Perfluorobutanoic acid (PFBA)	Fipronil sulfone		Boron
Copper	Perfluoropentanoiic acid (PFPeA)	Bifenthrin		Fluoride
Iron	Perfluorohexanoic acid (PFHxA)	Cyfluthrin		
Lead	Perfluoroheptanoic acid (PFHpA)	Cypermethrin		
Mercury	Perfluorooctanoic acid (PFOA)	Lambda-cyhalothrin		
Nickel	Perfluorononanoic acid (PFNA)	Permethrin		
Selenium	Perfluorodecanoic acid (PFDA)			
Zinc	Perfluoroundecanoic acid (PFUnDA)			
	Perfluorododecanoic acid (PFDoDA)			
	Perfluorotridecanoic acid (PFTrDA)			
	Perfluorotetradecanoic acid (PFTeDA)			
	Perfluorobutane sulfonic acid (PFBS)			
	Perfluoropentane sulfonoic acid (PFPeS)			
	Perfluorohexane sulfonic acid (PFHxS)			
	Perfluoroheptane sulfonic acid (PFHpS)			
	Perfluorooctane sulfonic acid (PFOS)			
	Perfluorodecane sulfonic acid (PFDS)			
	Perfluorooctanesulfonamide (PFOSA)			

Table 7-1. Analytes Required for Submission

Metals	Organics	Pesticides	Salts	Other
	N-Ethyl perfluorooctane sulfonamide ethanol (N-EtFOSE)			
	N-Methyl perfluorooctane sulfonamide ethanol (N-MeFOSE)			
	N-Ethyl perfluorooctane sulfonamide (N-EtFOSA)			
	N-Methyl perfluorooctane sulfonamide (N-MeFOSA)			
	N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)			
	N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)			
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)			
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)			
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)			
	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)			
	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)			
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)			
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)			

5) Submit an Industrial Waste permit application. Diversions from the stormdrain system are required to include the following elements:

   a) A telemetry system that allows LACSD to shut off the pumps remotely in case of emergency

   b) Controls that turn off pumps automatically after 0.1 inch of rainfall or when explosive gases are detected by the onsite lower explosive limit (LEL) meter

   c) A gas trap and air gap to prevent sewage and/or gas backing up into the project

   d) A flow meter for the sewer discharge and a method to calibrate it

   e) A sample box and flow and LEL recorders within 10 feet of the sewer discharge

   More information is available here at: https://www.lacsd.org/wastewater/industrial_waste/permit.asp.

6) If the project proposes any project features in the LACSD's right of way (i.e., pipe crossings, access roads, buildings, or a shoring systems to construct underground storage or a pump station, etc.), the project will require a Build Over review. Information on that process can be found here: https://www.lacsd.org/wastewater/buildover_procedures.asp.

   Projects must undergo a design review from LACSD's Sewer Design Section: https://www.lacsd.org/wastewater/default.asp#sewerreview

7) At the end of that process, an Industrial Waste Permit and Sewer Connection permit can be issued.

Diversions that meet the definition of a Local Governmental Diversion are exempt from connection fees. Specifically, this means diversions from a stormwater conveyance or stormwater impoundment facility that is: a) owned by a local agency; b) discharged to the sewer system solely during periods of unused capacity as defined in the Industrial Wastewater Discharge Permit; and c) dedicated to uses that directly benefit the public in general as opposed to a single class or classes of individuals. As such, diversions that are used to demonstrate stormwater compliance for an individual business will be assessed a connection fee, unless the business has secured an individual industrial waste permit to discharge through the diversion and paid the applicable connection fees.

LACSD is working on a project with the City of Carson to accept stormwater when capacity is available. Systems that involve the acceptance of stormwater will need to be analyzed to determine whether storage is needed to mitigate the SSO risks associated with accepting flows during a storm. Projects are being evaluated on a case-by-case basis.

7.3 Dry Weather Diversion and Wet Weather Diversion Regulatory Considerations

There are currently no NPDES permits or permit provisions specific to DWDs or WWDs. Existing DWDs are permitted by the sanitation agency that receives the diverted flow to set discharge limitations and evaluate capacity in the collection and treatment systems. In some instances where a permitting framework specific to DWDs has not been developed, these diversions are permitted as industrial wastewater discharges. This section identifies alignment with existing permits and regulatory considerations for implementation of future facilities.

Pollutants in stormwater and non-stormwater have damaging effects on both human health and aquatic ecosystems. Water quality assessments conducted by the Regional Water Board have identified impairments of beneficial uses of water bodies in the Los Angeles Region caused or contributed to by pollutant loading from municipal stormwater and non-stormwater discharges. Per LA County's MS4 Permit, each permittee will prohibit non-stormwater discharges through the MS4 to receiving waters, for the portion of the MS4 it owns or operates. There are exceptions where such discharges are either permitted under a separate NPDES permit, or temporarily authorized by EPA for emergency firefighting activities or natural flows (groundwater inflow and infiltration) (RWQCB, 2012). MS4 permittees can use the implementation of DWDs as a tool for to eliminate non-stormwater flow discharges to receiving waters by diversion to the sanitary sewer.

The introduction of dry and wet weather flows to the sanitary sewer system also changes the characteristics of the wastewater. As a result of conservation, many wastewater agencies have seen declining wastewater flows and increased pollutant and solids concentrations, which may increase blockages, odors, and corrosion in pipes. This leads to higher O&M costs, odor complaints, and an accelerated degradation of infrastructure (CUWA, 2017). The LACSD reports that higher-strength wastewater has not caused additional blockages but has been associated with increased hydrogen sulfide concentrations over the last decade. It is not possible to quantify the degree to which DWDs would reduce odors and corrosion. In theory there should be some benefit, but it would likely be marginal due to the widespread nature of higher-strength wastewater and the localized nature of DWDs.

Generally, a relatively better water quality of storm drain water diverted to the sanitary sewer may help dilute the higher-strength sewage for the wastewater treatment processes. Further study is recommended on the impacts to water quality from both conveyance and treatment perspectives.

The diversion of dry and wet weather flows to the sanitary sewer also increases the influent flows to WRPs, thereby increasing the potential for increased recycled water production. Per the State Water Board Recycled Water Policy, the State Water Board strongly supports recycled water as a safe alternative to fresh water or potable water. Recycled water is presumed to have a beneficial effect when supporting the sustainable use of groundwater and surface water with the intent of substituting for use of fresh water or potable water (SWRCB, 2018).

However, diverting wet weather flows to the sanitary sewer inherently increases the risk of an SSO. The Sanitary Sewer Systems WDR specifically identifies excessive stormwater (wet weather) inflow as a major cause of SSOs (SWRCB, 2006).

The owning sanitation agency is ultimately held responsible for the SSO occurrence and must report the overflow to the Regional Board. The following strategies may help minimize the potential of SSOs as a result of DWDs and WWDs:

- Develop a permitting framework specific for DWDs and WWDs.
- Implement smart diversion and sewer monitoring systems to provide real-time sewer flow conditions.
- Equip DWDs and WWDs with remote shutoff controls available to both the storm drain and sanitation agencies.
- Modify SSMPs to specifically address integration of DWDs and WWDs into the sanitary sewer system.
- Develop BMPs specific to DWDs and WWDs.

7.4 Typical Permits Required for Dry Weather Diversions and Wet Weather Diversions

Permits required for the facility's construction and operation should be determined during the planning stages of the project; the number of permits will depend on the project. This section provides information on typical permits, depending on the type of diversion. Based on permitting identified for the Carson Stormwater and Runoff Capture Project (Tetra Tech, 2017), permits required for DWDs and WWDs are assumed to be the same. The expansion of DWDs to WWDs would require revisions to the operational permit.

To divert from the storm drain (non-receiving water) to the sanitary sewer, the following permits are typically required:

- Operational permits:
  - Wastewater Discharge Permit: Required for any discharges to the downstream wastewater collection system receiving the diverted flows. The permit will be administered by the agency that owns the sewer or WRP; it may be referred to as an industrial wastewater discharge permit.
- Construction permits:
  - LACFCD Flood Control Permit: Required for any construction within LACFCD right-of-way
  - Construction General Permit (Order No. 2009-0009-DWQ): Required for land disturbance of more than 1 acre; administered by the Regional Water Board
  - Construction Dewatering Permit (Order No. R4-2018-0125): Required if groundwater is encountered during construction; administered by the Regional Water Board
  - Local Construction Permits: Potentially required by the local city jurisdiction for construction-related activities, including building, grading, and traffic control

Based on the Ballona Creek Low Flow Treatment Facility Project, diversions from a receiving water channel to the sanitary sewer may require additional permitting and approvals (LASAN, 2017):

- U.S. Army Corps of Engineers CWA Section 404 Permit and Section 408 Permit
- US Fish & Wildlife Service Endangered Species Act Section 7 Consultation
- Department of Fish and Wildlife California Fish and Game Code Section 1602 Permit
- Department of Fish and Wildlife California Endangered Species Act Section 2080 Consultation

7.5 Los Angeles Regional Board Outreach

Collaboration and communication between regulatory, drainage, and sanitation agencies is vital for the successful implementation of DWDs and WWDs. The LARWQCB serves as the regulatory agency responsible for protecting groundwater and surface water quality in Los Angeles and Ventura Counties by enforcing WDRs, including NPDES Permits, for both drainage and wastewater infrastructure. Throughout the development of this study, LARWQCB staff attended a series of outreach meetings. The LARWQCB has been both interested in, and supportive of, the study and the use of DWDs and WWDs as a tool for MS4 compliance. Meetings have taken place on the following dates:

- December 3, 2019: Outreach Call
  - LARWQCB Attendees: Renee Purdy, Jenny Newman, LB Nye
    Purpose: Introduce white paper study
- May 18, 2020: Outreach Call
  - LARWQCB Attendees: Renee Purdy, Jenny Newman, Cris Morris, Ivar Ridgeway
    Purpose: Provide a status update and preliminary findings of the DWD case studies (Section 4)
- July 2, 2020: Briefing to Los Angeles Regional Board
- July 9, 2020: Presentation to Los Angeles Regional Board Meeting

7.6 Summary and Conclusions

The purpose of this section was to provide an overview of the current regulatory setting and to summarize existing regulations, permits, and policies relevant to diversions of flows from the storm drain system to the wastewater system. Currently, the sanitary agency receiving the diverted flow is responsible for permitting the operations of the DWD facilities. These facilities are permitted as industrial wastewater discharges to the sewer system and not specifically as a DWD. The permitting process and requirements depend on the sanitation agency, which typically requires initial monitoring for both flow rates and water quality. While developing diversion projects, based on the downstream wastewater system, the sanitation agency will identify restrictions on the volume of flow diversions, the timing of discharges, and the water quality. Early coordination with the sanitation agency during project planning is highly recommended.

Currently, the discharges from MS4 in the Los Angeles Basin are regulated by three permits:

1) For Los Angeles County and incorporated cities therein, except the City of Long Beach, as mentioned
2) For Ventura County and incorporated cities therein
3) For the City of Long Beach

Each of these permits has expired but remains in effect until the LARWQCB adopts a new permit. The LARWQCB has released a Tentative Regional MS4 Permit, which includes the following regions (State of California, 2020):

- LACFCD
- Los Angeles County
- Eighty-five incorporated cities within the coastal watersheds of Los Angeles County
- Ventura County Watershed Protection District
- Ventura County
- Ten incorporated cities within Ventura County

If adopted, the Tentative Regional MS4 Permit (State of California, 2020) would supersede the three existing permits, except for enforcement. The Tentative Regional MS4 Permit is expected to mirror the provisions of the existing MS4 permits through implementation of the federal Phase I NPDES Storm Water Program requirements. These federal requirements include three fundamental elements (40 CFR 122.26):

1) The requirement to effectively prohibit non-stormwater discharges through the MS4
2) Requirements to implement controls to reduce the discharge of pollutants in stormwater to the maximum extent practicable
3) Other provisions the Los Angeles Water Board has determined appropriate for the control of such pollutants

Currently, 41 DWDs are operational in the Los Angeles Basin. However, those facilities are diverting a small fraction of the flows generated in Los Angeles County. For effective and efficient dry and wet weather runoff management in the built environment, it is recommended that agencies collaborate on potential resilient stormwater management strategies, including DWDs.

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Section 8. Diversion Roadmap for MS4 Permittees

8.1 Introduction

The DWDs and WWDs are permitted as industrial wastewater discharges to the sanitary sewer system. The permitting process and requirements depend on the sanitation agency, which typically requires initial monitoring for both flow rates and water quality. Based on the downstream wastewater system, the sanitation agency may impose restrictions or limits on quantity, timing of discharges, and water quality. Developing a diversion project requires identifying planning goals and required permits so all permits are secured and the maximum benefit of the project can be realized. The study team has developed a generalized roadmap to help guide MS4 permittees in the process of implementing diversion projects.

The purpose of this section is to present a roadmap for planning and implementing diversion projects under three scenarios: (1) operate an existing DWD with modifications to divert additional flows, (2) develop a new DWD, and (3) develop a new WWD with storage. The roadmap includes a step-by-step process to develop diversion projects under various phases. This section also discusses the regulatory requirements, permitting needs, costs, benefits, and limitations of diversion projects.

Note, this roadmap is generic and serves as a guiding tool to implement diversion projects. The step-by-step process will need to be tailored to the specific requirements of the project, location, constraints, and agencies involved.

8.2 Planning a Diversion Project

This section provides an overview of the approach for implementing a DWD or a WWD project as a tool from the toolbox of approaches to improve water quality of receiving waterbodies, achieve MS4 permit compliance, and generate additional water supply in the Los Angeles Basin. Figure 8-1 presents a flowchart with key steps to assess the implementation of DWD/WWD projects.

Step A of the approach is to identify the specific water quality issues in a watershed, which includes a review of the water quality data and load allocations provided in TMDL regulations for various pollutants.

Step B includes developing approaches to understand the sources of pollution and developing strategies to control or eliminate these sources. To implement the permit requirements, the County MS4 Permit allows individual permittees to develop a WMP to implement the requirements on a watershed scale through customized strategies, control measures, and BMPs. Permittees can also elect to develop an EWMP, a collaboration among jurisdictions in a common watershed. The WMPs and EWMPs for various Los Angeles Basin watersheds provide information on pollutants and a toolbox of approaches that include distributed and regional projects to manage stormwater. Once implemented, those projects or BMPs will reduce or remove pollutants from stormwater and help meet the MS4 permit requirements.

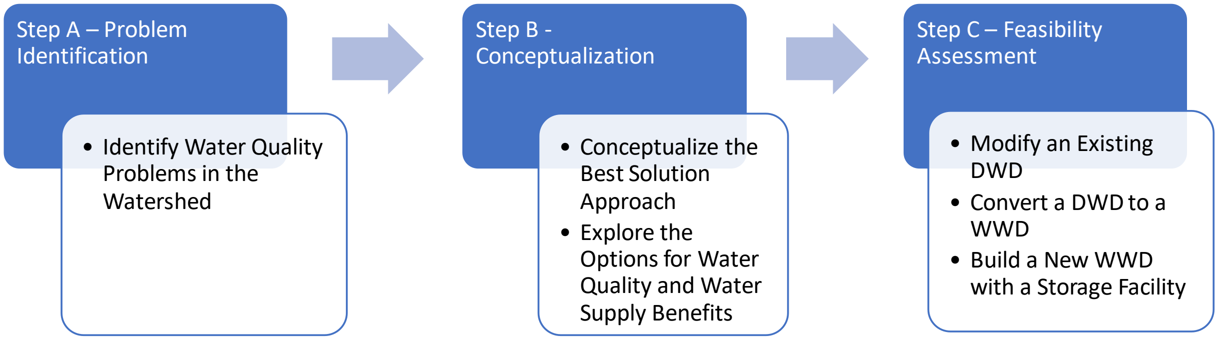

Figure 8-1. Stepwise Approach to Assess the Development of a DWD/WWD Project

Under Step C of the approach, the feasibility of implementing diversion projects is assessed.

The following section discusses three potential scenarios for implementing diversion projects (Figure 8-2).

8.2.1 Diversion Project Scenarios

Scenario 1: Use the existing DWD with modifications to divert additional flows: Under this scenario, there are two potential options to explore the full potential of the existing DWD, including the capacity of the diversion system and the collection system (that is, the combination of the sanitary sewer system and wastewater treatment system) to divert more than dry weather runoff:

- **Option 1: Use the existing DWD with <u>minor</u> modifications:** The modifications may include any, all, or a combination of the following:
  - Upgrading existing pumps of the DWD system
  - Implementing better flow control and monitoring system
  - Modifying the operational timing of existing DWDs to divert additional flows, such as shortening the delay in bringing the DWD back online after a storm event. Currently, the existing diversions are turned off for some period after 0.1 inch of rainfall (that is, for 72 hours for projects in the City of Los Angeles and 24 hours for projects tributary to LACSD)
- **Option 2: Use the existing DWD with <u>major</u> modifications including the use of storage:** The changes to the existing DWD may include:
  - Adding a storage facility and upgrading an existing DWD system to handle wet weather runoff or feasible portion of stormwater to assist in compliance with the wet weather requirements of the MS4 permit (that is, a WWD to capture stormwater volume generated from the 85th percentile, 24-hour rain event required for wet weather MS4 compliance)
  - Upgrading existing pumps of the DWD system
  - Implementing better flow control and monitoring system

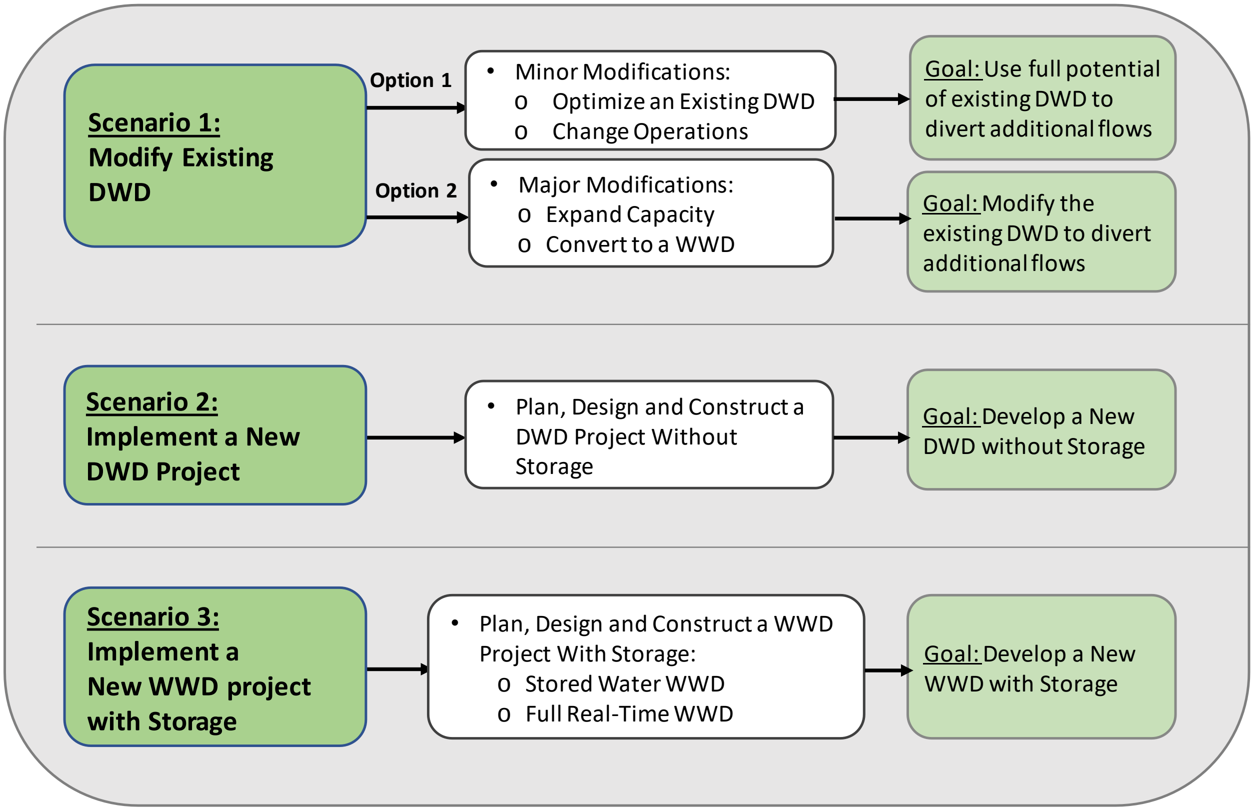

Figure 8-2. Scenarios to Divert Dry and Wet Weather Flows to the Sanitary Sewer System

- **Scenario 2 – Develop a new DWD project:** If a DWD is already planned as a part of the MS4 compliance approach for dry weather runoff, agencies can follow the steps presented in the roadmap provided in Section 8.3 to implement the project. Otherwise, they can assess the development of a diversion project to help achieve the water quality and water supply goals.
- **Scenario 3: Develop a new WWD project with storage:** If a WWD is already planned as a part of the MS4 compliance approach for dry weather runoff diversion, agencies can follow the steps presented in the roadmap provided in Section 8.3 to implement the project. In other cases, they can assess the development of a diversion project to help achieve the water quality and water supply goals. Under this scenario, the goal of the project can be to develop a single or multiple storage facilities to comply with the dry and wet weather MS4 permit requirements. Two potential options include:
  1) WWD with storage (also referred to as Stored Water WWD): Wet weather runoff is stored during a rain event and discharged to the sanitary sewer system when conveyance capacity becomes available.
  2) Real-time control of WWD: Wet weather runoff is stored and is discharged to the sanitary sewer system based on real-time sewer flow conditions and available wastewater treatment capacity.

Section 8.3 discusses the steps to implement these three types of scenarios for diversion projects.

A few key questions need to be answered while planning for any of these scenarios for the diversion project:

- What is the goal of the project (for example, meet the MS4 compliance requirements for dry weather or wet weather runoff or both)?
- How much flow is generated in the storm drain system (or in a channel) from the tributary area during dry and wet weather? What is the quality of the dry and wet weather runoff?

- Is there a potential to develop a new diversion project or modify an existing facility to incorporate a diversion project (such as adding a diversion to an existing PP), and/or is there potential to expand an existing DWD project to capture additional flows?
- Is there a potential for a storage facility to store water before diverting it to the sanitary sewer system? When and how can the flow from a storage facility be routed to the sanitary sewer system?
- What are the potential constraints and issues that need early consultation with agencies for resolution?
- What will be the cost, O&M requirements, and cost-effectiveness of the diversion project?
- What are the constraints and benefits of developing a diversion project in the watershed?

8.2.2 What are the Benefits of Diversion Projects?

The DWDs are a proven, effective control method and technology that prevent pollutants from reaching the receiving waterbodies. Historically, DWD projects have been implemented primarily along the coast, to improve beach water quality. Recently, diversions have been proposed inland to meet MS4 compliance requirements. Projects that divert water to treatment plants also provide water supply benefits by generating recycled water. In some cases, the underground cisterns incorporated for wet weather runoff storage can also provide water for onsite uses, such as irrigation. Diversion projects offer the following advantages and benefits:

- A diversion can completely eliminate the dry weather runoff and a significant portion of the wet weather runoff discharges from watersheds or storm drains to receiving waterbodies (the ocean, rivers, or creeks.) The water quality impairments in the receiving waterbodies can be eliminated or reduced by diverting the dry and wet weather runoff from storm drains or channels to the wastewater systems. Eliminating dry and wet weather runoff discharges from the coastal watersheds (for example, watersheds discharging to the SMB) will improve the beach water quality.
- Discharges occurring upstream of the watersheds or storm drain system will not reach receiving waterbodies. For example, water releases from construction sites and groundwater dewatering or a sewer spill can be diverted to the sanitary sewer system.
- Dry and wet weather runoff diverted from the watersheds can help augment local water supplies and reduce dependence on imported water.
- If the diversion project is designed with a storage component or integration with other projects (that is, a hybrid project), or both, it can generate multiple benefits (for example, habitat restoration and community benefits, along with water supply).

8.3 The Roadmap

The goals of the development of the roadmap are to identify steps and the process to:

- Help agencies understand the requirements, opportunities, and constraints of developing and implementing diversion projects.
- Guide the municipalities to gather and collect data needed for the project, initiate discussion among agencies involved, perform a feasibility assessment of the system, and understand the permitting needs prior to implementing a diversion project.
- Understand the process to get approvals from the sanitation agency for the project.
- Educate agencies on the complexity of individual stormwater systems, which require step-by-step approaches for mitigation strategies.

The goal of a new diversion project is to capture dry and potentially wet weather runoff from the uncaptured areas/watersheds and divert those to the sanitary sewer system and nearest WRPs. The overall project must be environmentally sound, cost-effective, and able to provide measurable reuse volumes and water quality improvements. Where diversion to the sanitary sewer system or directly to a WRP is deemed feasible by the MS4 permittees and sanitation agencies, various approaches (as discussed in Section 5) may be considered:

- Divert from a storm drain or surface waterbody directly to a nearby WRP
- Divert to a nearby interceptor sewer
- Provide new dedicated conveyance system from multiple DWDs to a WRP
- Divert to a sanitary sewer system
- Install a DWD at an existing stormwater pump station

All types of diversion projects are developed on a permissive and controllable manner because sewer surcharge and overflows must be prevented. In such cases, the wastewater agency and stormwater agency must closely coordinate the diversion operating strategy to ensure the safe operating integrity of both systems.

Generally, a diversion project is implemented using a five-step process (Figure 8-3) that includes:

1) Data and information collection
2) Coordination among the participating agencies
3) Planning and cost analysis
4) Permit approvals and project implementation
5) O&M and monitoring

Note, stakeholder and public participation is the key to successfully implement a project under any step of the process.

Figure 8-3. Steps to Implement a Diversion Project

8.3.1 Details of a Diversion Project Implementation

Figure 8-4 shows the details of the five steps and the processes to implement a diversion project under any scenario.

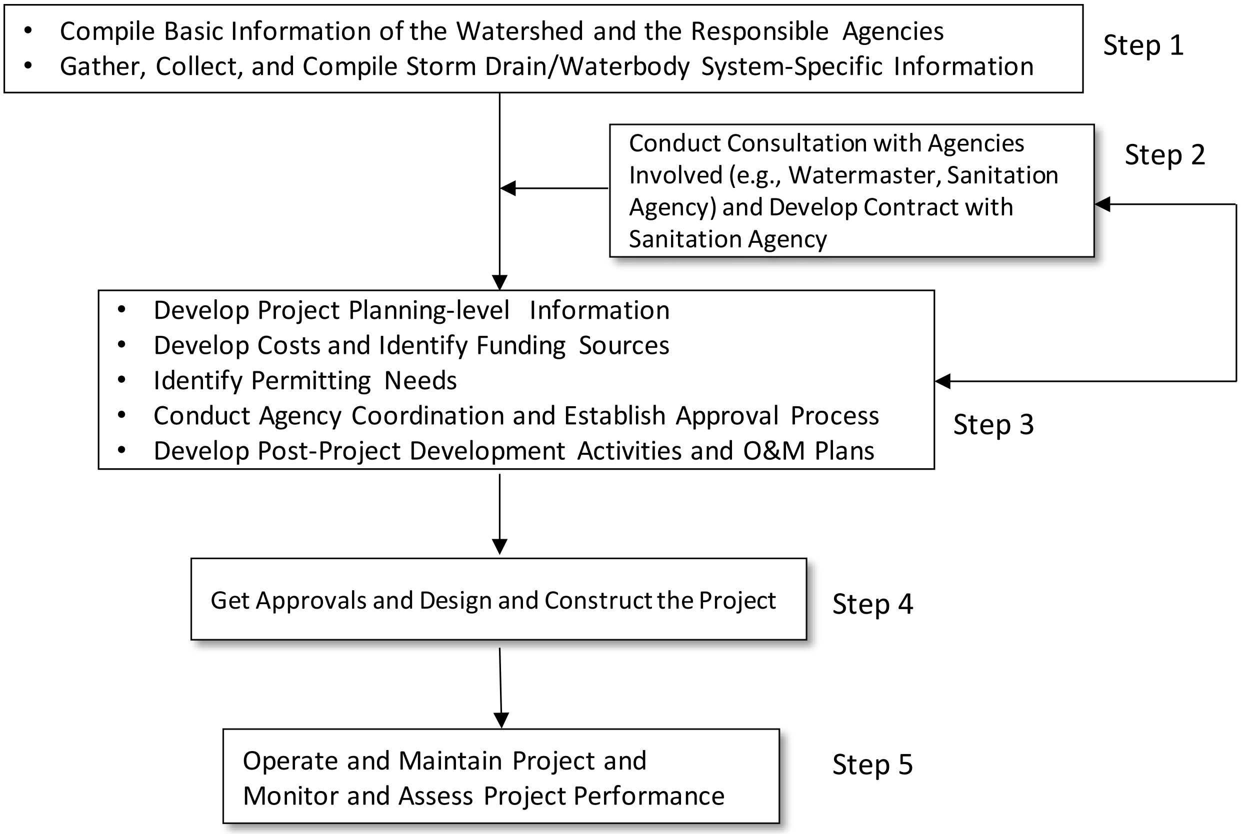

Figure 8-4. Generalized Steps to Implement a Diversion Project

This section summarizes the specific information needed for implementing each step. Based on the type of scenario and site-specific details, the steps need to be adjusted or modified on a case-by-case basis. This section also provides specific details about the types of permits required, as well as the costs of plan implementation and cost-effectiveness of various types of projects.

8.3.1.1 Step 1

- Define the goals of the project.
- Conceptualize the project (for example, potential for existing DWD modification, type of modification or operation change, and screening-level overview of additional costs and added benefits/value).
- Compile data for the location of the DWD project, watershed and sewershed, groundwater basin, and jurisdictions.
- Gather contact information for the agencies involved (for example, MS4 permittees, watermaster, groundwater basin management agency and sanitation agency).
- Gather O&M data if a modification to an existing DWD is planned, flow and water quality data during dry and wet weather; specifically, the dry and wet weather runoff that will be diverted.

- Use the current knowledge of the diversion and data to assess the performance of the system.
- Understand the sanitation agency's permit requirements and gather needed data.
- Identify data gaps and develop a priority with a schedule to gather the required data/information.

Example - Information needs for diverting the flows to the LACSD sanitary sewer system and getting approval of the Industrial Wastewater Permit and Sewer Connection Permit are as follows:

- Consult with the Watermaster, Water Replenishment District of Southern California, and the Los Angeles County Flood Control District (a requirement of LACSD's SB-485 authority).
- Submit the requested sewer diversion flow rate(s), planned hours of operation, flow monitoring, and modeling (if applicable).
- Submit water quality data (note, each sanitation agency may have specific requirements for monitoring of water quality constituents and the associated frequency).
- Submit an Industrial Wastewater Discharge Permit application.
- If the project proposes any project features in LACSD's right-of-way (such as pipe crossings, access roads, buildings, shoring systems to construct underground storage or a pump station), conduct a Build Over review.
- Get the design reviewed by LACSD's Sewer Design Section.

8.3.1.2 Step 2

- Consult with agencies in the watershed. Appendix C provides an example list of a few agencies with their contact information.
- Discuss constraints, opportunities, and risks with the project proponents.
- Define roles and responsibilities of the agencies and project proponents (for example, who will build, operate, and maintain the infrastructure? Who will be responsible for implementing the project? Who will pay for the project?).
- Set up the contract or Memorandum of Understanding, as needed, with the sanitation agency and/or Watermaster.
- Clarify data needs and requirements for the permitting application with the sanitation agency, including fees (for example, connection fee, treatment costs, and surcharge fee).

8.3.1.3 Step 3

- Collect data for the permit applications.
- Develop project planning-level information to conduct a feasibility analysis of the project.
- Review the project performance by analyzing historical data from a few years of DWD operations.
- Consult with O&M staff to understand issues (for example, flooding, pump failure, diversion structure, sedimentation).
- Determine the system's expansion capacity without major modifications; for example, by adding a sanitary sewer monitoring system.
- Identify gaps and priority needs, such as better flow control and implementation of smart system.
- Identify required changes to operate existing diversions more efficiently, to divert more than dry weather runoff safely.
- Determine the cost and cost-effectiveness of diverting additional flows based on the cost of upgrading the system and the operating costs of the modified system.
- Identify funding sources and apply for funding.

8.3.1.4 Step 4

- Pay the fees and obtain approvals from the permitting sanitation agency.
- Get funding and develop contracts for the project.
- Design and construct the project.
- Develop training programs to ensure stormwater professionals and maintenance staff are equipped with the latest knowledge and skills to maintain the DWDs.
- Assess the maintenance needs to guide the responsible agencies' resource needs (for example, personnel, tools, and O&M costs, including connection fees, treatment, and surcharge costs).
- Develop an O&M plan and a list of post-project implementation activities.

8.3.1.5 Step 5

- Implement the O&M plan.
- Adaptively manage the project by continuously monitoring the project performance.
- Retain adequate resources for the project's continued maintenance.
- Continue with staff training as defined in the O&M plan.
- Upgrade the system over time, as required.

Each of these steps may not be necessary for all scenarios. Some steps may not be needed to implement a project, depending on the status of that particular project. For example, some components of Steps 1 and 2 may already be known for either Option 1 or 2 in Scenario 1, compared to other scenarios. On the other hand, all the steps are necessary for Scenarios 2 and 3. Experience from design and operation of existing DWDs under Scenario 1 will be important for planning and implementing a new project under Scenarios 2 and 3.

8.3.2 Regulatory Requirements

The details of the current regulatory requirements regarding installation and operation of DWDs and WWDs are provided in Section 7. Appendix D summarizes the key existing regulations related to the MS4 permit to divert flow from the storm drain system to the sanitary sewer system.

8.3.3 Permits Needed for Diversion Projects

Diversions are permitted as industrial wastewater discharges to the sanitary sewer system. Permits required for the facility's construction and operations should be determined during the planning stages of the project; the number of permits needed will depend on the type of the project and the project location. This section provides information about typical permits, depending on the type of diversion. Two types of permits are required to develop diversion projects: (1) diverting flow from storm drains or (2) diverting flow from a storm drain or surface waterbody. This section summarizes the permits.

8.3.3.1 Diversion from a Storm Drain

To divert flow from a storm drain to a sanitary sewer system, the following permits are typically required (Tetra Tech, 2017):

- Operational Permits:
  - *Wastewater Discharge Permit*: Required for any discharges to the downstream wastewater collection system receiving the diverted flows; the permit will be administered by the agency that owns the sewer or WRP. This may be referred to as an Industrial Wastewater Discharge Permit.

As an example, for the details of the LACSD's Wastewater Discharge Permit application, the permit evaluation and approval process can be found at: https://www.lacsd.org/wastewater/industrial_waste/permit.asp

- Construction Permits:
  - LACFCD Flood Control Permit: Required for any construction within LACFCD right-of-way.
  - Construction General Permit (Order No. 2009-0009-DWQ): Required for land disturbance of more than 1 acre; administered by the LARWQCB.
  - Construction Dewatering Permit (Order No. R4-2018-0125): Required if groundwater is encountered during construction; administered by the LARWQCB.
  - Local Construction Permits: Potentially required by the local city jurisdiction for construction-related activities, including building, grading, and traffic control.

Any modifications to existing diversion projects would require revisions to the operational permit.

8.3.3.2 Diversion from a Surface Waterbody

In addition to the operational and construction permits, diversions from a stream, river or a channel to the sanitary sewer system require federal, state, regional/local, and city-specific permits and approvals. The following list provides the permits prepared for the Ballona Creek diversion project during the development of the Environment Impact Report, pursuant to CEQA Public Resources Code (Section 21000, et seq.) and City of Los Angeles CEQA Guidelines (LASAN, 2018):

- U.S. Army Corps of Engineers CWA Section 404 (Dredge and Fill) Permit and Section 408 (Coastal Water Work) Permit
- U.S. Fish & Wildlife Service Endangered Species Act Section 7 Consultation
- State Water Board Section 401 (Water Quality Certification) Permit
- Department of Fish and Wildlife California Endangered Species Act Section 2080 Consultation
- Department of Fish and Wildlife California Fish and Game Code Section 1602 Permit (Streambed Alteration Agreement)

The operations of the DWD facilities must also be permitted by the sanitation agency receiving the diverted flow. The permitting process and requirements depend on the sanitation agency, which typically requires initial monitoring for both flow rates and water quality. The sanitation agency may place restrictions on the quantity, timing of discharges, and water quality constituents for downstream capacity assurance. Early coordination with the sanitation agency during project planning is highly recommended. For example, Appendix E, prepared by LACSD, summarizes the steps to develop a new DWD or controlled wet weather runoff diversion project in the LACSD service area. Since the adoption of SB-485 in 2015, LACSD has been receptive to accepting wet weather runoff from controlled systems.

8.3.4 Cost and Cost-effectiveness of Projects

Benefits, costs, and environmental factors play an important role in developing projects for dry and wet weather runoff management. All types of diversion projects require resources, such as funds, equipment, tools, and personnel for continued O&M of the projects. In general, the costs of different types of projects depend on the type of project, location, right-of-way, land availability, and several other factors, such as expansion/modification of an existing infrastructure (Scenario 1) versus developing a new project (Scenarios 2 and 3). Conceptual or engineer's estimates are often used for long-term planning purposes.

Generally, existing large-scale groundwater infiltration basins, such as spreading grounds, are the low-cost methods for diverting wet weather runoff to generate groundwater supplies. However, on a long-term basis, an infiltration basin's capacity may limit its ability to accommodate more water than currently diverted. Moreover, the additional recharge of groundwater basins with recycled or wet weather runoff may require increasing the size of existing infiltration basins or developing new facilities, where constraints may exist. Other infiltration BMPs (for example, infiltration galleries) are appropriate where the site conditions indicate high infiltration rates or where concentrated pollutants in dry and wet weather runoff are not likely to be absorbed by the media or soil. The feasibility of infiltration may also be limited in areas with contaminated soils, septic system leach fields, buildout areas, high groundwater table, or large slopes, or that are especially close to bluffs.

In addition, only 28 percent of the Los Angeles Basin is underlain by an unconfined aquifer. Any water that is infiltrated outside of the unconfined aquifer does not contribute to water supply. Unfortunately, most of the area in Los Angeles County is urban and highly impervious, further limiting the potential of locally infiltrating stormwater. The costs for these types of projects can increase significantly with any land acquisition to develop new facilities, add storage, or develop underground infiltration facilities. Aboveground infiltration facilities are less expensive than underground facilities because they are easier to install and operate. Another potential concern includes an understanding of emerging contaminants and how they will be regulated in the future, which may add additional costs for the treatment of groundwater.

In the WMPs, diversion projects are considered a method to divert dry and wet weather runoff to sanitary sewer systems. The construction and O&M costs of diversion projects depend on the amount of flow, water quality, timing of flow releases, and interaction with other flow sources in the sewershed, and site complexities, including automated controls and monitoring. Agencies can work together to reduce diversion project costs by considering these potential approaches:

- Develop creative solutions with other agencies to develop hybrid projects (for example, integration of a regional or a distributed project with a diversion project, with or without a storage) and understand interactions with other existing or planned projects in the watershed.
- Reduce loadings of pollutants (such as total solids, nutrients) to reduce the treatment costs.
- Change operations of diversions to avoid potential charges associated with peak flows (At present, for diversions to the LACSD's system, the least-cost operations limit daytime flow rates to be no greater than annual average flow rates and diverts higher flows during off-peak hours).

Although the addition of a storage facility with a diversion project increases the cost of the project, it can potentially provide multiple benefits for the project, as previously described (Section 8.2.1). In addition, a hybrid project can make a project attractive from the standpoint of meeting MS4 compliance and providing community benefits.

Therefore, the cost of a project under any scenario varies greatly, depending on the factors described here. Project costs should be determined by conducting a feasibility study when the location and purpose are defined. Appendix F provides an example list of cost categories to consider during feasibility analysis of a typical diversion project. The list needs to be modified, depending on the goal and objectives of the diversion project.

Appendix G provides a checklist for developing a diversion project. The general checklist provides guidance to the project proponents about the potential steps needed to implement a project. This list includes items relevant to projects developed per Scenario 1, 2, and 3, described in the following section.

8.4 Summary, Conclusions, and Recommendations

Figure 8-5 provides a generalized summary of steps needed to implement various scenarios of a diversion project. The steps presented in the roadmap for various types of scenarios of diversion projects generally apply to all projects, but the specific details for the steps are on a case-by-case basis. For example, a new project for diverting dry and/or wet weather runoff will preferably be near the sanitary sewer system or WRP, with or without a storage facility. Balancing the costs and benefits of each scenario against the needs, goals, and priorities for the MS4 permittees, the sanitation agency, and other involved agencies can help identify the best solutions.

Scenario 1: Existing DWD	**Scenario 2: New DWD**	**Scenario 3: New WWD**
(*use the full potential of existing diversion to divert wet weather runoff*)	(*identify a diversion location to operate as a dry weather diversion without storage*)	(*identify suitable location to capture flow from a watershed, design-build diversion structure, pumps and storage component*)
• Use existing knowledge • Assess past consequences under high flow conditions • Quantify expansion without infrastructure modifications • Identify gaps and priority needs • Determine cost of diverting wet weather runoff	• Determine land availability for construction of a new DWD structure • Consult with stakeholders in the watershed • Check regulatory requirements	• Identify the best location to install diversion structure • Estimate storage volume, pumping and conveyance capacity • Determine land availability for the project • Investigate required permits; coordinate with agencies • Estimate the cost of installation and operation

Figure 8-5. Generalized Requirements/Approach to Implement Various Scenarios

The implementation of a diversion project depends on the cost-benefit analysis. The cost of a diversion project varies based on the scenarios discussed, the location of the diversion project, and site-specific constraints and opportunities. Certainly, the cost to modify an existing project is different from implementing a new project. The costs of available land for a new project and for conveying wet weather runoff to a WRP could also be a determining factor for new projects, with or without storage. A detailed investigation of the costs and cost-effectiveness of various types of projects with benefits and risks is recommended.

