County of Orange

&

Orange County Fire Authority

Local Hazard Mitigation Plan

December 2021

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Board of Supervisors Resolution

RESOLUTION OF THE BOARD OF SUPERVISORS OF
ORANGE COUNTY, CALIFORNIA
November 16, 2021

WHEREAS, the County of Orange ("County") recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the U.S. Congress passed the Disaster Mitigation Act of 2000 ("Disaster Mitigation Act", Public Law 106-390) emphasizing the need for pre-disaster mitigation of potential hazards; and

WHEREAS, the Disaster Mitigation Act made available hazard mitigation grants to state and local governments; and

WHEREAS, an adopted Local Hazard Mitigation Plan is required as a condition of future funding for mitigation projects under multiple Federal Emergency Management Agency ("FEMA") pre- and post-disaster mitigation grant programs; and

WHEREAS, the County of Orange has previously adopted the *County of Orange and Orange County Fire Authority Hazard Mitigation Plan* in 2016, 2011, and 2004; and

WHEREAS, the *County of Orange and Orange County Fire Authority Hazard Mitigation Plan* is required to be updated every five years; and

WHEREAS, the County fully participated in the FEMA-prescribed mitigation planning process to prepare the *2021 County of Orange and Orange County Fire Authority Hazard Mitigation Plan*; and

WHEREAS, the California Office of Emergency Services ("Cal OES") and FEMA Region IX officials have reviewed the *2021 County of Orange and Orange County Fire*

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Board of Supervisors Resolution (Continued)

Authority Hazard Mitigation Plan and approved it contingent upon this official adoption of the participating governing body; and

WHEREAS, Orange County desires to comply with the requirements of the Disaster Mitigation Act and to augment its emergency planning efforts by formally adopting the *2021 County of Orange and Orange County Fire Authority Hazard Mitigation Plan*; and

WHEREAS, adoption by the Board of Supervisors demonstrates the County's commitment to fulfilling the mitigation goals and objectives outlined in *2021 County of Orange and Orange County Fire Authority Hazard Mitigation Plan*; and

WHEREAS, adoption of this plan by the Board of Supervisors allows responsible agencies to carry out their responsibilities under the plan.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Supervisors of Orange County adopts the *2021 County of Orange and Orange County Fire Authority Hazard Mitigation Plan* as an official plan; and

BE IT FURTHER RESOLVED, Orange County will submit this adoption resolution to the Cal OES and FEMA Region IX officials to enable the plan's final approval in accordance with the requirements of the Disaster Mitigation Act and to establish conformance with the requirements of Government Code section 8685.9 (AB 2140).

WHEREAS, pursuant to Government Code section 8685.9, the County of Orange achieves enhanced eligibility for state reimbursement of California Disaster Assistance Act project costs though the adoption of its Hazard Mitigation Plan as part of the Safety Element of the General Plan, pursuant to Government Code section 65302.6

NOW, THEREFORE, BE IT RESOLVED that this Board adopts the *2021 County of Orange and Orange County Fire Authority Hazard Mitigation Plan.*

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Board of Supervisors Resolution (Continued)

The foregoing was passed and adopted by the following vote of the Orange County Board of Supervisors, on November 16, 2021, to wit:

AYES:	Supervisors:	KATRINA FOLEY, DONALD P. WAGNER, DOUG CHAFFEE LISA A. BARTLETT, ANDREW DO
NOES:	Supervisor(s):	
EXCUSED:	Supervisor(s):	
ABSTAINED:	Supervisor(s):	

CHAIRMAN

STATE OF CALIFORNIA)
)
COUNTY OF ORANGE)

I, ROBIN STIELER, Clerk of the Board of Orange County, California, hereby certify that a copy of this document has been delivered to the Chairman of the Board and that the above and foregoing Resolution was duly and regularly adopted by the Orange County Board of Supervisors

IN WITNESS WHEREOF, I have hereto set my hand and seal.

ROBIN STIELER
Clerk of the Board
County of Orange, State of California

Resolution No: 21-133
Agenda Date: 11/16/2021
Item No: S35E

I certify that the foregoing is a true and correct copy of the Resolution adopted by the Board of Supervisors, Orange County, State of California

Robin Stieler, Clerk of the Board of Supervisors
By _____ Deputy

FEMA Approval Letter

U.S. Department of Homeland Security
FEMA Region 9
1111 Broadway, Suite 1200
Oakland, CA 94607

FEMA

December 27, 2021

Randy Harper
Assistant Emergency Manager
Emergency Management Division
Orange County Sheriff's Department
2644 Santiago Canyon Road
Silverado, CA 92676

Dear Mr. Harper:

The *County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan 2021* was officially adopted by Orange County on November 16, 2021 and submitted for review and approval to the Federal Emergency Management Agency (FEMA). The review is complete, and FEMA finds the plan to be in conformance with the Code of Federal Regulations, Title 44, Part 201, Section 6 (44 C.F.R. 201.6).

This plan approval ensures Orange County continued eligibility for funding under FEMA's Hazard Mitigation Assistance programs, including the Hazard Mitigation Grant Program (HMGP), the Building Resilient Infrastructure and Communities program (BRIC), and the Flood Mitigation Assistance (FMA) program. All requests for funding are evaluated individually according to eligibility and other program requirements. Approved hazard mitigation plans may also be eligible for points under the National Flood Insurance Program's Community Rating System (CRS).

FEMA's approval is for a period of 5-years, effective starting the date of this letter. Prior to **December 27, 2026**, Orange County must review, revise, and submit their plan to FEMA for approval to maintain eligibility for grant funding. The enclosed plan review tool provides additional recommendations to incorporate into future plan updates.

If you have any questions regarding the planning or review processes, please contact the FEMA Region 9 Hazard Mitigation Planning Team at fema-r9-mitigation-planning@fema.dhs.gov.

Sincerely,

MARK L SHUGART

Digitally signed by MARK L SHUGART
Date: 2021.12.27 07:27:35 -08'00'

for Kathryn Lipiecki
Director, Mitigation Division
FEMA Region 9

Enclosure (1)
Orange County Plan Review Tool, dated December 27, 2021

cc: Mark Shugart, Acting Division Director, FEMA Region 9.
Alison Kearns, Risk Analysis Branch Chief, FEMA Region 9
Jennifer Hogan, State Hazard Mitigation Officer, California Governor's Office of Emergency Services
Victoria LaMar-Haas, Hazard Mitigation Planning Chief, California Governor's Office of Emergency Services

www.fema.gov

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Chapter 1 Introduction and Planning Process

Plan Description

The 2020 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP) was developed collaboratively with emergency management staff, County and external partners, and Orange County residents. The document is an update to the 2015 LHMP and is a critical step in continuing Orange County's commitment to hazard mitigation as one component of its comprehensive emergency management program.

The mission of the LHMP is to promote sound public policy designed to protect residents, critical facilities, infrastructure, key resources, private property, and the environment from natural hazards in unincorporated areas, fire hazards in the Fire Authority service area, and County and Fire Authority owned facilities.

This contribution to Orange County's hazard mitigation efforts will increase public awareness, document resources for risk reduction and loss prevention, and identify activities to guide the County toward building a safer, more sustainable and more resilient community.

Purpose

The Disaster Mitigation Act of 2000 (Public Law 106-390) amended the Robert T. Stafford Disaster and Emergency Assistance Act (42 USC 5121 et seq.) to describe a set of requirements for local mitigation planning. Local jurisdictions are required to maintain a LHMP under the Disaster Mitigation Act of 2000 to be eligible to receive FEMA mitigation project grants (42 USC 5165).

This LHMP is a multi-jurisdiction plan developed jointly between the County of Orange, a local government, and the Orange County Fire Authority, a Joint Powers Authority. This collaborative plan was developed to ensure that each participating agency has met the requirements of 44 CFR §201.6. The LHMP also meets the requirements of Activity 510 – Floodplain Management Planning under the National Insurance Program Community Rating System. The current approved LHMP is adopted as an element of The County of Orange General Plan under Chapter IX – Safety Element as required under California Government Code §8685.9 and §65302.6. As a multi-jurisdiction plan, the LHMP focuses on mitigating all natural hazards impacting unincorporated areas of the County as well as County and Orange County Fire Authority owned facilities.

Two Jurisdictions, One Emergency Organization

The County of Orange and the Orange County Fire Authority have been party to a Multi-Jurisdiction Hazard Mitigation Plan for the last ten years. Both the 2010 and 2015 Plans were developed, approved, and adopted by both jurisdictions as a baseline for ongoing countywide hazard mitigation efforts.

The Orange County Fire Authority was once a County department (as the Orange County Fire Department), but since 1995 has operated as a separate independent jurisdiction. However, OCFA has continued to provide fire and EMS services to the county unincorporated areas by contract with the County of Orange. Furthermore, CAL FIRE also contracts with OCFA to protect Orange County's SRA lands,

which include two State Parks, plus portions of the Trabuco Ranger District of the Cleveland National Forest.

Because of the unique relationship between the two jurisdictions, OCFA has been comprehensively integrated into the County's emergency organization. OCFA sits on the County's disaster council (Emergency Management Council), the Orange County Operational Area Executive Board, and assumes the lead decision-making role (Director of Emergency Services/Operational Area Coordinator) at the County's Emergency Operations Center when responding to certain hazards.

Hazard Mitigation Planning During a Pandemic

As the County of Orange and the Orange County Fire Authority were preparing to launch the initial planning meetings for the 2020 LHMP Update in early 2020, the world was also beginning to grapple with the impacts of what would become the COVID-19 pandemic. The first meetings were postponed in March 2020 following the issuance of local and state social distancing directives. Furthermore, the activation of Orange County's Emergency Operations Center committed staff from most County agencies for the initial response period, including key staff from the Orange County Sheriff's Department Emergency Management Division, the Orange County Fire Authority, and a number of other County agencies.

As the County Emergency Operations Center remained active through the summer and winter surges in COVID-19 cases, the County also responded to periods of civil unrest in the late spring and an unprecedented series of wildland fires in the fall of 2020 – two of which threatened the County Emergency Operations Center itself. Concurrent to the severe surge in COVID-19 cases in December 2020 and January 2021, the County also executed an all-hands operation to launch vaccination sites to facilitate the distribution of COVID-19 vaccines which is ongoing at the time of LHMP finalization.

Despite these challenges, the planning team was able to leverage a variety of technologies to continue the work of the LHMP Update, scheduling virtual meetings and exchanging digital documents. Harder to recreate was the in-person engagement with public stakeholders, but with careful consideration of Orange County's diverse community, the planning team was able to execute a strategy focused on digital engagement through the internet and social media in multiple languages.

2020 Plan Updates

First approved in 2004, the LHMP was previously updated in 2010 and in 2015 in line with the five-year hazard mitigation planning cycle. Building on the progress made during the 2015 LHMP update, the County of Orange incorporated preparations for the 2020 LHMP revision process into its comprehensive planning and preparedness efforts in the last five years:

Hazard Ranking and Analysis

As an action item coming out of the 2015 LHMP update, the Emergency Management Division embarked on a process to revise the hazard analysis and ranking methodology used for the LHMP and County of Orange and Orange County Operational Area Unified Emergency Operations Plan (County/OA EOP). The developed workflow was implemented in the 2019 County/OA EOP and has been implemented in this update of the 2020 LHMP. This enhancement contributes to a more consistent and cohesive approach across Orange County's plan documents.

GIS Capability Augmentation

Building on the quantitative exposure analysis commissioned for the 2015 LHMP update, the Emergency Management Division has put considerable effort into enhancing the use of GIS technology for hazard-specific planning and analysis. This has been a joint effort in coordination with the County's GIS team based out of OC Public Works. This effort has culminated in the development of the more comprehensive Risk and Vulnerability Assessment in Chapter 3.

Mitigation Action Updates to Aid in Community Rating System (CRS) Annual Recertification

As this LHMP also serves as the County's Floodplain Management Plan, OC Public Works provides updates on Mitigation Actions in the LHMP as a component of the Community Rating System (CRS) annual recertification.

Plan Development

Requirement §201.6(c)(1): *[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

In order to develop a comprehensive LHMP it was necessary to enlist participation from County agencies as well as the Fire Authority. This LHMP was developed through the work of the Orange County Hazard Mitigation Working Group (HMWG), the County Emergency Management Council, and the County Emergency Management Council Subcommittee. During the development phase of the 2020 LHMP update, the HMWG consisted of representatives from the following agencies, departments, and jurisdictions:

Orange County Fire Authority	
Phil Johnson	Assistant Chief, Field Operations
Lori Smith	Fire Marshal
County of Orange	
Sheriff's Department, Emergency Management Division	
Michelle Anderson	Director, Emergency Management Division
Donna Boston	Director, Emergency Management Division (Retired January 2021)
Randy Harper	Assistant Emergency Manager
Ethan Brown	Senior Emergency Management Program Coordinator
OC Sheriff's Department	
Peter Jimenez	Emergency Communications Coordinator, Emergency Communications Unit
Steve Hilleshiem	Research and Development (R&D)-Facilities Planning
OC Public Works	
Kevin Onuma, P.E	Chief Engineer
Nardy Khan, P.E	Manager, OC Infrastructure Programs
Penny Lew, P.E., CFM	Senior Civil Engineer, Flood Programs/Floodplain Management & Hydrology Section
Joyce Chen	Civil Engineering Assistant, Flood Programs/Floodplain Management & Hydrology Section
Joanna Chang	Land Use Manager, OC Development Services
Steven Giang	Associate Planner, OC Development Services
Richard Vuong	Planning Division Manager, OC Development Services

Trevor Richardson	Assistant Emergency Manager
Jeffrey Stiles	GIS Specialist, OC Survey
Health Care Agency	
Tammi McConnell	EMS Director, Medical/Health Operational Area Coordinator
Clerk of the Board	
Ronald Galang	Manager, Purchasing
Valerie Sanchez	Chief Deputy Clerk of the Board of Supervisors
County Counsel	
Anthony Lievanos	Staff Specialist
Jason Brown	Director of Administration
County Executive Office	
Jessica Witt	Director, Government & Community Relations
Molly Nichelson	Public Information Manager
AnnaSophia Servin	Public Information Officer
Orange County Community Resources	
Sabrina Hassan	Safety Manager
OC Animal Care	
Stefani Waterman	Program Supervisor II, Animal Shelter
OC Parks	
Chris Lorenzi	Operations Manager, Operations Support Group
OC Waste & Recycling	
Hugo Pineda	Capital Improvement Project & Planning Manager
Jordan Young	Safety Culture Manager

The HMWG was responsible for leading the LHMP update process. During the revision, members reviewed and updated the County's mitigation strategy, evaluated changes to the threat landscape, updated disaster histories to reflect recent incidents, analyzed impacts to unincorporated areas and County owned infrastructure, and updated and reprioritized mitigation action items. The County of Orange held responsibility for evaluating the majority of the hazards while the Orange County Fire Authority was responsible for evaluating fire threats, history, and mitigation action items across its service area. Both jurisdictions provided data on critical infrastructure to assist in evaluating risk.

