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City of Oxnard

Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.3
INFRASTRUCTURE MODELING AND ALTERNATIVES

REVISED FINAL DRAFT
September 2017

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PREFACE

The analysis and evaluations contained in these Project Memorandum (PM) are based on data and information available at the time of the original date of publication, December 2015. After development of the December 2015 Final Draft PMs, the City continued to move forward on two concurrent aspects: 1) advancing the facilities planning for the water, wastewater, recycled water, and stormwater facilities; and 2) developing Updated Cost of Service (COS) Studies (Carollo, 2017) for the wastewater/collection system and the water/distribution system. The updated 2017 COS studies contain the most recent near-term Capital Improvement Projects (CIP). **The complete updated CIP based on the near-term and long-term projects is contained in the Brief History and Overview of the City of Oxnard Public Works Department's Integrated Planning Efforts: May 2014 – August 2017 section.**

At the time of this Revised PWIMP, minor edits were also incorporated into the PMs. Minor edits included items such as table title changes and updating reports that were completed after the December 2015 original publication date.

City of Oxnard

Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.3
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TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 PMs Used for Reference 1
2.0 HYDRAULIC MODEL DEVELOPMENT 1
2.1 Modeled Collection System and Skeletonization 1
2.2 Hydraulic Model Elements 5
2.3 Model Update 6
2.4 Wastewater Load Allocation 6
3.0 HYDRAULIC MODEL CALIBRATION 7
3.1 Calibration Standards 8
3.2 Dry Weather Flow Calibration 11
3.3 Wet Weather Flow Calibration 13
4.0 COLLECTION SYSTEM ANALYSIS 15
4.1 Level of Service 15
4.2 Design Storm 17
4.3 Hydraulic Conditions 18
4.4 Existing System Analysis 19
4.4.1 Dry Weather Hydraulics 19
4.4.2 Wet Weather Hydraulics 19
4.5 Future System Analysis 24
5.0 RECOMMENDED PROJECTS 26
5.1 Collection System Improvements 26
5.2 Pipeline Improvements 28
5.3 Pump Station Improvements 33
6.0 RECOMMENDED PROJECT – COSTS AND PHASE 33
6.1 Cost Summary 33
6.1.1 Rehabilitation Projects 34
6.2 Project Prioritization 34

APPENDIX A DRY WEATHER FLOW CALIBRATION PLOTS
APPENDIX B WET WEATHER FLOW CALIBRATION PLOTS AND RAIN GAGE LOCATIONS
APPENDIX C WASTEWATER COLLECTION SYSTEM IMPROVEMENTS

LIST OF TABLES

Table 1 Modeled System Pipeline Summary 2
Table 2 Dry Weather Weekday Flow Calibration Summary 12
Table 3 Dry Weather Weekend Flow Calibration Summary 13
Table 4 Wet Weather Flow Calibration Summary 17
Table 5 Existing System Deficiencies 21
Table 6 Future Period Statistics 24
Table 7 Proposed Pipeline Improvements 29
Table 8 Recommended Project Cost Estimates and Phasing for Collection System Capacity Projects 35
Table 9 Recommended Project Cost Estimates and Phasing for Collection System Capacity Project 37

LIST OF FIGURES

Figure 1 Modeled Wastewater Collection System 3
Figure 2 OWTP Overview 4
Figure 3 Tributary Flow Meter Areas 9
Figure 4 Flow Monitoring Schematic Updated 10
Figure 5 Example RDII Hydrograph 16
Figure 6 Pipes with d/D greater than 0.85 20
Figure 7 Surcharged Pipes During 10 Year Design Storm 23
Figure 8 2040 Design Hydrograph 25
Figure 9 Proposed Improvements 27

INFRASTRUCTURE MODELING AND ALTERNATIVES

1.0 INTRODUCTION

This Project Memorandum (PM) summarizes the process of updating and calibrating the City's existing hydraulic wastewater model. This PM also discusses several wastewater improvement projects needed for the existing system to accommodate design level wet weather flows as well as future flows due to growth that needs to be served by the wastewater collection system.

1.1 PMs Used for Reference

The analyses performed in this PM may be supplemented with additional information found in the following related PMs:

- PM 3.1 - Wastewater System - Background Summary.
- PM 3.2 - Wastewater System - Flow and Load Projections.

2.0 HYDRAULIC MODEL DEVELOPMENT

A hydraulic model of a wastewater collection system is a simplification of the physical network that currently serves residential, commercial, and industrial facilities within the wastewater treatment plant's service area. Typically, a hydraulic model will not include every pipe within the system because many small pipes do not have capacity issues. Therefore the model for the City is skeletonized to include only those major pipes (usually greater than 10-inches in diameter).

The City provided an initial model that was developed previously in SewerGEMS. Carollo has been tasked by the City to update the model with recent information on the pipelines and pump stations, calibrate the model to measured dry and wet weather flows, and project what facilities are needed in the future to serve future expected growth within the service area.

2.1 Modeled Collection System and Skeletonization

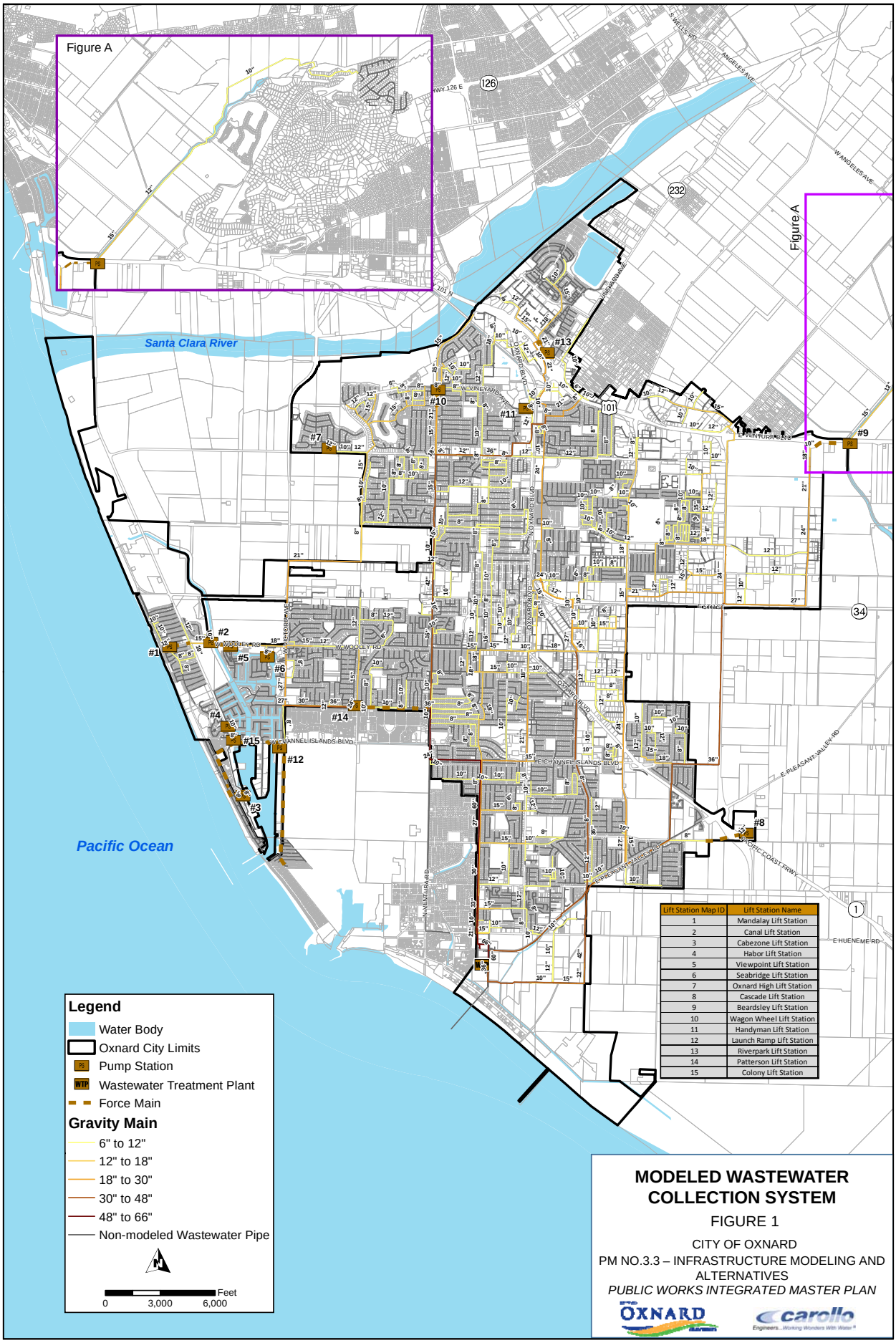
Skeletonization is the process by which sewer system models are stripped of pipelines not considered essential for the intended analysis purpose. The purpose of skeletonizing a system is to develop a model that accurately simulates the hydraulics of a collection system, while at the same time reducing the complexity of the model so that computational run times are kept to a minimum for analysis purposes.

It is common practice in sewer system master planning to exclude small diameter sewers when developing a hydraulic computer model. The City's hydraulic model primarily includes pipelines that are 8-inches in diameter and larger. Some smaller diameter sewers (6-inches in diameter and smaller) are also included in the City's hydraulic model where needed for connectivity.

The modeled sewer system consists of approximately 140 miles of sanitary sewer pipelines ranging in diameter from 4-inches to 66-inches, and 15 sanitary sewer lift stations. Table 1 summarizes the modeled sewer system by diameter and length of pipe. Not included in these totals are smaller sewers that were excluded during model skeletonization and therefore are not modeled. The modeled pipe length equals 736,708 feet which is approximately 32.4 percent of the entire collection system. Table 1 illustrates the City's modeled wastewater collection system, which is also shown in Figure 1. Figure 2 presents an overview of the pipes around the Oxnard Wastewater Treatment Plant (OWTP).

Table 1 Modeled System Pipeline Summary
Public Works Integrated Master Plan
City of Oxnard

Pipe Diameter, in.	Length, feet		Percent of Total, %	
	Force Main	Gravity Main	Force Main	Gravity Main
6 and smaller	6,753	1,313	21.4%	0.2%
8	8,586	143,937	27.2%	20.4%
10	4,235	143,327	13.4%	20.3%
12	7,955	94,551	25.2%	13.4%
15	0	86,962	0.0%	12.3%
16	0	1,762	0.0%	0.2%
18	0	42,840	0.0%	6.1%
20	4,000	0	12.7%	0.0%
21	0	33,839	0.0%	4.8%
24	0	30,547	0.0%	4.3%
27	0	21,080	0.0%	3.0%
30	0	6,982	0.0%	1.0%
33	0	2,549	0.0%	0.4%
36	0	50,284	0.0%	7.1%
42	0	27,722	0.0%	3.9%
48	0	94	0.0%	0.0%
60	0	16,322	0.0%	2.3%
66	0	1,068	0.0%	0.2%
Total	**31,529**	**705,179**	**100.0%**	**100.0%**



Lift Station Map ID	Lift Station Name
1	Mandalay Lift Station
2	Canal Lift Station
3	Cabezone Lift Station
4	Habor Lift Station
5	Viewpoint Lift Station
6	Seabridge Lift Station
7	Oxnard High Lift Station
8	Cascade Lift Station
9	Beardsley Lift Station
10	Wagon Wheel Lift Station
11	Handyman Lift Station
12	Launch Ramp Lift Station
13	Riverpark Lift Station
14	Patterson Lift Station
15	Colony Lift Station

MODELED WASTEWATER COLLECTION SYSTEM

FIGURE 1

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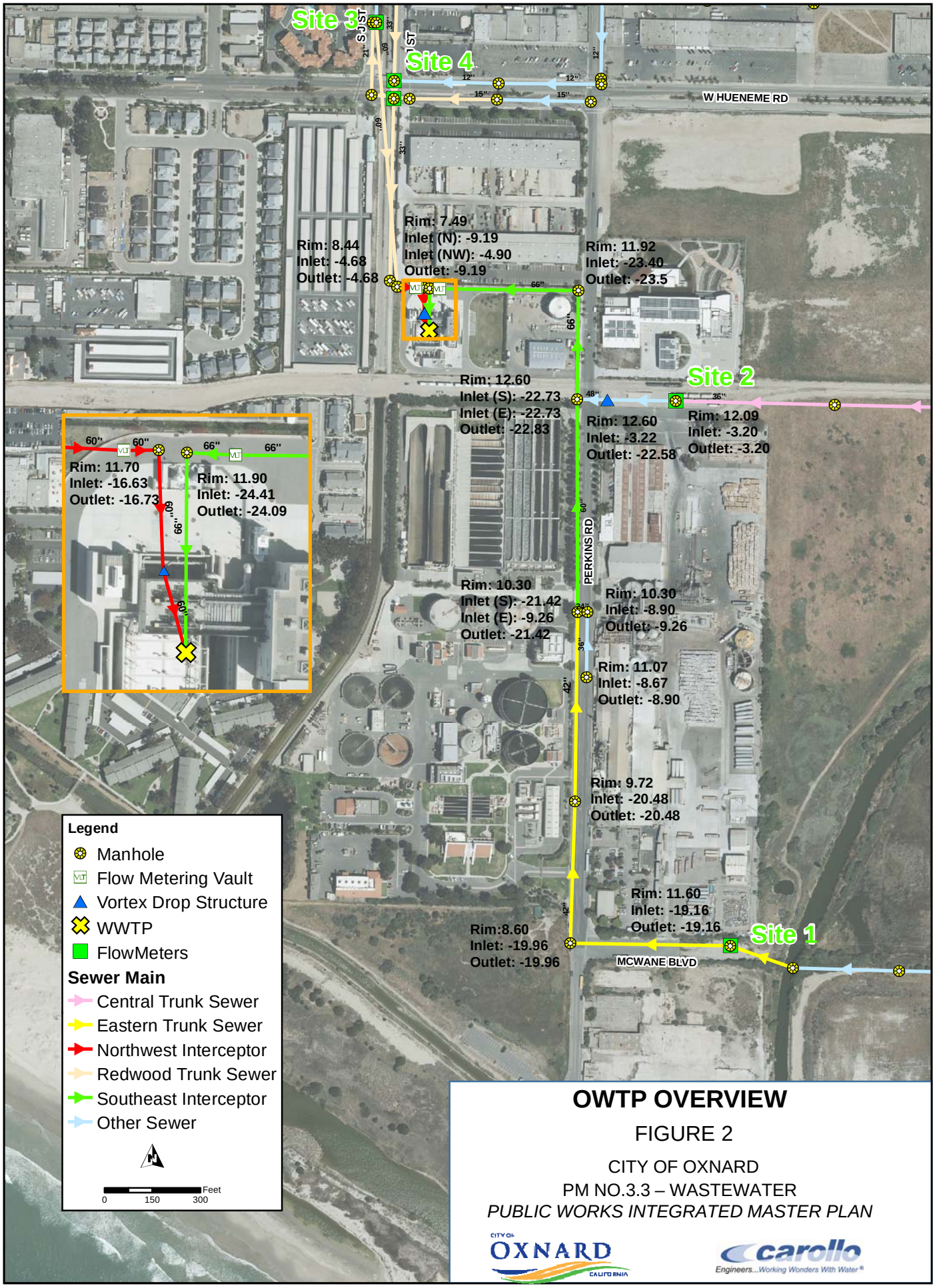

OWTP OVERVIEW

FIGURE 2

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2.2 Hydraulic Model Elements

The following provides a brief overview of the major elements of the hydraulic model and the required input parameters associated with each:

- **Conduits**: Gravity sewers are represented as conduits in the hydraulic model. Input parameters for pipes include length, friction factor (Manning's n), invert elevations, diameter and entrance and exit loss coefficients (k-factors).

- **Pressure Pipes**: Force mains are represented as pressure pipes in the hydraulic model. Input parameters for pipes include length, friction factor (Hazen Williams), invert elevations, diameter, and entrance and exit loss coefficients (k-factors).

- **Manholes**: Gravity sewer manholes, as well as other locations where gravity pipe sizes change or where gravity pipelines intersect are represented as junctions. Required inputs for junctions include rim elevation, invert elevation and diameter. Junctions are also used to represent locations where flows are split or diverted between two or more gravity sewers.

- **Outfall**: Outfalls represent areas where flow leaves the system. For sewer system modeling, an outfall typically represents the connection to the influent pump station at a wastewater treatment plant.

- **Pumps**: Pumps can be included in the hydraulic model. Input parameters for pumps include pump curve, invert elevation and operational controls (start/stop elevations, as well as any real time control algorithms).

- **Wet Wells**: Wet wells are typically required at pumping stations to store wastewater before it is pumped. Wet wells normally serve as collection/storage nodes for gravity systems. Input parameters for wet wells include, invert elevation, rim elevation, wet well depth, and wet well cross sectional area (depth and cross sectional are used to calculate the volume of the wet well).

- **Pressure Junctions**: Pressure junctions are basically connections between two or more pressure pipes. Inputs for pressure junction include rim elevation and invert elevation.

- **Inflows**: The following are the different types of wastewater flow sources that can be injected into individual model junctions:
  - **External**. External inflows can represent any number of flows into the collection system such as large industrial flow inputs. External inflows are applied to a specific model junction by applying a baseline flow value and a corresponding pattern that varies the flow by a certain time period.
  - **Dry Weather**. Dry weather inflows simulate base sanitary wastewater flows and represent the average flow. The dry weather flows can be multiplied by patterns

that vary the flow by a defined time period. The dry weather diurnal patterns are adjusted during the dry weather calibration process.

– **Rain Derived Infiltration and Inflow (RDII)**. RDII can be applied in the model in different ways, but the method chosen for the City's model is a triple triangular unit hydrograph method. It is applied in the model by assigning a unit hydrograph and a corresponding tributary area to a given junction. The unit hydrographs consist of several parameters that are used to adjust the peak and volume of RDII that enters the system at a given location. These parameters are adjusted during the wet weather calibration process.

2.3 Model Update

The City's hydraulic model combines information on the physical and operational characteristics of the wastewater collection system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes. The City provided the model as a SewerGEMS input file. Carollo is currently applying SewerGEMS v.8i to update the model and apply it for development of a capital improvement program.

The model update process consisted of the following steps, as described below:

- Step 1: The SewerGEMS hydraulic model obtained from the City was updated primarily with the City's GIS data. The Modelbuilder tool in SewerGEMS allowed the importing of the GIS data into a format that would be useable in SewerGEMS. As mentioned previously, the updated model primarily contains pipelines that are 8-inches in diameter and larger. Some smaller diameters were included where needed for connectivity.

- Step 2: Once the GIS data was imported into SewerGEMS, the updated hydraulic model was reviewed to verify that the model data was input correctly and the flow direction, size, and layout of the modeled pipelines were logical. Quality assurance and quality control (QA/QC) involved comparing the updated hydraulic model with limited other data sources such as record drawings, atlas sheets, and discussions with City personnel. Significant data input was not part of this effort.

2.4 Wastewater Load Allocation

An important component of the hydraulic modeling process is to determine the quantity of dry weather wastewater flows generated by a municipality and how these flows are distributed throughout the collection system. Various techniques can be used to assign wastewater flows to individual model junctions, depending on the type of data that is available. Adequate estimates of the volume of wastewater are important in maintaining and sizing sewer system facilities, both for present and future conditions.

Baseline wastewater loads were divided into residential loads and non-residential loads. Residential loads were allocated in the hydraulic model based on 2012 population data from Traffic Analysis Zones (TAZ) provided by the City. Non-residential loads were allocated in the hydraulic model based on water consumption data, which was also provided by the City, from January to March of 2012.

The general process for allocating the wastewater loads is described below:

- Step 1: The City's service area was broken up into 733 individual loading polygons. Each loading polygon represents the geographic area that contributes flows into a single model node (i.e., manhole). In a skeletonized model such as the City's hydraulic model, a loading polygon will usually encompass a group of lots.

- Step 2: For the residential loads, each loading polygon had to be assigned a population value. Since the population data was originally in the TAZ polygons, and certain TAZ polygons overlay one or more loading polygons, a weighted average was used to calculate the population numbers. It was assumed that the loading polygons only had population in the developed areas; information regarding the land type was obtained through the zoning polygons provided by the City. Once the loading polygons had a population number, a gallons per capita per day (gpcd) value, based on engineering judgment was assigned to each polygon to obtain the average residential flow in gallons per day (gpd).

- Step 3: For the non-residential loads, the average non-residential flow in gpd was calculated using water consumption data from January to March of 2012. Water consumption during these months was assumed to be primarily indoor consumption, which would give a good approximation of residential sewer discharges. Once average non-residential flows were obtained, the values were spatially mapped to the corresponding non-residential parcel point. Each parcel point represents the centroid of a non-residential parcel polygon. It was also assumed that all the flows from each non-residential parcel point flows to the loading polygon that it is located in.

- Step 4: The allocated loads were adjusted as necessary during the dry weather flow calibration process (refer to Section 3.2) to closely match the actual measured dry weather flows recorded during the flow monitoring period.

3.0 HYDRAULIC MODEL CALIBRATION

Hydraulic model calibration is a crucial component of the hydraulic modeling effort. Calibrating the model to match data collected during the flow-monitoring period ensures the most accurate results possible. The calibration process consists of calibrating to both dry and wet weather conditions.

For this project, both dry and wet weather flow monitoring were conducted. Refer to PM 3.11 for the Flow Monitoring Report. Dry weather and wet weather flow monitoring was conducted at 10 open-channel flow monitoring sites. Dry weather flow monitoring occurred from August 2, 2014 to August 24, 2014 and wet weather flow monitoring occurred from December 9, 2014 to February 25, 2015. Except for one location, the wet weather monitoring sites were at the same locations as the dry weather monitoring sites. The flow monitoring for Site 4A was performed one manhole upstream from Site 4 as the new site had better hydraulic conditions for flow monitoring. Rainfall data for five rainfall recording sites was obtained from the Ventura County Watershed Protection District Hydrologic Data Server. The location of the flow meters is presented in Figure 3 while a flow metering schematic is presented in Figure 4.

Dry weather flow (DWF) calibration ensures an accurate depiction of base wastewater flow generated within the study area. Wet weather flow (WWF) calibration consists of calibrating the hydraulic model to a specific storm event or events to accurately simulate the peak and volume of infiltration/inflow (I/I) into the sewer system. The amount of I/I is essentially the difference between the WWF and DWF components.

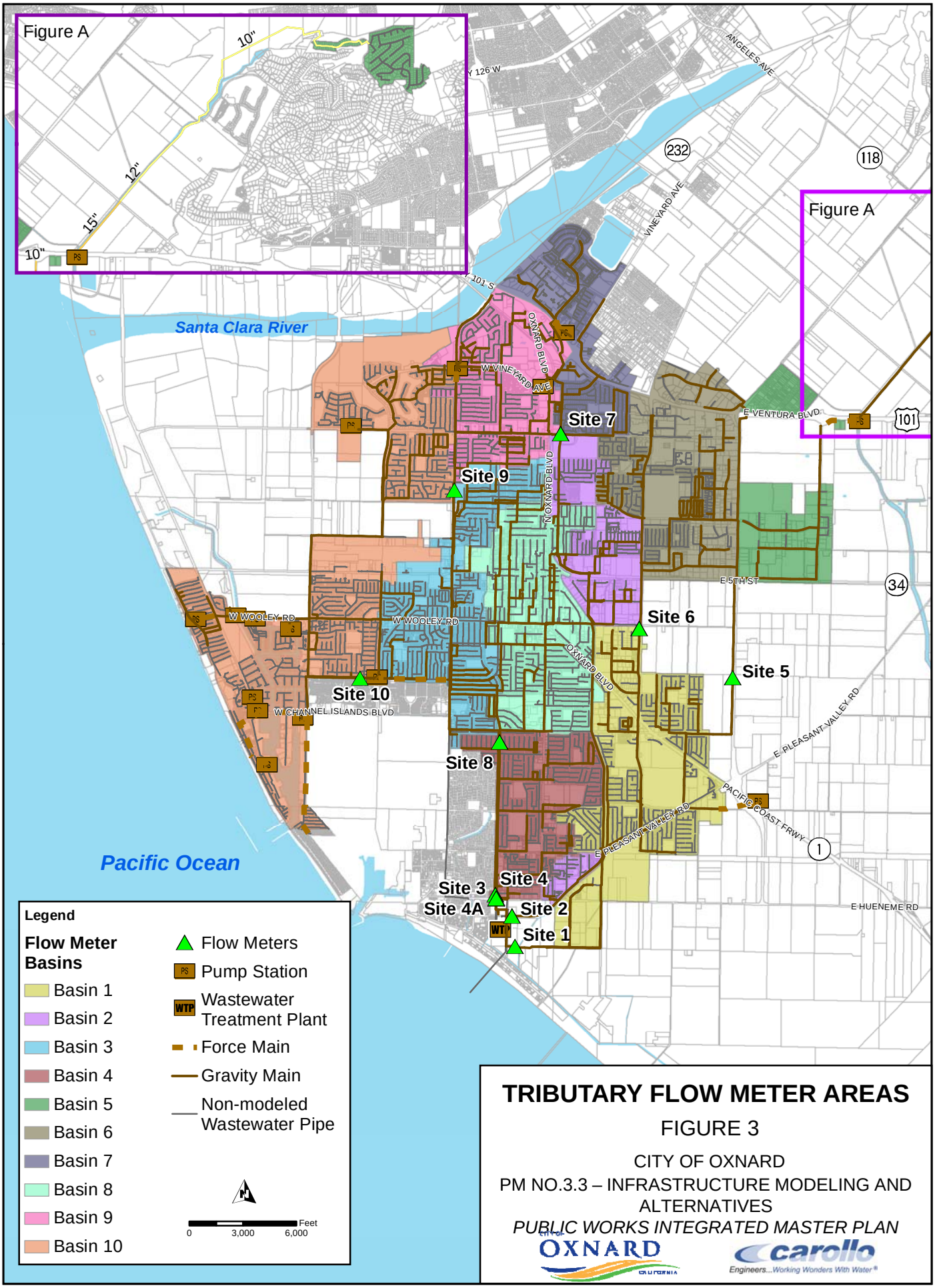
3.1 Calibration Standards

The hydraulic model was calibrated in accordance with international modeling standards. The Wastewater Planning Users Group (WaPUG), a section of the Chartered Institution of Water and Environmental Management (CIWEM), has established generally agreed upon principles for model verification. The dry weather and wet weather calibration focused on meeting the recommendations on model verification contained in the "Code of Practice for the Hydraulic Modeling of Sewer Systems," (http://www.ciwem.org/media/44426/Modelling_COP_Ver_03.pdf) published by the WaPUG (WaPUG 2002), and is summarized below:

- **Dry Weather Calibration Standards**: DWF calibration should be carried out for two dry weather days and the modeled flows and depths should be compared to the field measured flows and depths. Both the modeled and field measured flow hydrographs should closely follow each other in both shape and magnitude.

  In addition to the shape, the observed flow and model hydrographs should also meet the following criteria as a general guide:

  – The timing of the flow peaks and troughs should be within one hour.
  – The peak flow rate should be within the range of ±10 percent.
  – The volume of flow (or the average rate of flow) should be within the range of ± 10 percent. If applicable, care should be taken to exclude periods of missing or inaccurate data.



TRIBUTARY FLOW METER AREAS

FIGURE 3

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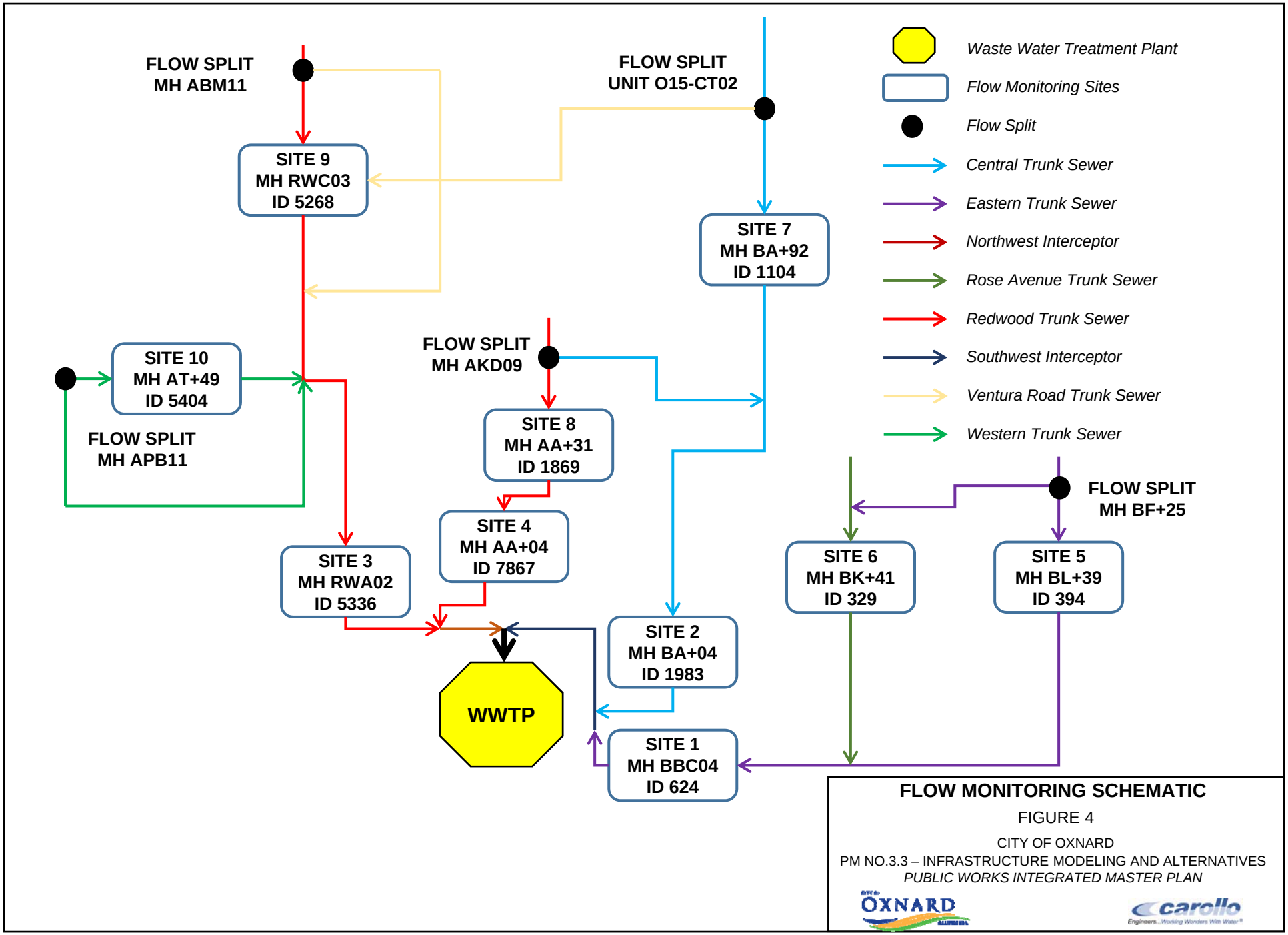

FLOW MONITORING SCHEMATIC

FIGURE 4

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- **Wet Weather Calibration Standards**: WWF calibration should be carried out and the modeled flows and depths should be compared to the field measured flows and depths. The flow hydrographs should closely follow each other in both shape and magnitude, until the flow has substantially returned to dry weather flow rates.

  In addition to the shape, the observed and modeled flow hydrographs should also meet the following criteria as a general guide:

  – The timing of the peaks and troughs should be similar with regard to the duration of the event.
  – The peak flow rates at each significant peak should be in the range of +25 percent to -15 percent and should be generally similar throughout the event.
  – The volume of flow (or the average flow rate) should be within the range of +20 percent to -10 percent. Care should be taken to exclude periods of missing or inaccurate data.

3.2 Dry Weather Flow Calibration

The DWF calibration process consists of several elements as outlined below:

- **Develop Tributary Flow Meter Areas**. The first step in the calibration process was dividing the City into flow meter tributary areas. Ten tributary flow areas were created, one for each flow meter. Once the tributary flow meter areas were defined, each loading polygon was assigned to a tributary flow meter area. The tributary flow meter areas can be seen in Figure 3.

- **Calculate Flow Volume within Each Flow Meter Area**. The next step was to define the flow volume within each flow meter area, which was accomplished in the wastewater load allocation. The flow volume was eventually adjusted as part of the calibration process. Adjustments included but were not limited to the following: modifying the gpcd values assigned to each loading polygon, spatially adjusting the location of the non-residential parcel points, and/or assigning external inflows.

- **Create Diurnal Patterns to Match the Temporal Distribution of Flow**. A diurnal pattern is a pattern of hourly multipliers that are applied to the base flow to simulate the variation in flow that occurs throughout the day. Two diurnal patterns were developed for each flow monitoring tributary area, one representing weekday flow and one representing weekend flow. The diurnal patterns were initially developed based on the flow monitoring data and adjusted as part of the calibration process until the model simulated flows closely matched the field measured flows. The calibrated weekday and weekend diurnal curves were developed for each of the meters and its tributary area. These curves are included in Appendix A.

- **Adjust Model Variables**. Once the model simulated flow volumes and diurnal patters acceptably matched the field measured flows, the model simulated velocity and flow depth were compared to the field measured velocity and flow depth. Adjustments were made to various model parameters until the modeled and measured velocity and depth closely matched one another. The primary varied parameter for this process is the amount of sediment in the pipe, since this is a way to adjust the flow depths upward to match measured conditions, while this also adjusts the velocity downward to match measured conditions, and thus matching measured flows. Other parameters can also be adjusted as calibration results are generated.