The key components for assessing the feasibility of a diversion project are:

- Scope and desired goal/outcome of the project
- Optimized use of existing infrastructure to target the "low-hanging fruit"
- Regulatory requirements
- Costs and benefits of the projects
- Strategy for hybrid projects to achieve goals
- Available funding sources and partnerships (e.g., implementation partners, Measure W funds, availability of grants and other funding sources)
- Opportunities and innovative solutions for constraint and risk management for permissive and controlled solutions
- Meeting and advancement of the region's goals and priorities

Section 8.2.1 discussed the benefits of diversion projects. Creative combinations of existing infrastructure, along with funding sources and partnerships among agencies, may offer the best solutions, helping to capture the maximum benefits for ratepayers at the lowest possible cost.

Diversion projects offer several benefits; however, they also present some limitations, risks, and challenges that should be considered as part of the roadmap:

- Existing DWDs without storage are limited in accepting wet weather runoff. Where feasible, diversion projects should be designed to capture the volume from the 85th percentile, 24-hour storm event. Those projects include storage facilities with controls and real-time monitoring of sanitary sewer flows.

- The flow volume that can be discharged from a diversion project to the sanitary sewer system requires an evaluation of the downstream conveyance and treatment capacities. Often, either or both become limiting factors for operating existing DWDs during higher-than-dry weather flow conditions.
- The emphasis of source control strategies must be continued to have effective control of pollution sources during wet weather.
- The MS4 permittees need to comply with the sanitation agencies' permit requirements. Any physical and operational modifications to an existing diversion system will require an amendment to the original Industrial Wastewater Permit issued by the sanitation agency. The conversion of an existing DWD to a WWD structure (Option 2 in Scenario 1) will require the issuance of new Industrial Wastewater Discharge Permit.

8.5 References

LA Sanitation & Environment (LASAN). 2018. *Ballona Creek Bacteria Total Maximum Daily Load Project Draft Environmental Impact Report Public Meeting*. https://lacitysan.org/san/sandocview?docname=cnt020142

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Section 9. Conclusions and Recommendations

The purpose of this section is to present a synthesized set of conclusions and recommendations based on the work conducted under this study.

9.1 Study Conclusions

DWDs are a proven control method to successfully divert flows and associated pollutants from the MS4 to the wastewater system. This approach is a permissive and highly controlled means of diverting dry and wet weather runoff to a wastewater system. Agencies in the Los Angeles Basin have successfully used this approach over the last two decades to protect the water quality of the receiving waterbodies.

The approach used for the Phase 2 White Paper study comprises the following steps:

- Prepare an inventory of the existing DWDs in the Los Angeles Basin.
- Understand the operations of existing DWDs, WRPs, and WWTPs.
- Identify potential opportunities and constraints for the expansion of existing DWDs to accept wet weather flows on a permissive basis to integrate harmoniously with the wastewater system.
- Estimate the remaining/uncaptured dry weather runoff in the Los Angeles Basin.
- Develop a roadmap for the MS4 permittees that want to develop and implement a new DWD or a WWD or modify an existing DWD to divert additional flows during wet weather.

These tasks were accomplished by gathering, compiling, and analyzing rainfall, DWD flows, and WRP/WWTP inflow data, as well as by developing an understanding the operations and configurations of the DWDs through field visits and discussions with the DWD and WRP operators, and through regular communications with stakeholders. The four case-study DWDs underwent a preliminary, high-level assessment of their capacities to divert flows from storm drains to the Hyperion WRP or the JWPCP. A more detailed site-specific feasibility analysis on a case-by-case basis is recommended.

The following conclusions were drawn based on the analyses conducted during this study.

9.1.1 Dry Weather Runoff Capture Potential

MS4 permittees have a long history of successfully implementing DWDs in the coastal watersheds with the goal of improving public health and safety of beach visitors. DWDs help achieve MS4 compliance with dry weather standards by preventing dry weather runoff and associated pollutants from entering surface waters.

9.1.1.1 DWDs under Existing Conditions

DWDs have been constructed in the Los Angeles Basin watersheds since 1999. The DWD inventory includes 41 existing DWDs in the Los Angeles Basin. However, the study focused on 31 DWDs that are owned and operated by the stakeholders of this study. The LACFCD and LASAN own and operate 19 and 12 of the DWDs, respectively. Details of the existing DWD inventory, including ownership, permitted capacity for discharge-to-sewer, tributary area, year of construction, sewershed, and storage can be found in Section 2.

DWDs have been successfully operated and the sanitary sewer systems have successfully delivered dry weather runoff from DWDs to WRPs for over 20 years. DWDs are permissive and controllable, and they have been operated without causing sewer overflows.

9.1.1.2 DWD Impact on Permit Compliance during Dry Weather

A principal concern is the dry weather runoff that, if not managed with BMPs, including diversions, will enter surface waters and cause water quality impairments. DWDs have the potential to improve water quality and achieve compliance for all pollutants of concern for a waterbody with TMDLs in effect. A rainfall data analysis was performed to characterize the percent of dry days in a year where DWDs can help protect water quality. While the rainfall pattern is variable in the Los Angeles Basin and in the inland watersheds, for planning purposes, data from rain gauge AL 461, located along the coast, and rain gauge 716 in downtown Los Angeles were analyzed.

Based on the rainfall data from October 1, 2008, through August 20, 2019 at Gauge AL 461, located near the SMB DWDs, 92 percent of days had no rainfall and 8 percent of days had some rainfall (Figure 9-1). During the entire analysis period, rainfall varied between 0.01 and 3 inches. For 50 percent of days when rain was detected, the rainfall depth was less than 0.1 inch, which is considered dry weather in MS4 permits and TMDLs.

This analysis demonstrates that for dry days (average of 350 days per year, in this example), DWDs can help achieve the MS4 compliance requirements by diverting dry weather runoff from the MS4 areas to the sanitary sewer systems, effectively protecting the water quality of the receiving waterbodies on average 96 percent of the days in a year[1].

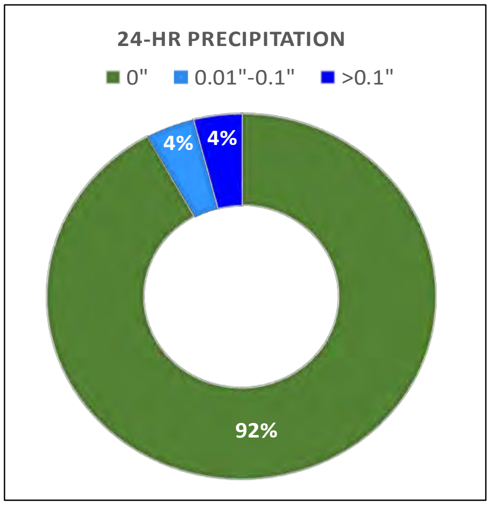

Figure 9-1. Rainfall Data Analysis for Gauge AL 461

9.1.1.3 Dry Weather Runoff in the Los Angeles County Watersheds

Key objectives for stormwater management in the Los Angeles Basin are to reduce or eliminate dry weather runoff, to reduce pollutants entering receiving waters, and to maximize the beneficial use of receiving waterbodies. A fundamental element of managing dry weather runoff is understanding the volume and quantity of dry weather runoff generated in the watersheds.

There have been several reports with analyses estimating the volume of dry weather runoff in the Los Angeles River watershed. However, there has not been an assessment of the dry weather runoff in the watersheds of LA County. This study was intended to set forth an approach for providing a high-level estimate of dry weather runoff for County watersheds. Based on the seven watersheds in the Los Angeles Basin, the estimated median runoff rate is 73 MGD, ranging from 43 to 137 MGD, for the 10th and 90th percentile flows, respectively. The range of runoff estimates within a watershed and among various watersheds is highly variable due to several factors, including land uses and sources (such as flows from dewatering and construction activities) and the frequency of flow releases from these sources to storm drains or to the receiving waterbodies. The range of dry weather runoff estimates also vary among studies for many reasons, including the variability in approaches used for runoff estimations and the time period used for the analysis. Robust methods, including flow balance approaches, can help refine these estimates.

Of the total dry weather runoff in LA County, on median value basis, it was estimated that the DWDs currently operating in the coastal watersheds (such as the SMB watersheds) divert about 4 percent of the total dry weather runoff produced in the entire County. The existing 31 DWDs implemented in these

[1] This estimate does not exclude dry days following rainfall

coastal watersheds account for less than 10 percent of LA County's total area. This indicates the magnitude of the opportunity for new DWDs in the inland watersheds of LA County that could achieve water quality compliance and increase recycled water supplies.

For consistency purposes, the amount of dry weather runoff diverted by the existing diversions was estimated. These high-level estimates should be refined based on storm drain monitoring or other watershed-specific approaches. For example, for the Los Angeles River watershed, the discharges from the WRPs and groundwater upwelling in the river can be subtracted from the measured flow data in the river at a downstream station to estimate the dry weather runoff.

9.1.1.4 Impact on Wastewater System Capacity Availability due to Water Conservation

Dry weather runoff is conveyed from the DWDs to a WRP/WWTP for treatment. The strategy takes advantage of the available capacity in the conveyance system and at the WRP/WWTPs that are designed to accommodate wet weather flows. Fortunately, water conservation measures in recent years have also reduced the volume of wastewater flow in LA County's wastewater collection systems and at the WRP/WWTPs. Phase 1 of the White Paper identified a 103,000-AFY or 11 percent reduction in wastewater flows in 2017 by comparing pre- and post-drought data for 21 WWTPs in LA County. As of 2017, the cumulative unused permitted capacity of the 21 WWTPs/WRPs in LA County was approximately 490 MGD. This trend is expected to continue in the future.

The reduction in the wastewater flows indicates that the sanitary sewer system has available capacity in many areas and will likely be able to convey additional dry weather runoff and deliver it to the WRP/WWTPs. Based on the preliminary analysis of available capacities based on the WRP's design capacity and the current diminishing wastewater flows in the sewer systems due to water conservation, most of the WRPs (and specifically the Hyperion WRP and JWPCP) appear to be potentially capable of receiving additional dry weather runoff. Currently, the discharge from the existing DWDs do not have much impact on the Hyperion WRP operations due to the insignificant fraction of diverted dry weather flows relative to the plant's wastewater influent flows (Kim, personal communications, 2019).

In a broad sense, even by diverting the estimated, currently uncaptured dry weather runoff, the conveyance systems and WRP/WWTPs will potentially operate during dry weather approaching flows of the pre-conservation period. This may also ease some of the wastewater system issues observed during the post-conservation period due to flows being below ideal operating conditions.

A site-by-site feasibility analysis for each DWD, along with the downstream sanitary sewer system and WRP/WWTPs, will be required to confirm available capacities before modifying or expanding existing DWDs and construct new DWDs and WWDs.

9.1.1.5 Potential Strategies for Increasing Dry Weather Runoff Capture

The conceptual plan for diverting the uncaptured dry weather runoff requires a diversified toolbox approach, as no single solution is suitable for Countywide implementation. The overall program must be environmentally sound and cost-effective, and must provide measurable reuse volumes and water quality improvements. The best dry weather runoff solution for each drainage area should be determined on a case-by-case basis. Where diversion to the sanitary sewer or directly to a WRP is deemed feasible by the MS4 permittee and the sanitation agency, the following diversion approaches may be considered:

- DWDs near WRPs directly discharge to WRPs.
- Divert nearby storm drains directly to WRPs.
- Divert storm drains to nearby interceptor sewers.
- Provide new dedicated conveyance from multiple DWDs to WRPs.
- Divert individual storm drains to local sanitary sewers.

In addition, LASAN and LACFCD own 60 stormwater pump stations to alleviate localized flooding at hydraulic low points in the storm drain systems in various watersheds. Several pump stations have DWDs installed to divert dry weather runoff, such as the Manhattan PP DWD. Where feasible, the remaining pump stations could be modified to include DWDs and/or WWDs to divert runoff to a sanitary sewer system.

Operations can be optimized via intelligent system deployment. During dry weather, the LASAN and LACFCD DWDs are operated automatically through a programmatic logic control based on level control. LASAN and LACFCD can monitor the DWDs but cannot remotely control the operations. The DWDs do not have uniform shutoff mechanisms during wet weather. LASAN and LACFCD DWDs are manually shut off before rain events forecasted to be 0.1 inch or greater in the area. It is a labor-intensive process to manually turn off the pumps and close the inlet sluice gates at all manually operated DWDs. LACFCD DWDs connected to the LACSD sewer system have onsite rain gauges and controls that shut down the DWD if 0.1 inch or more of rain is detected. DWDs to the LACSD's system already require SCADA pump control. Better controls and telemetry systems can optimize DWD operations and maximize dry weather runoff capture. This would enable operators to remotely operate the DWDs, shutting them down when wet weather occurs upstream of the DWD and restarting them afterwards. Operators would also be able to manage the DWDs during emergency events when sewer system capacity and/or treatment plant capacity becomes limited. Eliminating the need to travel to and from each DWD twice to shut down and restart DWDs manually also reduces risk to crew safety and benefits the environment.

9.1.2 Evaluating Existing DWDs for Potential Wet Weather Capture

To understand the performance of existing DWDs and examine their potential to accept wet weather runoff, four case study DWDs were analyzed. These were the SMC, Temescal Canyon, Manhattan Beach PP, and Pershing Drive DWDs. The analysis of the case-study projects provides a roadmap to evaluate DWDs for wet weather runoff diversion potential on a case-by-case basis.

The four-case study DWDs have been successfully diverting dry weather runoff to their respective sanitary sewer systems. Sanitary sewer system capacities are sufficient to convey the dry weather runoff to the WRPs, and the WRPs treat the dry weather runoff successfully.

All four case-study DWDs have unique characteristics related to configurations, site and environmental conditions (such as land use, site settings, location), size and designs, and opportunities and constraints. There is no generalized set of solutions that can be applied to all DWD projects for diverting wet weather runoff. The following conclusions can be drawn, summarized in Table 9-1:

- The proximity of the Pershing Drive DWD to the Hyperion WRP offers a unique opportunity for conveying wet weather runoff directly to the WRP without using the sanitary sewer system. A detailed feasibility study to expand the DWD to divert wet weather runoff would be necessary.
- The Temescal Canyon DWD can use existing storage and, potentially, a new storage system can be developed to store water during the leading edge of a storm event and discharge during off-peak hours when the capacity in the conveyance system becomes available. In addition, modifications to the conveyance system components and system operations will be needed.
- The SMC DWD has the capacity to potentially deliver additional flows beyond dry weather runoff with the existing structure. It appears that the available DWD capacity can be used during wet weather, provided the flow from the diversion can reach the Hyperion WRP without resulting in spills through the sanitary sewer system. A downstream sanitary sewer system analysis would be necessary.
- The capacity of the Manhattan Beach PP DWD will need to be increased to accommodate wet weather flows. In addition, the conveyance system for the Manhattan Beach PP DWD has capacity constraints, and it will be difficult to accept wet weather runoff because the sanitary sewer system downstream of Polliwog Park is complex, with a number of locations where the flow splits and rejoins. Based on the conveyance capacity analysis provided by the LACSD for this DWD, it was determined that this DWD cannot accept upstream wet weather runoff generated from more than 0.1 inch of rainfall in 24 hours under existing conditions.

The current wait period for the restart of the DWD from a shutdown period is 72 hours and 24 hours after a rain event of 0.1 inch and more for the DWDs discharging to the LASAN and LACSD sewer system, respectively. To overcome the challenges of diverting additional dry and wet weather flows with the DWD, a potential approach includes storing the wet weather runoff during storm events and discharging to the sanitary sewer system during off-peak hours. Two potential storage options are:

- **WWD with Storage (also referred to as Stored Water WWD):** Wet weather runoff from larger storms could be stored and discharged to the sanitary sewer system when the sewer conveyance capacity becomes available. Investigation and analysis with refined flow data and potential storage (for example, in the channel or beach parking lots, or in the watershed) would be required for an accurate assessment of the sewer conveyance capacity. In addition, modifications to the sanitary sewer system components and operations will be needed.
- **DWD Operational Time Change Potential:** For the DWDs that discharge to the LACSD sanitary sewer system, under current conditions, diversions are prohibited from restarting until 24 hours after the end of a rain event. Potential opportunities exist for the Manhattan Beach PP DWD, where the delay in restarting the DWD after a storm event can be shortened to 12 hours after the rainfall stops. A strategy would need to be developed to determine the storage potential at this location to store wet weather runoff and release it following 12 hours of a storm event up to an amount permissible for diversion.

Table 9-1. Summary of Case-study DWDs (Under Existing Conditions and Potential for Wet Weather Diversion)[a]

	Santa Monica Canyon		Temescal Canyon		Manhattan Beach PP		Pershing Drive	
Parameters	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather	Dry weather	Wet weather
DWD infrastructure available capacity	✓	Need sewer system analysis	✓	Need sewer system analysis	✓	Need sewer system analysis	✓	Need sewer system analysis
Conveyance capacity	✓	Investigate smart system	✓	Investigate smart system	✓	Investigate smart system	✓	Investigate smart system
Available capacity at WRP	✓	✓	✓	✓	[a]✓	[a]✓	✓	✓
First flush/First event	N/A	Need to investigate	N/A	Need to investigate	N/A	Expand DWD capacity	N/A	Need to investigate
Storage	N/A	needed	N/A	needed	N/A	needed	N/A	needed

[a] Manhattan Beach DWD discharges to the JWPCP; Other 3 DWDs discharge to the Hyperion WRP.

Notes:

The first flush of the season is the wet weather runoff from the first rain event, defined here as the first significant rain event of the season that occurred after a long, typically summer, dry period.

N/A = not applicable

Any modifications to an existing DWD or to convert a DWD into a WWD will require modification to the current permits and/or the issuance of new permits for industrial waste discharge.

9.1.3 Summary of Dry and Wet Weather Runoff Capture Potential

In summary, the planning-level analysis conducted during the Phase 2 White Paper study indicates DWDs are a viable option in the toolkit of approaches to divert uncaptured dry weather runoff in the Los Angeles Basin to comply with MS4 permits, improve surface water quality, and generate additional recycled water supplies. Potential approaches to maximize the expansion and modification of existing DWDs should be carefully evaluated on a case-by-case basis to maximize the value of ratepayer fees and the effective use of existing infrastructure, including sanitary sewer systems, storage, PPs, other BMPs, and the permissive integration of the storm drain and sanitary sewer system. The successful DWD implementation and operation in coastal watersheds of the Los Angeles Basin can be adopted to meet dry weather TMDLs for inland waters and improve water quality of receiving waterbodies.

The first step in optimizing existing diversions would require upgrades and enhancements to flow data gathering and processing, the installation of necessary equipment, and the use of online sensors and system controls to address operational challenges and data quality. Along with technical feasibility, MS4 permittees and other agencies need to determine economic feasibility, regulatory acceptability, environmental impacts, and public acceptability. Upgrading and using existing infrastructure to manage dry and wet weather runoff to meet MS4 compliance requirements should be determined on a case-by-case basis. Detailed investigations of each DWD, with the consideration of cumulative flow from all DWDs in a WRP or WWTP service area, are needed due to their uniqueness of design, operations, challenges, sewer conveyance system limitations, storage potential, and treatment capacity availability.

The high-level screening analysis conducted under this study can be used as guidance to determine the potential for expanding existing DWDs to divert wet weather runoff. As learned from the case-study projects, there is potential to divert wet weather runoff via DWDs, provided strategies can be adopted to mitigate the current limitations and risks.

The first logical step in optimizing existing diversions to divert wet weather runoff is to understand how much wet weather runoff can potentially be accepted in the sanitary sewer system based on the (variable) capacity of the sanitary sewer system from the location of the diversion to the WRP. A real-time decision support system would be beneficial, if not essential, to track rainfall and the real-time flow monitoring of sewers at critical locations in the sanitary sewer systems.

9.2 Data Gaps, Needs, and Considerations for Increasing Dry and Wet Weather Runoff Capture

9.2.1 Conveyance System Capacity Analysis

The data analysis of average daily influent flows at LA County's 21 WWTPs and WRPs indicated a downward trend in wastewater flows that increases conveyance and treatment availability. The analysis of influent flows to the Hyperion WRP and the JWPCP suggest that they are impacted by rain events; however, generally, to a lesser extent than the sewer conveyance system. It was learned from the DWD case studies that, generally, the sewer conveyance system capacity is the limiting factor and will likely govern DWD and WWD planning and implementation. A comprehensive capacity analysis of conveyance systems and other WRPs and WWTPs in the Los Angeles Basin is needed.

9.2.2 Storage Opportunities

It is important to investigate whether there is land available at existing DWDs for potential expansions. The extension can also include storage facilities near the DWD or upstream in the watershed. Land availability (for example, beneath lawns, recreational areas, parking lots) should be assessed, specifically in commercial, institutional, and industrial land uses to identify storage opportunities. Figure 9-2 presents a schematic of a storage facility with a DWD to optimize the use of existing infrastructure to capture and route wet weather runoff. Such a system could be controlled by real-time flow monitoring, telemetry, and SCADA system operations. Storage can also be operated autonomously with existing technology to capture wet weather runoff and release it through the DWD when conveyance system flows return to dry weather conditions.

In the context of WWDs, the goal has been to identify the most practical areas to develop a storage facility to retain wet weather runoff, while achieving other benefits, such as enhancing water quality, water supply, and flood control. Storage could be designed as a standalone project for a WWD project; however, if the land availability, land cost, and project costs prevent the development of a storage facility, an integrated approach can be developed to accommodate wet weather runoff with other smaller storage facilities, along with BMPs in the watersheds. More information is needed to identify and optimize storage opportunities and strategies throughout the Los Angeles Basin.

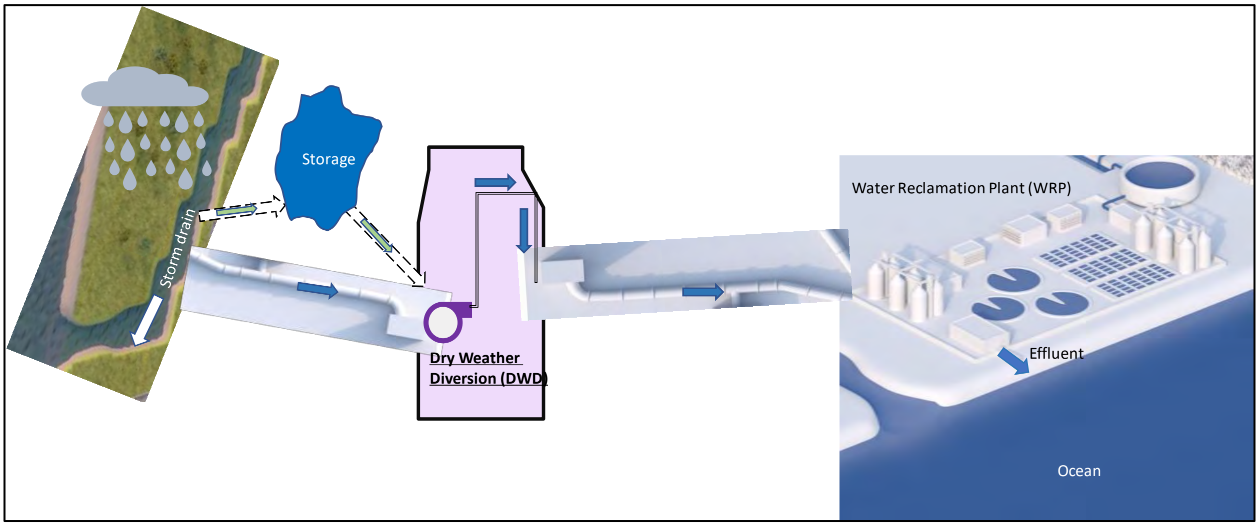

Figure 9-2. Conceptualization of a Storage Facility with a DWD to Potentially Divert Wet Weather Flows

9.2.3 Collection System Modeling

A calibrated sanitary sewer system dry and wet weather flow model with diversions, sanitary sewer conveyance systems, pump stations, and WRPs/WWTPs is invaluable for characterizing the performance of various components of the system under dry and wet weather conditions. The integration of real-time system monitoring data enhances the precision of the model and reduces uncertainty in model calculations for planning and design efforts. Feasibility studies should be performed for long-term DWD and WWD implementation and would necessitate the consideration of climate change scenarios in modeling. Scenario definitions will be needed to guide the identification of long-term precipitation, temperature, sea level, and other factors affected by climate change that will influence environmental, population, land uses, and other components of stormwater and wastewater management.

9.2.4 Monitoring and Data Management

Monitoring and data management are key elements to develop, design, and track diversion performance. Data may also be needed for regulatory requirements. A sound monitoring program with details of data collection method, data format, and quality assurance/quality control (QA/QC) protocols, as well as other factors or information (such as metadata) will be needed. Specifically, the following actions are recommended to fill the data needs for the DWD and WWD projects:

- **Manage DWD Flow Data:** The expansion of any DWD project to accept additional runoff depends on the understanding of the DWD's current operation. Available flow data with higher resolution (for example, daily, hourly, or smaller time resolution) are important. Accurate upstream area and land use data are needed to estimate dry and wet weather runoff. Adding flow monitoring devices downstream of existing DWD locations can help track new sources of flows downstream from the diversion location.

- **Use Smart Systems to Control DWD Operations:** The first step in optimizing existing diversions would require upgrades and enhancements to flow data gathering and processing, the installation of necessary equipment, and the use of online sensors and system controls to address operational challenges and data quality. The following are the data and control system needs:
  - **Implement real-time monitoring of the sewer levels and the system at critical locations** to help inform the depth of flow in the sewer to allow flows to be diverted from the DWDs. The real-time flow monitoring of sewers can provide better control and operation of diversions. In projects such as the Carriage Crest wet weather diversion project, wet weather runoff is stored and discharged to the sanitary sewer system based on a real-time sewer level sensor in the sewer conveyance system and available treatment capacity. Other diversion systems could be optimized with real-time flow monitoring in the sanitary sewer and a learning period established to relate a variety of rainfall conditions to sanitary sewer levels at critical locations. Where multiple diversion locations compete for limited capacity, SCADA-enabled diversion systems can be integrated to manage the timing of discharges to share the capacity.
  - **Optimize diversions to capture wet weather runoff based on real-time flow control** in the sanitary sewers and at WRP/WWTPs. Operations could include:
    - Diversions can potentially be operated during the entire period of a small rain event, reduced during the peak hydrograph period, and slowly reinstated to its permitted baseline flow conditions
    - Storage to retain wet weather runoff and release it to the conveyance system based on the capacity of the sanitary sewer system
  - **Incorporate Real-time Rainfall Data into SCADA** to provide information to guide the operators as to when it is safe to divert dry and wet weather runoff to the sanitary sewer system.
  - **Improve DWD Flow Monitoring Approach.** Most of the DWD flow data provided by LASAN were monthly total volumes pumped by the DWD to the sanitary sewer system, which were estimated based on the pump runtime. A telemetry system is recommended at the diversion structure. The telemetry system should include flow transducers and equipment to remotely monitor and control the flows at the diversion. The real-time monitoring of flows at these facilities can help inform the decisions for real-time operations of diversions and sanitary sewer systems. The quality and temporal resolution of data needs to be improved to better understand the operations of DWDs and the types of improvements needed for the infrastructure to accommodate wet weather runoff.

9.2.5 Potential Opportunities to Maximize the Use of Existing and Planned Projects

Dry and wet weather runoff management in urban areas requires the evaluation and application of a variety of management options, such as capturing, storing, and treating, while generating new sustainable water supplies. For example, if a diversion project is designed with a storage component and/or integration with other projects, it can generate additional benefits to flood risk management, habitat restoration, quality of life and environmental justice. To integrate the opportunities for diversions, the following are the key considerations:

- **Develop an Inventory of Projects for Prioritization:** A GIS inventory of the existing and planned distributed and regional projects in each watershed of the Los Angeles Basin is recommended to estimate the DWD expansion potential and new opportunities. Drainage area prioritization can be set based on flow estimates, TMDL priorities, and plans identified in the WMPs with a focus on BMPs that significantly improve the quality of the receiving water. A priority must be assigned to the development of a dry weather capture plan and its timely implementation in various watersheds. The plan must identify the best locations for DWD projects based on the sewer system capacity from the location of the diversion to the WRPs, and other factors, such as existing or planned stormwater projects to gain benefits from integrated projects.

- **Use Integrated Stormwater Management Approach to Maximize Benefits:** To maximize multi-benefits for water supply augmentation and water quality improvements, the already planned and developed regional and distributed BMPs could include diversions to the sanitary sewer system (Figure 9-3). This integrated approach can provide educational benefits, especially at public and highly visible sites, and provide community support for projects.
- **Use Long-term Planning Horizon based on Planned Treatment Plant Upgrades:** In the City of Los Angeles, some of the WRPs and WWTPs are undergoing, or have planned projects for upgrades of the wastewater system to generate more recycled water. It appears that these long-term upgrades to the wastewater systems will provide opportunities to handle runoff, specifically the uncaptured dry weather runoff. A detailed timeline for upgrades of treatment plants with potential for capturing dry and wet weather runoff is recommended.
- **Assess Climate Change and Other Impacts:** A climate change risk assessment can help assess various scenarios of threats and risks to infrastructure, assets, and communities to plan for mitigation and adaptation strategies. A climate change assessment is needed in terms of sizing storage volumes and estimating WWD capacities under wet weather flow conditions.

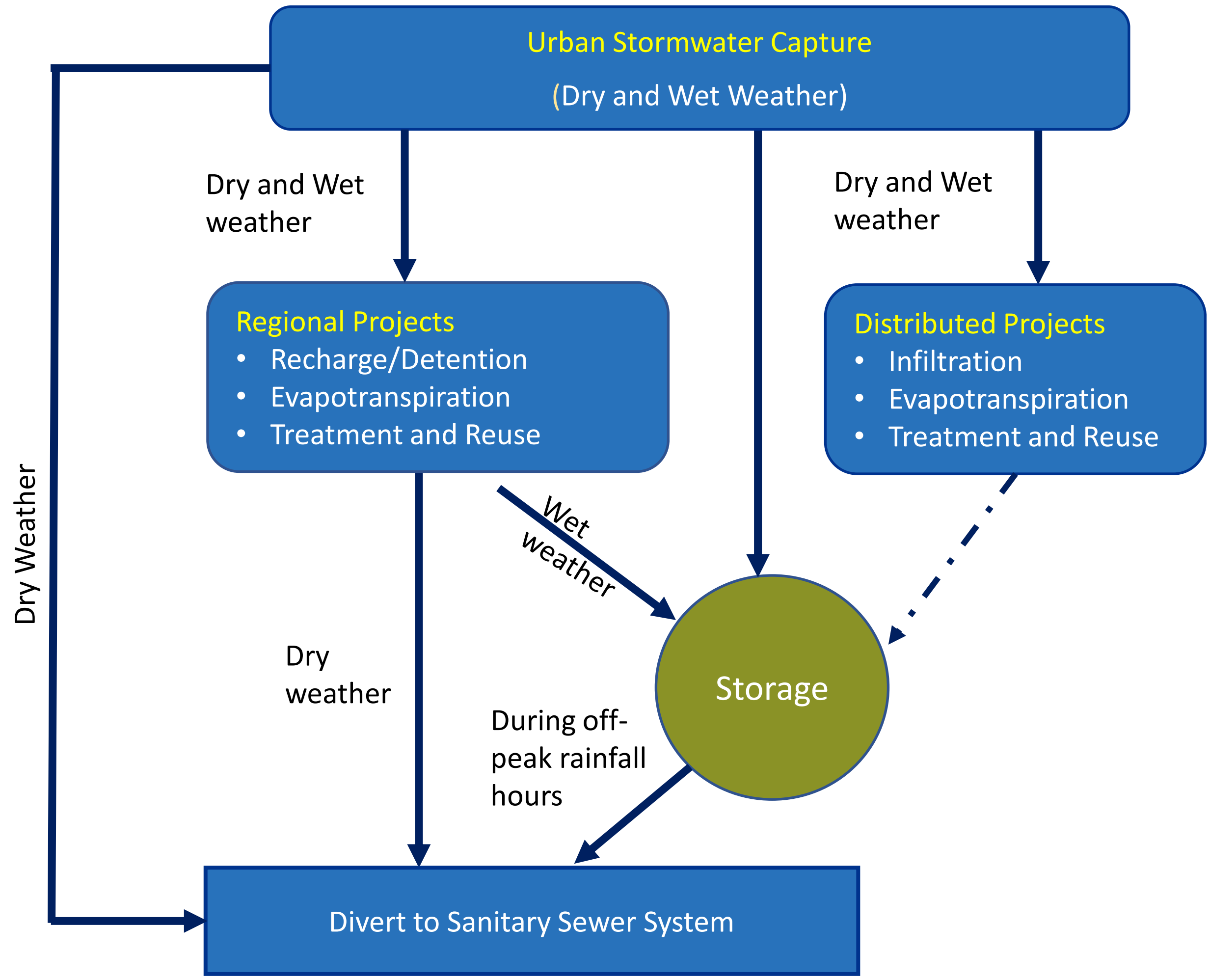

Figure 9-3. Integrated Stormwater Management Approach

9.2.6 Potential Approaches for Minimizing Costs of DWD Projects

As the treatment cost depends on the water quality of the diverted flow, potential approaches to improve the water quality of diverted flow can help reduce the treatment cost for flows diverted by DWDs.

Treatment surcharge costs for the LACSD's sanitary sewer system can be minimized by diverting no more than the annual average flow during the day and routing stored flows during off-peak hours when the capacity in the sanitary sewer system is available. Flows managed in this way result in the lowest annual costs for treatment.

9.2.7 Water Rights

MS4 permittees should get approval from the State Water Board, CDFW, and other regulatory agencies on water rights before diverting open channel flows. Water Code section 1605 requires the State Water Board to conduct a water right licensing inspection of the project and the use of water as soon as practicable after receiving notification that a permitted project is complete and ready for licensing. A permit is issued when the beneficial use of the water is established and compliance to the permit's terms and conditions is confirmed (State of California, 2022).

For adjudicated groundwater basins, water rights issues should be addressed with the Watermaster.

9.3 Path Forward

The roadmap developed in this study provides a path forward, with steps for agencies that wish to develop and implement new DWDs or modify an existing DWD. The key elements of DWD/WWD project implementation are to: (1) retrofit the existing DWD, and investigate and upgrade the system capacity, including the installation of a storage facility to capture wet weather runoff, if necessary; (2) install a new DWD to divert dry weather runoff with a possible expansion to divert wet weather runoff; and (3) install a new WWD project with the required conveyance capacity and storage for diverting wet weather runoff. Figure 9-4 presents key steps with data needs for the MS4 permittees to develop a DWD/WWD project or convert a DWD to a WWD as a strategy for MS4 permit compliance. The objectives of the roadmap are as follows:

- Assist MS4 permittees with understanding the requirements, opportunities, required permits, constraints, and cost-effectiveness of a diversion project.
- Guide municipalities on the gathering and collection of data needed for the project, the initiation of discussions among agencies involved, the feasibility assessment of the project, and an understanding of the permitting needs before implementation.
- Provide an approach to plan, execute, and assess steps to start a dialogue and obtain approvals from the agencies involved.
- Identify the process for obtaining approvals from the relevant sanitation agencies for the project.

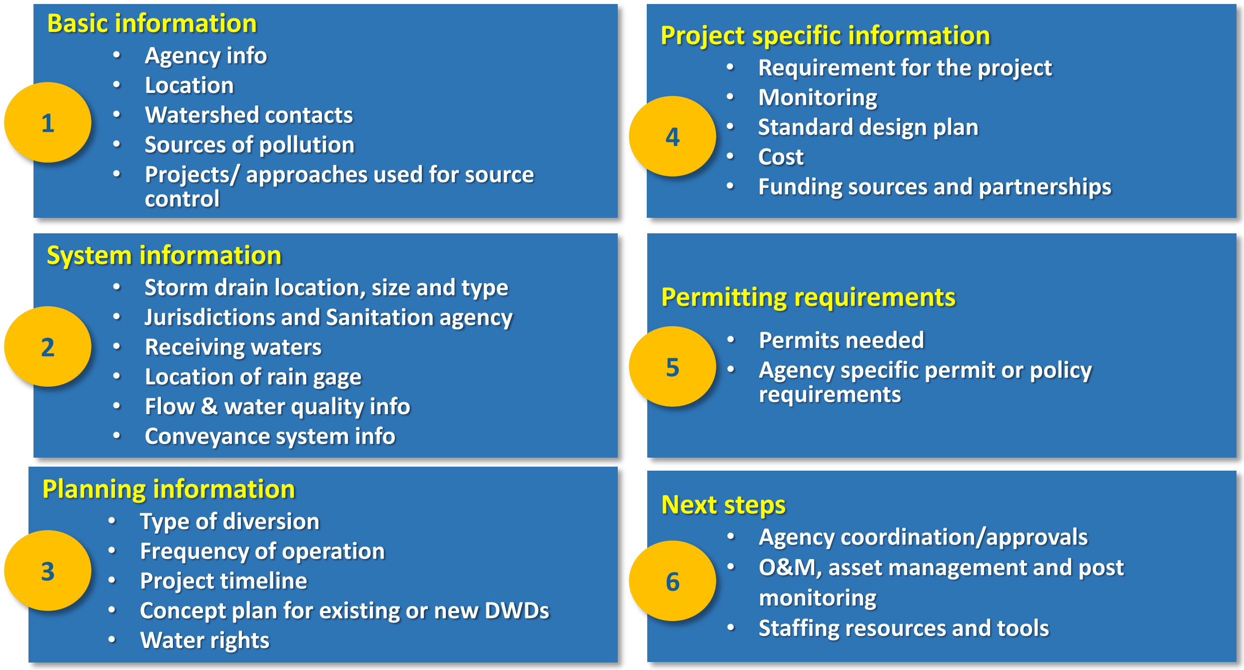

Figure 9-4. Roadmap Elements: Data and Information Needs for Implementation of DWD Projects

9.4 Recommendations

The results from this study were discussed in the monthly progress meetings with many of the project stakeholders. Various comments, input, and recommendations were received throughout the study. The project stakeholders found that the Steering and Technical Committees formed under this study enabled a collaborative approach to understanding individual stakeholder/agency perspectives on diversion projects, goals for stormwater capture, and diversion implementation challenges, as well as to elicit valuable feedback from a wide range of stakeholders to shape the outcome of the study. The stakeholder workshops provided a platform to discuss challenges and potential solutions for diversion implementation in the region. The stakeholders recommended the group stay engaged in some fashion to continue dialogue about the following key areas:

1) **Strategic Evaluation of New Diversions for the Uncaptured Dry Weather Runoff in the Los Angeles Basin**

   a) Conduct GIS mapping of storm drain and sanitary sewer system infrastructure to identify strategic locations to divert dry and/or wet weather runoff on a permissive basis throughout the Los Angeles Basin.

   b) Assess the cumulative impact of all diversions within each sanitary sewer system to help develop prioritized diversion locations with opportunities and constraints to manage dry and wet weather runoff for each system. Where multiple diversions are tributary to the same section of sewer, plan for smart controls to allow existing and future diversions to share limited capacity by coordinating the timing and/or flow rate of individual discharges.

   c) With long-term planned upgrades to the sanitary sewer systems, including WRPs and WWTPs, assess the entire sanitary sewer system to understand how, where, and the amount of dry and wet weather runoff each system can accept to help guide the implementation of various diversion projects with the goal of increasing additional regional water supplies.

   d) Conduct climate change vulnerability assessment on proposed diversion projects, including the conveyance system and WRPs, in accordance with NPDES permit requirements.

2) **Maximize the Potential of Using Existing Infrastructure through Development of Low-cost Solutions for Stormwater Capture**

   a) Conduct site-by-site feasibility analyses to evaluate the potential for expanding existing DWDs and/or implementing new diversion projects.

   b) Conduct feasibility studies to evaluate the potential of implementing DWDs at the existing LASAN- and LACFCD-owned PPs that alleviate localized flooding at hydraulic low points in the storm drain systems in various watersheds.

   c) Consider modifying the DWDs' operations to restart sooner following a rain event than the current practices of 24 hours and 72 hours for the LACSD and LASAN sewer systems, respectively. A case-by-case analysis is recommended to understand the constraints and opportunities of diverting additional dry and wet weather runoff.

   d) Develop an inventory of the existing and planned regional and distributed projects in various watersheds of the Los Angeles Basin and conduct a feasibility study to understand which existing and planned projects can include DWDs to achieve multiple benefits.

   e) Explore opportunities to develop storage facilities to capture wet weather runoff. The goal for a storage facility would be to retain wet weather runoff and convey it from diversion to the WRPs.

   f) Use an integrated approach by combining nature-based solutions with diversion projects to realize multiple benefits. This integration of green and grey infrastructure to provide green spaces and their benefits for communities and also solve water quality problems and generate local water supplies can go a long way.

3) **Conduct a Feasibility Study on the Cost-effectiveness of Diversions**

   Determine the cost-effectiveness of diversion projects to understand their costs and full equitable benefits. The approach to the maximum utilization of existing infrastructure could be cost-effective and environmentally sound, and it may enable budgets to be applied to higher-priority projects.

4) **Develop a Pilot Project using Smart Technology to Confirm a Proof of Concept to Incrementally Divert Wet Weather Runoff**

   Develop a pilot project to gain confidence in diverting wet weather runoff on an incremental basis, while improving data quality, accuracy, and reliability without impacting sanitary sewer system performance. The approach would incorporate smart technology to monitor the operations of the systems and incrementally diverting wet weather runoff on a permissive basis.

5) **Continue Strengthening Relationships among Stakeholders to Advance the Region's Goal of Stormwater Capture to Develop Sustainable (Local) Water Supplies**

   A collaborative approach is the most effective method to find cost-effective solutions to manage dry and wet weather runoff, to achieve water supply and water quality benefits, leading to more reliable and sustainable local water supplies.

   a) Continue strengthening partnerships among sanitation agencies, water suppliers, MS4 permittees, LACFCD, and if applicable, local watermasters, for the installation of new diversions at various locations within the Los Angeles Basin.

   b) Knowing the complexity of the issues, engage the stakeholders in the region's watersheds on a continuous basis to discuss potential institutional issues or other issues (such as water rights) that may impede either the implementation of new DWDs or WWDs or the modification of the existing DWDs.

