LEUCADIA WASTEWATER DISTRICT

HAZARD PREPAREDNESS & MITIGATION PLAN

Final Report
April 2015

Leucadia Wastewater District
1960 La Costa Avenue
Carlsbad, California 92009

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HAZARD PREPAREDNESS & MITIGATION PLAN

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1. EXECUTIVE SUMMARY

The Leucadia Wastewater District has developed a Hazard Preparedness and Mitigation Plan in order to identify potential natural hazard vulnerabilities and prioritize hazard mitigation action items on a hazard-level, vulnerability and probability basis. The overall goal of the Plan is to reduce the potential for damage to District assets from natural hazards.

Hazard mitigation planning is a dynamic process built on realistic assessments of past and present information that enables the District to anticipate future hazards and provide mitigation strategies to address possible impacts and identified needs. The overall approach to the Hazard Preparedness and Mitigation Plan included developing a baseline understanding of the natural hazards to the District, determining ways to reduce those risks, and prioritizing mitigation recommendations for implementation.

Hazard Identification and Risk Assessment

Located in a Southern California coastal community, the District is vulnerable to a wide range of natural hazards. In order to conduct a risk assessment, the following steps were followed:

1. Identifying Hazards – Reviewing past natural hazard incidents, available disaster archives, technical studies, etc. to determine which hazards pose a threat to the service area.
2. Profiling Hazards – Mapping identified hazards and their geographic extent.
3. Identifying Vulnerable Assets – Identifying District facilities that are located within identified hazard vulnerability zones.

Hazard Vulnerability Analysis

Vulnerability describes how exposed or susceptible to damage a facility is, and is dependent upon the facility construction, location, and the percentage of service area served. The vulnerability analysis predicts the extent of damage and environmental impact that may result from a hazard event of a given intensity in a given area on the existing District facilities. Each facility located within an area vulnerable to natural hazards was evaluated to determine the potential impact to the facility (e.g., inundation can damage facility electrical and controls, earthquake can cause physical damage and/or collapse, loss of function can result in environmental sewer system overflow, etc).

The table on the following page provides an overview of the District facilities and the associated vulnerability to natural hazards.

Facility	Earthquake	Liquefaction	Wildfire	Tsunami	Flood	Sea Level Rise	Dam Failure	Rain Induced Landslide
Avocado Pump Station	X							
Batiquitos Pump Station	X	X		X	X	X		
Diana Pump Station	X							
Encinitas Estates Pump Station	X							
La Costa Pump Station	X	X				X	X	
Leucadia Pump Station	X					X	X	
Rancho Verde Pump Station	X							
Saxony Pump Station	X		X			X		
Village Park 5 Pump Station	X							
Village Park 7 Pump Station	X							
Piping / Force Mains	X	X						X

Mitigation Strategies

Mitigation strategies are administrative and engineering project recommendations to reduce the vulnerability to the identified hazards. It was imperative to have engineers and vital District employees involved in this phase of the plan in order to develop strategies and projects that will mitigate the hazard and solve the problem cost-effectively, as well as ensure consistency with the District's long-term mitigation goals and capital improvements. The potential mitigation projects were reviewed in a team-setting to ensure the projects are aligned with District objectives.

The priority for implementing the mitigation recommendations depends upon the overall priority for the hazards mitigated by implementing the recommendation (and associated potential losses). Therefore, projects that provide all-hazard mitigation are prioritized above recommendations that provide mitigation for select hazards. To prioritize the hazard specific recommendations, each recommendation was assigned a priority rank based timeframe for implementation (high priority, medium priority, and long-term mitigation).

The table below provides a list of mitigation projects for consideration:

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
High Priority Recommendations		
1. Evaluate the feasibility of dry flood-proofing the Batiquitos Pump Station, including the installation of flood-proof doors and ensuring all hatches are water tight. Also, consider flood-proofing the area around the pump station vents to minimize water carryover through the vents.	Batiquitos Pump Station	Tsunami, Flood, Sea Level Rise, Severe Storm
2. Provide flood protection for the electrical / control components at the Saxony and La Costa Pump Stations.	Saxony & La Costa Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm
3. Develop detailed site specific flood response and contingency plans for vulnerable facilities.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
Medium Priority Recommendations		
1. Conduct training for sewer system overflow scenarios at stations susceptible to flooding, possibly coordinating with local agencies that may assist with response.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm
2. Implement vegetation management practices at the Saxony Pump Station (if possible due to environmental constraints) to provide an appropriate firebreak for the electrical and control equipment.	Saxony Pump Station	Wildfire
3. Survey the Batiquitos and Saxony Pump Station structures with respect to both datums (NAVD88 and NGVD29) to determine correlation to the sea level data.	Batiquitos & Saxony Pump Stations	Flood, Sea Level Rise
Long Term Recommendations		
1. Evaluate more robust long-term flood-proofing solutions for the Batiquitos Pump Station, possibly including building a wall around the pump station (may be subject to political and environmental limitations) or relocation of the pump station.	Batiquitos Pump Station	Tsunami, Flood, Sea Level Rise, Severe Storm
2. Evaluate elevating pump stations and emergency generators as they are rehabilitated or in new construction to account for potential sea level rise.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Sea Level Rise
3. Incorporate sea level rise into planning into master planning and capital improvement programs to account for projected sea level rise.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Sea Level Rise

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
4. Ensure that new sewer mains and manholes in low lying areas are sealed against floodwater inflow and groundwater infiltration. Expand programs to reduce inflow and infiltration through rehabilitation of sewer mains and manholes, prioritizing areas where risk of flooding is highest.	Force Mains & Manholes	Tsunami, Flood, Sea Level Rise, Severe Storm
5. Review detailed engineering analysis for the force mains at the railroad crossing and Pacific Coast Highway Bridge to ensure the design considered seismic hazards and follows good engineering practices (e.g., flexible restrained joints, lateral supports, anchorage redundancy, etc.).	Force Mains	Earthquake
6. Ensure the pipeline capital improvements program includes considerations for replacing piping vulnerable to earthquakes and/or other natural hazards.	Force Mains & Collection Pipelines	Earthquake
7. Evaluate whether the segment of the L1 force main located west of I-5 and east of the Pacific Coast Highway, in the area subject to landslide or cliff failure should be upgraded with materials more resistant to landslide (e.g., fusible PVC joints).	L1 Force Main	Landslide

2. INTRODUCTION

Hazard preparedness and mitigation planning is a dynamic process built on realistic assessments of past and present information that engages the Leucadia Wastewater District to anticipate future hazards and provide meaningful strategies to address possible impacts and identified needs. The overall approach to the hazard preparedness and mitigation plan development includes developing a baseline understanding of the natural hazards, identifying the potential risks to critical assets, determining ways to reduce those risks, and prioritizing those recommendations for implementation when considering both risk and benefit.

3. PLAN GOALS & OBJECTIVES

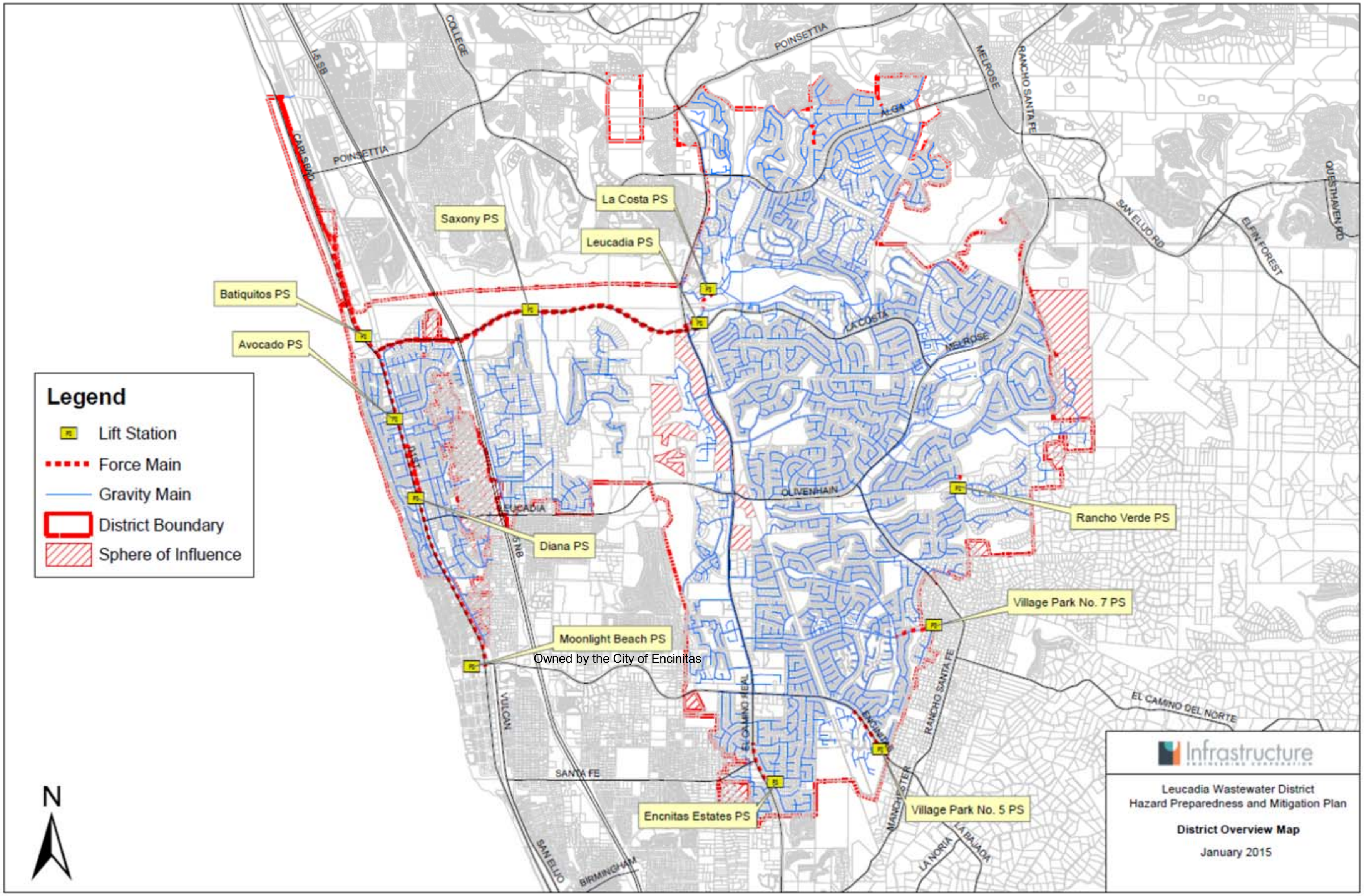
The primary goals and objectives of the plan are outlined below:

- Quantify the risk of public health impacts due to sewer system overflows and/or backing up into residences and businesses.
- Quantify the risk of discharge of untreated sewage into a receiving water due to loss of function of the collection system.
- Quantify the potential direct damage (and associated economic loss) due to a major hazard event.

4. DISTRICT OVERVIEW

4.1. SERVICE AREA DESCRIPTION

The Leucadia Wastewater District covers a total service area of 10,200 acres (16 square miles) which includes southern portions of the City of Carlsbad and northern portions of the City of Encinitas. The District provides wastewater collection, treatment, disposal and service to a population of approximately 60,000. The Leucadia Wastewater District’s existing wastewater system encompasses approximately 200 miles of gravity sewer pipeline, 5,000 manholes, ten pump stations and 16 miles of force mains, and a water recycling plant.



Legend
Lift Station
Force Main
Gravity Main
District Boundary
Sphere of Influence
La Costa PS
Saxony PS
Leucadia PS
Batiquitos PS
Avocado PS
Diana PS
Rancho Verde PS
Village Park No. 7 PS
Moonlight Beach PS
Owned by the City of Encinitas
Encnitas Estates PS
Village Park No. 5 PS
N
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
District Overview Map
January 2015

4.2. ASSET INVENTORY

Gravity Pipelines

The District owns an extensive gravity piping system, which ranges in size from 6-inch to 30-inch diameter. The following tables provide a summary of the length of pipeline by size and material in the District.

Summary of Gravity Sewer Piping by Diameter	
Pipe Diameter (inches)	**Pipe Length (feet)**
6	8,011
8	904,804
10	30,662
12	29,070
14	1,088
15	25,435
16	1,552
18	13,551
20	378
21	4,628
24	1,738
30	826
Total	**1,021,743**

Summary of Gravity Sewer Piping by Material	
Pipe Type	**Pipe Length (feet)**
ACP	2,024
CIP	353
DIP	344
HDPE	125
PVC	433,590
RCP	49
VCP	584,150
Unknown	1,108
Total	**1,021,743**

Force Mains

Each of the District's pump stations has a single or dual force main system. These force mains range in size from 4-inch diameter to 24-inch diameter. The force mains are constructed of cast iron (CIP), ductile iron (DIP), polyvinyl chloride (PVC), asbestos cement (AC), and high density polyethylene (HDPE). The following table contains a summary of the force main characteristics.

Force Main Characteristics			
Force Main	**Diameter (inches)**	**Length (feet)**	**Material**
Avocado	6	275	Original: AC Parallel: PVC
Batiquitos B2 Batiquitos B3	24 24	10,240 10,134	PVC DIP/PVC
Diana	10	2,300	Parallel: PVC (2)
Batiquitos B1 (Secondary Effluent Force Main)	14	28,000	CIP/DIP/PVC
Encinitas Estates	6	2,230	PVC
La Costa	10 12	1,127	Original: CIP/PVC Parallel: PVC/HDPE
Leucadia L1 Leucadia L2	24 24	13,989 14,000	DIP PVC/DIP/HDPE
Rancho Verde	4	460	PVC
Saxony	8	80	DIP
Village Park 5	6	1,945	PVC
Village Park 7	6	1,500	PVC

Pump Stations

Pump Stations				
Facility Name	**No. Pumps**	**Capacity**	**Motor Speed**	**Location**
Avocado	2	300 gpm	Constant	Avocado Street approximately 75 feet west of Old Highway 101
Batiquitos	4	8,000 gpm / 1 Force Main / 2 Pumps 12,000 gpm / 2 Force Main / 2 Pumps	Variable	Southwest shore of the Batiquitos Lagoon adjacent to Coast Highway 101
Diana	2	750 gpm	Constant	111 Diana Street west of Coast Highway 101
Encinitas Estates	2	450 gpm	Constant	2501 Oak Branch Drive in the southern portion of the District's service area
La Costa	2	2,200 gpm	Constant	Easement in the La Costa Resort and Spa adjacent to the main tennis court
Leucadia	4	6,500 gpm / 1 Force Main / 2 Pumps 9,000 gpm / 2 Force Main / 2 Pumps	Variable	Adjacent to the District Administrative Offices at 1960 La Costa Avenue
Rancho Verde	2	250 gpm	Constant	Corner of Camino Lindo and Calle Acervo
Saxony	2	900 gpm	Constant	Intersection of Saxony Avenue and La Costa Avenue adjacent to the Batiquitos Lagoon
Village Park 5	2	250 gpm	Constant	Encinitas Boulevard south of the intersection of Willow Springs Drive
Village Park 7	2	200 gpm	Constant	Near the District's eastern boundary along Mountain Vista Drive
Note: Big Blue is a portable pump that is capable of providing 6,000 gpm with one force main and 7,200 gpm with two force mains.				