Requirement §201.6(b)(2): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process* ***shall*** *include:*

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process

In addition to the work done by the HMWG, additional agencies, jurisdictions, and organizations were provided an opportunity to provide comments, input, and feedback on the LHMP. Entities who were invited to participate include:

County of Orange

- Assessor
- Auditor-Controller
- Board of Supervisors
- Child Support Services
- Clerk of the Board
- Clerk-Recorder
- County Counsel
- County Executive Office
- District Attorney
- Health Care Agency
- Human Resources
- John Wayne Airport
- OC Community Resources (OCCR)
    - OCCR – Animal Care Services
    - OCCR – OC Parks
- OC Public Works
- OC Waste & Recycling
- Orange County Sheriff's Department (OCSD)
- OCSD – Communications
- Orange County Fire Authority
- Probation
- Public Defender
- Registrar of Voters
- Social Services Agency
- Superior Courts of California, County of Orange
- Treasurer-Tax Collector

In addition to County agencies represented through the Emergency Management Council and the Emergency Management Council Subcommittee, feedback on the LHMP was solicited from the Orange County Emergency Management Organization (OCEMO). The group received a briefing on the LHMP Update process in April 2021. The draft LHMP was then distributed to the group for their review. Feedback and comments were collected in a structured worksheet and reviewed by the planning team for inclusion in the document, where appropriate. In addition, many other public and private sector partners, including surrounding counties and communities, were invited to provide feedback via maintained partner distribution lists during the OCEMO outreach campaign. See feedback invites in Attachment A for more information.

OCEMO is a standing subcommittee of the Orange County Operational Area Executive Board, tasked with developing and reviewing plans across the County to ensure consistency. Membership in the organization consists of representatives from each of the County's 34 cities along with members from special districts, school districts, and affiliated non-governmental organizations. OCEMO meetings are also often attended by interested members of the public. OCEMO member agencies include:

Plan Participants

- County of Orange
- Orange County Fire Authority

Cities

- Aliso Viejo
- Anaheim
- Brea
- Buena Park
- Costa Mesa
- Cypress
- Dana Point
- Fountain Valley
- Fullerton
- Garden Grove
- Huntington Beach
- Irvine
- La Habra
- La Palma
- Laguna Beach
- Laguna Hills
- Laguna Niguel
- Laguna Woods
- Lake Forest
- Los Alamitos
- Mission Viejo

- Newport Beach
- Orange
- Placentia
- Rancho Santa Margarita
- San Clemente
- San Juan Capistrano
- Santa Ana
- Seal Beach
- Stanton
- Tustin
- Villa Park
- Westminster
- Yorba Linda

School Districts

- Anaheim City School District
- Anaheim Union H.S. District
- Brea-Olinda Unified School District
- Capistrano Unified School District
- Centralia School District
- Coast Community College District
- Cypress School District
- Fountain Valley School District
- Fullerton Joint Union High School District
- Fullerton School District
- Garden Grove Unified School District
- Huntington Beach School District
- Huntington Beach Union High School District
- Irvine Unified School District
- La Habra City School District
- Laguna Beach Unified School District
- Los Alamitos Unified School District
- Lowell Joint School District
- Magnolia School District
- Newport-Mesa Unified School District
- North Orange County Community College District
- Orange County Department of Education
- Ocean View School District
- Orange Unified School District
- Placentia-Yorba Linda Unified School District
- Rancho Santiago Community College District
- Saddleback Valley Unified School District
- Santa Ana Unified School District
- Savanna School District
- South Orange County Community College District
- Tustin Unified School District
- Westminster School District

Special Districts

- Buena Park Library District
- Capistrano Bay Community Services District
- Costa Mesa Sanitary District
- East Orange County Water District
- El Toro Water District
- Emerald Bay Community Services District
- Garden Grove Sanitary District
- Irvine Ranch Water District
- Laguna Beach County Water District
- Mesa Consolidated Water District
- Midway City Sanitary District
- Moulton Niguel Water District
- Municipal Water District of Orange County
- Orange County Transportation Authority
- Orange County Cemetery District
- Orange County Sanitation District
- Orange County Vector Control
- Orange County Water District
- Placentia Library District of Orange County
- Rossmoor Community Services District
- Santa Margarita Water District
- Serrano Water District
- South Coast Water District
- Sunset Beach Sanitary District
- Trabuco Canyon Water District
- Yorba Linda Water District

Disabilities and Access and Functional Needs Working Group

Members of the Orange County Disabilities, Access and Functional Needs Working Group were given an opportunity to review and comment on the LHMP. This working group is composed of people with disabilities, community organizations, emergency planners, and advocates. The group works to ensure that all Orange County Operational Area emergency planning documents address the needs of the whole community.

Plan Meetings

As a critical component of the planning process, a full schedule of meetings were held to facilitate a thorough review and update of the LHMP (see Attachment A for planning meeting documentation). Between meeting dates, HMWG members were responsible for obtaining data, reviewing, and updating content. Below are the meetings and their purpose:

Date	Location	Purpose
March 26, 2020	Santa Ana, CA	Working Group: Kickoff Meeting – CANCELLED DUE TO COVID-19
July 22, 2020	Virtual	Working Group: Rescheduled Kickoff and Task Schedules
August 26, 2020	Virtual	Working Group: Demographics, Community Profile, and Community Capabilities
September 23, 2020	Virtual	Working Group: Hazard Review, Profiles and Updates
October 28, 2020	Virtual	CANCELLED DUE TO SILVERADO AND BLUE RIDGE FIRES
December 2, 2020	Virtual	Working Group: Hazard Ranking, Quantitative Review and Mitigation Goals
January 27, 2021	Virtual	Working Group: Mitigation Actions, Benefit-Cost Review and Prioritization
February 10, 2021	Virtual	OA Executive Board-Emergency Management Council Plan Briefing
April 1, 2021	Virtual	Orange County Emergency Management Organization Plan Brief
May 5, 2020	Virtual	Working Group: Plan Review and Outstanding Items
May 12, 2021	Virtual	OA Executive Board /Emergency Management Council Plan Review
June 2021 (est.)	Remote	Plan Submission to Cal OES/FEMA
August 2021 (est.)	Santa Ana, CA/ Irvine, CA	Plan Adoption (Pending Approval)

Public Involvement and Review

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process* ***shall*** *include:*

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

Due to restrictions on public meetings and gatherings related to COVID-19, the County of Orange solicited structured feedback from Orange County residents and businesses during the drafting stage of the update. The online survey received 155 responses from Orange County residents. Survey-takers were asked a variety of questions, including which, if any, hazards had impacted them in the past, their level of concern on different hazards, their preparedness level, and their knowledge of hazards in their area. The complete text of the survey with responses is available in Attachment A.

Results of the survey included:

- Almost all respondents (or their families) had experienced a disaster, with approximately 73% impacted by earthquake and approximately 70% impacted by epidemic.
- By far, respondents ranked earthquake as the natural disaster that poses the greatest threat to their neighborhood, with wildland and urban fire and climate change a distant second and third, respectively. Nearly 45% of respondents ranked earthquake as the greatest natural threat.
- Less than 30% of respondents ranked themselves as prepared or very prepared for a disaster. Approximately 70% of respondents ranked themselves as somewhat prepared or not prepared at all.
- More than 80% of respondents reported getting emergency preparedness information from the internet.
- Approximately 16% of respondents reported carrying flood insurance, while approximately 43% of respondents reported carrying earthquake insurance.
- Approximately 86% of respondents were signed up for AlertOC or another emergency mass notification system.

These survey results were used to validate the hazard risk assessment as well as the prioritization of mitigation strategy goals and action items.

A draft of the 2020 LHMP was also posted for public review on the Orange County Sheriff's Department Emergency Management Division's website. To publicize the plan's review, messages were sent through the Emergency Management Division's social media accounts to more than 18,000 followers.

Most of the feedback received on the publicly advertised draft plan focused on the hazard ranking of epidemic/pandemic, both in this plan and the County's Emergency Operations Plan. Given the ongoing nature of the COVID-19 pandemic, the County will assess feedback related to this issue as part of a comprehensive assessment of the pandemic ranking before making adjustments to the hazard analysis in Chapter 3. This will occur as a component of the after action reporting that will follow the end of the County's COVID-19 response.

After closing the public comment period, a Hazard Mitigation page will be maintained on the Emergency Management Division website providing a resource for members of the public on the County's mitigation strategy, plan documents, and opportunities to provide feedback and comments for consideration during each annual plan review. For more information, see Chapter 5.

Related Documents and Resources

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process* ***shall*** *include:*

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

During the LHMP review, update, and development, several other documents were reviewed to ensure consistency in planning efforts. Information from these documents has been incorporated throughout this plan. Both the County/OA EOP and the Urban Area Security Initiative Threat and Hazard Identification and Risk Assessment include hazard analysis of threats impacting the County. Reviewing the various methodologies used in these plans compared to the methodology in the LHMP was useful in evaluating

the risk and impact associated with each hazard included. Other plans and documents provided base level data either for statistical purposes or based on scientific research surrounding potential hazard impacts in the County. Finally, State and Local Hazard Mitigation Plans were reviewed to evaluate format and content. Many documents reviewed are also referenced in Chapter 6: Local Capability Assessment. Key documents, reports, and studies reviewed included:

- County of Orange and Orange County Operational Area Unified Emergency Operations Plan, 2019
- County of Orange General Plan, 2005
- County of Orange Comprehensive Annual Financial Report, 2020
- Orange County Essential Facilities Risk Assessment Project Report, 2009
- Anaheim/Santa Ana UASI THIRA, 2019
- California Adaptation Planning Guide, 2020
- California Multi-Hazard Mitigation Plan, 2018
- Integrating Disaster Data into Hazard Mitigation Planning, 2015
- Local Mitigation Plan Review Guide, 2011
- Local Mitigation Planning Handbook, 2013
- Mitigation Planning and the Community Rating System Key Topics Bulletin, 2018
- National Flood Insurance Program Community Rating System Coordinator's Manual, 2017 (with 2021 addendum)
- Overview of the ARkStorm Scenario (USGS Open File Report 210-1312), 2010
- Plan Integration: Linking Local Planning Efforts, 2015
- Southern California Catastrophic Earthquake Response Plan, 2010
- The ShakeOut Scenario (USGS Open File Report 2008-1150), 2008

Chapter 2 Community Profile

Orange County Overview

The County of Orange incorporated in 1889 from territory previously in Los Angeles County. Initially an agricultural community, Orange County industry in the early 20th century increasingly centered around oil extraction. During this era, Orange County tourism industry began to grow, benefited by proximity to the more populated Los Angeles region. World War II and the economic boom that followed brought new people and industry and by the 1980s, Orange County had a population of more than 2 million people. In the last forty years, Orange County has grown to be the sixth largest county in the United States and has almost completely developed what was once largely an agrarian area.

The County of Orange is comprised of 34 cities, with the largest being the City of Anaheim with a population of over 330,000 and the smallest being the City of Villa Park with under 6,000 residents (see Map 1). Many smaller cities contract for some services from County departments or the Orange County Fire Authority, with 13 cities receiving police services from the Orange County Sheriff's Department and 23 cities contracting for services from the Orange County Fire Authority. In addition, the County government provides services to many unincorporated communities. These communities include rural residential areas in the eastern foothills of the Santa Ana Mountains (including Orange Park Acres, Cowan/Lemon Heights, and Santiago, Silverado, Modjeska and Trabuco Canyons), unincorporated islands in the County's urban areas (such as Midway City, Rossmoor and El Modena), and planned communities in southern Orange County (such as Coto de Caza, Ladera Ranch, Las Flores, Wagon Wheel and Rancho Mission Viejo).

Orange County Fire Authority Overview

Prior to 1980, the California Department of Forestry provided fire services to the several cities and the unincorporated areas of Orange County. Between 1980 and 1995, fire services in the County were provided by the Orange County Fire Department, a County agency. In 1995, the Orange County Fire Authority (OCFA), a Joint Powers Authority, formed in coordination with the County of Orange and many Orange County cities.

The OCFA is a regional fire service agency that serves 23 cities in Orange County and all unincorporated areas. It provides emergency response to all fires, medical aids, rescues, hazardous materials incidents, wildland fires, aircraft fire and rescue services to John Wayne Airport, and other miscellaneous emergencies. It protects nearly 2 million residents from its 77 fire stations located throughout the County, with a coverage area of almost 600 square miles (see Map 2). In 2020, the OCFA responded to nearly 150,000 incidents, including almost 7,500 incidents in the County unincorporated areas.

Geography and the Environment

Orange County has an area of 948 square miles, of which 791 square miles is land and 157 square miles is water (including coastal waters). It is located in the southwestern portion of California and is bordered by Los Angeles County to the north, San Diego County to the south, Riverside and San Bernardino Counties to the east and the Pacific Ocean to the west. Orange County has 42 miles of coastline and three harbors. Thirty-four incorporated cities in the County are responsible for hazard mitigation planning within their

jurisdictions. The County is responsible for hazard mitigation planning in the approximately 276 square miles of unincorporated area and all County owned facilities and properties.

The geography of Orange County is dominated by three major features: the vast coastal plain of the Los Angeles basin in the north and west, the Santa Ana Mountains and foothills in the south and east, and the coastline of the Pacific Ocean to the southwest. Elevations in the County are as high as 5,689 feet at Santiago Peak down to sea level.

Land Use and Changes in Development and Vulnerability

Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Requirement §201.6(d)(3)): *A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.*

Unincorporated Orange County consists of 176,385 acres. According to the County's current Zoning Map, the County of Orange's residential areas comprise of approximately 23% of the County's total land area (see Map 3). Commercial, industrial, and public institutional uses account for three percent of the County's land area and land dedicated to open space and recreation constitute up to forty-six percent of the county. The County maintains approximately 81,733 acres of parkland, open space and shoreline, which includes the local parks and open space maintained by state and federal agencies.

Housing growth in unincorporated Orange County includes both infill within existing neighborhoods and new construction on vacant land. Since 2014, infill has consisted of construction of second units within residential areas and multi-unit developments on commercially zoned land. This has occurred mainly in the northern and central portions of the county. The southern and southeastern portions of the County typically see growth in the form of detached single-family housing.

New development in the County unincorporated area is most often new residential construction on the eastern perimeter of the urban area up against the foothills of the Santa Ana Mountains or the Chino Hills. The principal hazard for new foothill development will continue to be wildland fire and cascading hazards like landslide and debris flow. While this new construction tends to be hardened against wildfire, the threat remains given their location in the wildland urban interface.

All development occurring since the adoption of the 2015 LHMP was constructed in accordance with all local, state and federal land use, building and fire codes as well as zoning and environmental requirements. Due to these strict requirements and their enforcement over the past 5 years, the HMWG indicates no changes to the community's vulnerability to the natural hazards described in the 2020 LHMP. Planned and future development will be subject to these same requirements and reviews to minimize exposure of populations and structures.