9.5 References

Hi-Sang, Kim, Operator, Hyperion Water Reclamation Plant. 2019. Personal communication (operator interviews) with Jacobs staff.

State of California. 2022. *Water Rights; Frequently Asked Questions.* https://www.waterboards.ca.gov/waterrights/board_info/faqs.html#toc178761080

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Appendix A
Flow Analysis of LASAN-owned DWDs

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Appendix A. Flow Analysis of LASAN-owned DWDs

This appendix provides the flow analysis of the LASAN-owned and operated diversions based on historical monthly total flow data.

A.1 #710: 8th Street

Figure A-1 presents monthly total flow for the 8th Street DWD for the period 2011-2017. Peak flow ranged between 2 and 8 million gallons per month. Figure A-2 presents monthly average and monthly maximum flows. Maximum flows were recorded in November through January in the winter dry weather. Average flows in each month were less than 2.5 million gallons, whereas the peak flows varied between 5 and 8 million gallons.

Figure A-3 presents daily average flows per tributary area for 2011 through 2017. Flow varied between 60 and 160 gallons per day per acre (GPD/acre) in the winter dry weather, whereas, it varied between 40 and 80 GPD/acre in the dry weather period.

Figure A-4 presents daily average and daily maximum flow timeseries of the 8th Street DWD for the period between 2011 through 2017. Monthly maximum flow is about three times of the monthly average flow.

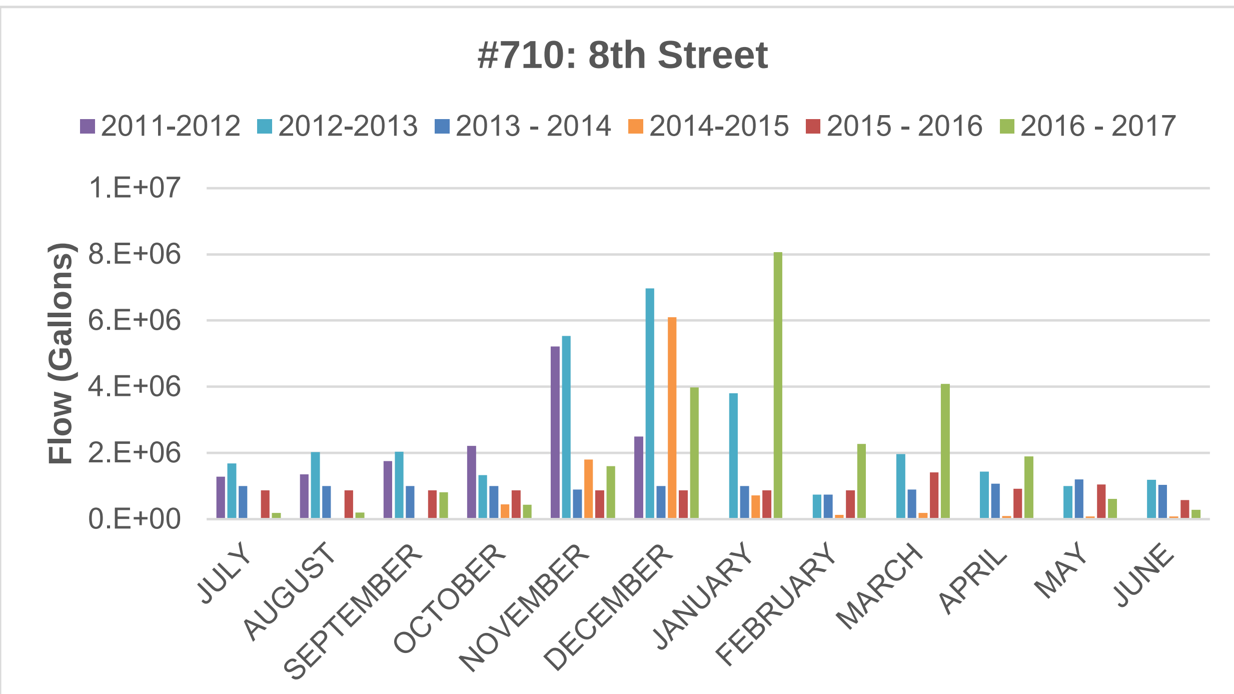

Figure A-1. Monthly Total Flow for the 8th Street DWD (2011–2017)

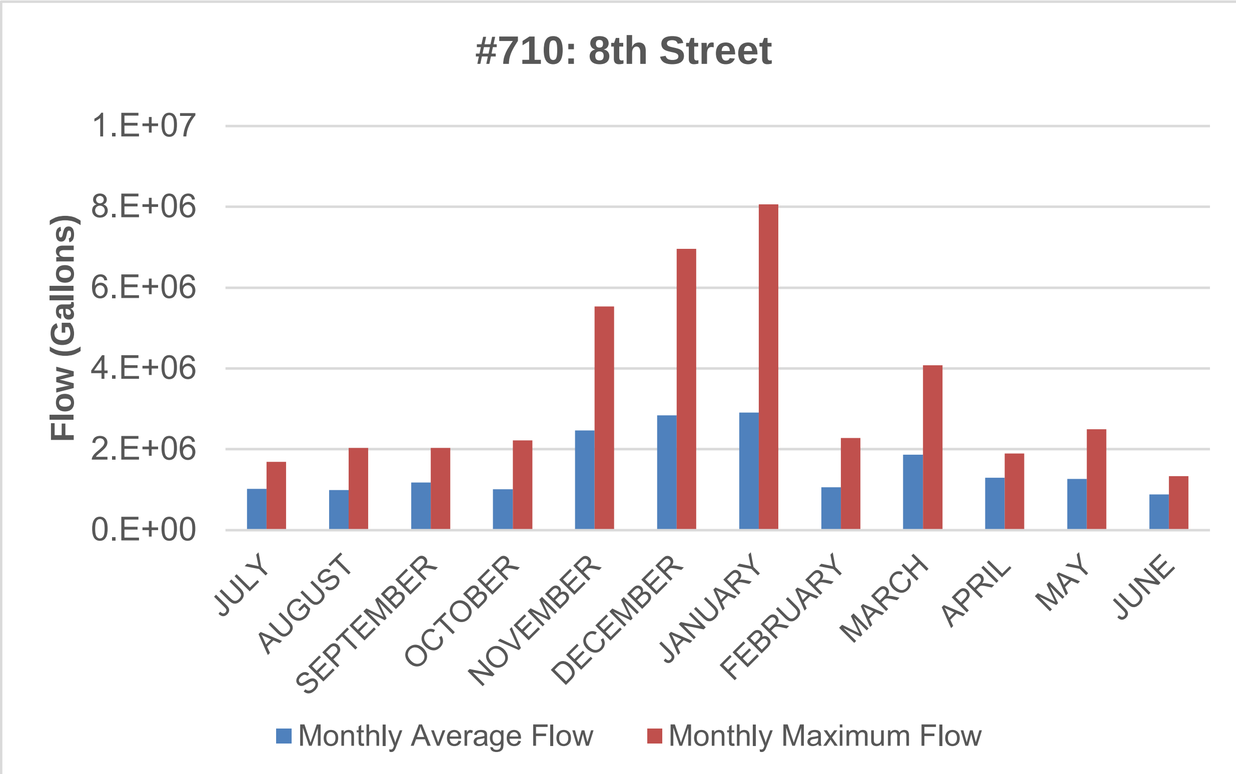

Figure A-2. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month for the 8th Street DWD between 2011 and 2017

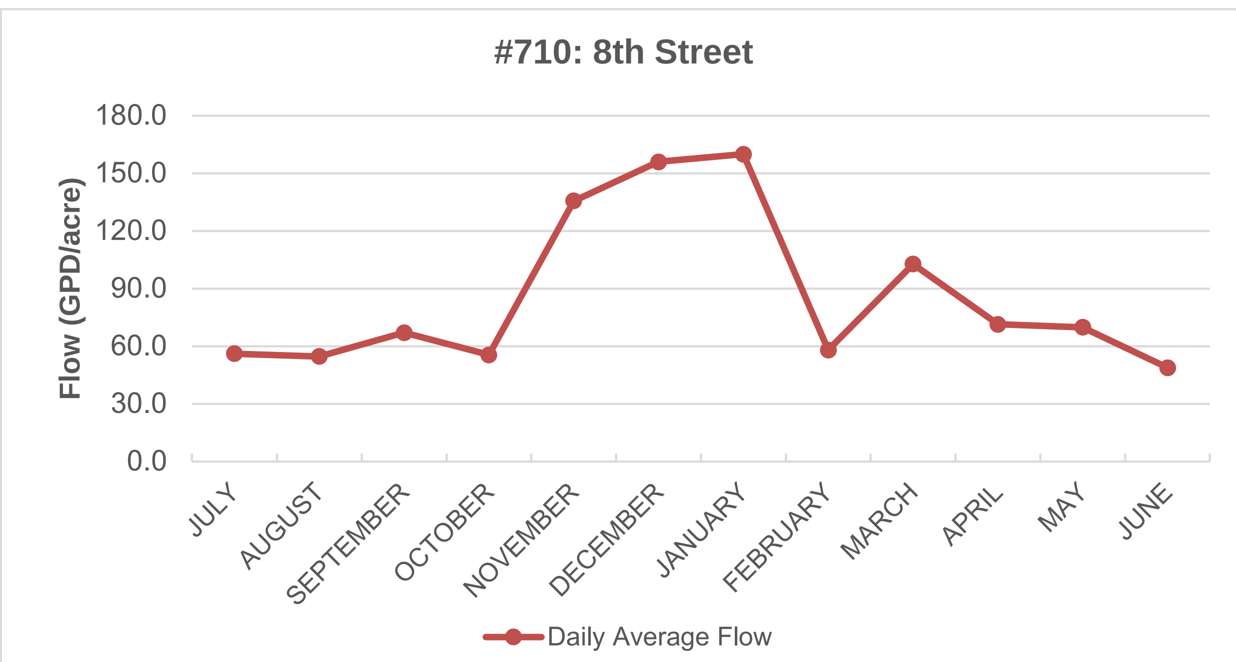

Figure A-3. Tributary-based Daily Average Flow (in GPD/acre) for each Month of the 8th Street DWD for the Data Between 2011 and 2017

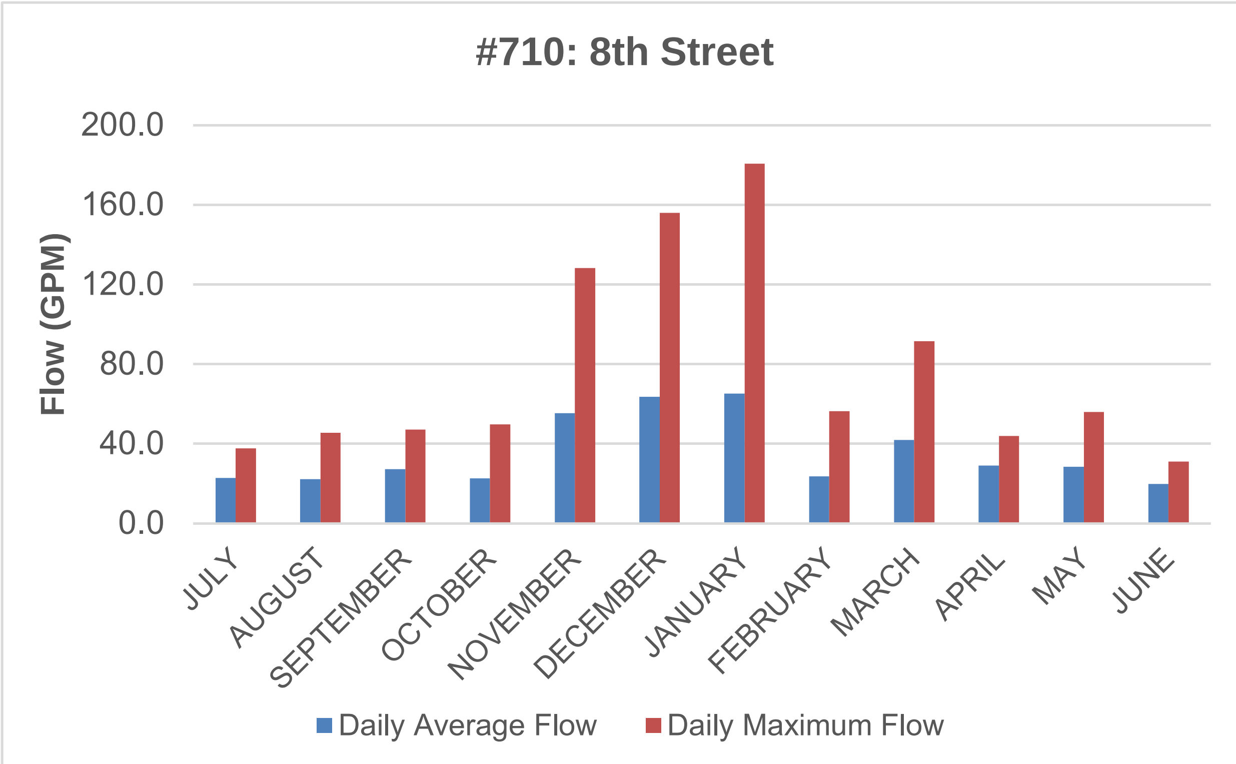

Figure A-4. Daily Average Flow and Daily Maximum Flow (in gpm) for each Month for the 8th Street DWD between 2011 and 2017

A.2 #730: Palisades Park

Figures A-5 and A-6 present monthly total flow for the Palisades Park DWD for 2008 through 2017. Peak flow varied between 500,000 and 40 million gallons per month. Figure A-7 presents monthly average and monthly maximum flows. Average flow was less than 500,000 gallons.

Figure A-8 presents daily average flows per tributary area for 2008 through 2017. Flow varied between 235 and 735 GPD/acre in the winter dry season, whereas, it was between 250 and 500 GPD/acre in the summer dry weather period.

Figure A-9 presents daily average and daily maximum flow timeseries for the Palisade Park DWD for the data between 2008 and 2017. Average flow varied between 50 and 150 gpm. Peak flows were as great as 960 gpm. Monthly maximum flow is about three times of the monthly average flow.

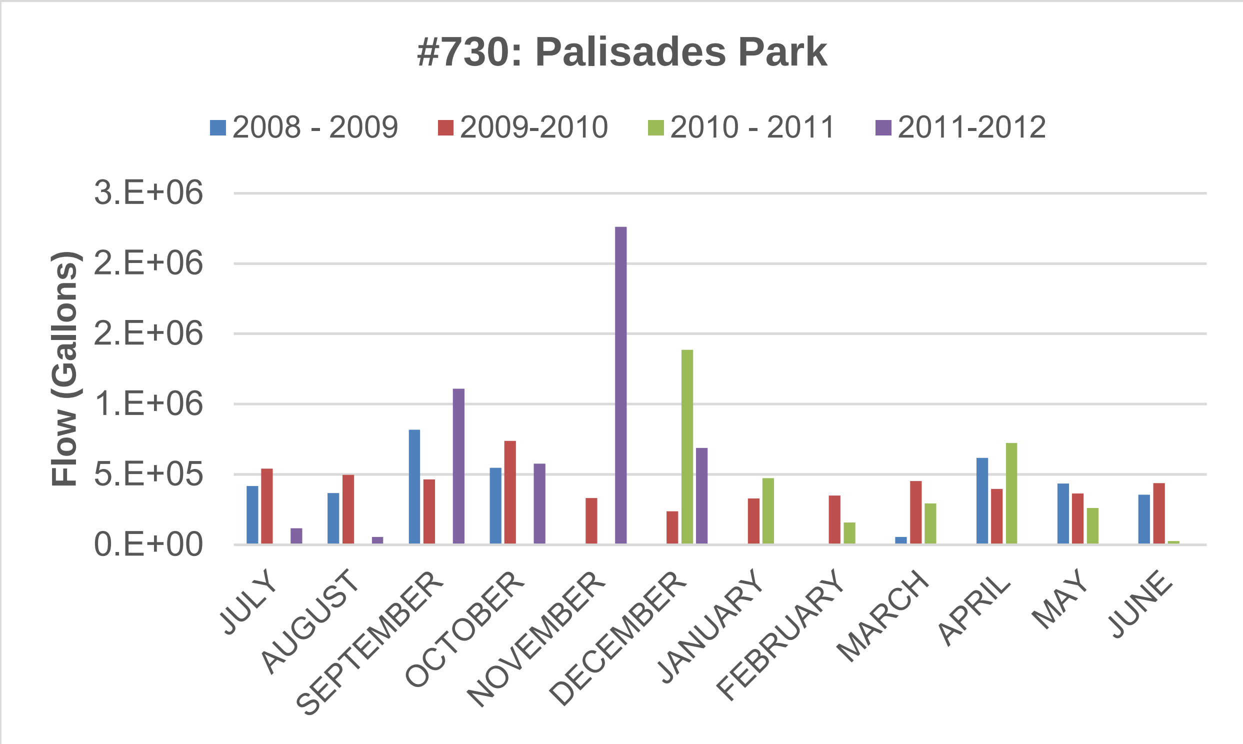

Figure A-5. Monthly Total Flow for the Palisades Park DWD (2008–2012)

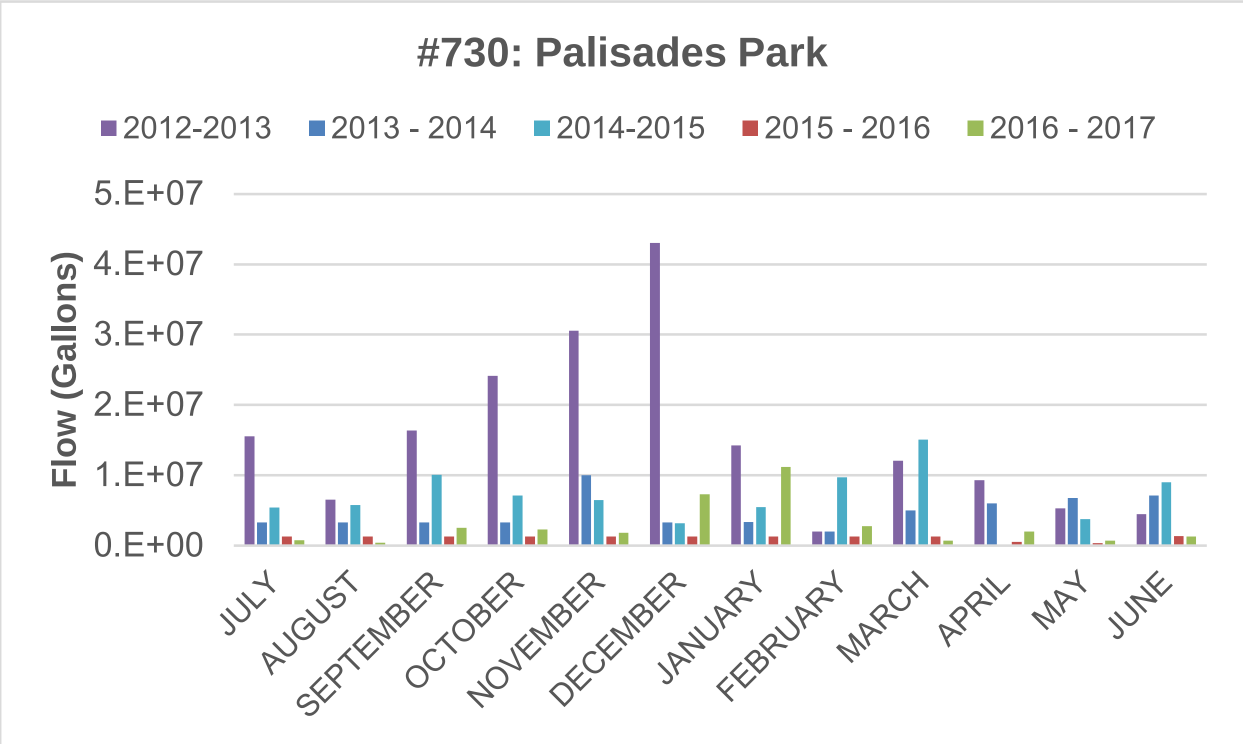

Figure A-6. Monthly Total Flow for the Palisades Park DWD (2012–2017)

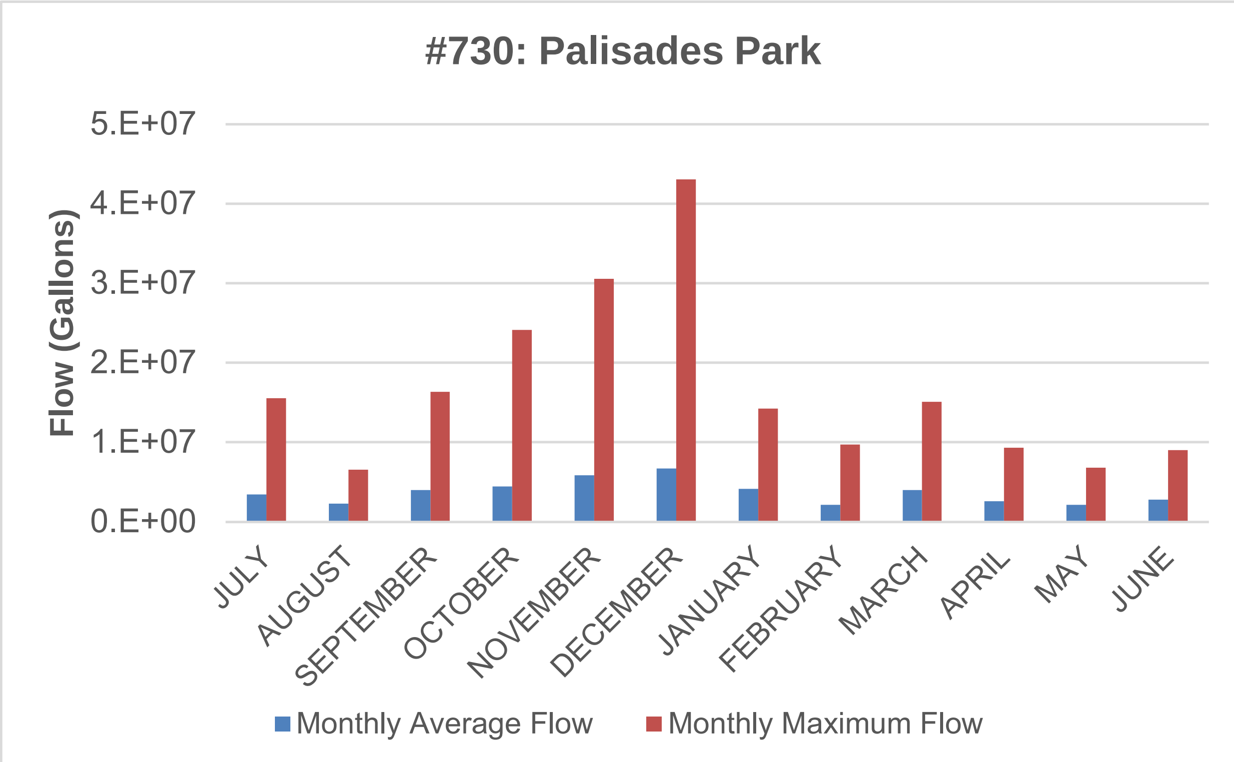

Figure A-7. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Palisades Park DWD (2008–2017)

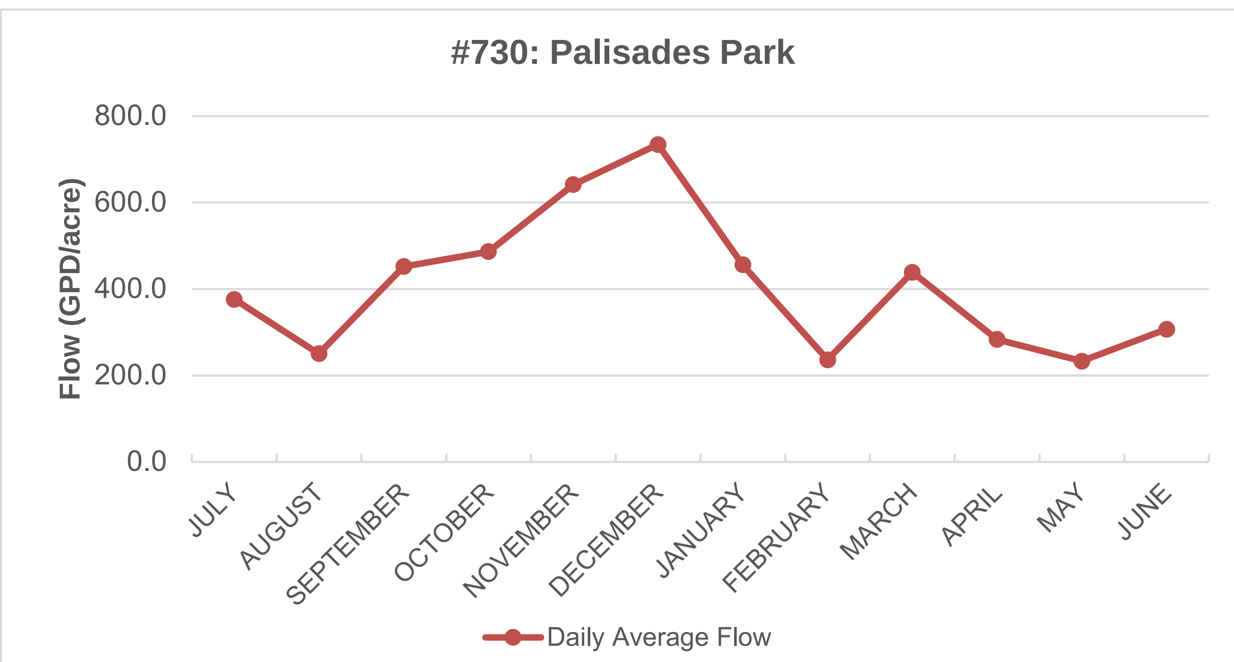

Figure A-8. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Palisades Park DWD (2008–2017)

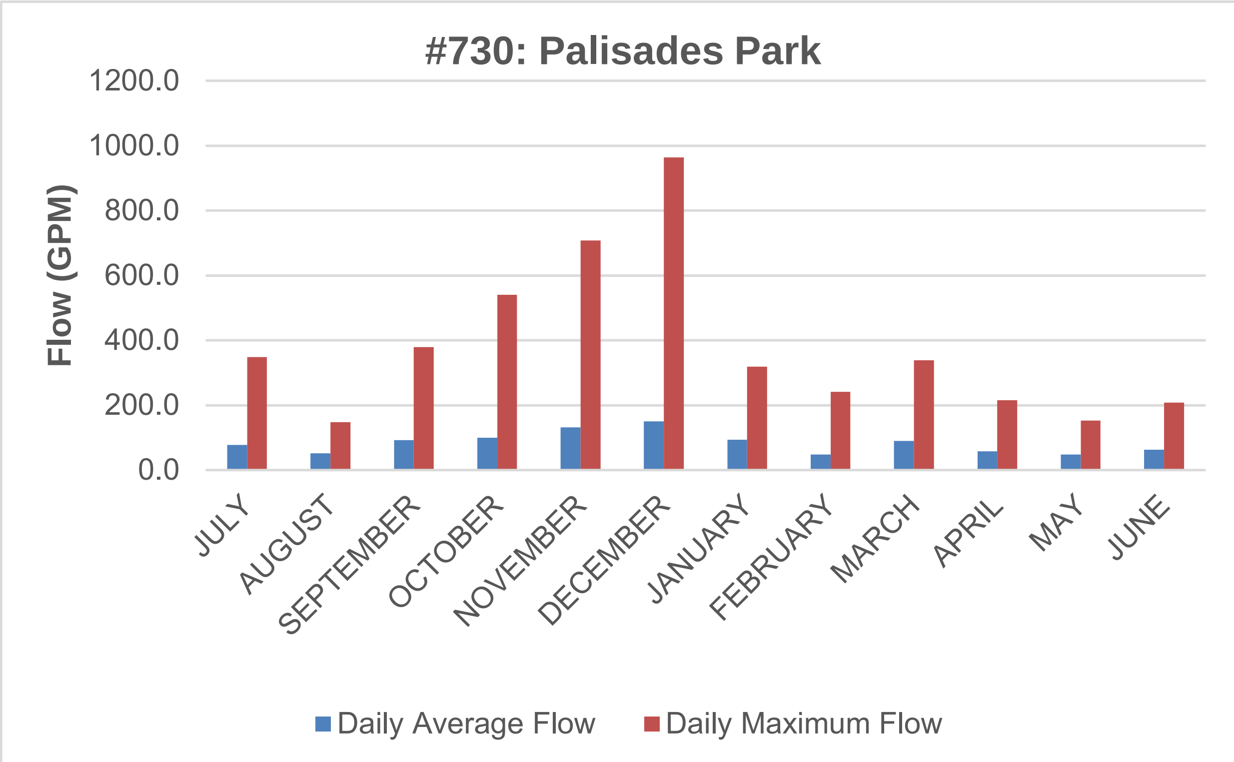

Figure A-9. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Palisades Park DWD (2008–2017)

A.3 #732: Marquez Canyon

Figures A-10 and A-11 present monthly total flow for the Marquez Canyon DWD for 2008–2017. Peak flows varied between 500,000 and 4 million gallons per month. Figure A-12 presents monthly average and monthly maximum flows between 2008 and 2017. Average flows in each month were less than 500,000 gallons.

Figure A-13 presents daily average flows per tributary area for the period from 2008 through 2017. Flow varied between 200 and 400 GPD/acre in the winter dry period, whereas, it varied between 100 and 200 GPD/acre in the summer dry period.

Figure A-14 presents daily average and daily maximum flows for each month for the period from 2008 through 2017. Average flow varied between 5 and 15 gpm and peak flows varied between 5 and 85 gpm. The monthly maximum flow is about nine times of monthly average flow.

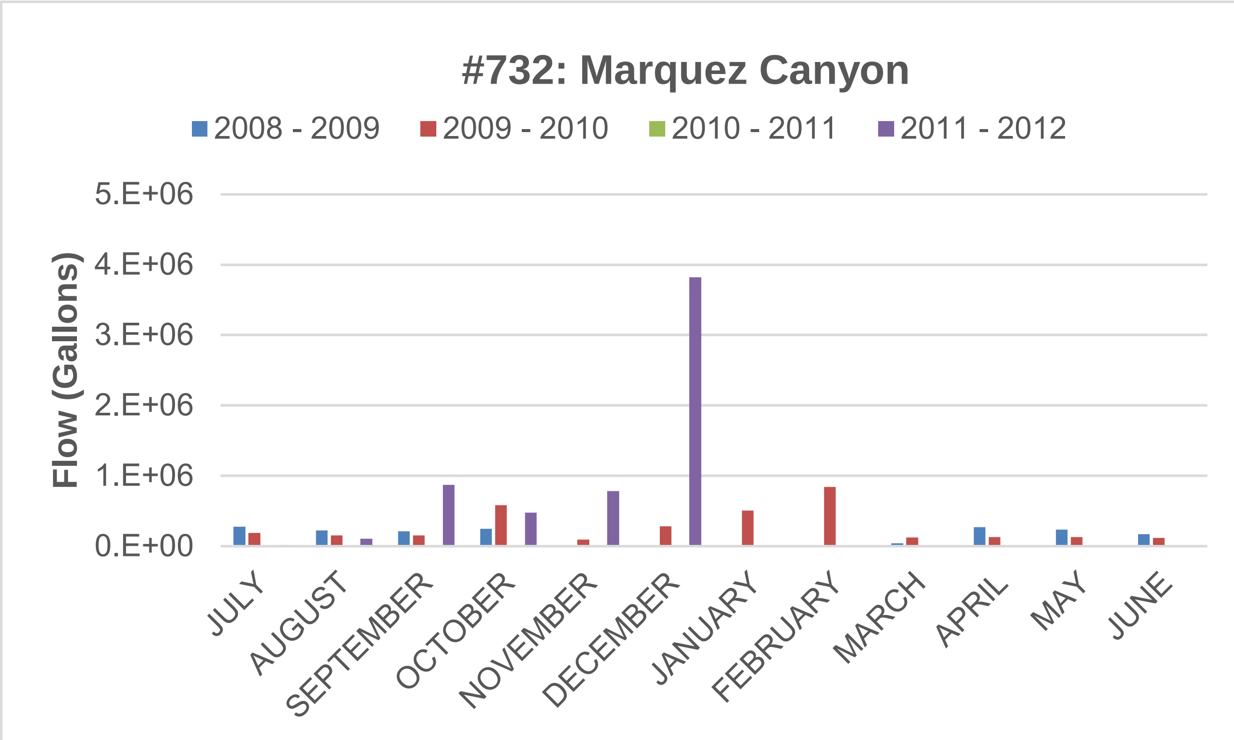

Figure A-10. Monthly Total Flow for the Marquez Canyon DWD (2008–2012)

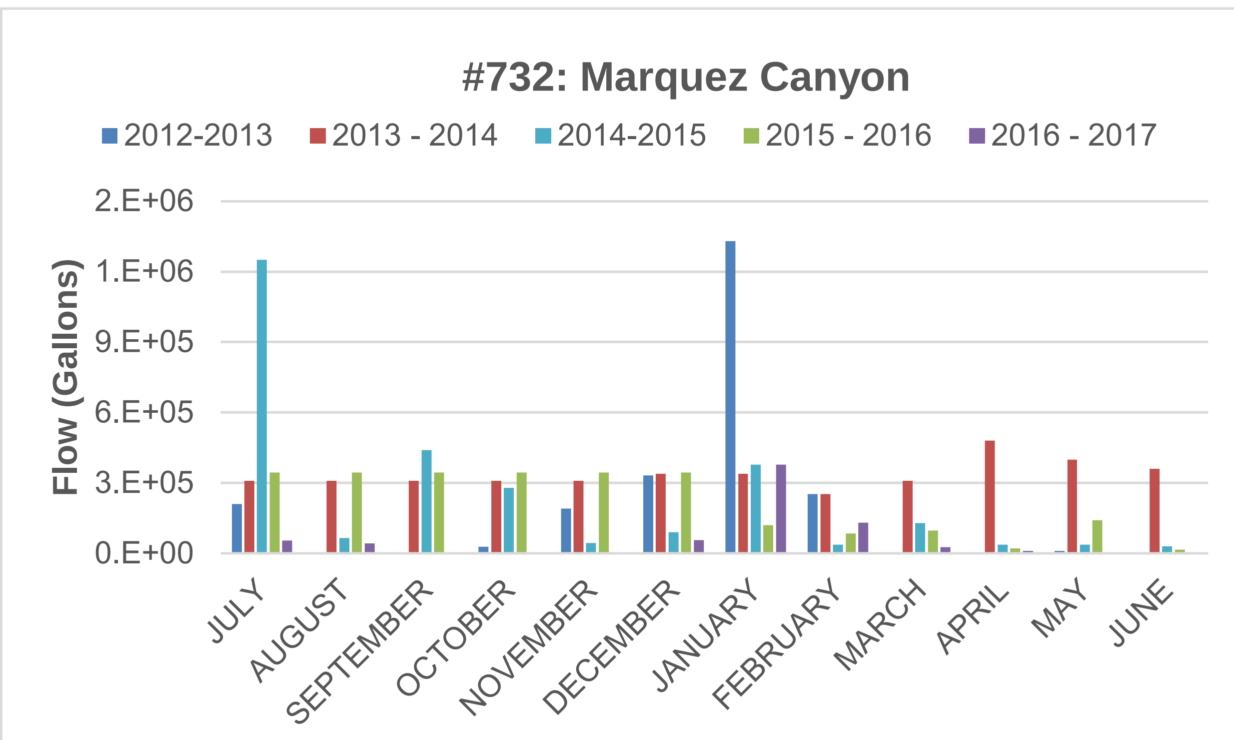

Figure A-11. Monthly Total Flow for the Marquez Canyon DWD (2012–2017)

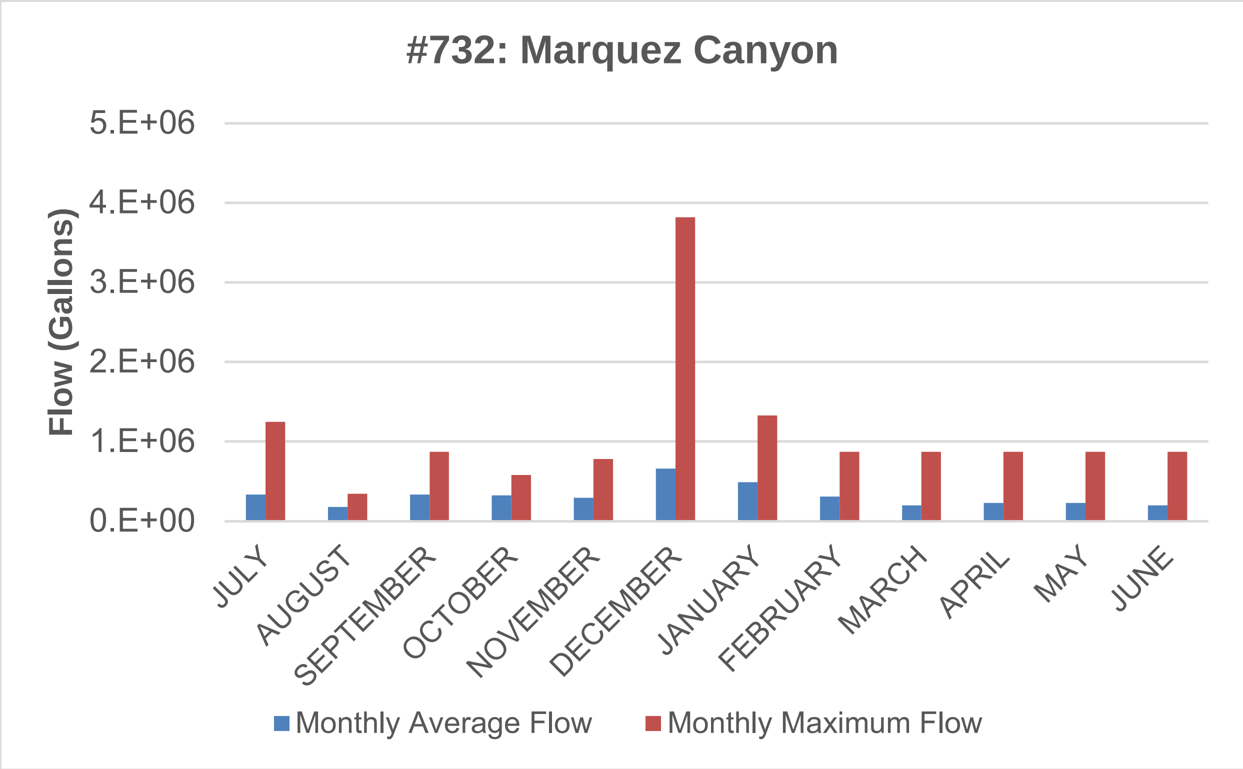

Figure A-12. Monthly Average Flow and Monthly Maximum Volume (in gallons) for each Month of the Marquez Canyon DWD (2008–2017)

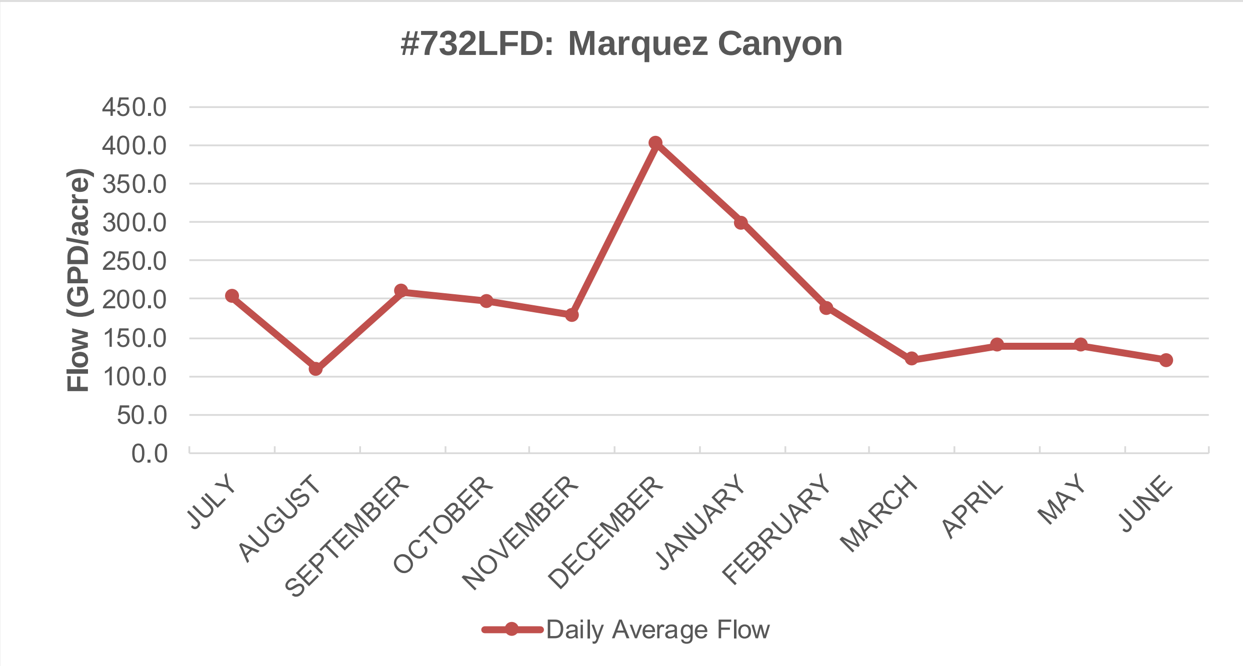

Figure A-13. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Marquez Canyon DWD (2008–2017)

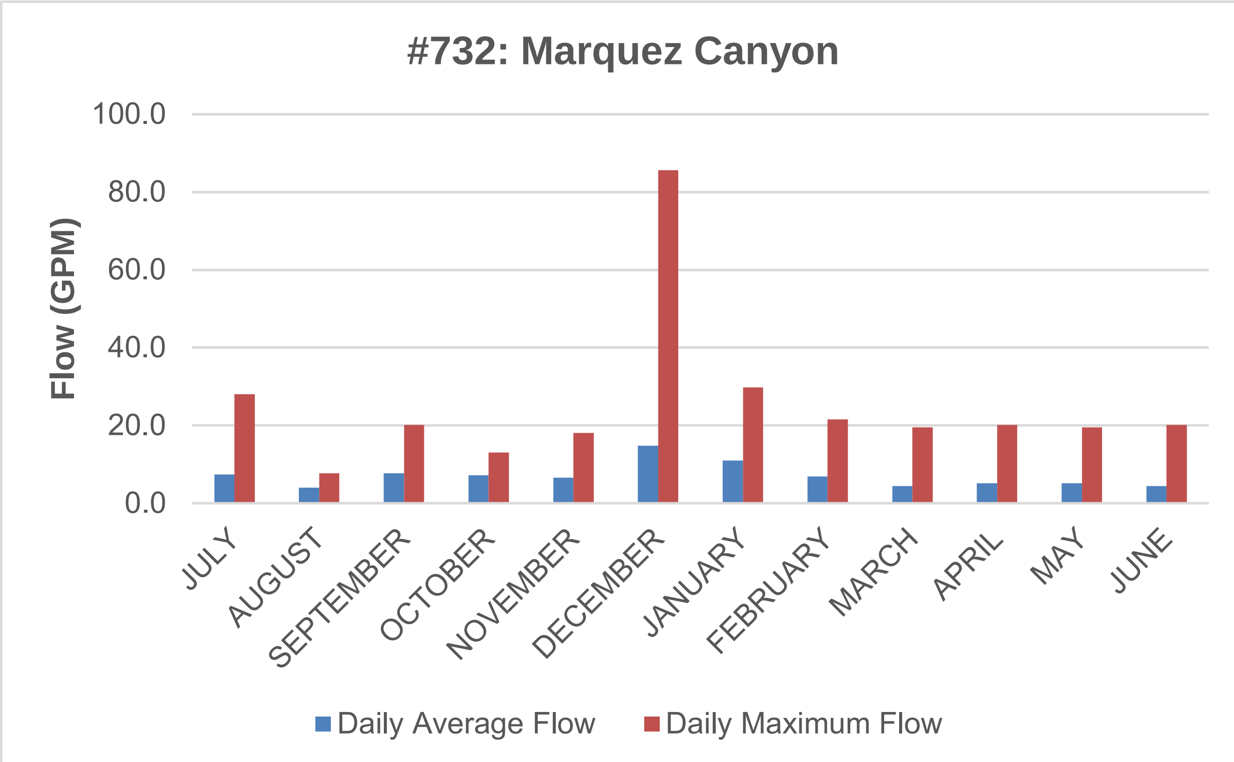

Figure A-14. Daily Average Flow and Daily Maximum Flow (in gpm) for each Month of the Marquez Canyon DWD (2008–2017)

A.4 #733: Santa Monica Canyon

Figures A-15 and A-16 present monthly total flow for the SMC DWD for the period between 2008 and 2016. Peak flows varied between 10 and 60 million gallons per month. Figure A-17 presents monthly average and monthly maximum flows between 2008 and 2016. Average flows in each month varied between 20 and 40 million gallons and peak flows varied between 20 and 60 million gallons.