Batiquitos Pump Station

The Batiquitos Pump Station contains four pumps (lead, lag, and two standby), which can pump 8,000 gallons per minute with one force main and two pumps and 12,000 gallons per minute with two force mains and two pumps. Each of the pumps is equipped with a 250 horsepower motor controlled with a variable speed drive. During dry weather flows, the lead and lag pumps pump into one of the two pump station force mains. During extreme wet weather flows, the lead and lag pumps can pump into both force mains. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force mains. If required, the portable pump Big Blue, is capable of pumping 6,000 gpm with one force main and 7,200 gpm with two force mains.

The Batiquitos Pump Station has a cast-in-place concrete wet well, dry well, emergency overflow basin, and dual force mains. A 480V emergency diesel generator is located on site that autostarts on a loss of power and is sized to provide enough power to two pumps. Additionally, an odor control system (Vapex fog system and US Filter Midas Carbon scrubber) is located onsite to eliminate pump station odors. The pump station conveys flows from both the District and the City of Encinitas. The District owns 77.86 percent of the pump station and the City of Encinitas owns 22.14 percent.

Leucadia Pump Station

The Leucadia Pump Station has a cast-in-place concrete wet well, dry well, and an above grade building. The pump station is located at the District headquarters and collects the majority of the flow from the eastern end of the Batiquitos Lagoon and pumps it west along La Costa Avenue. The pump station contains four 200 horsepower pumps (lead, lag, and two standby). The station is capable of pumping 6,500 gallons per minute with one force main and two pumps and 9,000 gallons per minute with 2 force mains and two pumps. The pump station is also configured with an emergency overflow basin, which allows for bypass pumping, and dual force mains (L1 and L2) to provide redundancy. If required, the portable pump Big Blue, is capable of pumping 6,000 gpm with one force main and 7,200 gpm with two force mains.

A 480V emergency diesel generator is located on site that autostarts on a loss of power and is sized to provide sufficient power to the pump station, main office and buildings 200,300 & 400. Additionally, an odor control system (Vapex fog system and US Filter Midas Carbon scrubber) is located onsite to eliminate pump station odors. Bioxide is also injected at the pump station to reduce H2S formation in the force main.

Diana Pump Station

The Diana Pump Station is a submersible pump station with above ground controls with a PVC force main. Approximately 250 feet of the force main is paralleled (PVC) in a 30” steel casing under Highway 101 and the railroad tracks from the pump station to Vulcan Avenue. The pump station contains two 15 horsepower pumps, duty and standby, each of which can pump 750 gallons per minute. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force mains. The pump station is equipped with a power receptacle and a manual transfer switch. In the case of a power failure, a trailer mounted portable standby diesel generator (480V/240V) is available as the source of emergency electrical power.

Avocado Pump Station

The Avocado Pump Station is a submersible pump station with above ground controls and a PVC parallel force main installed under Highway 101 and the railroad tracks. The pump station has two three horsepower pumps, duty and standby, each of which is capable of pumping 300 gallons per minute. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force mains. The pump station is equipped with a power receptacle and a manual transfer switch. In the case of a power failure, a trailer mounted portable standby diesel generator (480V/240V) is available as the source of emergency electrical power.

Encinitas Estates Pump Station

The Encinitas Estates Pump Station contains two 40 horsepower pumps, duty and standby, each of which pumps 450 gallons per minute and a 6-inch PVC force main. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force main. The Encinitas Estates Pump Station is configured with an emergency generator that utilizes natural gas from SDG&E and autostarts on a loss of power or below normal power (loss of phase, voltage drop, etc.).

La Costa Pump Station

The La Costa Pump Station contains two 30 horsepower pumps, duty and standby, each of which can pump 2,200 gallons per minute. The La Costa Pump Station has parallel force mains: a 10-inch PVC force main installed in 1976 and a 12-inch PVC force main installed in 1998. The force mains are interconnected such that either can be directed to the 12-inch HDPE force main which was directionally drilled under San Marcos Creek in 1998 and both discharge to the same downstream manhole. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force mains. The La Costa Pump Station is also configured with an onsite emergency generator (integral diesel fuel) that autostarts on a loss of SDG&E electrical power or below normal (loss of phase, voltage drop, etc.).

Rancho Verde Pump Station

The Rancho Verde Pump Station has a concrete wet well with submersible pumps and above ground structure. The pump station has two 7.5 horsepower pumps, duty and standby, each of which has a capacity of 250 gallons per minute. The pump station is equipped with a power receptacle and a manual transfer switch. In the case of a power failure, a trailer mounted portable standby diesel generator (480V/240V) is available as the source of emergency electrical power.

Saxony Pump Station

The Saxony Pump Station has a concrete wet well with submersible pumps and an above ground structure. The pump station has two 40 horsepower pumps, duty and standby, each of which has a capacity of 900 gallons per minute. In 2001, the offsite portion of the force main was replaced to connect to both Leucadia Pump Station force mains, L1 and L2. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force main. The Saxony Pump Station is also configured with an onsite emergency generator (integral diesel fuel) that autostarts on a loss of SDG&E electrical power or below normal (loss of phase, voltage drop, etc.). The Saxony Pump Station is also configured with the ability to inject Bioxide, which is not in use.

Village Park 5 Pump Station

The Village Park 5 Pump Station contains two 15 horsepower pumps, duty and standby, each of which has a capacity of 250 gallons per minute and a 6-inch PVC force main. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force main. The Village Park 5 Pump Station is also configured with an onsite emergency generator (integral diesel fuel) that autostarts on a loss of SDG&E electrical power or below normal (loss of phase, voltage drop, etc.).

Village Park 7 Pump Station

The Village Park 7 Pump contains two 20 horsepower pumps, duty and standby, each of which has a capacity of 200 gallons per minute and a 6-inch PVC force main. Bypass piping and valving is available at this pump station to bypass the pump station and utilize the pump station force main. The pump station is equipped with a power receptacle and a manual transfer switch. In the case of a power failure, a trailer mounted portable standby diesel generator (480V/240V) is available as the source of emergency electrical power.

5. HAZARD PROFILES

To identify the potential hazards, the District reviewed hazards identified in the San Diego County Hazard Mitigation Plan, historical hazard data, hazard-related GIS data, and engaged in discussions with District employees. Based upon this review, the District identified the following hazards for inclusion in the plan:

- Earthquake / Liquefaction
- Wildfire
- Coastal Storms / Tsunami
- Flooding / Extreme Rainfall / Sea Level Rise
- Dam Failure
- Rain Induced Landslide

Profiling the identified natural hazards entails describing the physical characteristics of past hazards such as their magnitude, duration, frequency, and probability, creating base maps of the study area and then collecting and mapping hazard event profile information obtained from various sources, including the following:

- USGS Seismic Hazard Mapping (Earthquake / Liquefaction)
- SanGIS Regional Data Warehouse (Wildfire)
- California Geologic Survey (Coastal Storms / Tsunami)
- Federal Emergency Management Agency (Flooding / Extreme Rainfall / Sea Level Rise)
- USGS National Hydrography Dataset (Dam Failure)

5.1. EARTHQUAKE / LIQUEFACTION

Hazard Overview

Earthquake

An earthquake is a sudden shaking that is caused by a release of strain accumulated within or along the edge of the Earth's tectonic plates. Earthquake impacts are geographically widespread and common effects of earthquakes are ground motion and shaking, surface fault ruptures, and ground failure. Ground motion is the vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter. Soft soils can further amplify ground motions. The severity of these effects is dependent on the amount of energy released from the fault or epicenter.

Additionally, earthquakes can result in significant secondary impacts including

- Fire
- Flood / Tsunami
- Landslides
- Liquefaction
- Power Failure
- Pipeline Failure (potable water, sewer, petroleum, natural gas, etc.)

These secondary impacts can result in a loss of these critical lifeline services, including the wastewater collection services provided by the District, that has the potential to impact public health and safety and cause discharges into sensitive environments.

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales. One of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology. The most commonly used scale today is the Moment Magnitude (Mw) Scale. Moment magnitude is related to the total area of the fault that ruptured and the amount of offset (displacement) across the fault. It is a more uniform measure of the energy released during an earthquake.

The other commonly used measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. In general, it decreases with distance from the source of an earthquake, but it may be increased or decreased by a number of factors.

Shaking intensity is often described using the Modified Mercalli Intensity Scale, which rates an earthquake's effects based on human observation. While an earthquake has only one magnitude it may have many intensity values, which will generally decrease with distance from the epicenter. The table below lists the Mercalli Scale's various intensity levels and corresponding Richter Scale magnitudes.

Mercalli Intensity		Description	Richter Scale Magnitude
I	Instrumental	Detected only by a seismograph	
II	Feeble	Noticed by sensitive people	0.1 to 3.4
III	Slight	Like the vibrations due to a passing truck	3.5 to 4.2
IV	Moderate	Felt by people while walking; rocking of loose objects, including standing vehicles	4.3 to 4.8
V	Rather Strong	Felt generally; most sleepers are awakened and bells ring	
VI	Strong	Trees sway and all suspended objects swing; damage by over-turning and falling of loose objects	4.9 to 5.4
VII	Very Strong	General alarm; walls crack; plaster falls	
VIII	Destructive	Car drivers seriously disturbed; masonry fissured; chimneys fall; poor constructed buildings damaged	5.5 to 6.1
IX	Ruinous	Some houses collapse where ground begins to crack and pipes break	6.2 to 6.9
X	Disastrous	Ground cracks badly; many buildings destroyed and railway lines bent; landslides on steep slopes	7.0 to 7.3
XI	Very disastrous	Few buildings remain standing; bridges destroyed; all services (railway, pipes, and cables) fail; great landslides and floods	7.4 to 8.1
XII	Catastrophic	Total destruction; objects thrown into air; ground rises and falls in waves	8.1 +

<u>Liquefaction</u>

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop on gentle slopes and entails the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil supporting structures liquefies and causes structures to settle and/or collapse from weakened foundations.

Historical Events

Earthquake

Two of the fault zones located in relatively close proximity to the District have experienced earthquakes in the past. The Elsinore Fault Zone was the cause of a 6.0 Mw earthquake in 1910, which was primarily focused in eastern Orange County and caused moderate damage. Additionally, the Laguna Salada Fault on the southern end of the Elsinore Fault Zone was the source of a magnitude 7 earthquake in 1892 and is also considered the cause of the 2010 magnitude 7.2 earthquake in Baja, Mexico. However, the 2010 earthquake did not result in significant damage to District facilities. The table below provides a list of historical earthquakes that have occurred in the vicinity of San Diego County:

Historical Earthquakes		
Name	**Year**	**Magnitude (Mw)**
Elsinore Earthquake	1910	6.0
San Jacinto Earthquake	1918	6.8
San Jacinto Fault (Terwilliger Valley) Earthquake	1937	6.0
Imperial Valley Earthquake	1940	6.0
San Jacinto Earthquake	1954	6.4
Borrego Mountain Earthquake	1968	6.5
Imperial Valley Earthquake	1979	6.4
Superstition Hills Earthquake	1987	6.6
El Mayor-Cucapah Earthquake	2010	7.2

Note that there have been additional notable earthquakes in Southern California, including Northridge, Big Bear / Landers, etc. that have had impacts outside of San Diego County, but are representative of the potential for earthquakes in the area.

Liquefaction

Liquefaction has not caused damage to District facilities in the past and is not known to have occurred historically in San Diego County (seismic shaking levels have not been sufficient to trigger liquefaction).

Probability, Frequency, and Magnitude

Earthquake

Earthquakes pose a significant threat to the District and can cause failure and direct damage to collection piping, force mains (especially at bridge crossings), and pump stations. Gravity piping generally performs better than pressurized piping because leaks do not typically result in a loss of function. Also, for pipelines attached to bridges, failure of the bridge or excessive bridge movements can cause failure of the pipeline and failures often occur at abutments, where differential movements may be large.

The effects could be aggravated by aftershocks and by secondary effects such as power failure, fire, liquefaction, landslides and dam failure. A major earthquake could be catastrophic in its effects on the population, and could exceed the response capability of the local communities and even the State.

Ground Shaking

The Peak Ground Acceleration (PGA) mapping represents peak horizontal acceleration of the ground on firm-rock conditions. The approach of representing peak horizontal ground acceleration on firm-rock is a common and widely used method of showing ground accelerations. The development of probabilistic acceleration maps are a result of three types of basic input parameters:

- Attenuation of ground shaking with distance from the earthquake source;
- Frequency of earthquakes within an area or region, termed recurrence; and
- The character and extent of regions and faults that generate earthquakes.