Table 2 and 3 provide a summary of the dry weather flow calibration using the average and daily peak flow results for both weekday and weekend conditions. As mentioned previously, the flow monitoring for Site 4A was performed one manhole upstream from Site 4 as the new site had better hydraulic conditions for flow monitoring. In general, the model simulated average and peak flows for both weekday and weekend DWF were all within ±10 percent.

Table 2 Dry Weather Weekday Flow Calibration Summary
Public Works Integrated Master Plan
City of Oxnard

Meter Number	Pipe Diameter (in)	Measured Data		Modeled Data		Percent Error(1)	
		Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (%)	Peak Flow (%)
1	41.5	5.390	7.021	5.343	7.139	-0.9%	1.7%
2	36	2.759	3.111	2.650	2.959	-4.0%	-4.9%
3	60	7.027	9.830	7.036	9.766	0.1%	-0.7%
4A(2)	33	3.131	4.786	3.438	4.639	9.8%	-3.1%
5	36	1.483	2.010	1.442	1.883	-2.8%	-6.3%
6	24	1.440	2.137	1.479	2.072	2.7%	-3.0%
7	24	0.310	0.420	0.314	0.424	1.3%	1.0%
8	27	1.820	2.547	1.979	2.705	8.7%	6.2%
9	42	2.014	2.876	2.172	3.096	7.9%	7.6%
10	37	1.876	2.332	1.908	2.392	1.7%	2.6%

Note:
(1) Percent Error = (Modeled - Measured)/Measured*100.
(2) Flow monitoring for Site 4A was performed one manhole upstream from Site 4. Flow monitoring data for Site 4A was available from December 9, 2014 to February 25, 2015.

Table 3	Dry Weather Weekend Flow Calibration Summary Public Works Integrated Master Plan City of Oxnard						
		Measured Data		Modeled Data		Percent Error(1)	
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (%)	Peak Flow (%)
1	41.5	4.547	5.655	4.567	5.812	0.4%	2.8%
2	36	2.352	2.656	2.353	2.757	0.1%	3.8%
3	60	7.515	11.051	7.362	10.783	-2.0%	-2.4%
4A(2)	33	3.378	5.088	3.481	4.887	3.1%	-4.0%
5	36	0.972	1.183	1.037	1.268	6.7%	7.3%
6	24	1.126	1.672	1.140	1.592	1.2%	-4.8%
7	24	0.317	0.444	0.309	0.436	-2.5%	-1.6%
8	27	1.842	2.630	1.996	2.845	8.3%	8.2%
9	42	2.113	3.188	2.259	3.518	6.9%	10.3%
10	37	2.036	2.917	1.942	2.744	-4.6%	-5.9%

Notes:
(1) Percent Error = (Modeled - Measured)/Measured*100.
(2) Flow monitoring for Site 4A was performed one manhole upstream from Site 4. Flow monitoring data for Site 4A was available from December 9, 2014 to February 25, 2015.

Appendix A contains a detailed DWF calibration summary sheet for each of the 10 meter sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for both weekday and weekend conditions. In general, there is good overall correlation of the field measured data to the model output results. However, there are a few sites where the modeled levels, and/or velocities were outside the generally accepted calibration tolerances. Although adjustments were tried, these sites could not be further adjusted to any better meet the measured data. Since the flow volumes and peak flows were within the acceptable calibration tolerances, the hydraulic model was considered calibrated for DWFs.

3.3 Wet Weather Flow Calibration

The WWF calibration enables the hydraulic model to accurately simulate I/I entering the collection system during a significant storm. As outlined below, the WWF calibration process consists of several elements:

- **Identify rainfall events for WWF Calibration**. The WWF calibration process consists of running model simulations of rainfall events based on data collected as part of the wet weather flow monitoring. The goal of any wet weather flow monitoring

program is to capture and characterize a system's response to a significant rainfall event, preferably during wet antecedent moisture conditions.

As previously stated, WWF monitoring was conducted from December 9, 2014 to February 25, 2015. During this time period, there were two notable rainfall events. Rainfall Event 1 occurred between December 11, 2014 and December 12, 2014; the total amount of rainfall was between 1.89 inches and 2.55 inches for the five rainfall recording sites. Rainfall Event 2 occurred between January 10, 2015 and January 11, 2015; the total amount of rainfall was between 1.46 and 2.26 inches for the five rainfall sites.

The selection of a particular calibration storm is based on a review of the flow and rainfall data. For WWF calibration, the model was run from December 10, 2014 to December 15, 2014 and calibrated to Rainfall Event 1. In general, it is better to use larger storms for WWF calibration. If longer durations are considered, Rainfall Event 1 was greater than a 2-year storm event for a 12-hour duration and greater than a 1-year storm event for a 2-day duration. Rainfall Event 2 was less than a 1-year storm event for all durations.

In order to run a model simulation for Rainfall Event 1, the average hourly rainfall data from the five rainfall recording sites were input into the model. Each flow monitoring tributary area was assigned a similar rainfall hyetograph.

- **Define RDII Tributary Areas**. For the WWF calibration process, RDII flows are superimposed on top of the DWF within the model. The model calculates RDII by assigning RDII flows to each node in the model that has a DWF flow assigned to it. RDII flows consist of both a unit hydrograph and the total developed area that is tributary to the model node. The RDII tributary areas were calculated in GIS using the loading polygons. The RDII tributary areas were composed mostly of developed land area, which meant that any large vacant, open space, or other areas in the City which are not expected to contribute to I/I into the collection system were excluded. The tributary area provides a means to transform hourly rainfall depth from the rainfall hyetographs into a rainfall volume. The rainfall volume is transformed in actual RDII flows using the unit hydrograph, as described in the next step.

- **Create I/I Parameter Database**. The main step in the WWF calibration process involves creating custom unit hydrographs for each flow monitoring tributary area using the RTK Method, which is widely used in collection system master planning. Using the RTK Method, the RDII unit hydrograph is the summation of three separate triangular hydrographs (short term, medium term, and long term), which are each defined by three parameters: R, T and K. R represents the fraction of rainfall over the tributary area that contributes directly to I/I; T represents the time to peak of the hydrograph; and K represents the ratio of time to recession to the time to peak. There

are a total of nine separate variables associated with each unit hydrograph. Figure 5 shows the shape of an example unit hydrograph.

The hydrographs utilize the R-values (percentage of rainfall that enters the collection system) calculated for each tributary area to simulate I/I. The nine variables in each unit hydrograph were initially set based on engineering judgment and then adjusted until the model simulated flows (both peak flows and volumes) matched closely with the field measured flows.

Similar to the DWF calibration process, the WWF calibration process compared meter data with the model output. Comparisons were made for average and peak flows as well as the temporal distribution of flow until flows returned to their baseline levels. The hydraulic model was considered to be satisfactorily calibrated based on the WWF calibration standards discussed in Section 3.1.

- **Refine Model Variables**. After the hydraulic model was considered to be satisfactorily calibrated for wet weather flows, the model simulated velocities and flow depths were checked against the field measured velocities and flow depths during the calibration rain event. Refinements were made to the various model parameters so that the modeled and measured velocity and depth closely matched one another.

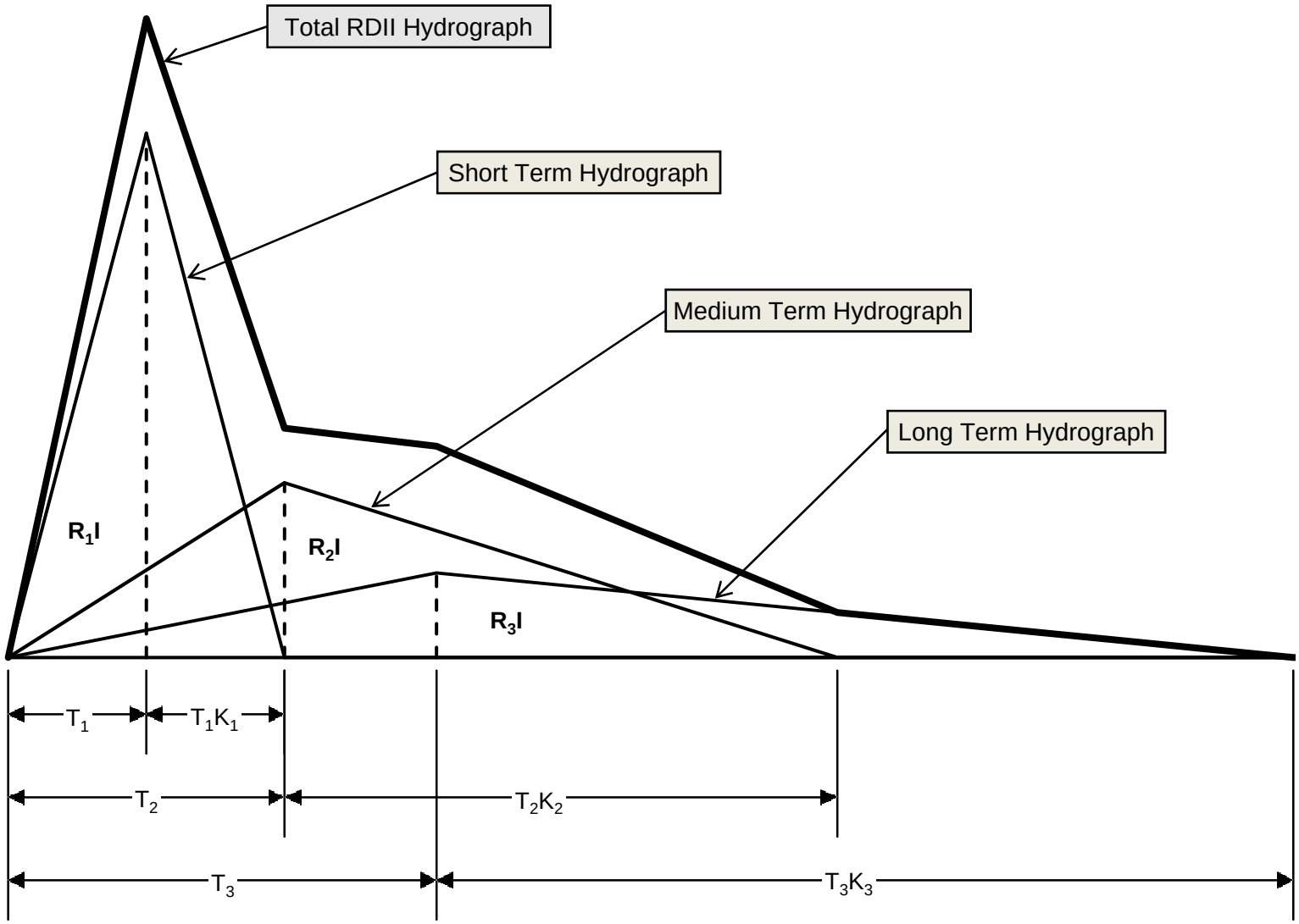
Appendix B contains the detailed wet weather flow calibration summary sheet for each of the ten meter sites as well as the locations of the five rain gages. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for the calibration storm. Table 4 provides a summary of the wet weather flow calibration using the average and peak flow results. In general, the model simulated average and peak flows for all meter sites were within the acceptable tolerances and therefore the model was calibrated and ready to use for capacity analysis purposes.

4.0 COLLECTION SYSTEM ANALYSIS

Once the collection system hydraulic model was calibrated, it was used to assess any capacity restrictions within the existing system. Capacity restrictions need to be defined within the context of a level of service. Level of service can be defined in many ways and will be discussed below as it relates to the existing and future capacity deficiencies.

4.1 Level of Service

Level of service (LOS) assumptions were developed by the City and Carollo to apply to the modeling effort to determine what conditions would need to be planned for in the future. The LOS criteria included assumptions on the level of design storm that would be applied to predict peak wet weather flows, the acceptable surcharge criteria in the pipelines to determine hydraulic deficiencies, and the improvement configurations for existing pipelines (e.g., parallel versus upsizing).



EXAMPLE RDII HYDROGRAPH

FIGURE 5

CITY OF OXNARD

PM NO.3.3 – INFRASTRUCTURE MODELING AND ALTERNATIVES

PUBLIC WORKS INTEGRATED MASTER PLAN

Table 4	Wet Weather Flow Calibration Summary Public Works Integrated Master Plan City of Oxnard						
		Rainfall Event 1 (12/11/2014 - 12/12/2014)					
		Measured Data		Modeled Data		Percent Error(1)	
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Flow (%)	Peak Flow (%)
1	41.5	5.284	6.808	5.506	7.395	4.2	8.6
2	36	3.063	5.780	2.744	6.086	-10.4	5.3
3	60	7.739	10.727	7.185	10.352	-7.2	-3.5
4A	33	3.298	4.818	3.779	5.413	14.6	12.3
5	36	1.634	2.663	1.475	2.739	-9.7	2.8
6	24	1.350	1.921	1.517	2.078	12.4	8.2
7	24	0.331	0.503	0.328	0.481	-0.8	-4.5
8	27	2.292	4.191	2.305	4.260	0.6	1.6
9	42	2.301	3.231	2.380	3.421	3.4	5.9
10	37	2.297	3.533	2.169	3.279	-5.6	-7.2

Note:
(1) Percent Error = (Modeled - Measured)/Measured*100.

4.2 Design Storm

It was decided by the City and Carollo that a 10-year, 24-hour design storm would be used to determine inflow conditions that would test the hydraulic capacity of the sewers during wet weather conditions. The 10-year, 24-hour design storm for Oxnard has a peak 1-hour intensity of 1.04 inches per hour and a total volume of 4 inches of rain in 24 hours. This design event was developed using a SCS Type IA distribution.

This level event is commonly used to plan sanitary sewer collection system improvements because it provides a reasonable level of wet weather I/I. But this level event does not tend to overestimate the amount of I/I that can enter a system during very large events, since it is very difficult to quantify flows during extreme flood events (e.g. greater than a 10-year event) due to the unknown interaction between the sanitary and separate storm drain system. This design event will produce the majority of the inflow within the model, but assumptions need to be made to estimate a design condition for infiltration since this short duration, high intensity rainfall event will not produce appreciable wet weather infiltration, which occurs due to long wet periods that saturate the soil conditions.

4.3 Hydraulic Conditions

Two hydraulic conditions are used to examine the hydraulic results in the model; depth to diameter ratio (d/D), and surcharge. A d/D ratio is used to examine the “capacity” of the pipeline under certain flow conditions. The “d” is the depth of peak flow in any give interceptor segment and the “D” is the diameter of the pipes within that segment. Although a d/D of 100 percent typically is referred to as full pipe “capacity,” more flow can be conveyed through a sewer pipe under surcharge conditions (when the slope of the hydraulic grade line exceeds the slope of the pipe and the complete sewer segment is surcharged).

Therefore d/D is typically used to assess dry weather flow conditions. DWF (which includes base sanitary flow and dry weather infiltration) are applied in the model and the d/D ratios are examined to judge how efficient the system is in conveying DWFs. This ratio should always be lower than 90 percent and is typically judged acceptable if it is in the 75 to 85 percent range during peak dry weather flows. If this ratio is found to be too low during peak DWF (e.g. 20 percent) then deposition can be a problem since the flushing velocities will be low (e.g., less than 2 feet/second).

The conditions listed above are for PDWF analysis of existing sewers. Parameters used to analyze existing sewers can be different from those same parameters used to design sewers. For example, City design standards indicate that d/D for pipelines 10-inches in diameter and less should be 0.5, while d/D for pipelines 12-inches in diameter and greater should be 0.67. These d/D's are for design, but there can be additional infiltration that occurs in actual sewers over time that cause the d/D to exceed design parameters. Therefore, for this planning analysis of existing sewers the design d/D's will be relaxed to planning level d/D's as mentioned above (0.75 - 0.85).

The wet weather LOS surcharge condition for analysis of deficiencies in the previous master plan was a d/D no greater than 1 (full pipe). This criteria is very conservative for 10-year event and will produce an excessive amount of pipelines in need of replacement.

Therefore, for this analysis, a different LOS was chosen for wet weather conditions. The wet weather LOS for the existing network and future system configurations were chosen to be a peak hydraulic grade line (HGL) no closer than 3 foot below the rim elevation of any manhole along a reach of pipeline during the 10-year, 24-hour design event. This criterion would allow some surcharge during design event conditions, but allowed a margin of safety in the HGL predictions so as to limit the potential for SSOs. If a manhole has a rim elevation less than 3 feet from the crown of the pipe, this criteria does not apply since these shallow manholes are usually sealed and allow for surcharge conditions (or may need to be sealed in the near future - further investigation of these shallow manholes should be undertaken).

However, this surcharge condition does include some associated risk. This risk depends on the invert elevations of the lateral sewers that connect into the interceptor system. These

lateral sewers are not included in the model but are the smaller diameter pipelines that directly service residential, commercial, and some industrial facilities. The City indicated that there were very few complaints related to wet weather backups and flooding due to wet weather events within the service area. As growth continues, and rainfall events larger than a 10-year, 24 hour event occur (which will happen, and may be more frequent due to climate change), surcharge and flooding should be closely tracked to make sure lateral sewers aren't being affected due to peak HGLs in the interceptor system.

4.4 Existing System Analysis

The above criteria were applied to the baseline conditions in the existing model to examine what capacity deficiencies are currently present within the interceptor system. The flows generated by the model include the 10-year, 24 hour inflow, the wet weather infiltration, the existing sanitary flow, and the dry weather infiltration. The model was run over a two day period (weekday and weekend). The hydraulic conditions the model produced were then examined based on the LOS criteria for d/D for dry weather and surcharge criteria for wet weather.

4.4.1 Dry Weather Hydraulics

The model was initially run using calibrated DWFs to examine the hydraulic conditions within the interceptor system during typical dry periods. It was found that peak dry weather flow (PDWF) conditions did not contribute to any surcharging in the current interceptor system. The current ADWF equals 18.1 mgd, with a PDWF of 22.9 mgd at the Oxnard Wastewater Treatment Plant (OWTP).

However, PDWFs caused some pipelines to exhibit high depths to diameter (d/D) ratios near 0.85 (or 85 percent capacity). Therefore, the current interceptor is properly sized for existing DWFs, but some interceptor reaches are approaching their peak DWF capacity. Pipes with peak d/D ratios greater than 85 percent are presented in Figure 6.

4.4.2 Wet Weather Hydraulics

The model was also run using the calibrated WWFs to examine if any surcharge was present in the system and if the surcharge criteria were violated during the 10-year, 24-hour event. Since the 10-year event is an intense rainfall event with significant volume over a short period of time, it is not surprising that surcharge will occur in parts of the system. The peak wet weather flow for the design event for existing conditions was 39.5 mgd at the OWTP.

However, since SSOs are not allowed as per the Clean Water Act (CWA), any discharges out of manholes are not allowed and improvements will need to be initiated to remediate this type of hydraulic situation. Based on the design level flows and hydraulics within the model, no junctions in the model showed flooding for the current baseline existing system.

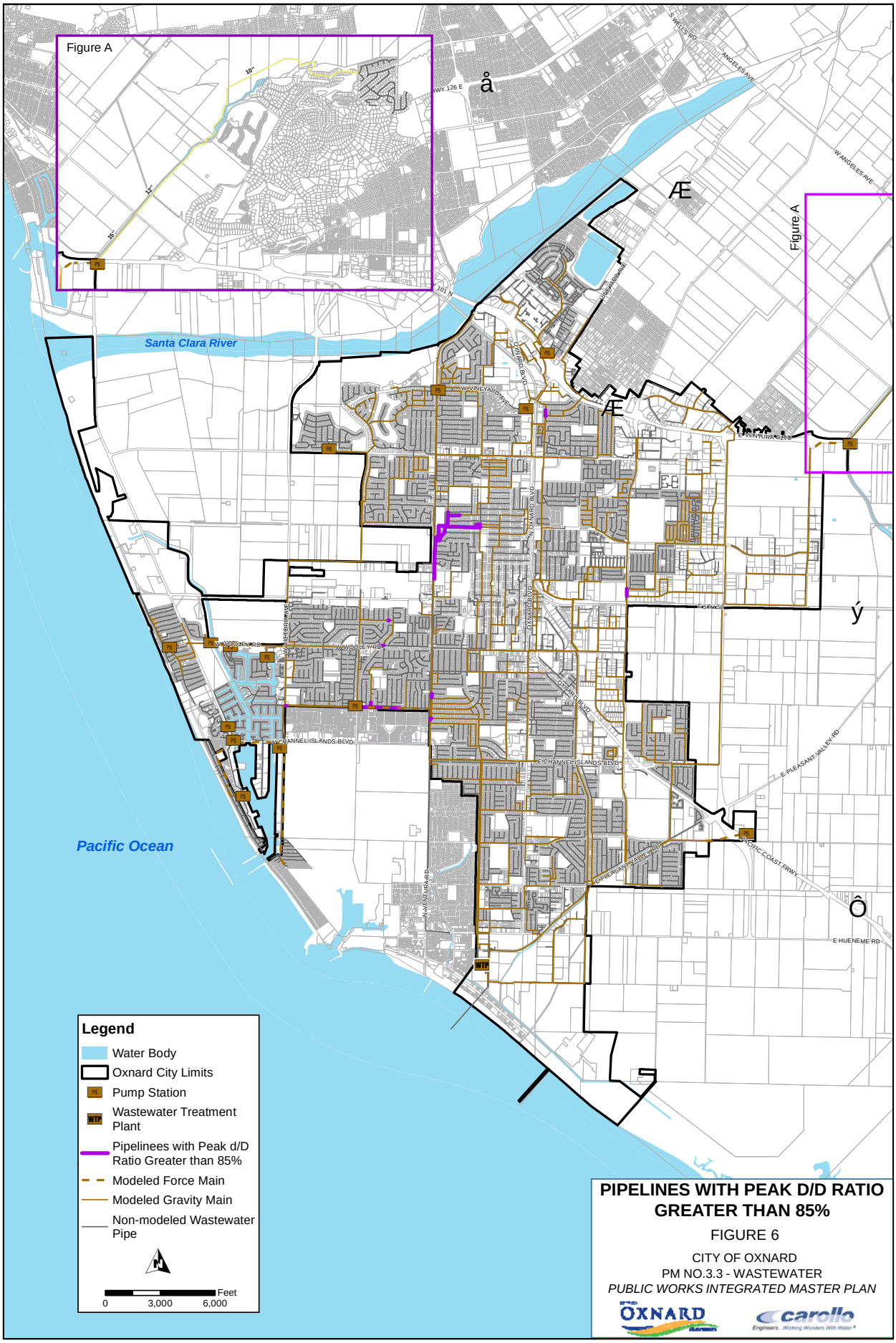


Figure A
Figure A
Santa Clara River
Pacific Ocean
Legend
Water Body
Oxnard City Limits
Pump Station
Wastewater Treatment Plant
Pipelinees with Peak d/D Ratio Greater than 85%
Modeled Force Main
Modeled Gravity Main
Non-modeled Wastewater Pipe
Feet
0
3,000
6,000
PIPELINES WITH PEAK D/D RATIO GREATER THAN 85%
FIGURE 6
CITY OF OXNARD
PM NO.3.3 - WASTEWATER
PUBLIC WORKS INTEGRATED MASTER PLAN

Surcharge was observed at several locations for existing conditions. Figure 7 illustrates the locations within the interceptor that exhibit surcharge during the 10-year, 24-hour event. None of these locations represent significant surcharge - beyond the above LOS criteria - but do show the general locations of restrictive areas. However, only portions of these areas will include the specific restrictive pipes that will need to be corrected. The locations illustrated on Figure 7 are generally described in Table 5. The pipelines shown summarized in Table 5 are only meant to give a broad sense of potential deficiencies, however, not all of these deficiencies need to be improved. The improvements needed to meet LOS goals in these areas for existing as well as future conditions will be discussed in detail below.

Table 5 Existing System Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Location Description	Pipe Description	Hydraulic Issues
S Rose Ave and La Puerta Ave	Rose Avenue Trunk Sewer (15-inches in diameter)	Pipeline surcharged.
Terrace Ave and E Pleasant Valley Rd	Eastern Trunk Sewer (12-inches in diameter)	Pipeline surcharged.
N Ventura Rd and W Vineyard Ave	Ventura Road Trunk Sewer (8-inches in diameter)	Pipeline surcharged.
N Ventura Rd and W Vineyard Ave	Ventura Road Trunk Sewer (8-inches in diameter)	Pipeline surcharged.
S Marquita St and E Second St	Sewers in the La Colonia Neighborhood (8-inches to 10-inches in diameter	Pipeline surcharged.
Diaz Ave and E Fifth St	Sewers by the Oxnard Metrolink Facility(12-inches to 15-inches in diameter)	Pipeline surcharged.
N H St and Aster St	Ventura Road Trunk Sewer (8-inches to 10-inches in diameter)	Pipeline surcharged.
N Oxnard Blvd and W Vineyard Ave	Central Trunk Sewer (10-inches in diameter)	Pipeline surcharged.
S E St and W Fourth St	Redwood Trunk Sewer (8-inches to 10-inches in diameter)	Pipeline surcharged.
Cary Drive and Deodar Ave	Sewers in the Wilson Neighborhood (8-inches in diameter)	Pipeline surcharged.

Table 5 Existing System Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Location Description	Pipe Description	Hydraulic Issues
N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer (8-inches to 15-inches in diameter)	Pipeline surcharged.
S Ventura Services Rd and W Fir Ave	Sewer in the Bartolo Square North Neighborhood (8-inches in diameter)	Pipeline surcharged.
S C St and Maxwood Way	Redwood Trunk Sewer (10-inches in diameter)	Pipeline surcharged.
S E St and Ninth St	Redwood Trunk Sewer (10-inches in diameter)	Pipeline surcharged.
S F St and W Juniper St	Redwood Trunk Sewer (18-inches in diameter)	Pipeline surcharged.
S J St and Redwood St	Redwood Trunk Sewer (18-inches in diameter)	Pipeline surcharged.
S J St and Glacier Ave	Redwood Trunk Sewer (27-inches in diameter)	Pipeline surcharged.
Elsinore Ave and W Hemlock St	Sewers in the Marina West Neighborhood (8-inches to 10-inches in diameter)	Pipeline surcharged.
Novato Dr and W Wooley Rd	Sewers along W Wooley Rd (8-inches in diameter)	Pipeline surcharged.
Sterling Hills Golf Club	Western Trunk Sewer (10-inches in diameter)	Pipeline surcharged.
S Ventura Rd and N Ninth St	Sewer along S Ventura Rd (16-inches in diameter)	Pipeline surcharged.
S Ventura Service Rd and Hill St	Sewer along S Ventura Service Rd (8-inches in diameter)	Pipeline surcharged.
Ventura Blvd and Cortez St	Sewers by the Martinez Shopping Center (6-inches in diameter)	Pipeline surcharged.
S Harbor Blvd and Cabezone Way	Sewers by the Cabezone Pump Station (8-inches in diameter)	Pipeline surcharged.
Stanford Ave and Vanderbilt Dr	Central Trunk Sewer (24-inches in diameter)	Pipeline surcharged.

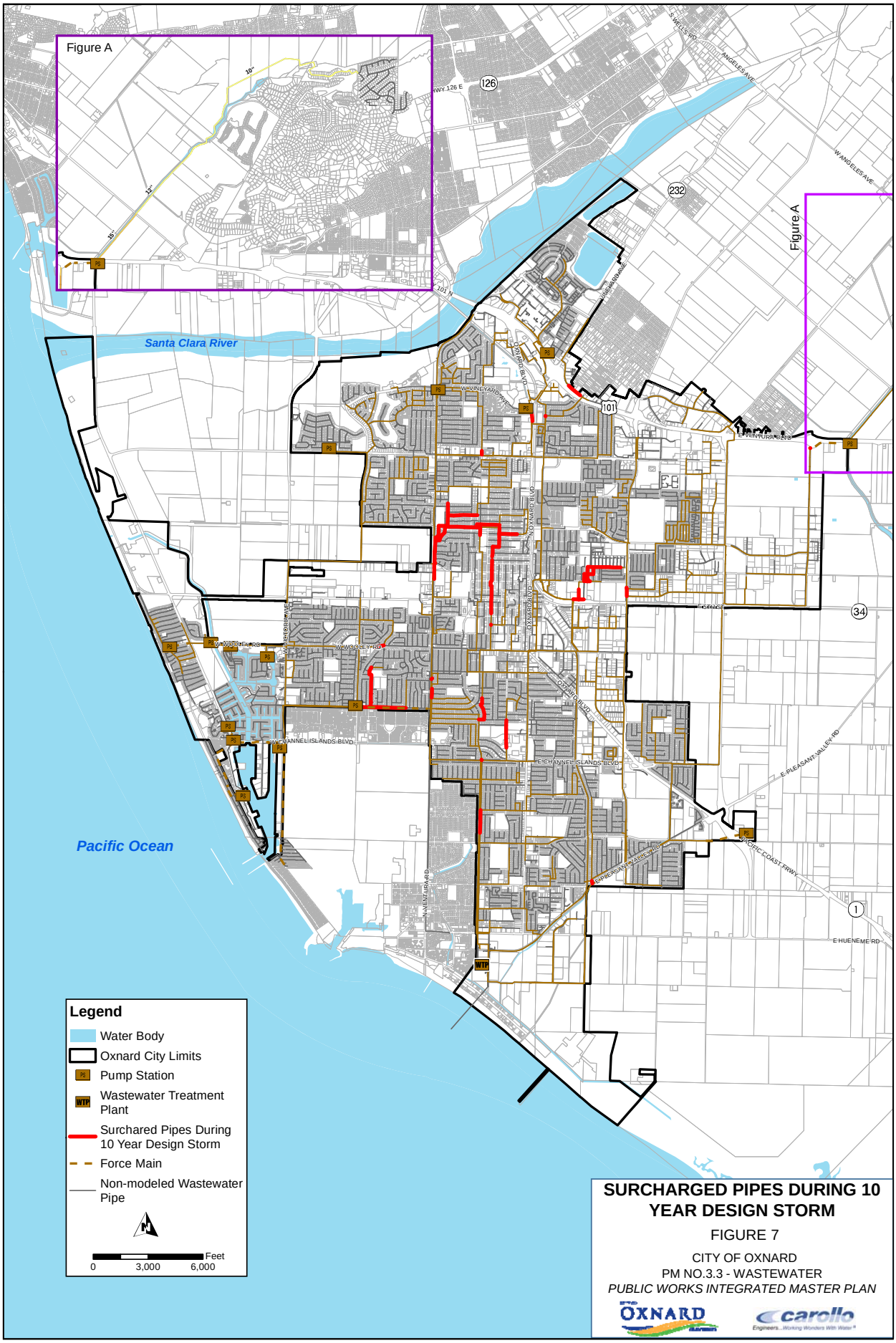


Figure A
Figure A
Santa Clara River
Pacific Ocean
Legend
Water Body
Oxnard City Limits
Pump Station
Wastewater Treatment Plant
Surcharged Pipes During 10 Year Design Storm
Force Main
Non-modeled Wastewater Pipe
Feet
0
3,000
6,000
SURCHARGED PIPES DURING 10 YEAR DESIGN STORM
FIGURE 7
CITY OF OXNARD
PM NO.3.3 - WASTEWATER
PUBLIC WORKS INTEGRATED MASTER PLAN

4.5 Future System Analysis

Several time periods in the future were examined based on input from the City to identify changes in growth patterns in the City, which would require improvements within the collection system. Table 6 below summarizes the three future time periods that were analyzed using the collection system model and pertinent statistics (Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF)) assumed for those periods.