Figure A-18 presents daily average flows per tributary area for the period from 2008 through 2016. Flow varied between 50 and 70 GPD/acre in the winter dry weather, whereas, it was between 65 and 90 GPD/acre in the summer dry period.

Figure A-19 presents daily average and daily maximum flows for each month for 2008 through 2016. Average flow varied between 350 and 700 gpm and peak flows varied between 60 and 1,400 gpm. Monthly maximum flow is about three times of monthly average flow.

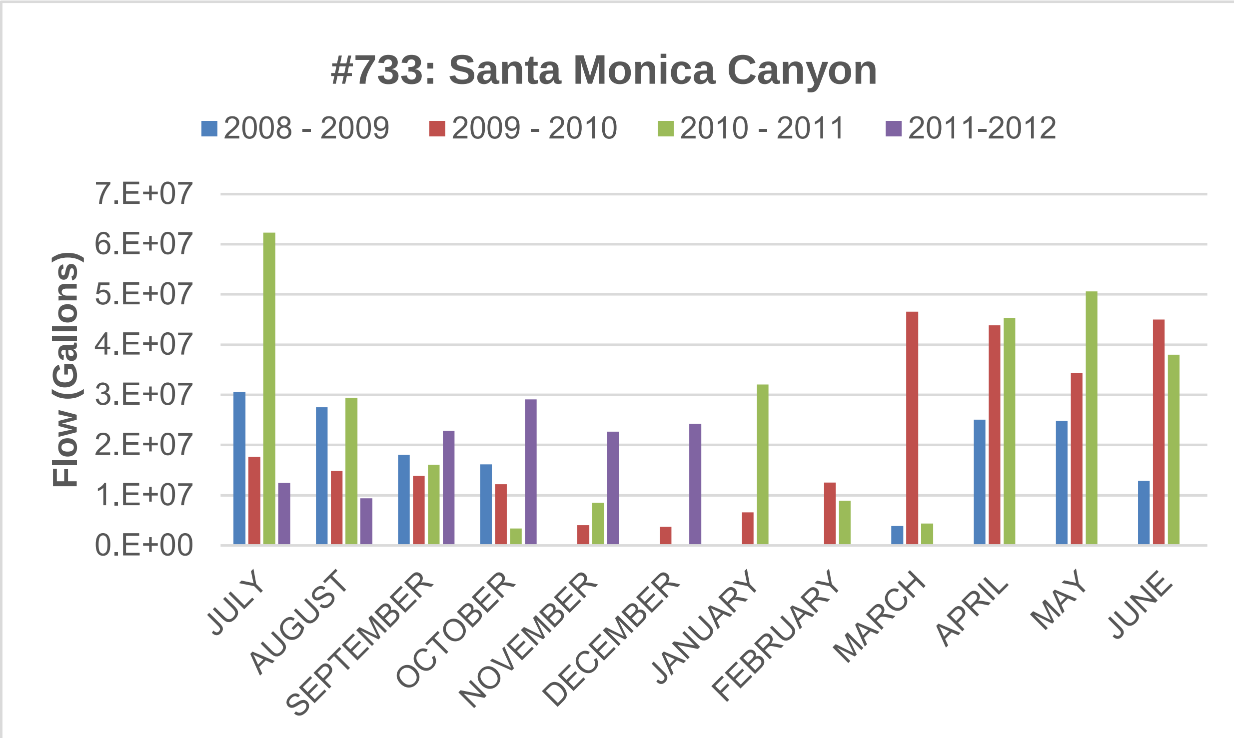

Figure A-15. Monthly Total Flow for the Santa Monica Canyon DWD (2008–2012)

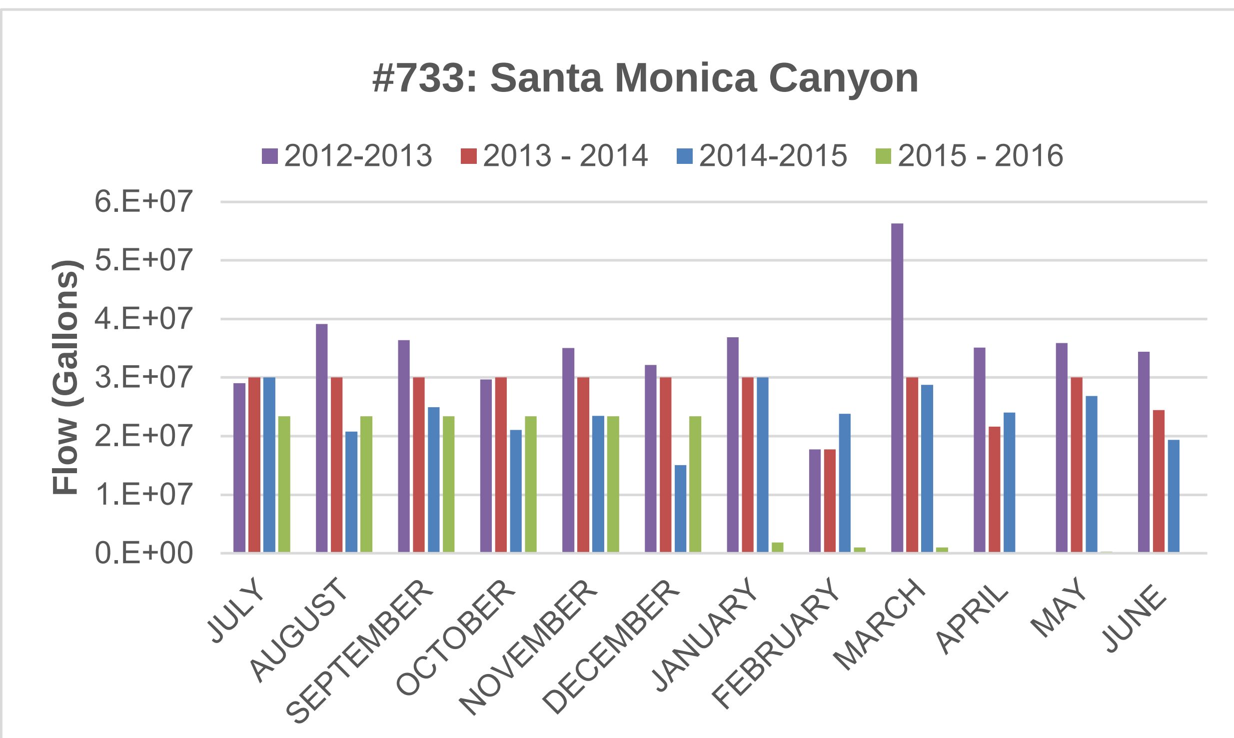

Figure A-16. Monthly Total Flow for the Santa Monica Canyon DWD (2012–2016)

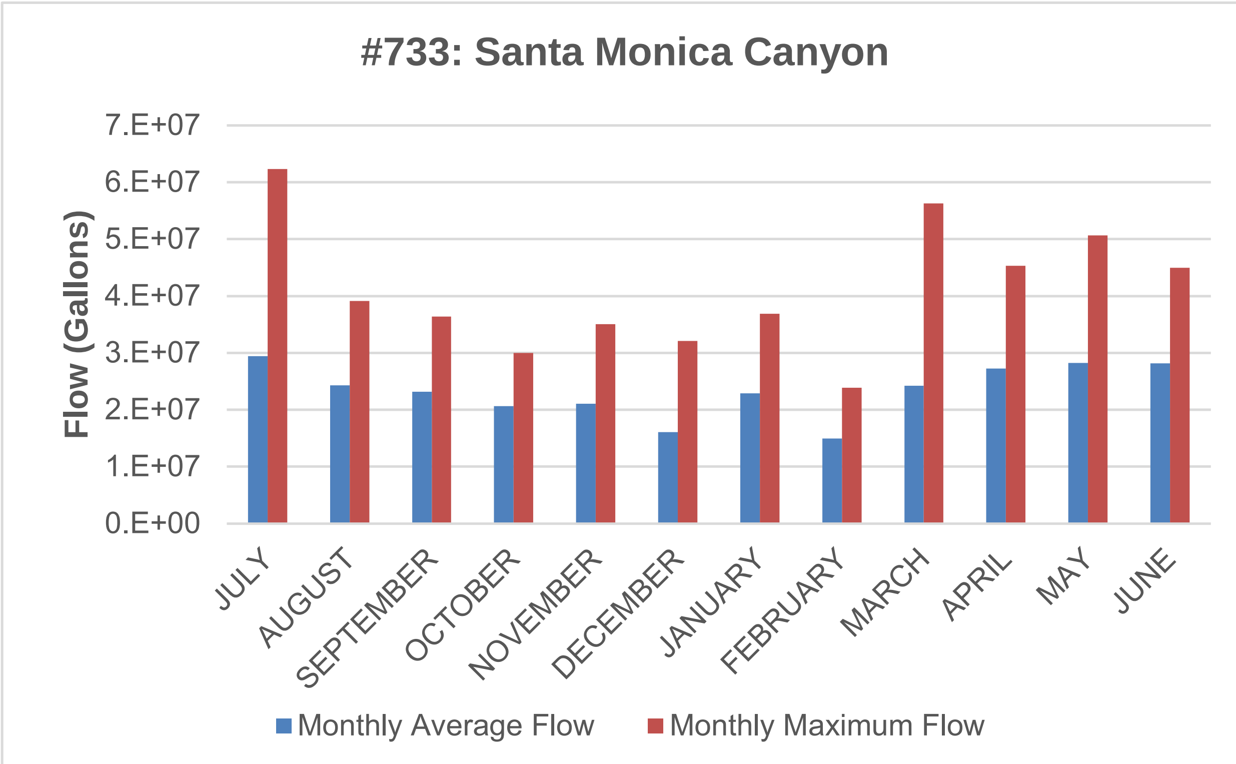

Figure A-17. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Santa Monica Canyon DWD (2008–2016)

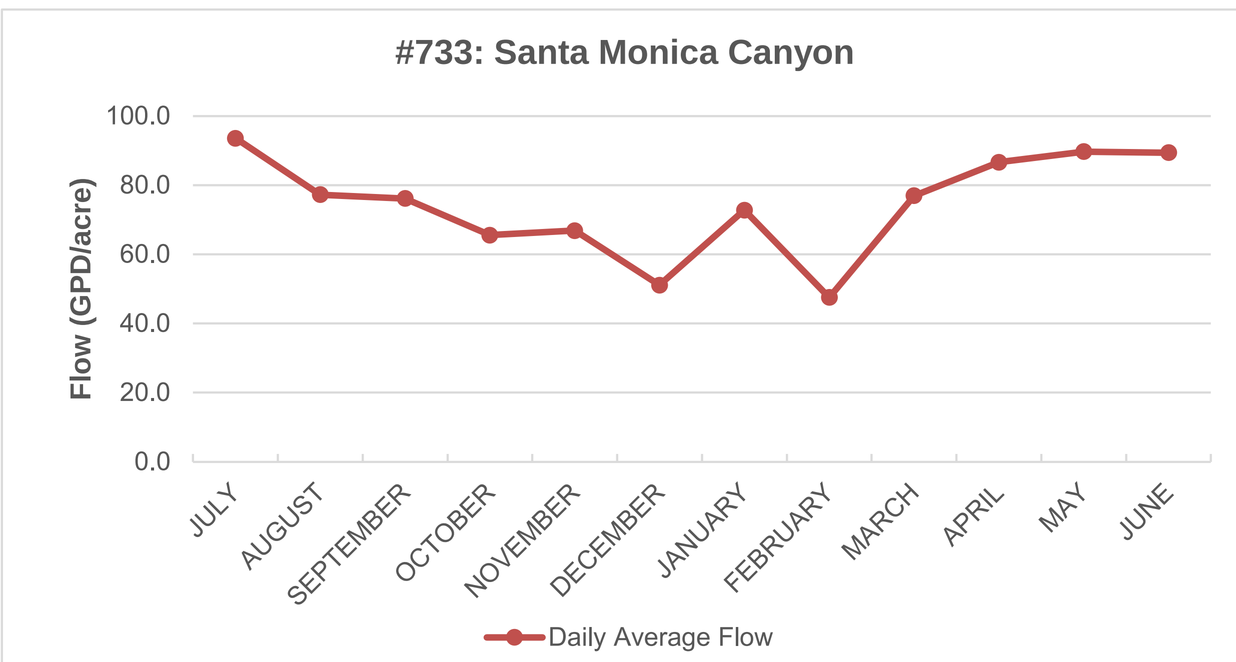

Figure A-18. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Santa Monica Canyon DWD (2008–2016)

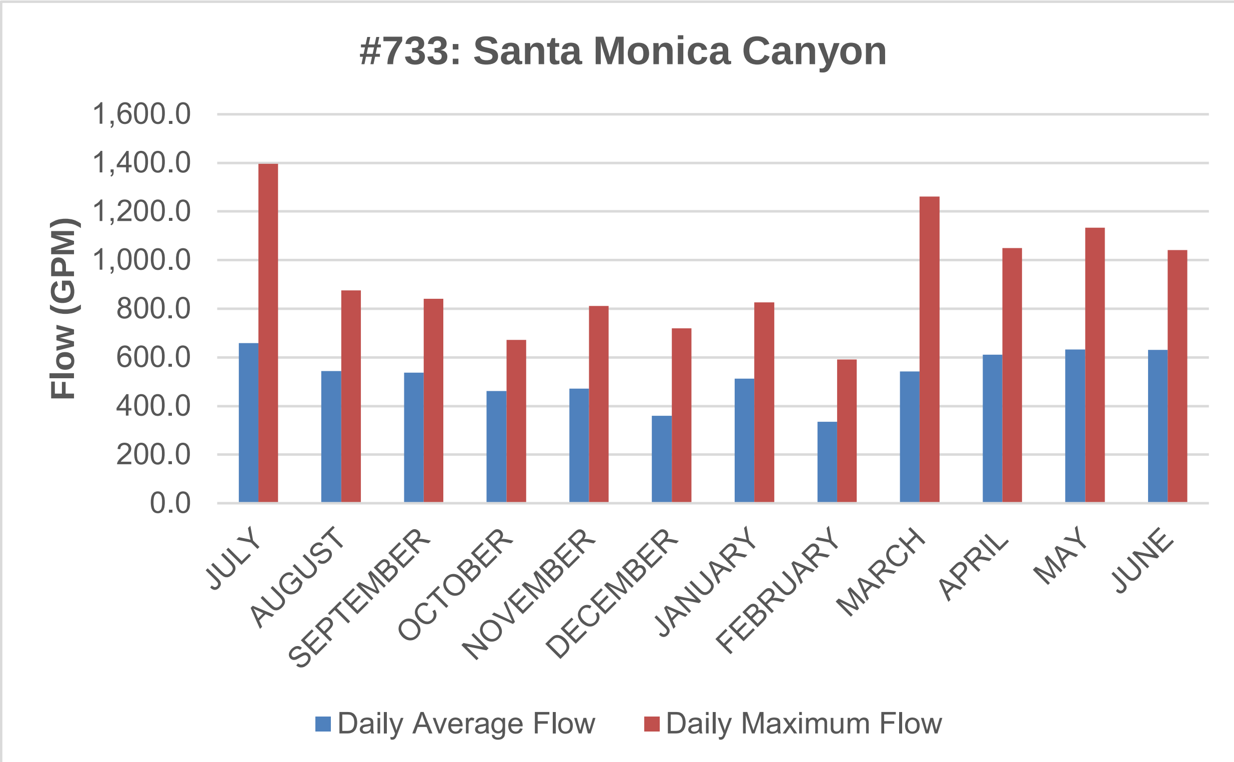

Figure A-19. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Santa Monica Canyon DWD (2008–2016)

A.5 #734: Temescal Canyon

Figures A-20 and A-21 present monthly total flow for the Temescal Canyon DWD for the period between 2008 and 2017. Peak flows varied between 1 and 55 million gallons per month. Figure A-22 presents monthly average and monthly maximum flows for 2008–2017. Average flows in each month varied between 1 and 10 million gallons.

Figure A-23 presents daily average flows per tributary area for the period from 2008 through 2017. Flow varied between 23 and 35 GPD/acre in the winter dry weather, whereas, it varied between 30 and 220 GPD/acre in the summer dry period.

Figure A-24 presents daily average and daily maximum flows for each month for the period between 2008 and 2017. Average flow varied between 25 and 250 gpm and peak flows varied between 90 and 1,260 gpm. Peak discharges recorded in September 2012–2013 and May 2009–2010.

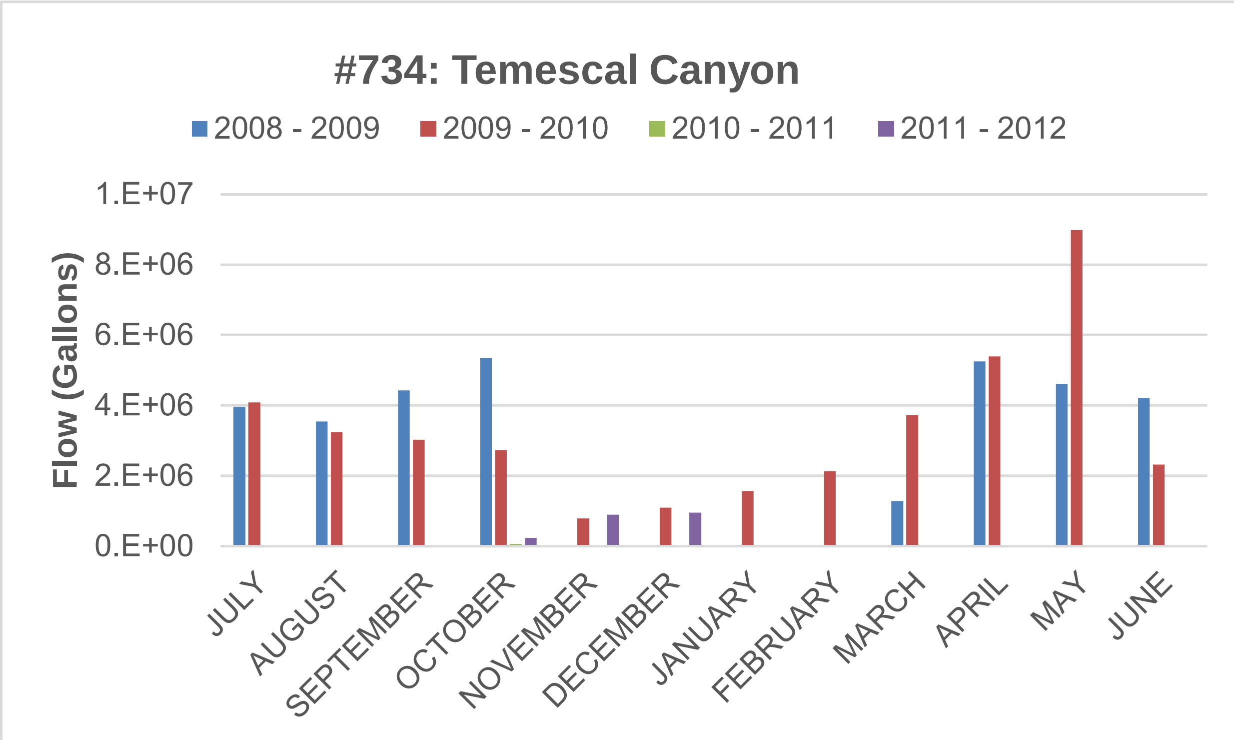

Figure A-20. Monthly Total Flow for the Temescal Canyon DWD (2008–2012)

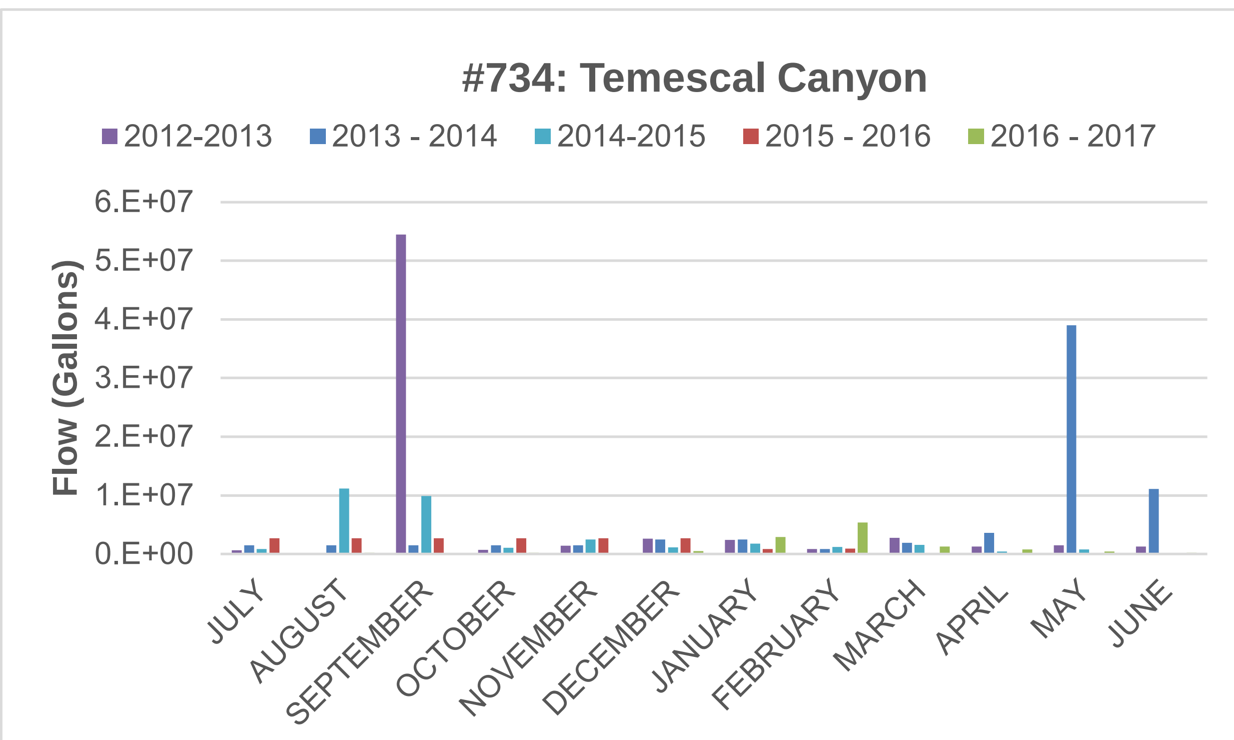

Figure A-21. Monthly Total Flow for the Temescal Canyon DWD (2012–2017)

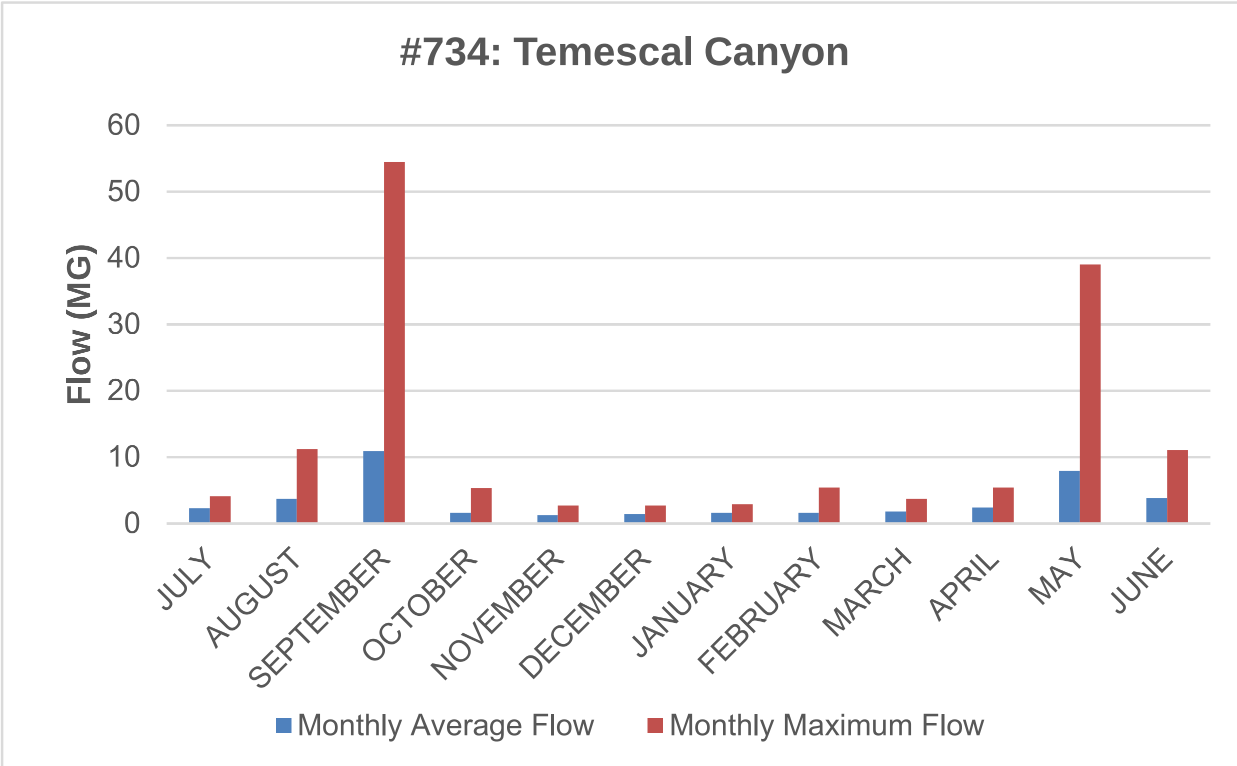

Figure A-22. Monthly Average Flow and Monthly Maximum Flow volume (in gallons) for each Month of the Temescal Canyon DWD (2008–2017)

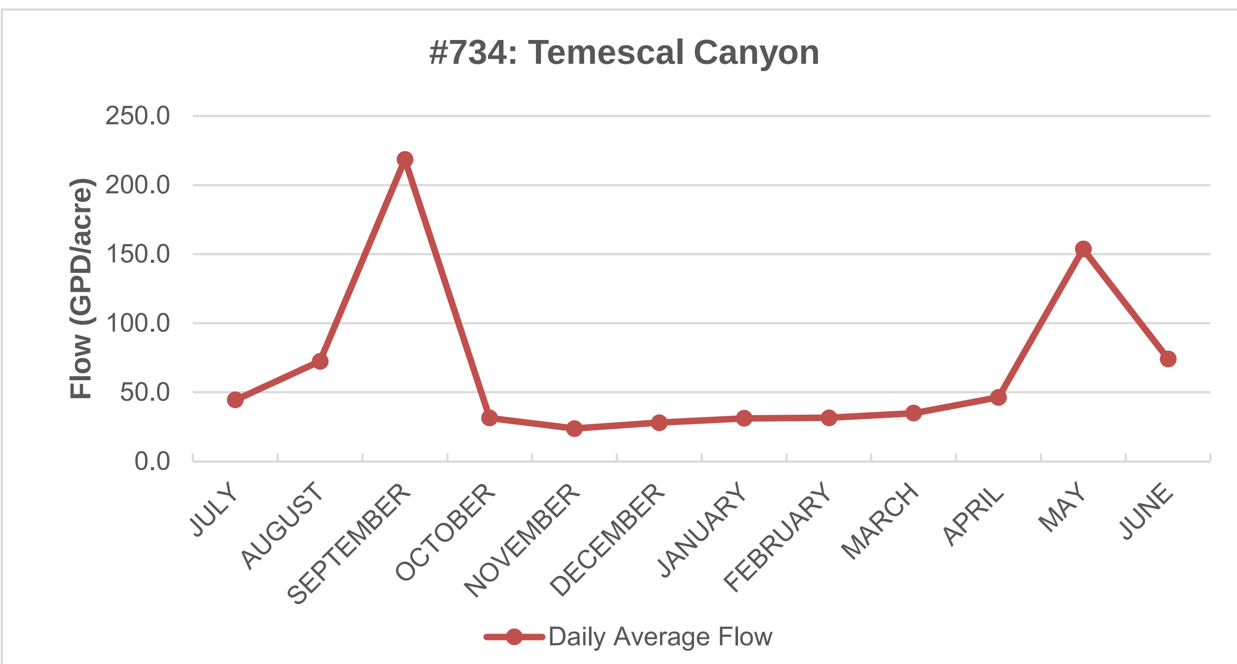

Figure A-23. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Temescal Canyon DWD (2008–2017)

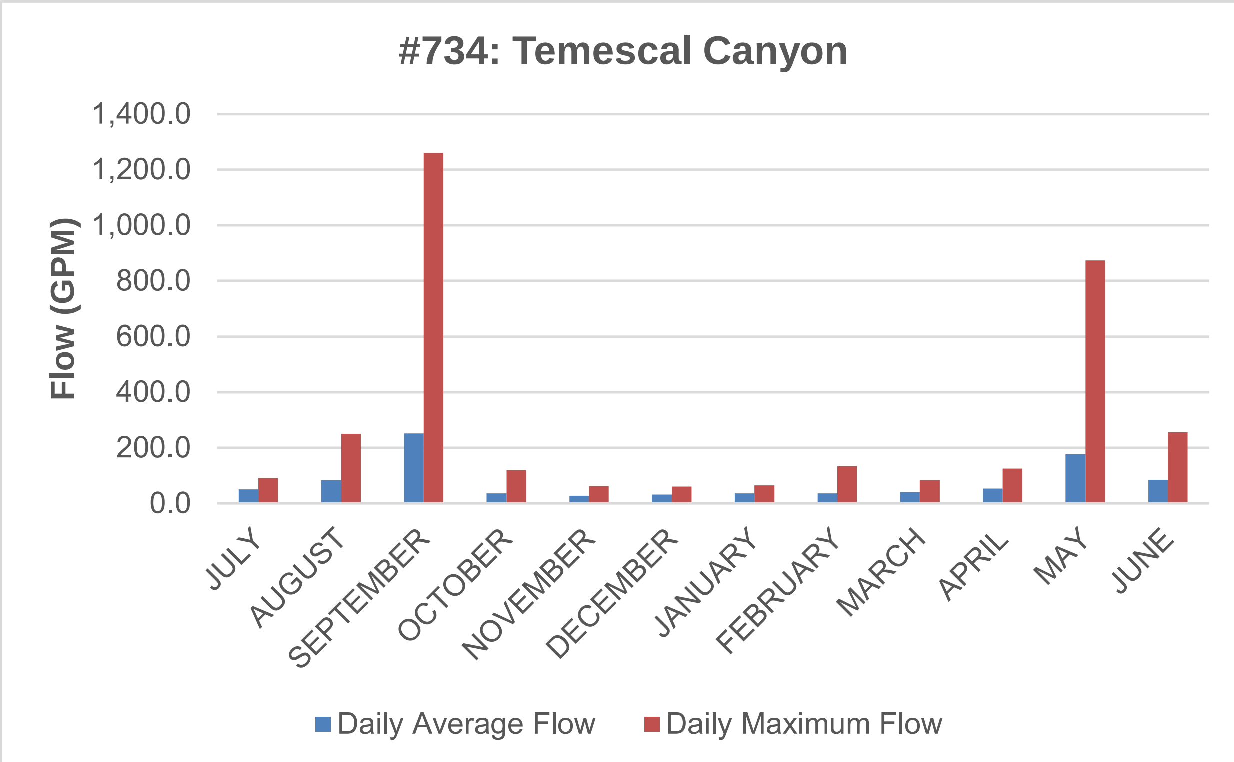

Figure A-24. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Temescal Canyon DWD (2008–2017)

A.6 #739: Bay Club

Figures A-25 and A-26 present monthly total flow for the Bay Club DWD for the period between 2008 and 2017. Peak flows occurred between August through December of 2011–2012 at about 3.5 million gallons per month. Figure A-27 presents monthly average and monthly maximum flows for 2008–2017. Average flows in each month varied between 290,000 and 550,000 gallons.

Figure A-28 presents daily average flows per tributary area for the period from 2008 through 2017. Flow varied between 154 and 200 GPD/acre in the winter dry weather, whereas, it varied between 100 and 200 GPD/acre in the summer dry period.

Figure A-29 presents daily average and daily maximum flows for each month between 2008 and 2017. Average flow varied between 6 and 13 gpm and peak flows varied between 40 and 80 gpm. Peak discharges were recorded in August through December of 2011–2012 and the peak flows varied between 9,000 and 18,000 GPD.

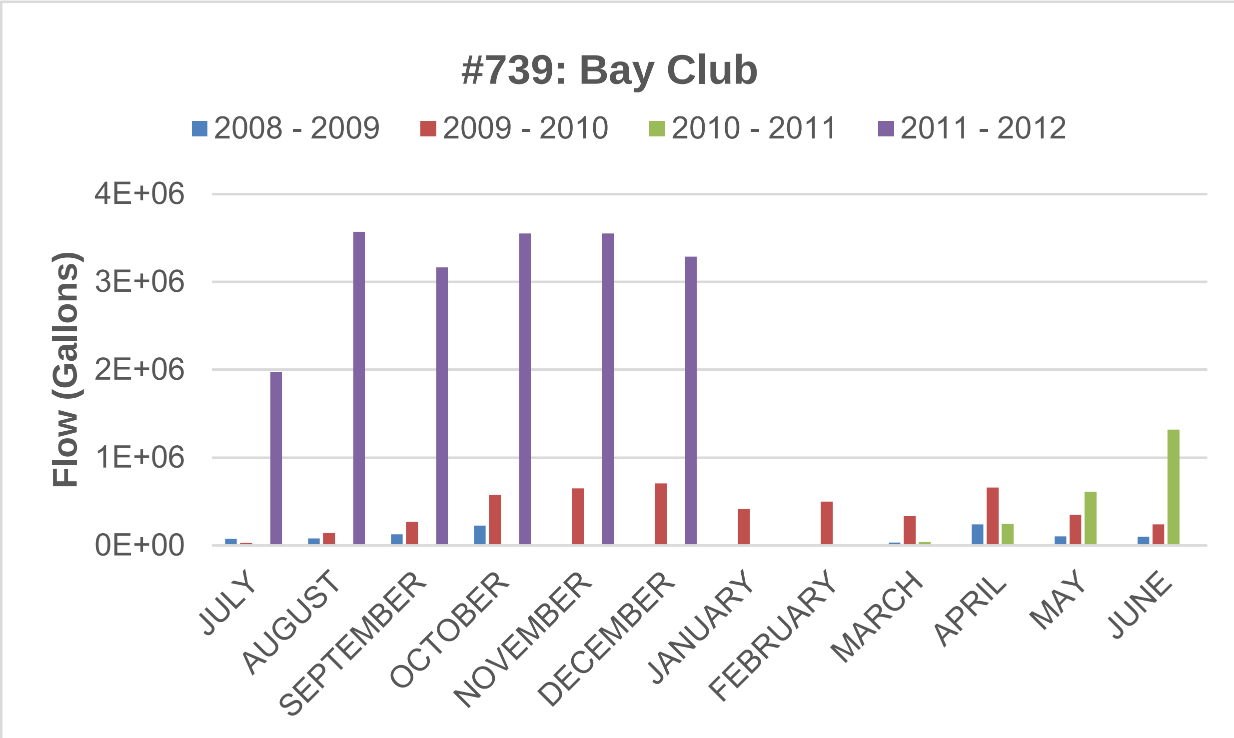

Figure A-25. Monthly Total Flow for the Bay Club DWD (2008–2012)

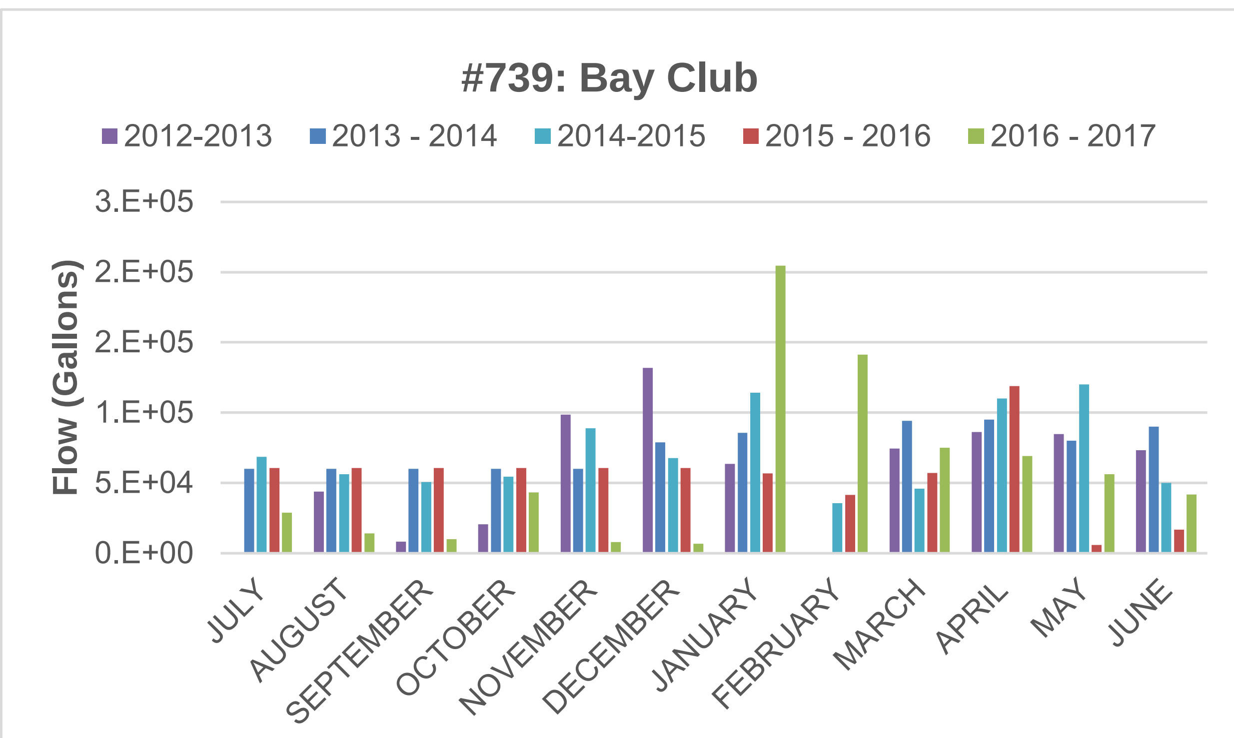

Figure A-26. Monthly Total Flow for the Bay Club DWD (2012–2017)