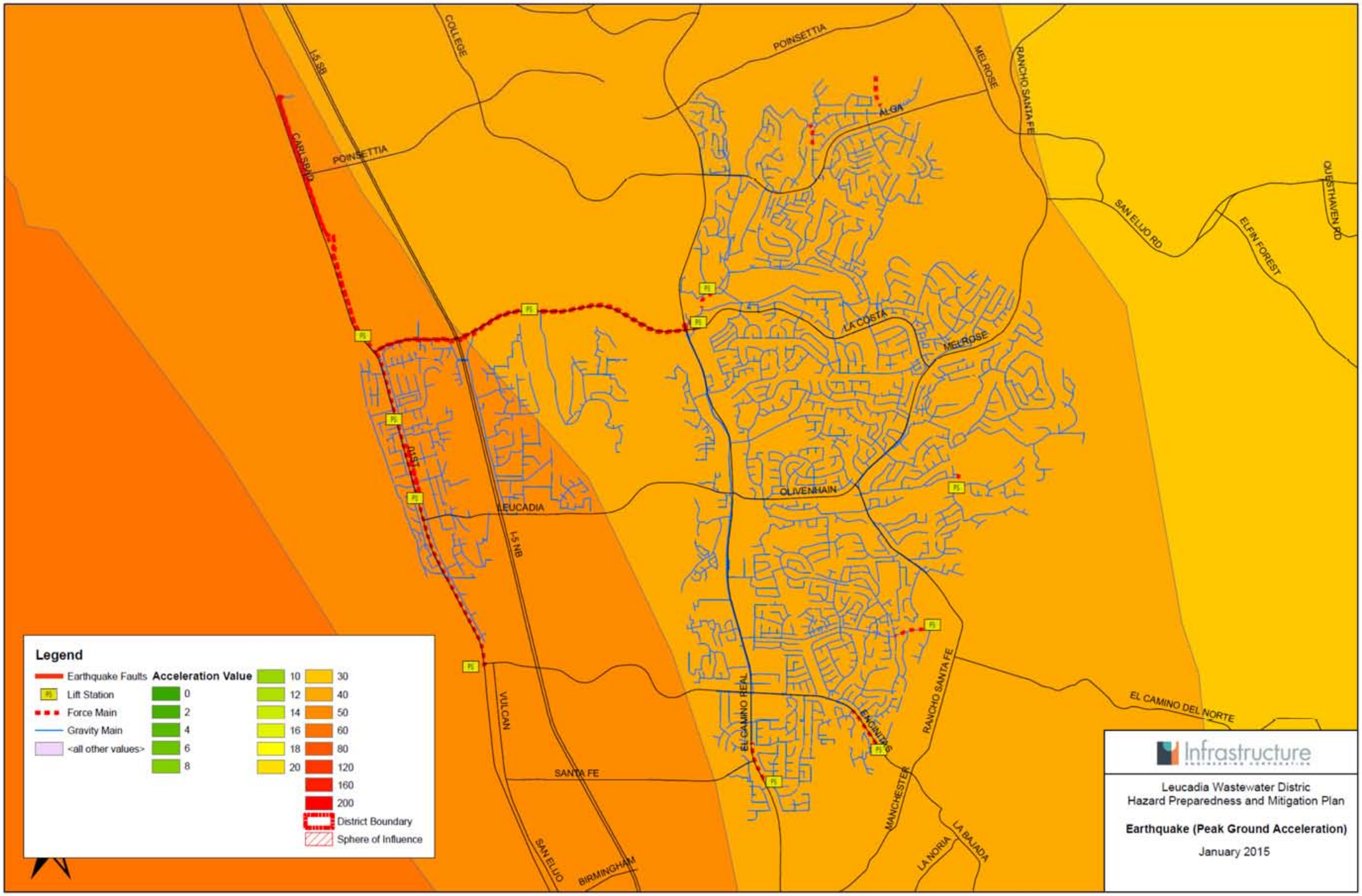
According to the following Probabilistic Seismic Hazard Map, the District facilities are located in an area that will experience a PGA ranging from 40 %g to 50 %g with 2% exceedance in 50 years (equates to an approximate 6.2 to 6.4 earthquake). Due to the geographic extent of earthquakes, all District facilities are subject to potential damage. The following fault zones are located in close proximity to the District:

- Newport-Inglewood-Rose Canyon Fault Zone: This fault zone is located entirely offshore and extends from South Orange County to North San Diego County (approximately 90 km). According to the Southern California Earthquake Data Center (SCEDC), the slip rate is estimated at between 0.8 and 2.1 mm/yr (typical slip rate for an active fault) and probable earthquake magnitudes for the fault zone to be in the range of Mw 6.0 to 7.2.
- Elsinore Fault Zone: This fault zone is approximately 180 km and follows a general line from Los Angeles County easterly of the Santa Ana Mountains, through Temecula and into Mexico. According to SCEC, the slip rate is estimated at 4.0 mm/yr (typical slip rate for an active fault) and probable earthquake magnitudes for the fault zone to be in the range of Mw 6.5 to 7.5.

Although these are the fault zones located in the closest proximity to the District, there are additional faults and earthquake scenarios that can impact the District.

Liquefaction

In addition to hazards posed by ground shaking, the La Costa Pump Station and Batiquitos Pump Station are located in an area subject to liquefaction. Liquefaction can cause significant damage to collection piping and force mains due to the settling of the soil and loss of structural support.



Legend
Earthquake Faults
Lift Station
Force Main
Gravity Main
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Acceleration Value
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60
80
120
160
200
District Boundary
Sphere of Influence
Infrastructure
Leucadia Wastewater Distric
Hazard Preparedness and Mitigation Plan
Earthquake (Peak Ground Acceleration)
January 2015
POINSETTIA
ALGA
LA COSTA
MELROSE
RANCHO SANTA FE
SAN ELIJO RD
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OLIVENHAIN
LEUCADIA
I-5 NB
I-5 SB
CARLSBAD
COLLEGE
VULCAN
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EL CAMINO REAL
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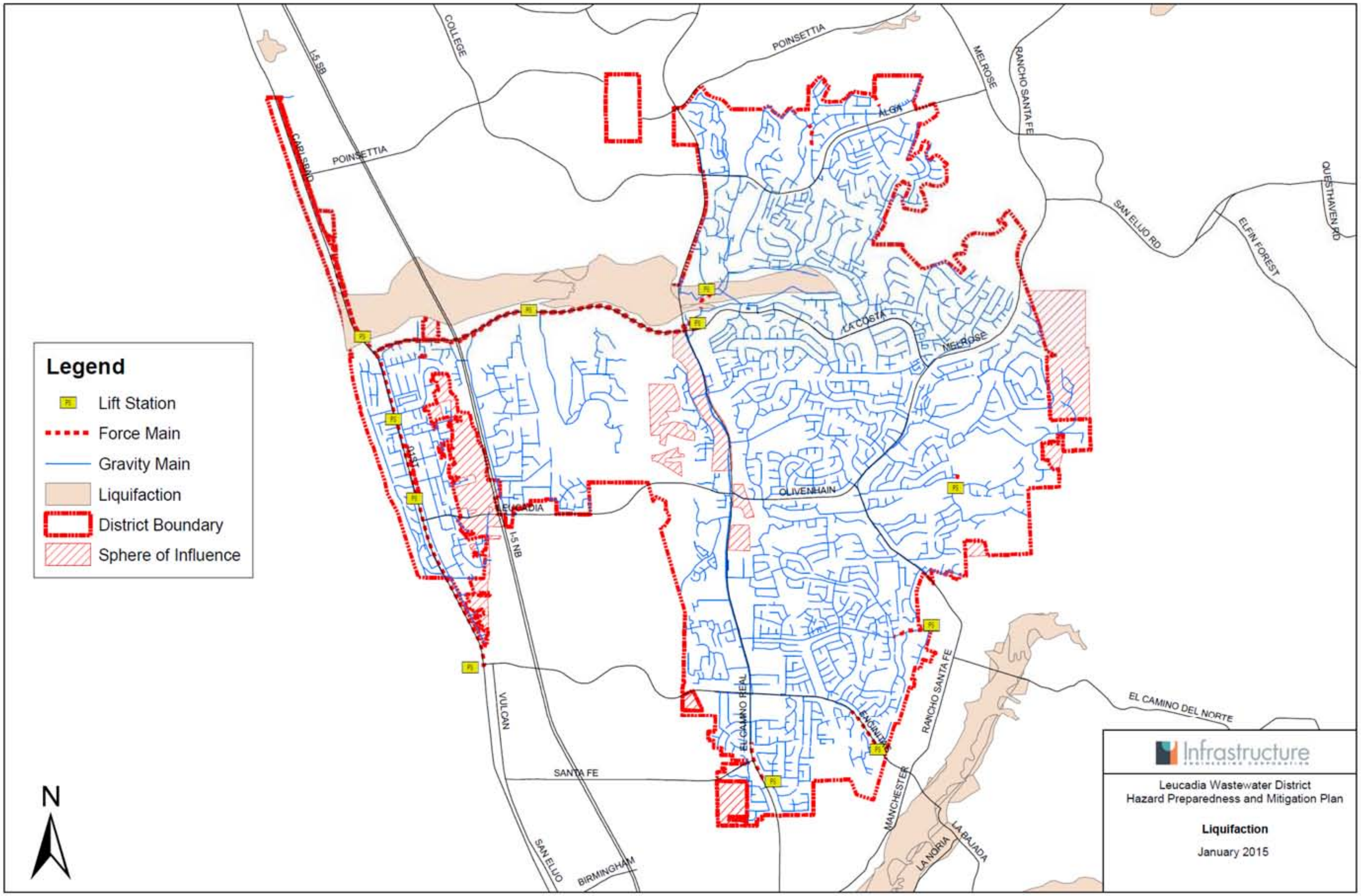
Legend
Lift Station
Force Main
Gravity Main
Liquifaction
District Boundary
Sphere of Influence
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LA COSTA
MELROSE
OLIVENHAIN
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EL CAMINO DEL NORTE
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BIRMINGHAM
EL CAMINO REAL
RANCHO SANTA FE
MANCHESTER
LA NORIA
LA BAJADA
SAN ELIJO RD
ELFIN FOREST
QUESTHAVEN RD
COLLEGE
I-5 SB
I-5 NB
CARLSBAD
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
Liquifaction
January 2015

5.2. WILDFIRE

Hazard Overview

A wildland fire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may fill the area for miles around. Wildfires can be human-caused through acts such as arson or campfires, or can be caused by natural events such as lightning. Fires are typically classified according to the following categories:

- Urban fires are primarily those associated with structures and the activities in and around them.
- Wildland fires occur in forests or other generally uninhabited areas and are fueled primarily by natural vegetation.
- Urban Interface fires occur where development and forest interface, with both vegetation and structures providing fuel. (May also be referred to as urban-wildland interface fires)

The following factors contribute significantly to aforementioned wildland fire behavior:

- Slope/Topography: As slope increases, the rate of wildland fire spread increases. South facing slopes are also subject to greater solar radiation, making them drier and thereby intensifying wildland fire behavior.
- Vegetation/Fuel: Weight and volume are the two methods of classifying fuel, with volume also referred to as fuel loading (measured in tons of vegetative material per acre). Each fuel is assigned a burn index (the estimated amount of potential energy released during a fire), an estimate of the effort required to contain a wildland fire, and an expected flame length.
- Weather: Variations in weather conditions have a significant effect on the occurrence and behavior of wildfires.

Firestorms that occur during extreme weather (e.g., high temperatures, low humidity, and high winds) have high intensity making fire suppression virtually impossible. These events typically burn until the conditions change or the fuel is exhausted.

Historical Events

The District has not experienced any historical damage due to wildfire; however, the County of San Diego has been subject to several of the most catastrophic wildfires in California history, including the following:

- Poinsettia Fire: In May 2014, the Poinsettia Fire burned over 600 acres, destroying multiple homes and causing one fatality. The fire began at the intersection of Poinsettia Lane and Alicante and crossed El Camino Real where it threatened numerous homes and structures.

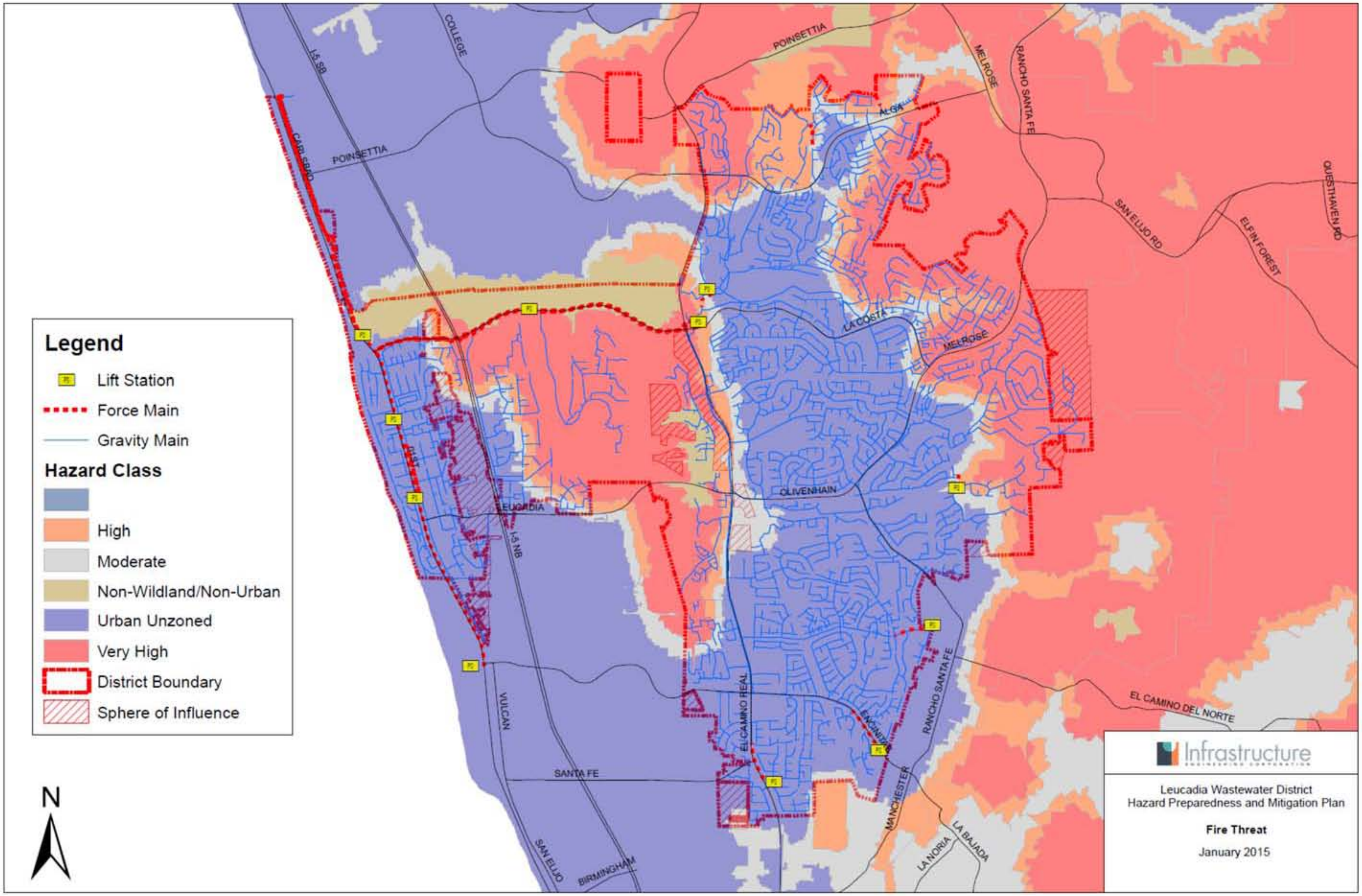
- Cedar Fire: In October 2003, the Cedar Fire ravaged more than 200,000 acres of land in San Diego County, killing 15 people and destroying thousands of homes. The Cedar Fire is the largest fire in California history, burning over 273,246 acres.
- Witch Fire: The Witch Fire started on Oct. 21, 2007 and later merged with the Guejito Fire. Two people died and some 1,125 residential structures were destroyed. The fires triggered the largest evacuation in county history. The Witch Fire burned over 197,990 acres.
- Harmony Grove Fire: The Harmony Grove fire occurred on October 21-22, 1996 and destroyed 120 homes (several within the District service area) and burned over 8,600 acres. The fire started near Harmony Grove Road west of Escondido and burned almost to Batiquitos Lagoon. The District administration building was used as an evacuation center.
- Laguna Fire: The Laguna Fire in 1970 started in Cleveland National Forest near the Kitchen Creek area in San Diego County. It resulted in five deaths and burned over 175,425 acres.