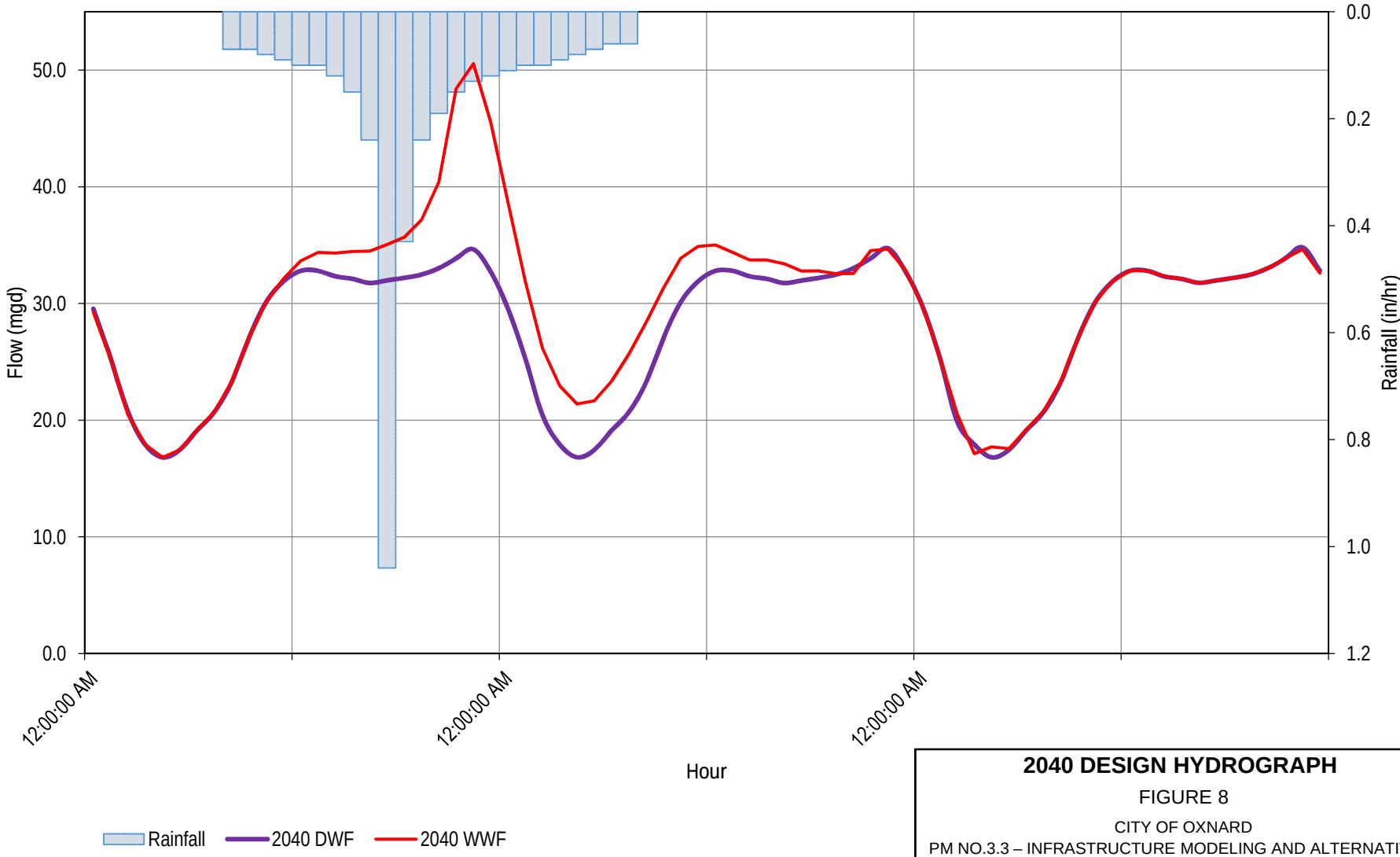
Table 6 Future Period Statistics
Public Works Integrated Master Plan
City of Oxnard

Period	ADWF (mgd)	PDWF (mgd)	PWWF (mgd)
2020	23.7	29.3	45.4
2030	25.8	31.9	48.1
2040	28.0	34.8	50.5

Figure 8 illustrates the design hydrograph for 2040 at the OWTP. This figure includes the DWF's as well as the WWF's and the 10-year rainfall design hyetograph. The ratios for PDWF to ADWF are 1.24 for each of the future years. The ratios for PWWF to ADWF are 1.92, 1.86, and 1.80 for the 2020, 2030, and 2040 respectively.

Future flows consist of residential flows and industrial flows. Residential flows are based on the 2030 General Plan Low Forecast population projections. Industrial flows are based on the 38 Significant Industrial Users (SIUs) and Naval Base Ventura County (NBVC), all of which have been identified in PM 3.2; future industrial developments mentioned in PM 1.3 were also used.

For the residential flows, each loading polygon was assigned a population value. Since the projected population data was originally given for the entire city, a weighted average was used to calculate the population values for each loading polygon. It was assumed that the loading polygons only had population in the developed areas; information regarding the land type was obtained through the zoning polygons provided by the City. Once the loading polygons had a population number, a gpcd value of 71.6 was used to calculate the flow from each loading polygon. The gpcd value is consistent with the estimated domestic per capita flow mentioned in PM 3.2.



2040 DESIGN HYDROGRAPH

FIGURE 8

CITY OF OXNARD

PM NO.3.3 – INFRASTRUCTURE MODELING AND ALTERNATIVES

PUBLIC WORKS INTEGRATED MASTER PLAN

For the industrial flows, the location of the industrial users was identified and their flow was assigned to the closest manhole. The projected flows for the industrial users are based on information presented in PMs 1.3 and 32 and they are as follows:

- The 38 SIUs as well as NBVC were assigned flows based on their Average Day Flow (ADF) Permit Limit. It was assumed that all the flows for the projected years would be constant at the ADF Permit Limit.
- The future industrial developments were assigned 2020 and 2040 projected flows based on the Average Day Demands (ADD) identified in PM 2.2. Flows between these years were scaled down linearly.

The flows for the period 2040 were used to size future improvements, along with the I/I generated from the 10-year, 24-hour event, and the LOS criteria described above. Some projects may be needed before 2040, but if a project is completed in 2020 to increase capacity, it should provide enough capacity to accommodate 2040 flows since the useful life of a sewer pipe is well beyond this 20 year time period. Therefore, the scheduling of projects may require pipes to be upsized several years in advance (to account for design and construction time frames), but the diameter of pipeline improvements will need to be able to accommodate future flows as well.

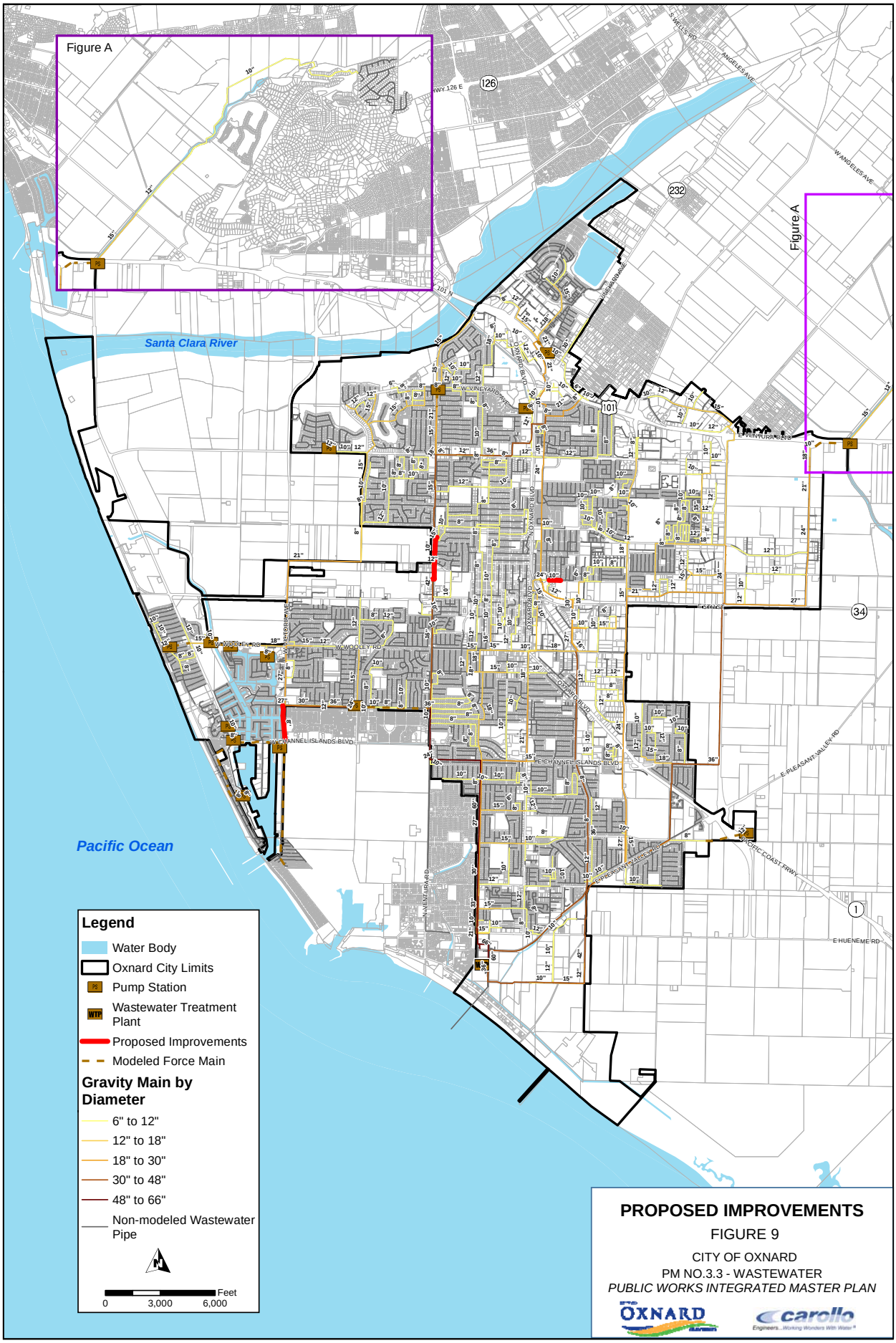
5.0 RECOMMENDED PROJECTS

With additional DWFs due to future growth, the wet weather capacity restrictions will only become more severe. The flows estimated for year 2040 were input to the model and run to examine how severe additional surcharge became in the already restrictive locations (illustrated in Figure 9). If the LOS criteria were violated (e.g., HGL greater than 3-feet below rim elevation), then downstream pipes were examined to identify restrictive elements that need replacement.

5.1 Collection System Improvements

When an increase to capacity is required, existing sewers can be upgraded or a parallel or relief sewer can be constructed. For the purposes of this study, unless otherwise stated, it was assumed that a capacity deficient sewer would be upgraded to a larger diameter. The upgraded pipeline generally followed the same slope as the existing pipeline, with the exception where survey data revealed negative or flat slopes in an existing alignment.

In essence, there are two alternatives for every trunk sewer project, but the decision to replace or construct a parallel sewer should be made during the preliminary design phase. During the preliminary design phase, the existing sewer should be inspected by closed circuit television (CCTV) to determine its structural condition. If severely deteriorated, the existing sewer should be upgraded. If moderately deteriorated, slip lining or cured-in-place pipe lining can rehabilitate the existing sewer.



PROPOSED IMPROVEMENTS

FIGURE 9

CITY OF OXNARD

PM NO.3.3 - WASTEWATER

PUBLIC WORKS INTEGRATED MASTER PLAN

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow, it is recommended that the proposed pipeline diameters be constructed so that the facilities have sufficient capacity for build out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended due to the extended useful life of the improvements proposed herein. The proposed pipe diameter represents the ultimate diameter for build out conditions.

5.2 Pipeline Improvements

The system was analyzed to examine both DWF and WWF criteria for existing and future flow conditions. Certain portions of the existing system cannot adequately convey both peak DWF and WWF conditions using the LOS criteria defined above. Future flow conditions also stress the system and require upgrades to meet the LOS criteria.

The improvements discussed herein are for pipelines that require upgrades due to capacity deficiencies. Pipeline improvements due to deterioration, such as the Central Trunk improvements, are not discussed herein, but are accounted for in the pipeline costs in the overall CIP. Since limited condition information exists for most of the pipeline in the system (other than the Central Trunk specific condition assessments), no improvements other than those noted due to deterioration can be ascertained at this time.

As flows increase over time, the system will require upgrades to meet capacity restrictions. Both PDWF and PWWF were examined to determine system improvements in the future. By 2040, the system exhibited PDWF that surcharged more sewers. This condition is not acceptable as described in the LOS criteria above. Therefore, pipelines in these areas that exhibited capacity deficiencies were upsized to convey PDWF without surcharge.

PWWFs were also run through the model to examine if the LOS criteria for the design storm were violated. It was found using the LOS criteria above (no HGL could exceed 3-feet below the lowest rim elevation along a pipeline reach) that no improvements are needed through 2040 due to the 10-year design event. There is surcharge throughout the system during these conditions, but no sewers required upgrades because of violation in the criteria. However, the improvements that are needed to accommodate PDWFs also decrease the surcharge in these segments for PWWFs.

For example, Project 1 detailed in Table 7, is needed because the existing PDWF exceeds LOS criteria. Therefore, in upgrading this section of pipe, it also significantly decreases the HGL for the PWWF. Therefore, this project is needed for DWFs but also helps in managing WWFs. If it was just a WWF issue in this area, a cross-connection could be made between this sewer and the Redwood Trunk Sewer which is right across the road. The invert elevations of the two parallel pipelines are similar, and an elevated pipe could be used to balance WWFs into the larger interceptor. However, this is not needed since the Project 1 pipelines are needed for PDWF and therefore must be upgraded regardless. If the City wants to plan in the future for higher design storm flows, then this cross-connection should be reinvestigated.

Table 7 Proposed Pipeline Improvements
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Hydraulic Issues	Conduit	Inlet Node	Outlet Node	Existing Diameter (inches)	Replacement Diameter (inches)	Length (feet)
Project 1									
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	4943	1427	1426	10	15	84
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	4956	1426	1445	10	15	167
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1429	1445	1480	10	15	310
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1431	1480	1521	10	15	309
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1432	1521	1520	10	15	17
WW-P-1	N Ventura Rd / S Ventura Rd and W	Ventura Road Trunk Sewer	Pipeline Surcharged	1443	1520	1583	10	15	368

Table 7 Proposed Pipeline Improvements
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Hydraulic Issues	Conduit	Inlet Node	Outlet Node	Existing Diameter (inches)	Replacement Diameter (inches)	Length (feet)
	Second St								
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	4276	1583	1622	10	15	258
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1460	1622	1638	10	15	116
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1461	1638	1684	10	15	369
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1462	1684	1725	10	15	373
WW-P-1	N Ventura Rd / S Ventura Rd and W Second St	Ventura Road Trunk Sewer	Pipeline Surcharged	1463	1725	L21-RWB20	10	15	49
								Project 1 Subtotal	**2,420**

Table 7 Proposed Pipeline Improvements
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Hydraulic Issues	Conduit	Inlet Node	Outlet Node	Existing Diameter (inches)	Replacement Diameter (inches)	Length (feet)
Project 2									
WW-P-2	Navarro St and E First St	Sewers in the La Colonia Neighborhood		2888	1745	1742	10	12	316
WW-P-2	Navarro St and E First St	Sewers in the La Colonia Neighborhood		2889	1742	1740	10	12	313
								Project 2 Subtotal	**629**
Project 3									
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	Pipeline Surcharged	501	3429	3346	8	12	352
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	Pipeline Surcharged	{74B96752-98B2-4F5D-AF2A-21B06EE4909C}	3346	3266	8	12	196

Table 7 Proposed Pipeline Improvements
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Hydraulic Issues	Conduit	Inlet Node	Outlet Node	Existing Diameter (inches)	Replacement Diameter (inches)	Length (feet)
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	Pipeline Surcharged	P-2471	MH-2420	3429	8	12	1,369
								Project 3 Subtotal	**1,917**
								Total	**4,965**

The same is true for the other projects; Projects 2 and 3 are needed due to PDWF requirements, but also help in managing the peak HGL during WWFs. It should also be noted that Project 3 is a short section of gravity sewer, but drains a significant area upstream where pump stations forcemains discharge into this gravity main.

Figure 9 illustrates the proposed pipeline improvements required to accommodate future flows. Table 7 provides details for each improvement project. Appendix C illustrates the HGLs within these segments for flows estimated in 2040 before and after improvements are made.

5.3 Pump Station Improvements

The pump stations within the model were also analyzed to see if upgrades were necessary for future flows. The City provided pump curves for the pump stations but were not able to provide the start and stop elevations within the wet wells for the operations of the pumps. The pump stations seem to be able to convey future flows adequately, but without the actual stop and start elevations, it is difficult to assess whether the pump stations will be able to accommodate these future flows adequately. Therefore, the City should make a concerted effort to measure these stop and start elevations and the model should be updated in Phase 2.

6.0 RECOMMENDED PROJECT – COSTS AND PHASE

Cost estimates, implementation phase and schedule were also developed for the recommended projects for the collection system projects, as summarized in the previous section. This information will be included in the overall Capital Improvement Program (CIP) and used as the basis for the financial analysis portion of the PWIMP to determine financial impact of the project to the City and its rate payers. The costs and timing presented in this PM represent Carollo's best professional judgment of the capital expenditure needs of the City and of the timing needed to maintain a reliable and compliant system that can meet current and future wastewater generation needs. Timing was set to align with the seven master plan drivers, namely: R&R, regulatory requirements, economic benefit, performance benefit, growth, resource sustainability, and policy decisions. Timing is also based on input from City staff and the condition assessments performed.

While the costs developed in this PM match the costs analyzed as part of the Cost of Service Study, the timing presented may differ. The Cost of Service Study will balance not only the CIP projects identified but also the rates and rate payer affordability based on a yearly balance and also the integrated costs for the different City funds and enterprises.

6.1 Cost Summary

The Collection System project costs for capacity related projects are presented in Table 8 and are based on the preliminary layouts, sizing and configuration. Project costs are

estimated based on unit costs developed from estimating guides, equipment manufacturer's information, unit prices and construction costs of similar facilities and other locations. A more detailed discussion of the basis of costs is included in PM 1.4, *Overall - Basis of Cost*.

Sewer pipeline improvements range in size from 12-inches to 15-inches in diameter in this study. At this point, overall unit project costs were used to estimate total project costs. Unit costs for the pipeline projects, include appurtenances (e.g., manholes) are assumed to be $30.00 per in-foot of pipe. Therefore the above diameters and lengths of each pipeline segment were multiplied by this unit cost to estimate the overall cost of each project. The unit costs are for typical field conditions with construction in stable soil at a depth ranging between 10 feet and 15 feet.

Using the costs assumptions presented in the above sections, project cost estimates were developed and are summarized in Table 8. The total estimated project cost is estimated at $3.2. million. The phasing of these projects will be further examined during Phase 2 of this PWIMP.

6.1.1 Rehabilitation Projects

In addition to projects recommended for capacity deficiencies described in the sections above, the collection system CIP also includes rehabilitation projects shown in Table 9. During the collection system assessment, it was determined that only minimal information is known about the existing condition and age of the collection system piping. Thus a detailed system rehabilitation program could not be practically developed as part of this PWIMP. Instead, the CIP recommendations for rehabilitation projects are based on the City's understanding of project needs.

6.2 Project Prioritization

Prioritizing the required capital improvements for the City's sewer system is an important aspect of this study. The projects were grouped into the following phases:

- Phase 1: Proposed facilities address existing LOS issues (dry or wet weather flow).
- Phase 2. - Proposed facilities address LOS issues under planning year 2020 modeling conditions.
- Phase 3. - Proposed facilities address LOS issues under planning year 2030 modeling conditions.
- Phase 4. Proposed facilities address LOS issues under planning year 2040 modeling conditions.

Table 8 Recommended Projects Cost Estimates and Phasing for Collection System Capacity Projects[(1)(2)(3)]
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Conduit	Recommended Project Cost ($)	Project Phase
Project 1					
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	4943	$60,708	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	4956	$120,859	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1429	$225,158	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1431	$223,950	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1432	$12,503	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1443	$266,801	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	4276	$186,837	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1460	$84,471	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1461	$267,890	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1462	$270,365	1
WW-P-1	N Ventura Rd and S Ventura Rd	Ventura Road Trunk Sewer	1463	$35,657	1
			Project 1 Subtotal	**$1,755,197**	
Project 2					
WW-P-2	Navarro St and E First St	Sewers in the La Colonia Neighborhood	2888	$183,218	2
WW-P-2	Navarro St and E First St	Sewers in the La Colonia Neighborhood	2889	$181,651	2
			Project 2 Subtotal	**$364,869**	
Project 3					
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	501	$203,996	2

Table 8 Recommended Projects Cost Estimates and Phasing for Collection System Capacity Projects[(1)(2)(3)]
Public Works Integrated Master Plan
City of Oxnard

Project	Location Description	Pipe Description	Conduit	Recommended Project Cost ($)	Project Phase
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	{74B96752-98B2-4F5D-AF2A-21B06EE4909C}	$113,743	2
WW-P-3	S Victoria Ave and W Hemlock St	Sewers in the Channel Islands Neighborhood	P-2471	$794,528	2
			Project 3 Subtotal	**$1,112,267**	
			Total	**$3,232,333**	

Notes:
(1) Pipeline Unit Cost = $30 per inch-foot.
(2) 20-City Average Index ENR CCI of 9,962 was used for February 2015. A R.S. Means Location Factor of 106.6 for Oxnard was used.
(3) Project costs, schedules, and phasing are based on data and information available at the time of the original date of preparation – December 2015. The updated CIP is contained in the Brief History section of the PMs, the Summary Report, and the Executive Summary.

Table 9 Recommended Projects Cost Estimates and Phasing for Collection System Capacity Project[(1)(2)]
Public Works Integrated Master Plan
City of Oxnard

Project	Description	Driver	Recommended Project Cost ($)	Recommended Project Phase
WW-P-4	Central Trunk Condition Assessment	Rehabilitation and Replacement	$200,000	1
WW-P-5	Headworks meter vaults/vortex structures coating	Rehabilitation and Replacement	$1,000,000	1
WW-P-6	Phase 1 Central Trunk manholes reconstruction	Rehabilitation and Replacement	$1,500,000	1
WW-P-7	Existing asbestos concrete pipe (ACP) replacement	Rehabilitation and Replacement	$5,000,000	1
WW-P-8	Harbor Blvd manhole rehabilitation	Rehabilitation and Replacement	$100,000	1
WW-P-9	Redwood tributary manholes rehabilitation	Rehabilitation and Replacement	$200,000	1
WW-P-10	Lift Station 23 - Wagon Wheel Replacement	Rehabilitation and Replacement	$1,000,000	1
WW-P-11	Lift Station 6 - Canal Rehabilitation	Rehabilitation and Replacement	$500,000	1
WW-P-12	Lift Station 4 - Mandaley & Wooley Rehabilitation	Rehabilitation and Replacement	$500,000	1
WW-P-13	Phase 2 Central Trunk manholes reconstruction	Rehabilitation and Replacement	$200,000	2
WW-P-14	Phase 1 Central Trunk replacement	Rehabilitation and Replacement	$36,500,000	1
WW-P-15	Phase 2 Central Trunk replacement	Rehabilitation and Replacement	$30,000,000	2
WW-P-16	Rice Ave (Rice & 5th) sewer replacement	Rehabilitation and Replacement	$1,300,000	1
WW-P-17	Other Collection System Improvements	Rehabilitation and Replacement	$66,600,000	2
WW-P-18	Casden Village Lift Station	Performance	$1,000,000	1
		Total:	**$145,600,000**	

Notes:
(1) 20-City Average Index ENR CCI of 9,962 was used for February 2015. A R.S. Means Location Factor of 106.6 for Oxnard was used.
(2) Project costs, schedules, and phasing are based on data and information available at the time of the original date of preparation – December 2015. The updated CIP is contained in the Brief History section of the PMs, the Summary Report, and the Executive Summary.

The projects were phased based on the best available information for how the City will develop moving forward. The actual implementation of the improvements serving future users ultimately depends on growth. The phases presented below are estimates, and changes in the City's planning assumptions or growth projections could increase or decrease the phase of each improvement.

APPENDIX A – DRY WEATHER FLOW CALIBRATION PLOTS

Table 1 Dry Weather Flow Calibration Results
Public Works Integrated Master Plan
City of Oxnard

		Weekday Dry Weather Flow												Weekend Dry Weather Flow												Average Dry Weather Flow[4]		
		Measured Data[1]				Modeled Data[2]				Percent Error[3]				Measured Data[1]				Modeled Data[2]				Percent Error[3]						
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Measured ADWF (mgd)	Modeled ADWF (mgd)	Percent Difference (%)
SITE 1	41.5	5.390	7.021	2.53	16.0	5.343	7.139	2.75	15.4	-0.9%	1.7%	8.7%	-3.4%	4.547	5.655	2.42	14.6	4.567	5.812	2.61	14.5	0.4%	2.8%	7.7%	-1.2%	5.149	5.122	-0.5%
SITE 2	36	2.759	3.111	1.70	13.8	2.650	2.958	1.86	13.4	-4.0%	-4.9%	9.1%	-3.1%	2.352	2.656	1.65	12.6	2.353	2.757	1.77	12.9	0.1%	3.8%	7.2%	2.0%	2.643	2.565	-2.9%
SITE 3	60	7.027	9.830	2.35	16.8	7.034	9.771	2.53	17.5	0.1%	-0.6%	7.9%	4.1%	7.515	11.051	2.40	17.1	7.359	10.772	2.56	17.7	-2.1%	-2.5%	6.5%	3.8%	7.166	7.127	-0.5%
SITE 4A	33	3.131	4.786	1.60	17.7	3.438	4.639	1.75	17.6	9.8%	-3.1%	9.5%	-0.8%	3.378	5.088	1.67	18.0	3.481	4.887	1.75	17.6	3.1%	-4.0%	4.9%	-2.1%	3.202	3.450	7.8%
SITE 5	36	1.483	2.010	1.95	11.4	1.442	1.883	1.38	11.7	-2.8%	-6.3%	-29.5%	2.8%	0.972	1.183	1.68	10.2	1.037	1.268	1.18	10.7	6.7%	7.3%	-29.4%	4.3%	1.337	1.327	-0.8%
SITE 6	24	1.440	2.137	1.66	10.4	1.479	2.072	1.97	10.5	2.7%	-3.0%	18.7%	1.2%	1.126	1.672	1.36	10.3	1.140	1.592	1.78	9.5	1.2%	-4.8%	30.7%	-7.5%	1.351	1.382	2.3%
SITE 7	24	0.310	0.420	1.18	4.4	0.314	0.424	1.31	4.5	1.3%	1.0%	10.8%	1.6%	0.317	0.444	1.17	4.5	0.309	0.436	1.29	4.4	-2.5%	-1.6%	10.7%	-0.7%	0.312	0.312	0.2%
SITE 8	27	1.820	2.547	2.47	8.7	1.979	2.705	2.64	9.0	8.7%	6.2%	7.0%	3.6%	1.842	2.630	2.49	8.7	1.996	2.845	2.65	9.0	8.3%	8.2%	6.2%	3.9%	1.826	1.984	8.6%
SITE 9	42	2.014	2.876	3.35	6.3	2.172	3.096	2.49	8.3	7.9%	7.6%	-25.6%	32.5%	2.113	3.188	3.36	6.4	2.259	3.518	2.50	8.4	6.9%	10.3%	-25.6%	31.3%	2.042	2.197	7.6%
SITE 10	37	1.876	2.332	1.38	12.1	1.909	2.391	1.67	12.9	1.7%	2.5%	20.7%	7.2%	2.036	2.917	1.44	12.3	1.942	2.748	1.68	13.0	-4.6%	-5.8%	16.7%	5.1%	1.922	1.918	-0.2%

Notes:

1. Temporary Flow Monitoring Program, V&A Consulting Engineers
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data. Maximum flow values are hourly peaks corresponding to either weekend or weekday conditions, as appropriate.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Average Dry Weather Flow = (5*Weekday Dry Weather Flow + 2*Weekend Dry Weather Flow)/7

City of Oxnard

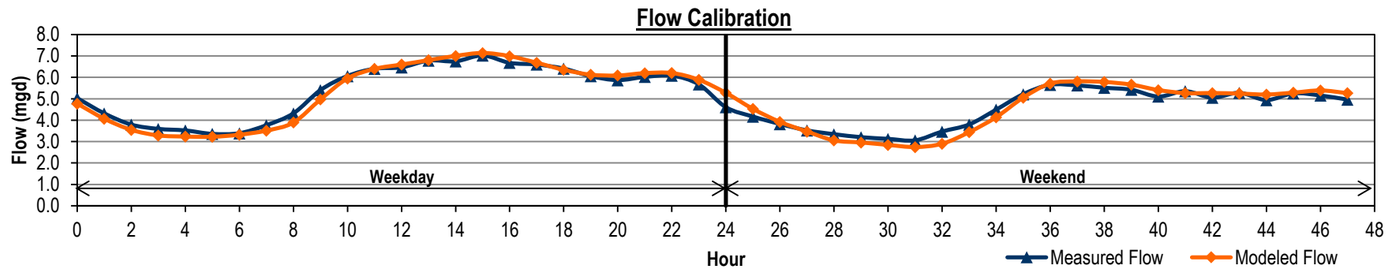
Public Works Integrated Master Plan

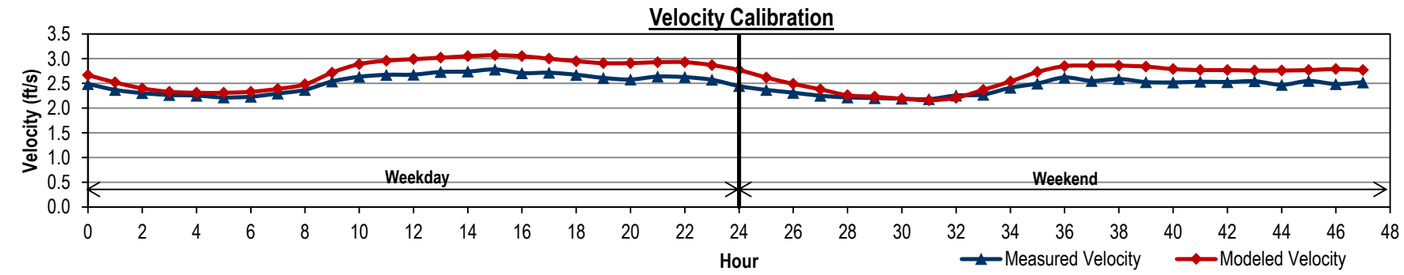
FLOW MONITORING SITE 1 DRY WEATHER FLOW CALIBRATION

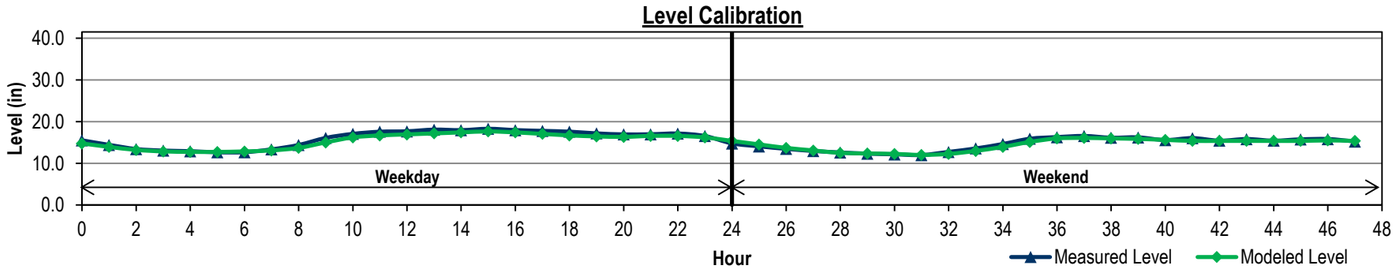
		Measured Data			Modeled Data			Diurnal		
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Initial Curve	Modified Curve	Calibrated Diurnal
Weekday	0	5.027	15.5	2.49	4.772	14.8	2.67	0.84	0.60	0.60
	1	4.318	14.4	2.37	4.067	13.9	2.52	0.74	0.44	0.44
	2	3.793	13.4	2.30	3.548	13.2	2.40	0.70	0.41	0.41
	3	3.593	13.0	2.27	3.287	12.8	2.33	0.68	0.47	0.47
	4	3.521	12.9	2.25	3.235	12.7	2.31	0.65	0.57	0.57
	5	3.360	12.6	2.22	3.224	12.7	2.31	0.66	0.65	0.65
	6	3.392	12.7	2.23	3.321	12.8	2.33	0.73	0.83	0.83
	7	3.765	13.3	2.30	3.513	13.1	2.39	0.84	1.00	1.00
	8	4.320	14.4	2.37	3.890	13.7	2.48	1.05	1.06	1.06
	9	5.404	16.1	2.54	4.969	15.0	2.72	1.18	1.22	1.22
	10	6.062	17.0	2.63	5.952	16.2	2.89	1.24	1.25	1.25
	11	6.402	17.6	2.67	6.395	16.7	2.96	1.26	1.26	1.26
	12	6.467	17.7	2.68	6.598	16.9	2.99	1.32	1.28	1.28
	13	6.787	18.1	2.73	6.804	17.2	3.02	1.31	1.30	1.30
	14	6.749	17.9	2.74	7.004	17.4	3.05	1.36	1.40	1.40
	15	7.021	18.3	2.78	7.139	17.6	3.07	1.30	1.22	1.22
	16	6.677	18.0	2.71	6.992	17.4	3.05	1.28	1.18	1.18
	17	6.600	17.8	2.72	6.684	17.0	3.00	1.24	1.14	1.14
	18	6.410	17.6	2.68	6.352	16.7	2.95	1.18	1.18	1.18
	19	6.055	17.2	2.61	6.124	16.4	2.91	1.14	1.26	1.26
	20	5.871	16.9	2.58	6.088	16.3	2.91	1.17	1.34	1.34
	21	6.020	17.0	2.64	6.197	16.6	2.93	1.18	1.34	1.34
	22	6.080	17.1	2.63	6.202	16.6	2.93	1.10	1.17	1.17
	23	5.670	16.5	2.57	5.885	16.2	2.87	0.98	0.91	0.91
Weekend	24	4.605	14.8	2.45	5.275	15.4	2.77	0.81	0.60	0.60
	25	4.169	14.1	2.37	4.528	14.5	2.62	0.74	0.55	0.55
	26	3.822	13.5	2.31	3.921	13.7	2.49	0.68	0.53	0.53
	27	3.522	12.9	2.25	3.471	13.1	2.38	0.65	0.51	0.51
	28	3.345	12.6	2.22	3.056	12.5	2.26	0.62	0.49	0.49
	29	3.205	12.3	2.20	2.959	12.4	2.23	0.61	0.46	0.46
	30	3.127	12.1	2.19	2.845	12.2	2.19	0.59	0.43	0.43
	31	3.057	12.0	2.18	2.745	12.0	2.16	0.67	0.66	0.66
	32	3.469	12.7	2.26	2.899	12.2	2.21	0.74	1.00	1.00
	33	3.799	13.6	2.27	3.440	13.0	2.37	0.87	1.20	1.20
	34	4.491	14.6	2.41	4.139	13.9	2.54	1.01	1.43	1.43
	35	5.214	15.9	2.50	5.053	15.1	2.73	1.10	1.55	1.55
	36	5.655	16.3	2.62	5.713	16.0	2.85	1.09	1.35	1.35
	37	5.624	16.5	2.55	5.812	16.1	2.86	1.07	1.33	1.33
	38	5.514	16.1	2.59	5.785	16.0	2.86	1.05	1.30	1.30
	39	5.421	16.2	2.53	5.659	15.8	2.84	0.99	1.04	1.04
	40	5.104	15.6	2.52	5.408	15.6	2.79	1.04	1.11	1.11
	41	5.353	16.0	2.54	5.263	15.4	2.77	0.98	1.01	1.01
	42	5.055	15.4	2.53	5.267	15.4	2.77	1.02	1.15	1.15
	43	5.278	15.8	2.55	5.242	15.4	2.76	0.96	1.02	1.02
	44	4.942	15.4	2.47	5.199	15.4	2.76	1.02	1.26	1.26
	45	5.253	15.7	2.55	5.286	15.4	2.77	1.00	1.22	1.22
	46	5.152	15.8	2.49	5.389	15.5	2.79	0.96	1.17	1.17
	47	4.961	15.2	2.52	5.263	15.4	2.77	0.89	0.91	0.91
Average										
Weekday		**5.390**	**16.0**	**2.53**	**5.343**	**15.4**	**2.75**	**1.05**	**1.02**	**1.02**
Weekend		**4.547**	**14.6**	**2.42**	**4.567**	**14.5**	**2.61**	**0.88**	**0.97**	**0.97**
ADWF[1]		**5.149**	**15.6**	**2.50**	**5.122**	**15.1**	**2.71**	**1.00**	**1.01**	**1.01**
% Error										
Weekday					-0.9%	-3.4%	8.7%			
Weekend					0.4%	-1.2%	7.7%			