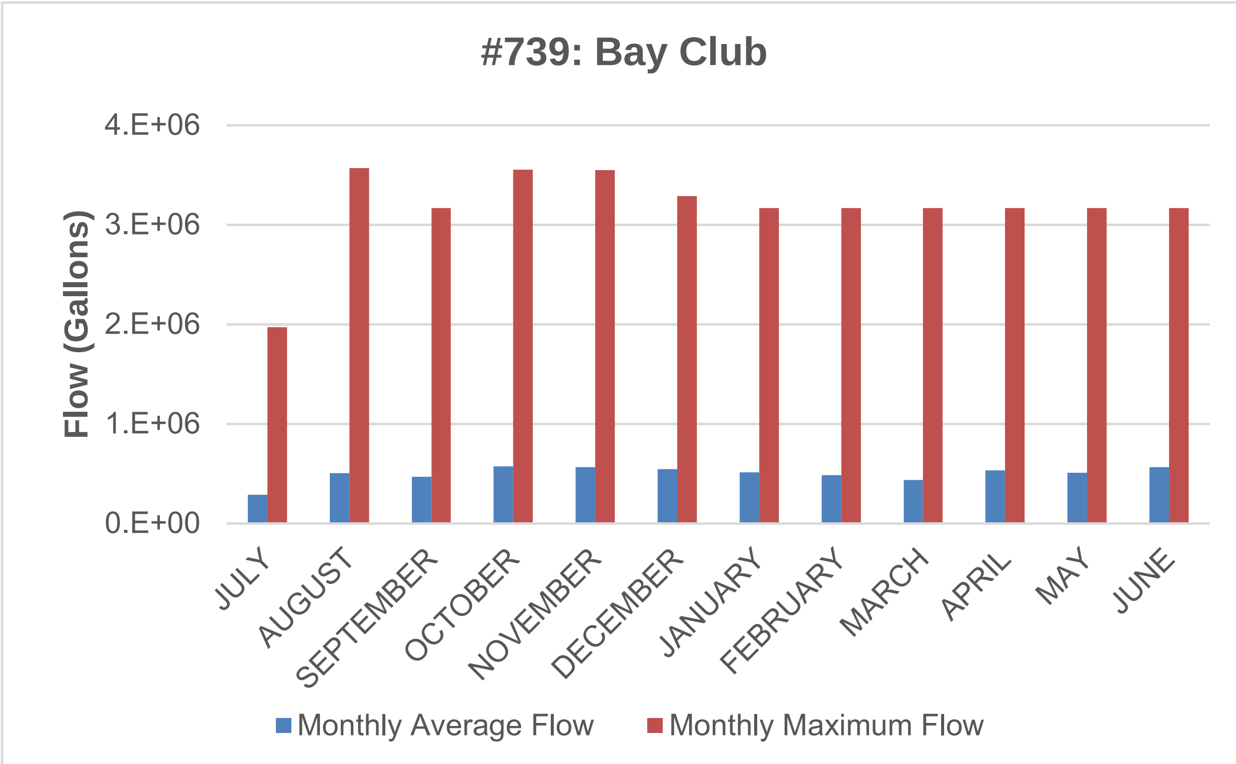

Figure A-27. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Bay Club DWD (2008–2017)

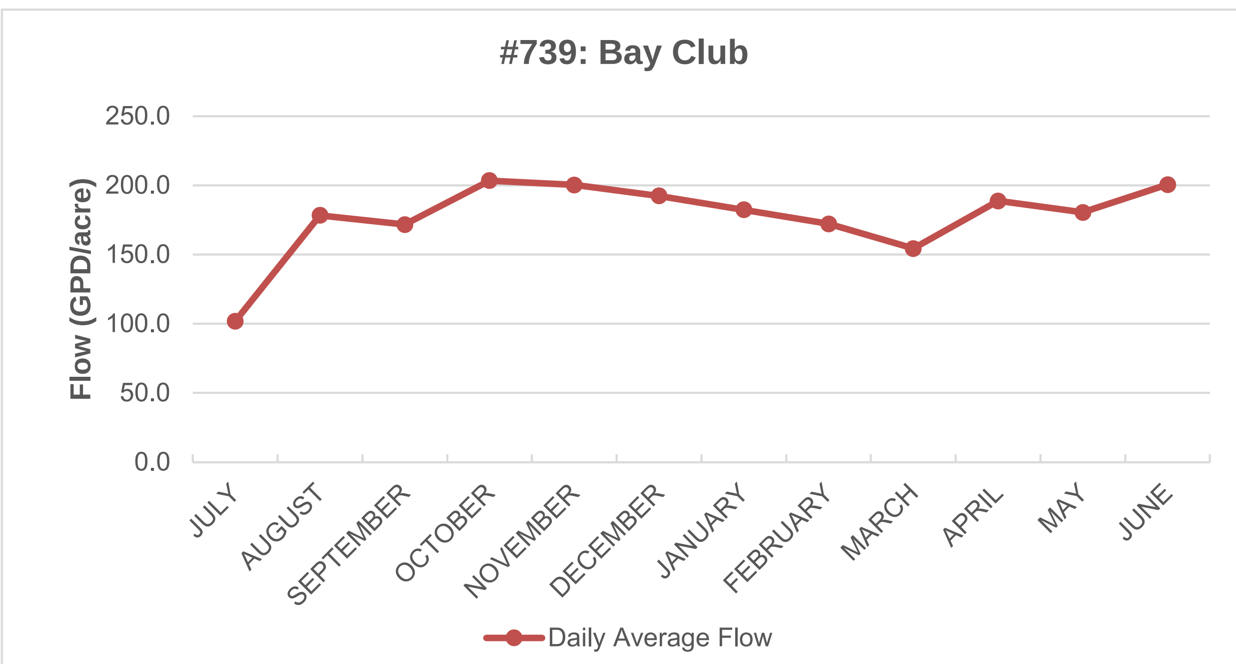

Figure A-28. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Bay Club DWD (2008–2017)

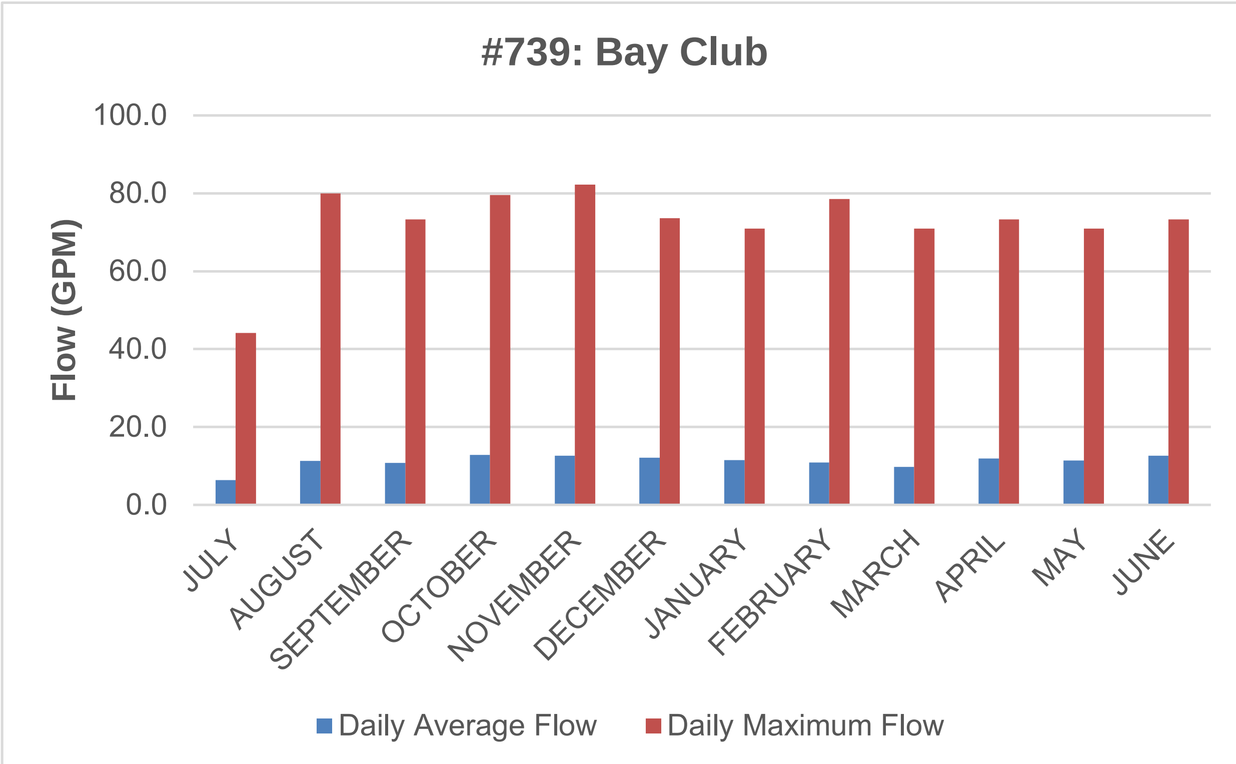

Figure A-29. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Bay Club DWD (2008–2017)

A.7 #747: Thornton Ave.

Figures A-30 and A-31 present monthly total flow for the Thornton Ave. DWD for the period between 2008 and 2017. Peak flows occurred in October 2009–2010 and 2012–2013 at about 2 and 4.7 million gallons per month, respectively. Figure A-32 presents monthly average and monthly maximum flows for 2008–2017. Average flows in each month varied between 130,000 and 1,100,000 gallons.

Figure A-33 presents daily average flows per tributary area for the period from 2008 through 2017. Flow varied between 12 and 52 GPD/acre in the winter dry weather, whereas, it varied between 13 and 105 GPD/acre in the summer dry period.

Figure A-34 presents daily average and daily maximum flows for each month for 2008–2017. Average flow varied between 6 and 24 gpm and the peak flows varied between 12 and 106 gpm.

The following can be observed from the analysis:

- Peak discharges were recorded in October of 2014–2015, and 2009–2010
- Flows were varied between 50 and 105 GPD/acre

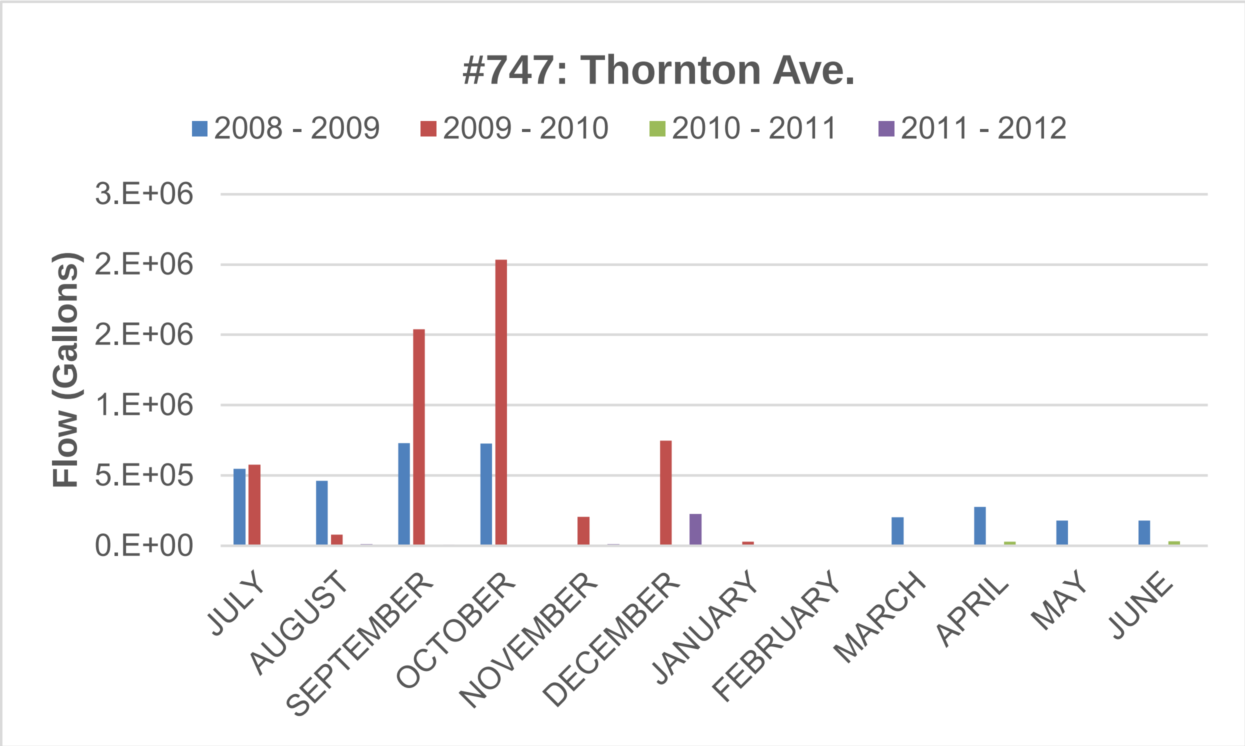

Figure A-30. Monthly Total Flow for the Thornton Ave. DWD (2008–2012)

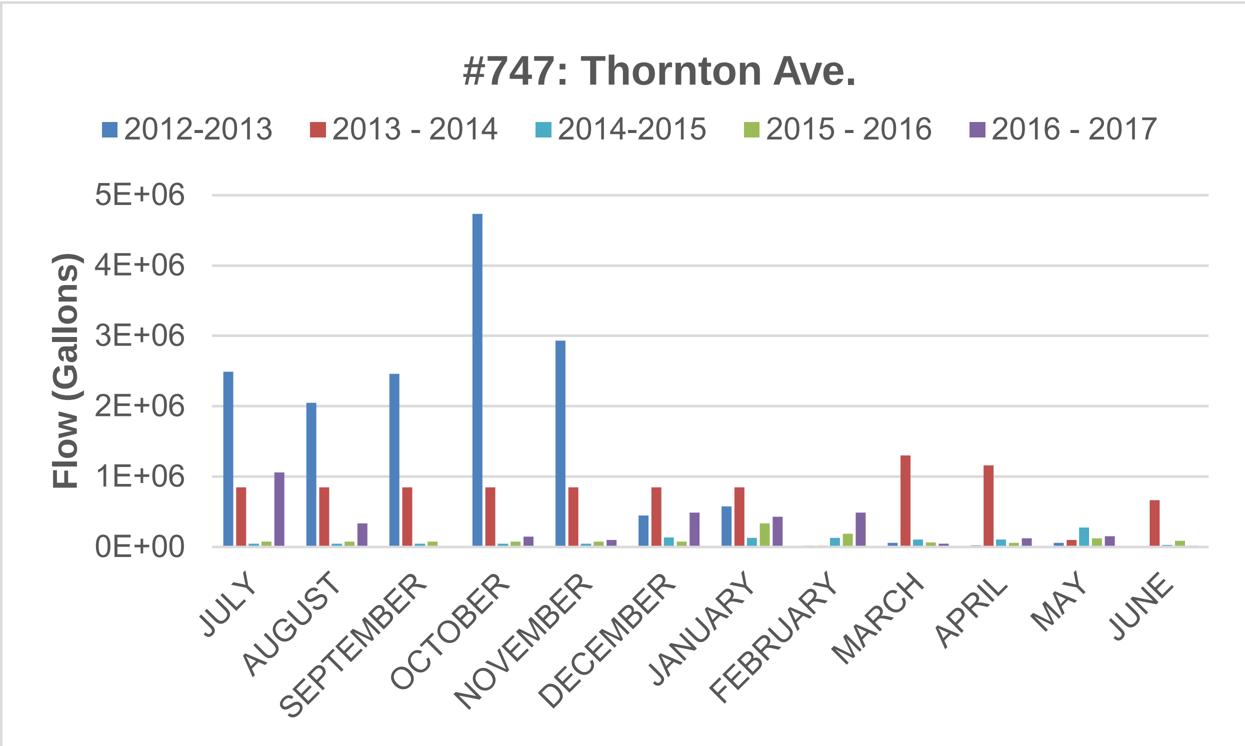

Figure A-31. Monthly Total Flow for the Thornton Ave. DWD (2012–2017)

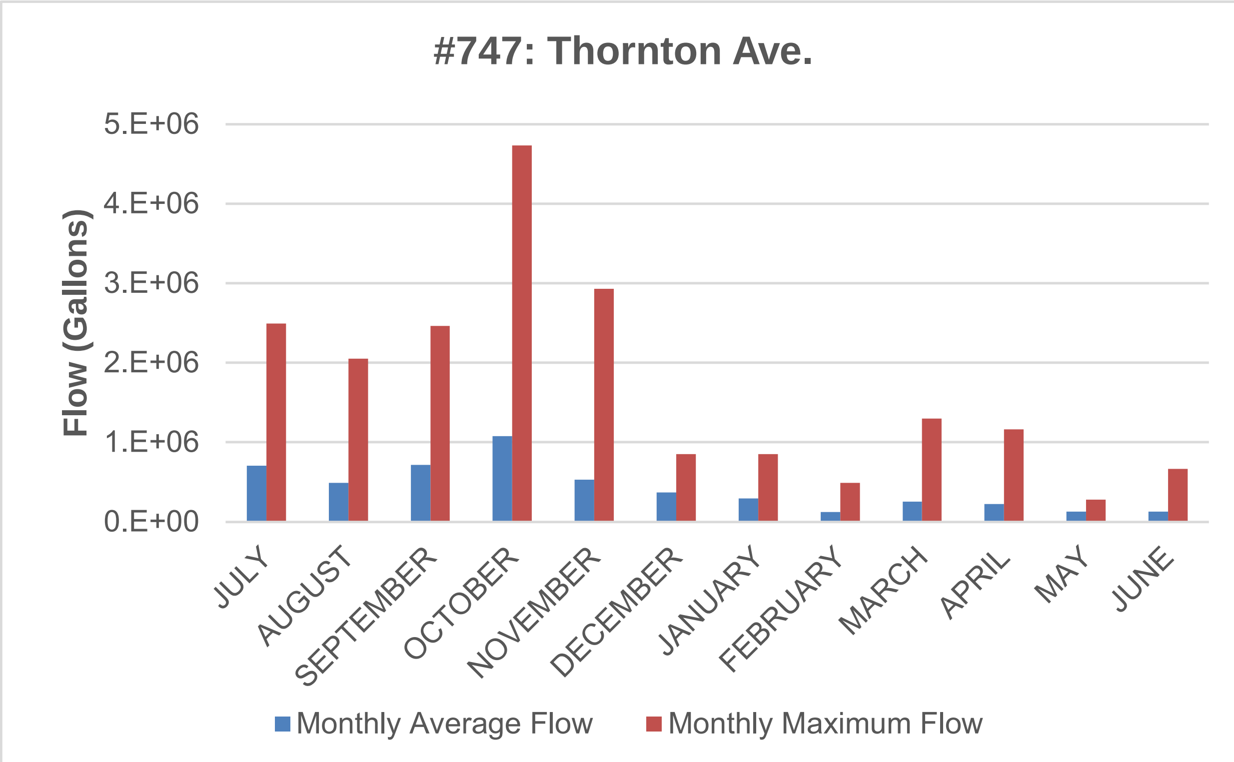

Figure A-32. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Thornton Ave. DWD (2008–2017)

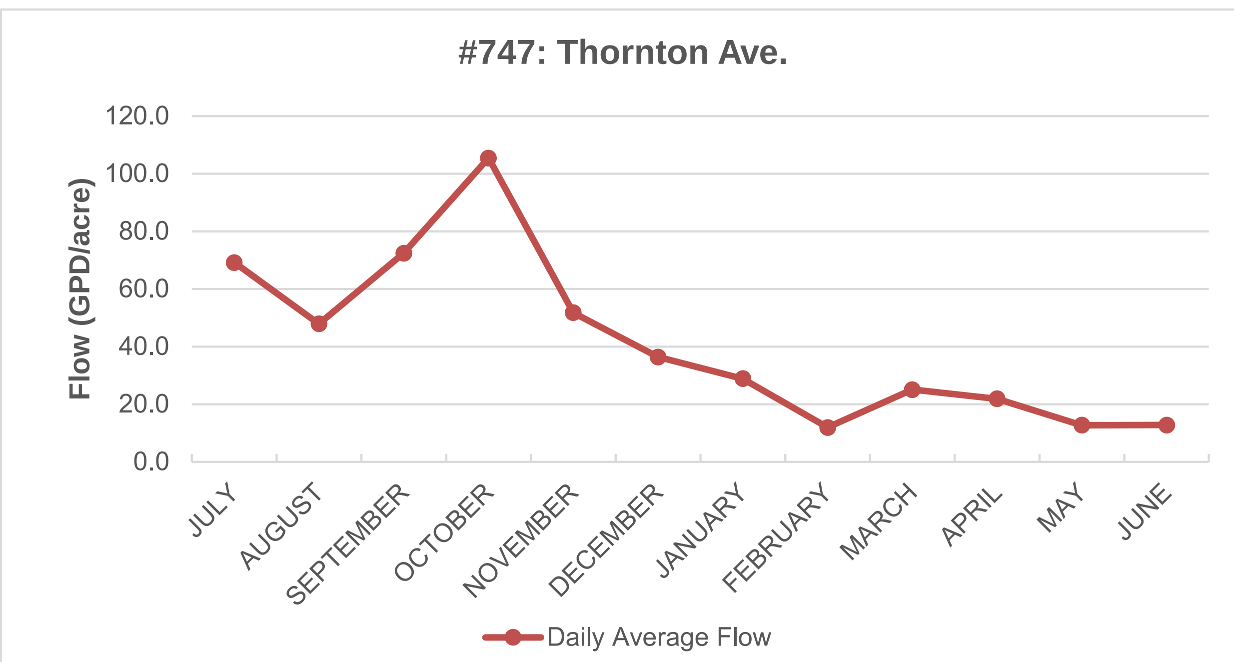

Figure A-33. Tributary-based Daily Average Flow and Daily Maximum Flow Volume (in GPD/acre) for each Month of the Thornton Ave. DWD (2008–2017)

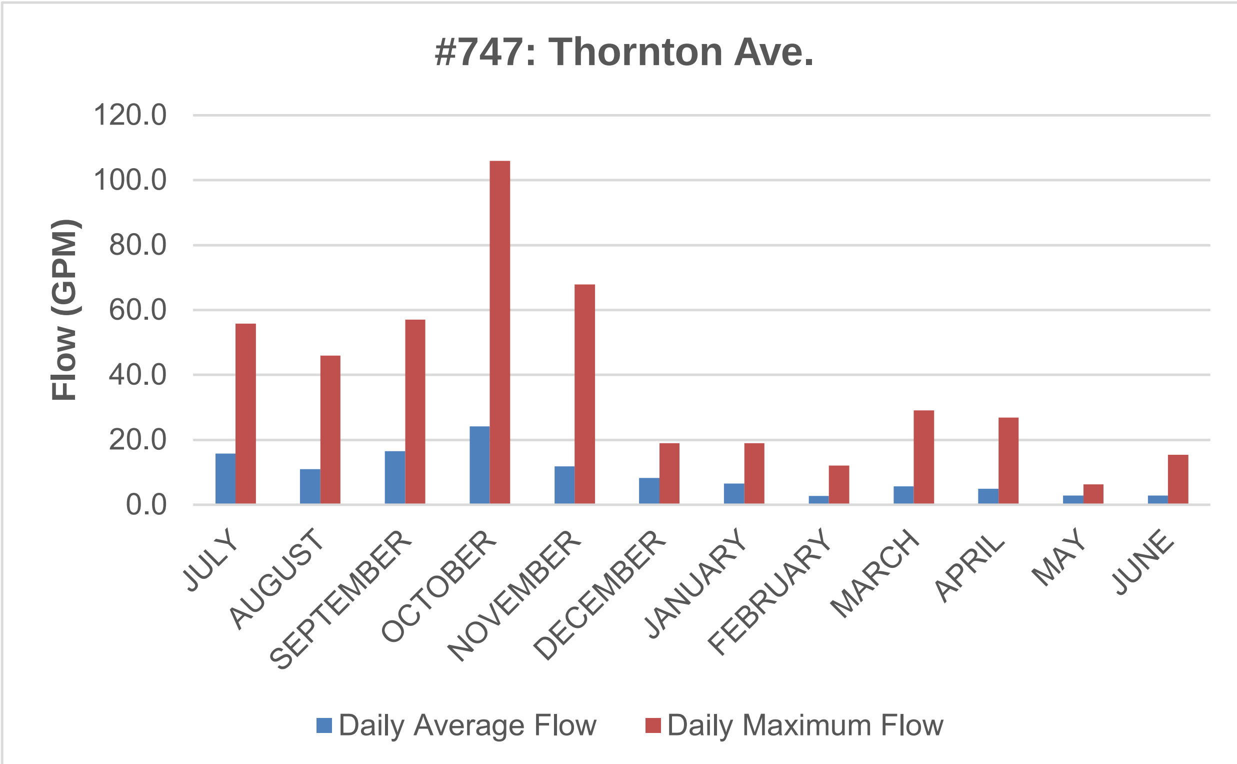

Figure A-34. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Thornton Ave. DWD (2008–2017)

A.8 #750: Imperial Hwy

Figures A-35 and A-36 present monthly total flow for the Imperial Hwy DWD for the period between 2008 and 2016. Peak flows varied between 400,000 and 12 million gallons per month. Figure A-37 presents monthly average and monthly maximum flows for 2008–2016. Average flows in each month ranged between 200 and 2.5 million gallons.

Figure A-38 presents daily average flows per tributary area for the period from 2008 through 2016. Flow was less than 1.0 GPD/acre in the winter dry weather, whereas, it varied between 2 and 41.5 GPD/acre in the summer dry period.

Figure A-39 presents daily average and daily maximum flows for each month for 2008–2016. Average flow varied between 5 and 55 gpm and peak flows varied between 10 and 260 gpm.

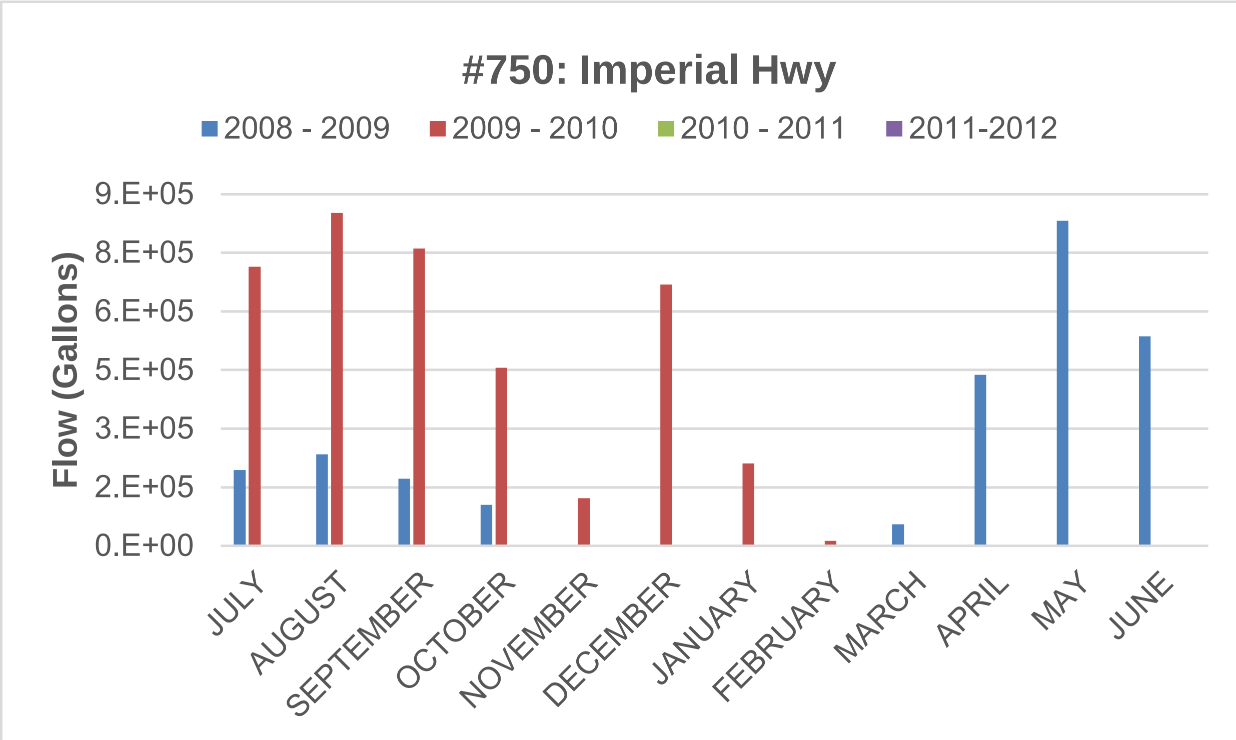

Figure A-35. Monthly Total Flow for the Imperial Hwy DWD (2008–2012)

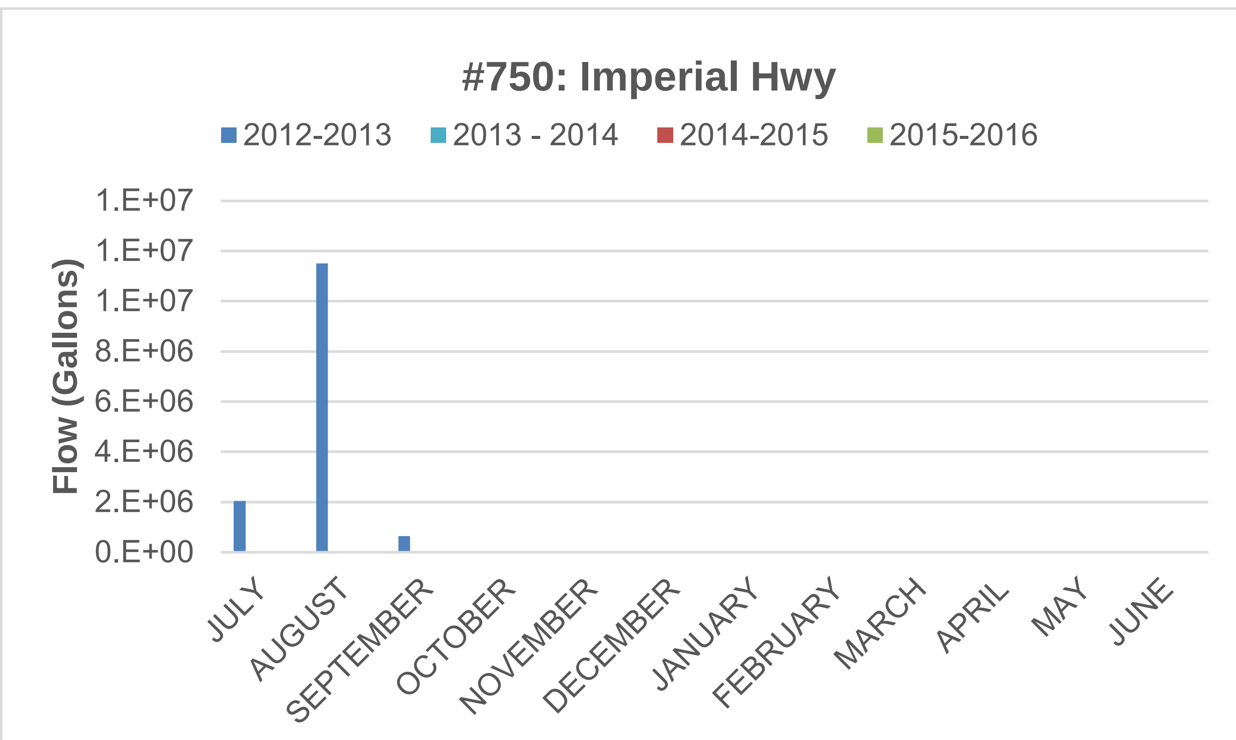

Figure A-36. Monthly Total Flow for the Imperial Hwy DWD (2012–2016)

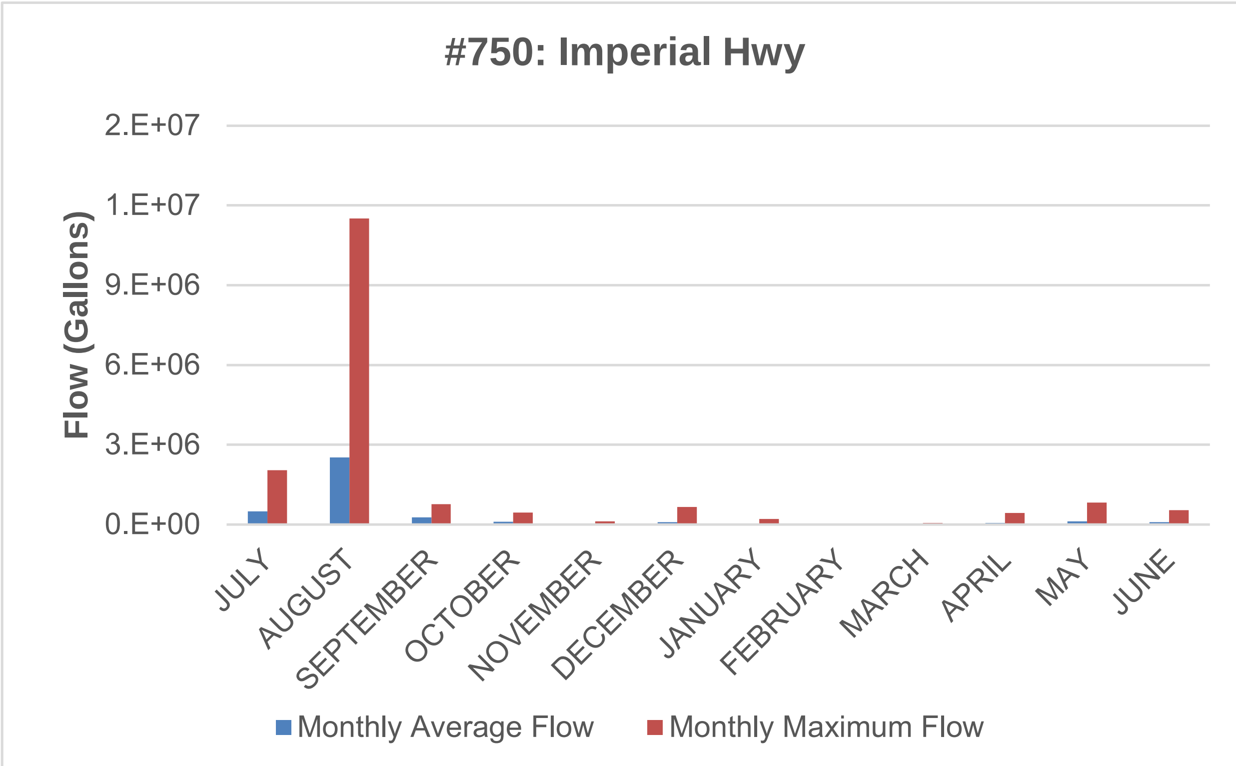

Figure A-37. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Imperial Hwy DWD (2008–2016)

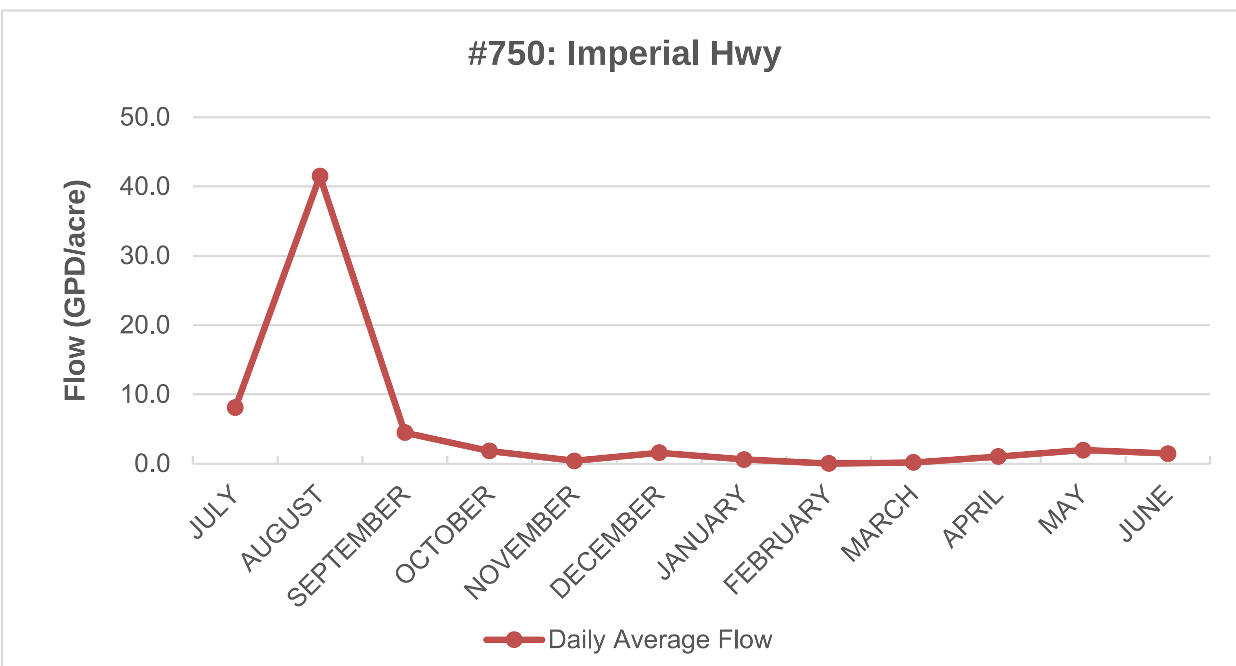

Figure A-38. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Imperial Hwy DWD (2008–2016)

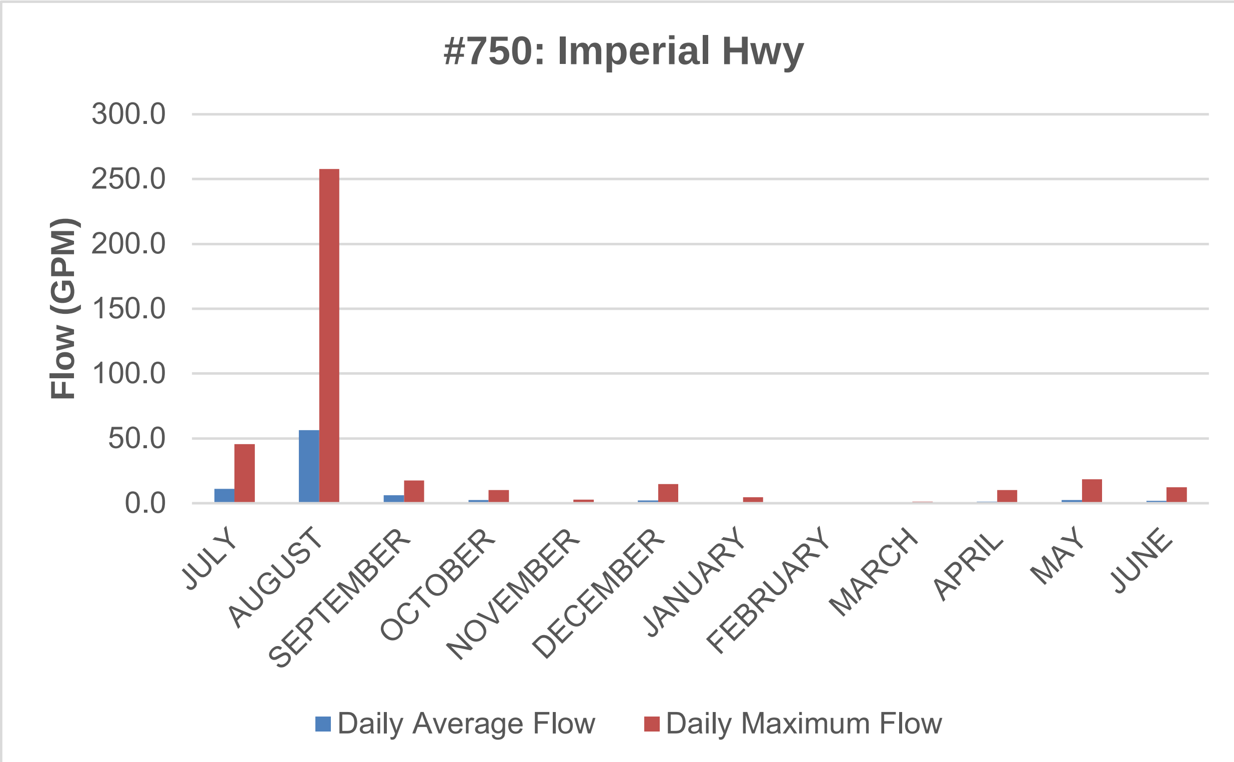

Figure A-39. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Imperial Hwy DWD (2008–2016)

A.9 #647: Venice Pavilion

Figures A-40 and A-41 present monthly total flow for the Venice Pavilion DWD for the period between 2008 and 2017. Peak flows varied between 600,000 and 2,820,000 gallons per month. Figure A-42 presents monthly average and monthly maximum flows for 2008–2017. Average flows in each month varied between 300,000 and 620,000 gallons.

Figure A-43 presents daily average flows per tributary area for the period from 2008 through 2017. Flow varied between 116 and 154 GPD/acre in the winter dry weather, whereas, it was between 80 and 160 GPD/acre in the summer dry period.

Figure A-44 presents daily average and daily maximum flows for each month for 2008–2017. Average flow varied between 10 and 15 gpm and peak flows varied between 12 and 70 gpm.