Probability, Frequency, and Magnitude

The Fire Threat Map for San Diego County indicated that the following District facilities are located in fire risk zones:

Map Identified Fire Risk		
Moderate Fire Risk	**High Fire Risk**	**Extremely High Fire Risk**
La Costa Pump Station Rancho Verde Pump Station	Leucadia Pump Station	Saxony Pump Station

However, the La Costa Pump Station is located adjacent to a tennis court with a large fire break is not considered subject to wildfire. The Leucadia Pump Station is located next to the District Main Office next to a parking lot and is not considered subject to wildfire. Additionally, the Rancho Verde Pump Station is located next to a wide road in a landscaped area and is not subject to wildfire. Thus, only the Saxony Pump Station is subject to wildfire.


Legend
Lift Station
Force Main
Gravity Main
Hazard Class
High
Moderate
Non-Wildland/Non-Urban
Urban Unzoned
Very High
District Boundary
Sphere of Influence
N
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
Fire Threat
January 2015
POINSETTIA
COLLEGE
I-5 SB
I-5 NB
CARLSBAD
MELROSE
RANCHO SANTA FE
ALGA
SAN ELIJO RD
ELFIN FOREST
QUESTHAVEN RD
LA COSTA
OLIVENHAIN
LEUCADIA
EL CAMINO REAL
ENCINITAS
EL CAMINO DEL NORTE
MANCHESTER
LA NORIA
LA BAJADA
VULCAN
SANTA FE
SAN ELIJO
BIRMINGHAM

5.3. COASTAL STORMS / TSUNAMI

Hazard Overview

Coastal Storms

Coastal storms can cause storm surge, wind speed, and erosion. Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tide. Storm surges can inundate coastal areas and cause damage due to flooding / inundation.

Tsunami

A tsunami is a wave, or series of waves, generated by an earthquake, landslide, volcanic eruption, etc. Typically a large, submarine earthquake (magnitude 8 or higher) creates a significant upward movement of the sea floor resulting in a rise or mounding of water at the ocean surface. This mound of water moves away from this center in all directions as a tsunami. A tsunami can travel across the open ocean at approximately 500-miles per hour. As the wave approaches land and as the ocean shallows, the wave speed and wavelength decrease and the wave amplitude (height) increases greatly.

Historical Events

The following lists of historical tsunami events were obtained from the California Geological Survey:

Local Sources

Local tsunami sources include large offshore faults and massive submarine landslides, which can impact adjacent coastal communities quickly. Examples of local tsunamis that have impacted California include:

- January 26, 1700 - An earthquake estimated at a magnitude 9 ruptured the entire length of the Cascadia Subduction Zone, likely causing a 50- foot tsunami in parts of northern California. Though there were no local written accounts, scientists have reconstructed the event based on geologic evidence and oral histories from the Native American people in the area, and determined the exact date and time from Japanese documents that describe the effects of a large tsunami that hit the coast of Japan later that same day.
- December 21, 1812 – A tsunami struck the Santa Barbara and Ventura coastline shortly after a large earthquake was felt in the area. Though reports of the size of this tsunami have been debated, the event was large enough to inundate lowland areas and cause damage to nearby ships.

Distant Sources

A tsunami caused by a very large earthquake elsewhere on the Pacific Rim could reach the California coast many (4 to 15) hours after the earthquake. The Alaska-Aleutians Subduction Zone is an example of a distant source that has caused destructive tsunamis in California. Notable distant tsunamis that have impacted California include:

- April 1, 1946 – A magnitude 8.8 earthquake in the Aleutian Islands generated a tsunami that caused damage along the coast of California, including flooding over 1000-feet inland in Half Moon Bay.
- March 28, 1964 – Twelve people were killed in California when a tsunami was generated by a magnitude 9.2 earthquake off the coast of Alaska. A surge approximately 20-feet high flooded 29 city blocks of Crescent City.
- February 26, 2010 – A magnitude 8.8 earthquake struck the Maule region of central Chile, which resulted in large tidal fluctuations, strong currents, and significant erosion/scour. Damage was inflicted on docks, boats, and harbor infrastructure. The following harbors were impacted: Santa Cruz, Santa Barbara, Ventura, Los Angeles, Two Harbors/Catalina, Dana Point, Mission Bay, and San Diego.
- March 11, 2011 – A magnitude 9.0 earthquake in the Tohoku region of Japan produced a moderate amplitude tsunami in California. Although it did not generate significant flooding in California, strong tsunami currents caused one death and over $50-million in significant damage to 27 harbors statewide, with the most significant damage occurring in Crescent City and Santa Cruz.

Probability, Frequency, and Magnitude

The 2009 California Tsunami Inundation Map, Encinitas Quadrangle was developed by the University of Southern California (USC) Tsunami Research Center funded through the California Emergency Management Agency (CalEMA) by the National Tsunami Hazard Mitigation Program. The tsunami modeling process included the evaluation of multiple scenarios, considering both realistic local and distant earthquake and landslide sources. The following outlines the scenarios considered in the map development:

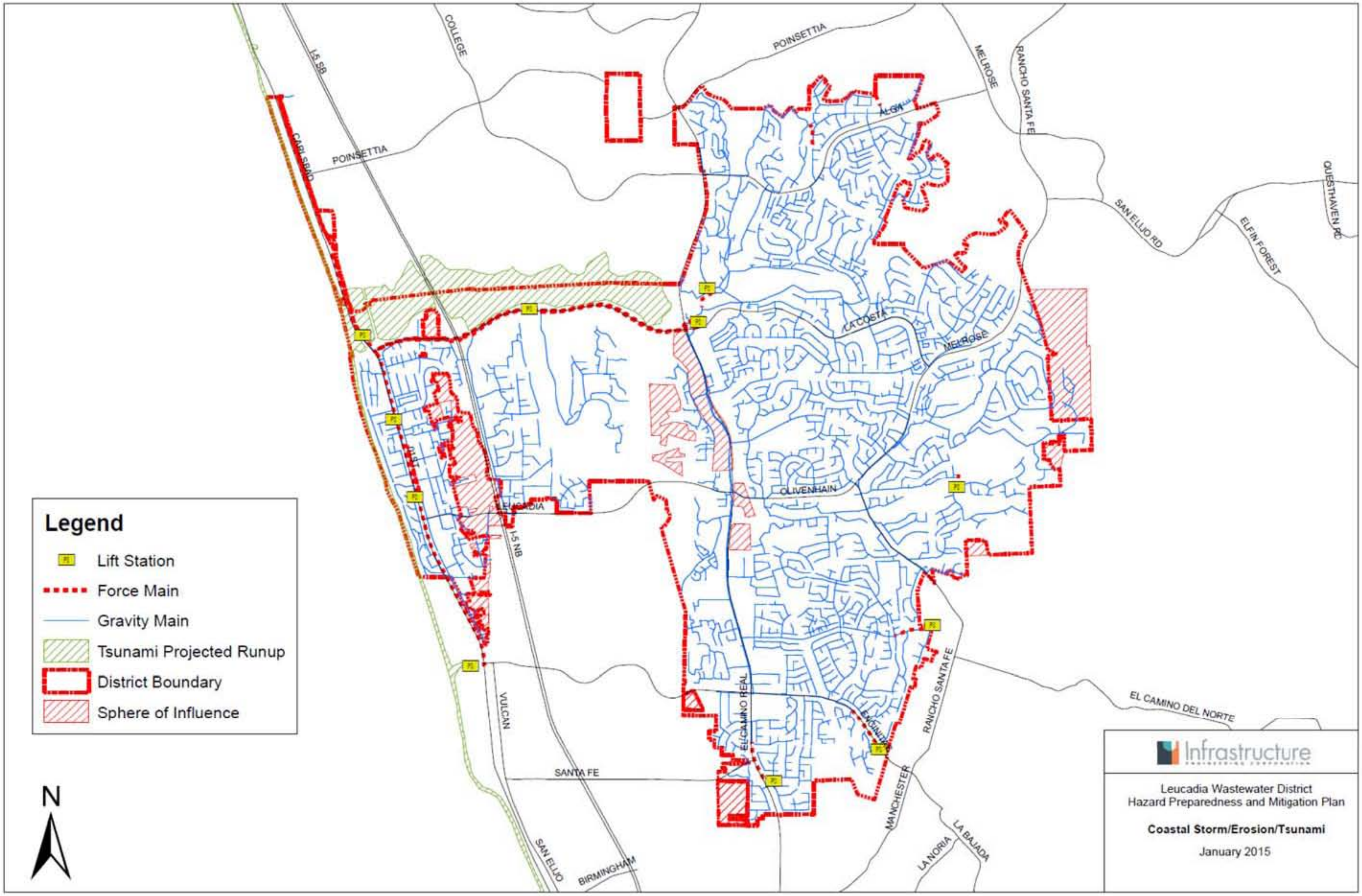
Local Sources

- Carlsbad Thrust Fault
- Catalina Fault
- Coronado Bank Fault
- Lasuen Knoll Fault
- San Clemente Fault Bend Region
- San Clemente Island Fault
- Coronado Canyon Landslide #1

Distant Sources

- Cascadia Subduction Zone #3 (M9.2)
- Central Aleutians Subduction Zone #2 (M8.9)
- Central Aleutians Subduction Zone #3 (M9.2)
- Chile North Subduction Zone (M9.4)
- 1960 Chile Earthquake (M9.3)
- 1964 Alaska Earthquake (M9.2)
- Japan Subduction Zone #2 (M8.8)
- Kuril Islands Subduction Zone #2 (M8.8)
- Kuril Islands Subduction Zone #3 (M8.8)
- Kuril Islands Subduction Zone #4 (M8.8)

According to the tsunami inundation maps, the Batiquitos Pump Station is the only District facility located within the inundation zone. Inundation would be severe and result in potential failure of the pump station electrical equipment (including pump motors) and controls.


Legend
Lift Station
Force Main
Gravity Main
Tsunami Projected Runup
District Boundary
Sphere of Influence
N
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
Coastal Storm/Erosion/Tsunami
January 2015
POINSETTIA
COLLEGE
MELROSE
RANCHO SANTA FE
I-5 SB
CARLSBAD
ALGA
SAN ELIJO RD
ELFIN FOREST
QUESTHAVEN RD
LA COSTA
OLIVENHAIN
LEUCADIA
I-5 NB
VULCAN
EL CAMINO REAL
ENCINITAS
EL CAMINO DEL NORTE
SANTA FE
MANCHESTER
SAN ELIJO
BIRMINGHAM
LA NORIA
LA BAJADA

5.4. FLOODING / EXTREME RAINFALL / SEA LEVEL RISE

Hazard Overview

Flooding / Extreme Rainfall

A flood occurs when excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto a river's bank or to adjacent floodplains. Floodplains are lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods.

A flash flood is a rapid flooding of low-lying areas, rivers and streams, that is caused by the intense rainfall associated with a thunderstorm, or multiple thunderstorms. Flash flooding occurs when the ground under a storm becomes saturated with water so quickly that it cannot be absorbed. The runoff collects in low-lying areas and flows rapidly downhill. The heavy rainfall associated with these storm systems contributes to urban flooding in a number of ways. Primarily, heavy rainfall will often overwhelm the capacity of the conventional drainage system made up of storm drains, catch basins, sewers, and additional natural mechanisms for storm-water management. These systems typically cannot handle more than one or two inches of rainfall per hour before they begin to backup and overflow. This amount is further diminished if the storm drains, and other components of the storm-water management system, have not been adequately maintained, are clogged with debris such as trash or natural waste, or are old and in a state of disrepair. Heavy rainfall, combined with storm-water runoff, can cause local waterways to rise and overflow their banks.

Additionally, El Niño conditions can result in increased precipitation and flooding conditions. El Niño Southern Oscillation is the effects of a band of sea surface temperatures which are anomalously warm or cold for long periods of time that develops off the western coast of South America and causes climatic changes across the tropics and subtropics. The "Southern Oscillation" refers to variations in the temperature of the surface of the tropical eastern Pacific Ocean, with warming known as El Niño and cooling known as La Niña, and in air surface pressure in the tropical western Pacific. During El Niño events, increased precipitation is expected in California due to a more southerly, zonal, storm track.

Sea Level Rise

The California Climate Change Center conducted a study entitled "The Impacts of Sea Level Rise on the California Coast" to develop a model to predict potential sea level rise along the California Coast. According to the Center, the sea level has risen nearly eight inches along the California Coast and with current climate change impacts the Center projects a 1.4 meter sea level rise by the year 2100. The sea level rise is projected to increase the 100-year flood plain zone in San Diego County to impact approximately 210% more population, from 3,000 people to 9,300 people.

However, the NOAA historical mean sea level rise trend at the La Jolla station indicates a 2.02 mm per year historical mean sea level rise (from 1924 to 2013), which equates to a change of 0.66 feet in 100 years. Given the discrepancies between future predictions and historical evidence, the sea level rise projections are controversial in nature; however, since the nature of the hazard is long term future monitoring and planning is typically the best course of action.

Historical Events

According to the 2007 San Diego County Floodplain Management Plan, there were 29 floods recorded from 1770 to 1952, and between 1950 and 2006 flooding / severe storms caused 13 proclaimed States of Emergency in the County of San Diego. The following table from the County Floodplain Management Plan lists the major flooding events in San Diego County:

Date	Description
1862	6 weeks of rain
1891	33 inches in 60 hours
1916	Destroyed 2 dams, 22 deaths. $4.5 million in losses (County of San Diego Sanitation and Flood Control)
1918	Heavy rains – subtropical in nature 1927 Washed out railroad bridge Old Town $117,000 in damages (County of San Diego Sanitation and Flood Control)
1937/1938	$600,000 in flood losses (County of San Diego Sanitation and Flood Control)
1965	6 killed. Primary area affected was Spring Valley 1969 All of state declared disaster area
1974	Short duration heavy rainfall in the Urban San Diego River Basin
1976	Tropical Storm Kathleen. Desert flooding
1976	Jamul Valley Storm. Short duration heavy rainfall during thunderstorm
1977	Tropical Storm Doreen. Desert flooding
1978	Fallbrook. One of heaviest short-duration rainfalls recorded in County, subtropical origin
1978	Lakeside. Long-duration heavy rainfall (60 days) leading to flooding in Lakeside region

Date	Description
1979	Cities of La Mesa, Lemon Grove, National City, San Marcos, San Diego and unincorporated areas. Relatively short-duration high-intensity rainfall, low snow levels to 3000', highly unstable weather. Losses totaled $2,766,268 (County OES)
1980	San Diego River topped out in Mission Valley. The most severe storm season to date after the 1916 & 1927 seasons. $120 million in losses (County of San Diego Sanitation and Flood Control; Earth Times)
1983	March 1983 storms. First year of the ALERT flood warning system
1991	The "Miracle March" storms that saved the County from one of its worst recorded drought years in recent history
1992	Extreme high-intensity short-duration rainfall at Palomar Observatory and Laguna Mountain Jan 1993 Heavy rain. Caused some flooding of small streams and several road and intersection closures 7-Feb
1993	Storm flooding over-topped I-5 at Santa Margarita River.
1993	Isolated showers. Flooding affecting Fallbrook and Lakeside areas 20-Feb
1993	Rain in scattered areas. Shallow flooding experienced in Lakeside and Bonita
1994	Extended-period heavy rainfall – subtropical origin
1995	San Diego County declared disaster area. Moderately-heavy one- to two-hour rainfall. Tens of Millions in losses (County OES)
1995	Flooding in North County. 1% annual chance (100-year)+ short-duration flooding
1995	San Felipe Valley Region. Thunderstorm in San Felipe Valley that produced localized minor flooding
2-Feb 1998	Streamflow on Spring Valley Creek. Rising waters briefly stranded motorists
23-Feb- 1998	Widespread flooding led to a Presidential Disaster Declaration that covered four counties. The San Diego River peaked on the 24th at 15.1 feet, which is 3.8 feet above flood stage. 200 people were evacuates from three mobile home parks in Oceanside.
28-Mar- 1998	Flooding in the El Cajon area.
29-Aug- 2000	Much of Borrego Springs was inundated with 12 inches of water, mud and rocks. Along County Road S-22 leading from Borrego Springs down to the Salton Sea, floodwaters carried five foot boulders onto the road surface and washed out several sections, trapping motorists on the higher sections of the roadway.