Since 2014, the County has issued 4,565 units of housing within the unincorporated area. These projects also represent the key development projects in the Orange County Fire Authority's service area. Major projects include:

Rancho Mission Viejo Planned Community

Housing construction is now beginning on vacant undeveloped land in the southern and eastern parts of the county. Over the last several years, construction on the 14,000 unit Rancho Mission Viejo Planned Community (RMV PC) in unincorporated Orange County has resulted in over three thousand units completed and construction is ongoing. 15,121 acres will remain as a permanent protected open space preserve. The RMV PC follows the countywide trend toward higher density single family housing and more attached/multi-unit structures. Since the grand opening of PA1 in 2013, the master developer (RMV) and neighborhood builders have completed and sold/rented 1,247 housing units in Sendero PA1, of which 286 are deed-restricted senior housing (Age Qualified) units. In addition, 107 senior affordable apartments have been leased. Since the grand opening of PA2 in 2015 and through the end of 2019, the master developer (RMV) and neighborhood builders have obtained building permits for 2,507 market rate units in Esencia PA2, and occupancy permits (closings) for 2,475 market rate units, of which 830 have been deed-restricted senior housing (Age Qualified) units. In addition, a 112-unit affordable family apartment project has been leased.

Saddle Crest

The 65-unit Saddle Crest development east of Santiago Canyon Road are in various planning approval/pre-construction stages. Construction within these single-family home developments will likely begin within the 2020-2025 planning period.

Esperanza Hills

On June 2, 2015, the Board of Supervisors adopted the Esperanza Hills Specific (Specific Plan) located in north Orange County within the sphere of influence of the City of Yorba Linda. The Specific Plan will allow a maximum of 340 single family residences on approximately 469 acres. The project is designed to cluster residential development to maximize preservation of natural open space areas including all major ridgelines bordering Chino Hills State Park. The Specific Plan will provide over 12 acres of parks, more than 35,000 feet of trails, and over 120 acres of landscaped slopes. The Specific Plan will be developed in two phases and is anticipated to be built-out by 2030.

Potter's Lane

In August 2016, the County issued permits for Potter's Lane, a 16-unit affordable housing development located in Midway City. The development will restrict 15 studio units and include one unrestricted manager's unit. Restricted units will serve homeless veterans. The development was completed on February 27, 2017.

Cielo Vista

On December 13, 2016, the Board approved the Cielo Vista project, which will add 80 single-family homes in North Orange County. The County of Orange is currently reviewing the building permits.

The Retreat

On December 13, 2016, the Board approved "The Retreat", an 88-unit senior housing residential development located in Midway City. Completion is scheduled to occur within the next few years.

Population and Demographics

As of January 2020, the California Department of Finance estimates Orange County's population as 3,194,332, an increase of over 80,000 residents since 2015. Of those, about 128,421 live in the unincorporated areas of the County, an increase of nearly 7,000 residents since 2015.[1]

The latest data depicts a diverse community, as shown in Table 1 below.

☐ **Table 1 – Orange County Population By Race**

Percentage of Total Orange County Population	
Non-Hispanic White	44.1%
Hispanic of any race	33.7%
Non-Hispanic Asian	17.7%
Non-Hispanic Black	1.5%
All Other Non-Hispanic Races	3.1%

Source: CSU Fullerton Center for Demographic Research 2019 Orange County Progress Report

46.6% of Orange County residents (over age 5) speak a language other than English at home, 18.7% speak English less than "very well" and 29.7% were born outside of the United States.[2] Widely spoken languages other than English spoken in Orange County households included Spanish, Vietnamese, Korean, Chinese, Tagalog, Persian, Arabic and Japanese.[3]

In 2014, the U.S. Census Bureau estimated that 8.6% of the noninstitutionalized population in Orange County was living with a disability. This percentage increases among the older population, with nearly 31% of the population 65 and older having some type of disability.

☐ **Table 2 – Orange County Disability Demographics**

	Under 18	**18-64**	**65 +**
Population	**688,989**	**1,990,355**	**478,660**

[1] E-1 Current Population Estimates - California Department of Finance. Retrieved September 16, 2020, from http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php

[2] American Community Survey - SDC - Demographic Research - California Department of Finance. Retrieved September 16, 2020, from http://www.dof.ca.gov/research/demographic/state_census_data_center/american_community_survey/

[3] Languages Other Than English Spoken at Home (Orange County, 2012). Retrieved September 16, 2020, from http://cpehn.org/chart/languages-other-english-spoken-home-orange-county-2012

Disability	Count	Rate	Count	Rate	Count	Rate
Hearing Difficulty 77,725	5,728	0.8%	21,976	1.1%	49,991	10.4%
Vision Difficulty 43,877	4,878	0.7%	18,265	0.9%	20,734	4.3%
Cognitive Difficulty 101.608	15,656	3.1%	49,279	2.5%	36,673	7.7%
Ambulatory Difficulty 138,675	4,441	0.9%	45751	2.3%	88,483	18.5%
Self-Care Difficulty 65,085	6,893	1.4%	20,570	1.0%	37,622	7.9%
Independent Living Difficulty 107,321	-	-	41,251	2.1%	66,070	13.8%

Source: U.S. Census Bureau, Disability Characteristics, 2019 American Community Survey 1-Year Estimates

Employment and Industry

Due to the ongoing COVID-19 pandemic and associated protective measures, Orange County has seen wide swings in key economic and employment data. As the local, national and global economies continue to weather these impacts, the metrics in this section will continue to fluctuate. Recovery in the post-COVID-19 economy is anticipated to be sluggish and protracted.

As of June 2020, roughly 50% of the Orange County workforce was employed in service industries (including Information, Professional and Business Services, Educational and Health Services, Leisure and Hospitality, and Other Services). Approximately 10% of the workforce was employed by the manufacturing sector and 10% were employed in the retail trades. The top employers in Orange County were the Walt Disney Company, The University of California - Irvine, the County of Orange, St. Joseph's Health, and Kaiser Permanente.[4]

As of December 2020, the unemployment rate in Orange County was 7.4%.[5]

In 2019, Orange County hosted 50 million visitors.[6]

78.2% of the workforce commutes alone, 9.4% carpool and 1.9% use public transportation.[7] The high mobility of employees commuting from surrounding areas to industrial and business centers creates a greater dependency on roads, communications, accessibility and emergency plans.

[4] County of Orange Comprehensive Annual Financial Report - Principal Employers (2020). Retrieved September 20, 2020 from https://ac.ocgov.com/wp-content/uploads/2020/12/FY-19-20-CAFR.pdf

[5] Labor Market Information. Retrieved January 20, 2021, from http://www.labormarketinfo.edd.ca.gov/

[6] Orange County Business Council. (2020). OC Community Indicators: 2020. Retrieved March 10, 2021, from https://www.ocbc.org/wp-content/uploads/2020/09/2020-Community-Indicators-Report.pdf

[7] Orange County Business Council. (2020). OC Community Indicators: 2020. Retrieved March 10, 2021, from https://www.ocbc.org/wp-content/uploads/2020/09/2020-Community-Indicators-Report.pdf

History of Disasters

Since 1953, Orange County has received 37 federal disaster proclamations including 25 Presidential Disaster Declarations, 3 Presidential Emergency Proclamations, and 9 Fire Management Assistance declarations (shown in the table below). While the greatest recurring threat is flood and wildfire, the risk of catastrophic earthquake is ever-present.

Since the LHMP was last revised in 2015, the County of Orange has received four federal disaster declarations, including for flooding and damage from a major winter storm in January 2017, the Canyon II Fire in October 2017, the Holy Fire in 2018, and the ongoing COVID-19 pandemic in 2020. In the fall of 2020, Fire Management Assistance Grants (FMAGs) were approved for the Silverado and Bond Fires in the County's rural unincorporated areas and the Blue Ridge Fire near Yorba Linda and Chino Hills State Park.

Federal Disaster Declarations for Orange County			
Disaster Number	**(Fiscal) Year**	**Incident Type**	**Incident Title**
FM-5383	2021	Fire	BOND FIRE
FM-5381	2021	Fire	BLUE RIDGE FIRE
FM-5380	2021	Fire	SILVERADO FIRE
DR-4482	2020	Biological	COVID-19 PANDEMIC
FM-5268	2018	Fire	WILDFIRES (HOLY FIRE)
DR-4344	2018	Fire	CANYON 2 FIRE
FM-5213	2017	Fire	CANYON FIRE
DR-4305	2017	Flood	SEVERE WINTER STORMS, FLOODING, AND MUDSLIDES
DR-1952	2011	Flood	SEVERE WINTER STORMS, FLOODING, AND DEBRIS AND MUD FLOWS
FM-2792	2008	Fire	FREEWAY FIRE COMPLEX
DR-1810	2008	Fire	WILDFIRES
FM-2737	2007	Fire	SANTIAGO FIRE
FM-2683	2007	Fire	241 FIRE
EM-3279	2007	Fire	WILDFIRES
DR-1731	2007	Fire	WILDFIRES, FLOODING, MUD FLOWS, AND DEBRIS FLOWS
FM-2630	2006	Fire	SIERRA FIRE
DR-1585	2005	Severe Storm	SEVERE STORMS, FLOODING, LANDSLIDES, AND MUD AND DEBRIS FLOWS
EM-3248	2005	Hurricane	HURRICANE KATRINA EVACUATION
DR-1577	2005	Severe Storm	SEVERE STORMS, FLOODING, DEBRIS FLOWS, AND MUDSLIDES
FM-2405	2002	Fire	ANTONIO FIRE
DR-1203	1998	Severe Storm	SEVERE WINTER STORMS AND FLOODING
EM-3120	1996	Fire	SEVERE FIRESTORMS
DR-1046	1995	Severe Storm	SEVERE WINTER STORMS, FLOODING LANDSLIDES, MUD FLOW
DR-1044	1995	Severe Storm	SEVERE WINTER STORMS, FLOODING, LANDSLIDES, MUD FLOWS
DR-1008	1994	Earthquake	NORTHRIDGE EARTHQUAKE
DR-1005	1993	Fire	FIRES, MUD/LANDSLIDES, FLOODING, SOIL EROSION
DR-979	1993	Flood	SEVERE WINTER STORM, MUD & LAND SLIDES, & FLOODING
DR-935	1992	Flood	RAIN/SNOW/WIND STORMS, FLOODING, MUDSLIDES
DR-812	1988	Flood	SEVERE STORMS, HIGH TIDES & FLOODING
DR-799	1987	Earthquake	EARTHQUAKE & AFTERSHOCKS
DR-677	1983	Coastal Storm	COASTAL STORMS, FLOODS, SLIDES & TORNADOES
DR-657	1982	Fire	URBAN FIRE
DR-635	1980	Fire	BRUSH & TIMBER FIRES
DR-615	1980	Flood	SEVERE STORMS, MUDSLIDES & FLOODING
DR-547	1978	Flood	COASTAL STORMS, MUDSLIDES & FLOODING
DR-566	1978	Flood	LANDSLIDES
DR-253	1969	Flood	SEVERE STORMS & FLOODING

Chapter 3 Risk and Vulnerability Assessment

Overview of the Risk Assessment Process

A risk assessment provides information on the location of hazards, the value of existing infrastructure in hazard locations, and an analysis of risk to life, property, and the environment resulting from a natural hazard event. For the 2020 LHMP, the County of Orange used the Risk Assessment method described below:

1) Hazard Identification

Through an established hazard analysis process, the County of Orange regularly identifies its major hazards during the revision of the County/OA EOP. The process used the best available data to balance historical occurrence, future probability and potential impact.

2) Hazard Profiling

This process describes the cause and characteristic of each hazard, the effect on the County in the past, and the historical vulnerability specific to Orange County's population, infrastructure, and environment. Each hazard section provides a profile for the hazards discussed in this LHMP.

3) Identification of Community Assets and Critical Infrastructure

This is a combination of hazard identification with an inventory of the existing (or planned) property development(s) owned by Orange County. Critical facilities are of particular concern. These entities provide essential products and services to the public, preserving the welfare and quality of life in the County and fulfill important public safety, emergency response, and/or disaster recovery functions.

4) Vulnerability Assessment

Estimating potential losses involves assessing the likely damage, injuries, and financial cost sustained in a geographic area over a given period. This analysis involves mathematical models with two measurable components of risk analysis: magnitude of the harm that may result expressed in monetary terms and the likelihood of the harm occurring. Describing vulnerability in terms of dollar loss provides the community and the state with a common framework to measure the effects of hazards on assets. At this time, quantitative estimates on losses have been calculated on flood, wildland fire, earthquake, dam failure, landslide, and tsunami hazards, and are available in the Quantitative Exposure Analysis section at the end of this chapter. The remaining hazards (drought, climate change, epidemic) lack an easily definable spatial extent or are compounding factors for other hazards. In these situations, a vulnerability assessment is qualitative in nature and included in the appropriate hazard profile.

Hazard assessments are subject to the availability of hazard-specific data. Each hazard-specific section of the LHMP includes a section on hazard identification using data and information from the County or State agency sources.

Using the data available for hazard assessments, the County has numerous strategies available for reducing risk (described in Action Items, Chapter 4). Mitigation strategies further reduce disruption of critical services, risk to human life, and damage to personal and public property, and infrastructure. Action items throughout the hazard sections provide recommendations to improve data collection, hazard

mapping and hazard assessments.

Hazard Identification

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction.*

A hazard analysis has indicated that the County of Orange is at risk from numerous hazards associated with natural disasters and technological incidents. Many of the hazards that exist in or adjacent to Orange County have the potential for causing disasters exceeding any one jurisdiction's capabilities to successfully respond, making centralized command and control and the support of the County and its department's essential functions. The County will review and update the hazard analysis in conjunction with the review of the County/OA EOP. The hazard analysis in Figure 1 below was last approved in 2019.

The following criteria were used to establish each potential hazard rating, based upon historical and recent events to validate frequency and impacts:

Probability

- Likely: There may or may not have been historic occurrences of the hazard in the community or region but experts feel that it is likely that the hazard will occur in the community. Between 10% and 100% annual probability.
- Possible: There may or may not have been a historic occurrence of the hazard in the community or region but experts feel that it is possible that the hazard could occur in the community. Less than 10% annual probability.
- Unlikely: There have been no historic occurrences of the hazard in the community or region and experts agree it is highly unlikely that the hazard will occur in the community. Less than 1% annual probability.

Impact

- High: Catastrophic/Critical. The consequences will be significant in terms of building damage and loss of life.
- Moderate: Limited. Consequences are thought to be modest in terms of building damage and loss of life, limited either in geographic extent or magnitude.
- Low: Negligible. Little building damage and trivial impact to infrastructure and critical facilities.

Impact and Extent	Likely	Possible	Unlikely
High	• Civil Unrest • Earthquake • Misinformation	• Economic Collapse • Large Special Events • Product Contamination	• Act of War • Flood/Levee/Reservoir Failure • Pandemic/High Consequence Disease • SONGS • Terrorism
Moderate	• Aircraft Accident • Sea Level Rise • Wildland and Urban Fire • Excessive Temperature • Flood/Storm	• Drought • Rail Accident • Oil Spill	• Tsunami
Low	• Disease Outbreak • Hazardous Materials Release • High Winds	• Utility Failure • Landslide/Mudslide/Debris Flow • Vector-Borne Disease	

Probability of Occurrence

☐ **Table 3 -- 2019 Unified County and OA EOP Hazard Matrix**

All hazards in Table 3 are profiled briefly in the County/OA EOP. Many hazards also have supporting planning documents:

- Information regarding the County's planning for instances of civil unrest is included in the Orange County Sheriff's Department Policy Manual.
- Information regarding the County and Operational Area planning for flooding and dam and reservoir failure is included in the Flood, Dam and Reservoir Annex to the Unified EOP.
- Information regarding the County and Operational Area planning for epidemics and disease outbreaks is included in the Disease Outbreak Response Annex to the Unified EOP.
- Information regarding the County and Operational Area planning related to the San Onofre Nuclear Generating Station (SONGS) is included in the SONGS EOP and supporting documents.
- Information regarding the County and Operational Area planning related to the terrorism is included in the Terrorism Annex to the Unified EOP.
- Information regarding the County and Operational Area's planning related to the aviation accidents is included in the Aviation Accident Annex to the Unified EOP.
- Information regarding the County and Operational Area planning related to the extreme heat and cold events is included in the Extreme Temperature Annex to the Unified EOP.