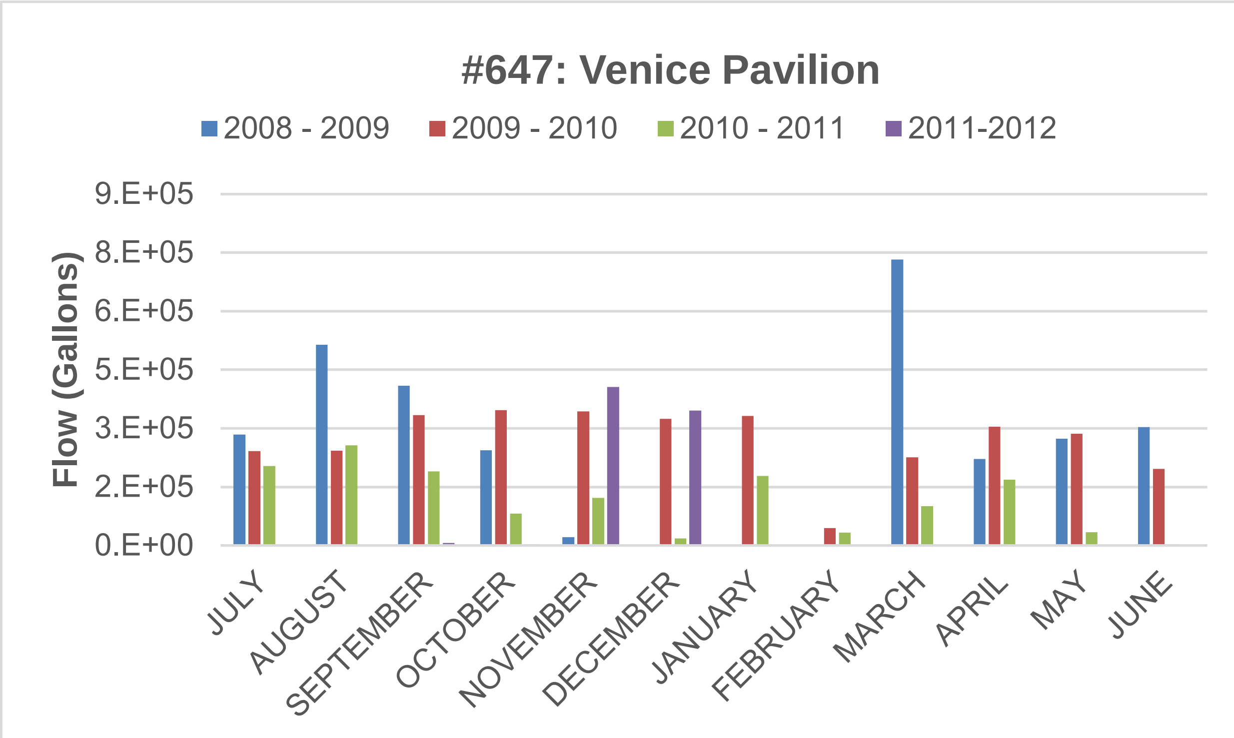

Figure A-40. Monthly Total Flow for the Venice Pavilion DWD (2008–2012)

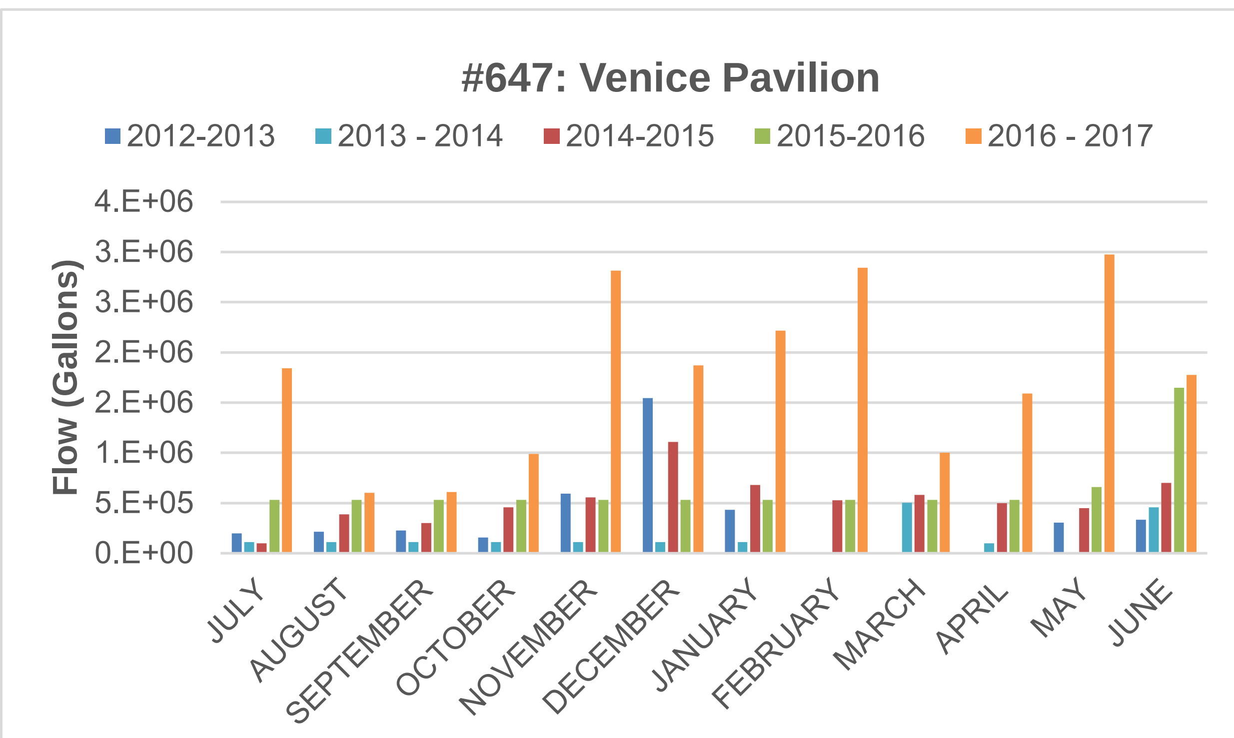

Figure A-41. Monthly Total Flow for the Venice Pavilion DWD (2012–2017)

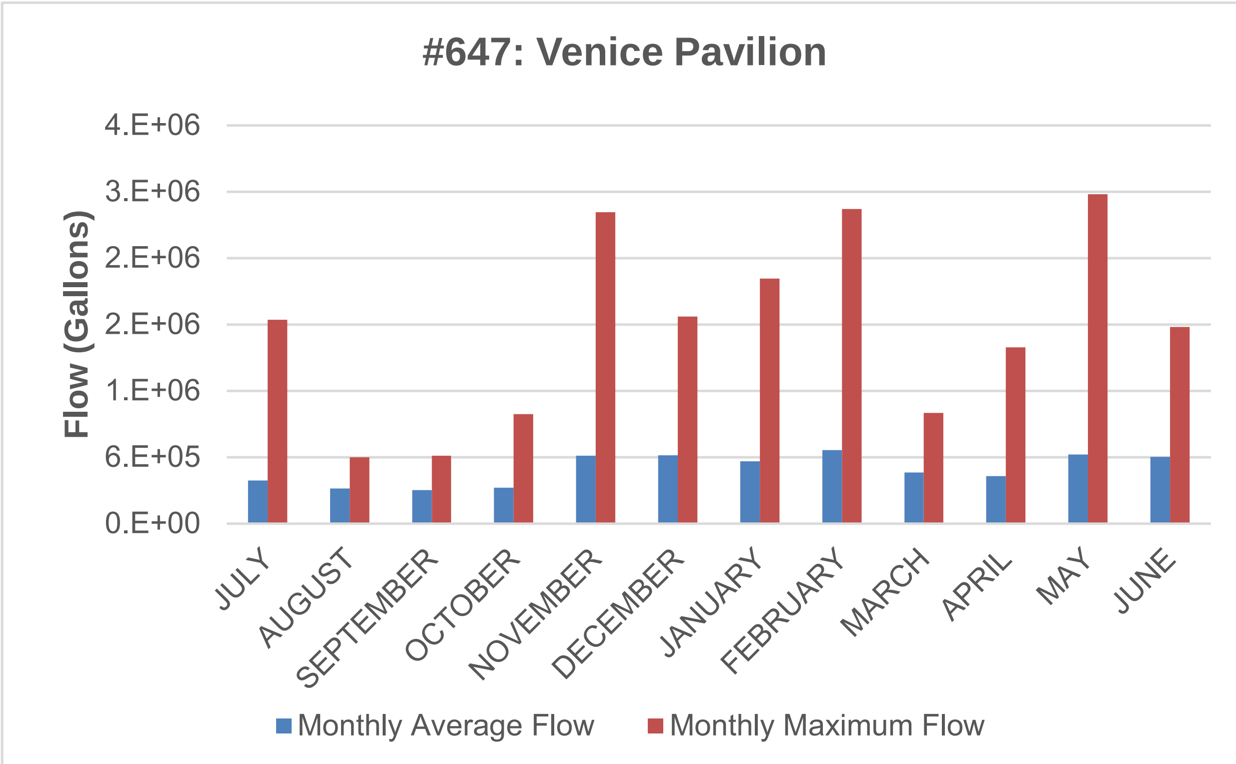

Figure A-42. Monthly Average Flow and Monthly Maximum Flow Volume (in gallons) for each Month of the Venice Pavilion DWD (2008–2017)

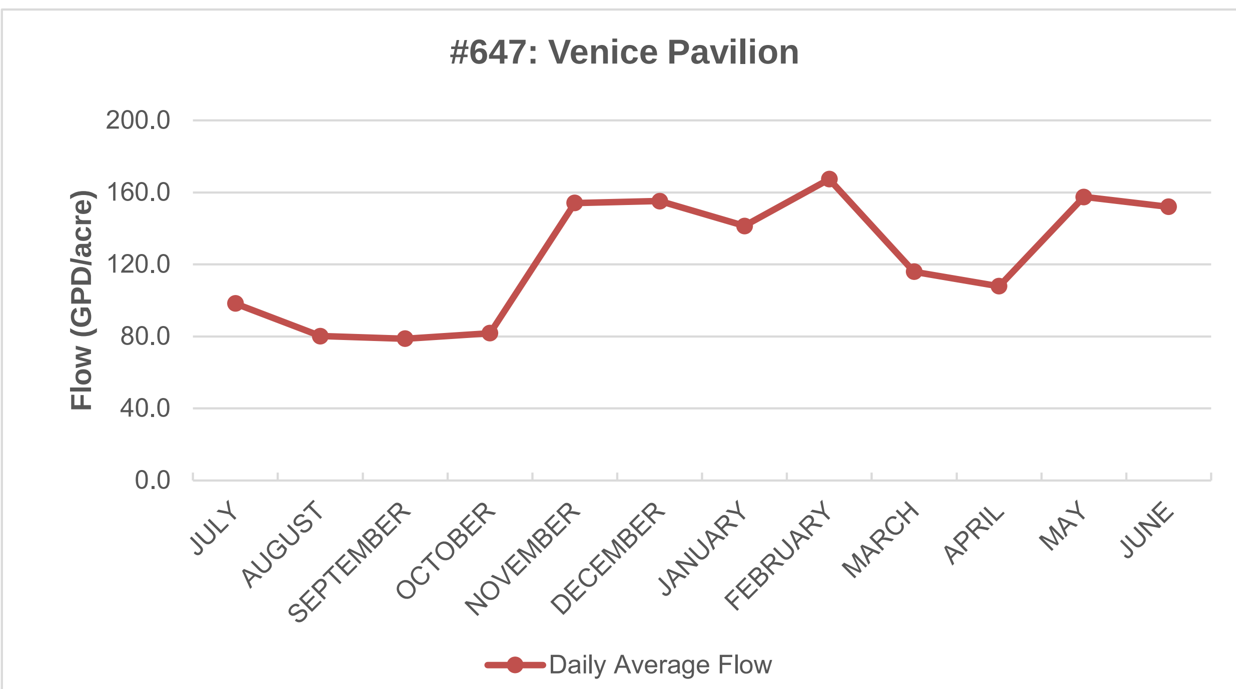

Figure A-43. Tributary-based Daily Average Flow Volume (in GPD/acre) for each Month of the Venice Pavilion DWD (2008–2017)

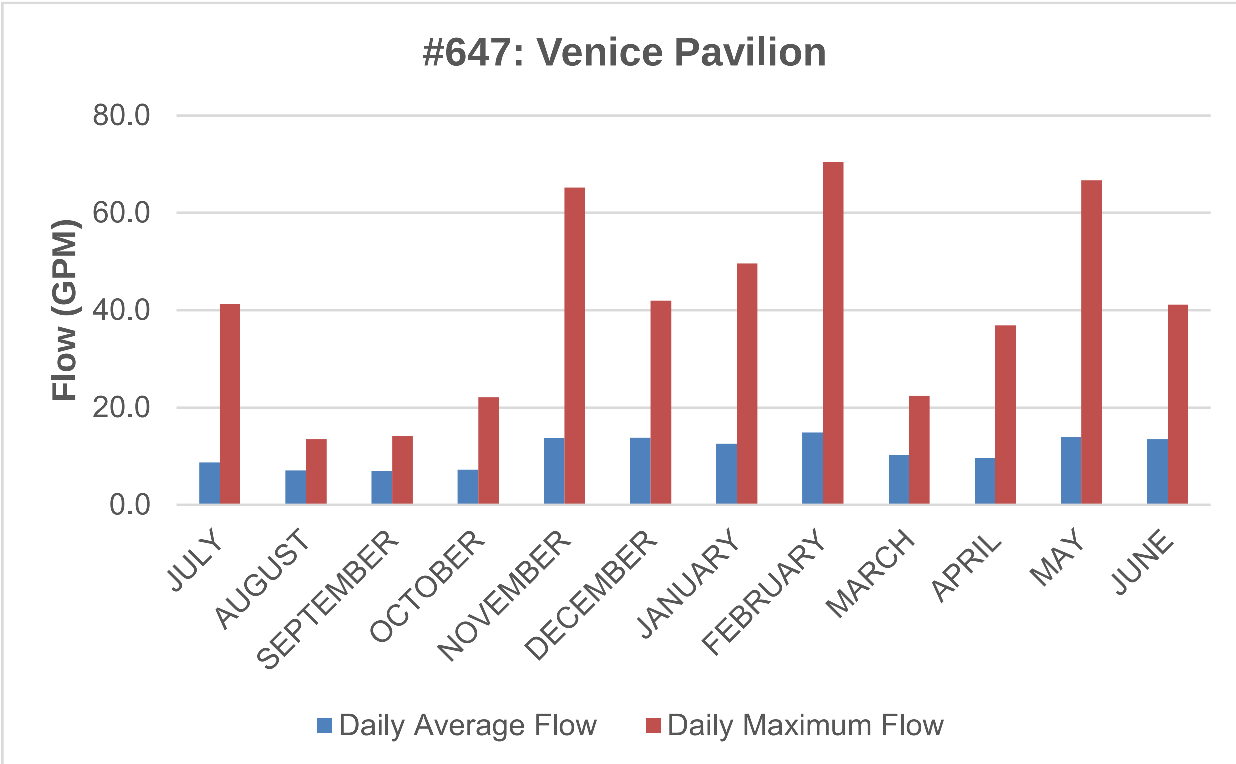

Figure A-44. Daily Average Flow and Daily Maximum Flow in gpm for each Month of the Venice Pavilion DWD (2008–2017)

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Appendix B
Flow Analysis of LACFCD-owned DWDs

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Appendix B. Flow Analysis of LACFCD-owned DWDs

B.1 Boone-Olive DWD

The Boone-Olive DWD project is integrated into a stormwater PP. It diverts urban runoff generated from a 70-acre tributary area and discharges into the Hyperion WRP via an 8-inch sewer line. The project system has approximately 105,000 gallons of storage and the discharge to the storm drain is controlled manually based on the intensity of the storm.

Figure B-1 presents the average daily total runoff by month for the Boone-Olive DWD from 2010 through 2019. Daily average flow rates are variable from year to year, with a declining trend in the last few years (that is, 2017–2019). Most of the peak flows were significantly less than the diversion capacity of 96 gpm, except in 2015.

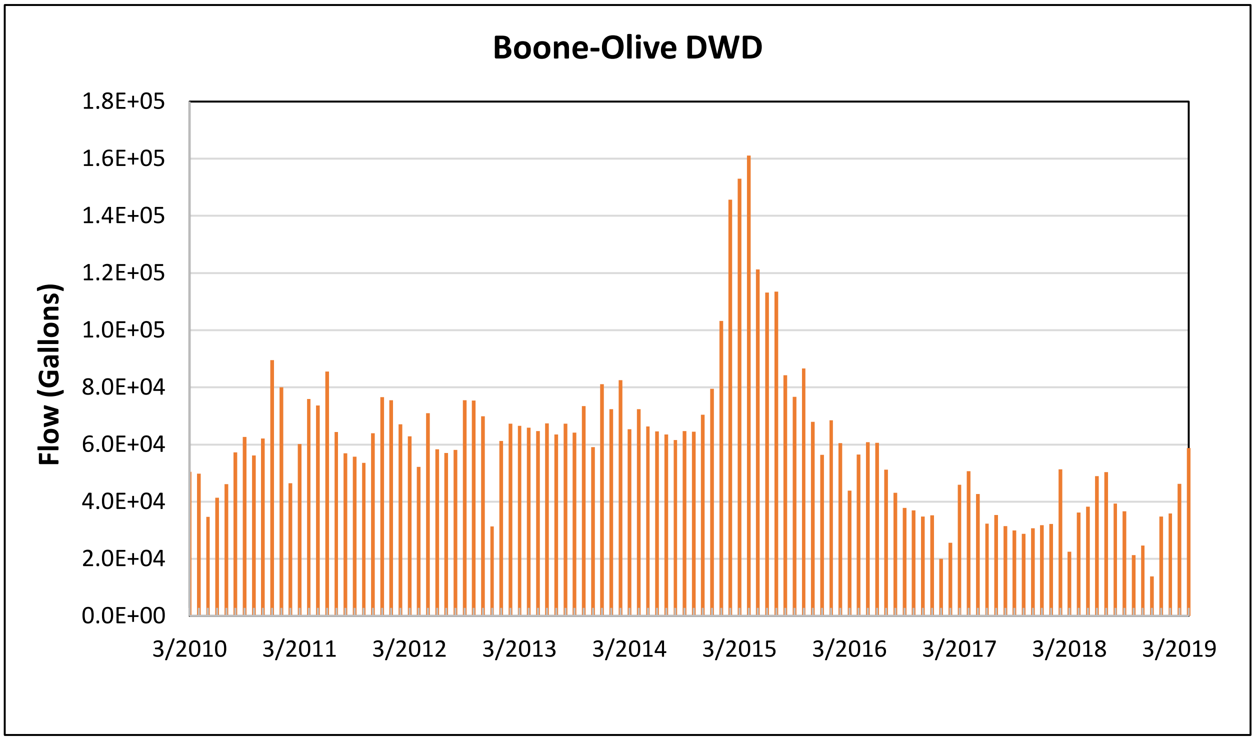

Figure B-1 Average Daily Flow Diverted to Sewer at the Boone-Olive DWD (2010–2019)

Figure B-2presents monthly average flows for the Boone-Olive DWD from 2010 through 2019. Maximum flows were recorded in February through April in 2015. In 2015, the average monthly flows from January through October were the highest among all the years. The peak monthly average flow varied between 15 and 115 gpm. Tributary area-based average flow varied between 760 and 970 GPD/acre.

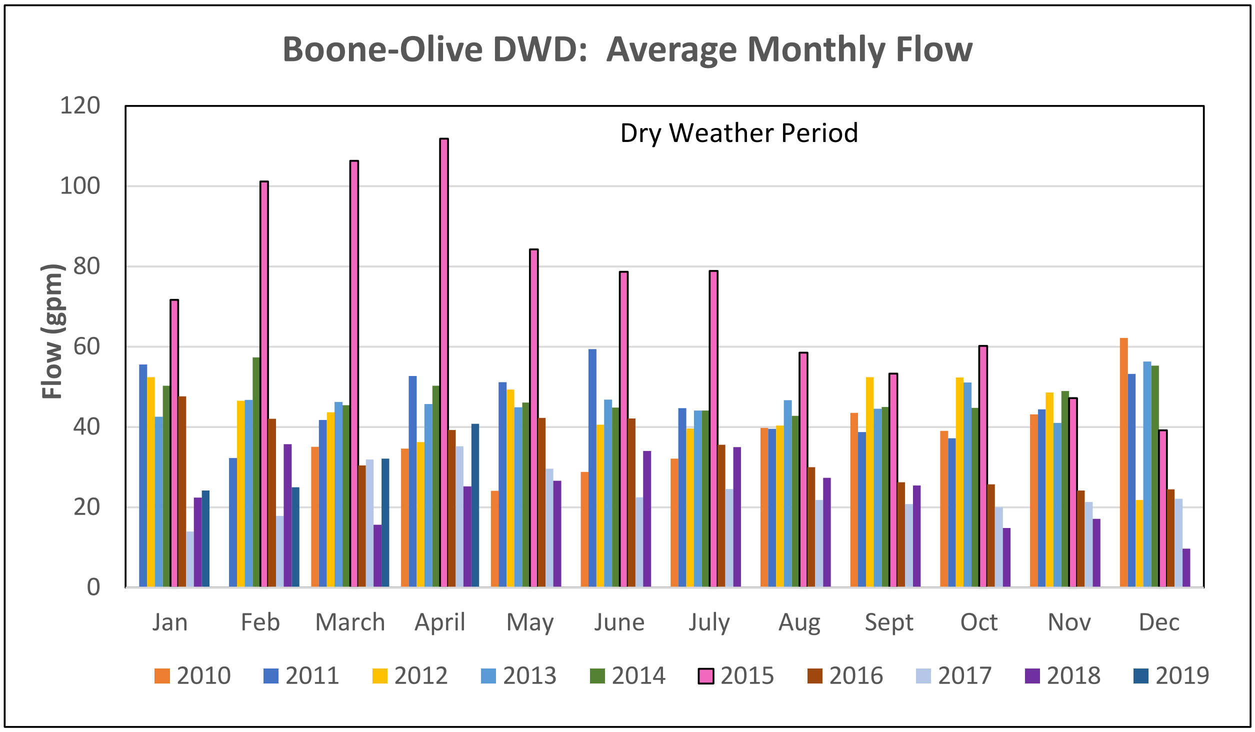

Figure B-2. Average Monthly Flow at the Boone-Olive DWD (2010–2019)

B.2 28th Street DWD

The 28th Street DWD diverts urban runoff generated from 1,190 acres of tributary area and discharges to the JWPCP via a 4-inch sewer line. The system has approximately 43,000 gallons of storage and is equipped with an automatic rain gauge shutoff mechanism.

Figure B-3presents average daily flow for the 28th Street DWD between 2008 and 2019. Maximum flows were recorded in in 2018 and 2019. Figure B-7presents average monthly flow between 2008 and 2019 for the 28th street DWD. The monthly flows were variable over the years. The average monthly flows were less than the discharge capacity of 130 gpm. Based on the long-term trend, the overall flows during from 2017 through 2019 were higher compared to the 2008 through 2016 period.

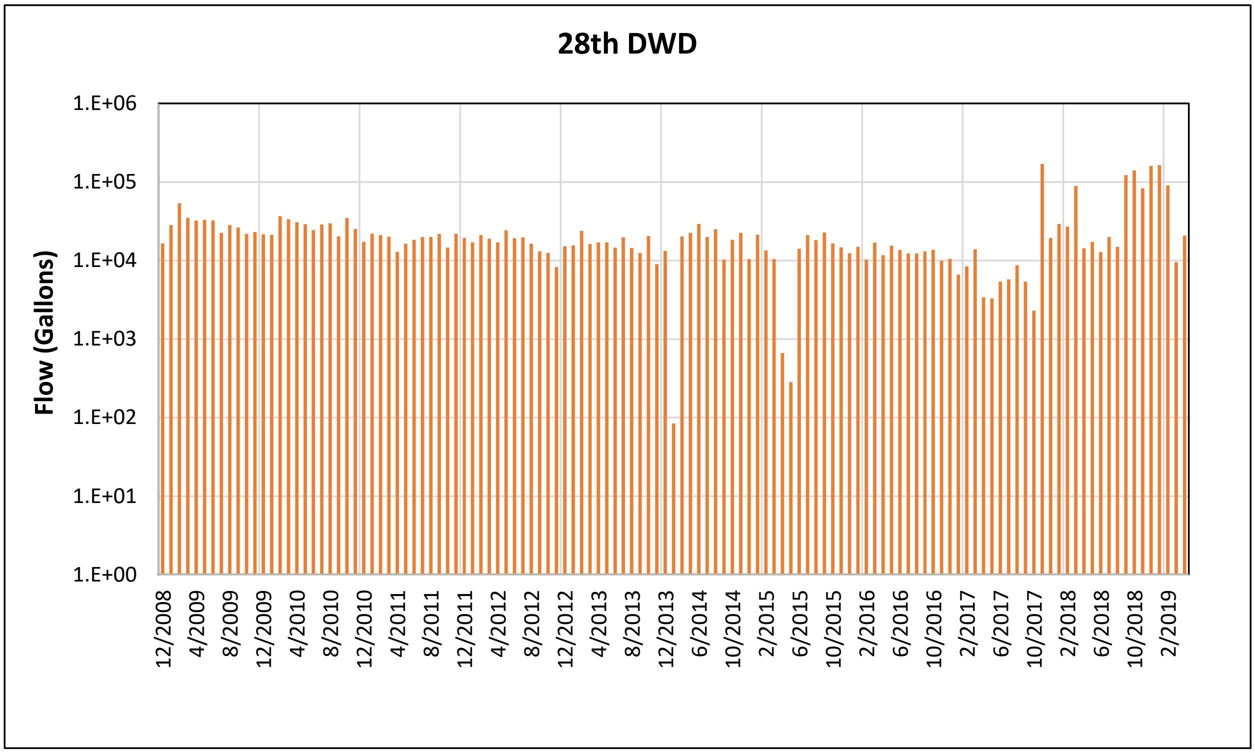

Figure B-3. Average Daily Flow to Sewer by the 28th Street DWD (2008–2019)

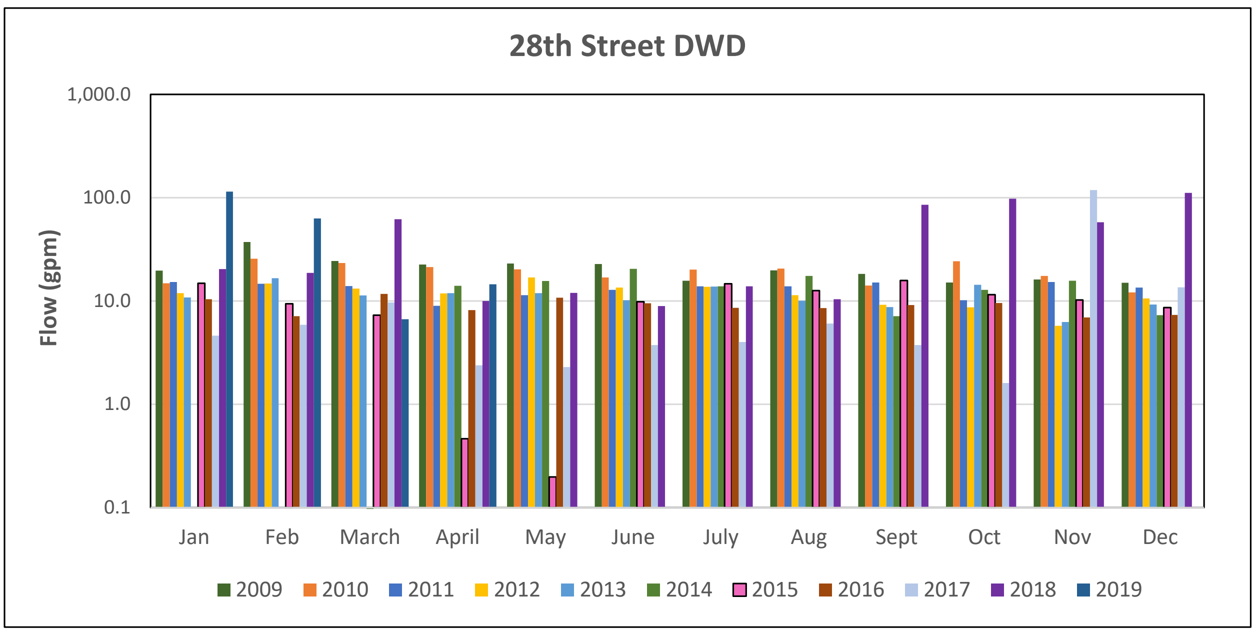

Figure B-4. Average Monthly Flow to Sewer at the 28th Street DWD (2009–2019)

B.3 Alamitos DWD

The Alamitos DWD diverts runoff generated from 270 acres of tributary area and discharges to the JWPCP via a 6-inch sewer line. The system has approximately 146,000 gallons of storage and is equipped with an automatic rain gauge shutoff mechanism.

Due to the data quality issue, only partial data for 2018 and 2019 were used for analysis purposes. Figure B-5presents average monthly flows for the Alamitos DWD for the data recorded between 2018 and 2019. Maximum flows were recorded in June of 2018. Overall, the monthly peak flows were less than the discharge capacity of 120 gpm, which is the upper limit of flow that can be discharged by the DWD to the sewer system. No trends in data can be inferred due to limited data.

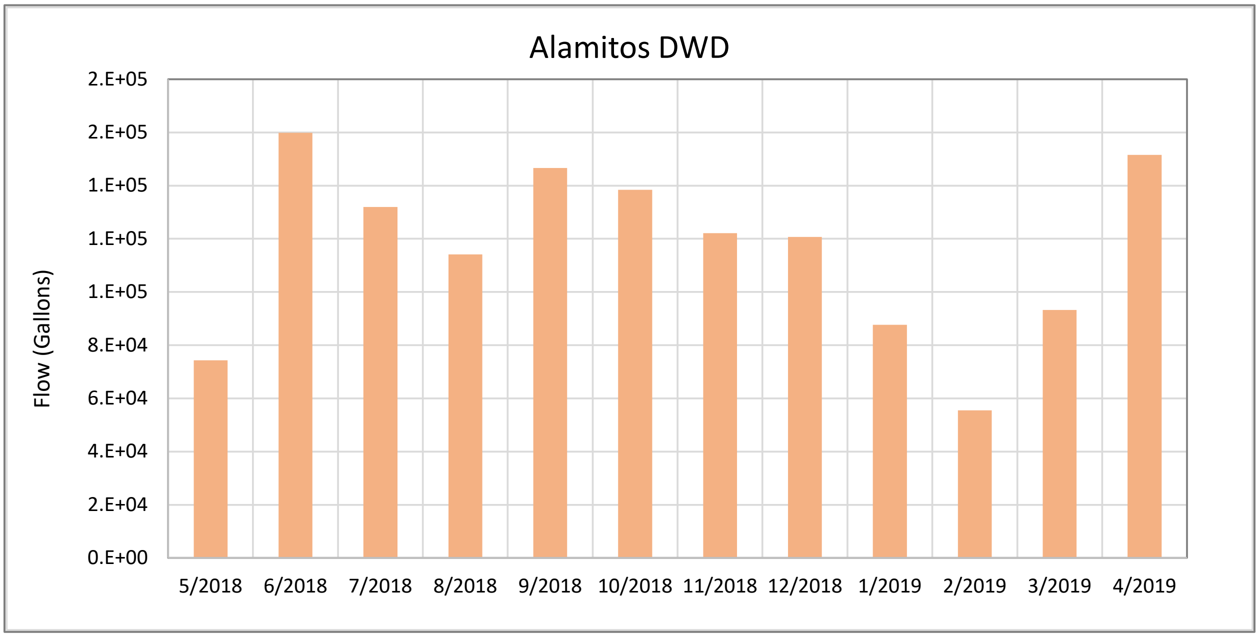

Figure B-5. Daily Average Flow to Sewer at the Alamitos DWD (2018–2019)

Data for only one day were available in May 2018.

B.4 Ashland DWD

The Ashland DWD diverts urban runoff generated from 200 acres of tributary area and discharges to Hyperion WRP via a 15-inch sewer line. The system has approximately 240 gallons of storage. The DWD at Ashland Avenue started operating in June 2006.

Figure B-6presents average monthly flows for the Ashland DWD from December 2008 through March 2019. Based on the long-term trend, the flows increased from 2015 through 2019 compared to the prior years; that is, from 2007 through 2014.

Figure B-7presents average monthly flows from 2008 through 2019 for the Ashland DWD. Overall, the flows were less than 10 gpm from 2008 through June 2014, with a few spikes due to unusually high flows. Average monthly flows were less than the discharge capacity of 30 gpm before July 2014. Potential reasons could be malfunctioning of instruments or data logger/flow monitoring system or pumps. Flow from a permitted or illicit discharge may be another possibility. Data for some days could also be reflective of the approach used for the analysis.

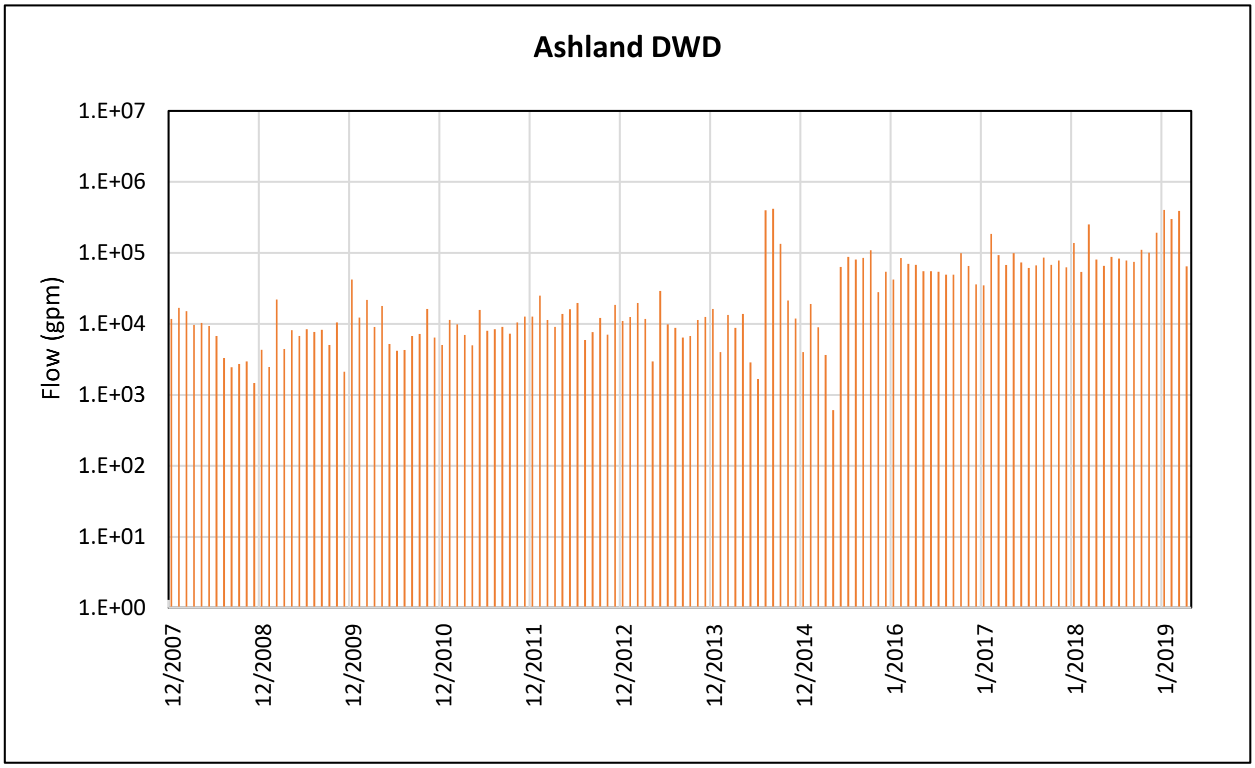

Figure B-6. Average Daily Flow Diverted to Sewer by the Ashland DWD (2008–2019)

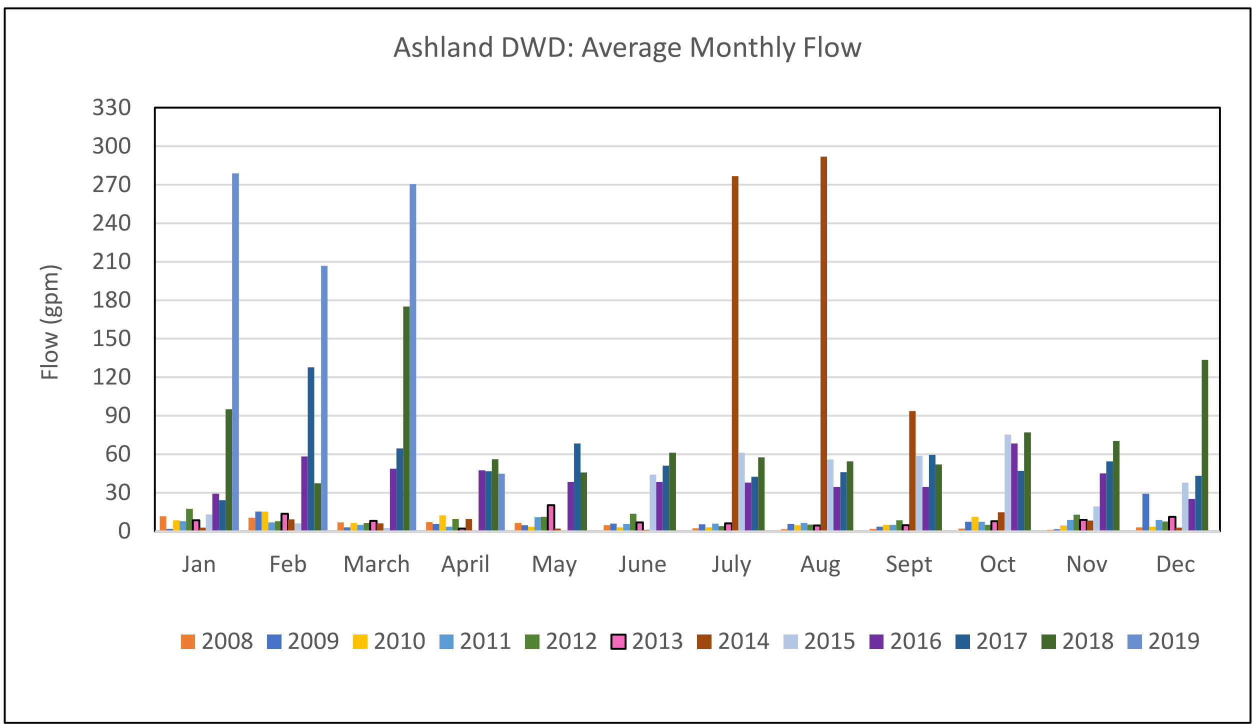

Figure B-7. Monthly Average Flow at the Ashland DWD (2008–2019)

B.5 Avenue I DWD

The Avenue I DWD diverts urban runoff generated from 330 acres of tributary area and discharges to the JWPCP via a 12-inch sewer line. The system has approximately 400 gallons of storage and is equipped with an automatic rain gauge shutoff mechanism.

Figure B-8presents the average daily flows for the Avenue I DWD between 2007 and 2019. Maximum flows were recorded in June 2008. Based on the long-term trend, the average monthly flows remained less than 10 gpm. Figure B-9presents average monthly flow timeseries for the data between 2007 and 2019 for the Avenue I DWD. Monthly average flows were less than the discharge capacity, which is the upper limit of flow that can be discharged by this DWD to the sewer system.

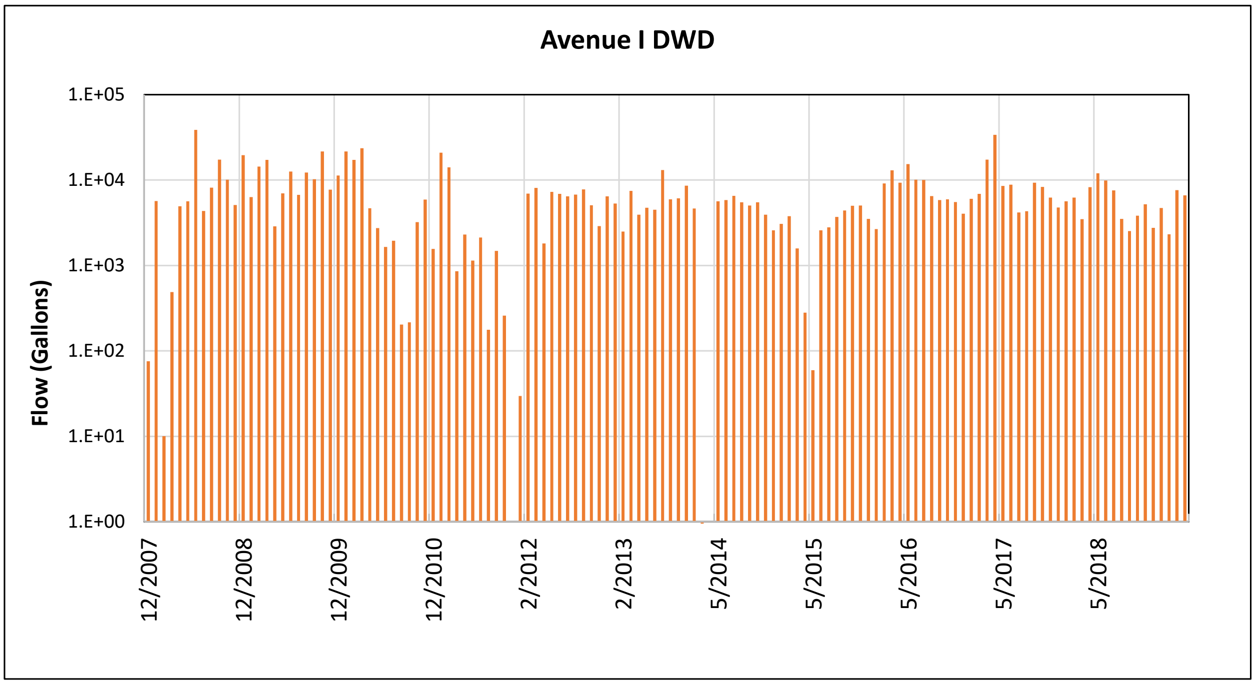

Figure B-8. Average Daily Flow Diverted to Sewer by the Avenue I DWD (2008–2019)

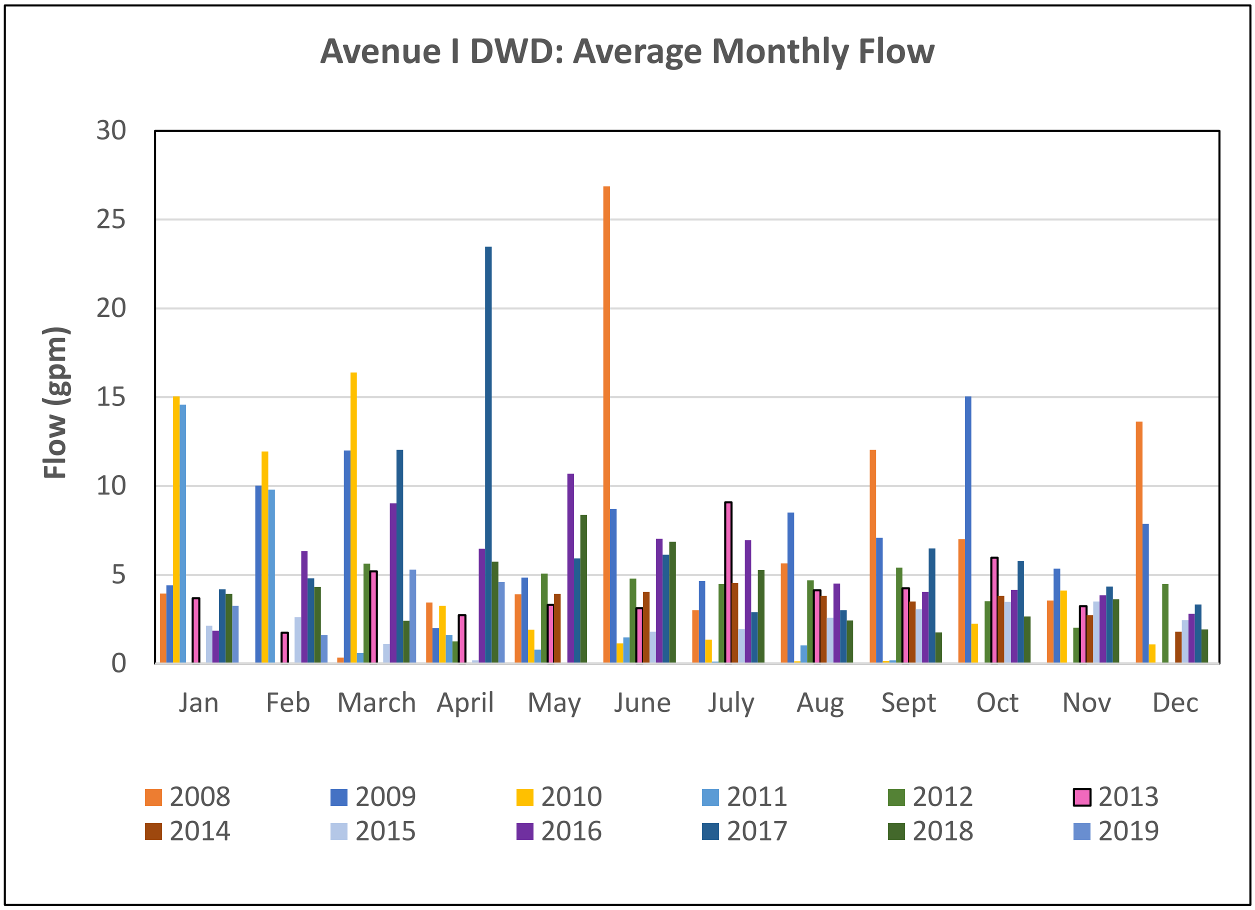

Figure B-9. Average Monthly Flow for the Avenue I DWD (2008–2019)

B.6 Herondo DWD

The Herondo DWD diverts urban runoff generated from 2,780 acres of tributary area and discharges to the JWPCP via an 8-inch sewer line. The system has approximately 12,500 gallons of storage beyond wet well and is equipped with an automatic rain gauge shutoff mechanism. The sanitary sewer discharge capacity for this DWD is 60 gpm in peak period and 120 gpm in off-peak period.