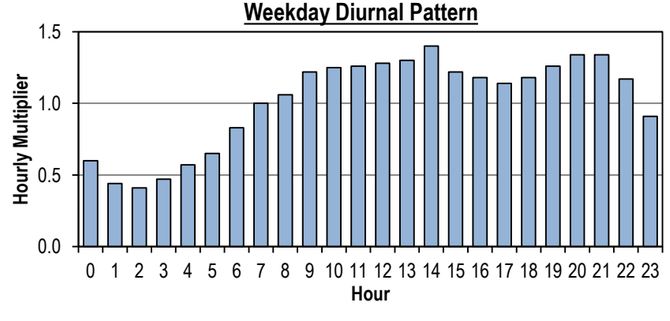
Note:

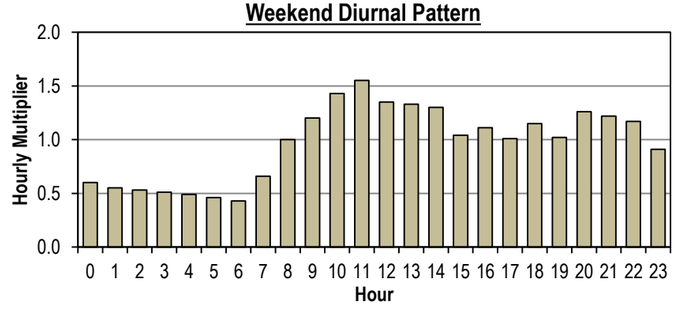
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

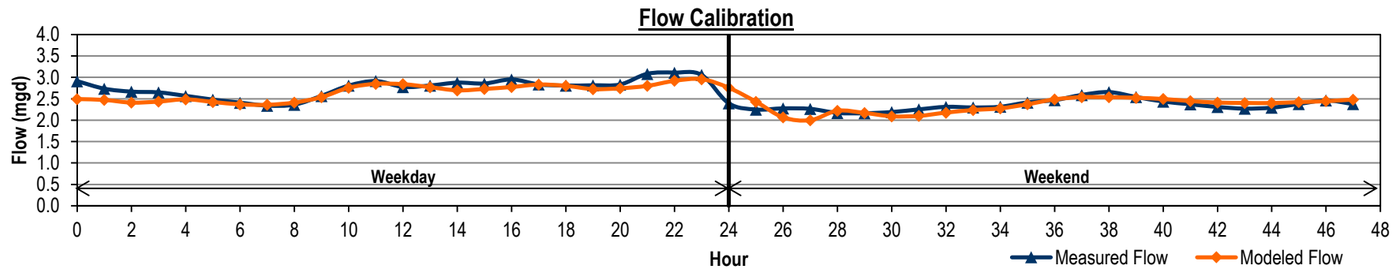
Public Works Integrated Master Plan

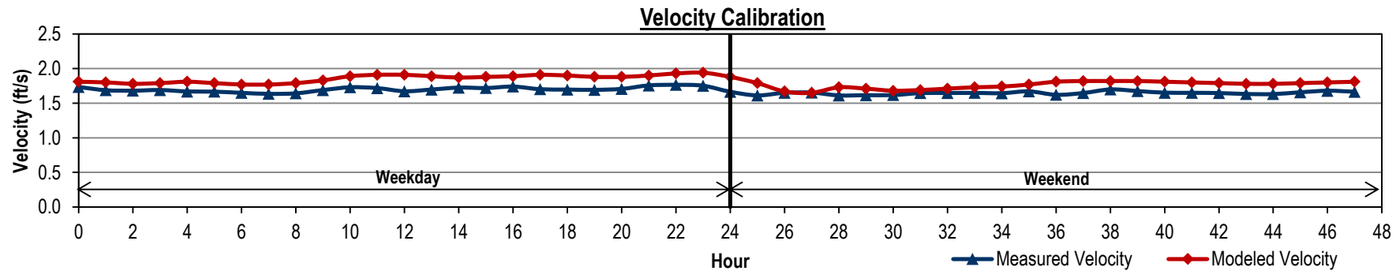
FLOW MONITORING SITE 2 DRY WEATHER FLOW CALIBRATION

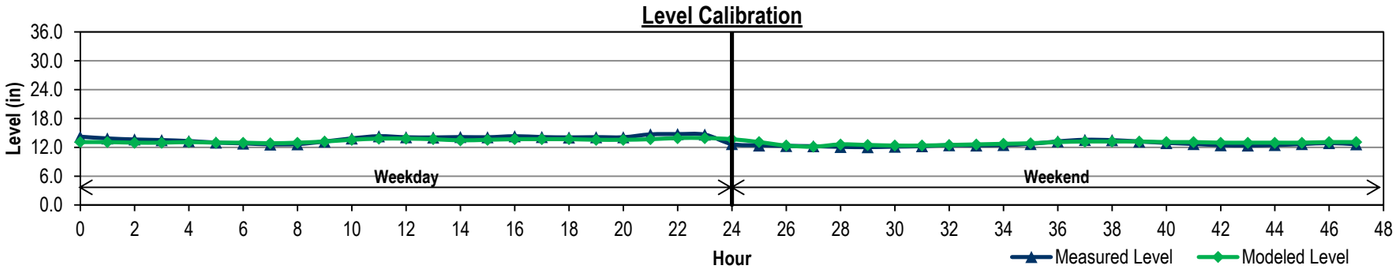
		Measured Data			Modeled Data			Diurnal		
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Initial Curve	Modified Curve	Calibrated Diurnal
Weekday	0	2.912	14.2	1.73	2.493	13.1	1.81	1.03	0.88	0.88
	1	2.735	13.8	1.69	2.473	13.1	1.80	1.01	1.10	1.10
	2	2.666	13.6	1.68	2.410	13.0	1.78	1.00	1.08	1.08
	3	2.649	13.5	1.69	2.435	13.0	1.79	0.97	1.06	1.06
	4	2.568	13.3	1.67	2.487	13.1	1.81	0.94	1.04	1.04
	5	2.480	13.0	1.67	2.426	13.0	1.79	0.91	1.02	1.02
	6	2.409	12.8	1.65	2.369	13.0	1.77	0.89	1.00	1.00
	7	2.340	12.6	1.63	2.359	12.8	1.77	0.89	1.05	1.05
	8	2.362	12.7	1.64	2.412	13.0	1.79	0.97	1.10	1.10
	9	2.568	13.2	1.69	2.538	13.2	1.83	1.06	1.12	1.12
	10	2.808	13.8	1.73	2.758	13.6	1.89	1.10	1.14	1.14
	11	2.914	14.3	1.72	2.849	13.8	1.91	1.05	1.04	1.04
	12	2.776	14.1	1.67	2.840	13.8	1.91	1.06	1.03	1.03
	13	2.810	14.0	1.70	2.771	13.7	1.89	1.09	1.09	1.09
	14	2.877	14.1	1.73	2.697	13.4	1.87	1.08	1.12	1.12
	15	2.857	14.1	1.72	2.730	13.6	1.88	1.12	1.21	1.21
	16	2.952	14.3	1.74	2.774	13.7	1.89	1.07	1.09	1.09
	17	2.835	14.1	1.70	2.832	13.7	1.91	1.06	1.08	1.08
	18	2.808	14.1	1.70	2.802	13.7	1.90	1.07	1.07	1.07
	19	2.816	14.1	1.69	2.726	13.6	1.88	1.07	1.08	1.08
	20	2.833	14.1	1.71	2.744	13.6	1.88	1.17	1.23	1.23
	21	3.083	14.7	1.76	2.801	13.7	1.90	1.18	1.23	1.23
	22	3.111	14.7	1.77	2.919	13.9	1.93	1.16	1.09	1.09
	23	3.056	14.6	1.75	2.958	13.9	1.94	1.10	0.73	0.73
Weekend	24	2.393	12.7	1.67	2.757	13.7	1.88	0.85	0.50	0.50
	25	2.249	12.4	1.61	2.432	13.1	1.79	0.86	1.00	1.00
	26	2.276	12.3	1.65	2.067	12.4	1.67	0.86	0.95	0.95
	27	2.264	12.2	1.65	2.000	12.1	1.65	0.82	0.88	0.88
	28	2.169	12.1	1.61	2.220	12.6	1.73	0.82	0.88	0.88
	29	2.162	12.0	1.62	2.169	12.5	1.71	0.83	0.90	0.90
	30	2.190	12.1	1.62	2.091	12.4	1.68	0.85	0.90	0.90
	31	2.252	12.2	1.65	2.100	12.4	1.69	0.87	0.91	0.91
	32	2.311	12.4	1.65	2.177	12.5	1.71	0.87	0.91	0.91
	33	2.297	12.4	1.65	2.237	12.6	1.73	0.88	0.92	0.92
	34	2.313	12.5	1.64	2.275	12.7	1.74	0.91	0.92	0.92
	35	2.415	12.7	1.67	2.372	12.8	1.77	0.93	0.93	0.93
	36	2.468	13.2	1.62	2.486	13.1	1.81	0.98	0.93	0.93
	37	2.590	13.6	1.65	2.538	13.2	1.82	1.01	0.94	0.94
	38	2.656	13.5	1.70	2.536	13.2	1.82	0.96	0.94	0.94
	39	2.542	13.2	1.68	2.522	13.2	1.82	0.92	0.91	0.91
	40	2.435	12.9	1.65	2.495	13.1	1.81	0.90	0.91	0.91
	41	2.371	12.7	1.65	2.446	13.1	1.80	0.87	0.90	0.90
	42	2.308	12.4	1.65	2.411	13.0	1.79	0.86	0.90	0.90
	43	2.269	12.4	1.63	2.402	13.0	1.78	0.87	0.89	0.89
	44	2.292	12.5	1.63	2.400	13.0	1.78	0.90	0.89	0.89
	45	2.378	12.7	1.66	2.422	13.0	1.79	0.93	0.92	0.92
	46	2.463	12.9	1.68	2.444	13.1	1.80	0.90	0.91	0.91
	47	2.376	12.6	1.67	2.482	13.1	1.81	0.91	0.90	0.90
Average										
	Weekday	**2.759**	**13.8**	**1.70**	**2.650**	**13.4**	**1.86**	**1.04**	**1.07**	**1.07**
	Weekend	**2.352**	**12.6**	**1.65**	**2.353**	**12.9**	**1.77**	**0.89**	**0.90**	**0.90**
	ADWF[(1)]	**2.643**	**13.5**	**1.69**	**2.565**	**13.2**	**1.83**	**1.00**	**1.02**	**1.02**
% Error										
	Weekday				-4.0%	-3.1%	9.1%			
	Weekend				0.1%	2.0%	7.2%			

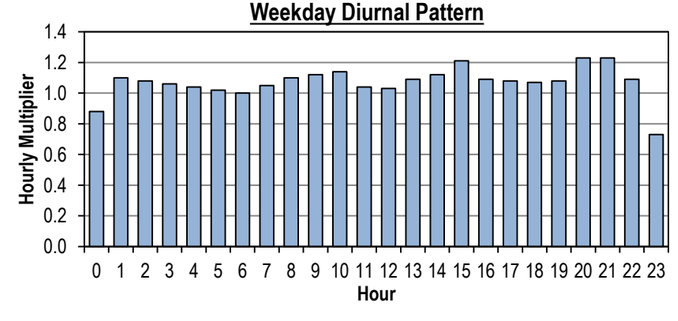
Note:

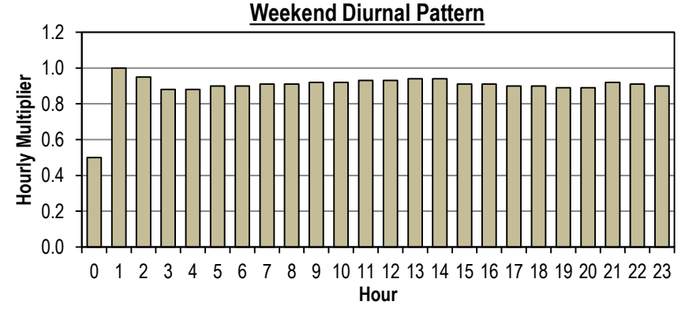
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

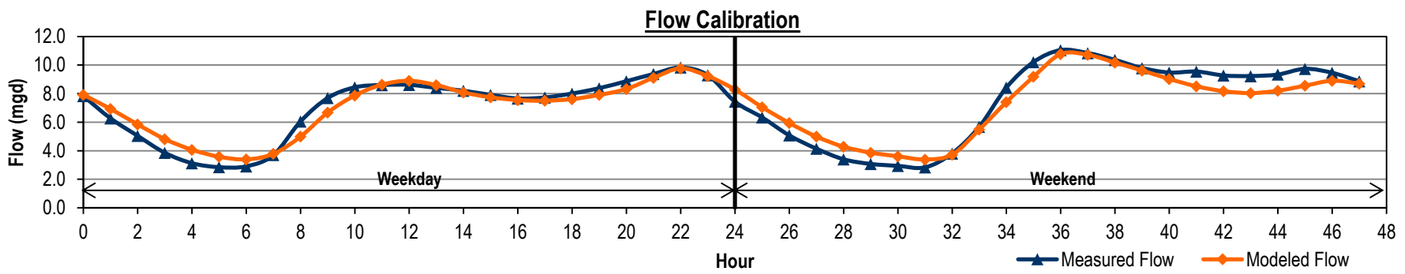
Public Works Integrated Master Plan

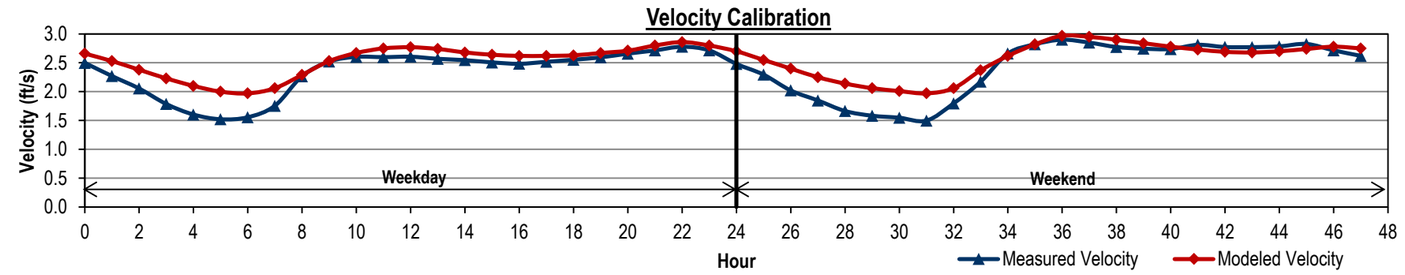
FLOW MONITORING SITE 3 DRY WEATHER FLOW CALIBRATION

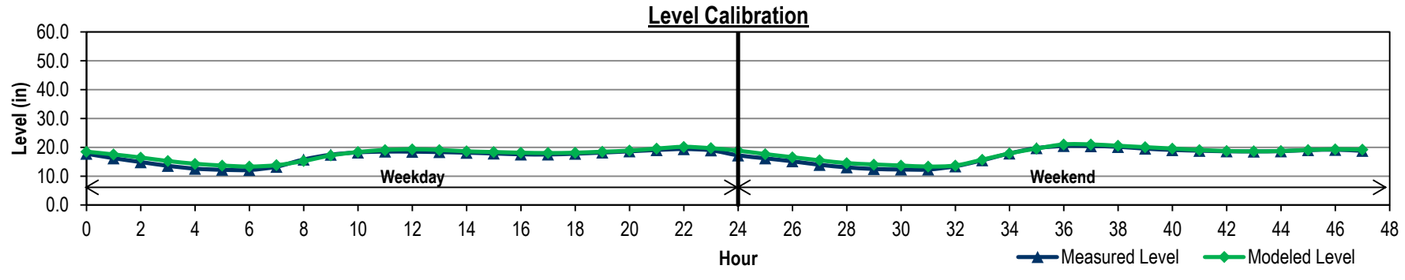
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	7.830	17.8	2.50	7.920	18.5	2.66	0.87	0.60	0.60
	1	6.270	16.2	2.27	6.930	17.5	2.53	0.70	0.40	0.40
	2	5.041	14.9	2.05	5.843	16.4	2.38	0.54	0.32	0.32
	3	3.856	13.6	1.79	4.814	15.2	2.23	0.44	0.25	0.25
	4	3.126	12.6	1.60	4.067	14.3	2.10	0.40	0.20	0.20
	5	2.846	12.2	1.52	3.577	13.7	2.00	0.41	0.30	0.30
	6	2.904	12.1	1.56	3.395	13.3	1.97	0.52	0.60	0.60
	7	3.700	13.3	1.76	3.780	13.8	2.06	0.84	1.00	1.00
	8	6.051	15.8	2.27	4.990	15.2	2.29	1.07	1.15	1.15
	9	7.694	17.4	2.52	6.675	17.2	2.53	1.18	1.30	1.30
	10	8.442	18.2	2.60	7.868	18.4	2.67	1.20	1.40	1.40
	11	8.603	18.5	2.60	8.629	19.1	2.75	1.20	1.50	1.50
	12	8.616	18.5	2.61	8.901	19.3	2.77	1.17	1.20	1.20
	13	8.404	18.3	2.57	8.595	19.1	2.74	1.14	1.09	1.09
	14	8.202	18.1	2.55	8.087	18.6	2.68	1.10	1.05	1.05
	15	7.912	17.9	2.51	7.741	18.4	2.64	1.07	1.04	1.04
	16	7.661	17.6	2.48	7.550	18.1	2.62	1.08	1.07	1.07
	17	7.732	17.5	2.52	7.502	18.0	2.62	1.12	1.14	1.14
	18	8.008	17.8	2.55	7.618	18.1	2.63	1.17	1.18	1.18
	19	8.381	18.2	2.59	7.912	18.5	2.67	1.24	1.26	1.26
	20	8.870	18.6	2.66	8.323	18.8	2.71	1.31	1.60	1.60
	21	9.377	19.1	2.71	9.110	19.6	2.80	1.37	1.80	1.80
	22	9.830	19.4	2.78	9.771	20.2	2.86	1.30	1.17	1.17
	23	9.297	18.9	2.72	9.227	19.7	2.80	1.09	0.91	0.91
Weekend	24	7.437	17.2	2.48	8.288	18.8	2.70	0.88	0.60	0.60
	25	6.335	16.2	2.30	7.052	17.6	2.55	0.71	0.44	0.44
	26	5.076	15.1	2.02	5.944	16.6	2.40	0.58	0.39	0.39
	27	4.144	13.9	1.85	4.989	15.5	2.25	0.47	0.33	0.33
	28	3.400	13.0	1.66	4.278	14.5	2.14	0.43	0.28	0.28
	29	3.073	12.5	1.58	3.864	14.0	2.06	0.41	0.25	0.25
	30	2.939	12.3	1.55	3.609	13.7	2.01	0.40	0.20	0.20
	31	2.831	12.3	1.50	3.386	13.3	1.97	0.53	0.80	0.80
	32	3.813	13.4	1.80	3.725	13.7	2.06	0.79	1.36	1.36
	33	5.678	15.5	2.17	5.482	15.7	2.37	1.18	1.75	1.75
	34	8.427	17.9	2.66	7.410	17.9	2.62	1.43	1.90	1.90
	35	10.216	19.7	2.82	9.185	19.6	2.82	1.54	2.10	2.10
	36	11.051	20.4	2.90	10.772	21.0	2.97	1.51	1.50	1.50
	37	10.844	20.4	2.85	10.718	21.0	2.95	1.45	1.40	1.40
	38	10.363	20.2	2.77	10.178	20.5	2.90	1.37	1.30	1.30
	39	9.793	19.5	2.75	9.621	20.0	2.84	1.32	1.20	1.20
	40	9.477	19.1	2.74	9.027	19.6	2.78	1.33	1.07	1.07
	41	9.548	18.8	2.81	8.511	19.1	2.73	1.29	1.14	1.14
	42	9.272	18.6	2.77	8.173	18.7	2.69	1.29	1.18	1.18
	43	9.233	18.6	2.77	8.039	18.6	2.68	1.30	1.26	1.26
	44	9.339	18.7	2.79	8.203	18.7	2.70	1.36	1.34	1.34
	45	9.740	19.0	2.83	8.555	19.1	2.74	1.32	1.34	1.34
	46	9.458	19.2	2.72	8.905	19.3	2.78	1.24	1.17	1.17
	47	8.864	18.8	2.62	8.704	19.2	2.75	1.04	0.91	0.91
Average										
Weekday		**7.027**	**16.8**	**2.35**	**7.034**	**17.5**	**2.53**	**0.98**	**0.98**	**0.98**
Weekend		**7.515**	**17.1**	**2.40**	**7.359**	**17.7**	**2.56**	**1.05**	**1.05**	**1.05**
ADWF[1]		**7.166**	**16.9**	**2.36**	**7.127**	**17.5**	**2.54**	**1.00**	**1.00**	**1.00**
% Error										
Weekday					0.1%	4.1%	7.9%			
Weekend					-2.1%	3.8%	6.5%			

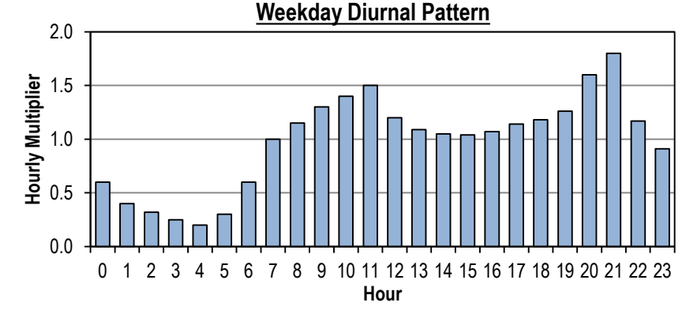
Note:

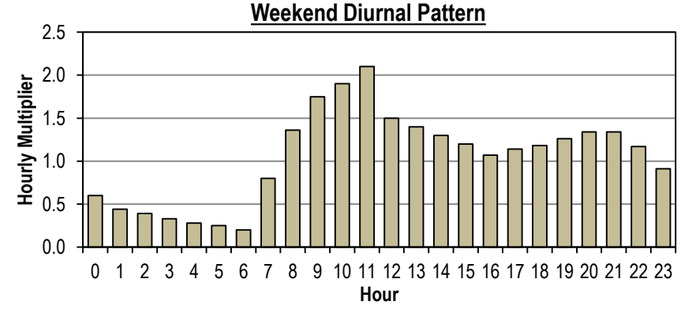
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

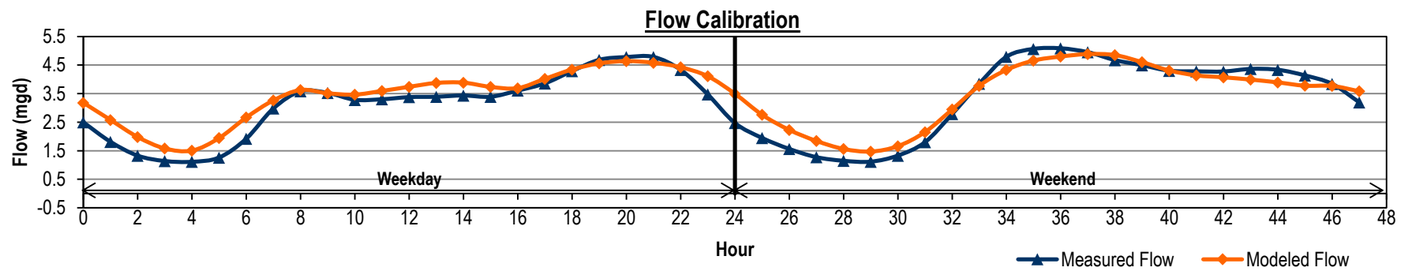
Public Works Integrated Master Plan

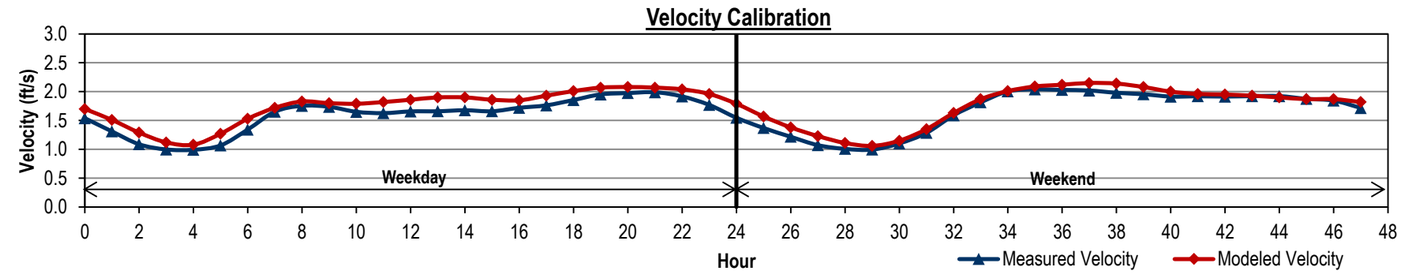
FLOW MONITORING SITE 4A DRY WEATHER FLOW CALIBRATION

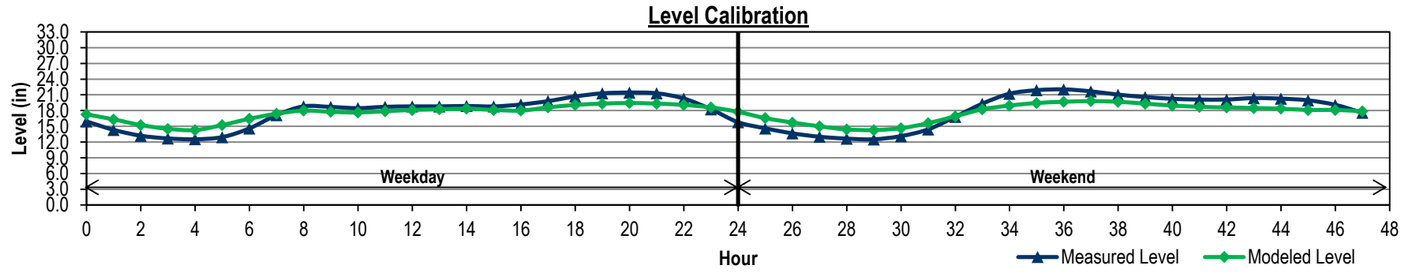
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	2.495	15.9	1.54	3.180	17.3	1.70	0.57	0.55	0.55
	1	1.811	14.3	1.31	2.579	16.3	1.51	0.41	0.39	0.39
	2	1.327	13.2	1.09	1.980	15.2	1.29	0.36	0.34	0.34
	3	1.139	12.7	1.00	1.579	14.5	1.12	0.35	0.33	0.33
	4	1.112	12.5	0.99	1.504	14.3	1.08	0.39	0.75	0.75
	5	1.261	12.9	1.07	1.944	15.2	1.27	0.60	1.25	1.25
	6	1.921	14.6	1.34	2.664	16.4	1.53	0.93	1.43	1.43
	7	2.981	17.1	1.65	3.264	17.4	1.72	1.12	1.60	1.60
	8	3.582	18.8	1.76	3.628	18.0	1.83	1.10	1.10	1.10
	9	3.526	18.7	1.74	3.513	17.8	1.80	1.03	0.81	0.81
	10	3.284	18.5	1.65	3.466	17.6	1.79	1.03	0.81	0.81
	11	3.303	18.7	1.63	3.594	17.9	1.82	1.06	0.81	0.81
	12	3.378	18.8	1.66	3.740	18.1	1.86	1.06	0.81	0.81
	13	3.391	18.8	1.66	3.875	18.2	1.90	1.07	0.81	0.81
	14	3.435	18.9	1.68	3.885	18.4	1.90	1.06	0.81	0.81
	15	3.391	18.8	1.66	3.735	18.1	1.86	1.13	0.81	0.81
	16	3.607	19.2	1.72	3.692	18.0	1.85	1.21	1.25	1.25
	17	3.860	19.8	1.76	4.019	18.6	1.93	1.34	1.47	1.47
	18	4.291	20.7	1.86	4.345	19.1	2.01	1.46	1.57	1.57
	19	4.684	21.3	1.95	4.561	19.3	2.07	1.49	1.57	1.57
	20	4.780	21.4	1.98	4.639	19.4	2.08	1.49	1.45	1.45
	21	4.786	21.3	1.99	4.582	19.3	2.07	1.35	1.24	1.24
	22	4.335	20.3	1.92	4.424	19.1	2.04	1.08	1.10	1.10
	23	3.471	18.3	1.77	4.109	18.6	1.96	0.78	0.91	0.91
Weekend	24	2.470	15.8	1.55	3.495	17.8	1.79	0.61	0.60	0.60
	25	1.947	14.6	1.37	2.759	16.6	1.57	0.49	0.60	0.60
	26	1.562	13.7	1.22	2.230	15.7	1.38	0.40	0.55	0.55
	27	1.274	13.0	1.07	1.843	15.0	1.23	0.36	0.45	0.45
	28	1.147	12.7	1.01	1.562	14.4	1.11	0.35	0.41	0.41
	29	1.116	12.5	1.00	1.471	14.3	1.06	0.41	0.55	0.55
	30	1.329	13.1	1.10	1.660	14.6	1.15	0.56	0.68	0.68
	31	1.798	14.4	1.29	2.153	15.6	1.35	0.87	0.93	0.93
	32	2.785	16.8	1.59	2.945	16.9	1.63	1.20	1.25	1.25
	33	3.850	19.3	1.82	3.777	18.2	1.87	1.50	1.41	1.41
	34	4.791	21.2	2.01	4.331	19.0	2.01	1.58	1.55	1.55
	35	5.067	21.9	2.04	4.658	19.4	2.09	1.59	1.53	1.53
	36	5.088	22.0	2.03	4.799	19.7	2.12	1.55	1.41	1.41
	37	4.953	21.7	2.02	4.887	19.8	2.15	1.46	1.38	1.38
	38	4.675	21.0	1.98	4.850	19.7	2.14	1.40	1.35	1.35
	39	4.494	20.6	1.96	4.602	19.3	2.08	1.34	1.34	1.34
	40	4.303	20.2	1.92	4.309	19.0	2.00	1.34	1.34	1.34
	41	4.281	20.1	1.92	4.139	18.7	1.96	1.34	1.34	1.34
	42	4.276	20.1	1.92	4.072	18.6	1.95	1.36	1.18	1.18
	43	4.366	20.4	1.92	3.991	18.5	1.93	1.35	1.10	1.10
	44	4.335	20.3	1.92	3.893	18.4	1.90	1.29	0.82	0.82
	45	4.137	20.0	1.88	3.777	18.1	1.87	1.20	0.80	0.80
	46	3.841	19.1	1.85	3.769	18.1	1.87	1.00	0.70	0.70
	47	3.193	17.6	1.72	3.583	17.9	1.82	0.77	0.65	0.65
Average										
Weekday		**3.131**	**17.7**	**1.60**	**3.438**	**17.6**	**1.75**	**0.98**	**1.00**	**1.00**
Weekend		**3.378**	**18.0**	**1.67**	**3.481**	**17.6**	**1.75**	**1.06**	**1.00**	**1.00**
ADWF[(1)]		**3.202**	**17.8**	**1.62**	**3.450**	**17.6**	**1.75**	**1.00**	**1.00**	**1.00**
% Error										
Weekday					**9.8%**	**-0.8%**	**9.5%**			
Weekend					**3.1%**	**-2.1%**	**4.9%**			