- Information regarding the County and Operational Area planning related to the tsunami is included in the Tsunami Annex to the Unified EOP.
- Information regarding the County and Operational Area planning related to utility failure is included in the Power Outage Annex to the Unified EOP.

The HMWG, including representatives from OCFA, reviewed the results of the 2019 Hazard Assessment, along with the Risk Assessment in the 2015 LHMP, and developed the following list of natural hazards for inclusion in the 2020 LHMP:

- Earthquake
- Flood/Storm
- Wildland/Urban Fire
- Climate Change
- Dam/Levee/Reservoir Failure
- Epidemic
- Drought
- Tsunami
- Landslide/Mudslide/Debris Flow

During the meeting where the list above was approved by the HMWG, information from the 2019 EOP Hazard Analysis was used to create a summarized vulnerability assessment to provide an at-a-glance view of the relative risks posed by the County's top natural hazards. The HMWG then reviewed and approved the chart below as a conceptual summary of their updated assessment of the natural hazards that face Orange County.

Later in the planning process, the HMWG came to a consensus on using the Table 4 below as the main summary table of the relative risk posed by Orange County's major natural hazards. This table was also recognized as accurate assessment of the hazards in the Orange County Fire Authority's service area.

		Probability of Occurrence		
		Likely	**Possible**	**Unlikely**
Impact and Extent	**High**	• Earthquake		• Dam/Levee/Reservoir Failure • Epidemic
	Moderate	• Flood/Storm • Wildland and Urban Fire • Climate Change	• Drought	• Tsunami
	Low		• Landslide/Mudslide/Debris Flow	

☐ **Table 4 -- 2020 LHMP Hazard Matrix**[8]

[8] Differing hazard naming is a result of differing planning timelines for the various hazard documents maintained by the County of Orange. These discrepancies are to be eliminated with the 2021 Unified EOP revision.

Other natural hazards, such as high wind, extreme temperatures and tornado are not specifically described or assessed in this document as the related impacts to the County's unincorporated areas are minimal compared to the major hazards.

Profile of Hazard Events

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.*

The following information details each of the nine natural hazards addressed in the LHMP, their effect on Orange County in the past, and the portion of the County's population, infrastructure, and environment that has been historically vulnerable to each specific hazard, based on available data.

3.1 Earthquake

Nature of Hazard

An earthquake is the sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge of the earth's tectonic plates, a volcanic eruption, or by a manmade explosion. Most earthquakes occur at the boundaries where the earth's tectonic plates meet (faults); less than 10% of earthquakes occur within plate interiors.

According to the United States Geological Society (USGS) Earthquake Hazards Program, an earthquake hazard is any disruption associated with an earthquake that may affect residents' normal activities. This includes surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, tsunami, and seiches. Ground shaking is the primary cause of earthquake damage to man-made structures.

Seismic waves are the vibrations from earthquakes that travel through the earth. These waves are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a measured value of the earthquake size, or amplitude of the seismic waves, using a seismograph. The Richter magnitude scale (Richter scale) was developed in 1932 as a mathematical device to compare the sizes of earthquakes. The Richter scale is the most widely known scale that measures the magnitude of earthquakes. It is not used to express damage. An earthquake in a densely populated area, which results in many deaths and considerable damage, may have the same magnitude as an earthquake in a remote area that did not experience any damage. For this reason, the use of intensity scales, such as the Modified Mercalli Scale, are used to measure and describe the level of shaking at a particular location

Location and Extent

Large faults that could affect Orange County include the San Andreas Fault, the Newport-Inglewood Fault, the Whittier Fault, the Elsinore Fault, and the San Jacinto Fault. Smaller faults include the Norwalk Fault, and the El Modena and Peralta Hills Faults. In addition, newly studied thrust faults, such as the San Joaquin Hills Fault and the Puente Hills Fault could also have a significant impact on the County. Each of the major fault systems are described briefly below. Map 4 shows the major fault systems in or immediately adjacent to Orange County.

San Andreas Fault Zone: The dominant active fault in California, it is the main element of the boundary between the Pacific and North American tectonic plates. The longest and most publicized fault in California, it extends from Cape Mendocino in northern California to east of San Bernardino in southern California, and is approximately 35 miles northeast of Orange County. This fault was the source of the 1906 San Francisco earthquake, which resulted in some 700 deaths and millions of dollars in damage. It is the southern section of this fault that is currently of greatest concern to the scientific community. Geologists can demonstrate that at least eight major earthquakes (Richter magnitude 7.0 and larger) have occurred along the Southern San Andreas Fault in the past 1200 years with an average spacing in time of 140 years, plus or minus 30 years. The last such event on the Southern San Andreas occurred in 1857 (the Fort Tejon earthquake). A new California earthquake study by the US Geological Survey (USGS), California Geological Survey (CGS), and the Southern California Earthquake Center (SCEC) estimates for the

likelihood that California will experience a magnitude 8 or larger earthquake in the next 30 years has increased from about 4.7% to about 7%.[9]

Newport-Inglewood Fault Zone: Extends from the Santa Monica Mountains southeastward through the western part of Orange County to the offshore area near Newport Beach and was the source of the destructive 1933 Long Beach earthquake (magnitude 6.4), which caused 120 deaths and considerable property damage. During the past 60 years, numerous other shocks ranging from magnitude 3.0 to 5+ have been recorded. SCEC reports probable earthquake magnitudes for the Newport-Inglewood fault to be in the range of 6.0 to 7.4.[10]

Elsinore Fault Zone: Located in the northeast part of the county, this fault follows a general line east of the Santa Ana Mountains into Mexico. The main trace of the Elsinore Fault zone is about 112 miles long. The last major earthquake on this fault occurred in 1910 (magnitude 6.0), and the interval between major ruptures is estimated to be about 250 years. SCEC reports probable earthquake magnitudes for the main trace of the Elsinore fault to be in the range of 6.5 to 7.5.[11] At the northern end of the Elsinore Fault zone, the fault splits into two segments: the 25 mile long Whittier Fault (probable magnitudes between 6.0 and 7.2[12]), and the 25 mile long Chino Fault (probable magnitudes between 6.0 and 7.0[13]).

San Jacinto Fault Zone: Located approximately 30 miles north and east of the county. The interval between ruptures on this 130 mile long fault zone has been estimated by SCEC to be between 100 and 300 years, per segment. The most recent event (1968, magnitude 6.5) occurred on the southern half of the Coyote Creek segment. SCEC reports probable earthquake magnitudes for the San Jacinto fault zone to be in the range of 6.5 to 7.5.[14]

San Joaquin Hills Fault: A recently discovered southwest-dipping blind thrust fault originating near the southern end of the Newport-Inglewood Fault close to Huntington Beach, at the western margins of the San Joaquin Hills. Rupture of the entire area of this blind thrust fault could generate an earthquake as large as magnitude 7.3. In addition, a minimum average recurrence interval of between about 1650 and 3100 years has been estimated for moderate-sized earthquakes on this fault (Grant and others, 1999)[15].

Puente Hills Thrust Fault: This is another recently discovered blind thrust fault that runs from northern Orange County to downtown Los Angeles. This fault is now known to be the source of the 1987 Whittier Narrows earthquake. Recent studies indicate that this fault has experienced four major earthquakes ranging in magnitude from 7.2 to 7.5 in the past 11,000 years, but that the recurrence interval for these large events is on the order of several thousand years.[16]

[9] Retrieved from https://www.conservation.ca.gov/cgs/Pages/Earthquakes/UCERF3.aspx
[10] Retrieved from https://scedc.caltech.edu/significant/newport.html
[11] Retrieved from https://scedc.caltech.edu/significant/elsinore.html
[12] Retrieved from https://scedc.caltech.edu/significant/whittier.html
[13] Retrieved from https://scedc.caltech.edu/significant/chino.html
[14] Retrieved from https://scedc.caltech.edu/significant/sanjacinto.html
[15] Retrieved from http://geode.colorado.edu/~structure/mueller_refs/22_Grant_etal_1999_OrangeCoGeology.pdf
[16] Retrieved from http://thesoutherncalifornian.blogspot.com/2014/03/know-your-faults-puente-hills-fault.html

In addition to the major faults described above, rupture of a number of smaller faults could potentially impact Orange County, including the Norwalk Fault (located in the north of the county in the Fullerton area), the El Modena Fault (located in the Orange area), and the Peralta Hills Fault in the Anaheim Hills area.

These fault systems can produce a multitude of possible earthquakes events. Predicted ground shaking patterns throughout Southern California for hypothetical scenario earthquakes are available from the United States Geological Survey as part of their on-going "ShakeMap" program. These maps are provided in terms of Instrumental Intensity, which is essentially Modified Mercalli Intensity (see Table 5 for the Modified Mercalli Intensity Scale) estimated from instrumental ground motion recordings.

Maps depicting strong ground shaking patterns for eight hypothetical scenario events potentially impacting Orange County are provided in Maps 5 through 12, as follows:

- M 7.8 repeat of the 1857 Fort Tejon Earthquake on the San Andreas Fault (Map 5)
- M 7.8 event on the Southern San Andreas Fault – "ShakeOut Scenario" (Map 6)
- M 6.9 earthquake on the Newport-Inglewood Fault (Map 7)
- M 6.8 earthquake on the Whittier Fault (Map 8)
- M 6.8 earthquake on the Elsinore Fault (Map 9)
- M 7.1 earthquake on the Palos Verdes Fault (Map 10)
- M 6.6 earthquake on the San Joaquin Hills Fault (Map 11)
- M 7.1 earthquake on the Puente Hills Fault (Map 12)

Modified Mercalli Intensity Scale		
Value	**Shaking**	**Description**
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

Modified Mercalli Intensity Scale		
Value	**Shaking**	**Description**
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

☐ **Table 5 - Modified Mercalli Intensity (MMI) Scale**

Previous Occurrences

The most recent earthquake resulting in damage in Orange County was the magnitude 5.1 La Habra earthquake on the Puente Hills fault system on March 28, 2014.

1769 Los Angeles Basin	1925 Santa Barbara
1800 San Diego Region	1933 Long Beach
1812 Wrightwood	1941 Carpenteria
1812 Santa Barbara Channel	1952 Kern County
1827 Los Angeles Region	1954 W. of Wheeler Ridge
1855 Los Angeles Region	1971 San Fernando
1857 Great Fort Tejon Earthquake	1973 Point Mugu
1858 San Bernardino Region	1986 North Palm Springs
1862 San Diego Region	1987 Whittier Narrows
1892 San Jacinto or Elsinore Fault	1992 Petrolia
1893 Pico Canyon	1992 Landers
1894 Lytle Creek Region	1992 Big Bear
1894 E. of San Diego	1994 Northridge
1899 Lytle Creek Region	1999 Hector Mine
1899 San Jacinto and Hemet	2004 San Luis Obispo
1907 San Bernardino Region	2008 Chino Hills
1910 Glen Ivy Hot Springs	2010 Baja California
1916 Tejon Pass Region	2014 La Habra

1918 San Jacinto	2019 Ridgecrest
1923 San Bernardino Region	

Source: USGS

☐ **Table 6 -- Southern California Region Earthquakes with a Magnitude 5.0 or Greater**

Probability of Future Occurrence

In 2015, a study by the USGS, California Geological Survey, and the Southern California Earthquake Center, the third Uniform California Earthquake Rupture Forecast, calculated the probability of a future earthquake on a variety of fault systems. The study indicates a 96% chance of a 6.0 or greater earthquake in the greater Los Angeles area in the next 30 years, and a 60% chance of an earthquake at least as strong as the 1994 Northridge earthquake. Further information on the implications of this study for Orange County and the Los Angeles Region are available in the figure below.[17]

Los Angeles region					
Magnitude (greater than or equal to)	Average repeat time (years)		30-year likelihood of one or more events		Readiness
5	1.4	(0.6)	100%	(1.0)	1.0
6	10	(1.1)	96%	(1.0)	1.0
6.7	40	(2.1)	60%	(0.8)	1.1
7	61	(2.0)	46%	(0.7)	1.2
7.5	109	(1.3)	31%	(0.9)	1.3
8	532	(0.4)	7%	(2.5)	1.3

Impact

Following major earthquakes, extensive search and rescue operations may be required to assist trapped or injured persons. Emergency medical care, food and temporary shelter would be required for injured or displaced persons. In the event of a truly catastrophic earthquake, identification and burial of the fatalities would pose difficult problems. Mass evacuation may be essential to save lives, particularly in areas below dams. Many families could be separated if the earthquake should occur during working hours. Emergency operations could be seriously hampered by the loss of communications and damage to transportation routes within, to and out of the disaster area and by the disruption of public utilities and services. Unless

[17] Explanation of Los Angeles Region data adapted from study: Figure depicts average time between earthquakes in the Los Angeles Region together with the likelihood of having one or more such earthquakes in the next 30 years (starting from 2014). Values listed in parentheses indicate the factor by which the rates and likelihoods have increased, or decreased, since the previous model (UCERF2). "Readiness" indicates the factor by which likelihoods are currently elevated, or lower, because of the length of time since the most recent large earthquakes (see text). These values include aftershocks. It is important to note that actual repeat times will exhibit a high degree of variability. https://www.scec.org/ucerf

properly secured, hazardous materials can be released, causing significant damage to the environment and people. Extensive federal assistance could be required and could continue for an extended period.

A significant earthquake (5.0 or greater) in the Orange County area or the region can strike without warning, and may create cascading effects.

- Earthquakes can cause large and sometimes disastrous landslides and mudslides. Any steep slope is vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils.
- Earthquakes can also cause dam failures. The most common mode of earthquake-induced dam failure is slumping or settlement of earth-fill dams where the fill has not been property compacted. If the slumping occurs when the dam is full, then overtopping of the dam, with rapid erosion leading to dam failure is possible. Dam failure is also possible if strong ground motions heavily damage concrete dams. Earthquake-induced landslides into reservoirs have also caused dam failures.
- Another secondary effect of earthquakes that is often observed in low-lying areas near water bodies is ground liquefaction. Liquefaction is the conversion of water-saturated soil into a fluid-like mass. This can occur when loosely packed, waterlogged sediments lose their strength in response to strong shaking. Liquefaction effects may occur along the shorelines of the ocean, rivers, and lakes and they can also happen in low-lying areas away from water bodies in locations where the ground water is near the earth's surface.
- Tsunamis can be formed as a result of undersea earthquakes of the Orange County coastline when huge amounts of energy are released as a result of quick, upward bottom movement. A wave is formed when huge volumes of ocean water are pushed upward. A large earthquake can lift large portions of the seafloor, which will cause the formation of huge waves.