Date	Description
10-Sep-2004	70 to 90 homes were damaged in the Sun Gold and De Anza areas of Borrego Springs. In the Sun Gold community some residents had as much as 2 feet of mud rush into their homes. The wall of water and mud was observed to be 8-10 feet high and 150 yards wide at times as it came down Borrego Palm Canyon.
27-Oct-2004	The Cedar Fire of October 2003 burned watershed throughout San Diego County Estates (Ramona), Harbison Canyon, and others. Sizeable rainfall on October 27 and subsequent storms resulted in sediment-laden runoff flooding a number of homes, with large amounts of deposition occurring within natural streams. Federal assistance through the Natural Resources Conservation Service resulted in Emergency Watershed protection projects and Damage Survey Reports.
Jan 2005	Continuous rains caused similar damage as the October 27, 2004 rains did throughout the same areas including Forrester Creek at La Cresta Road and San Vicente Creek in Ramona. Federally declared disaster. Federal assistance resulted in Emergency Watershed Protection projects and Damage Survey Reports and Hazard Mitigation proposals.
23-Feb-05	San Diego River rose above flood stage flooding areas around the Fashion Valley Mall and washing out a low water crossing in the Mission Valley area. A 20 foot section of State Route 6 was washed out. Several homes were flooded in the El Cajon area.

El Nino Events

El Nino events are recurring and the stronger the episode (i.e., the larger the sea surface temperature differs from the expected normal temperature across the central equatorial Pacific area) the higher the probability of increased rainfall. According to the National Oceanic and Atmospheric Administration (NOAA), during the two strongest events in the past 60 years (1982/83 and 1997/98), much-above-median rainfall amounts fell across the entire state of California. Median or above-median precipitation was recorded over the entire state during strong episodes in both 1957/58 and 1972/73. However, strong events in 1991/92 and 2009/10 only provided small surpluses in the southern part of the state, while precipitation during 1965/66 was generally average to below-average across the state.

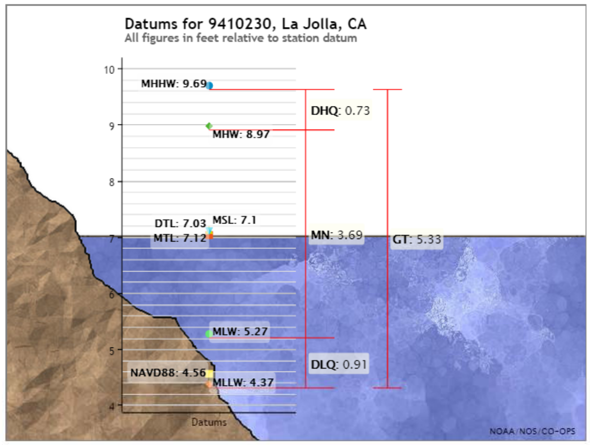
High Tide Elevations

The closest NOAA station to the Leucadia Wastewater District is the La Jolla station. The figure on the following page provides datum for the station and historical information regarding tide levels. Note that the mean sea level is indicated at 7.10 feet which is based upon the station as the datum (reference point). However, when adjusted for the North American Vertical Datum of 1988 (NAVD88) reference point, this corresponds to a 2.73 foot mean sea level (computed as part of the National Geodetic Survey – see below).

Elevations on Station Datum

Station: 9410230, La Jolla, CA
T.M.: 120
Status: Accepted (Oct 6 2011)
Epoch: 1983-2001
Units: Feet
Datum: STND

Datum	Value	Description
MHHW	9.69	Mean Higher-High Water
MHW	8.97	Mean High Water
MTL	7.12	Mean Tide Level
MSL	7.10	Mean Sea Level
DTL	7.03	Mean Diurnal Tide Level
MLW	5.27	Mean Low Water
MLLW	4.37	Mean Lower-Low Water
NAVD88	4.56	North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	5.33	Great Diurnal Range
MN	3.69	Mean Range of Tide
DHQ	0.73	Mean Diurnal High Water Inequality
DLQ	0.91	Mean Diurnal Low Water Inequality
HWI	5.01	Greenwich High Water Interval (in hours)
LWI	11.07	Greenwich Low Water Interval (in hours)
Maximum	12.03	Highest Observed Water Level
Max Date & Time	01/11/2005 17:00	Highest Observed Water Level Date and Time
Minimum	1.50	Lowest Observed Water Level
Min Date & Time	12/17/1933 23:36	Lowest Observed Water Level Date and Time
HAT	11.51	Highest Astronomical Tide
HAT Date & Time	08/09/1987 03:54	HAT Date and Time
LAT	2.49	Lowest Astronomical Tide
LAT Date & Time	01/28/1987 22:48	LAT Date and Time



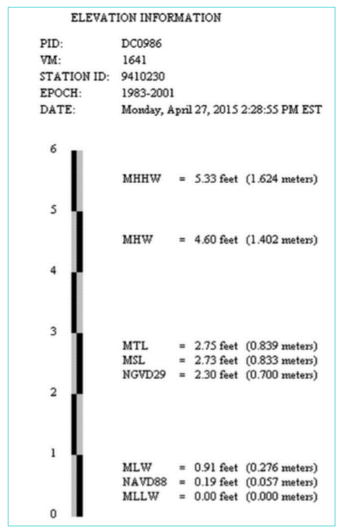
Showing datums for
9410230 La Jolla, CA

Data Units ◉ Feet ○ Meters

Epoch ◉ Present (1983-2001) ○ Superseded (1960-1978)

Submit

The figure to the right shows the following tidal datums referenced on 1983-2001 Epoch:



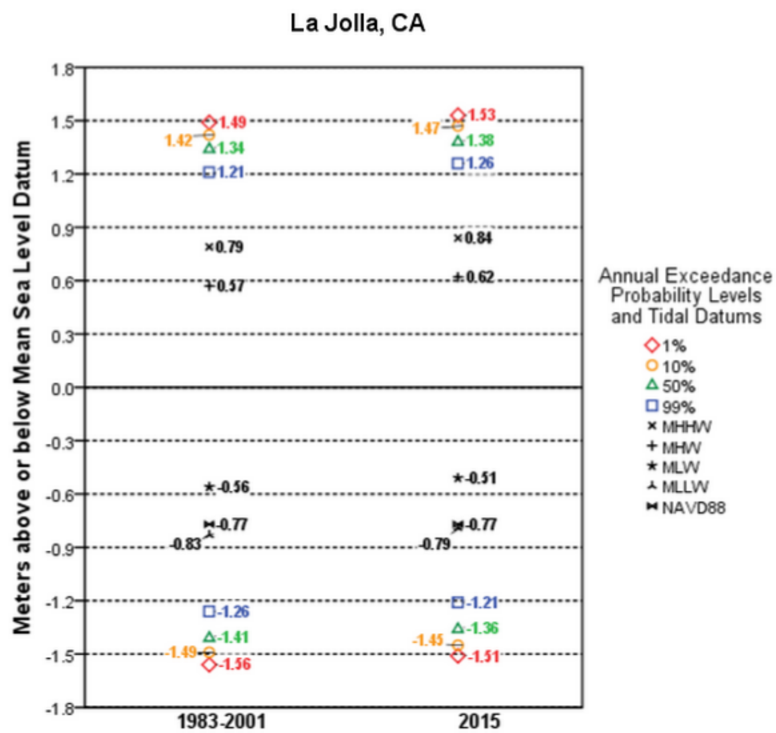
- Mean Higher High Water (MHHW)
- Mean High Water (MHW)
- Mean Tide Level (MTL)
- Mean Sea Level (MSL)
- Mean Low Water (MLW)
- Mean Lower Low Water (MLLW)

Probability, Frequency, and Magnitude

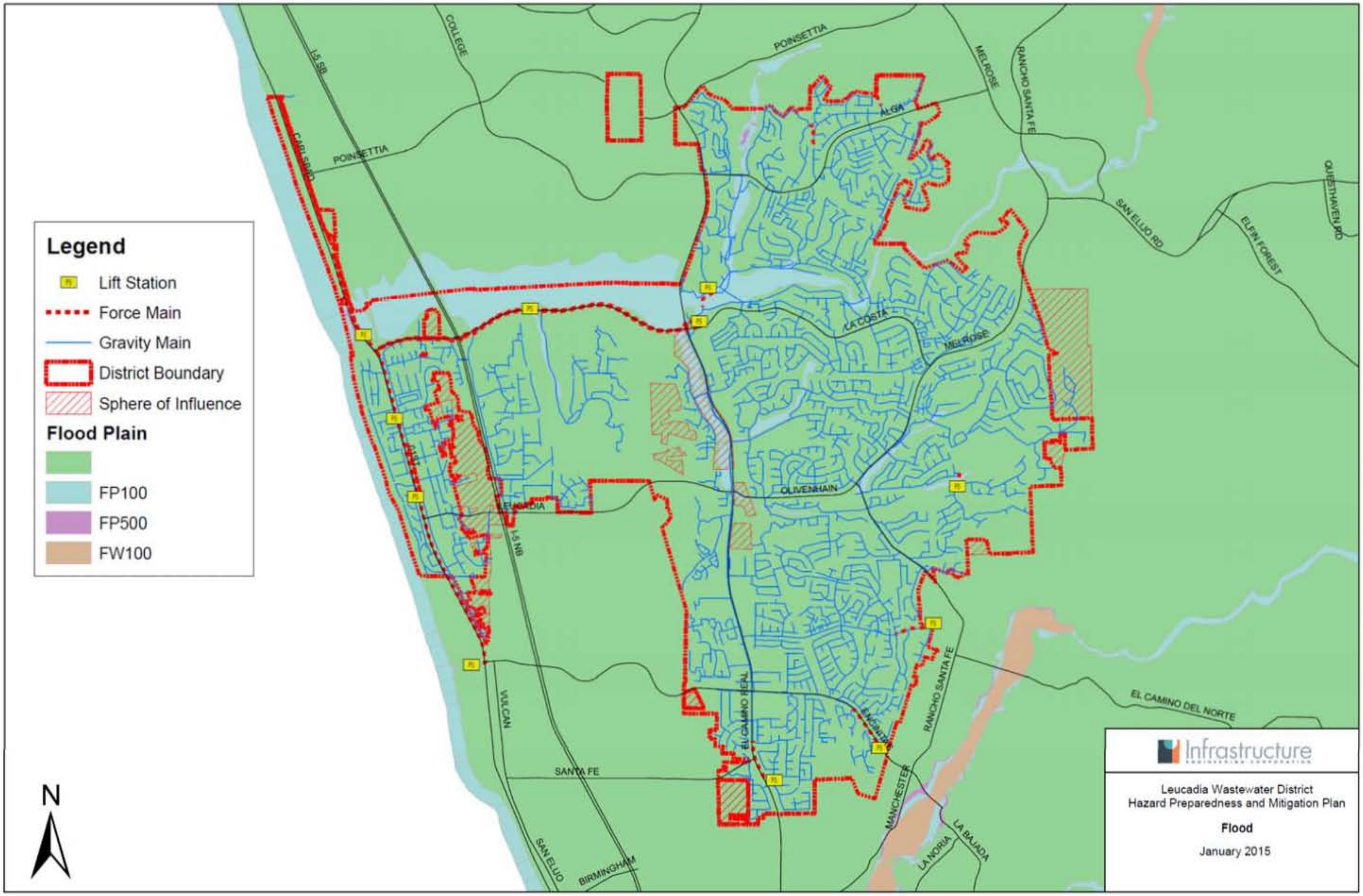
According to the FEMA Flood Insurance Rate Map (FIRM) data illustrated on the map in this section, the Batiquitos Pump Station is the only District facility located in the 100-year flood plain. The 100-year recurrence intervals indicate a 0.01 annual probability of a flooding event. Vulnerability to inundation is also compounded due to the effects of sea level rise.

Additionally, while the La Costa, Leucadia, and Saxony pump stations are located very near the edge of the FEMA 100-year flood zones, they may be vulnerable to flooding affects due to sea level rise or storm surge conditions. Due to the close proximity of the flood zone, potential flooding mitigation measures should also be considered for these stations.

High and low annual exceedance probability levels are shown below relative to the tidal datums and the geodetic NAVD88. The levels are in meters relative to the National Tidal Datum Epoch (1983-2001) Mean Sea Level datum of 2.73 feet. The extreme levels measured by the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) tide gauges during storms are called storm tides, which are a combination of the astronomical tide, the storm surge, and limited wave setup caused by breaking waves. They do not include wave runup, the movement of water up a slope and are thus, different than the FEMA 100-year flood zone.



The figure above from NOAA indicates that there is a 1% chance of a tide 1.53 meters (5.0 feet), 10% change of a tide 1.47 meters (4.8 feet), 50% chance of a tide 1.38 meters (4.5 feet), and 99% chance of a tide 1.26 meters (4.1 feet) above the mean sea level datum of 2.73 feet at the La Jolla station in 2015. This is representative of potential tide fluctuations that could impact the Batiquitos, Saxony, La Costa and Leucadia Pump Stations that are located along the floodplain.



Legend
Lift Station
Force Main
Gravity Main
District Boundary
Sphere of Influence
Flood Plain
FP100
FP500
FW100
N
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
Flood
January 2015
POINSETTIA
COLLEGE
MELROSE
RANCHO SANTA FE
ALGA
SAN ELIJO RD
ELFIN FOREST
QUESTHAVEN RD
LA COSTA
OLIVENHAIN
I-5 NB
I-5 SB
VULCAN
SANTA FE
SAN ELIJO
BIRMINGHAM
EL CAMINO REAL
MANCHESTER
LA NORIA
LA BAJADA
EL CAMINO DEL NORTE


PACIFIC INSTITUTE
California Flood Risk: Sea Level Rise
Encinitas Quadrangle
Encinitas
Solana Beach
0 0.25 0.5 1 1.5 2
Miles
0 0.5 1 2 3
Kilometers

5.5. DAM FAILURE

Hazard Overview

Dam failure is the uncontrolled release of impounded water from behind a dam. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, and terrorism can all cause a dam to fail. Dam failure causes downstream flooding that can affect life and property. The San Marcos Dam is the only dam in the north San Diego County area that has the potential to inundate District facilities.