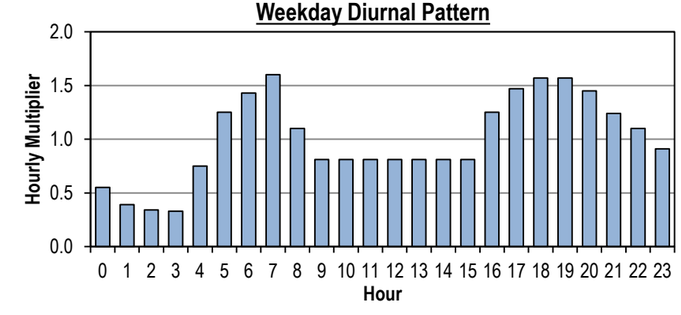
Note:

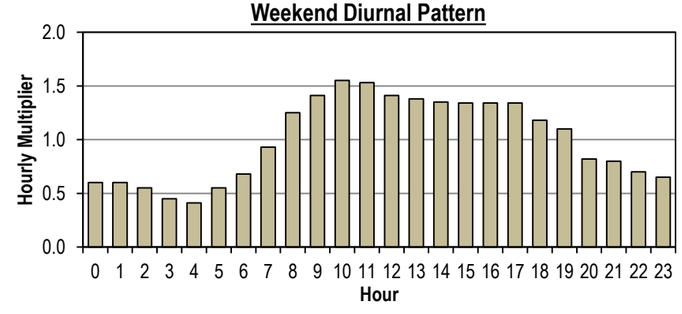
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

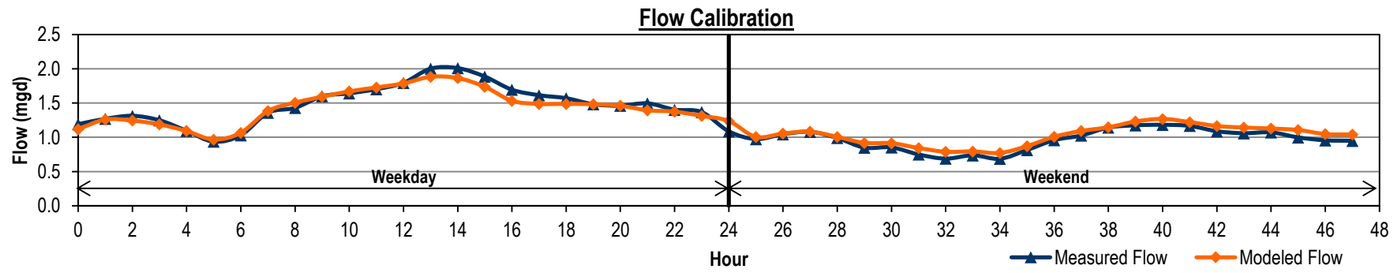
Public Works Integrated Master Plan

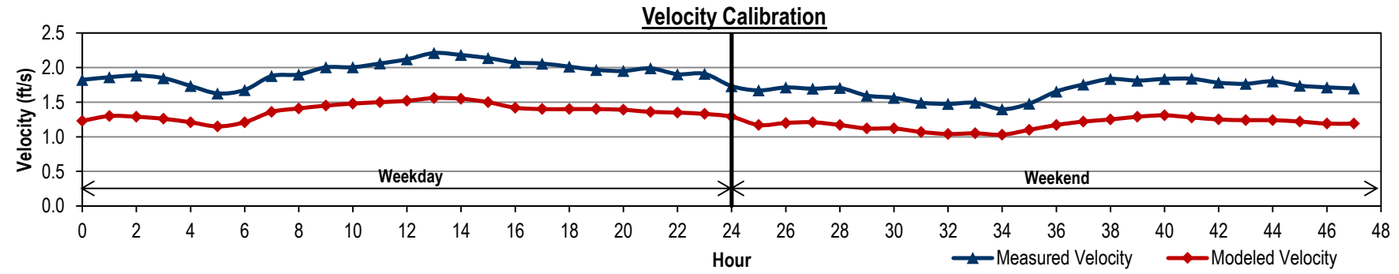
FLOW MONITORING SITE 5 DRY WEATHER FLOW CALIBRATION

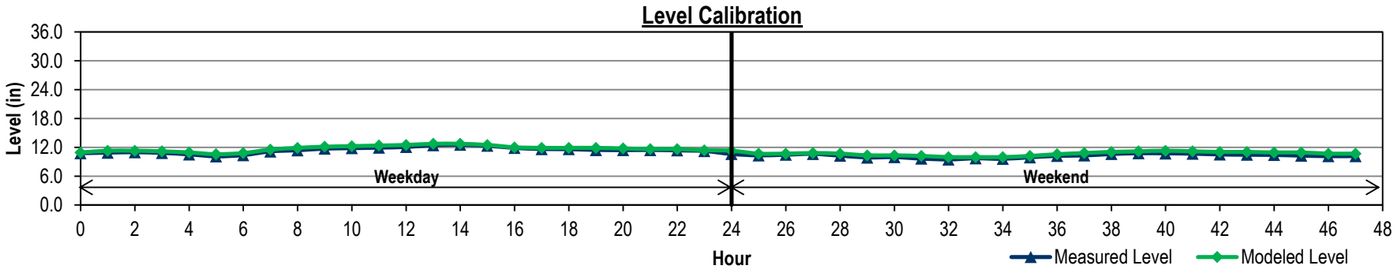
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	1.192	10.8	1.82	1.119	10.9	1.23	0.95	1.00	1.00
	1	1.269	10.9	1.86	1.259	11.3	1.30	0.98	0.95	0.95
	2	1.313	11.0	1.89	1.244	11.3	1.29	0.93	0.90	0.90
	3	1.248	10.8	1.85	1.188	11.2	1.26	0.82	0.80	0.80
	4	1.095	10.5	1.74	1.092	10.9	1.21	0.70	0.65	0.65
	5	0.937	10.1	1.63	0.968	10.6	1.15	0.77	0.82	0.82
	6	1.030	10.4	1.68	1.067	10.8	1.21	1.02	1.15	1.15
	7	1.358	11.1	1.88	1.383	11.5	1.36	1.07	1.18	1.18
	8	1.429	11.4	1.90	1.506	11.9	1.41	1.20	1.26	1.26
	9	1.599	11.7	2.00	1.592	12.1	1.45	1.23	1.35	1.35
	10	1.642	11.8	2.01	1.670	12.2	1.48	1.27	1.41	1.41
	11	1.703	11.9	2.06	1.728	12.4	1.50	1.34	1.46	1.46
	12	1.795	12.1	2.12	1.787	12.5	1.52	1.50	1.57	1.57
	13	2.002	12.4	2.21	1.883	12.7	1.56	1.50	1.54	1.54
	14	2.010	12.5	2.18	1.864	12.7	1.55	1.41	1.40	1.40
	15	1.887	12.3	2.14	1.738	12.5	1.50	1.27	1.15	1.15
	16	1.695	11.9	2.07	1.532	12.0	1.42	1.21	1.14	1.14
	17	1.614	11.6	2.06	1.487	11.9	1.40	1.17	1.14	1.14
	18	1.571	11.6	2.01	1.488	11.9	1.40	1.11	1.13	1.13
	19	1.483	11.4	1.97	1.482	11.9	1.40	1.09	1.11	1.11
	20	1.461	11.4	1.95	1.460	11.8	1.39	1.12	1.03	1.03
	21	1.495	11.4	1.99	1.395	11.6	1.36	1.05	1.03	1.03
	22	1.403	11.4	1.90	1.374	11.6	1.35	1.02	0.96	0.96
	23	1.368	11.2	1.91	1.313	11.4	1.33	0.89	0.91	0.91
Weekend	24	1.087	10.6	1.73	1.237	11.3	1.29	0.73	0.60	0.60
	25	0.975	10.3	1.67	1.006	10.7	1.17	0.78	0.80	0.80
	26	1.045	10.5	1.71	1.056	10.7	1.20	0.81	0.80	0.80
	27	1.080	10.6	1.69	1.082	10.8	1.21	0.74	0.70	0.70
	28	0.990	10.3	1.71	1.006	10.7	1.17	0.64	0.61	0.61
	29	0.849	9.9	1.60	0.918	10.3	1.12	0.64	0.65	0.65
	30	0.853	9.9	1.56	0.914	10.3	1.12	0.56	0.52	0.52
	31	0.749	9.6	1.49	0.844	10.2	1.07	0.51	0.45	0.45
	32	0.689	9.5	1.48	0.788	10.0	1.04	0.55	0.47	0.47
	33	0.737	9.7	1.49	0.793	10.0	1.05	0.51	0.43	0.43
	34	0.687	9.6	1.40	0.772	10.0	1.03	0.61	0.60	0.60
	35	0.814	9.9	1.48	0.871	10.2	1.10	0.72	0.73	0.73
	36	0.958	10.2	1.65	1.008	10.6	1.17	0.77	0.80	0.80
	37	1.026	10.3	1.76	1.093	10.8	1.22	0.85	0.85	0.85
	38	1.143	10.6	1.84	1.146	11.0	1.25	0.88	0.95	0.95
	39	1.175	10.8	1.81	1.230	11.2	1.29	0.88	0.98	0.98
	40	1.183	10.7	1.84	1.268	11.3	1.31	0.87	0.91	0.91
	41	1.167	10.7	1.84	1.222	11.2	1.28	0.81	0.84	0.84
	42	1.088	10.5	1.78	1.165	11.0	1.25	0.79	0.82	0.82
	43	1.060	10.4	1.77	1.142	11.0	1.24	0.80	0.80	0.80
	44	1.072	10.4	1.80	1.128	10.9	1.24	0.75	0.77	0.77
	45	0.999	10.3	1.74	1.106	10.9	1.22	0.71	0.69	0.69
	46	0.956	10.2	1.71	1.048	10.7	1.19	0.71	0.71	0.71
	47	0.949	10.2	1.70	1.041	10.7	1.19	0.81	0.82	0.82
Average										
Weekday		**1.483**	**11.4**	**1.95**	**1.442**	**11.7**	**1.38**	**1.11**	**1.13**	**1.13**
Weekend		**0.972**	**10.2**	**1.68**	**1.037**	**10.7**	**1.18**	**0.73**	**0.72**	**0.72**
ADWF[1]		**1.337**	**11.1**	**1.87**	**1.327**	**11.4**	**1.32**	**1.00**	**1.01**	**1.01**
% Error										
Weekday					-2.8%	2.8%	-29.5%			
Weekend					6.7%	4.3%	-29.4%			

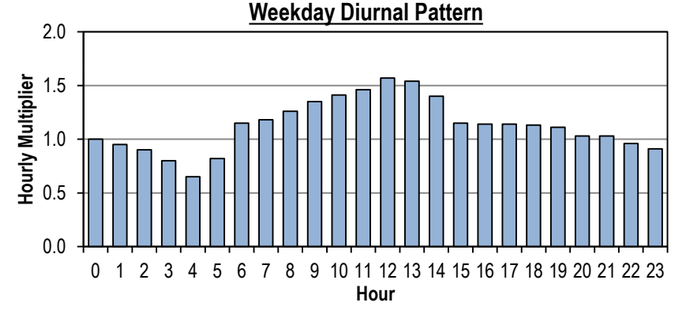
Note:

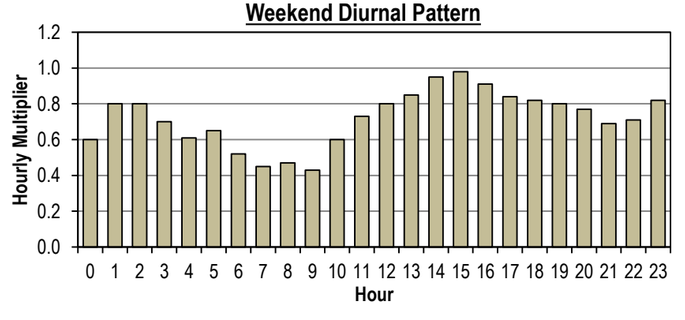
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

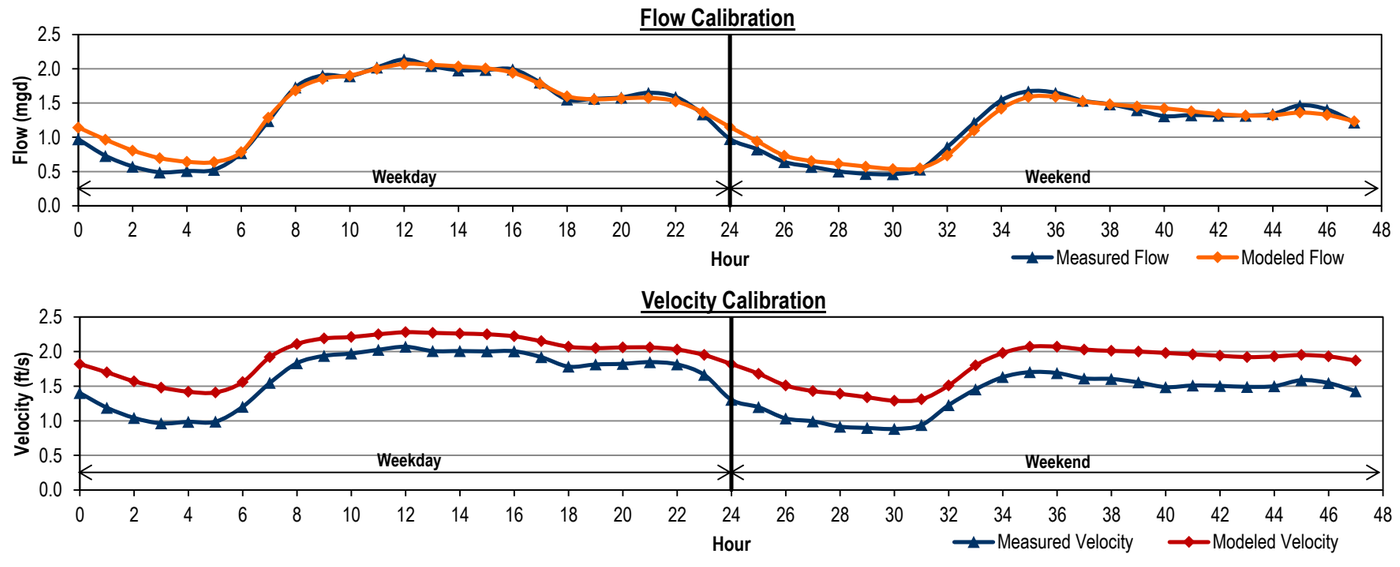
Public Works Integrated Master Plan

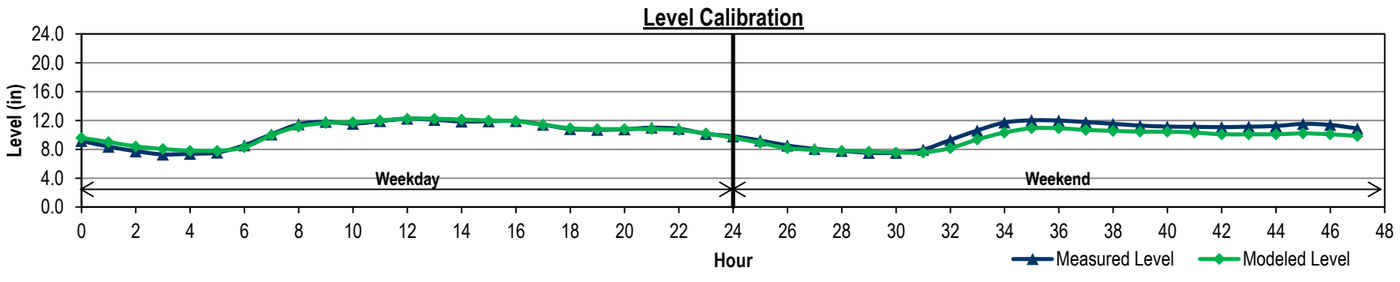
FLOW MONITORING SITE 6 DRY WEATHER FLOW CALIBRATION

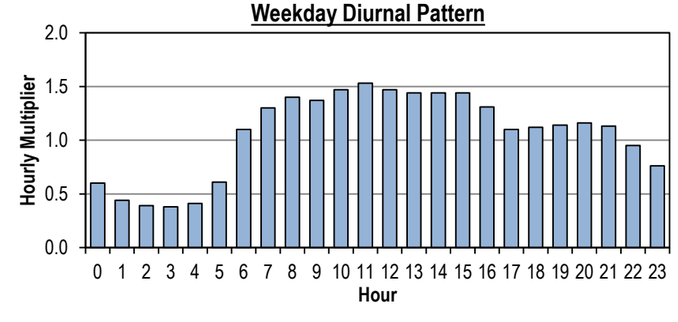
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	0.972	9.2	1.40	1.144	9.6	1.82	0.54	0.60	0.60
	1	0.730	8.4	1.19	0.966	9.0	1.70	0.43	0.44	0.44
	2	0.575	7.7	1.04	0.808	8.4	1.57	0.36	0.39	0.39
	3	0.490	7.3	0.96	0.696	8.0	1.48	0.38	0.38	0.38
	4	0.509	7.4	0.98	0.643	7.8	1.42	0.39	0.41	0.41
	5	0.527	7.5	0.99	0.639	7.8	1.41	0.57	0.61	0.61
	6	0.770	8.6	1.20	0.786	8.3	1.56	0.92	1.10	1.10
	7	1.238	10.1	1.55	1.290	10.0	1.92	1.28	1.30	1.30
	8	1.731	11.5	1.83	1.685	11.2	2.11	1.41	1.40	1.40
	9	1.904	11.8	1.94	1.855	11.6	2.19	1.40	1.37	1.37
	10	1.893	11.6	1.97	1.902	11.8	2.21	1.50	1.47	1.47
	11	2.021	11.9	2.03	1.998	12.0	2.25	1.58	1.53	1.53
	12	2.137	12.2	2.07	2.072	12.2	2.28	1.51	1.47	1.47
	13	2.041	12.1	2.01	2.058	12.2	2.27	1.47	1.44	1.44
	14	1.979	11.8	2.01	2.035	12.1	2.26	1.47	1.44	1.44
	15	1.984	11.9	2.00	2.008	12.0	2.25	1.48	1.44	1.44
	16	1.993	11.9	2.01	1.944	11.9	2.22	1.33	1.31	1.31
	17	1.802	11.4	1.92	1.782	11.4	2.15	1.15	1.10	1.10
	18	1.553	10.8	1.78	1.599	10.9	2.07	1.16	1.12	1.12
	19	1.563	10.7	1.81	1.555	10.8	2.05	1.17	1.14	1.14
	20	1.583	10.8	1.82	1.568	10.8	2.06	1.22	1.16	1.16
	21	1.650	11.0	1.85	1.576	10.8	2.06	1.18	1.13	1.13
	22	1.591	10.8	1.82	1.527	10.7	2.03	0.99	0.95	0.95
	23	1.336	10.2	1.66	1.366	10.2	1.95	0.72	0.76	0.76
Weekend	24	0.976	9.8	1.30	1.150	9.6	1.82	0.61	0.60	0.60
	25	0.826	9.2	1.20	0.942	8.9	1.68	0.47	0.44	0.44
	26	0.641	8.5	1.03	0.734	8.2	1.51	0.42	0.39	0.39
	27	0.571	8.1	0.99	0.655	7.9	1.43	0.37	0.38	0.38
	28	0.503	7.8	0.92	0.616	7.8	1.39	0.35	0.36	0.36
	29	0.468	7.5	0.90	0.573	7.7	1.34	0.34	0.35	0.35
	30	0.463	7.5	0.88	0.538	7.6	1.29	0.39	0.35	0.35
	31	0.531	8.0	0.94	0.549	7.6	1.31	0.63	0.64	0.64
	32	0.855	9.3	1.23	0.736	8.2	1.51	0.90	0.98	0.98
	33	1.213	10.6	1.46	1.100	9.4	1.80	1.14	1.21	1.21
	34	1.541	11.7	1.63	1.418	10.3	1.98	1.24	1.34	1.34
	35	1.672	12.0	1.70	1.588	10.9	2.07	1.22	1.25	1.25
	36	1.651	12.0	1.69	1.592	10.9	2.07	1.14	1.15	1.15
	37	1.535	11.8	1.61	1.524	10.7	2.03	1.10	1.12	1.12
	38	1.482	11.5	1.60	1.482	10.6	2.01	1.04	1.08	1.08
	39	1.400	11.3	1.55	1.451	10.4	2.00	0.97	1.04	1.04
	40	1.309	11.1	1.49	1.424	10.4	1.98	0.98	1.00	1.00
	41	1.325	11.1	1.51	1.381	10.3	1.96	0.98	0.98	0.98
	42	1.318	11.1	1.50	1.339	10.1	1.94	0.98	0.98	0.98
	43	1.318	11.1	1.49	1.319	10.1	1.92	0.99	0.98	0.98
	44	1.342	11.2	1.50	1.322	10.1	1.93	1.09	1.05	1.05
	45	1.467	11.5	1.59	1.361	10.2	1.95	1.04	1.00	1.00
	46	1.406	11.4	1.55	1.326	10.1	1.93	0.90	0.91	0.91
	47	1.218	10.9	1.43	1.234	9.8	1.87	0.72	0.85	0.85
Average										
	Weekday	**1.440**	**10.4**	**1.66**	**1.479**	**10.5**	**1.97**	**1.07**	**1.06**	**1.06**
	Weekend	**1.126**	**10.3**	**1.36**	**1.140**	**9.5**	**1.78**	**0.83**	**0.85**	**0.85**
	ADWF[1]	**1.351**	**10.3**	**1.58**	**1.382**	**10.2**	**1.92**	**1.00**	**1.00**	**1.00**
% Error										
	Weekday				2.7%	1.2%	18.7%			
	Weekend				1.2%	-7.5%	30.7%			

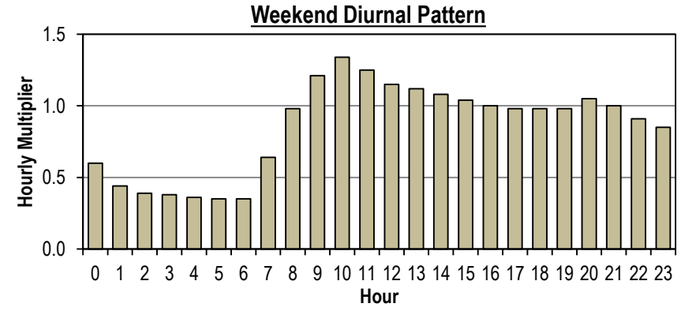
Note:

1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









City of Oxnard

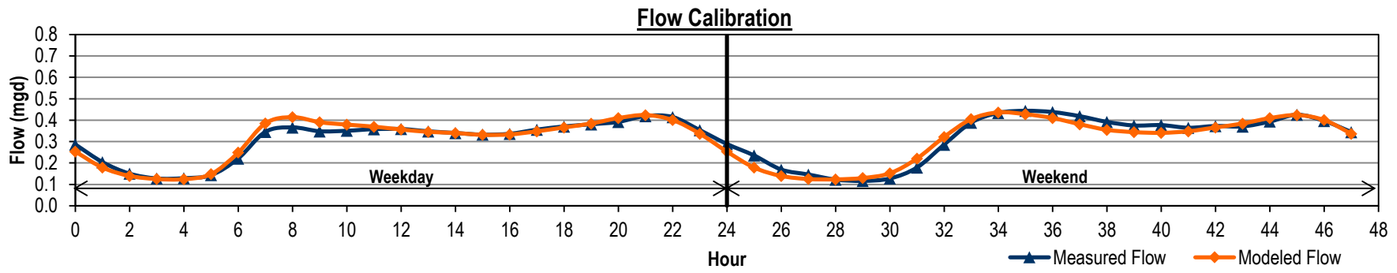
Public Works Integrated Master Plan

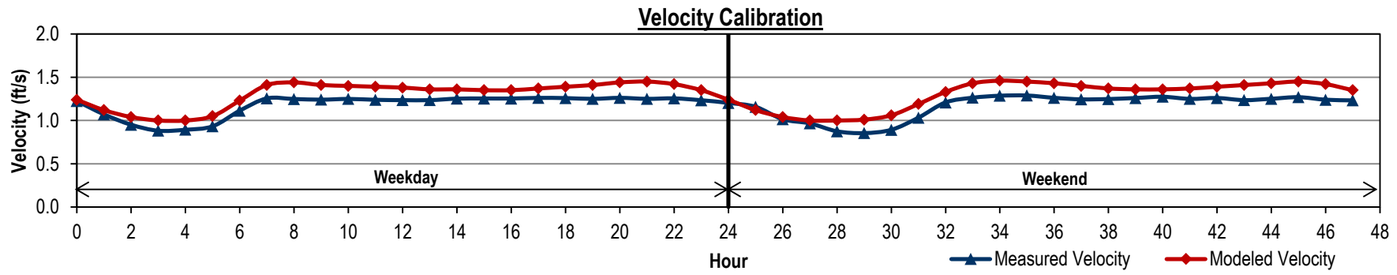
FLOW MONITORING SITE 7 DRY WEATHER FLOW CALIBRATION

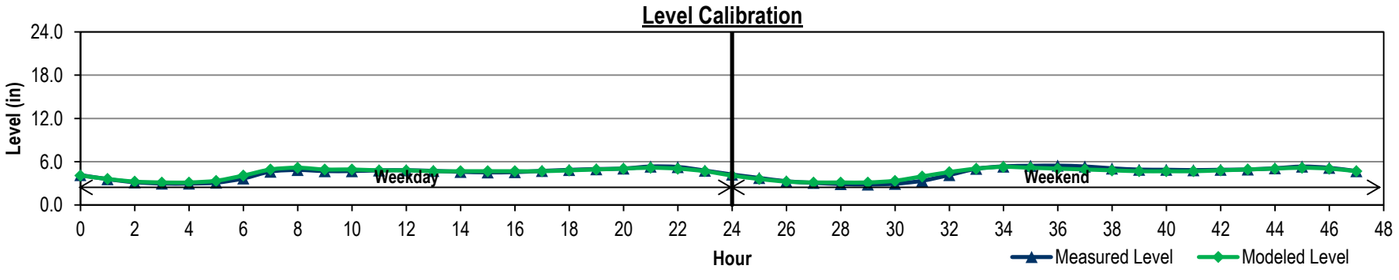
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	0.286	4.1	1.22	0.253	4.1	1.24	0.65	0.60	0.60
	1	0.204	3.6	1.07	0.179	3.6	1.12	0.48	0.44	0.44
	2	0.150	3.2	0.95	0.140	3.2	1.04	0.41	0.39	0.39
	3	0.128	3.0	0.88	0.125	3.1	1.00	0.41	0.38	0.38
	4	0.129	3.0	0.89	0.124	3.1	1.00	0.46	0.41	0.41
	5	0.143	3.1	0.93	0.148	3.4	1.05	0.71	0.61	0.61
	6	0.221	3.7	1.11	0.249	4.1	1.23	1.11	1.12	1.12
	7	0.345	4.6	1.26	0.385	4.9	1.41	1.17	1.36	1.36
	8	0.366	4.8	1.25	0.414	5.2	1.44	1.12	1.25	1.25
	9	0.348	4.7	1.24	0.391	4.9	1.41	1.12	1.21	1.21
	10	0.351	4.7	1.25	0.379	4.9	1.40	1.15	1.18	1.18
	11	0.358	4.8	1.24	0.370	4.8	1.39	1.15	1.15	1.15
	12	0.359	4.8	1.24	0.356	4.8	1.38	1.12	1.09	1.09
	13	0.348	4.7	1.24	0.346	4.7	1.36	1.09	1.09	1.09
	14	0.340	4.6	1.25	0.340	4.7	1.36	1.07	1.05	1.05
	15	0.332	4.5	1.25	0.332	4.7	1.35	1.08	1.04	1.04
	16	0.336	4.6	1.25	0.333	4.7	1.35	1.14	1.07	1.07
	17	0.356	4.7	1.26	0.348	4.7	1.37	1.19	1.14	1.14
	18	0.371	4.9	1.26	0.366	4.8	1.39	1.22	1.18	1.18
	19	0.381	5.0	1.25	0.384	4.9	1.41	1.26	1.26	1.26
	20	0.392	5.0	1.26	0.410	5.0	1.44	1.35	1.34	1.34
	21	0.420	5.3	1.25	0.424	5.2	1.45	1.33	1.34	1.34
	22	0.415	5.3	1.26	0.401	5.0	1.42	1.13	1.17	1.17
	23	0.353	4.8	1.23	0.337	4.7	1.35	0.92	0.91	0.91
Weekend	24	0.289	4.2	1.20	0.253	4.1	1.24	0.75	0.60	0.60
	25	0.235	3.7	1.16	0.179	3.6	1.12	0.54	0.44	0.44
	26	0.169	3.3	1.01	0.140	3.2	1.04	0.47	0.39	0.39
	27	0.146	3.1	0.97	0.125	3.1	1.00	0.39	0.38	0.38
	28	0.122	2.9	0.88	0.123	3.1	1.00	0.37	0.40	0.40
	29	0.116	2.9	0.85	0.130	3.1	1.01	0.41	0.43	0.43
	30	0.128	2.9	0.89	0.152	3.4	1.06	0.57	0.60	0.60
	31	0.179	3.4	1.03	0.221	4.0	1.19	0.92	0.90	0.90
	32	0.286	4.2	1.21	0.322	4.6	1.33	1.25	1.20	1.20
	33	0.389	5.0	1.26	0.405	5.0	1.43	1.39	1.39	1.39
	34	0.434	5.3	1.29	0.436	5.3	1.46	1.42	1.37	1.37
	35	0.444	5.4	1.29	0.428	5.2	1.45	1.40	1.33	1.33
	36	0.438	5.5	1.26	0.410	5.0	1.43	1.34	1.25	1.25
	37	0.419	5.3	1.24	0.381	4.9	1.40	1.26	1.14	1.14
	38	0.392	5.1	1.25	0.355	4.8	1.37	1.20	1.09	1.09
	39	0.375	4.9	1.26	0.344	4.7	1.36	1.21	1.08	1.08
	40	0.377	4.9	1.27	0.341	4.7	1.36	1.17	1.07	1.07
	41	0.365	4.8	1.25	0.348	4.7	1.37	1.20	1.14	1.14
	42	0.373	4.9	1.26	0.366	4.8	1.39	1.19	1.18	1.18
	43	0.371	4.9	1.24	0.384	4.9	1.41	1.26	1.26	1.26
	44	0.394	5.1	1.25	0.410	5.0	1.43	1.36	1.34	1.34
	45	0.425	5.3	1.27	0.424	5.2	1.45	1.27	1.34	1.34
	46	0.396	5.1	1.24	0.400	5.0	1.42	1.11	1.17	1.17
	47	0.345	4.7	1.23	0.337	4.7	1.35	0.93	0.91	0.91
Average										
Weekday		0.310	4.4	1.18	0.314	4.5	1.31	0.99	0.99	0.99
Weekend		0.317	4.5	1.17	0.309	4.4	1.29	1.02	0.98	0.98
ADWF[1]		0.312	4.4	1.18	0.312	4.5	1.30	1.00	0.99	0.99
% Error										
Weekday					1.3%	1.6%	10.8%			
Weekend					-2.5%	-0.7%	10.7%			

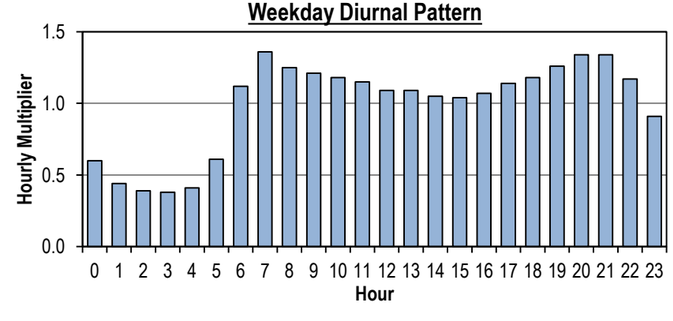
Note:

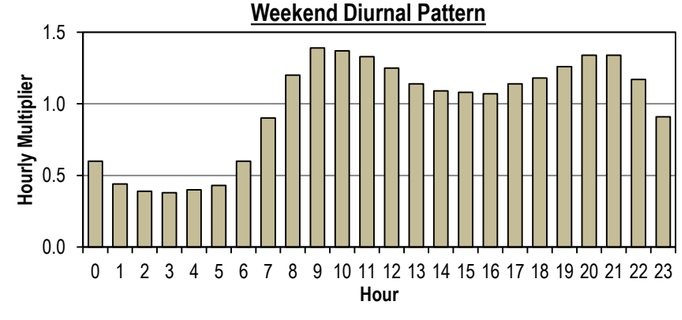
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