3.2 Flood-Storm

Nature of Hazard

Flood hazard includes riverine (inland) flooding, coastal flooding, and storm-water flooding. Flooding caused by dam and levee failure, or tsunamis is discussed under those separate hazard profiles.

Location and Extent

While extensive flood control protection efforts have mitigated much of the threat, The Santa Ana River has experienced much of the historic flooding countywide. Other areas subject to flooding during severe storms include areas adjacent to Bolsa Chica Channel, Anaheim-Barber, Stanton Storm Channel, Santa Ana-Santa Fe, Cañada, Paularino, Westminster, Trabuco, Borrego, Serrano, Laguna Canyon, Atwood Channel, Brea Creek Channel, Fullerton Creek Channel, Carbon Creek Channel, San Juan Creek Channel, and East Garden Grove-Wintersburg Channel. Areas adjacent to Santiago Creek and Collins Channel in the central portion of the County and large portions of the San Diego Creek watershed in the City of Irvine and unincorporated areas of the County are also subject to inundation. In the southern portion of the county, canyon areas are subject to flooding.

Map 5 provides locations of the various watersheds throughout Orange County.

Previous Occurrences

Orange County's 948 square miles are comprised of mountain terrain and floodplain. The County's rapid growth and transformation from an agricultural based community to an urban community has changed flood control of large flows from mountains and hills to include control of additional runoff produced by development of the plains. Although there is a countywide system of flood control facilities, the majority of these are inadequate for conveying runoff from major storms. The frequency of very large floods further obscures the County's flood hazard. Storms labeled "severe" have occurred in less than 10 of the past 175 years. Major floods in Orange County are shown in Table 6 below.

Date	Description
1770, Jan.	▪ Information regarding this flood is gathered from Father Juan Crespi's diary
1780, Dec.	▪ Information regarding this flood is gathered from Father Junipero Serra's diary.
1825	▪ Greatest flood of previous 100 years. ▪ Santa Ana River changed main course from Anaheim Bay to Newport Bay.
1862, Jan.	▪ The greatest flood in California's history. ▪ The rain began on Christmas Eve 1861 continuing for 30 days. The sun shone a total of 45 minutes in that thirty-day period. ▪ Fifty inches of rain fell during December and January. ▪ Water ran four feet deep through downtown Anaheim.

Date	Description
1862	Agua Mansa Story ▪ The entire population of Agua Mansa survived the great flood in a small church. Granite monuments were placed on the steps of the church to mark the place where waters stopped rising. ▪ In 1967, archeologists and the Riverside County Surveyor located the ruined foundation of the Agua Mansa Mission near the present-day Route 60 bridge in Riverside. ▪ The water surface established by the mission monuments and other data from old irrigation works enabled the calculation of flow at Agua Mansa to be 315,000 CFS. Nearly 700 square miles are tributary to Prado Dam downstream of Agua Mansa, estimated flow in the Santa Ana Canyon was 400,000 CFS.
1884 Feb.	▪ Santa Ana River created a new ocean outlet
1888-1891	▪ Annual floods
1914	▪ Heavy flooding
1916	▪ Hundreds of square miles inundated Orange County. The flow in the Santa Ana River was about 75,000 cfs., overflowing into Anaheim Bay. ▪ Santiago Creek overflowed into El Modena and Tustin.
1921	▪ Flooding
1927	▪ Moderate flood
1938 Mar	Devastation to all of Orange County. ▪ Greatest flood since 1862 – about 100,000 cfs in Santa Ana River. ▪ 22" of rain fell in 5 days in the San Bernardino Mountains. ▪ Santa Ana River levees failed in many places and waters flowed into Anaheim Bay. ▪ 34 lives lost in Orange County. ▪ Damage reached $14 million (1938).
1969	Great damage, especially to governmental infrastructure. ▪ The January storm was the greatest since 1938. There was one heavy flood after 9 day storm and another moderate flood. ▪ February storm greater than January but both were moderate intensity, long duration (i.e., large volume) events. 1-hour intensity and 24-hour volume. ▪ Prado Dam inflow : 77,000 cfs, outflow 6,000 cfs. ▪ Maximum Santa Ana river capacity is 40,000 cfs. ▪ 1 ½ million cubic yards of sediment carried by Santa Ana River nearly caused levee failure due to the invert rising over five feet near the river mouth. ▪ Prado Dam was 60% filled.
1974	▪ 100-year rainfall along the coast of Orange County. Damage limited by substantial flood control improvements and 3-hour duration of high intensity rainfall.
1983	A very damaging record-breaking storm. ▪ 6-hours in duration covering about 100 square miles of western Orange County. ▪ Severe property damage in Huntington Beach, Fountain Valley, and Costa Mesa. ▪ The storm influenced the criteria published in the 1986 Orange County Hydrology Manual.
1995	▪ A very damaging storm with record breaking intensities for 2 and 3 hour duration. Flooded homes in Los Alamitos, Seal Beach, and Garden Grove.
1997	The most severe storm ever measured in Orange County. ▪ New records set for 30 minutes, 1 hour, 2 hour, 3 hour, 6 hour, 12 hour, and 24-hour rainfall. ▪ There was severe damage to Laguna Beach, Lake Forest, Irvine, and to the I-5 Freeway. ▪ 100-year rainfall covered over 200 square miles of our 800 square mile county. ▪ This storm and the similar, but slightly less severe 1983 and 1995 events, revealed vulnerability of older flood control facilities built. It was thought this type of intense storm was too rare to consider protective measures. ▪ Too many record-breaking storms hit in too short a period.

Date	Description
2005	▪ A series of "Pineapple Express" storms in January and February were the most significant since El Nino of 1998 causing mud flows and flooding throughout Orange County. Both state proclamations and federal declarations of disaster were made for these storms.
2010	▪ Significant storms occurring in January and December resulted in damage from flooding and mud flows in Laguna Beach. Levee damage occurred in San Juan Capistrano along Trabuco Creek.
2019	▪ Significant storm occurred in February which resulted in channel lining failures in Laguna Beach alongside Laguna Canyon Rd and San Juan Capistrano alongside Trabuco Creek Rd.
Sources: Santa Ana River Mainstem Project – OC Public Works/Santa Ana River Division	

☐ **Table 7 - Historic Flooding in Orange County**

Probability of Future Occurrence

Flood maps and Flood Insurance Studies (FIS) are often used to identify flood-prone areas. The National Flood Insurance Program (NFIP) was established in 1968 to provide low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations focusing on building codes and sound floodplain management. Although NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60, 3) require all new construction in floodplains be elevated at or above the base flood level, the Orange County Ordinance (09-008) requires that new construction be elevated at least one foot above the base flood elevation (BFE).

Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by FEMA delineating Special Flood Hazard Areas (SFHA) in communities where NFIP regulations apply. FIRMs are also used by insurance agents and mortgage lenders to determine flood insurance requirements and applicable rates.

FIRMs are developed by combining water surface elevations with topographic data. Information derived through this process illustrates areas with the potential for inundation during a 100-year flood. They may also include BFEs and areas located within the 500-year floodplain. Flood Insurance Studies and FIRMs produced for the NFIP provide assessments of the probability of flooding in a specific location. Flood Insurance Studies conducted in the late 1970's and early 1980's by FEMA show flood risk in specific areas. FEMA recently updated these floodplain maps during the Digital Flood Insurance Rate Map update. Human caused and natural changes to the environment continue to change the dynamics of storm water run-off.

Map 6 depicts the County's 100 and 500 year floodplains.

Impact

The largest impact to communities in a flood event is the loss of life and property to both private and public entities. Development in the floodplains of Orange County increases the risk of extensive property loss resulting in flooding and flood damage.

The type of property damage resulting from flood events is dependent upon the depth and velocity of the floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep cars

downstream. High waters combined with flood debris can damage infrastructure, pipelines, and bridges. Landslide damage related to soil saturation can cause extensive damage. Water saturation of materials susceptible to loss (i.e., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances), in many cases, renders a home unlivable.

Flooding impacts businesses when damaged property interrupts operation, forcing closure for repairs, and customer access is cut off. A community maintains economic vitality in the face of flood damage with quick response to the needs of businesses affected by the flood. Response to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

The Orange County Essential Facilities Risk Assessment project ran detailed models for three flood scenarios (1% Annual Chance Flood Event (with levees), 100 Year Flood (without levees), and 500 Year Flood) in Orange County. That data can be found in Attachment B – OCEFRA HAZUS Report. In addition, assessments were performed using updated data in ArcGIS and are available at the end of this chapter in the Quantitative Exposure Analysis section.

3.3 Wildland and Urban Fire

Nature of Hazard

California experiences large, destructive wildland fires almost every year and Orange County is no exception. Wildland fires have occurred within the county, particularly in the fall of the year, ranging from small, localized fires to disastrous fires covering thousands of acres. The most severe fire protection problem in the unincorporated areas is wildland fire during Santa Ana wind conditions.

Location and Extent

More than 160,000 acres of Orange County are designated as being in High or Very High Fire Hazard Severity Zones by County and State fire agencies, not including federal response areas within the Cleveland National Forest.

Map 7 depicts Orange County's Fire Hazard Severity Zones, as defined by CAL FIRE, in the Local and State Responsibility Areas.

Previous Occurrences

Wildfires are a significant threat to Orange County, where a regular pattern of warm, dry conditions in the summer are followed by periods of high speed winds with even lower humidity in the fall, creating prime conditions for wildfires to grow quickly and exhibit extreme fire behavior. Most recently, in 2017, the Canyon 2 Fire burned 9,217 acres and destroyed 79 structures, including homes and businesses. In 2007, the Santiago Fire burned for 31 days, charring over 28,000 acres and destroying 12 structures. In 2008, the Freeway Complex Fire burned over 30,000 acres, damaging or destroying over 300 structures and forcing 40,000 people from their homes. In 1993, the Laguna Beach Fire burned 14,337 acres and 441 structures. In all the majority of cases above, the fire burning in Orange County was one of several major wind-driven fires burning in Southern California. Looking back further, Orange County has had a history of even larger fires that pre-date much of the development that occurred in the last part of the 20th century. The 1958 Steward Fire burned nearly 70,000 acres in Southeastern Orange County and the Cleveland National Forest, its footprint covering much of what is now the community of Coto de Caza. The 1948 Green River Fire burned over 50,000 acres in Northeastern Orange County, its footprint covering most of what is now Anaheim Hills.

Although communities without Wildland Urban Interface are much less likely to experience a catastrophic fire, urban fires, potentially as a cascading impact of high winds or major earthquake, are a real, if more unlikely threat. The 1989 Loma Prieta Earthquake, the 1991 Oakland Hills Fire, and Japan's recent Hokkaido Nansei-oki Earthquake all demonstrate the possibility of a large fire developing into a conflagration. In Orange County, the April 1982 apartment fires in the City of Anaheim illustrated the capability for urban conflagration in Orange County. The fire broke out shortly before dawn and, fueled by Santa Ana winds, quickly swept through a four-block area near Cerritos Avenue and Euclid Street, ultimately destroying several hundred apartment units as well as other homes and businesses.

Orange County's extensive history with wildland fire is further detailed in Table 7 below.

Year	Fire Name	Acreage	Year	Fire Name	Acreage
1914	Unknown	18,754	1979	Paseo	3,644
1915	Unknown	1,794	1980	Owl	18,332
1917	Unknown	3,164	1980	Carbon Canyon	14,613
1919	Unknown	2,225	1980	Indian	28,938
1920	Unknown	2,724	1982	Gypsum	19,986
1923	Unknown	2,150	1985	Shell	1,635
1925	Unknown	8,650	1986	Bedford 1	2,956
1926	Unknown	9,934	1987	Bedford	4,070
1927	Unknown	1,837	1987	Silverado	6,018
1929	Unknown	1,085	1988	Ortega	2,471
1937	Unknown	4,916	1989	Ortega	8,170
1943	Unknown	1,930	1989	Assist 108	13,478
1943	Unknown	2,727	1990	Carbon Canyon	6,664
1948	Green River	53,079	1990	Yorba	7,884
1952	Indian Potrero	5,604	1993	Laguna Fire	14,337
1954	Weigand	4,956	1993	Ortega	21,010
1954	Jameson	7,881	1997	Baker	6,320
1955	Niger	1,606	1998	Santiago Canyon	7,760
1956	Cornwall	3,173	2002	Green	2,234
1958	Unknown	11,774	2002	Antonio	1,480
1958	Kelly	2,380	2006	Sierra Peak	10,515
1958	Steward	69,444	2007	241	1,618
1959	Talega	3,187	2007	Santiago	28,517
1961	Unknown	5,273	2008	Freeway Complex	30,305
1961	Outside Origin #2	5,019	2014	Silverado	968
1966	Indian	1,405	2017	Canyon I	2,661
1967	Paseo Grande	51,075	2017	Canyon II	9,217
1970	Nelson	3,586	2018	Aliso	176
1975	Grundy	1,915	2018	Holy	23,136
1976	Pendleton	2,111	2020	Silverado	12,465
1977	Mine	4,956	2020	Blue Ridge	13,694
1978	Soquel	5,428	2020	Bond	6,680

☐ **Table 8 - Historic Wildfires in Orange County**

Probability of Future Occurrence

Orange County's probability of experiencing a wildland fire hazard increases proportionately with the number of houses being built in the Wildland Urban Interface. Every year the growing population expands further and further into the foothills. The increased "interface" between urban/suburban areas and the open spaces created by this expansion has produced a significant increase in threats to life and property from fires and challenges existing fire protection systems design and capability.

Impact

Continued development in the Wildland Urban Interface means the impact of future wildland fires will only worsen in the coming years. More than 160,000 acres are designated as being in High or Very High Fire Hazard Severity Zones by County and State fire agencies, not including federal response areas within

the Cleveland National Forest. These zones also intersect with over 67,000 single-family residential parcels in the Orange County Landbase.

Damage to infrastructure is also a primary concern with urban and wildland fire, with utility assets throughout the County, clustered in the Wildland Urban Interface and networks often extending into the wildland itself. Some critical infrastructure, like public safety facilities, major water infrastructure, and private communications and broadcasting infrastructure lies within the wildland fire interfaces. Public safety communications structures for federal, state, and local agencies could be impacted or destroyed by wildland fires. Furthermore, major urban and wildland fires have the potential to cause road closures, evacuations, unhealthful air quality, business closures and other issues.

In addition to threatening life and safety and destroying buildings and critical facilities, wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control, and involve hundreds of operating hours on fire apparatus. There are also many direct and indirect costs to local businesses that excuse employees from work to evacuate their homes, check on their families and pets, and recover from any losses.

3.4 Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC), Earth's average temperature has risen by about 2°F over the past century and is projected to rise another 2.5 to 10°F over the next hundred years. Small changes in the average temperature of the planet can result in large and potentially dangerous shifts in climate and weather.