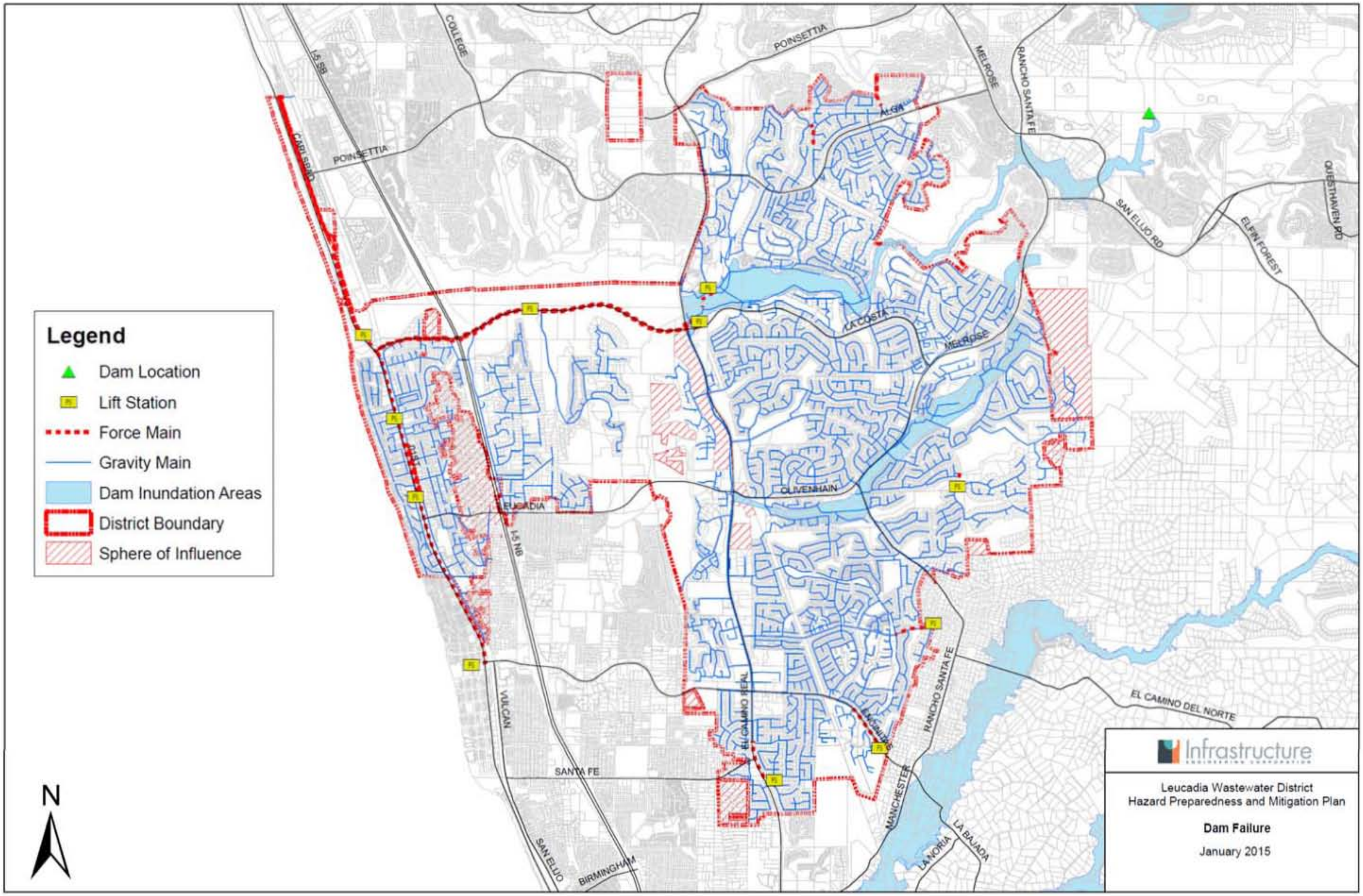
Historical Events

Two major dam failures have been recorded in San Diego County. The Hatfield Flood of 1916 caused the failure of the Sweetwater and Lower Otay Dams, resulting in 22 deaths. Most of those deaths were attributed to the failure of Lower Otay Dam (County of San Diego Sanitation and Flood Control, 2002).

Probability, Frequency, and Magnitude

The La Costa Pump Station and Leucadia Pump Station are both located in the inundation zone from the San Marcos Lake Dam. The following table provides dam details:

Dam #	Dam Name	Owner	Stream	Year Built	Capacity	Reservoir Area	Crest Elevation	Height	Length
848-000	San Marcos	Private Entity	San Marcos Creek	1946	480 AF	54 Acres	503.5 ft	52 ft	290 ft


Legend
Dam Location
Lift Station
Force Main
Gravity Main
Dam Inundation Areas
District Boundary
Sphere of Influence
N
Infrastructure
Leucadia Wastewater District
Hazard Preparedness and Mitigation Plan
Dam Failure
January 2015
POINSETTIA
COLLEGE
MELROSE
RANCHO SANTA FE
ALGA
LA COSTA
OLIVENHAIN
EL CAMINO REAL
EL CAMINO DEL NORTE
SANTA FE
VULCAN
SAN ELIJO
BIRMINGHAM
MANCHESTER
LA BAJADA
SAN ELIJO RD
ELFIN FOREST
QUESTHAVEN RD
I-5 SB
I-5 NB

5.6. RAIN INDUCED LANDSLIDE

Hazard Overview

Landslides occur when masses of rock, earth, or debris move down a slope, including rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (mining and construction of buildings, railroads, and highways) and natural factors (geology, precipitation, and topography). Frequently they accompany other natural hazards such as floods, earthquakes, and volcanic eruptions. Although landslides sometimes occur during earthquake activity, earthquakes are rarely their primary cause. The most common cause of a landslide is an increase in the down slope gravitational stress applied to slope materials (oversteepening). Undercutting of a valley wall by stream erosion or of a sea cliff by wave erosion are ways in which slopes may be naturally oversteeped. Other ways include excessive rainfall or irrigation on a cliff or slope. Another type of soil failure is slope wash, the erosion of slopes by surface-water runoff. The intensity of slope wash is dependent on the discharge and velocity of surface runoff and on the resistance of surface materials to erosion. Surface runoff and velocity is greatly increased in urban and suburban areas due to the presence of roads, parking lots, and buildings, which have zero filtration capacities and provide generally smooth surfaces that do not slow down runoff.

Historical Events

While there have been incidents of landslides in San Diego County, including events in the City of Encinitas and Carlsbad, the District has not sustained damage due to landslides. Specifically, in 2005, the slope beneath the Marbella Condominium complex, located on La Costa Avenue about three-fourths of a mile east of El Camino Real, collapsed after heavy rains causing cracks in the private road and damage to the condominium units. Additionally, in 2005 the Agua Dulce landslide threatened to damage the Rancho Santa Fe Road at the La Costa intersection.

Probability, Frequency, and Magnitude

According to the landslide susceptibility map in the San Diego County Hazard Mitigation Plan, while the Leucadia Wastewater District facilities may be located in areas that have steep slopes, the facilities are not considered at relative risk for landslide hazards. The L1 force main located west of I-5 and east of the Pacific Coast Highway may be vulnerable to landslides due to the steep slope susceptible to erosion and shearing. Both Leucadia force mains are vulnerable along La Costa Avenue just east of the North County Transit District right-of-way which appears to be threatened by landslide.

6. VULNERABILITY ASSESSMENT

Vulnerability describes the degree to which a facility is susceptible to damage from a hazard. Specific vulnerability depends on the facility construction, condition, contents and the economic value of its functions. Additionally, indirect effects can be much more widespread and damaging than direct effects; especially when considering that outages at wastewater facilities can result in significant economic and environmental consequences. A vulnerability analysis estimates the extent of damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment identifies the effects of natural hazard events by estimating the relative exposure of existing and future population, land development, and infrastructure to hazardous conditions.

Since the damage to pump stations caused by inundation is consistent for multiple natural hazards, the coastal storm / tsunami, flooding / extreme rainfall / sea level rise, and dam failure vulnerability assessments were completed in tandem.

Direct Damage – The vulnerability assessment includes direct damage to the pump station and/or pipeline due to the natural hazard. For hazards that primarily impact electrical / controls these costs have been separated from the overall asset value. For damage to a facility greater than 50% it is assumed as a total replacement cost.

Loss of Function – The wastewater system component loss of function is provided with a FEMA value for services, which is $45 per person per day. This value includes economic impacts due to loss of wastewater services as well as potential public health impacts. The loss of function impacts were calculated for each pump station using the percentage of service area multiplied by the total service area of 60,000 customers. This provided the number of customers serviced per station, which was multiplied by the $45 per day.

Environmental – Sewer System Overflows into public areas and sensitive receiving waters can result in potential public health risks and significant environmental impact. Additional costs and monitoring are required in order to clean-up and mitigate the release. Fines for releases of untreated sewage can be up to $10 per gallon. The estimates of fines are based upon the maximum capacity of the pump station in gallons per minute, which is multiplied by the conversion factor to obtain gallons per day, which is then multiplied by the $10 per gallon potential fine. Note that because this is the maximum capacity of the station and assumes no intervention to recapture or mitigate the spill, the fines are significantly overestimated. Additionally, the sewer system overflow fine amounts provided in the loss estimates are for informational purposes only and it is uncertain whether fines will be assessed as a result of a natural disaster.

6.1. EARTHQUAKE / LIQUEFACTION

All District facilities are subject to potential damage and failure due to ground shaking and are located in an area that will experience a PGA ranging from 40 %g to 50 %g with 2% exceedance in 50 years (expressed as a percentage of gravity). The annual probability of the earthquake is found by utilizing the following equation:

$$\text{Annual Probability} = 0.02(1+0.5*.02) / 50 = 0.0004$$

Additionally, the La Costa Pump Station and Batiquitos Pump Station are located in an area subject to liquefaction. Liquefaction can cause significant damage to collection piping and force mains due to the settling of the soil and loss of structural support. The table on the following page provides an overview of the estimated facility damage due to seismic hazards. Additionally, bridge/railroad crossings and gravity/force main failure estimates are also provided.

Facility	Asset Replacement Value	Capacity (gpm)	No. Pumps	% Service Area Impacted	Probability of Hazard (per year)	Vulnerability - Direct Economic	Vulnerability - Loss of Function (per day)	Vulnerability – Environmental Fine (per day)	Environmental Impact
Avocado Pump Station	$1,209,000	300	2	4%	0.0004	$1,209,000	$95,971.56	$4,320,000	Discharge to public area
Batiquitos Pump Station	$11,003,000	8,000	4	100%	0.0004	$11,003,000	$2,700,000.00	$115,200,000	Discharge to Batiquitos Lagoon
Diana Pump Station	$1,958,000	750	2	9%	0.0004	$1,958,000	$239,928.91	$10,800,000	Discharge to public area
Encinitas Estates Pump Station	$2,057,000	450	2	5%	0.0004	$2,057,000	$143,957.35	$6,480,000	Discharge to public area
La Costa Pump Station	$2,572,000	2,200	2	13%	0.0004	$2,572,000	$351,000.00	$31,680,000	Discharge to public area and San Marcos Creek
Leucadia Pump Station	$9,020,000	6,500	4	58%	0.0004	$9,020,000	$1,561,137.44	$93,600,000	Discharge to public area and San Marcos Creek
Rancho Verde Pump Station	$928,000	250	2	3%	0.0004	$928,000	$79,976.30	$3,600,000	Discharge to public area
Saxony Pump Station	$1,599,000	900	2	11%	0.0004	$1,599,000	$287,914.69	$12,960,000	Discharge to Batiquitos Lagoon
Village Park 5 Pump Station	$1,728,000	250	2	3%	0.0004	$1,728,000	$79,976.30	$3,600,000	Discharge to public area
Village Park 7 Pump Station	$1,377,000	200	2	2%	0.0004	$1,377,000	$63,981.04	$2,880,000	Discharge to public area

Bridge and Railroad Crossings

Highways and railroad bridges often support pipelines. Movements of a bridge structure with respect to its abutments may damage the pipeline. Collapse of the bridge will destroy the pipeline segment. If the bridge collapses, repair of the pipeline requires extensive and expensive temporary pipe bridge or other means, pending repair or replacement of the bridge. Meaningful assessment of the bridge's vulnerability, and its potential relative movements (structure versus abutments) requires a high level of effort and significant expertise (with specific bridge engineering details). Good engineering practices for pipelines on bridge crossings includes flexible restrained joints and lateral supports and appropriate redundancy for anchors / supports. Even with good engineering practices considering seismic hazards, the locations where the Leucadia Wastewater District force mains cross the railroad, cross Interstate 5, and along the Pacific Coast Highway are vulnerable to failure during seismic events.

Railroad Crossing

Pacific Coast Highway Bridge Crossing

Gravity and Force Main Failures

Wastewater gravity pipeline performance is generally better than pressurized pipelines. Gravity pipelines are weaker because they are not designed to resist pressure. However, gravity pipeline failures that result in failure of the overall system are unusual because gravity pipeline leaks have little immediate impact on the function of the pipe. Pipeline breaks may cause loss of function but only after the pipeline is physically separated or offset to the extent that sewage cannot pass.

Wastewater system pipelines can be damaged by a number of factors, including seismic waves (measured as Peak Ground Velocity - PGV), landslides, soil liquefaction, and fault crossings (measured as Permanent Ground Deformation - PGD). For this analysis, the pipeline damage algorithm is expressed in terms of wave propagation (PGV) and includes a fragility curve modification factor (K) which is dependent upon the pipe material, joint type, soil specifications, and pipe diameter. The pipeline damage algorithm for wave propagation used in this analysis is detailed in the Seismic Fragility Formulations for Water Systems guidelines developed by the American Lifelines Alliance and is provided below.

Pipeline Damage Algorithm Repair Rate (per 1,000 feet of pipeline) = K*(0.00187)*PGV

The following table provides the fragility curve modification factors used in the analysis. Note, no factor is provided for vitrified clay so a K factor of 1.00 was utilized to reduce the equation to the general pipeline repair rate.