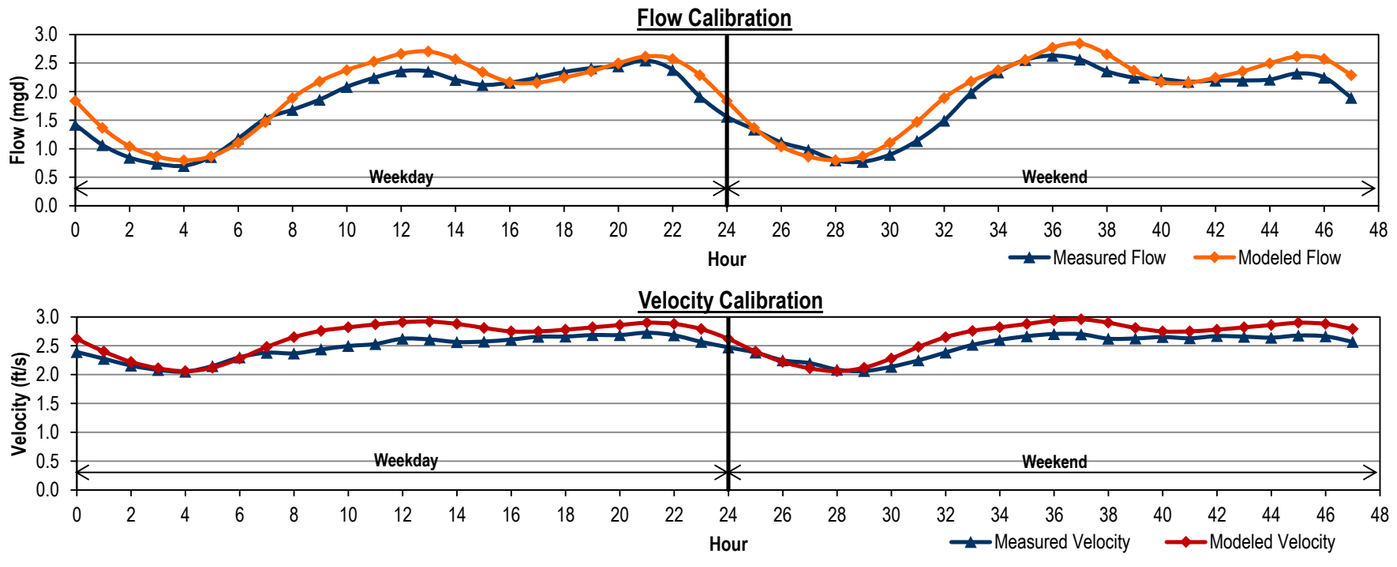
Public Works Integrated Master Plan

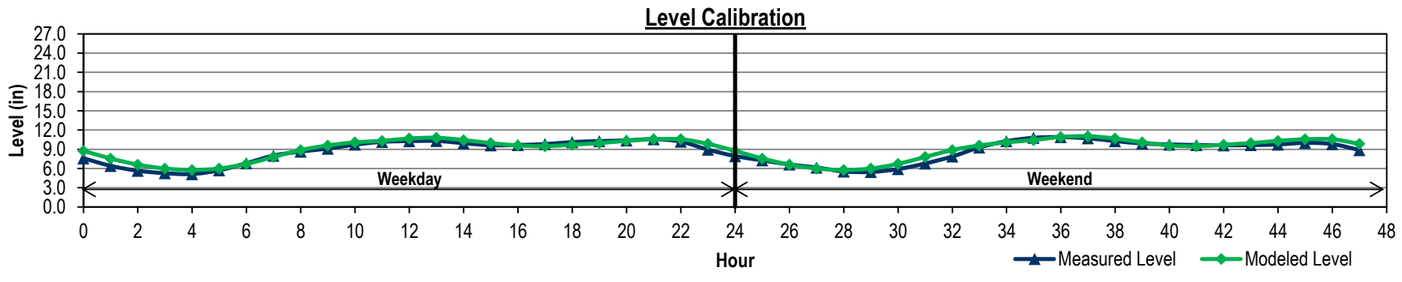
FLOW MONITORING SITE 8 DRY WEATHER FLOW CALIBRATION

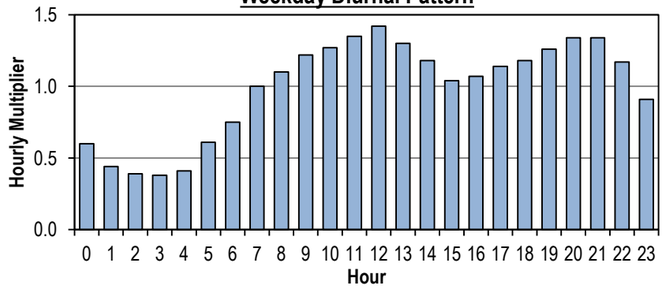
		Measured Data			Modeled Data			Diurnal		
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Initial Curve	Modified Curve	Calibrated Diurnal
Weekday	0	1.421	7.6	2.39	1.837	8.8	2.62	0.583	0.60	0.60
	1	1.066	6.4	2.28	1.366	7.6	2.40	0.462	0.44	0.44
	2	0.845	5.7	2.16	1.039	6.6	2.22	0.404	0.39	0.39
	3	0.737	5.3	2.08	0.862	6.0	2.11	0.384	0.38	0.38
	4	0.702	5.1	2.05	0.797	5.8	2.06	0.469	0.41	0.41
	5	0.857	5.7	2.15	0.865	6.0	2.12	0.645	0.61	0.61
	6	1.179	6.8	2.30	1.104	6.7	2.28	0.834	0.75	0.75
	7	1.524	8.0	2.38	1.471	7.8	2.48	0.922	1.00	1.00
	8	1.684	8.6	2.37	1.890	8.9	2.65	1.019	1.10	1.10
	9	1.861	9.1	2.44	2.179	9.6	2.76	1.141	1.22	1.22
	10	2.083	9.7	2.50	2.378	10.1	2.82	1.228	1.27	1.27
	11	2.242	10.2	2.53	2.526	10.3	2.87	1.291	1.35	1.35
	12	2.358	10.3	2.62	2.662	10.7	2.91	1.289	1.42	1.42
	13	2.354	10.3	2.61	2.705	10.8	2.92	1.209	1.30	1.30
	14	2.208	10.0	2.57	2.568	10.4	2.88	1.160	1.18	1.18
	15	2.118	9.6	2.57	2.343	10.0	2.81	1.182	1.04	1.04
	16	2.158	9.7	2.61	2.167	9.6	2.75	1.229	1.07	1.07
	17	2.244	9.8	2.66	2.155	9.5	2.75	1.282	1.14	1.14
	18	2.342	10.1	2.66	2.245	9.7	2.78	1.321	1.18	1.18
	19	2.412	10.3	2.69	2.357	10.0	2.82	1.339	1.26	1.26
	20	2.446	10.4	2.69	2.498	10.3	2.86	1.394	1.34	1.34
	21	2.547	10.6	2.73	2.617	10.6	2.90	1.304	1.34	1.34
	22	2.382	10.2	2.68	2.575	10.6	2.88	1.048	1.17	1.17
	23	1.913	8.9	2.57	2.291	9.8	2.79	0.778	0.91	0.91
Weekend	24	1.561	7.9	2.47	1.837	8.8	2.62	0.732	0.60	0.60
	25	1.337	7.3	2.38	1.367	7.6	2.40	0.608	0.44	0.44
	26	1.111	6.6	2.25	1.039	6.6	2.22	0.537	0.39	0.39
	27	0.981	6.2	2.20	0.862	6.0	2.11	0.436	0.38	0.38
	28	0.797	5.5	2.09	0.797	5.8	2.06	0.423	0.41	0.41
	29	0.772	5.5	2.06	0.865	6.0	2.12	0.490	0.61	0.61
	30	0.895	5.9	2.14	1.104	6.7	2.28	0.624	0.75	0.75
	31	1.140	6.8	2.25	1.470	7.8	2.48	0.818	1.00	1.00
	32	1.495	7.9	2.39	1.890	8.9	2.65	1.084	1.10	1.10
	33	1.979	9.3	2.52	2.179	9.6	2.76	1.281	1.22	1.22
	34	2.340	10.3	2.60	2.378	10.1	2.82	1.401	1.27	1.27
	35	2.558	10.8	2.67	2.559	10.4	2.88	1.440	1.42	1.42
	36	2.630	10.9	2.71	2.772	10.9	2.94	1.403	1.51	1.51
	37	2.563	10.7	2.70	2.845	11.0	2.96	1.290	1.35	1.35
	38	2.356	10.3	2.62	2.656	10.7	2.90	1.230	1.18	1.18
	39	2.246	9.9	2.63	2.370	10.1	2.81	1.216	1.04	1.04
	40	2.221	9.8	2.65	2.170	9.6	2.75	1.190	1.07	1.07
	41	2.173	9.7	2.63	2.155	9.5	2.75	1.202	1.14	1.14
	42	2.196	9.6	2.67	2.245	9.7	2.78	1.202	1.18	1.18
	43	2.195	9.7	2.66	2.357	10.0	2.82	1.211	1.26	1.26
	44	2.212	9.8	2.64	2.498	10.3	2.86	1.269	1.34	1.34
	45	2.318	10.0	2.68	2.617	10.6	2.90	1.231	1.34	1.34
	46	2.248	9.8	2.66	2.575	10.6	2.88	1.036	1.17	1.17
	47	1.893	8.9	2.57	2.291	9.8	2.79	0.855	0.91	0.91
Average										
Weekday		**1.820**	**8.7**	**2.47**	**1.979**	**9.0**	**2.64**	**1.00**	**0.99**	**0.99**
Weekend		**1.842**	**8.7**	**2.49**	**1.996**	**9.0**	**2.65**	**1.01**	**1.00**	**1.00**
ADWF[1]		**1.826**	**8.7**	**2.48**	**1.984**	**9.0**	**2.64**	**1.00**	**1.00**	**1.00**
% Error										
Weekday					**8.7%**	**3.6%**	**7.0%**			
Weekend					**8.3%**	**3.9%**	**6.2%**			

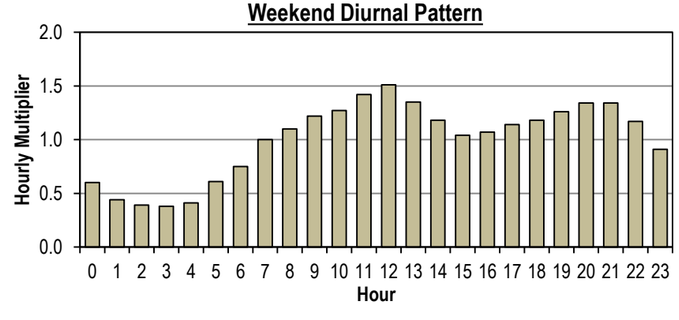
Note:

1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









City of Oxnard

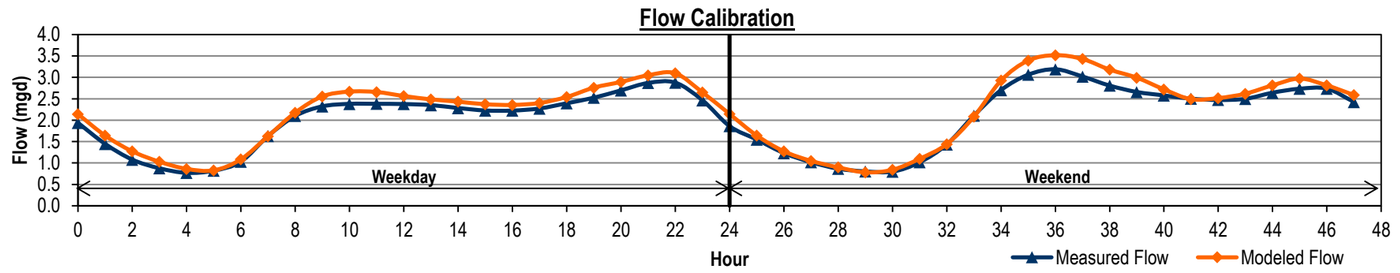
Public Works Integrated Master Plan

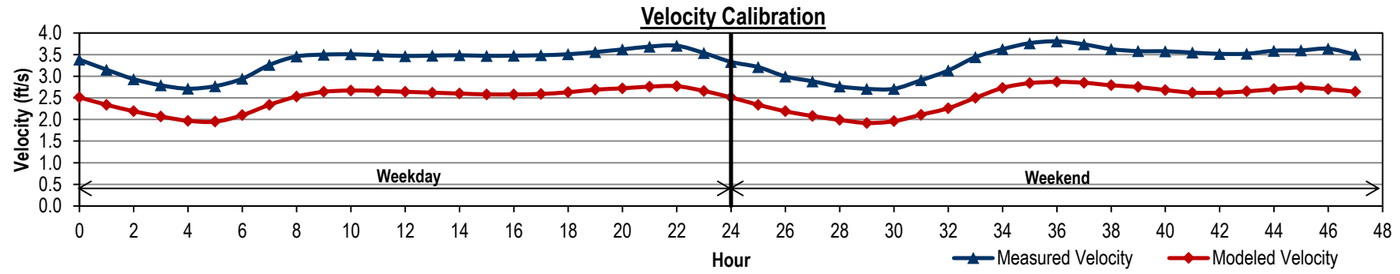
FLOW MONITORING SITE 9 DRY WEATHER FLOW CALIBRATION

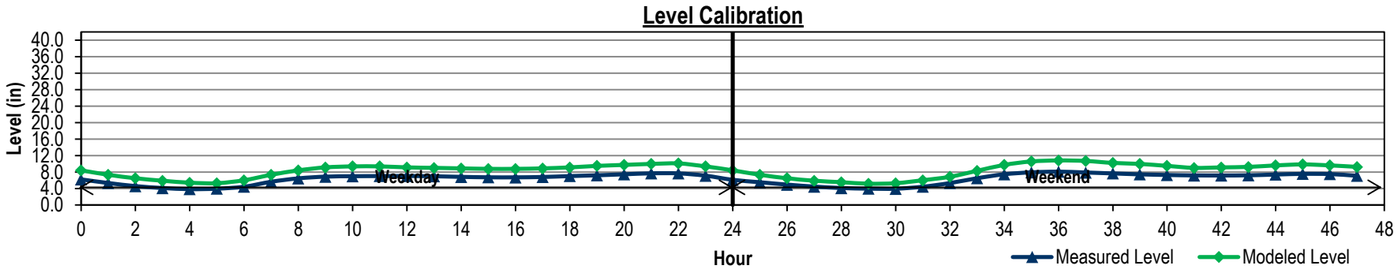
		Measured Data			Modeled Data			Diurnal		
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Initial Curve	Modified Curve	Calibrated Diurnal
Weekday	0	1.938	6.2	3.38	2.141	8.4	2.51	0.71	0.60	0.60
	1	1.446	5.3	3.15	1.640	7.3	2.34	0.53	0.44	0.44
	2	1.078	4.6	2.93	1.272	6.5	2.19	0.43	0.39	0.39
	3	0.876	4.1	2.79	1.029	5.9	2.07	0.38	0.30	0.30
	4	0.770	3.8	2.71	0.863	5.4	1.97	0.40	0.30	0.30
	5	0.820	3.9	2.77	0.828	5.3	1.95	0.50	0.45	0.45
	6	1.031	4.4	2.94	1.085	6.0	2.10	0.80	0.85	0.85
	7	1.630	5.6	3.26	1.626	7.3	2.34	1.03	1.08	1.08
	8	2.098	6.5	3.46	2.176	8.4	2.53	1.14	1.13	1.13
	9	2.322	6.9	3.50	2.556	9.1	2.64	1.17	1.15	1.15
	10	2.381	7.0	3.51	2.667	9.4	2.67	1.17	1.20	1.20
	11	2.382	7.0	3.49	2.657	9.4	2.66	1.16	1.14	1.14
	12	2.377	7.0	3.47	2.564	9.1	2.64	1.15	1.09	1.09
	13	2.352	7.0	3.48	2.485	9.0	2.62	1.12	1.09	1.09
	14	2.284	6.8	3.48	2.432	8.9	2.60	1.09	1.05	1.05
	15	2.226	6.7	3.47	2.372	8.8	2.58	1.09	1.04	1.04
	16	2.224	6.7	3.48	2.356	8.8	2.58	1.11	1.07	1.07
	17	2.273	6.8	3.49	2.401	8.9	2.59	1.17	1.14	1.14
	18	2.395	7.0	3.51	2.542	9.1	2.63	1.24	1.30	1.30
	19	2.525	7.2	3.56	2.760	9.5	2.69	1.32	1.34	1.34
	20	2.696	7.4	3.62	2.893	9.7	2.72	1.40	1.39	1.39
	21	2.869	7.7	3.69	3.050	10.0	2.76	1.41	1.56	1.56
	22	2.876	7.7	3.71	3.096	10.1	2.77	1.21	1.17	1.17
	23	2.466	7.1	3.54	2.649	9.4	2.66	0.95	0.91	0.91
Weekend	24	1.861	6.1	3.33	2.144	8.4	2.51	0.76	0.60	0.60
	25	1.548	5.5	3.21	1.641	7.3	2.34	0.60	0.44	0.44
	26	1.231	4.9	3.00	1.273	6.5	2.19	0.50	0.39	0.39
	27	1.019	4.5	2.88	1.049	5.9	2.08	0.42	0.38	0.38
	28	0.866	4.1	2.76	0.897	5.5	1.99	0.39	0.22	0.22
	29	0.803	4.0	2.71	0.782	5.2	1.92	0.39	0.30	0.30
	30	0.798	3.9	2.71	0.841	5.3	1.96	0.50	0.50	0.50
	31	1.016	4.4	2.91	1.098	6.0	2.11	0.70	0.65	0.65
	32	1.433	5.3	3.13	1.440	6.8	2.26	1.03	1.00	1.00
	33	2.106	6.5	3.44	2.082	8.3	2.50	1.32	1.45	1.45
	34	2.703	7.4	3.63	2.925	9.7	2.73	1.50	1.65	1.65
	35	3.062	7.9	3.76	3.394	10.6	2.84	1.56	1.70	1.70
	36	3.188	8.1	3.81	3.518	10.8	2.87	1.48	1.70	1.70
	37	3.020	7.9	3.74	3.429	10.7	2.85	1.37	1.50	1.50
	38	2.807	7.7	3.63	3.181	10.2	2.79	1.30	1.45	1.45
	39	2.658	7.4	3.58	2.993	10.0	2.75	1.26	1.30	1.30
	40	2.578	7.3	3.58	2.720	9.5	2.68	1.23	1.07	1.07
	41	2.502	7.2	3.55	2.489	9.0	2.62	1.21	1.14	1.14
	42	2.472	7.2	3.52	2.515	9.1	2.62	1.22	1.18	1.18
	43	2.499	7.2	3.52	2.619	9.2	2.65	1.29	1.26	1.26
	44	2.642	7.4	3.59	2.814	9.6	2.70	1.34	1.45	1.45
	45	2.734	7.5	3.60	2.971	9.8	2.74	1.34	1.25	1.25
	46	2.736	7.5	3.64	2.812	9.6	2.70	1.19	1.17	1.17
	47	2.426	7.1	3.50	2.588	9.2	2.64	0.91	0.91	0.91
Average										
Weekday		**2.014**	**6.3**	**3.35**	**2.172**	**8.3**	**2.49**	**0.99**	**0.97**	**0.97**
Weekend		**2.113**	**6.4**	**3.36**	**2.259**	**8.4**	**2.50**	**1.03**	**1.03**	**1.03**
ADWF[1]		**2.042**	**6.3**	**3.35**	**2.197**	**8.3**	**2.49**	**1.00**	**0.98**	**0.98**
% Error										
Weekday					7.9%	32.5%	-25.6%			
Weekend					6.9%	31.3%	-25.6%			

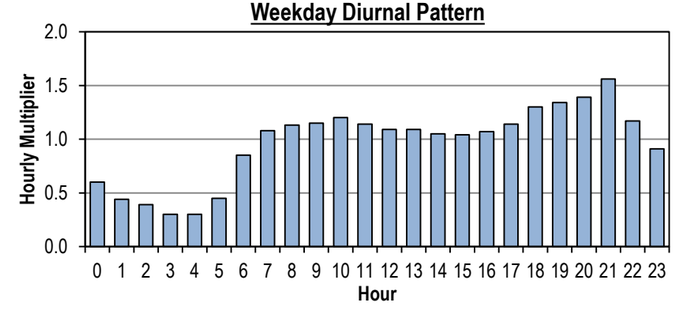
Note:

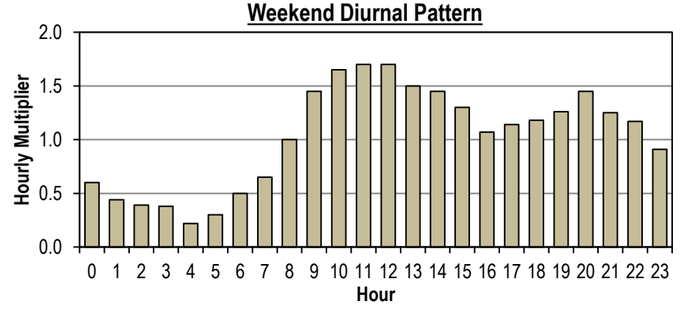
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











City of Oxnard

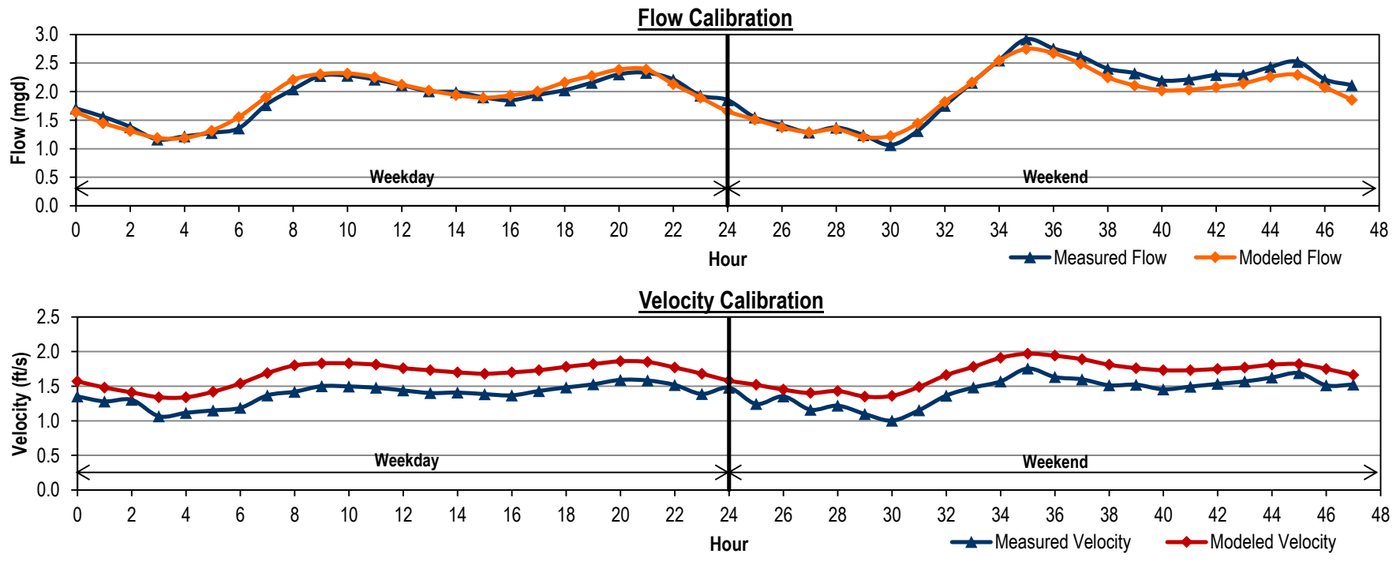
Public Works Integrated Master Plan

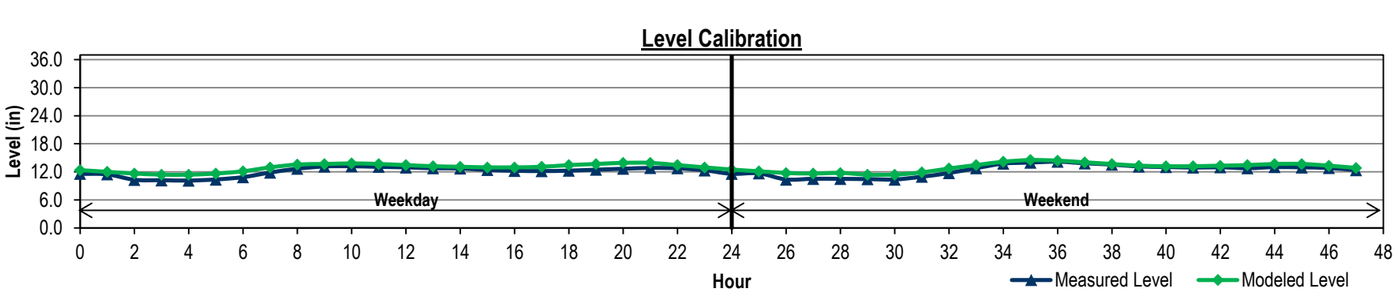
FLOW MONITORING SITE 10 DRY WEATHER FLOW CALIBRATION

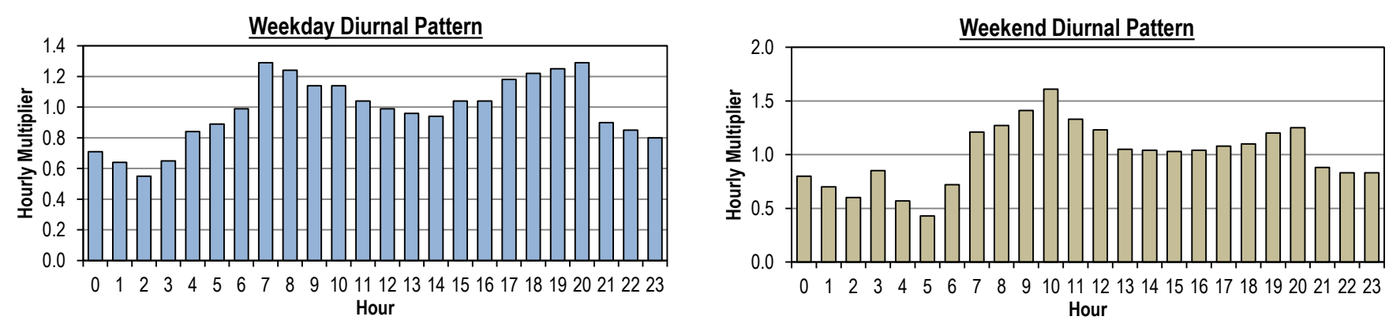
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Initial Curve	Diurnal Modified Curve	Diurnal Calibrated Diurnal
Weekday	0	1.706	11.6	1.35	1.639	12.4	1.57	0.81	0.71	0.71
	1	1.561	11.5	1.28	1.450	12.0	1.48	0.72	0.64	0.64
	2	1.382	10.3	1.30	1.312	11.6	1.41	0.61	0.55	0.55
	3	1.163	10.2	1.07	1.189	11.4	1.34	0.63	0.65	0.65
	4	1.218	10.1	1.12	1.188	11.4	1.34	0.67	0.84	0.84
	5	1.278	10.4	1.15	1.318	11.6	1.42	0.71	0.89	0.89
	6	1.360	10.9	1.19	1.556	12.1	1.54	0.92	0.99	0.99
	7	1.768	11.9	1.37	1.901	13.0	1.69	1.06	1.29	1.29
	8	2.041	12.7	1.42	2.207	13.6	1.80	1.19	1.24	1.24
	9	2.277	13.2	1.50	2.308	13.7	1.83	1.19	1.14	1.14
	10	2.281	13.2	1.50	2.320	13.8	1.83	1.15	1.14	1.14
	11	2.214	13.1	1.48	2.256	13.7	1.81	1.10	1.04	1.04
	12	2.115	13.0	1.44	2.124	13.4	1.76	1.04	0.99	0.99
	13	2.007	12.8	1.40	2.022	13.2	1.73	1.04	0.96	0.96
	14	1.994	12.7	1.41	1.942	13.1	1.70	0.99	0.94	0.94
	15	1.901	12.4	1.39	1.892	13.0	1.68	0.96	1.04	1.04
	16	1.848	12.2	1.37	1.934	13.0	1.70	1.01	1.04	1.04
	17	1.940	12.2	1.43	2.007	13.1	1.73	1.06	1.18	1.18
	18	2.028	12.3	1.48	2.162	13.4	1.78	1.12	1.22	1.22
	19	2.157	12.5	1.53	2.275	13.7	1.82	1.20	1.25	1.25
	20	2.304	12.7	1.59	2.388	13.9	1.86	1.21	1.29	1.29
	21	2.332	12.8	1.58	2.391	13.9	1.85	1.15	0.90	0.90
	22	2.213	12.8	1.52	2.133	13.4	1.77	1.01	0.85	0.85
	23	1.932	12.3	1.39	1.895	13.0	1.68	0.89	0.80	0.80
Weekend	24	1.852	11.6	1.48	1.657	12.5	1.58	0.81	0.80	0.80
	25	1.549	11.7	1.24	1.513	12.1	1.52	0.74	0.70	0.70
	26	1.415	10.4	1.35	1.375	11.8	1.45	0.67	0.60	0.60
	27	1.288	10.5	1.16	1.289	11.6	1.40	0.71	0.85	0.85
	28	1.372	10.5	1.22	1.342	11.8	1.43	0.65	0.57	0.57
	29	1.241	10.4	1.10	1.206	11.4	1.35	0.55	0.43	0.43
	30	1.065	10.4	1.00	1.223	11.4	1.36	0.68	0.72	0.72
	31	1.312	11.0	1.15	1.443	11.9	1.49	0.91	1.21	1.21
	32	1.753	11.7	1.36	1.821	12.7	1.66	1.12	1.27	1.27
	33	2.157	12.8	1.48	2.161	13.4	1.78	1.33	1.41	1.41
	34	2.550	13.8	1.57	2.542	14.2	1.91	1.52	1.61	1.61
	35	2.917	14.0	1.76	2.748	14.5	1.97	1.43	1.33	1.33
	36	2.756	14.2	1.63	2.674	14.4	1.94	1.36	1.23	1.23
	37	2.621	13.8	1.60	2.490	14.0	1.89	1.25	1.05	1.05
	38	2.402	13.6	1.51	2.249	13.7	1.81	1.21	1.04	1.04
	39	2.325	13.1	1.52	2.109	13.3	1.76	1.14	1.03	1.03
	40	2.196	13.1	1.45	2.023	13.2	1.73	1.15	1.04	1.04
	41	2.216	12.9	1.49	2.033	13.2	1.73	1.19	1.08	1.08
	42	2.293	13.0	1.53	2.080	13.3	1.75	1.20	1.10	1.10
	43	2.298	12.8	1.57	2.145	13.4	1.77	1.27	1.20	1.20
	44	2.434	13.0	1.63	2.260	13.7	1.81	1.31	1.25	1.25
	45	2.525	13.0	1.69	2.293	13.7	1.82	1.15	0.88	0.88
	46	2.215	12.8	1.51	2.077	13.3	1.75	1.10	0.83	0.83
	47	2.114	12.4	1.52	1.858	12.8	1.66	0.96	0.83	0.83
Average										
Weekday		**1.876**	**12.1**	**1.38**	**1.909**	**12.9**	**1.67**	**0.98**	**0.98**	**0.98**
Weekend		**2.036**	**12.3**	**1.44**	**1.942**	**13.0**	**1.68**	**1.06**	**1.00**	**1.00**
ADWF[1]		**1.922**	**12.1**	**1.40**	**1.918**	**12.9**	**1.67**	**1.00**	**0.99**	**0.99**
% Error										
Weekday					1.7%	7.2%	20.7%			
Weekend					-4.6%	5.1%	16.7%			

Note:

1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







APPENDIX B – WET WEATHER FLOW CALIBRATION PLOTS AND RAIN GAUGE LOCATIONS

Table 1 Wet Weather Flow Calibration Results
Public Works Integrated Master Plan
City of Oxnard

Meter Number	Pipe Diameter (in)	Storm 1 (12/11/2014-12/12/2014)											
		Measured Data[1]				Modeled Data[2]				Percent Error[3]			
		Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)
SITE 1	41.5	5.284	6.808	2.62	16.6	5.506	7.395	2.78	15.6	4.2%	8.6%	5.9%	-6.0%
SITE 2	36	3.063	5.780	1.78	14.4	2.744	6.086	1.87	13.5	***-10.4%***	5.3%	4.6%	-6.0%
SITE 3	60	7.739	10.727	2.32	18.3	7.185	10.352	2.31	19.2	-7.2%	-3.5%	-0.6%	5.0%
SITE 4A	33	3.298	4.818	1.67	18.1	3.779	5.413	1.95	17.3	14.6%	12.3%	16.8%	-4.3%
SITE 5	36	1.634	2.663	1.42	10.6	1.475	2.739	1.38	11.8	-9.7%	2.8%	-2.9%	11.0%
SITE 6	24	1.350	1.921	2.10	8.3	1.517	2.078	2.37	8.3	12.4%	8.2%	13.2%	-0.2%
SITE 7	24	0.331	0.503	1.25	4.4	0.328	0.481	1.33	4.5	-0.8%	-4.5%	6.5%	2.4%
SITE 8	27	2.292	4.191	2.61	9.9	2.305	4.260	2.76	9.8	0.6%	1.6%	5.5%	-1.2%
SITE 9	42	2.301	3.231	3.43	6.8	2.380	3.421	2.56	8.7	3.4%	5.9%	***-25.3%***	***27.9%***
SITE 10	37	2.297	3.533	1.76	11.5	2.169	3.279	2.03	11.4	-5.6%	-7.2%	15.6%	-1.2%

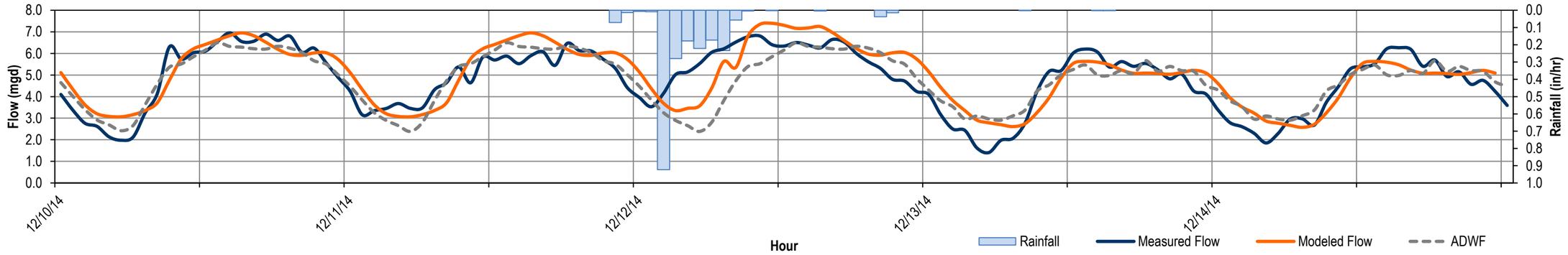
Notes:
1. Temporary Flow Monitoring Program, V&A Consulting Engineers
2. Average flows are calculated from flow monitoring data. Maximum flow values are hourly peaks.
3. Percent Difference = (Modeled - Measured)/Measured*100.