With increases in temperature, Earth's climate is changing. Snow and rainfall patterns are shifting, and more extreme climate events like heavy rainstorms and record high temperatures are already occurring. Scientists are highly confident that many of these observed changes can be linked to the climbing levels of carbon dioxide and other greenhouse gases in our atmosphere, which are caused by human activities.

Many places have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves. The planet's oceans and glaciers have also experienced some big changes - oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising. As these and other changes become more pronounced in the coming decades, they will likely present challenges to our society and our environment.

Data from National Oceanic and Atmospheric Administration (NOAA) shows increases in observed sea level rise around the United States and globally. Climate models provide data and projections using atmosphere-ocean general circulation models (GCM) that drive climate models. They are showing an increase in carbon dioxide concentrations where multiple GCMs have been run to project 21st century climate.

Climate Change Impacts

Water Supply & Demand

Drinking water supply for Orange County is approximately half local and half imported. The Metropolitan Water District (MWD) of Southern California provides Orange County with its import water, which is obtained from the State Water Project (SWP) and from the Colorado River Aqueduct. Water from both sources is purified and tested at the Diemer Filtration Plant in Yorba Linda then piped to the various water districts in Orange County. The groundwater basin is recharged with recycled water, natural recharge, Santa Ana River base flows, and storm flow. According to data from the Orange County Water District (OCWD), the demand for groundwater has more than doubled in the last 60 years; however, basin storage must be managed within limits or risk adverse impacts.

Because of the importance of imported water supply to Orange County, potential impacts of climate change to water resources must be considered over a region broader than the Orange County area. Changes in observed climatic variables in this larger region representing the Western U.S. have been studied through data collected over the past 100 years. Within this period, it has been observed particularly in winter and spring, temperatures have risen significantly across western North America. Data collected over the past 50 years indicate warming in the mountainous western North America that has led to a higher rain-to-snow ratio, lower snow water content, a decline in March snow cover, and a shift toward earlier annual snowmelt. These observations strongly support the need for incorporating climate change into long-term water resources planning efforts.

An overall assessment of vulnerability to climate change for Orange County following a checklist presented in the DWR Climate Change Handbook for Regional Water Planning, and specifically recommended for climate change planning was performed and is available from Orange County Public Works. As noted, the major water supply system vulnerabilities are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts.

The current understanding of climate change has been incorporated in the assessment of impacts, especially those relating to water supply and sea level rise. Several major planning studies have been performed for Orange County water supply regions that consider the impacts of climate change. Based on projected climate change conditions for the region, comprehensive analyses for both the California and the Colorado basins are severely water constrained indicating it will be challenging to meet current allocations in future years. The planning model projections indicate there will be years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future with assumptions that no changes are made to the existing operational infrastructure of the system. Population growth and anticipated increases in municipal demands must be addressed in the dual challenge of reduced supplies and increased demand. Looking forward, it is expected that these plans will be updated as better information on climate projections, including extreme events become available, and impacts to other sectors, such as water quality and habitats will be similarly evaluated.

Sea Level Rise

Although variable at different points along the coast due to regional factors, sea levels are rising globally due to climate warming including expansion of ocean water and melting of land ice. Along the Pacific Coast, the sea level rise in Southern California has been reported at the NOAA gauge in Los Angeles, where the observed increase has been 0.39 inches per decade between 1924 and 2017. This rate is projected to accelerate over the 21st century.

There are a number of different calculation approaches used to determine estimated global sea level rise that depend on variables such as probabilistic ice sheet dynamics and emissions scenarios. California's Fourth Climate Change Assessment for the Los Angeles Region in 2018 projected that sea level rise will be approximately 1 to 13 inches by 2050 and 10 to 91 inches by 2100. Numerous studies have been done that will report different results as each are based on different methodologies. Future sea level rise estimates will vary based on future greenhouse gas emissions and projections.

Maps illustrating the effects of sea level have been developed for California to identify approximate vulnerable areas. An example is shown for Orange County in Map 8.

Much of the damage from this accelerated sea level rise will be likely caused by an increase in the frequency and intensity of coastal flooding and erosion associated with extreme weather events and storm surges. In addition to sea-level rise, California's coastal and ocean resources are expected to experience dramatic changes. These include more severe atmospheric events (e.g. El Nino events); changes in ocean chemistry (e.g. temperature and pH) and estuarine chemistry (temperature, pH, and salinity); and changes to ecosystem processes (e.g. nutrient upwelling). The outlook and future of the coast is uncertain; however, we will need to change the way we manage our natural assets. Existing laws

such as the California Coastal Act, provides state and local governments with tools for addressing the effects of climate change but also impose some significant limitations.

Water Quality

Less frequent but more intense rainfall patterns could have serious consequences on water quality at our beaches. Lower precipitation in summertime may also leave contaminants more concentrated in stream flows. Heavy runoff offers a medium for infectious disease vectors to spread and multiply. Large amounts of runoff could overwhelm the capacity of infrastructure including storm drains, flood control channels and pump stations.

Flooding

Past El Nino events have resulted in significant financial damages and exposed large numbers of people to flooding hazards. Flooding having a significant impact in the Canyon areas and along flood control channels also creates challenges for wastewater utilities as they receive increased flows in their systems. Climate change will likely exacerbate these impacts with larger waves and higher water levels. Coastal erosion and sediment transport patterns will be impacted by larger and longer duration of winter waves and increased exposure to tropical weather systems.

Property

If plans are not made to mitigate for sea level rise and protection from storm surges and other flood related events, the largest impact on the community from gradual sea water inundation would be the loss of property. Known risk areas would include, but are not limited to: City, county and state Beaches; buildings and other types of structures, and in harbors and along coastal inundation areas. In coastal areas where topography is relatively flat, the risk would include low-lying areas adjacent to but further away from the coast. As sea levels continue to rise, structures on the inland side of Pacific Coast Highway will be affected. Although sea level rise would be a gradual, planning and implementation would greatly reduce impacts to lives.

Orange County has many communities along its coastline with high to very high-priced homes. The results of sea level rise due to climate change could potentially destroy or damage thousands of homes and businesses over time resulting in displacement and relocation of people and businesses.

Infrastructure

Over time, if infrastructure is not relocated outside possible inundation areas, damage to roads, bridges, water infrastructure, power lines, vital equipment, and other property and facilities could occur due to flooding. Damage to public water and sewer systems, and transportation networks would greatly impact residents.

Consideration and planning for the protection of infrastructure will be very challenging as coastal Orange County is completely developed; however, there would be direct consequences to the local economy resulting from non-action to protect infrastructure.

Services

Planning considerations and efforts of local agencies and community entities whose facilities and offices are located within the possible inundation areas should include the possibility of relocation. While some time allows for planning, locations of public offices, schools, senior homes and emergency services-hospitals, fire and police stations should all be studied.

Ecosystem and Habitat Vulnerability

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Environmental effects are likely to become permanent. Wildlife habitat, for example, may be degraded through the loss of their habitat; however, many species could relocate, survive and maybe recover adjusting to new environments, resulting in the entry of invasive species crowding out already stressed native species and the local appearance of tropical disease vectors. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Earth's oceans have maintained a relatively stable acidity level for tens of millions of years. But research shows that this balance is being undone by a recent and rapid drop in surface pH that could have devastating global consequences.

Since the early 1800s, fossil fuel-powered machines have driven human industry and advancement. Unfortunately, the consequence has been the emission of billions of tons of carbon dioxide (CO_2) and other greenhouse gases into Earth's atmosphere. Scientists know that about half of this man-made CO_2 has been absorbed over time by the oceans. Relatively new research is finding that the introduction of massive amounts of CO_2 into the seas is altering water chemistry and affecting the life cycles of many marine organisms, particularly those at the lower end of the food chain.

Vulnerability and Risk

Climate change has the possibility of producing impacts that span many sectors of the economy and reaches well beyond the areas experiencing physical sea level rise or long-term temperature rise. The impacts would be complex and can be direct or indirect. A few examples of direct impacts are productivity from agriculture could decrease; wildfire hazard could increase; drinking water levels could decrease; wildlife mortality rates and damage to wildlife and fish habitat could increase. The consequences of these impacts may result in reduced income for businesses, increased prices for food and resources, unemployment, reduced tax revenues due to reduced expenditures, increased crime, foreclosures on bank loans to businesses, and migration. The web of impacts would be complex making it challenging to come up with financial estimates of damages. The impacts of climate change can be categorized as economic, environmental, or social.

Social impacts involve public safety, health, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social

components as well. We could see migration out of the coastal areas where increasing pressure on the social infrastructure could result.

Municipalities will have to make decisions about which critical assets to protect, relocate, or remove and what is economically feasible. It will be challenging to achieve multiple goals such as protection of critical infrastructure, sustained coastal recreation, and ecosystem protection. Agencies need to recognize there could be conflicts and develop priorities while working with the regulatory agencies.

3.5 Dam Failure

Nature of Hazard

Dam failures can result from a number of natural or human caused threats such as earthquakes, erosion of the face or foundation, improper siting, rapidly rising flood waters, and structural/design flaws.

A dam failure will cause loss of life, damage to property, and other ensuing hazards, as well as the displacement of persons residing in the inundation path. Damage to electric generating facilities and transmission lines could also impact life support systems in communities outside the immediate hazard areas.

Levees are generally man-made earth embankment structures that convey floodwaters and reduce the risk of temporary flooding. Approximately 84 miles of levees are part of the 380 mile flood control system in Orange County. Levees are generally subject to settlement, underseepage, and seismic activity. The County actively works on projects to maintain and improve levees to the best of its ability with the available funding and resources and where regulatory restrictions allow. However, if a levee were to fail during a storm event, it could potentially compound flooding that may be occurring in the areas behind the levee.

Location and Extent

Currently, there are 44 dams and reservoirs registered within or immediately adjacent to Orange County. This include reservoirs which capture water from flood control facilities but may be dry most of the year. Their capacity range from 18 acre-feet (Diemer No. 8) to 314,400 acre-feet (Prado Dam) holding capacity. Map 9 depicts shows the location of Orange County's dams.

The County of Orange owns and operates 16 dams and reservoirs, the smallest facility is Harbor View with a capacity of 28 acre-feet and is located in Corona Del Mar to the Villa Park Dam with a capacity of 15,600 acre-feet and is located in Orange.

The following is a list of all registered dams and reservoirs in Orange County along with their owners and/or operators[18] and locations.

Dam and Reservoir Name	Owner	Year Built	Capacity (acre feet)	Risk Rating	Impacted Jurisdictions	Location
30 MG Central Reservoir	City of Brea	1924	92	High	Brea	Brea
Agua Chinon	County of Orange	1998	256	High	Irvine	Irvine
Bee Canyon Retention Basin	County of Orange	1994	243	Low	Irvine	Irvine

[18] https://water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams

Dam and Reservoir Name	Owner	Year Built	Capacity (acre feet)	Risk Rating	Impacted Jurisdictions	Location
Big Canyon	City of Newport Beach	1959	600	Extremely High	Newport Beach	Newport Beach
Brea Dam	Army Corps of Engineers	1942	4,018	DSAC III	Fullerton Buena Park Cypress Los Alamitos Seal Beach Los Angeles County	Multiple North Orange County Cities and Southern Los Angeles County
Carbon Canyon Dam	Army Corps of Engineers	1961	7,033	DSAC III	Fullerton Brea Placentia Yorba Linda Anaheim Buena Park Cypress Stanton Los Alamitos Los Angeles County	Yorba Linda
Diemer No. 8	Metropolitan Water District of Southern California	1968	18	Significant	Yorba Linda Brea	Yorba Linda
Diemer Ozone Contact Basin	Metropolitan Water District of Southern California	2011	23	Extremely High	Yorba Linda	Yorba Linda
Diemer Reservoir	Metropolitan Water District of Southern California	1963	80	Extremely High	Yorba Linda	Yorba Linda
Dove Canyon	Dove Canyon Master Association	1989	415	High	County Unincorp. Coto De Caza	Rancho Santa Margarita
East Hicks Canyon Retarding Basin	County of Orange	1997	75	Low	Irvine	Irvine
Eastfoot Retarding Basin	City of Irvine	2007	213	High	Irvine	Irvine
El Toro Reservoir	El Toro Water District	1967	877	Extremely High	Mission Viejo Lake Forest	Mission Viejo
Fullerton Dam	Army Corps of Engineers	1941	706	DSAC IV	Fullerton Anaheim Buena Park	Fullerton

Dam and Reservoir Name	Owner	Year Built	Capacity (acre feet)	Risk Rating	Impacted Jurisdictions	Location
Galivan Retarding Basin	County of Orange	2000	169	Low	Laguna Niguel	Laguna Niguel
Harbor View	County of Orange	1964	28	High	Newport Beach	Newport Beach
Hicks Canyon Retention Basin	County of Orange	1997	110	Low	Irvine	Irvine
Lake Mission Viejo	Lake Mission Viejo Association, Inc.	1976	4,300	Extremely High	Mission Viejo Laguna Niguel San Juan Capistrano Dana Point	Mission Viejo
Lower Peters Canyon Retarding Basin	County of Orange	1990	206	Extreme High Hazard	Tustin Irvine	North Tustin
Marshburn Retarding Basin	County of Orange	1998	424	Extreme High Hazard	Irvine	Irvine
Orange County (Humble) Reservoir	Metropolitan Water District of Southern California	1941	217	Extremely High	Brea Fullerton County	Brea
Orchard Estates Retarding Basin	County of Orange	1999	138	Extreme High Hazard	Irvine	Irvine
Palisades Reservoir	South Coast Water District	1963	147	Extremely High	San Clemente	San Clemente
Peters Canyon	County of Orange	1932	1,090	Extreme High Hazard	Cowan Heights-County Uncorp. Tustin Irvine	North Tustin
Portola	Santa Margarita Water District	1980	586	High	Coto de Caza	County Uncorp-Coto de Caza
Prado Dam	Army Corps of Engineers	1941	314,400	DSCAC-II	Multiple	Corona
Rattlesnake Canyon	Irvine Ranch Water District	1959	1,480	Extremely High	Irvine	Irvine
Rossmoor No. 1	El Toro Water District	1964	43	High	Laguna Woods Laguna Hills Lake Forest Irvine	Laguna Woods
Rossmoor Retarding Basin	County of Orange	2002	175	Low	Rossmoor-County Uncorp	Rossmoor

Dam and Reservoir Name	Owner	Year Built	Capacity (acre feet)	Risk Rating	Impacted Jurisdictions	Location
Round Canyon Retarding Basin	County of Orange	1994	286	Low	Irvine	Irvine
San Joaquin Reservoir	Irvine Ranch Water District	1966	3,036	Extremely High	Newport Beach Irvine	Newport Beach
Sand Canyon	Irvine Ranch Water District	1912	960	Extremely High	Irvine Newport Beach	Irvine
Santiago Creek (Irvine Lake)	Serrano and Irvine Ranch Water Districts	1933	25,000	Extremely High	Orange Villa Park Tustin Irvine Santa Ana Costa Mesa Newport Beach	Silverado
Sulphur Creek	County of Orange	1966	520	High	Laguna Niguel Laguna Beach	Laguna Niguel
Syphon Canyon	Irvine Ranch Water District	1949	500	High	Irvine	Irvine
Trabuco	Trabuco Canyon Water District	1984	138	High	Rancho Santa Margarita	Rancho Santa Margarita
Trabuco Retarding Basin	County of Orange	1996	390	Extreme High Hazard	Irvine	Irvine
Trampas Canyon	Premier Silica LLC	1975	5,700	Extremely High	San Juan Capistrano Dana Point	San Juan Capistrano
Upper Chiquita	Santa Margarita Water District	2012	753.5	Extremely High	County Unicorp.	Rancho Santa Margarita
Upper Oso	Santa Margarita Water District	1979	3,700	Extremely High	Mission Viejo	Mission Viejo
Veeh Reservoir	Lake Hills Community Church	1936	185	High	Laguna Hills Lake Forest Irvine	Laguna Hills
Villa Park Dam	County of Orange	1963	15,600	Extreme High Hazard	Orange Villa Park Tustin Santa Ana Irvine Costa Mesa Newport Beach	Orange
Walnut Canyon	City of Anaheim	1968	2,570	Extremely High	Anaheim	Anaheim

Dam and Reservoir Name	Owner	Year Built	Capacity (acre feet)	Risk Rating	Impacted Jurisdictions	Location
Yorba	County of Orange	1907	1,200	Extreme High Hazard	Yorba Linda Anaheim	City of Anaheim

Previous Occurrences

Westminster Water Tank Failure – Westminster, Orange County

On September 21, 1998, at 5:47am, a 5 million gallon precast concrete above ground water storage tank ruptured, sending a 6 foot high wave of water through a nearby fire station and the Hefley Square Townhomes in the City of Westminster. Six people were injured and 30 were left temporarily homeless after the tidal wave gushed from the 22 foot high rupture in the tank. The fire station, 70 homes, 32 outbuildings, 2 businesses and 25 vehicles sustained damages or were destroyed. Gas, electric and telephone services were disrupted.