Fragility Curve Modification Factors (K)				
Pipe Material	**Joint Type**	**Soils**	**Diameter**	**K**
Cast Iron	Cement	All	Small	1.00
Cast Iron	Cement	Corrosive	Small	1.40
Cast Iron	Cement	Non Corrosive	Small	0.70
Cast Iron	Rubber Gasket	All	Small	0.80
Welded Steel	Lap - Arc Welded	All	Small	0.60
Welded Steel	Lap - Arc Welded	Corrosive	Small	0.90
Welded Steel	Lap - Arc Welded	Non Corrosive	Small	0.30
Welded Steel	Lap - Arc Welded	All	Large	0.15
Welded Steel	Rubber Gasket	All	Small	0.70
Welded Steel	Screwed	All	Small	1.30
Welded Steel	Riveted	All	Small	1.30
Asbestos Cement	Rubber Gasket	All	Small	0.50
Asbestos Cement	Cement	All	Small	1.00
Concrete w/Steel Cylinder	Lap - Arc Welded	All	Large	0.70

Fragility Curve Modification Factors (K)				
Concrete w/Steel Cylinder	Cement	All	Large	1.00
Concrete w/Steel Cylinder	Rubber Gasket	All	Large	0.80
PVC	Rubber Gasket	All	Small	0.50
Ductile Iron	Rubber Gasket	All	Small	0.50

There are two damage states associated with pipelines – leaks and breaks. FEMA has developed a standardized multi-hazard loss estimation tool (HAZUS) that includes definitions of pipeline damage states due to earthquakes. The FEMA HAZUS Technical Manual makes the assumption that pipeline damage due to seismic wave propagation will consist of 80% leaks and 20% breaks. Therefore, the repair rates are multiplied by the length of pipeline included in the analysis to calculate the total number of repairs, which is then multiplied by 0.80 to obtain the total number of leaks and by 0.20 to obtain the total number of breaks. These calculations result in a separate damage function for both leaks and breaks. The following tables provide the total number of expected leaks and breaks for the District. The highlighted portions of the tables are based on the District facilities being located in an area with a PGA ranging from 40 - 50 %g.

Gravity Lines Failure (Leaks / Breaks)							
PGA (%g)	**Earthquake Magnitude**	**# Breaks - ACP**	**# Breaks - CIP**	**# Breaks - DIP**	**# Breaks - PVC**	**# Breaks - Other**	**Total Breaks**
4-8	4.5 - 5.0	0.00	0.00	0.00	0.16	0.44	0.61
8-16	5.1 - 5.8	0.00	0.00	0.00	0.34	0.92	1.27
16-32	5.9 - 6.1	0.01	0.00	0.00	0.71	1.91	2.63
32-55	6.2 - 6.4	0.01	0.00	0.00	1.33	3.58	4.93
55-80	6.5 - 6.7	0.02	0.00	0.00	2.11	5.70	7.83
80-100	6.8 - 6.9	0.03	0.00	0.00	2.86	7.72	10.61
>100	>7.0	0.04	0.01	0.00	3.87	10.45	14.37
PGA (%g)	**Earthquake Magnitude**	**# Leaks - ACP**	**# Leaks - CIP**	**# Leaks - DIP**	**# Leaks - PVC**	**# Leaks - Other**	**Total Leaks**
4-8	4.5 - 5.0	0.01	0.00	0.00	0.66	1.77	2.44
8-16	5.1 - 5.8	0.01	0.00	0.00	1.36	3.68	5.06
16-32	5.9 - 6.1	0.03	0.00	0.00	2.83	7.65	10.52
32-55	6.2 - 6.4	0.05	0.01	0.00	5.31	14.33	19.71
55-80	6.5 - 6.7	0.08	0.01	0.01	8.44	22.79	31.33
80-100	6.8 - 6.9	0.11	0.02	0.01	11.43	30.87	42.43
>100	>7.0	0.14	0.03	0.01	15.48	41.81	57.48

Force Main Failure (Leaks / Breaks)			
PGA (%g)	**Earthquake Magnitude**	**Total Number of Leaks**	**Total Number of Breaks**
4-8	4.5 - 5.0	0.13	0.03
8-16	5.1 - 5.8	0.26	0.07
16-32	5.9 - 6.1	0.55	0.14
32-55	6.2 - 6.4	1.03	0.26
55-80	6.5 - 6.7	1.64	0.41
80-100	6.8 - 6.9	2.22	0.55
>100	>7.0	3.00	0.75

Based upon the calculations provided above, the District can expect approximately 5 breaks and 20 leaks in the gravity sewer lines and approximately 0.25 breaks and 1 leak in the force mains during a magnitude 6.2 to 6.4 earthquake.

6.2. WILDFIRE

The Saxony Pump Station has been identified to be located in areas that are subject to wildfire. Wildfire can result in substantial damage to above-ground facilities, including electrical / control equipment, structures, backup power generators, etc.

The failure of the pump station can result in sewer system overflows potentially impacting public health and the environment. The Saxony Pump Station overflows directly to the Batiquitos Lagoon, which is a sensitive environment. Fines associated with discharges to the environment that are not recaptured can be as much as $10 per gallon.

Additionally, the loss of wastewater service has been assigned a monetary value of $45 per day and the District service area consists of approximately 60,000 customers. Saxony provides services to approximately 11% of the service area, or 6,600 customers.

The following table provides a vulnerability analysis of the potential impacts due to wildfire.

Facility	Asset Replacement Value	Capacity (gpm)	No. Pumps	% of Service Area Impacted	Vulnerability - Electrical / Controls Replacement Value	Vulnerability - Loss of Function (per day)	Vulnerability – Environmental Fine (per day)
Saxony	$1,599,000	900	2	11%	$1,280,000	$287,915	$12,960,000 SSO to Batiquitos Lagoon

Wildfire has the potential to damage the electrical equipment and controls at the Saxony Pump Station. This station services approximately 11% of the service area and loss of function due to a damage to the electrical / controls can result in a loss of sewer collection services for those customers. Additionally, a loss of function can result in a sewer system overflow directly to the Batiquitos Lagoon, which is a sensitive habitat and may result in a fine up to $10 per gallon of untreated sewage discharged (fine calculated based upon maximum capacity of the pump station assuming no intervention).

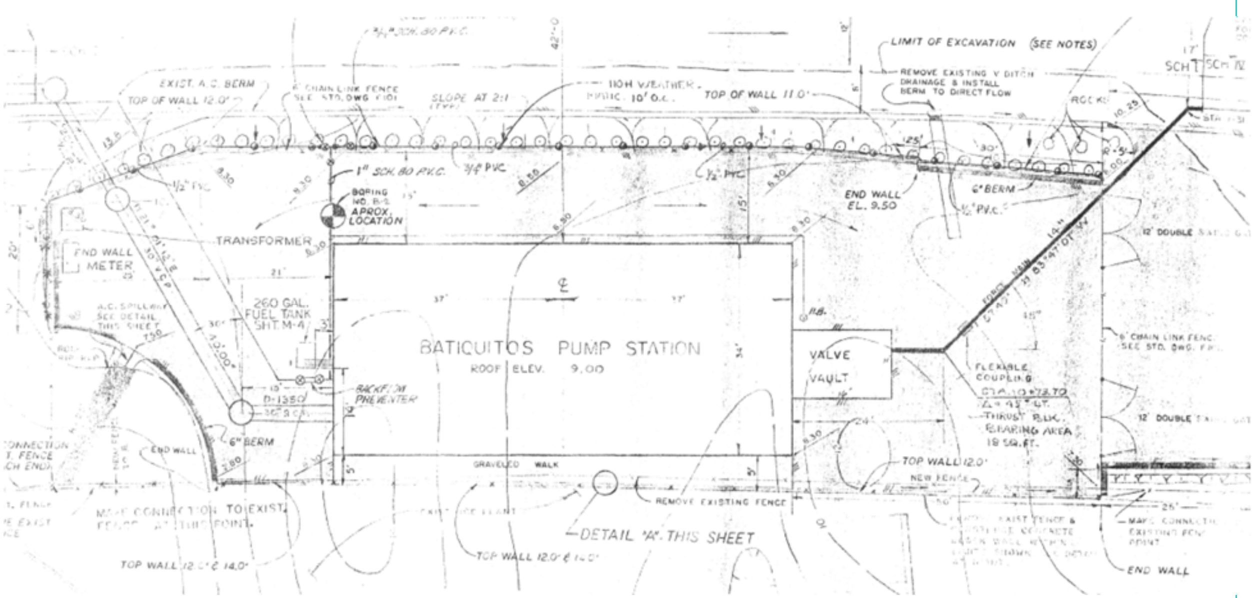
6.3. COASTAL STORMS / TSUNAMI / FLOODING / EXTREME RAINFALL / SEA LEVEL RISE / DAM FAILURE VULNERABILITY

Inundation and flooding of wastewater pump stations can result in significant damage to electrical and control components, as well as backup power sources. Additionally, inundation hazards due to a sudden flooding with swift water (e.g., tsunami, dam inundation) there is also the potential for mechanical damage. The electrical and/or mechanical damage can result in a failure of the pump station to operate and cause sewer system overflows potentially impacting public health and the environment. Additionally, the loss of wastewater service has been assigned a monetary value of $45 per day and the District service area consists of approximately 60,000 customers. Additionally, fines for discharges of untreated wastewater can be up to $10 per gallon. Due to the similar consequence of inundation to the facilities, the following hazards were evaluated concurrently:

- Coastal Storms / Tsunami
- Flooding / Extreme Rainfall / Sea Level Rise
- Dam Failure

The following sections provide site specific vulnerability analysis for flooding / inundation.

Batiquitos Pump Station



Batiquitos Pump Station

Inundation Hazard

Inundation of the Batiquitos Pump Station can result in damage to the pump electrical equipment/controls and diesel generator in the dry well as well as electrical equipment and controls in the above-grade control room. Additionally, failure of the pump station would have significant secondary impacts including the total loss of sewer services for the District service area (approximately 60,000 customers) and the overflow of sewage directly into the Batiquitos Lagoon with environmental impacts, public health impacts, and associated fines and clean-up costs.

If the damage is electrical (loss of power or flooded dry well) with the structure of the pump station still intact, the diesel driven bypass pump (Big Blue) can be connected in approximately 3 to 4 hours. However, this would require a diver to go into the dry well to open the suction valve or pump out the dry well just enough to enable a person to go in and open the valve. Thus, it can be up to 6 to 8 hours after the debris/water is cleared and access to the pump station is established to get the equipment in place. If the pump station structure; wet well, emergency basin, etc. is damaged, the pump station would have to be bypassed from La Costa Avenue to north of the Lanikai Lane Mobile Home Park (manhole to manhole) which is approximately 10,500 feet. Based on the amount of damage to the force main, intermediate manholes could be constructed on the north and south undamaged force mains sections for bypassing. Thereby, reducing the bypass pumping distance. This would have to be hard pipe with bypass pump(s), which may take up to two weeks. Loss estimates in the table are listed on a per day basis.

Coastal Storm / Tsunami Vulnerability

The Batiquitos Pump Station is located within the California mapped tsunami inundation zone. Probabilistic tsunami scenarios have estimated approximate 6 foot wave heights for tsunamis impacting the San Diego coastline making the facility vulnerable to inundation.

Flooding / Extreme Rainfall Vulnerability

The Batiquitos Pump Station is located in FEMA 100-year flood zone AE, with a base flood elevation of 7 feet. According to the site plan, the Batiquitos Pump Station grade elevation is 9 ft (datum needs verification). Subsequently, the facility is potentially not at risk for inundation due to 100-year flooding.

Batiquitos Pump Station

Sea Level Rise Vulnerability

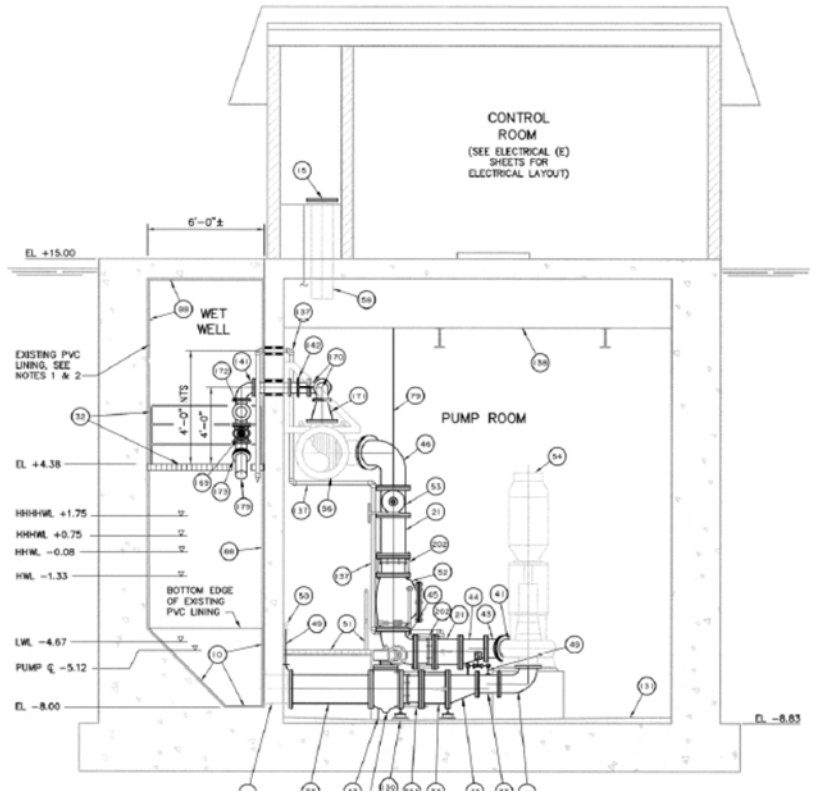
With a 4.6 feet (1.4 meter) predicted sea level rise by the year 2100, the Batiquitos Pump Station is at risk of flooding during high tide and 100-year flood events with the grade elevation of 9 feet during future sea level rise scenarios. Projections for sea level rise should be monitored to determine the risk to the Batiquitos pump station.

Dam Failure Inundation

The Batiquitos Pump Station is not located within a dam inundation zone.

Facility	Asset Replacement Value	Capacity (gpm)	Base Elevation (ft)	% of Service Area Impacted	Vulnerability - Electrical / Controls Replacement Value	Vulnerability - Loss of Function (per day)	Vulnerability - Environmental Fines (per day)
Batiquitos	$11,003,000	8,440	9	100%	$4,300,000	$2,700,000	$115,200 Lagoon SSO

Leucadia Pump Station



Inundation Hazard

Inundation of the Leucadia Pump Station can result in damage to the pump electrical equipment/controls in the dry well as well as electrical equipment and controls in the above-grade control room. The backup power generator is at an elevated risk because it is located above grade. Additionally, failure of the pump station would have significant secondary impacts including the loss of sewer services for approximately 58% of the District service area and the overflow of sewage directly into a public area and/or San Marcos Creek with public safety, environmental impacts and associated fines and clean-up costs. The wet well and emergency storage also has the potential to overflow if the facility is inundated.

Coastal Storm / Tsunami Vulnerability

The Leucadia Pump Station is not located in a tsunami inundation zone.

Flooding / Extreme Rainfall Vulnerability

The Leucadia Pump Station is not located in the FEMA 100-year flood; however, it is located very near the edge of the defined flood zone. The Leucadia Pump Station grade level at 15 feet.