City of Oxnard

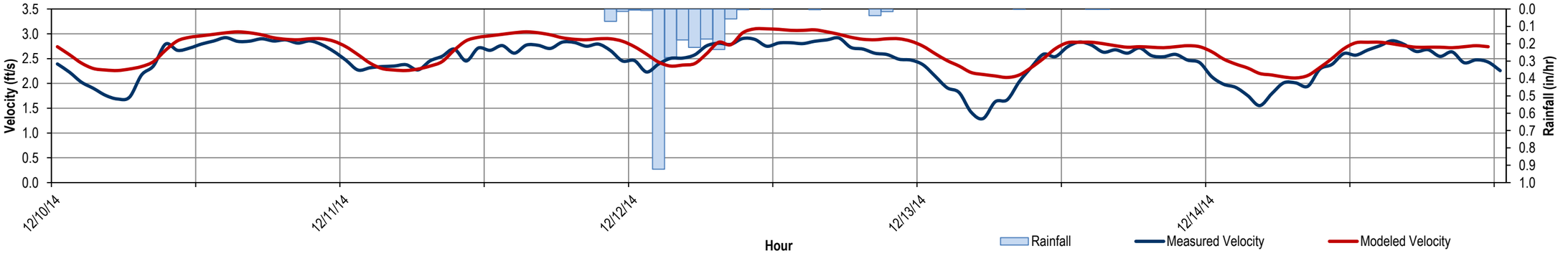
Public Works Integrated Master Plan

FLOW MONITORING SITE 1 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

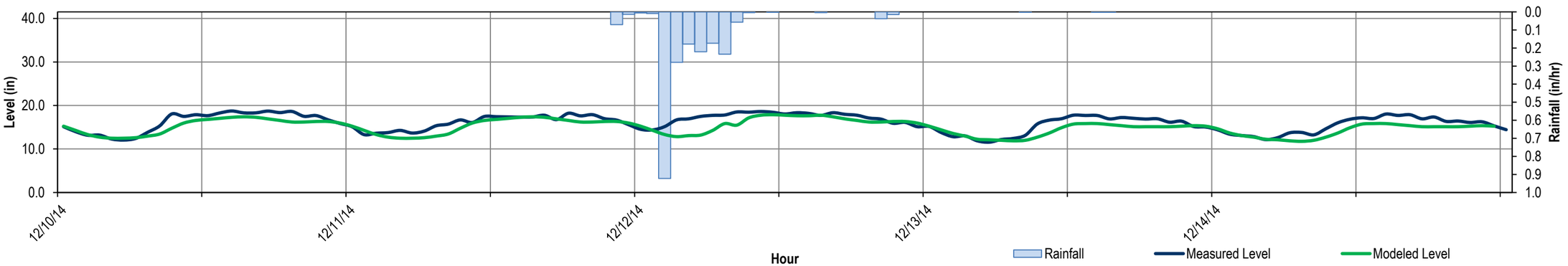
Flow Calibration



Velocity Calibration



Level Calibration

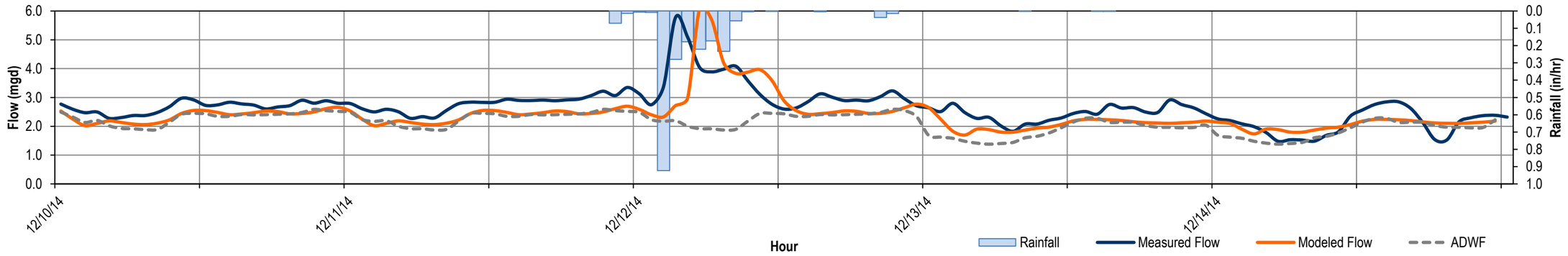


City of Oxnard

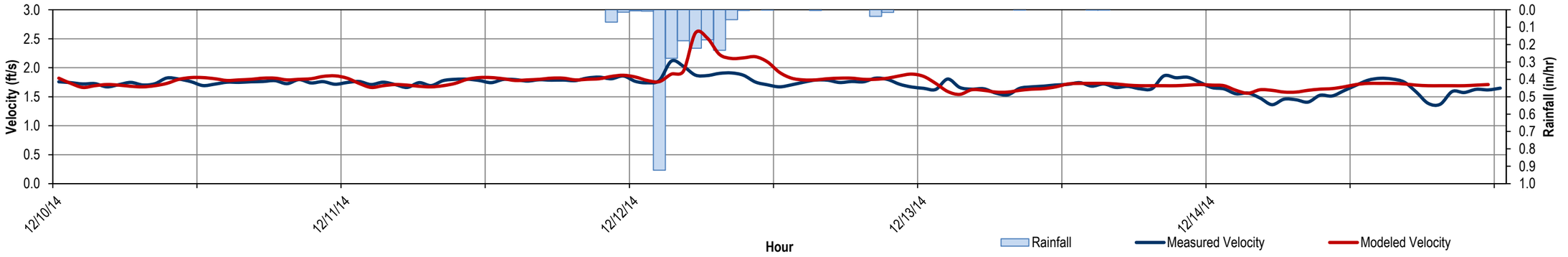
Public Works Integrated Master Plan

FLOW MONITORING SITE 2 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

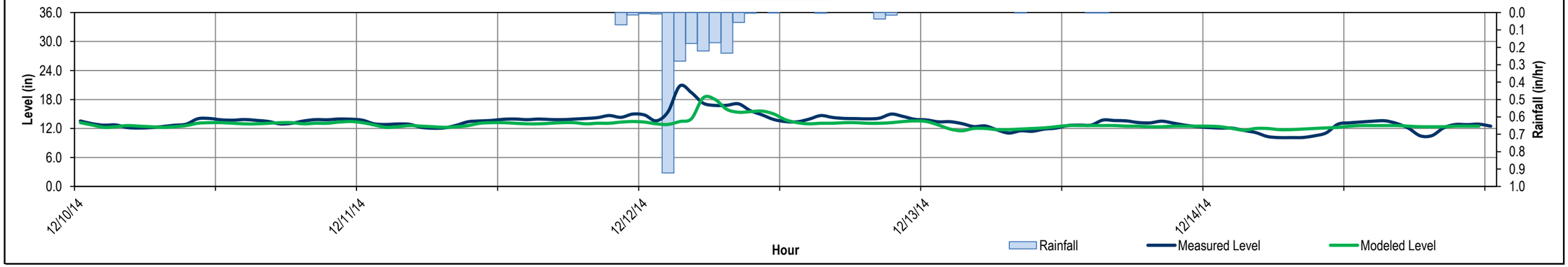
Flow Calibration



Velocity Calibration



Level Calibration

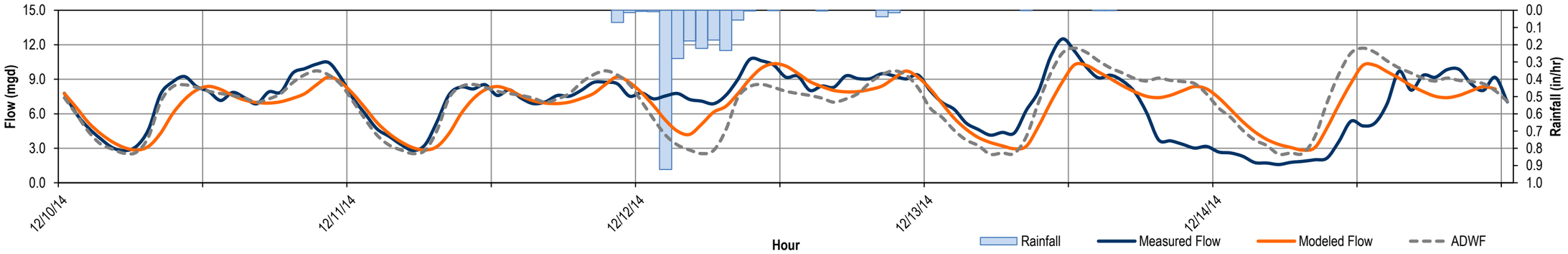


City of Oxnard

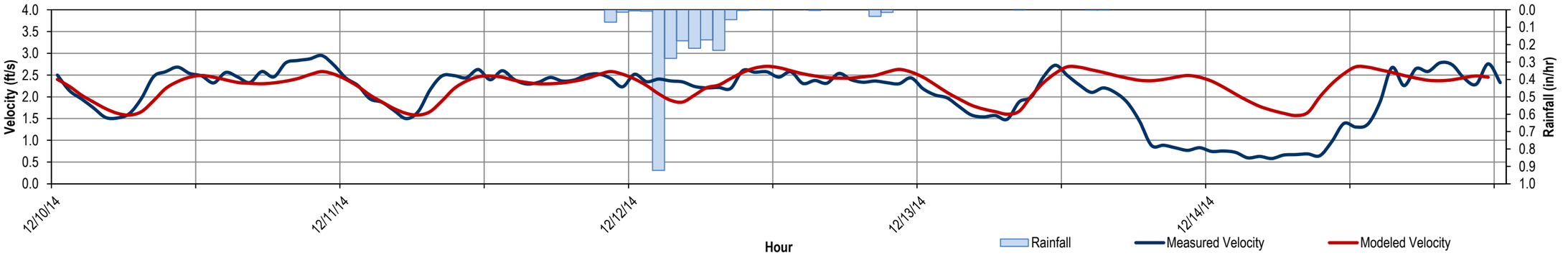
Public Works Integrated Master Plan

FLOW MONITORING SITE 3 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

Flow Calibration



Velocity Calibration



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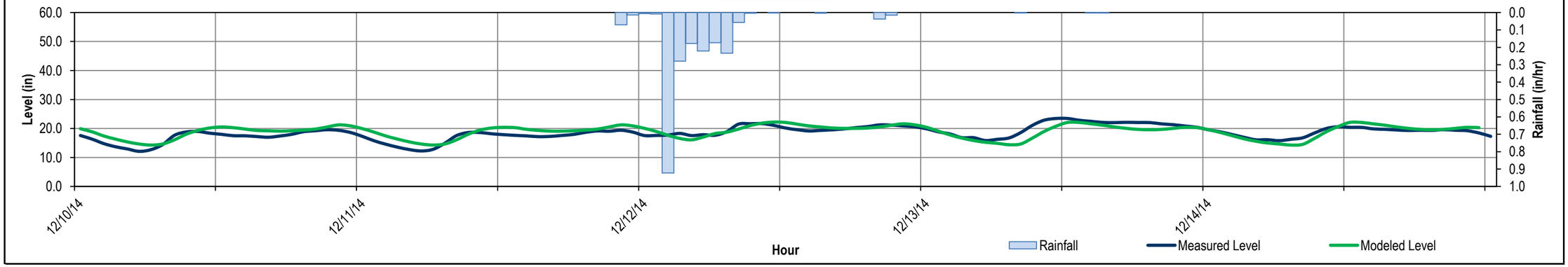
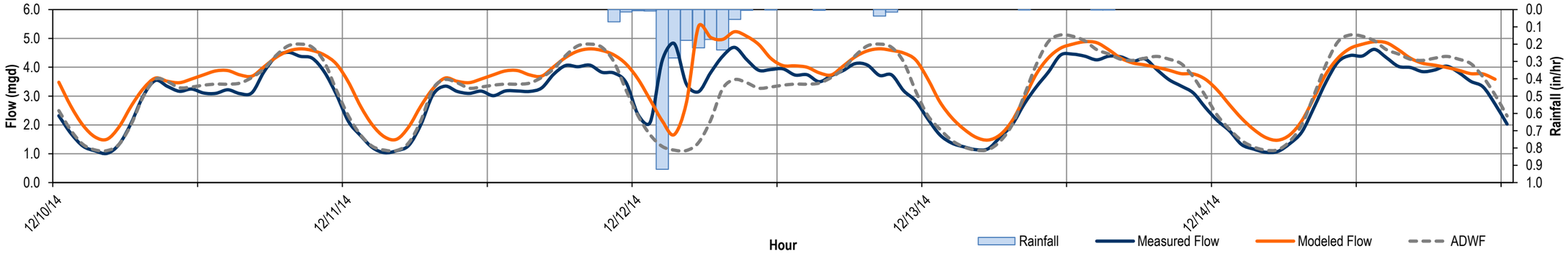


City of Oxnard

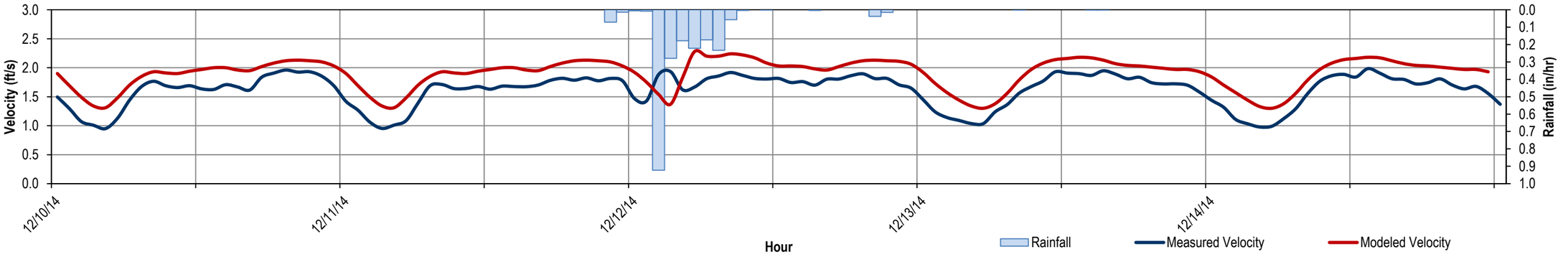
Public Works Integrated Master Plan

FLOW MONITORING SITE 4A WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

Flow Calibration



Velocity Calibration



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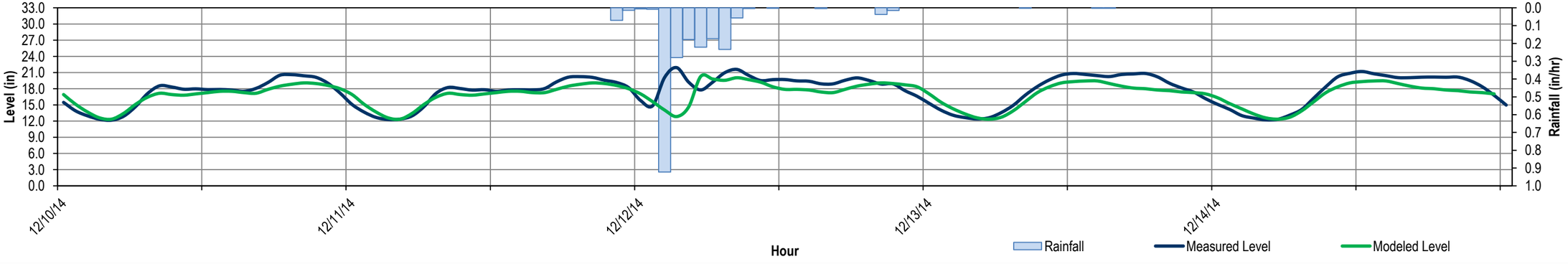
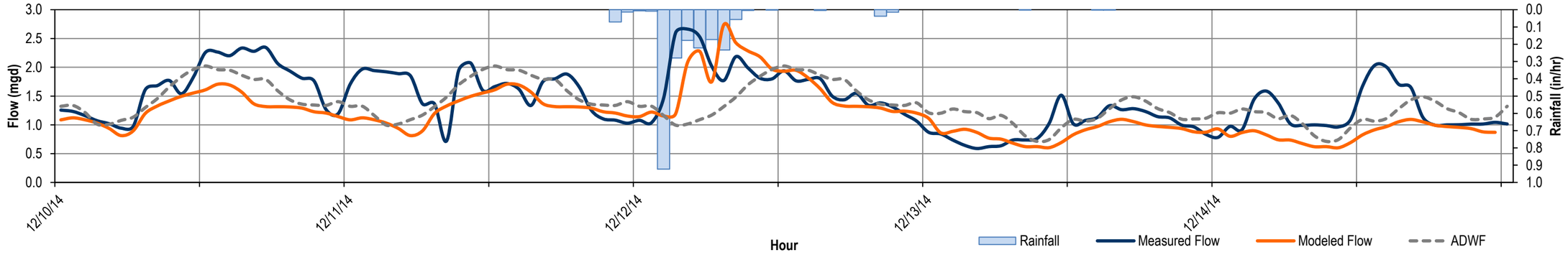


City of Oxnard

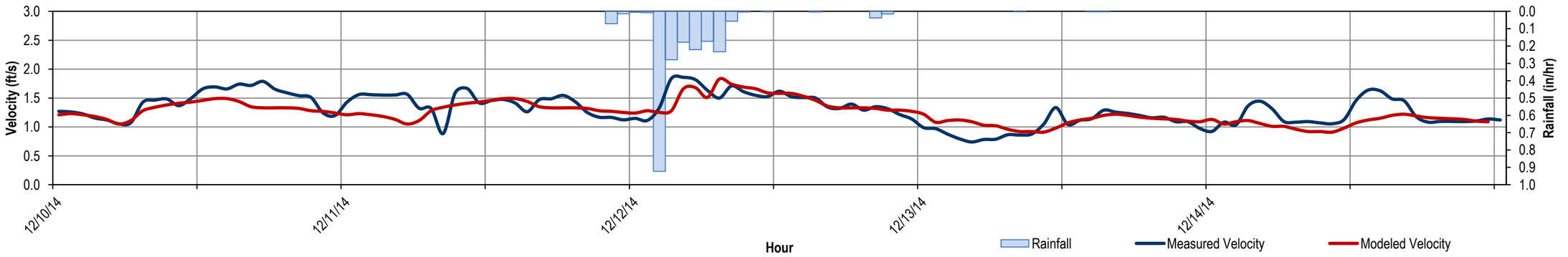
Public Works Integrated Master Plan

FLOW MONITORING SITE 5 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

Flow Calibration



Velocity Calibration



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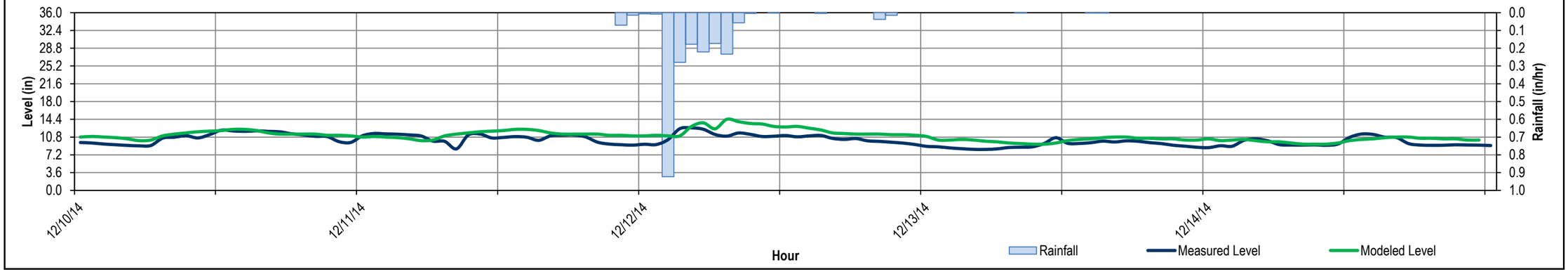
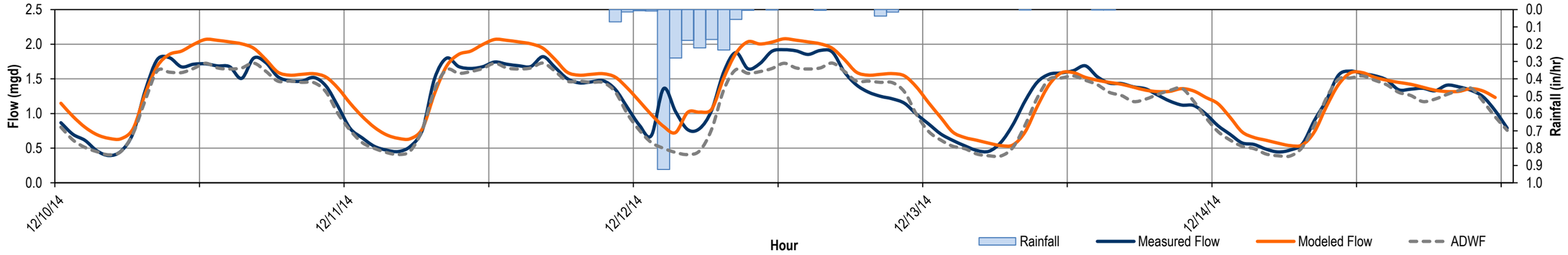


City of Oxnard

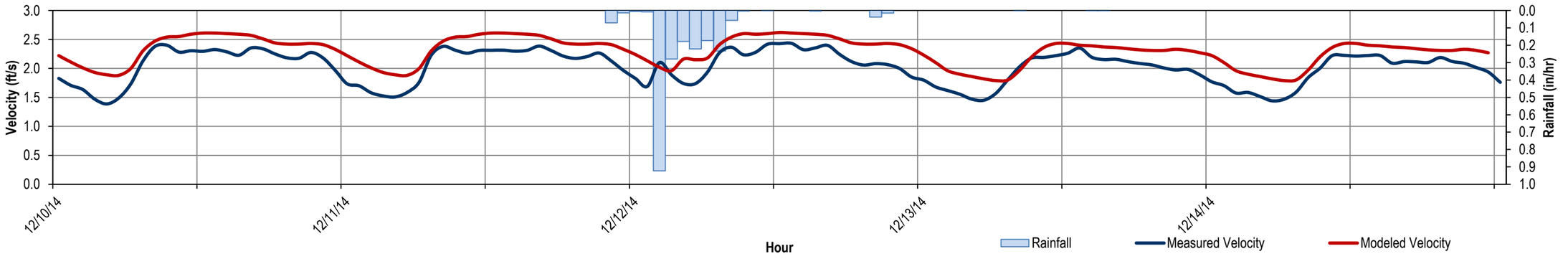
Public Works Integrated Master Plan

FLOW MONITORING SITE 6 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

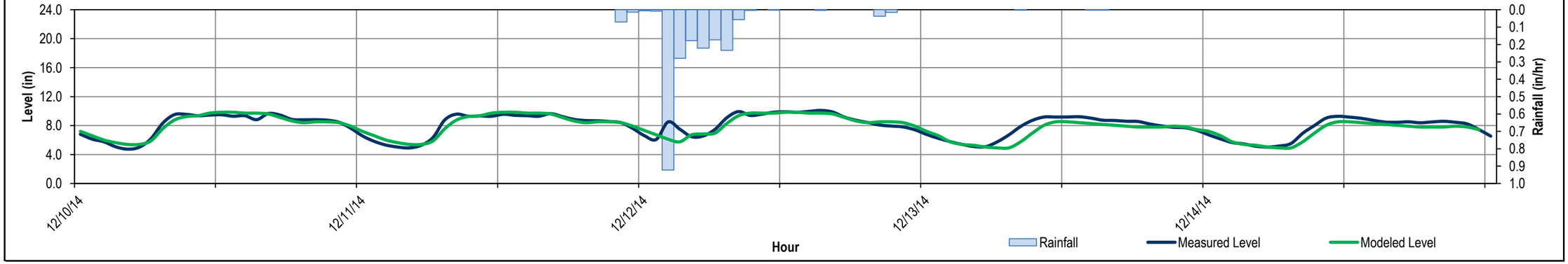
Flow Calibration



Velocity Calibration



Level Calibration

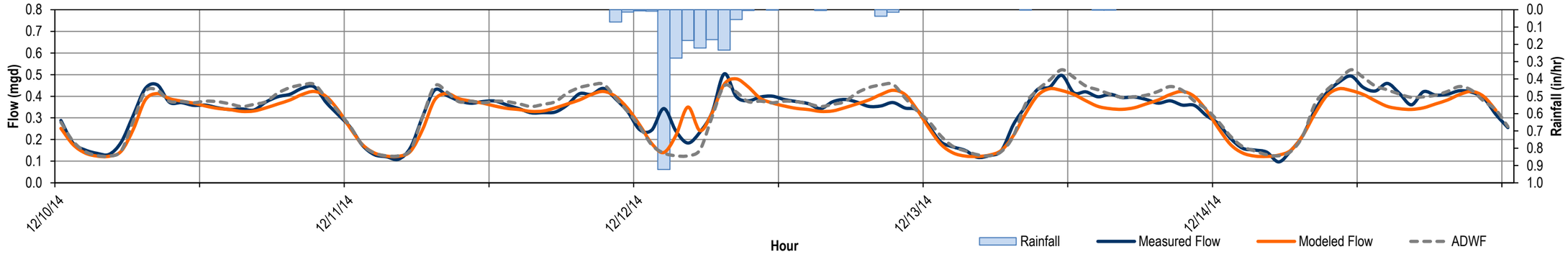


City of Oxnard

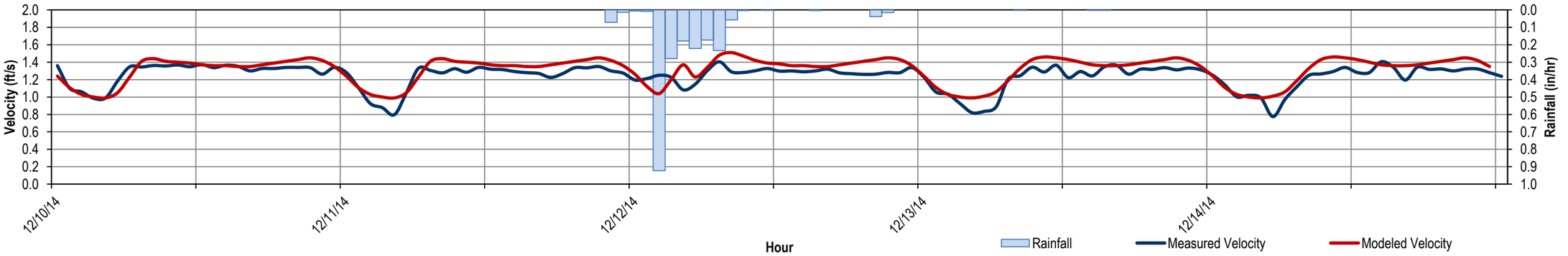
Public Works Integrated Master Plan

FLOW MONITORING SITE 7 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

Flow Calibration



Velocity Calibration



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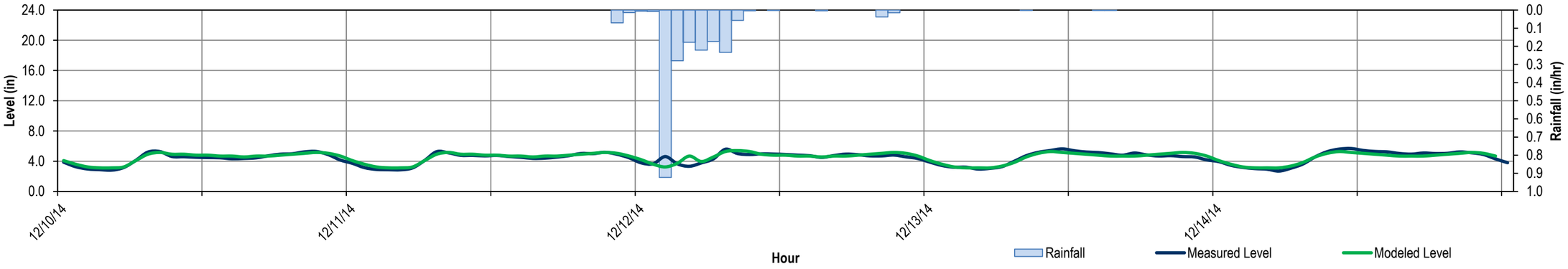
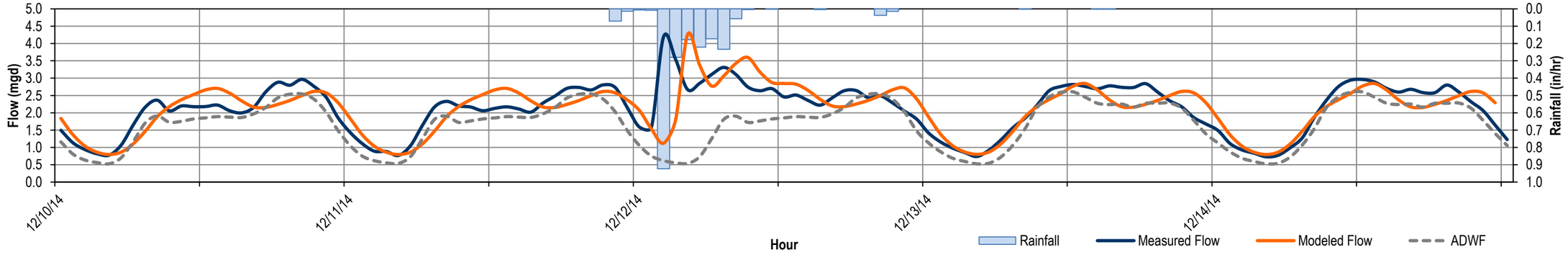


City of Oxnard

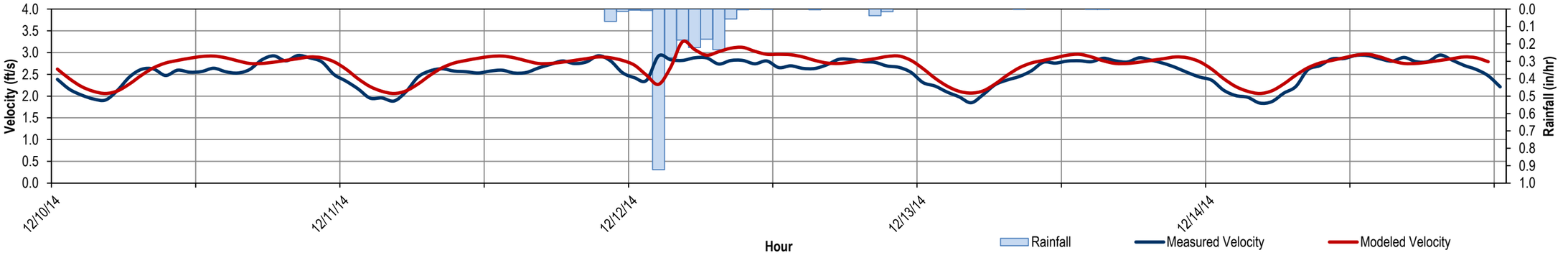
Public Works Integrated Master Plan

FLOW MONITORING SITE 8 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

Flow Calibration



Velocity Calibration



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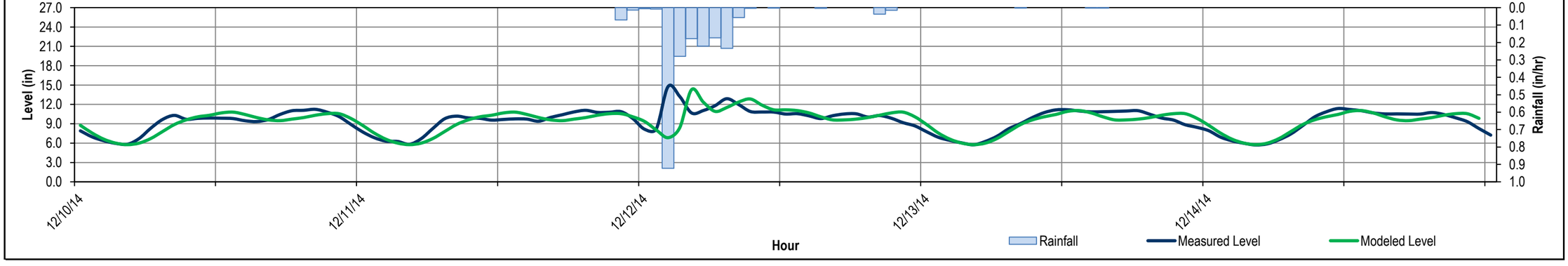
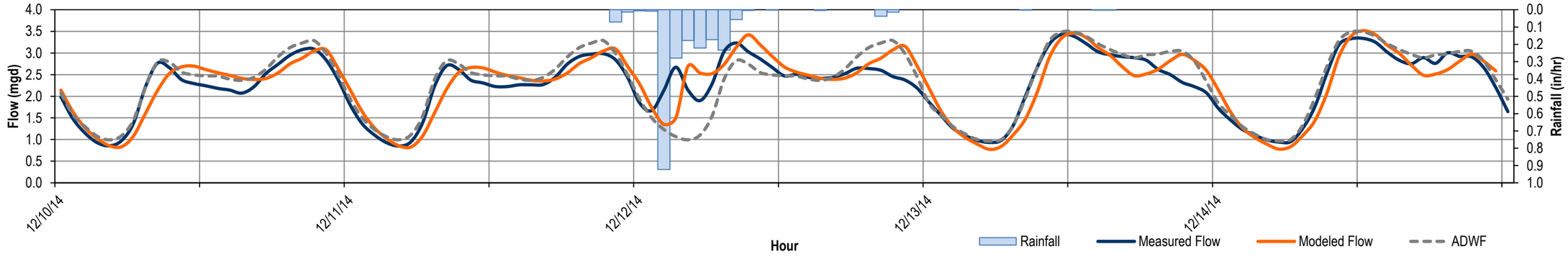