Prado Dam Seepage

In January 2005, due to preceding storm activity which produced near record water levels behind Prado Dam, the reservoir water surface elevation behind the dam peaked at 527.4 feet above sea level. On January 13, the U.S. Army Corps of Engineers discovered minor seepage on the downstream face of Prado Dam. The seepage was located in an area that was under construction to build new outlet works as part of the overall flood control improvement to Prado Dam. As a precautionary measure Corona city officials evacuated over 800 homes below the dam and Orange County officials relocated campers in the Canyon RV Park because of their proximity to the adjacent floodplain.

To decrease the amount of water behind Prado dam the release of water was increased from 5,000 cubic feet per second (cfs) to 10,000 cfs to reduce the level of water being held to 505 feet. In addition to the increase in water release, the U.S. Army Corps began holding back floodwaters upstream at both the San Antonio Dam in Los Angeles County and Seven Oaks Dam near Redlands to reduce the inflow of water to Prado Dam. As the water level was lowered, the hydraulic pressure on the dam abutment subject to seepage was reduced. When the water was reduced to 505 feet (25,750 acre feet of water) on Monday, January 17, 2005, the USACE was able to start the reconditioning of the cofferdam in order to be ready for subsequent flood inflows to the dam.

Probability of Future Occurrence

The probability of future occurrence of a dam failure impacting Orange County is largely tied to major storm events and unusually heavy precipitation over a rainy season or extended period of time. There is also the possibility of dam failure during a major earthquake. Finally, many dams in Orange County are considered potential terrorist targets and could fail as a result of a deliberate attack.

Impact

Vulnerable properties are those located closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since this is where the dam waters would collect.

Residential property in low-lying areas in an inundation zone would be heavily impacted. The failure of a large dam could potentially destroy or damage hundreds of homes spreading debris for miles.

A dam failure event would impact businesses by damaging property and by interrupting business and services. Any residential or commercial structure with weak reinforcement would be susceptible to damage.

Dam failure can also damage buildings, power lines, and other property and infrastructure due to flooding.

Orange County's transportation infrastructure is vulnerable to dam inundation. Roads, railroad, and bridges in inundation areas have the potential to be severely damaged or destroyed, creating isolation issues. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas. Dam failure can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Damage to public water and sewer systems, transportation networks, and flood channels would greatly impact daily life for residents.

Roads blocked by objects during or after a dam failure may have severe consequences to people who are attempting to evacuate or who need emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from dam failure related to both physical damages and interrupted services.

While all 44 dams in Orange County would have some impact on infrastructure if there were to be a failure event, by far the greatest threat is from Prado Dam on the Santa Ana River just east of the County boundary. With more than ten times the capacity of the next largest dam on the list, it is the primary concern when it comes to dam and reservoir failure planning in Orange County. A failure of the Prado Dam is the scenario available in the quantitative exposure analysis section at the end of this chapter.

3.6 Epidemic

Vaccines, antibiotics, and improved living conditions resulted in dramatic declines in communicable diseases in the latter part of the 20th Century. However, infectious diseases have become an increasing threat to all persons in Orange County over the past decades due to a variety of factors such as: population growth (crowding, aging, migration), methods of food production (large scale, wide distribution, importation), environmental changes (drought, encroachment of humans on wild areas, global warming), microbial adaptation (resistance to antibiotics, re-assortment of genetic material), changes in health care (drugs causing immunosuppression, widespread use of antibiotics), and human behavior (travel, diet, sexual behavior, compromised immune systems, immunization rates).

Although transmission of communicable diseases occurs on a daily basis in every community, most instances are not of the severity or magnitude to be considered a county-wide hazard. However, an outbreak, epidemic, or pandemic, or the introduction of a novel disease, could pose a large threat to the health of the community. An outbreak is an increase, usually sudden, of occurrences of a particular disease over the baseline occurrence, for a specific time period and place. An epidemic is an outbreak that spreads quickly and widely through a given community or location over a relatively short period of time. A pandemic is a widespread outbreak or epidemic that spreads to other geographic areas, countries or continents.

Current epidemic threats include:

- Foodborne illness, including norovirus;
- Influenza, including seasonal, novel, and/or pandemic influenza strains;
- Childhood vaccine-preventable diseases, such as measles and pertussis;
- Vector-borne diseases including mosquito-borne, and flea-borne diseases
- Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2)
- Emerging pathogens such as Middle East Respiratory Syndrome Coronavirus (MERS-CoV), and Ebola.

Foodborne Illness, including Norovirus

Nature of Hazard

The Centers for Disease Control and Prevention (CDC) estimates that every year approximately one in six Americans (or 48 million people) gets sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases in the United States. Extrapolated to the Orange County population, that would suggest approximately 500,000 people get sick with foodborne illness each year. Examples of reportable infections that may potentially be food-borne include bacteria such as Salmonella, Campylobacter, and shiga-toxin producing Escherichia coli (STEC). In Orange County, in a non-COVID pandemic year, on average approximately 400 cases of Salmonella, 500 Campylobacter, and 70 STEC are reported each year. Not all foodborne illness is reportable and even the diseases that are reportable are under-reported and under-diagnosed. We do not have exact numbers of how many people are affected.

In general, foodborne illnesses cause symptoms such as diarrhea, vomiting, and/or abdominal cramps. Some people may also have fever. Complications of foodborne illnesses include dehydration, and spread of the infection to the blood or other parts of the body, especially if a bacteria is involved.

Previous/Future Occurrences

Foodborne illnesses can result from exposure to contaminated food prepared at home or at a restaurant or market, from contaminated food sources and/or human error in preparation or storage. Each year, the Orange County Health Care Agency receives 800-1,000 reports of foodborne illness, and investigates 20-40 foodborne outbreaks. Most foodborne illnesses can be prevented with proper handling and preparation of food and avoiding having ill persons handle and serve food.

Impact

While most foodborne illnesses resolve without clinical diagnosis or treatment, more severe illness can lead to hospitalization and even death in elderly, children or immune compromised persons. Even mild illness can lead to a loss of income for those without paid sick leave or who have the need to care for an ill child. Other economic impacts can include lost sales due to temporary food facility closures. The HCA Communicable Disease Control Division has participated in clusters of foodborne illness related to contaminated foods that were nationally distributed, clusters related to ill food handlers and/or lack of appropriate food handling procedures.

References

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Influenza, including Seasonal, Novel, and/or Pandemic Influenza Strains

Nature of Hazard

Influenza is a contagious respiratory illness caused by influenza viruses. Although many illnesses are self-limited and mild, complications of seasonal influenza cause on average more than 200,000 hospitalizations and up to 49,000 deaths each year in the United States. In Orange County, severe influenza cases (defined as persons who have influenza and are admitted to the intensive care unit or die) in persons less than 65 years of age are reportable. The last severe influenza season, excluding the 2009 pandemic, was 2017-2018, where Orange County investigated 104 severe case of influenza.

A pandemic occurs when a new (novel) virus that humans have not encountered before, and therefore have no immunity to, begins circulating, causes infections and spreads quickly from person to person, causing substantial morbidity and mortality across geographic areas. Orange County HCA routinely does surveillance for seasonal influenza as well as enhanced surveillance for novel strains and human infections with bird (avian) or pig (swine) influenza strains that are circulating in other parts of the country and the world.

Previous Occurrences

In 2009, an H1N1 influenza pandemic spread quickly and led to over 200 severe influenza cases and 50 deaths in Orange County. The 2009 H1N1 influenza virus quickly established itself as a seasonal influenza strain and was the predominant virus in the 2013-2014 influenza season. Although the mortality rate from H1N1 Influenza during this pandemic was low, other strains may cause more severe illness with case fatality rates over 3%.

Probability of Future Occurrence

An influenza pandemic is likely to occur in "waves" of infection, each lasting approximately 8 to 12 weeks and separated by weeks of inactivity. In total, it could last from 18 months to several years. An influenza pandemic is likely to affect everyone in Orange County at some point and can greatly impact "business as usual" in any sector of society or government.

Impact

Major impacts of severe influenza seasons include increase in diversion hours at local emergency rooms, increase in hospital admissions in persons with underlying health conditions, and death occurring amongst individuals under the age of 65. Maintaining an active surveillance allows public health to make timely recommendations to intervene on the widespread transmission of influenza. An influenza pandemic would place a great strain on existing health care resources and may exceed available resources. Personnel, supplies, equipment, and pharmaceutical responses (e.g., vaccination and antivirals) may be in short supply and/or unavailable. If transportation is compromised in the region or country, food and other essentials may be unavailable as well. Outbreaks are expected to occur simultaneously throughout much of the County and the State, which may limit the availability of mutual aid assistance and resources from other areas.

Childhood Vaccine-Preventable Diseases, such as Measles and Pertussis

Nature of Hazard

Before the middle of the last century, life-threatening diseases such as Haemophilus influenzae, diphtheria, polio, measles and rubella affected hundreds of thousands of infants, children, and adults in the United States, with thousands dying every year. Since the advent and widespread use of vaccines, these diseases have declined dramatically and nationally, vaccine-preventable disease levels are at or near record lows. Vaccinations for chickenpox, diphtheria, Haemophilus influenzae type B, hepatitis A, hepatitis B, influenza, measles, mumps, pertussis, polio, pneumococcus, rotavirus, and rubella are now routinely available for infants and children. However, this is not the case throughout the world and outbreaks of diseases such as polio and measles still occur regularly. Even though most children in the U.S. have received the recommended vaccines by age 2 years, many under-immunized children remain, leaving the

community vulnerable to outbreaks of these diseases. The California Department of Public Health compiles data annually on immunization rates at kindergarten entry by school and makes it available on an interactive website (http://www.shotsforschool.org/k-12/how-doing/). For Orange County-specific data on vaccination rates for the MMR (measles, mumps, rubella) vaccine by school district, see https://media.ocgov.com/civicax/filebank/blobdload.aspx?BlobID=41625.

Previous Occurrences

- **Measles** - Measles is one of the most contagious of all infectious diseases with over 90% of exposed people developing infection if they are not already immune, either by previous infection or immunization. In the pre-vaccination era, there were on average over 500,000 cases in the U.S. and almost 500 deaths reported annually. Cases dropped dramatically after vaccination against measles was introduced in the 1960's and a second dose of vaccine was routinely recommended in 1989. In 2000, measles was declared eliminated in the U.S., meaning there was no ongoing transmission, but cases and outbreaks continue to occur from visitors or returning travelers from countries were measles is still common introducing the virus into unvaccinated or under-vaccinated communities. In the U.S. there have been between 37 to 644 cases of measles reported each year, with multiple outbreaks reported in 2013, 2014, and now 2015. In Orange County, 0-1 cases of measles were reported annually between 2010 and 2013, but large outbreaks resulted in 23 cases reported in 2014, and 35 cases reported in the first few months of 2015.

- **Pertussis** - Pertussis (whooping cough) is a highly contagious respiratory infection caused by a bacteria Bordetella pertussis. Although symptoms may be mild and resemble an ordinary "cold" in some people, the infection may become more serious, particularly in infants, and cause hospitalizations and even death. Infections in the U.S. decreased dramatically with the advent of the whole-cell DTP (diphtheria, tetanus, pertussis) vaccine in the 1940's, but have increased over the past 20-30 years, partially because of increased awareness, improved testing, better reporting, and waning immunity from the acellular pertussis vaccine (DTaP) used since the 1990's. California has had particularly large outbreaks since 2010 with numbers as high as those in the 1940's. Over 9,000 pertussis cases and 10 infant deaths were reported with disease onset in 2010 and over 11,000 cases and 3 infant deaths were reported with disease onset in 2014. In Orange County, 467 pertussis cases were reported in 2010 and 397 in 2014.

Probability of Future Occurrences

It is likely we will continue to see cases of pertussis on an annual basis and we will most likely continue to see sporadic cases that may result in clusters or outbreaks of measles.

Impact

Low impact outcomes of vaccine-preventable diseases are school absenteeism and disease transmission amongst unvaccinated household members. Major include severe morbidity that require admission to the intensive care unit and even mortality. Vaccinations play a vital role in reducing the burden of disease amongst our youngest community members.

References

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CDC. Immunization Schedules. CDC National Center for Immunization and Respiratory Diseases 2015. Web (http://www.cdc.gov/vaccines/schedules/index.html). 9 July 2015.

Vector-Borne Diseases

Nature of Hazard

According to the Centers for Disease Control and Prevention (CDC), vector-borne diseases are among the most complex of all infectious diseases to prevent and control due to the difficulty of predicting habits of vectors like mosquitoes, fleas, and ticks. These vectors transmit viruses, bacteria, or other pathogens that infect animals as well as humans.

The Orange County Mosquito and Vector Control District (OCMVCD) is an independent special district charged with protecting the citizens of Orange County from vectors and vector-borne disease under the California Health and Safety Code (CAL. HSC. § 2000-2910). OCMVCD operates year-round to provide service to all 34 cities within Orange County as well as unincorporated areas, federal, and state lands.