Figure B-10presents the monthly total flows for the Herondo DWD for the data recorded between 2008 and 2017. Overall, the flows have declined in the last few years starting from 2014. Figure B-11presents average monthly flow from 2008 through 2019 for the Herondo DWD. Average monthly flow rates were variable from year to year. Year-to-year variations in average monthly flows were lower in August through October (in the dry weather periods) compared to other months.

The flows are compared with the discharge capacity for this DWD, which is 60 gpm during peak hours (6 a.m.–10 p.m.) and 120 gpm (10 p.m.–6 a.m.) in off-peak hours. The average monthly peak flows were less than the discharge capacity, which is the upper limit of flow that can be discharged by this DWD to the sewer system. Monthly average flow per acre of tributary area varied between 6 and 12 GPD/acre.

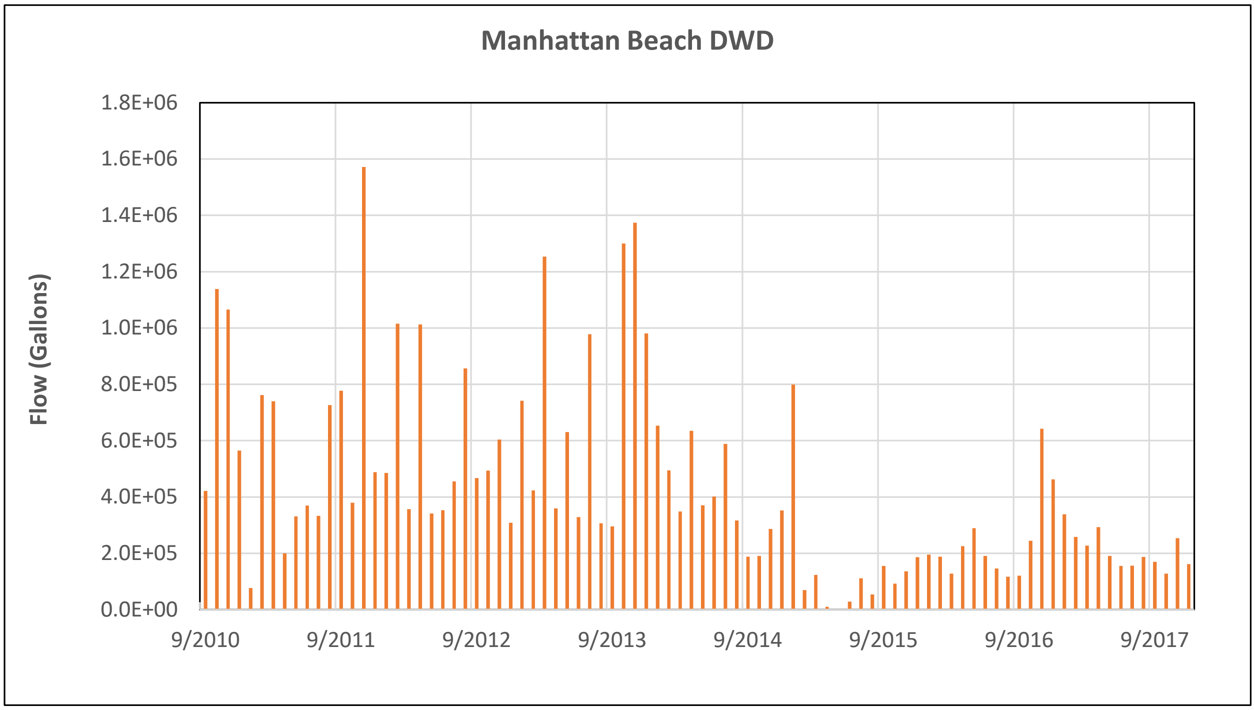

Figure B-10. Daily Average Flow Diverted to Sewer at the Herondo DWD (2008–2017)

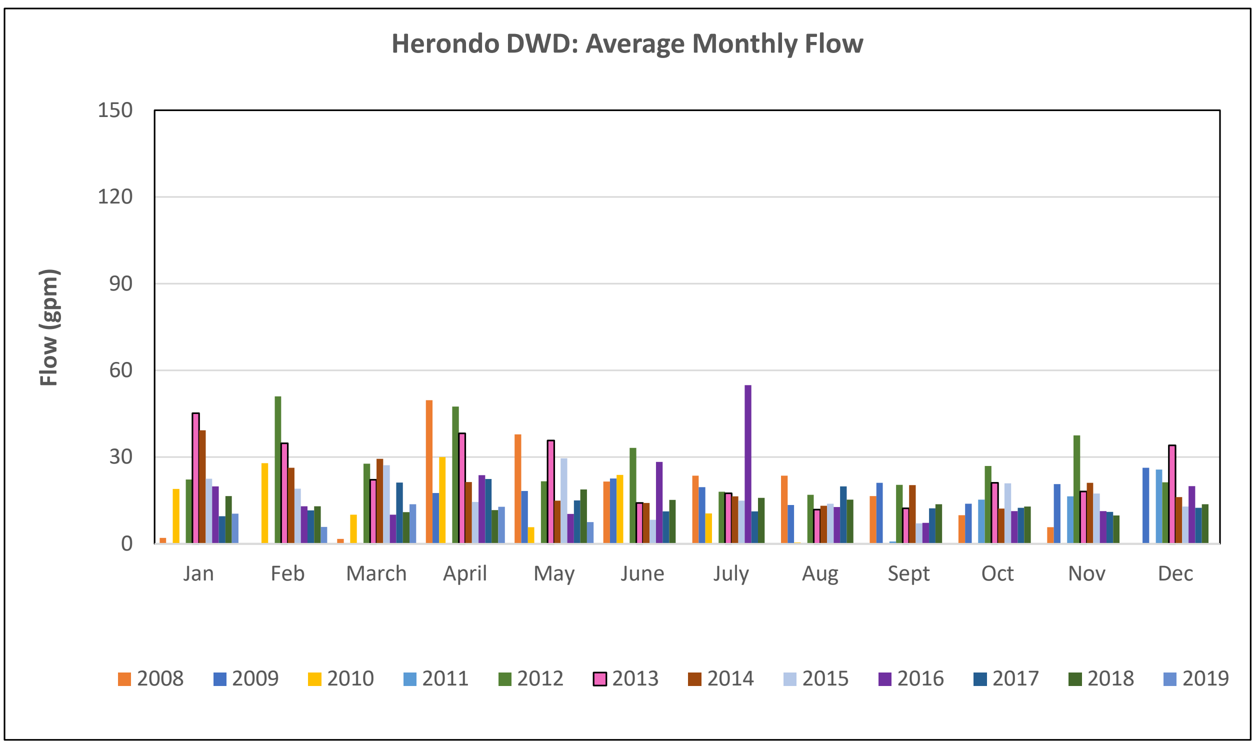

Figure B-11. Average Monthly Flow for the Herondo DWD (2008–2019)

B.7 Manhattan Beach Pump Plant DWD

The Manhattan Beach PP DWD (called as Manhattan Beach DWD here) diverts urban runoff generated from 300 acres of tributary area and discharges to the JWPCP via an 18-inch sewer line. The system has approximately 68,000 gallons of storage beyond wet well and is equipped with an automatic rain gauge shutoff mechanism. The sanitary sewer discharge capacity for this DWD is 50 gpm.

Figure B-12presents the average monthly flows for the Manhattan Beach DWD for the data recorded between 2010 and 2018. Maximum average monthly flow was 107 gpm, which was recorded in August 2018. Overall, the flows were lower from 2015 through 2017, potentially due to drought and consequently conservation measures applied for water use.

Figure B-13presents average monthly flows from 2010 through 2018 for the Manhattan Beach DWD. Generally, average monthly flows varied over the years. The flows were least variable in the month of June during the entire duration. Based on the long-term trend, the average monthly flow was 10 gpm. Monthly average flows were less than the discharge capacity of 50 gpm. The discharge capacity is the upper limit of flow that can be discharged by this DWD to the sewer system. Monthly average flows per acre of tributary area varied between 30 and 82 GPD/acre.

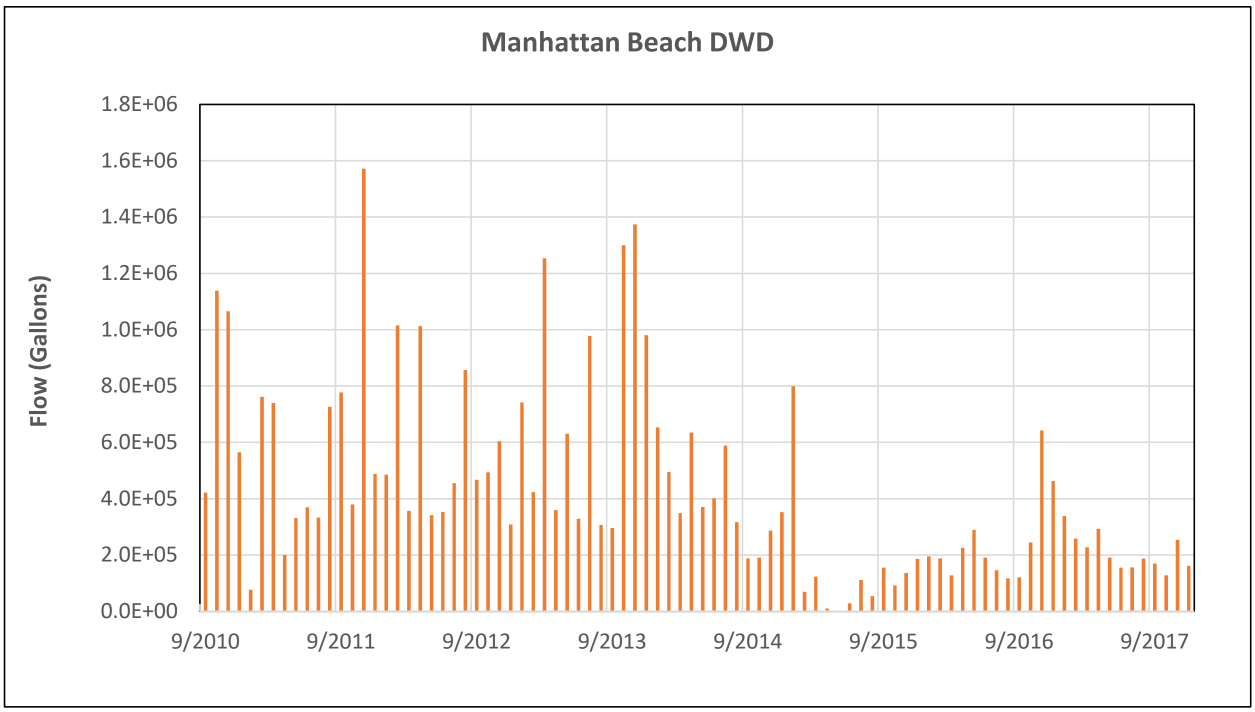

Figure B-12. Daily Average Flow Diverted to Sewer at the Manhattan Beach DWD (2010–2018)

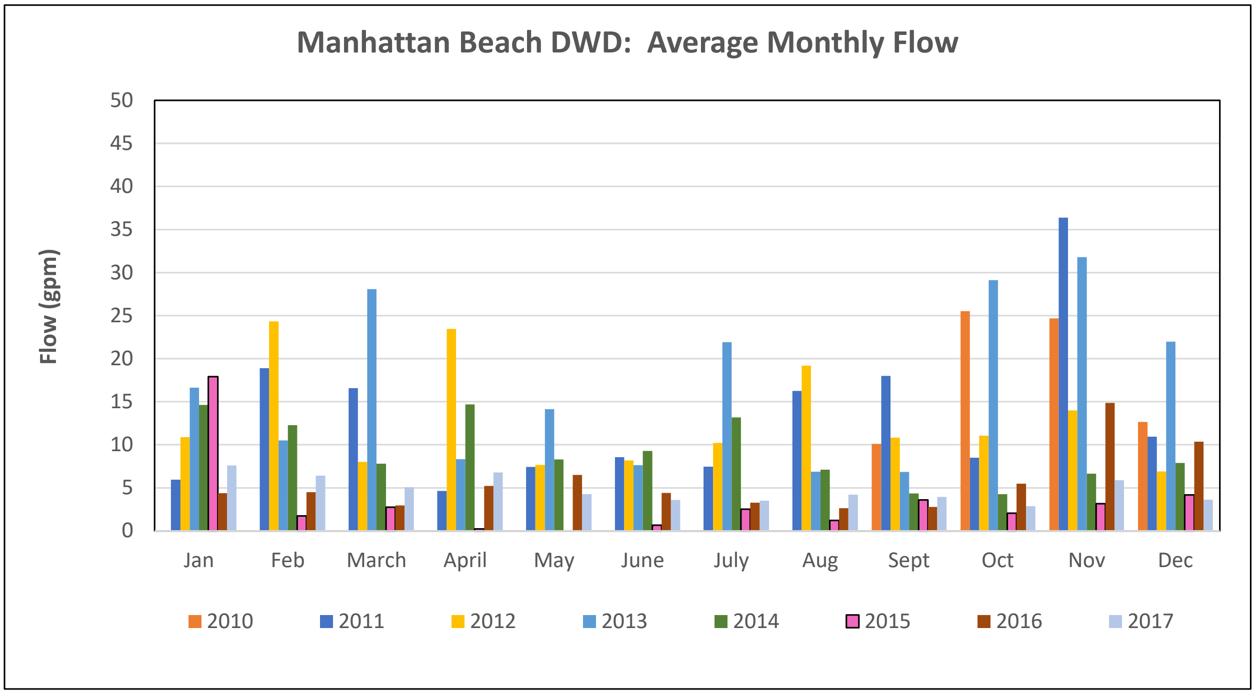

Figure B-13. Average Monthly Flow for the Manhattan Beach DWD (2010–2018)

B.8 Marina Del Rey DWD

The Marina Del Rey DWD diverts urban runoff generated from 190 acres of tributary area and discharges to Hyperion WRP via a 4-inch sewer line. The project does not have a storage beyond wet well and the DWD's shutoff mechanism is based on the high-water cutoff. The sanitary sewer discharge capacity for this DWD is 200 gpm.

Figure B-14presents average monthly flows from 2010 through 2018 for the Marina Del Rey DWD. The flows are compared with the discharge capacity of this DWD, which is 200 gpm, Monthly average peak flows were less than the discharge capacity for all months except in October and November of 2017 (Figure B-15). The discharge capacity is the upper limit of flow that can be discharged by this DWD to the sewer system. The flows were generally higher throughout the year 2017 and January through April of 2019 compared to the rest of the period. Monthly average flow per acre of tributary area varied between 356 and 596 GPD/acre.

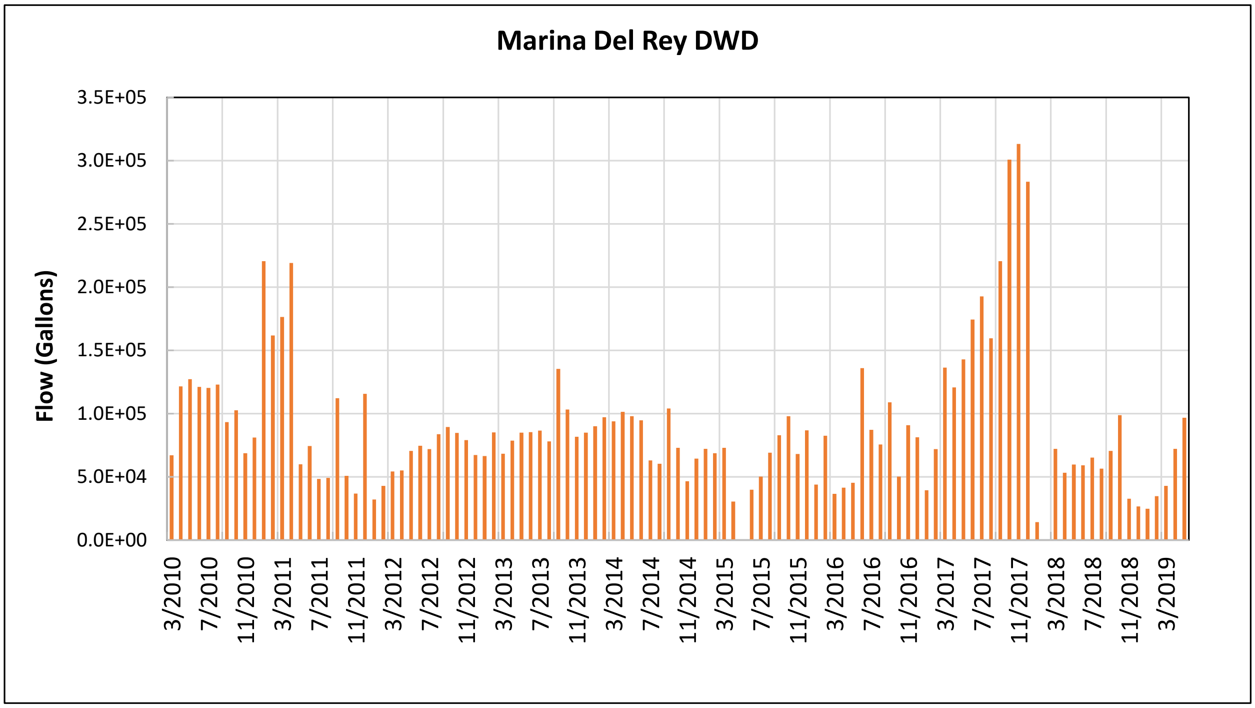

Figure B-14. Daily Average Flows Diverted to Sewer at the Marina Del Rey DWD (2010–2018)

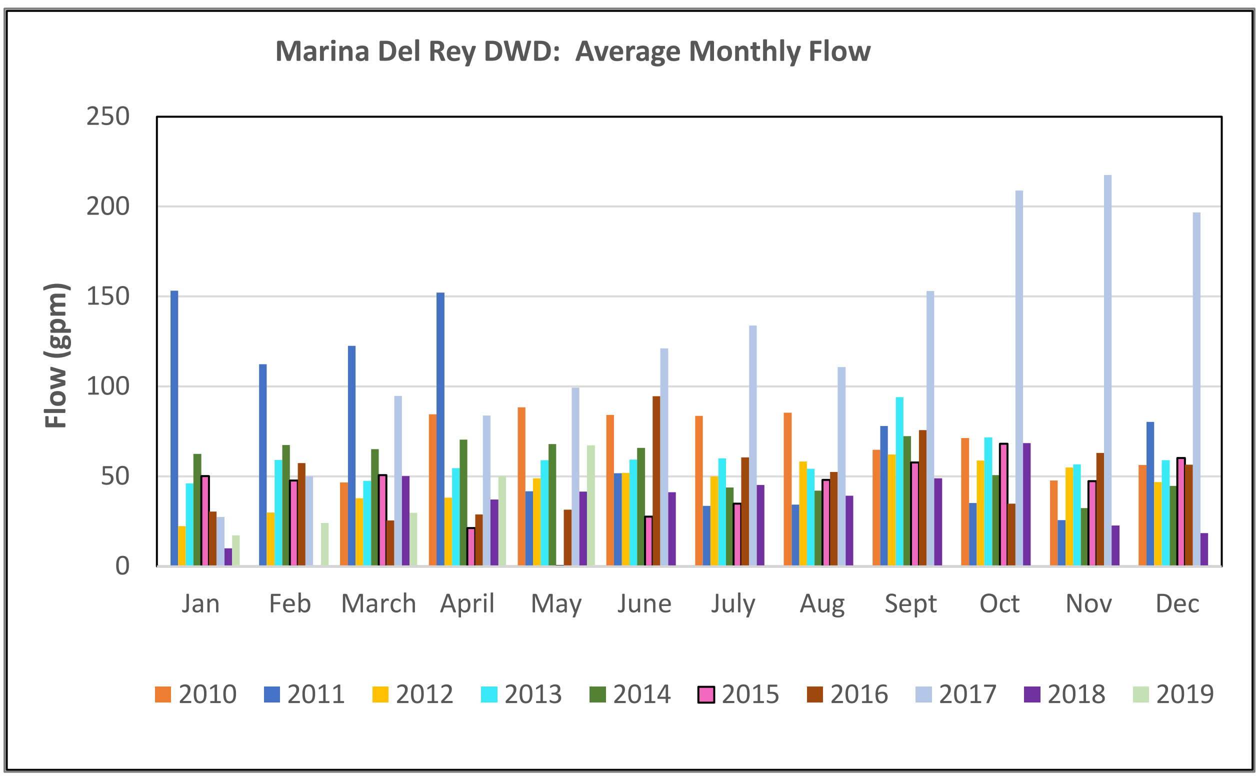

Figure B-15. Average Monthly Flow for the Marina Del Rey DWD (2010–2018)

B.9 Parker Mesa DWD

The Parker Mesa DWD project diverts urban runoff generated from 370 acres of tributary area and discharges to Hyperion WRP via a 10-inch sewer line. The system has limited storage of approximately 175 gallons. The sanitary sewer discharge capacity for this DWD is 75 gpm.

Figure B-16presents the average daily flow for the Parker Mesa DWD project from 2008 through 2019. Maximum average monthly flow was 63 gpm and the average flow was 33 gpm. The flows were higher in 2011 than in other years.

Figure B-17presents average monthly flows from 2008 through 2019 for the Parker Mesa DWD. Monthly average peak flows were less than the discharge capacity, which is 75 gpm. The discharge capacity is the upper limit of flow that can be discharged by this DWD to the sewer system. Monthly average flow per acre of tributary area varied between 105 and 158 gpd. Flows were higher in dry weather period.

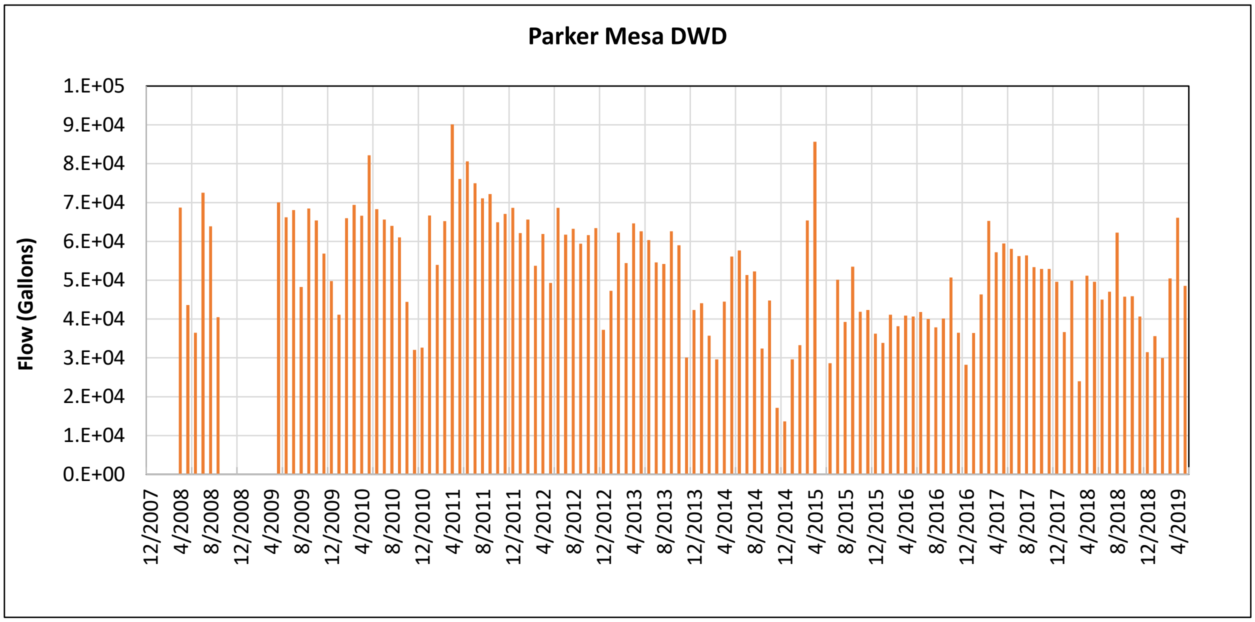

Figure B-16. Daily Average Flow Diverted to Sewer by the Parker Mesa DWD (2007–2019)

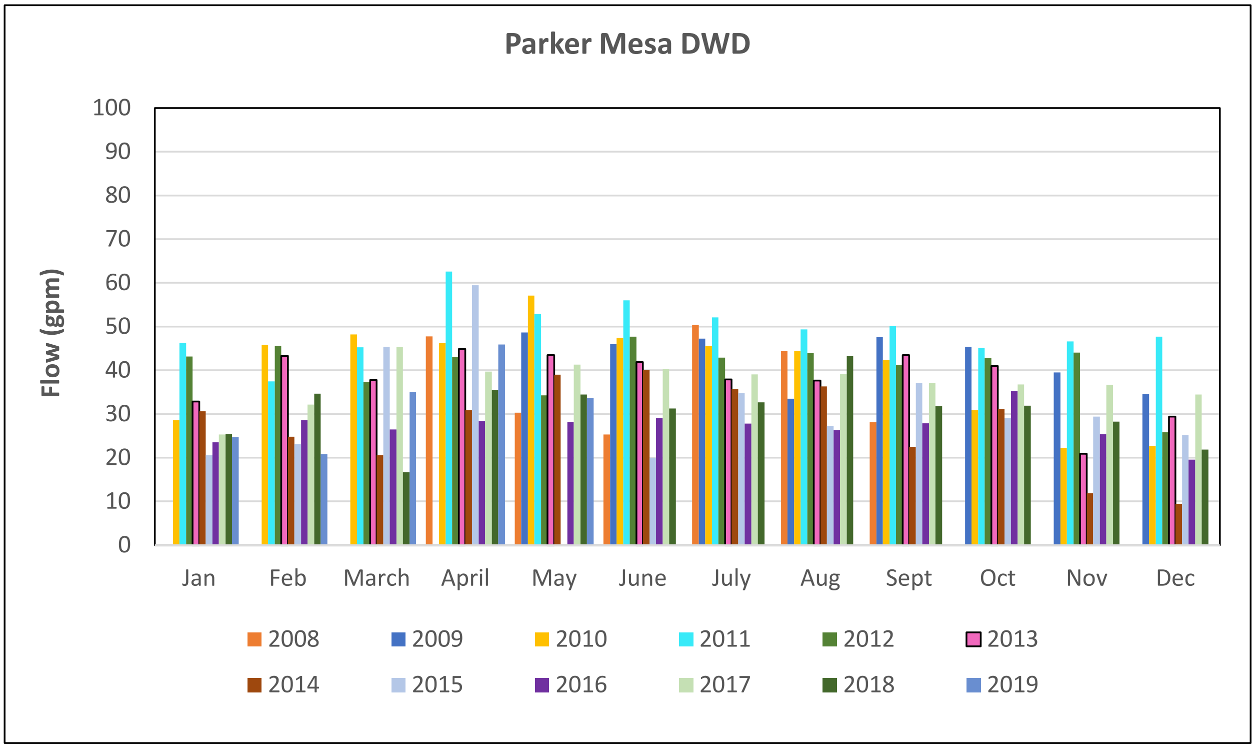

Figure B-17. Average Monthly Flow for the Parker Mesa DWD (2007–2019)

B.10 Pershing Drive DWD

The Pershing Drive DWD diverts urban runoff generated from 300 acres of tributary area and discharges to the JWPCP via an 18-inch sewer line. The system has approximately 68,000 gallons of storage and is equipped with an automatic rain gauge shutoff mechanism. The sanitary sewer discharge capacity for this DWD is 50 gpm.

Figure B-18presents the average daily flow by month diverted by the Pershing Drive DWD based on the flow data recorded between 2008 and 2019. Maximum average monthly flows were measured in December 2018. Figure B-19presents average monthly flows between 2010 and 2018 for the Pershing Drive DWD. The flows are compared with the discharge capacity of this DWD, which is 240 gpm. Among all other years the flows were consistently higher in 2018, which was a wet year. Monthly average flows per acre of tributary area varied over the course of the period.

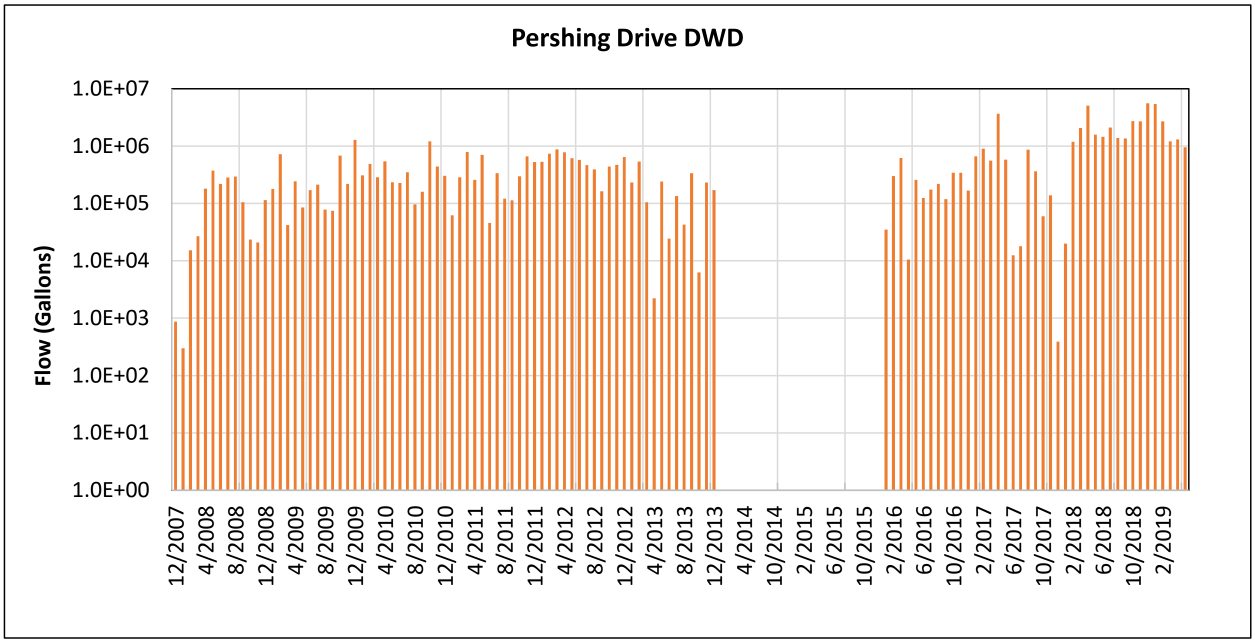

Figure B-18. Average Daily Flows at the Pershing Drive DWD (2008–2019)

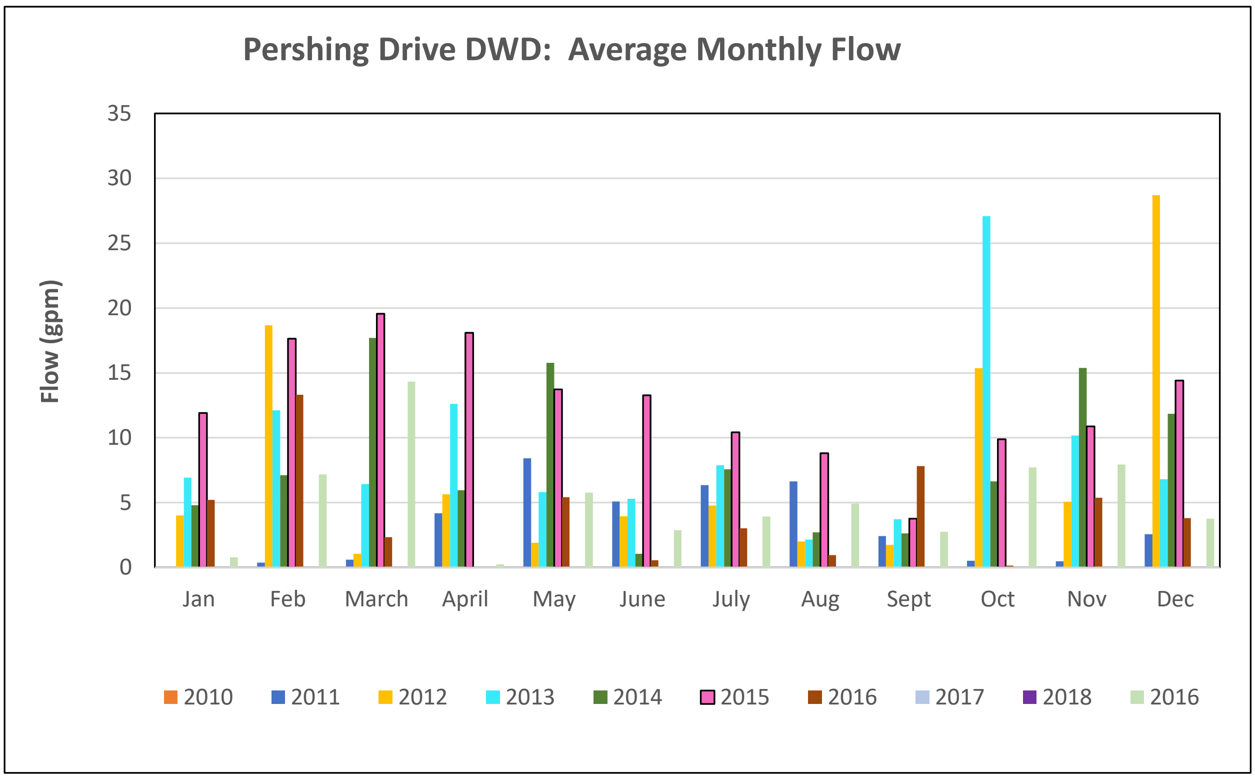

Figure B-19. Average Monthly Flow for the Pershing Drive DWD (2008–2019)

B.11 Pulga Canyon DWD

The Pulga Canyon DWD project diverts urban runoff generated from 1,000 acres of tributary area and discharges to Hyperion WRP via a 24-inch sewer line. The system has limited storage of approximately 60 gallons and the DWD is shutoff manually during storm events. The sanitary sewer discharge capacity for this DWD is 260 gpm.

Figure B-20presents the average daily flows for Pershing Drive DWD for the data recorded between 2007 and 2019. Figure B-21presents average monthly flows between 2010 and 2018 for the Pulga Canyon DWD. The flows are compared with the discharge capacity of this DWD, which is 260 gpm. In the entire duration, relatively higher flows were recorded in 2011. Monthly average daily flow per acre of tributary area varied between 87 and 155 gpm.

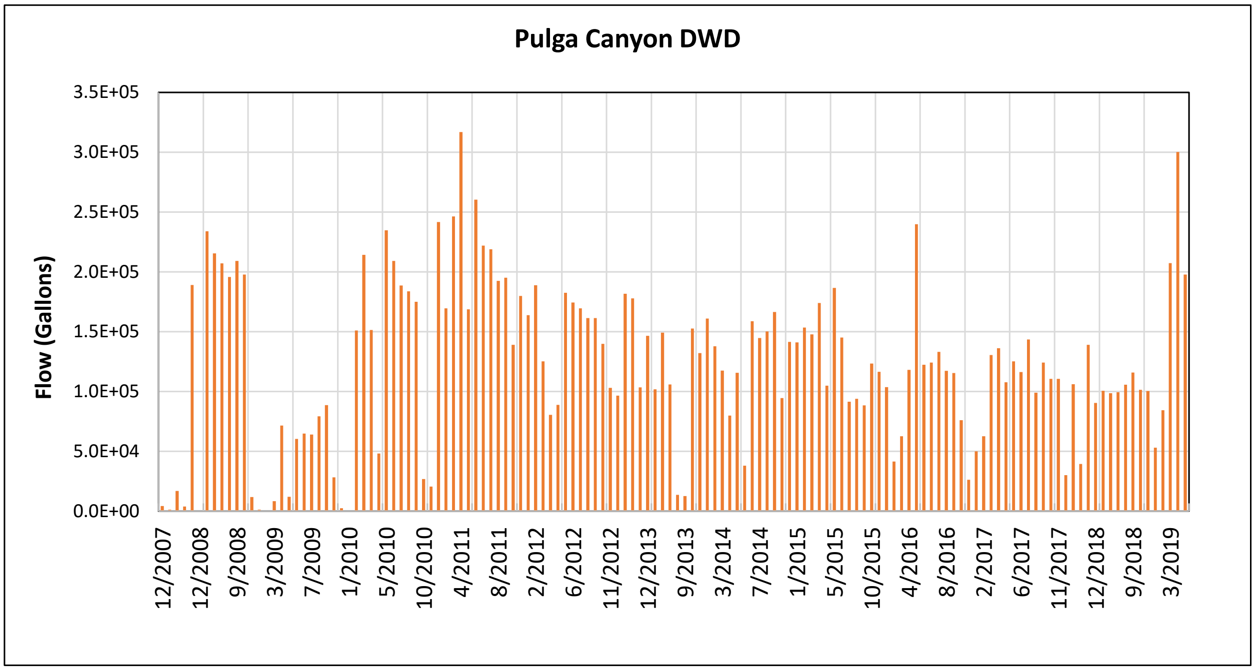

Figure B-20. Average Daily Flows Diverted to Sewer by the Pulga Canyon DWD (2010–2018)

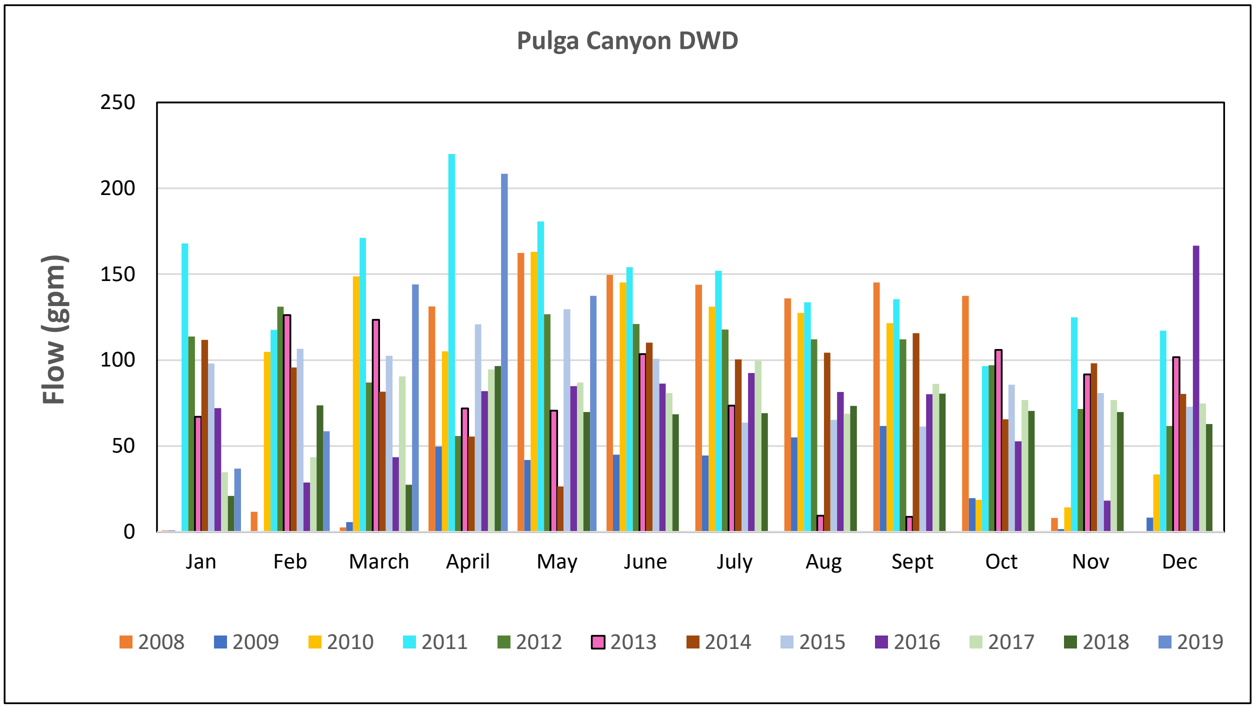

Figure B-21. Average Monthly Flow for the Pulga Canyon DWD (2010–2018)

B.12 Rose Avenue DWD

The Rose Avenue DWD project diverts urban runoff generated from 1,910 acres of tributary area and discharges to the Hyperion WRP via a 36-inch sewer line. The system has limited storage of approximately 360 gallons and the DWD is turned off manually during storm events. The sanitary sewer discharge capacity for this DWD was not available.