City of Oxnard

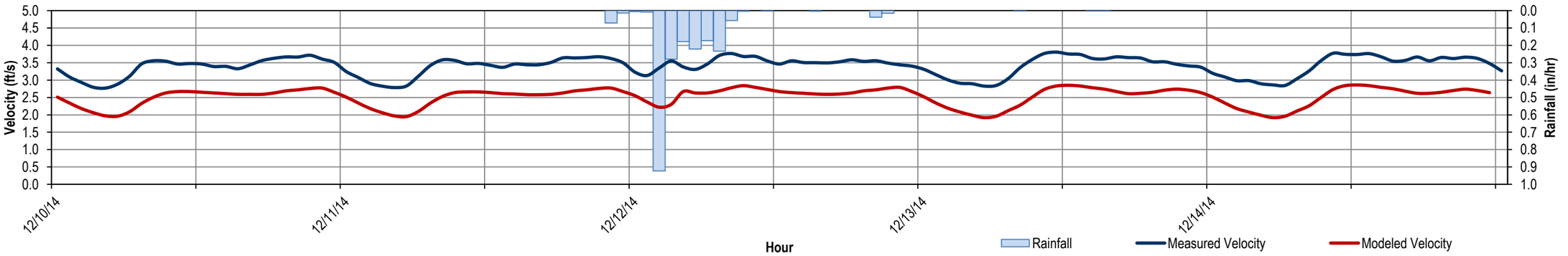
Public Works Integrated Master Plan

FLOW MONITORING SITE 9 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

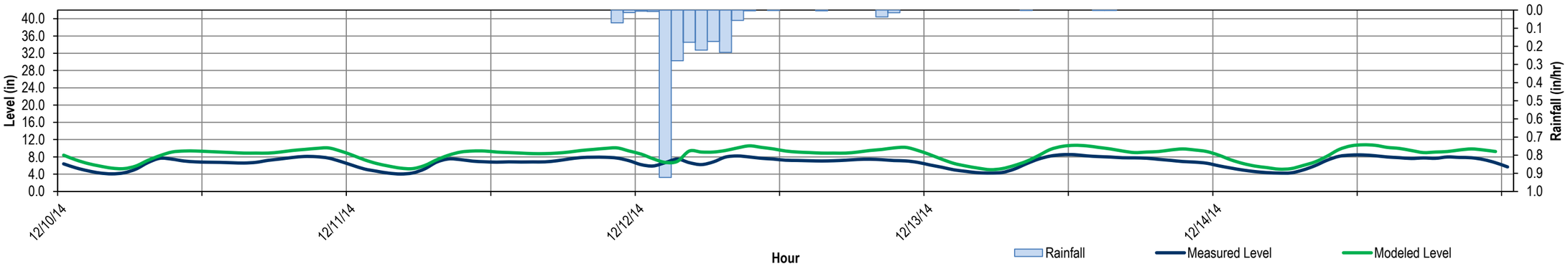
Flow Calibration



Velocity Calibration



Level Calibration

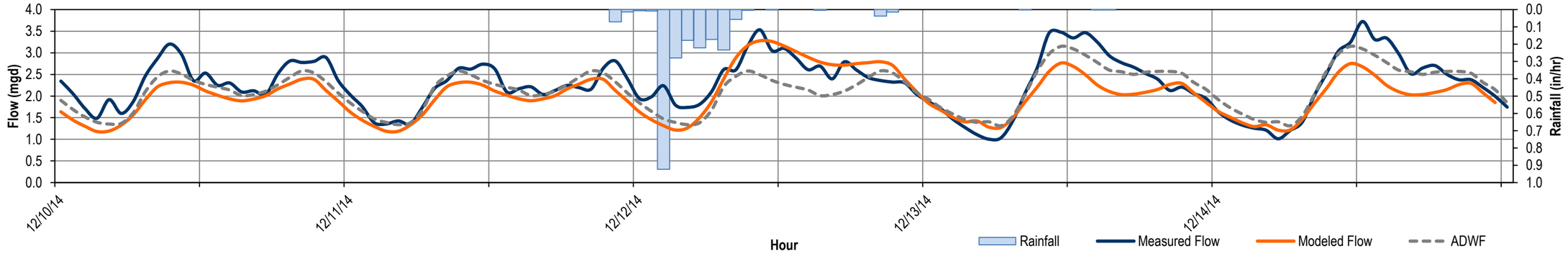


City of Oxnard

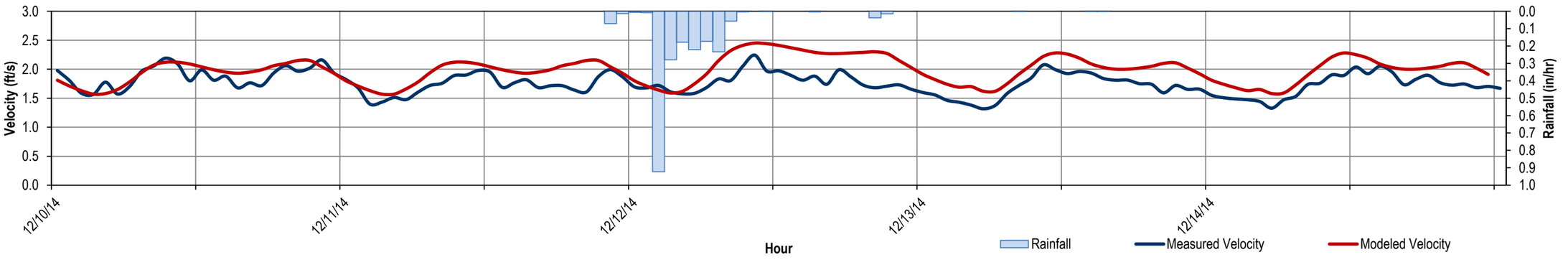
Public Works Integrated Master Plan

FLOW MONITORING SITE 10 WET WEATHER FLOW CALIBRATION (12/10/14-12/15/14)

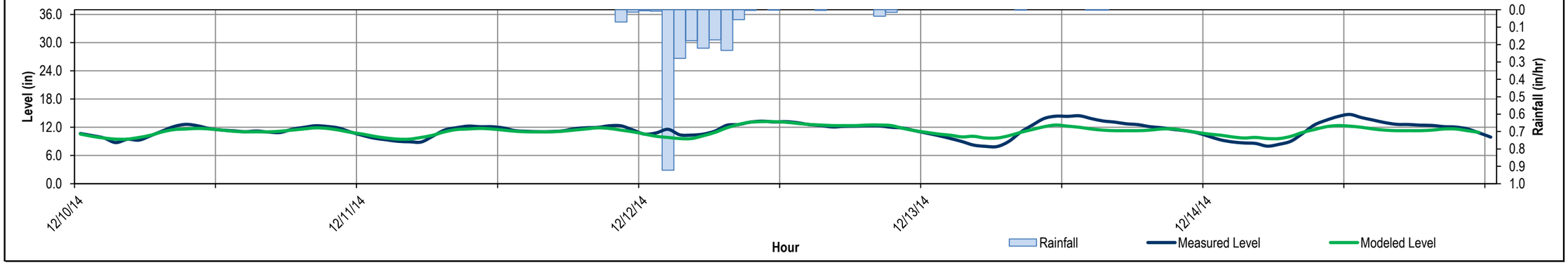
Flow Calibration



Velocity Calibration



Level Calibration



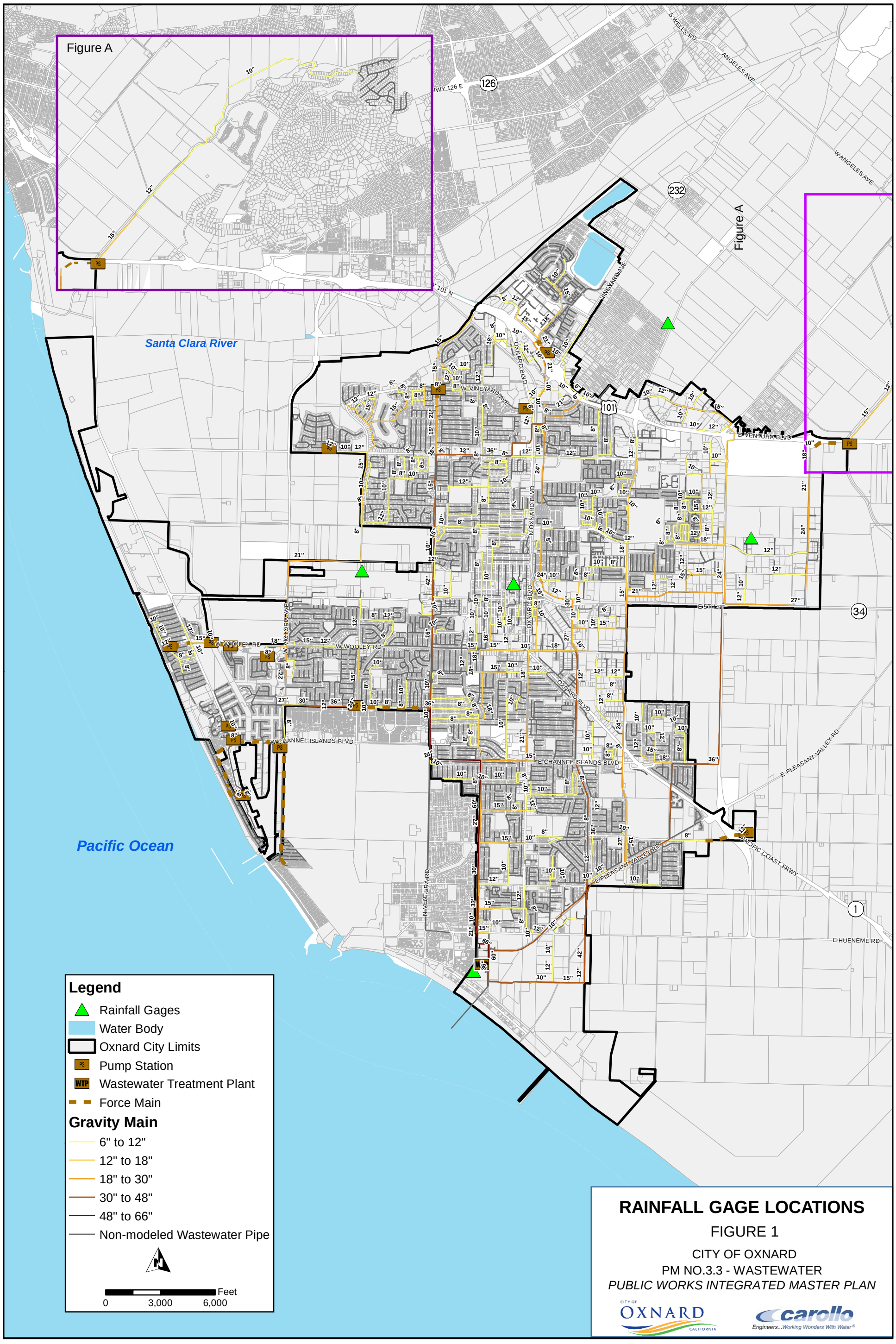


Figure A
Figure A
Santa Clara River
Pacific Ocean
S WELLS RD
ANGELES AVE
W ANGELES AVE
HWY 126 E
126
232
101
34
1
VINEYARD AVE
OXNARD BLVD
W VINEYARD AVE
W WOOLEY RD
W CHANNEL ISLANDS BLVD
E CHANNEL ISLANDS BLVD
VENTURA BLVD
N VENTURA RD
W VICTORIA AVE
E 5TH ST
E PLEASANT VALLEY RD
PACIFIC COAST FRWY
E HUENEME RD
PS
WTP
Legend
Rainfall Gages
Water Body
Oxnard City Limits
Pump Station
Wastewater Treatment Plant
Force Main
Gravity Main
6" to 12"
12" to 18"
18" to 30"
30" to 48"
48" to 66"
Non-modeled Wastewater Pipe
N
Feet
0
3,000
6,000
RAINFALL GAGE LOCATIONS
FIGURE 1
CITY OF OXNARD
PM NO.3.3 - WASTEWATER
PUBLIC WORKS INTEGRATED MASTER PLAN
CITY OF OXNARD CALIFORNIA
carollo
Engineers...Working Wonders With Water®

APPENDIX C – WASTEWATER COLLECTION SYSTEM IMPROVEMENTS

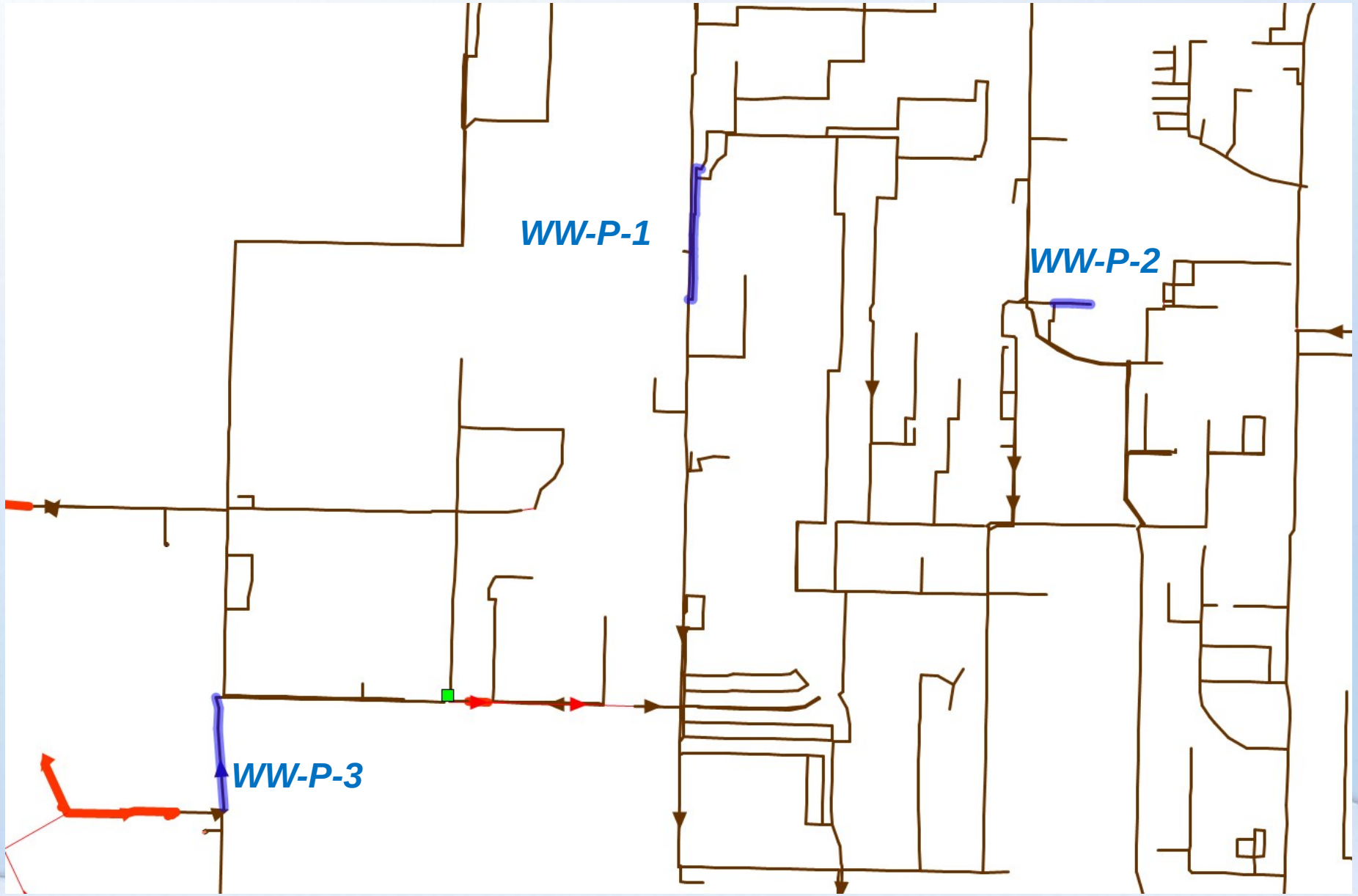
Waste Water Collection System Improvements

Oxnard, CA

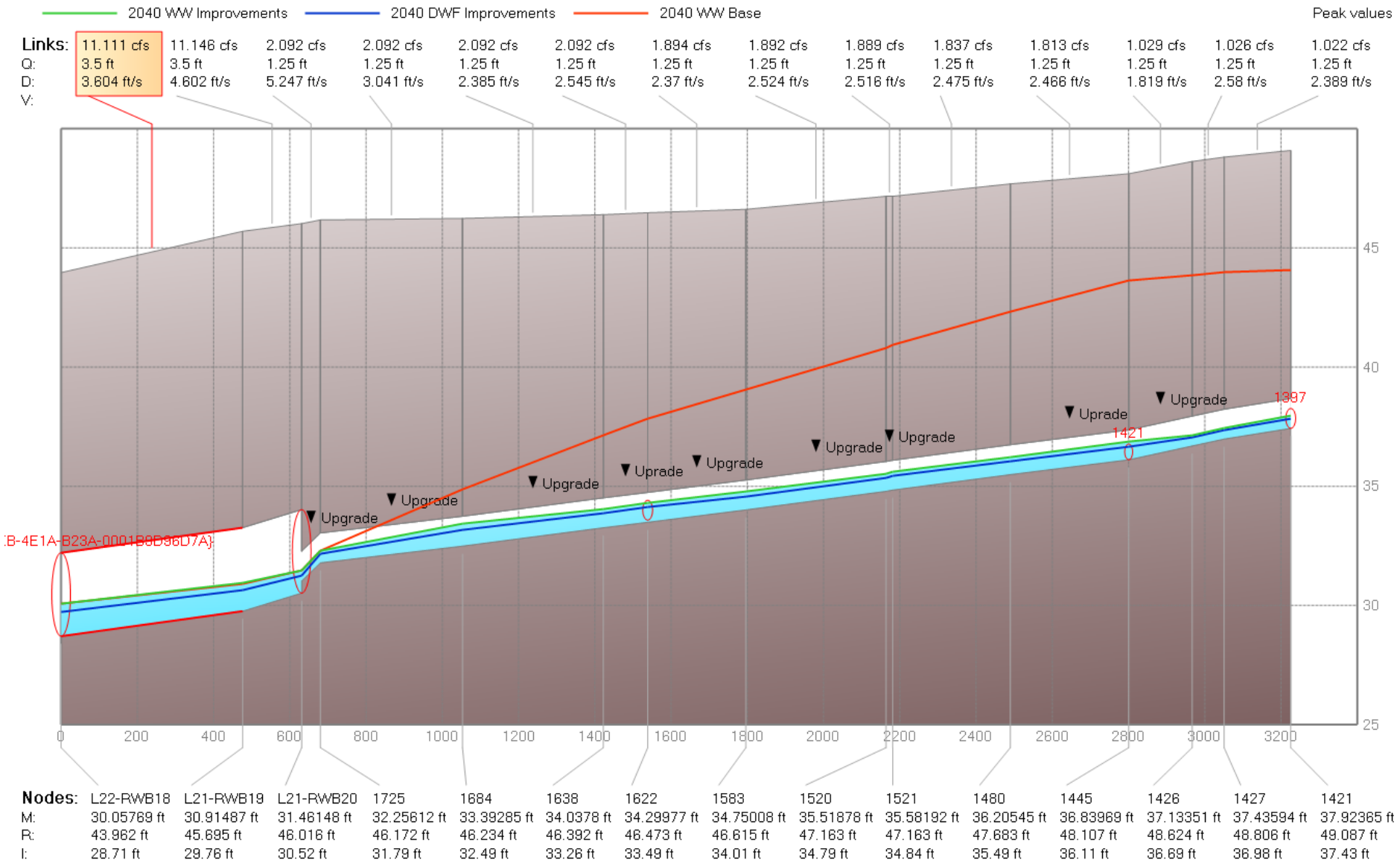
08/09/2015

CarolloBlueTemplateWithLogo.pptx

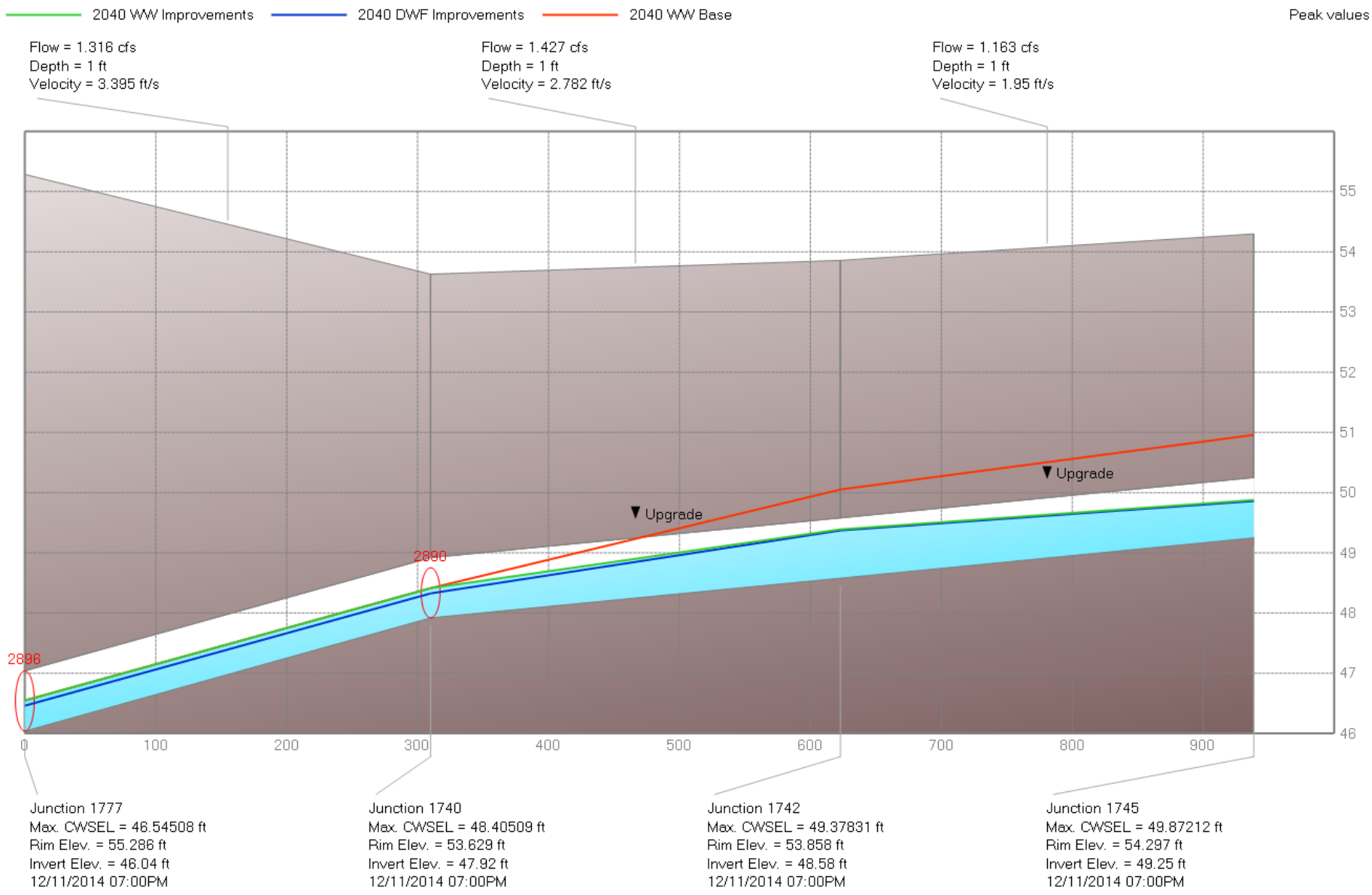
Upgrade Locations



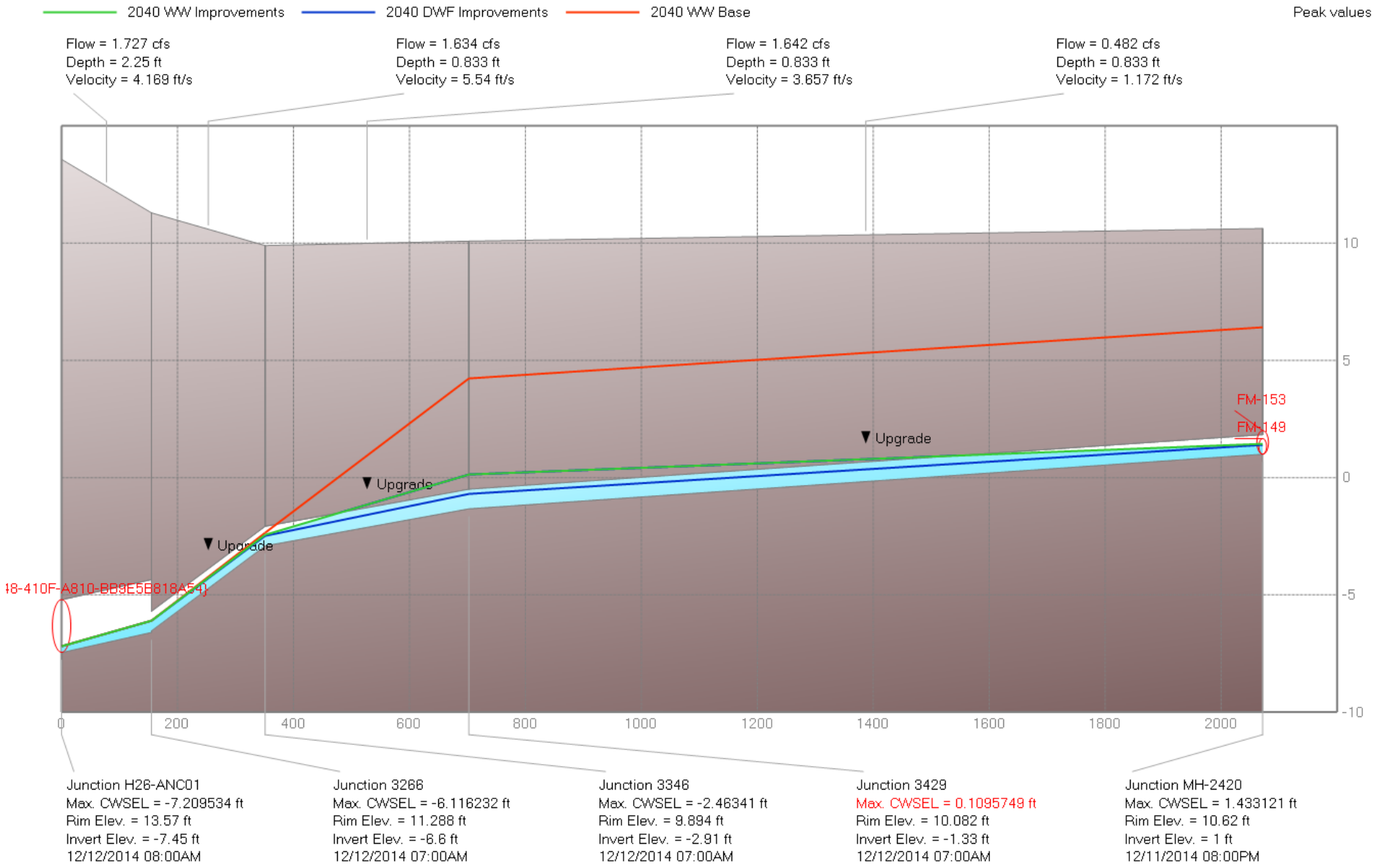
WW-P-1


2040 WW Improvements
2040 DWF Improvements
2040 WW Base
Peak values
Links:
Q:
D:
V:
11.111 cfs 3.5 ft 3.604 ft/s
11.146 cfs 3.5 ft 4.602 ft/s
2.092 cfs 1.25 ft 5.247 ft/s
2.092 cfs 1.25 ft 3.041 ft/s
2.092 cfs 1.25 ft 2.385 ft/s
2.092 cfs 1.25 ft 2.545 ft/s
1.894 cfs 1.25 ft 2.37 ft/s
1.892 cfs 1.25 ft 2.524 ft/s
1.889 cfs 1.25 ft 2.516 ft/s
1.837 cfs 1.25 ft 2.475 ft/s
1.813 cfs 1.25 ft 2.466 ft/s
1.029 cfs 1.25 ft 1.819 ft/s
1.026 cfs 1.25 ft 2.58 ft/s
1.022 cfs 1.25 ft 2.389 ft/s
Upgrade
1421
1397
45
40
35
30
25
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
Nodes:
M:
R:
I:
L22-RWB18 30.05769 ft 43.962 ft 28.71 ft
L21-RWB19 30.91487 ft 45.695 ft 29.76 ft
L21-RWB20 31.46148 ft 46.016 ft 30.52 ft
1725 32.25612 ft 46.172 ft 31.79 ft
1684 33.39285 ft 46.234 ft 32.49 ft
1638 34.0378 ft 46.392 ft 33.26 ft
1622 34.29977 ft 46.473 ft 33.49 ft
1583 34.75008 ft 46.615 ft 34.01 ft
1520 35.51878 ft 47.163 ft 34.79 ft
1521 35.58192 ft 47.163 ft 34.84 ft
1480 36.20545 ft 47.683 ft 35.49 ft
1445 36.83969 ft 48.107 ft 36.11 ft
1426 37.13351 ft 48.624 ft 36.69 ft
1427 37.43594 ft 48.806 ft 36.98 ft
1421 37.92365 ft 49.087 ft 37.43 ft

WW-P-2


2040 WW Improvements
2040 DWF Improvements
2040 WW Base
Peak values
Flow = 1.316 cfs
Depth = 1 ft
Velocity = 3.395 ft/s
Flow = 1.427 cfs
Depth = 1 ft
Velocity = 2.782 ft/s
Flow = 1.163 cfs
Depth = 1 ft
Velocity = 1.95 ft/s
Upgrade
Upgrade
2886
2880
55
54
53
52
51
50
49
48
47
46
0
100
200
300
400
500
600
700
800
900
Junction 1777
Max. CWSEL = 46.54508 ft
Rim Elev. = 55.286 ft
Invert Elev. = 46.04 ft
12/11/2014 07:00PM
Junction 1740
Max. CWSEL = 48.40509 ft
Rim Elev. = 53.629 ft
Invert Elev. = 47.92 ft
12/11/2014 07:00PM
Junction 1742
Max. CWSEL = 49.37831 ft
Rim Elev. = 53.858 ft
Invert Elev. = 48.58 ft
12/11/2014 07:00PM
Junction 1745
Max. CWSEL = 49.87212 ft
Rim Elev. = 54.297 ft
Invert Elev. = 49.25 ft
12/11/2014 07:00PM

WW-P-3


2040 WW Improvements
2040 DWF Improvements
2040 WW Base
Peak values
Flow = 1.727 cfs
Depth = 2.25 ft
Velocity = 4.169 ft/s
Flow = 1.634 cfs
Depth = 0.833 ft
Velocity = 5.54 ft/s
Flow = 1.642 cfs
Depth = 0.833 ft
Velocity = 3.657 ft/s
Flow = 0.482 cfs
Depth = 0.833 ft
Velocity = 1.172 ft/s
Upgrade
Upgrade
Upgrade
FM-153
FM-149
10
5
0
-5
-10
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Junction H26-ANC01
Max. CWSEL = -7.209534 ft
Rim Elev. = 13.57 ft
Invert Elev. = -7.45 ft
12/12/2014 08:00AM
Junction 3266
Max. CWSEL = -6.116232 ft
Rim Elev. = 11.288 ft
Invert Elev. = -6.6 ft
12/12/2014 07:00AM
Junction 3346
Max. CWSEL = -2.46341 ft
Rim Elev. = 9.894 ft
Invert Elev. = -2.91 ft
12/12/2014 07:00AM
Junction 3429
Max. CWSEL = 0.1095749 ft
Rim Elev. = 10.082 ft
Invert Elev. = -1.33 ft
12/12/2014 07:00AM
Junction MH-2420
Max. CWSEL = 1.433121 ft
Rim Elev. = 10.62 ft
Invert Elev. = 1 ft
12/11/2014 08:00PM