Leucadia Pump Station

Sea Level Rise Vulnerability

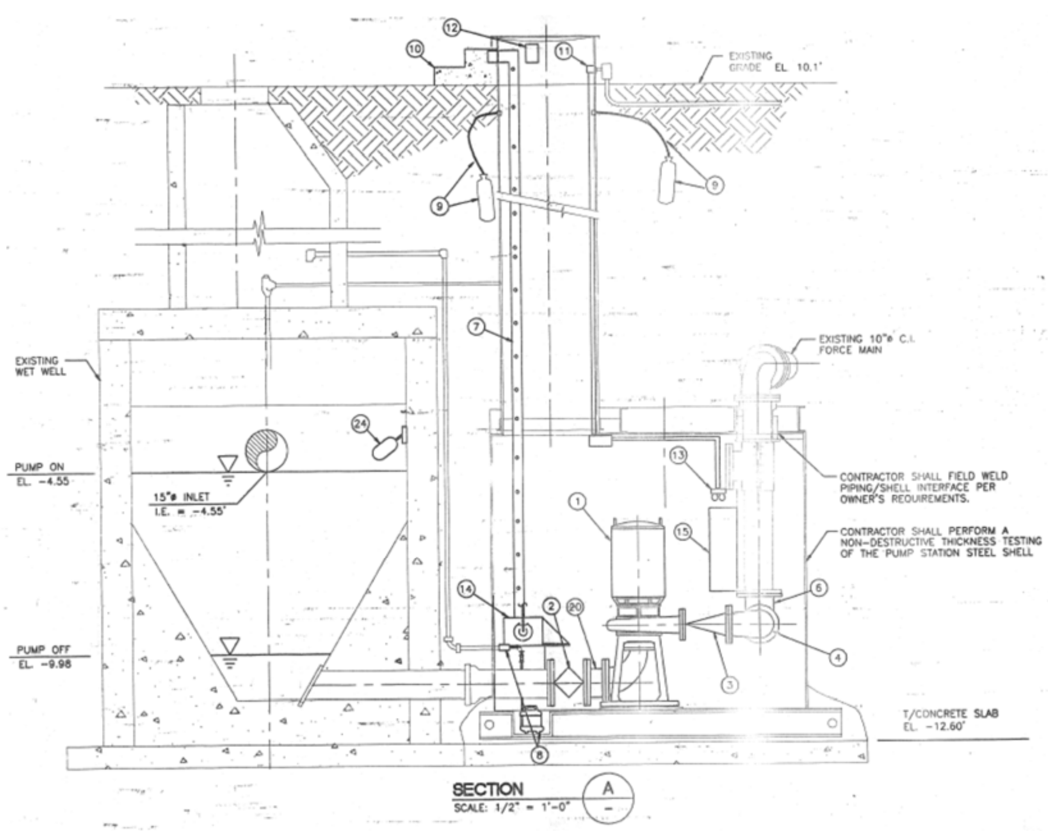
The 4.6 feet (1.4 meter) predicted sea level rise by the year 2100 can potentially place the Leucadia Pump Station at risk for 100-year flood and storm surge events.

Dam Failure Inundation

The Leucadia Pump Station is located within a dam inundation zone from the San Marcos Dam. Failure of the dam can result in facility inundation and associated damage.

Facility	Asset Replacement Value	Capacity (gpm)	Base Elevation (ft)	% of Service Area Impacted	Vulnerability - Electrical / Controls Replacement Value	Vulnerability - Loss of Function (per day)	Vulnerability - Environmental
Leucadia	$9,020,000	8,000	15	58%	$4,500,000	$1,561,137	$93,600,000 Public SSO

La Costa Pump Station



La Costa Pump Station

Inundation Hazard

Inundation of the La Costa Pump Station (submersible) can result in damage to the above grade pump electrical equipment/controls and above grade backup power diesel generator. Additionally, failure of the pump station would have significant secondary impacts including the loss of sewer services for approximately 13% of the District service area and the overflow of sewage directly into a public area (next to tennis court and golf facility) and/or San Marcos Creek with public safety, environmental impacts and associated fines and clean-up costs.

Coastal Storm / Tsunami Vulnerability

The La Costa Pump Station is not located in a tsunami inundation zone.

Flooding / Extreme Rainfall Vulnerability

The La Costa Pump Station is not located in the FEMA 100-year flood; however, it is located very near the edge of the defined flood zone. The La Costa Pump Station grade elevation is 10.1 ft and given the close proximity to the defined flood zone the facility may be at risk for inundation.

Sea Level Rise Vulnerability

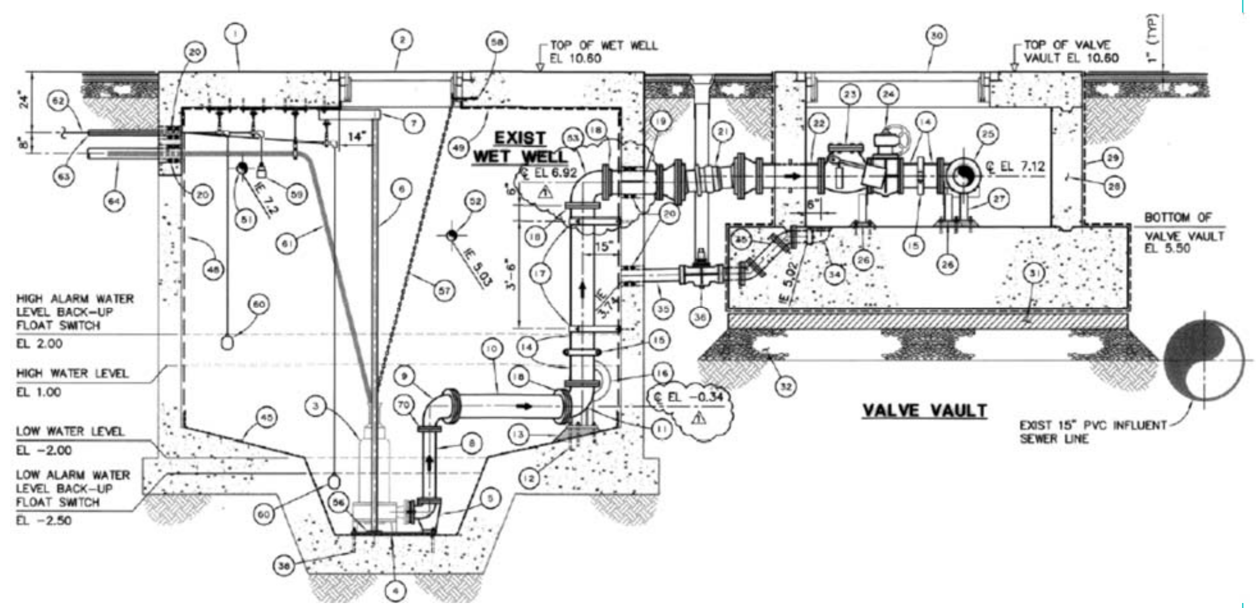
With a 4.6 feet (1.4 meter) predicted sea level rise by the year 2100, the La Costa Pump Station is at risk of flooding during high tide and 100-year flood events with the grade elevation of 10.1 feet during future sea level rise scenarios.

Dam Failure Inundation

The La Costa Pump Station is located within a dam inundation zone from the San Marcos Dam. Failure of the dam can result in facility damage.

Facility	Asset Replacement Value	Capacity (gpm)	Base Elevation (ft)	% of Service Area Impacted	Vulnerability - Electrical / Controls Replacement Value	Vulnerability - Loss of Function (per day)	Vulnerability - Environmental Fines
La Costa	$2,572,000	2,200	10.1	26%	$990,000	$703,791	$31,680,000 Public / River SSO

Saxony Pump Station



Inundation Hazard

Inundation of the Saxony Pump Station (submersible) can result in damage to the above grade pump electrical equipment/controls and above grade backup power diesel generator. Additionally, failure of the pump station would have significant secondary impacts including the loss of sewer services for approximately 11% of the District service area and the overflow of sewage directly into the Batiquitos Lagoon with public safety, environmental impacts and associated fines and clean-up costs.

Coastal Storm / Tsunami Vulnerability

Tsunami modeling indicates that the Saxony Pump Station is not located in a tsunami inundation zone; however, it is located on the edge of the inundation zone and may be subject to potential facility inundation and damage during a large scale tsunami incident.

Flooding / Extreme Rainfall Vulnerability

The Saxony Pump Station is not located in the FEMA 100-year flood; however, it is located very near the edge of the defined flood zone. The Saxony Pump Station grade elevation is 10.6 feet and given the close proximity to the defined flood zone the facility may be at risk for inundation.

Sea Level Rise Vulnerability

With a 4.6 feet (1.4 meter) predicted sea level rise by the year 2100, the Saxony Pump Station is at risk of flooding during high tide and 100-year flood events with the grade elevation of 10.6 feet during future sea level rise scenarios.

Dam Failure Inundation

The Saxony Pump Station is not located within a dam inundation zone.

Facility	Asset Replacement Value	Capacity (gpm)	Base Elevation (ft)	% of Service Area Impacted	Vulnerability - Electrical / Controls Replacement Value	Vulnerability - Loss of Function (per day)	Vulnerability - Environmental Fines
Saxony	$1,599,000	900	10.6	11%	$1,280,000	$287,914	$12,960,000 Lagoon SSO

6.4. RAIN INDUCED LANDSLIDE

Areas within the District have slopes greater than 25%, which are potentially susceptible to landslides. However, no facilities have been identified in the landslide risk zones by San Diego County. The District has identified that the L1 force main located west of I-5 and east of the Pacific Coast Highway may be subject to landslides due to the steep cliff and shearing can result in damage to or loss of the force main. This would cause a release of sewage to Batiquitos Lagoon as well as the loss of sewer services to most of the District service area.

7. MITIGATION STRATEGIES

Mitigation strategies are administrative and engineering project recommendations to reduce the vulnerability to the identified hazards. It is imperative to have engineers and vital District employees involved in this phase of the plan in order to develop strategies and projects that will mitigate the hazard and solve the problem cost-effectively, as well as ensure consistency with the District's long-term mitigation goals and capital improvements. A team-based approach was utilized to brainstorm mitigation projects based on the identified hazards and associated loss estimates. Each of the mitigation recommendations fall into one or more of the following categories:

Prevention

- Planning and Modeling
- Capital Improvements Program

Engineering

- Elevation of equipment to avoid potential flood damage.
- Submergence-rated equipment where elevation cannot be deployed.
- Bracing or anchorage of equipment.
- Installation of a floodwall to protect a critical facility.
- Accelerated replacement of older more vulnerable pipelines.
- Hardening Emergency Operations Centers and other buildings critical to wastewater systems operations.

Land Use

- Alternative siting for critical facilities out of hazard zone.

System Enhancement

- Development of alternative sources of electric power and other energy sources.
- Development of backup communication systems.
- Providing facility bypass provisions and parallel force mains.
- Installation or upgrade of a Supervisory Control and Data Acquisition (SCADA) system.

Emergency Response

- Emergency Response Plan / Sewer System Overflow Response Plan development.
- Emergency response training, including drills and simulations.
- Mutual aid agreements and cooperative activities with responding agencies.
- Spare parts, materials, equipment, etc.

7.1. EXISTING MITIGATION MEASURES

The District has implemented mitigation efforts to ensure the continuous supply of wastewater collection services, including the installation of back-up power sources or provisions to readily deploy portable generators and pumps. Additionally, parallel force mains and the ability to bypass facilities with portable pumps (e.g., “big blue”) also provide additional redundancy and mitigation.

7.2. PROPOSED MITIGATION MEASURES

The priority for implementing mitigation recommendations depends upon the overall priority for the hazards mitigated by implementing the recommendation. Therefore, projects that provide mitigation for high hazard scenarios should be implemented prior to hazards that are low risk or long term. Based upon the risk and vulnerability assessment, the following lists the hazard vulnerability priority:

- Flooding / Extreme Rainfall
- Coastal Storms / Tsunami
- Sea Level Rise
- Earthquake / Liquefaction
- Wildfire
- Dam Failure
- Rain Induced Landslide

The following list provides potential mitigation strategies that can be implemented by the District in order to mitigate natural hazards:

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
High Priority Recommendations		
1. Evaluate the feasibility of dry flood-proofing the Batiquitos Pump Station, including the installation of flood-proof doors and ensuring all hatches are water tight. Also, consider flood-proofing the area around the pump station vents to minimize water carryover through the vents.	Batiquitos Pump Station	Tsunami, Flood, Sea Level Rise, Severe Storm

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
2. Provide flood protection for the electrical / control components at the Saxony and La Costa Pump Stations.	Saxony & La Costa Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm
3. Develop detailed site specific flood response and contingency plans for vulnerable facilities.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm
Medium Priority Recommendations		
1. Conduct training for sewer system overflow scenarios at stations susceptible to flooding, possibly coordinating with local agencies that may assist with response.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Tsunami, Flood, Sea Level Rise, Severe Storm
2. Implement vegetation management practices at the Saxony Pump Station (if possible due to environmental constraints) to provide an appropriate firebreak for the electrical and control equipment.	Saxony Pump Station	Wildfire
3. Survey the Batiquitos and Saxony Pump Station structures with respect to both datums (NAVD88 and NGVD29) to determine correlation to the sea level data.	Batiquitos & Saxony Pump Stations	Flood, Sea Level Rise
Long Term Recommendations		
1. Evaluate more robust long-term flood-proofing solutions for the Batiquitos Pump Station, possibly including building a wall around the pump station (may be subject to political and environmental limitations) or relocation of the pump station.	Batiquitos Pump Station	Tsunami, Flood, Sea Level Rise, Severe Storm

Mitigation Recommendations		
Recommendations	**Facilities Protected**	**Hazard Mitigated**
2. Evaluate elevating pump stations and emergency generators as they are rehabilitated or in new construction to account for potential sea level rise.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Sea Level Rise
3. Incorporate sea level rise into planning into master planning and capital improvement programs to account for projected sea level rise.	Batiquitos, Saxony, La Costa & Leucadia Pump Stations	Sea Level Rise
4. Ensure that new sewer mains and manholes in low lying areas are sealed against floodwater inflow and groundwater infiltration. Expand programs to reduce inflow and infiltration through rehabilitation of sewer mains and manholes, prioritizing areas where risk of flooding is highest.	Force Mains & Manholes	Tsunami, Flood, Sea Level Rise, Severe Storm
5. Review detailed engineering analysis for the force mains at the railroad crossing and Pacific Coast Highway Bridge to ensure the design considered seismic hazards and follows good engineering practices (e.g., flexible restrained joints, lateral supports, anchorage redundancy, etc.).	Force Mains	Earthquake
6. Ensure the pipeline capital improvements program includes considerations for replacing piping vulnerable to earthquakes and/or other natural hazards.	Force Mains & Collection Pipelines	Earthquake
7. Evaluate whether the segment of the L1 force main located west of I-5 and east of the Pacific Coast Highway, in the area subject to landslide or cliff failure should be upgraded with materials more resistant to landslide (e.g., fusible PVC joints).	L1 Force Main	Landslide