Figure B-22presents the average monthly flows for the Rose Avenue DWD for the data recorded between 2007 and 2019. The average monthly flows declined from 2014 onwards. Figure B-23presents average monthly flows between 2010 and 2018 for the Rose Avenue DWD project. In the entire duration, relatively higher flows were recorded from April through July 2012. Monthly average flow per acre of tributary area varied between 8 and 21 gpd.

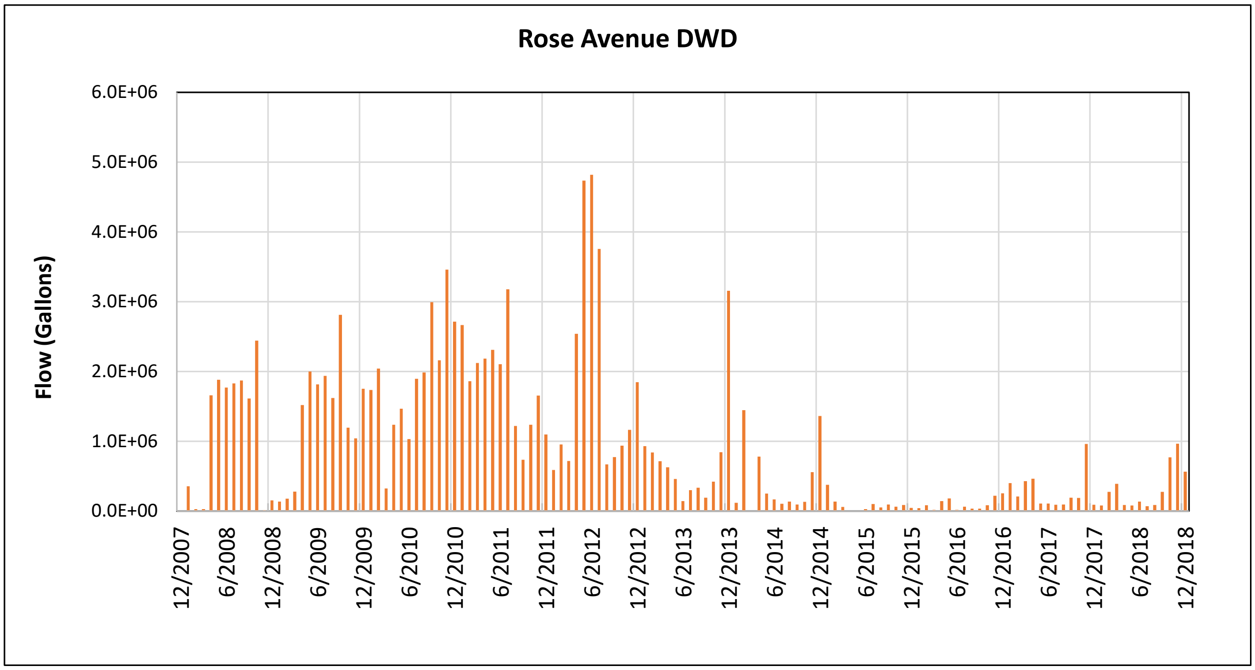

Figure B-22. Average Daily Flow Diverted to Sewer by the Rose Avenue DWD (2007–2018)

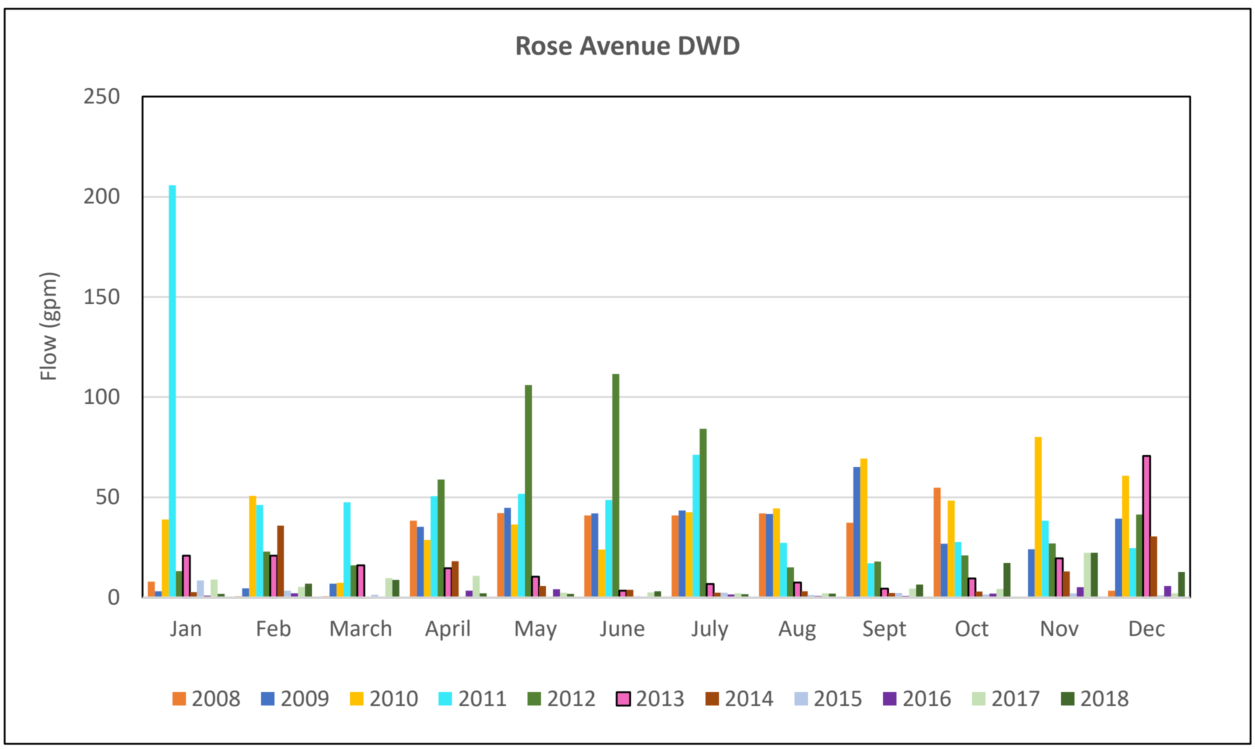

Figure B-23. Average Monthly Flow for the Rose Avenue DWD (2008–2018)

B.13 Santa Ynez DWD

The Santa Ynez DWD project diverts urban runoff generated from 4,490 acres of tributary area and discharges to the Hyperion WRP via a 24-inch sewer line. The system has approximately 2,300 gallons of storage. The DWD is turned off manually during storm events. The sanitary sewer discharge capacity for this DWD is 826 gpm.

Figure B-24presents the average daily flows for Santa Ynez DWD for the data recorded between 2007 and 2019. The flows averaged around 520 gpm. Figure B-25presents average monthly flows between 2010 and 2018 for this DWD. Monthly average flows per acre of tributary area were relatively higher in January through March.

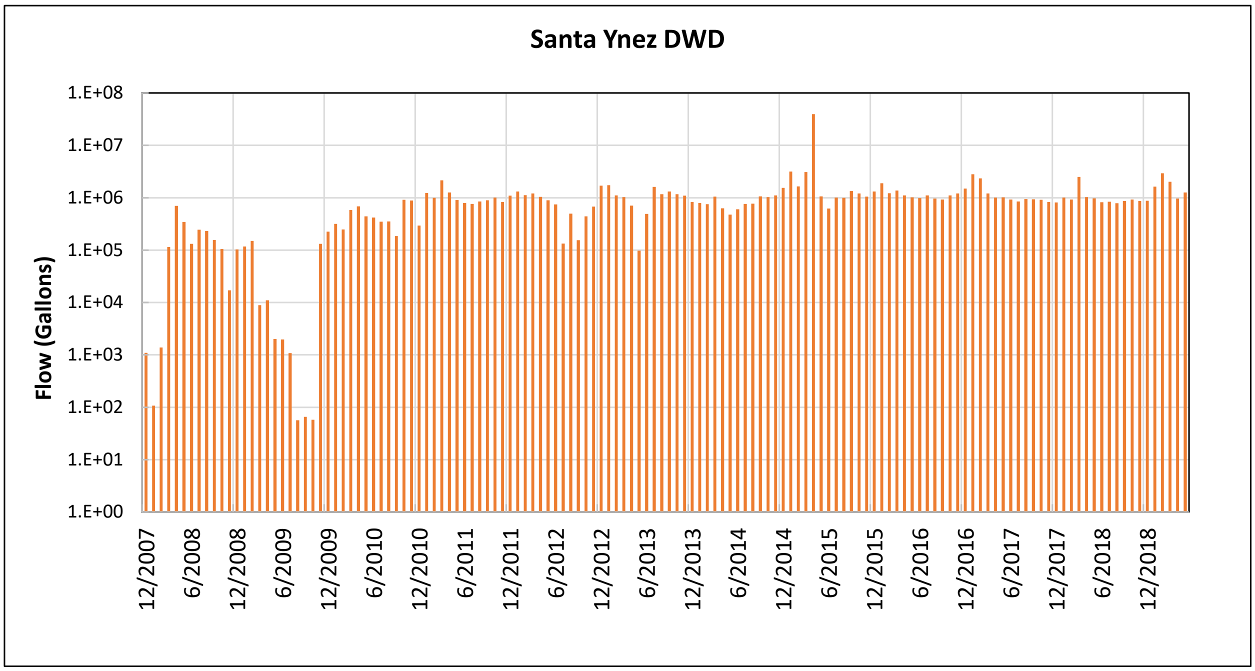

Figure B-24. Average Daily Total Flow Diverted to the Sewer by the Santa Ynez DWD (2008–2019)

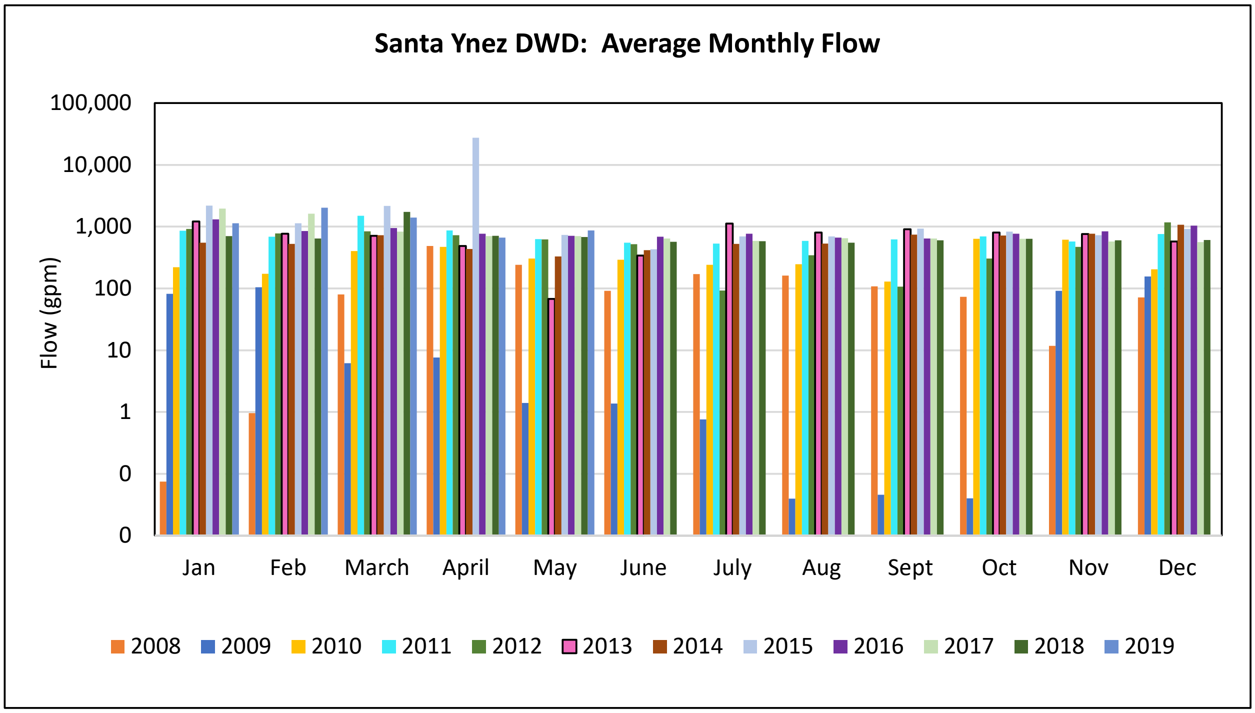

Figure B-25. Average Monthly Flow for the Santa Ynez DWD (2008–2019)

B.14 Washington Blvd DWD

The Washington Blvd DWD project diverts urban runoff generated from 480 acres of tributary area and discharges to the Hyperion WRP via an 8-inch sewer line. The system has approximately 1,400 gallons of storage. The DWD is turned off manually during storm events. The sanitary sewer discharge capacity for this DWD is 63.9 gpm.

Figure B-26presents the average total daily flows for Washington Blvd DWD for the data recorded between 2008 and 2019. Figure B-27presents average monthly flows between 2008 and 2019 for the Washington Blvd DWD project. The average monthly flows were less than the permitted diversion capacity.

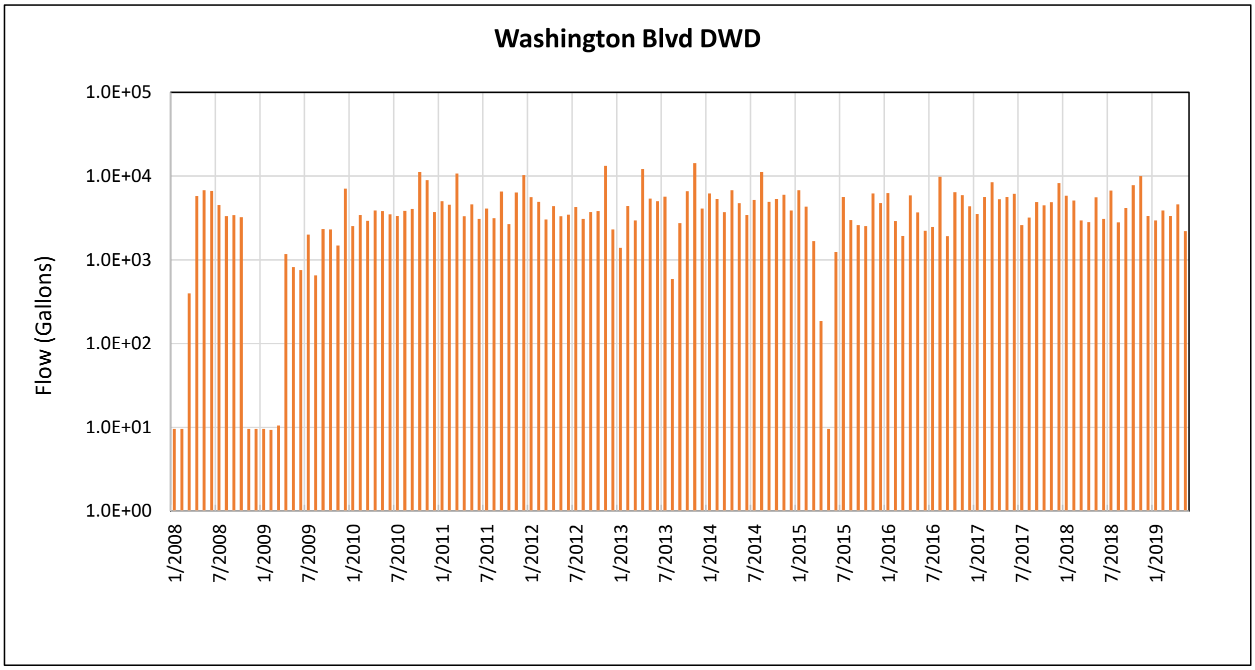

Figure B-26. Average Daily Total Flow Diverted to the Sewer by the Washington Blvd DWD (2010-2018)

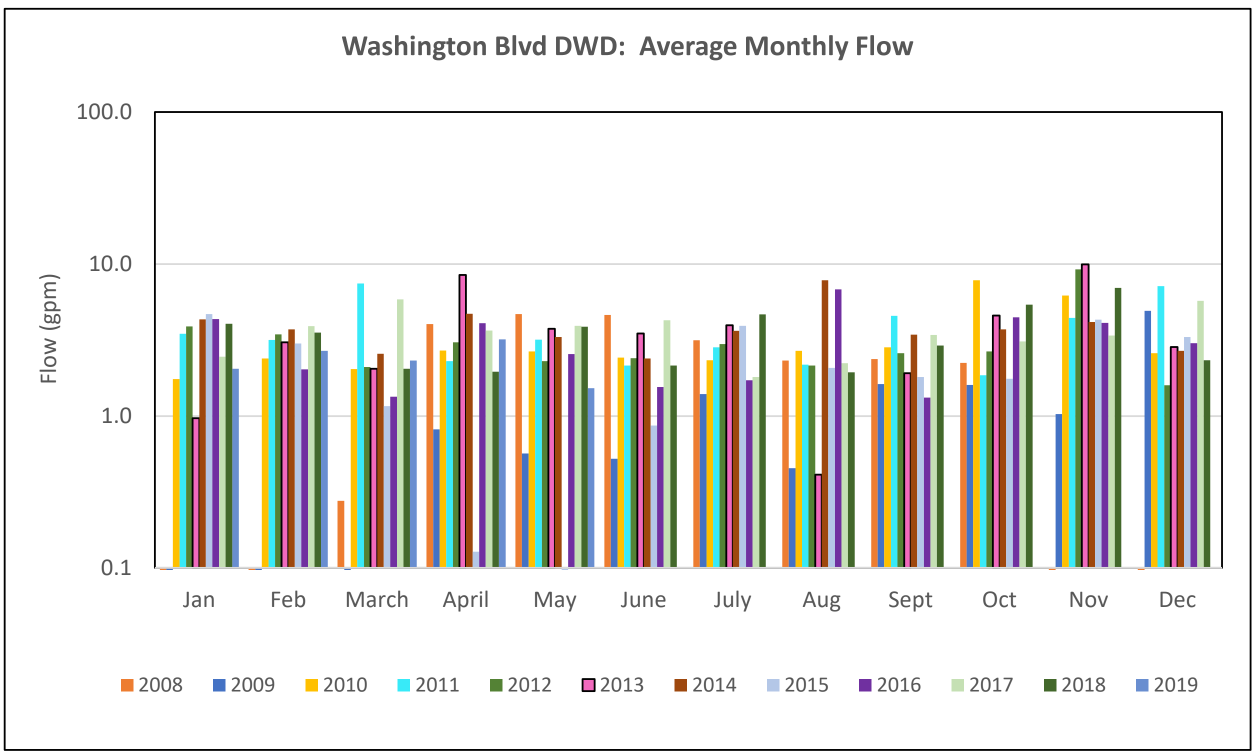

Figure B-27. Average Monthly Flow for the Washington Blvd DWD (2010–2018)

B.15 Westchester DWD

The Westchester DWD project diverts urban runoff generated from 2,400 acres of tributary area and discharges to the Hyperion WRP via a 72-inch sewer line. The system has limited storage of approximately 50 gallons. The DWD is turned off manually during storm events. The sanitary sewer discharge capacity for this DWD is 125 gpm.

Figure B-28presents the average monthly flows for Westchester DWD for the data recorded between 2008 and 2019. The average monthly flows were relatively higher in 2014 and 2016 than in other years. Figure B-29presents average monthly flows between 2008 and 2019 for the Westchester DWD project. In general, the average monthly flows were less than the permitted diversion.

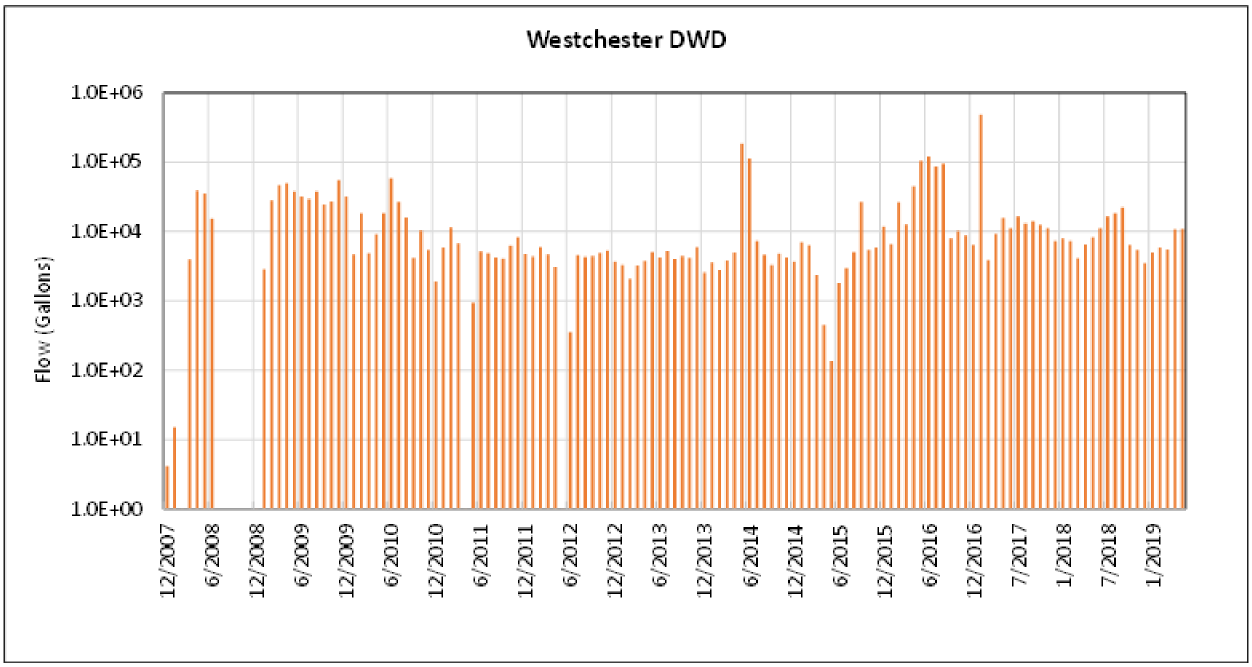

Figure B-28. Average Daily Total Flows Diverted to Sewer by the Westchester DWD (2008–2019)

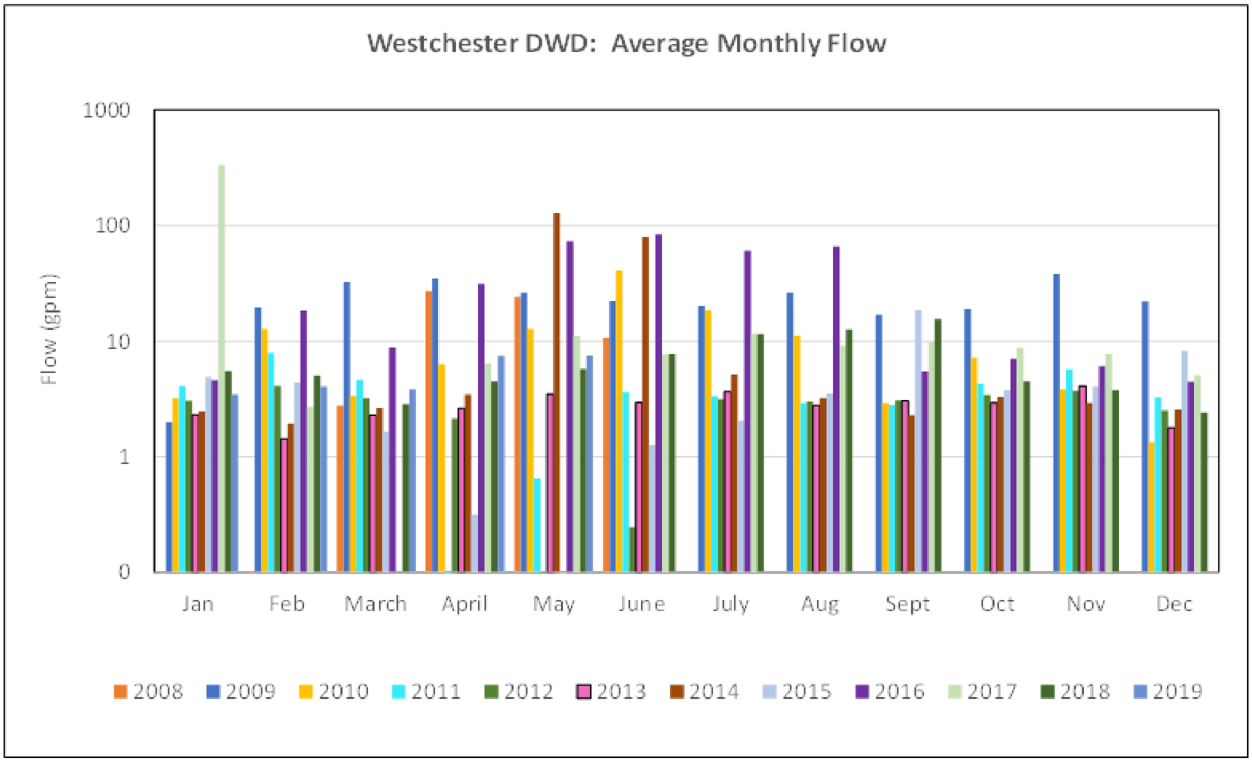

Figure B-29. Average Monthly Flow for the Westchester DWD (2008–2019)

Appendix C
List of Agencies and Contact Information

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Appendix C. List of Agencies and Contact Information

Table C-1 lists agencies and the associated contact information.

Table C-1. Agency and Contact Information

Agency	Contact Information
City of Los Angeles, LA Sanitation and Environment	Michael Scaduto, (Acting) Division Manager of Watershed Protection Division michael.scaduto@lacity.org, 213-485-3981 Mailing Address: 1149 S Broadway 9th floor, Los Angeles, CA 90015
Los Angeles County Sanitation Districts	Kristen Ruffell, Division Engineer kruffell@lacsd.org 562-908-4288x2826 Mailing Address: P. O. Box 4998 Whittier, CA 90607
Las Virgenes Municipal Water District	John Zhao, Director of Facilities and Operations Jzhao@lvmwd.com 818 251-2230 Mailing Address: 4232 Las Virgenes Road Calabasas, CA 91302
Los Angeles County Flood Control District	Cung Nguyen cnguyen@dpw.lacounty.org, (626) 458-4341

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Appendix D
Summary of Regulatory Requirements for MS4 Permit

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Appendix D. Summary of Regulatory Requirements for MS4 Permit

The LARWQCB implements the Los Angeles Basin Plan by issuing and enforcing WDRs to individuals, municipalities, or businesses, whose waste discharges can affect water quality, through the issuance of NPDES permits. The WDRs for storm drain system (MS4) discharges within the coastal watersheds of the County regulate discharges of stormwater and non-stormwater (or dry weather flow) from the following MS4s:

- LACFCD
- County of Los Angeles
- Eighty-four incorporated cities within the LACFCD except for the City of Long Beach

The LARWQCB has released a Draft Regional Phase 1 MS4 NPDES Permit (Tentative Regional MS4 Permit), which includes the following areas (State of California, 2020):

- LACFCD
- County of Los Angeles
- Eighty-five incorporated cities within the coastal watersheds of the County of Los Angeles
- Ventura County Watershed Protection District
- Ventura County
- Ten incorporated cities within Ventura County

If adopted, the Tentative Regional MS4 Permit (State of California, 2020) will supersede the existing permits, except for enforcement. The Tentative Regional MS4 Permit reflects the federal Phase I NPDES Storm Water Program requirements. These federal requirements include three fundamental elements (40 CFR 122.26):

1) A requirement to effectively prohibit non-stormwater discharges through the MS4
2) Requirements to implement controls to reduce the discharge of pollutants in storm water to the maximum extent practicable
3) Other provisions the LARWQCB has determined appropriate for the control of such pollutants

The definitions, provisions, and requirements of the new Regional MS4 Permit are expected to mirror the existing MS4 permits, described here.

Stormwater discharges consist of those originating from rain events. A rain event is defined by the Regional MS4 Permit as an event greater than 0.1 inch in 24 hours. Wet weather is also defined in the Bacteria TMDLs as a day with 0.1 inch or more of rain and 3 days following the rain event (State of California, 2020).

Non-stormwater discharges (dry weather runoff) consist of all discharges through an MS4 that do not originate from rain events. Non-stormwater discharges through an MS4 are prohibited unless they are subject to one of the following exceptions (State of California, 2020):

- Authorized under a separate NPDES permit
- Authorized by U.S. Environmental Protection Agency
- Composed of natural flows
- The result of emergency firefighting activities
- Conditionally exempted (discharges from drinking water supplier distribution system releases and non-emergency firefighting activities)

As mentioned, to implement the permit requirements, the Los Angeles County MS4 Permit allows permittees to develop a WMP to implement the requirements on a watershed scale through customized, management approaches.

Appendix E
Example LACSD Policy Requirements for a Diversion Project

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Appendix E. Example LACSD Policy Requirements for a Diversion Project

Since the implementation of SB 485, LACSD has been open to accepting stormwater from controlled systems. The following steps outline the process for developing a new DWD or WWD:

1) Set up a Stormwater Services Agreement to reimburse staff effort (a requirement of their SB485 authority)

2) Conduct a consultation with the Watermaster, Water Replenishment District, and the Flood Control District (a requirement of their SB485 authority)

3) Submit requested sewer diversion flow rate(s), planned hours of operation, flow monitoring and modeling of diversion operation and storage utilization (if applicable).

   Consider operational scenarios that will reduce long term operational costs by avoiding the peak flow component of the sewer service charge. Specifically, to be cost-effective, daytime flow rates (typically, between 8 am and 10 pm, although this will vary on a case-by-case basis) should be no greater than the anticipated annual average flow. Excess flow should be diverted to the sewer at night (typically between 10 pm and 8 am) in a manner that uses the smallest flow rate that will reliably draw down the storage component of the project. The proponent's flow monitoring and modeling (if applicable) will be reviewed to evaluate the sewer capacity usage. The Sanitation District's staff will perform the sewer capacity studies to determine whether capacity is available at the requested times and provide the lag time between rainfall and reinitiating of the diversion.

   Real-time wet weather diversions, like the Carriage Crest project, require additional monitoring of the sanitary sewer level at the point of discharge to the sewer. The sanitary sewer level monitoring is used to operate variable speed pumps to adjust the diversion output to the available capacity. Currently, there are no real-time diversions at locations that require significant travel time in the sanitary sewer prior to arrival at a treatment plant. If a diversion is proposed at a location that is distant from the treatment plant, the Sanitation Districts would require additional safeguards to prevent a sewer overflow. At a minimum, any such project would require additional sewer level monitoring at critical locations downstream, the provision of gauge-adjusted radar rainfall (GARR) data (or equivalent) in a SCADA-enabled format, and a multi-year phase-in period to evaluate the sewer capacity during a wide range of rainfall conditions. These data would then be used to set the operational conditions when diversion would be allowed.

4) Submit water quality data. Table E-1 shows the analytes required at the time this white paper was prepared. Please contact the Sanitation Districts for an updated list prior to beginning a sampling program. Please submit one sample for all the parameters in the table, with two additional samples for the salts, pH, COD, SS, and turbidity. Sanitation Districts' staff will use these data to determine the diversion's impacts on downstream treatment processes.

Table E-1. Analytes Required for Submission

Metals	Organics	Pesticides	Salts	Other
Antimony	1,2,3-Trichloropropane	2,4-Dichlorophenoxyacetic acid	Conductivity	pH
Arsenic	1,4-dioxane	Fipronil	TDS	COD
Barium	Perchlorate	Fipronil desulfinyl	Chloride	SS
Cadmium	Tert-butyl alcohol	Fipronil sulfide	Sulfate	Turbidity
Chromium	Perfluorobutanoic acid (PFBA)	Fipronil sulfone		Boron
Copper	Perfluoropentanoiic acid (PFPeA)	Bifenthrin		Fluoride

Metals	Organics	Pesticides	Salts	Other
Iron	Perfluorohexanoic acid (PFHxA)	Cyfluthrin		
Lead	Perfluoroheptanoic acid (PFHpA)	Cypermethrin		
Mercury	Perfluorooctanoic acid (PFOA)	Lambda-cyhalothrin		
Nickel	Perfluorononanoic acid (PFNA)	Permethrin		
Selenium	Perfluorodecanoic acid (PFDA)			
Zinc	Perfluoroundecanoic acid (PFUnDA)			
	Perfluorododecanoic acid (PFDoDA)			
	Perfluorotridecanoic acid (PFTrDA)			
	Perfluorotetradecanoic acid (PFTeDA)			
	Perfluorobutane sulfonic acid (PFBS)			
	Perfluoropentane sulfonoic acid (PFPeS)			
	Perfluorohexane sulfonic acid (PFHxS)			
	Perfluoroheptane sulfonic acid (PFHpS)			
	Perfluorooctane sulfonic acid (PFOS)			
	Perfluorodecane sulfonic acid (PFDS)			
	Perfluorooctanesulfonamide (PFOSA)			
	N-Ethyl perfluorooctane sulfonamide ethanol (N-EtFOSE)			
	N-Methyl perfluorooctane sulfonamide ethanol (N-MeFOSE)			
	N-Ethyl perfluorooctane sulfonamide (N-EtFOSA)			
	N-Methyl perfluorooctane sulfonamide (N-MeFOSA)			
	N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)			
	N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)			
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)			
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)			
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)			
	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)			
	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)			
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)			
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)			

5) Submit an Industrial Wastewater Discharge Permit application. Diversions from the storm drain system are required to include the following elements:
   - A telemetry system that allows the Districts to shut off the pumps remotely in case of emergency
   - Controls that turn off pumps automatically after 0.1 inch of rainfall (does not apply for real-time diversions based on sewer level) or when explosive gases are detected by the onsite lower explosive limit meter
   - A gas trap and air gap to prevent sewage and/or gas backing up into the project
   - A flow meter for the sewer discharge and a method to calibrate it
   - A sample box and flow and lower explosive limit recorders within 10 feet of the sewer discharge

   More information is available at https://www.lacsd.org/wastewater/industrial_waste/permit.asp
6) If the project proposes any project features in the LACSD's easement (such as pipe crossings, access roads, buildings, shoring systems to construct underground storage or a pump station), submit a Build Over application. Information on that process can be found here:

   https://www.lacsd.org/wastewater/buildover_procedures.asp
7) There is a design review from LACSD's Sewer Design Section:

   https://www.lacsd.org/wastewater/default.asp#sewerreview

At the end of that process an Industrial Wastewater Discharge Permit and Sewer Connection Permit can be issued.

The Sanitation Districts have also made significant changes to their fee structures to make diversions more feasible from a cost perspective. Specifically, since the implementation of SB 485, the Sanitation Districts have exempted diversions that meet the definition of a Local Governmental Diversion from connection fees. This means diversions from a stormwater conveyance or stormwater impoundment facility that is: a) owned by a local agency; b) discharged to the sewer system solely during periods of unused capacity as defined in the Industrial Wastewater Discharge Permit; and c) dedicated to uses that directly benefit the public in general as opposed to a single class or classes of individuals. This represents a significant savings to these projects. For example, a diversion with 20 milligrams per liter (mg/L) of COD and 20 mg/L of SS would be exempted from the one-time connection fee of $3,435/acre-ft[1 2]. This represents a significant cost savings for Local Governmental Diversion projects

Diversion projects are also charged lower treatment surcharge fees because stormwater is cleaner and easier to treat than sewage. For example, the treatment costs for sanitary sewage is $1,275.25/acre-ft[1]. Stormwater with 20 mg/L of chemical oxygen demand and 20 mg/L of suspended solids that is discharged to the sewer as recommended in Item 3 above (that is, operated to avoid the peak flow charge) would incur treatment costs (also known as the treatment surcharge) of $334.75/acre-ft[1]. The treatment surcharge that stormwater diversions pay is their share of the costs of operating the sewer, treatment plants, and necessary support functions minus the income from sales of treated water and other contract revenue sources.

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[1] To calculate the connection fee in this example, the project proponent would need to review the operation of the proposed project to identify the anticipated volume in acre-feet that would be diverted to the sewer over a typical calendar year.

[2] Calculations were made using Fiscal Year 20/21 rates for District 2. Rates are adjusted annually based on the cost of service. To calculate rates for another district or using other assumptions for peak flow operations or COD and SS loading, please see the rates on the Sanitation Districts website https://www.lacsd.org/services/wastewater/revenueprogram/RevenueDocuments.asp#section2

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Appendix F
Example Cost Categories

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Appendix F. Example Cost Categories

Table F-1 provides sample cost categories to construct and operate a diversion project.

Table F-1. Cost of Construction and Operations of a Diversion Project

Item
A. Annual O&M Costs
Treatment cost
Power and pumping Laboratory and sampling Compliance reporting
Miscellaneous (e.g., personnel time, equipment, and tools)
Total Annual O&M Cost
B. Construction (Capital) Costs
Diversion Structure
New diversion structure and removal of any existing structure and laying of conveyance pipelines Land acquisition cost Modification of existing diversion Pre-treatment unit Miscellaneous (e.g., piping, valves, control, monitoring, and equipment) Variable flow drive pump for flow discharge
Storage unit
Land acquisition cost
Underground / overground storage
Odor control feed pump
Cleaning equipment
Miscellaneous (e.g., piping, valves and equipment)
Total Construction (Capital) Cost
Total cost (Annual O&M cost and capital cost)
Unit cost for construction and operation ($/Gallons or $/acre-foot)

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Appendix G
Example Diversion Project Checklist

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Appendix G. Example Diversion Project Checklist

Table G-1 provides a sample checklist for diversion projects.

Table G-1. Sample Diversion Project Checklist

Number	Information Requirement Category	Action Items	Additional Clarification Needs
1	Goal/Project planning	Define project goals, objectives, and desired outcome.	Define the type of project: local or regional project and/or hybrid, new project or modification of an existing project
2	Coordination	Identify MS4 permittees and coordinate with them to discuss the project. Agencies may include: the stormwater and groundwater basin management agencies (e.g., the watermaster, groundwater management agencies, the LACFCD).	Identify and compile contact information of agencies involved in the project
3	System information and the site map	Gather project information, including location of the project, watershed and sewershed, location and size of storm drain/waterbody from where flows will be diverted; size and type of sewer line where flows will be diverted. Develop maps with the location of the project, including but not limited to, the watershed, storm drains, sewer network, and sewersheds.	Identify project needs (e.g., land availability for the diversion project and/or land for storage facility for expansion of an existing project)
4	Conceptual Plan/Planning level information	Develop a high-level project conceptual plan, including high-level technical and economic feasibility of the project; may include optimization of an existing diversion project or development of a new diversion project.	Gather high level project details, identify project constraints and data gaps
5	Permitting needs	Understand the permitting requirements of the project, including Environmental Impact Report/CEQA and individual permit requirements of the sanitation agency.	Understand the specific permits needed for the type of diversion (e.g., diverting flow from a storm drain or from a receiving waterbody)
6	Develop/gather missing information (e.g., flow and water quality data)	Gather additional flow and water quality data during dry and wet weather from the storm drain or waterbody that will be diverted by the diversion, specifically gather data per the requirements of the sanitation agency receiving the flows to understand the concentrations of specific pollutants to determine the diversion's impacts on downstream treatment processes.	Check existing (historical) data and/or develop and implement a monitoring plan to gather water quality data per the requirements of the sanitation agency.

Number	Information Requirement Category	Action Items	Additional Clarification Needs
7	Coordination; MOU/Contract with agencies	Define roles and responsibilities of agencies and project proponents (e.g., who will build, operate and maintain the infrastructure? Who will be responsible for implementing the project? Who will pay for the project?)	Develop a detailed project execution plan and share with agencies
8	Project costs	Develop project costs, including construction and O&M costs, with treatment costs and permit fee. Treatment cost will vary by agency based on the specific water quality requirements and fee structure.	Check requirements of the agencies for treatment fee and application fee
9	Detailed planning level analysis	Develop the project feasibility plan, including conveyance capacity analysis, diversion system capacity analysis, WRP capacity, size of storage for water detention, diversion operation timings, storage operations; Design and implementation plan of the project.	Identify constraints/issues and data gaps; Develop a plan to gather info and develop solutions for issues and mitigate risks.
10	Develop project funding plan, including cost sharing options	Apply funding for the project	Explore if Measure W funding can be secured for the construction and O&M of the project
11	Permitting	Apply and secure permits for the project	Complete all permit documents
12	Implementation	Design and construct the project	Coordinate with agencies as needed
13	O&M	Operate and maintain the project, monitor flow and water quality per the sanitation agency requirements; Monitor the conveyance system performance during dry and wet weather; Assess project performance	Prepare sampling and monitoring plan and post-project implementation activities

Notes:

MOU = Memorandum of Understanding

Jacobs

Challenging today.
Reinventing tomorrow.