OCMVCD utilizes an Integrated Vector Management (IVM) Program strategy to control populations of mosquitoes, filth flies and black flies, red imported fire ants (RIFA), and rats. The IVM Program consists of the following activities:

1. Surveillance for vectors, vector habitats, and associated pathogens/diseases, including field and laboratory analysis of vectors in order to evaluate populations and emerging disease threats;
2. Source reduction to limit breeding by vectors, including management of vegetation, land, and water with appropriate landowners to minimize vector production and harborage;
3. Education and outreach efforts targeted toward the public and private landowners in ways to facilitate source reduction and minimize disease-carrying vectors;
4. Distribution of mosquito fish (Gambusia affinis), a biological control measure used to reduce mosquito production in isolated aquatic features, such as neglected residential swimming pools; and
5. Application of pesticides to minimize vector populations and reduce the threat of potential vector-borne disease transmission to humans.

The vector-borne diseases currently of major public health threat in Orange County include:

- West Nile Virus and other mosquito-borne infections;
- Flea-borne typhus and other flea-borne infections;
- Other vector-borne diseases with the potential to emerge or re-emerge in Orange County.

West Nile Virus (WNV) and other Mosquito-Borne Infections

Nature of Hazard, Location, Extent and Previous Occurrences

West Nile virus (WNV), which is primarily a disease of birds, can be transmitted to humans and other animals by the bite of a mosquito. WNV has been responsible for causing 364 reported neuroinvasive

infections, including 24 deaths, since its introduction to the county in 2004. It has remained well-established in Orange County since its introduction.

Epidemics of West Nile virus infections are expected every year. Although only a small proportion of persons infected develop symptoms, which can include fever, body aches, headaches, and/or rash, infection can also be very severe, resulting in meningitis or encephalitis (inflammation of the brain) and serious sequelae. HCA works closely with the OCMVCD to monitor the presence of the virus in the County.

Other mosquito-borne diseases potentially transmitted by locally abundant Orange County mosquitoes include Saint Louis Encephalitis (SLE), Western equine encephalitis (WEE), and malaria. Although SLE was considered the most important mosquito-borne virus in North America until the arrival of WNV in 1999, SLE virus activity has not been detected in Orange County since the introduction of WNV into the County in late 2003. WEE was a significant cause of death and disease in humans and horses in the United States prior to the establishment of organized vector control programs in the late 1940s. However, WEE has not been detected in mosquitoes, or host animals such as birds in Orange County in many years, and is unlikely to pose a threat in the future.

Malaria is a serious infection caused by a parasite called Plasmodium. Although malaria is thought to be eradicated in the United States, imported malaria cases among travelers returning home have the potential to spark a reintroduction of locally-transmitted malaria among the County's Anopheles mosquitoes, which are largely restricted to wetland habitats in Orange County. The last confirmed outbreak of locally transmitted malaria in Southern California occurred in 1991 along the San Diego County/Orange County border. HCA works closely with the OCMVCD to monitor the presence of imported cases of malaria in the County.

Probability of Future Occurrence

Mosquito-borne diseases transmitted by Aedes mosquitoes not currently known to be present in Orange County but in other areas of California include dengue and chikungunya**.** With recent introductions of several species of non-native mosquitoes from the genus Aedes in southern California, including the Asian tiger mosquito (Aedes albopictus) and the yellow fever mosquito (Aedes aegypti), there is potential for diseases like chikungunya and dengue to become established in Orange County. These mosquitoes are known vectors of dengue and chikungunya viruses. Although local transmission of these viruses is not known from Orange County, human cases of dengue and chikungunya are regularly reported to HCA from travelers returning from known endemic disease areas. Therefore, traveling humans infected with the virus could spread the disease once in areas of Orange County with established populations of these mosquitoes.

- **Dengue** -The World Health Organization reports that dengue is the most rapidly spreading mosquito-borne viral disease in the world. Dengue is transmitted by the bite of a mosquito infected with one of the four dengue virus serotypes. Unlike other mosquitoes, Aedes aegypti, the main vector for dengue, bites during the day. Aedes albopictus, a secondary dengue vector, can survive in cooler temperate regions. Similar to chikungunya, dengue would likely enter Orange County via an infectious person returning from an area of the world where these diseases are endemic. Symptoms of dengue include fever, severe headache, pain behind the eyes, muscle and

joint pain, swollen glands and rash. There is no vaccine or any specific medicine to treat dengue. The only method to reduce the transmission of dengue virus is to control vector mosquitoes and protect against mosquitoes bites. HCA works closely with the OCMVCD to monitor the presence of imported cases of dengue of in the County.

- **Chikungunya** - Chikungunya is a viral tropical disease transmitted by Aedes mosquitoes. In recent years the virus has been regularly detected in parts of Mexico and the Caribbean. Typical symptoms are an acute illness with fever, skin rash and incapacitating joint pains that can last for weeks. The latter distinguishes chikungunya virus from dengue, which otherwise shares the same vectors, symptoms and geographical distribution. Most patients recover fully but, in some cases, joint pain may persist for several months or even years. The spread of disease via movement of infected humans is specifically relevant for a pathogen such as chikungunya virus. As with dengue, the only method to reduce transmission of chikungunya is to control vector mosquitoes and protect against mosquitoes bites. HCA works closely with the OCMVCD to monitor the presence of imported cases of chikungunya in the County.

Impact

WNV is endemic in Orange County, and heavy WNV seasons tend to occur every 3-5 years. Most infections occur in the northern areas. Geographically, Santa Ana, Anaheim, Fullerton, and Tustin areas see the highest densities of infections. Older adults are disproportionally impacted by WNV.

Orange County experienced an outbreak of WNV cases in 2014 and reached an incidence rate of 8.85 cases per 100,000 residents. This was more than 3.5 times the incidence rate experienced by Los Angeles county (where WNV is also endemic), and more than four times the incidence rate experienced by California as a whole.

While asymptomatic cases are the most common, they are severely underreported because they are rarely identified. The reported asymptomatic cases are almost always found through routine screenings of blood donations, since the disease can be passed on through blood transfusion. West Nile fever is also underreported: persons with West Nile fever will often not see a medical provider for their illness, and providers seeing a case of West Nile fever will often not test for this disease. This results in surveillance methods which skew toward detection of neuroinvasive cases, though they are the least common form of the disease. Thus, the number of cases reported to the county severely underestimates the total number of WNV cases in the county.

References

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Flea-Borne Diseases

Nature of Hazard

Flea-borne typhus is a disease caused by the bacteria Rickettsia typhi, and possibly Rickettsia felis. The bacteria live in the feces of infected fleas which can be found on cats, dogs, raccoons, skunks, and opossums. After a flea bite, bacteria may remain on the skin's surface. A human becomes exposed to the bacteria by scratching the site of a flea bite, which allows bacteria from the skin's surface to enter the bloodstream.

People infected with typhus may experience fever, headache, chills, and muscle aches 6 - 14 days after a *Rickettsia*-infected flea bite. Some people also develop a rash. The disease is treated with antibiotics. Most people recover within several days, though hospitalization with serious illness does occur.

Previous and Future Occurrences

- **Flea-borne typhus** - Orange County has experienced a resurgence of flea-borne typhus over the last ten years. Since 2006, 132 human cases have been reported to HCA. Flea-borne typhus is a bacterial (rickettsial) infection transmitted by fleas found on backyard wildlife and domestic pets. The transmission cycle in Orange County involves cat fleas, cats, opossums, and other backyard wildlife. Symptoms include fever, muscle aches, rash, and sometimes vomiting and headache. Approximately 85% of cases reported to HCA are hospitalized. HCA works closely with Orange County Mosquito and Vector Control District to investigate exposure sites with large populations of fleas and host animals. Flea-borne typhus exposure sites with large populations of host animals may be referred to local animal care agencies for assistance.
- **Plague** - Plague is a zoonotic disease caused by the bacterium Yersinia pestis. In its sylvatic cycle, it is transmitted by fleas found on locally abundant ground squirrels, rodents and rabbits. Humans usually get plague after being bitten by a rodent flea that is carrying the plague bacterium or by handling an animal infected with plague. Most persons with plague develop fever and swollen lymph nodes. Plague bacteria can also migrate to the lungs causing a pneumonic presentation where respiratory droplets may serve as the source of person-to-person transfer that can lead to localized outbreaks or devastating epidemics. According to the California Department of Public Health (CDPH), plague is rare among humans but is found each year among squirrels, chipmunks, and other rodents in California and the southwestern U.S. Plague epizootics can be detected by large die-offs of naturally infected hosts such as rabbits and ground squirrels. Domestic cats are also susceptible to plague and can pass the infection to their owners.

The CDPH Vector-Borne Disease Section lists the Santa Ana Mountains as a plague endemic area. Plague has occurred in Orange County sporadically, including instances in ground squirrels during 1982 in the Anaheim Hills and in a roof rat from the City of Orange in 1998. Pneumonic plague transmission last occurred along the Orange County and Los Angeles County border in 1988 and involved a pet cat. HCA works closely with the OCMVCD to monitor the presence of plague in the County.

Impact

Flea-borne typhus is considered endemic in areas of Orange County. The geographic areas with the highest density of typhus infections are the areas surrounding Orange, Garden Grove, Westminster, and Anaheim. Orange County sees higher incidence rates of murine typhus than California as a whole. Case counts are highest in the summer months, though illness is seen year-round.

The number of annual reported cases averages approximately 19, the overwhelming majority of which are hospitalized. From the years 2011-2018, cases were 63% male, 54% non-Hispanic white, and 55% in the age range 18-49. 2013 had the highest overall incidence rate with 1.06 typhus cases per 100,000 Orange County residents. 2017 saw the lowest overall rate, with 0.34 cases per 100,000 residents.

References

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Other Vector-Borne Diseases

Although less prevalent than West Nile virus and flea-borne typhus, other vector-borne diseases have the potential to re-emerge or emerge in Orange County should environmental conditions change or new competent vector species successfully become established. These diseases are not considered a major health hazard in Orange County at this time, but include tick-borne diseases such as Lyme disease, Pacific Coast tick fever, and tularemia, and rodent-borne diseases such as Hantavirus. OCMVCD is constantly monitoring local vector populations in order to detect the presence of these diseases and mitigate the potential for these hazards.

Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2)

Nature of Hazard

Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) also known as Coronavirus (COVID-19) is a new disease first identified in Wuhan China in 2019. It is caused by a novel (or new) coronavirus that has not previously been seen in humans. The virus mainly spreads from person to person when they are in close contact (within 6 feet of for at least 15 minutes within a 24 hour period during the infectious period). Although most people who have COVID-19 have mild symptoms, COVID-19 can also cause severe illness and even death. Some groups, including older adults and people who have certain underlying medical conditions, are at increased risk of severe illness. Severity of illness may require hospitalization, including intensive care, and may result in death.

The global COVID-19 pandemic has spread to 223 countries, areas, or territories with over 100 million cases and millions of deaths reported worldwide. The United States has over 30 million cases and over 500,000 COVID-19 associated deaths.

Previous Occurrences

Coronaviruses are a large group of viruses that infect many animals and humans and are responsible for many diseases. In the past century, a number of coronavirus global pandemics have occurred but only SARS-CoV that causes severe acute respiratory syndrome (SARS) in 2003 and MERS-CoV that causes Middle East respiratory syndrome (MERS) in 2012 were transmissible in humans. Orange County had its first case of confirmed SARS-CoV-2 in January of 2020 and has experienced 2 large surges of cases since the beginning of the pandemic.

Probability of Future Occurrences

There are a number of approved SARS-CoV-2 vaccines for emergency use from Pfizer, AstraZeneca/Oxford, Johnson & Johnson, and Moderna. These vaccines have all demonstrated high

efficacy and safety in clinical trials. The vaccines are expected to provide at least some protection against new virus variants and are effective at preventing serious illness and death. Vaccines create a broad immune response, and any virus changes or mutations should not make vaccines completely ineffective. It is likely that Orange County with continue to have some level of SARS-CoV-2 disease transmission including clusters and outbreaks as we work toward broader herd immunity in the community.

Impact

Orange County cases of COVID-19 has exceeded 255,000 cases and resulted in over 5000 deaths. Each week every county in California is assigned into COVID-19 county risk tier based on its positivity rate, adjusted case rate, and health equity metric ranging from Minimal to Widespread. Based on the risk tier certain activities and businesses are permitted to operate. During 2020, many non-essential indoor businesses were closed or operated under health and safety limitations. Kindergarten to 12th grade schools and higher education was restricted to remote online education. Death and chronic disease especially in older populations are expected especially in unvaccinated individuals who become infected. Depending on severity of disease and due to the need for non-pharmaceutical interventions including isolation and quarantine, this disease has the potential for serious economic impacts for individuals and the community.

References

Lessons of Past Coronavirus Pandemics. Population and Development Review Volume 46, Issue 3, September 2020, pages 633-637.

Centers for Disease Control and Prevention, World Health Organization, and Orange County Healthcare Agency websites on COVID-19.

Emerging Pathogens such as Middle East Respiratory Syndrome Coronavirus (MERS-CoV), and Ebola.

Nature of Hazard

With the increasing ease of international travel, diseases can quickly spread throughout the world. Orange County with its diverse population and large tourism industry is particularly at risk for importation of diseases that may have previously been localized to other countries or continents. These diseases pose a significant hazard if they are highly transmissible from person to person and if they have significant morbidity or mortality. Although these diseases may have different modes of transmission, symptoms, and natural history, the approach to handling the threat of an emerging or novel communicable disease is similar.

Previous Occurrences

Since 2000, Orange County agencies have prepared to respond have prepared to respond to multiple such diseases such as Severe Acute Respiratory Syndrome (SARS), H1N1, avian influenza H5N1, MERS-CoV, Zika, Ebola and SARS-CoV-2.

Probability of Future Occurrences

Given the international experience in the last 20 years, it seems likely that at least one emergent disease with pandemic potential will be introduced into Orange County in the next decade.

Impact

Hazard events have the potential to cause significant morbidity and mortality. They have the potential to cause thousands of deaths, overwhelm our healthcare system, and seriously impact our regional economy. Our preparatory mitigation efforts are likely to be very valuable and cost-effective in protecting our community.

3.7 Drought

Nature of Hazard

Unlike most natural hazards, drought is not a sudden, catastrophic occurrence. Because drought can occur over several years, it is difficult to define when a drought begins and ends. A drought is characterized by a prolonged period of abnormally low levels of precipitation that has adverse impacts on people, vegetation, and animals. A drought is a temporary phenomenon and as such, it is distinct from aridity, which is a climatic feature of a particular region. Droughts occur periodically in every climatic zone, although some areas are more drought-prone than others.

There are a number of indices which measure the severity of drought with varying degrees of accuracy due to local variability. The most common index used to monitor drought is the Palmer Drought Severity Index (PDSI) which includes indicators such as: levels of precipitation, soil conditions (moisture), and temperature. Weekly maps of PDSI for the United States are available at: http://www.cpc.ncep.noaa.gov/. Of particular interest in California, is the impact of evapotranspiration (ET) whose exacerbation of drought conditions is experimentally monitored through Evaporative Stress Index (ESI) and Evaporative Demand Drought Index (EDDI)[19].

There are four categories of drought:

Meteorological – When there is a measurable departure of precipitation from normal, adjusted for regional climate differences.

Agricultural – When the amount of moisture in the soil no longer meets the needs of crops.

Hydrological – When surface and subsurface water supplies are below normal.

Annual Indicators – In California, when the Department of Water Resources assesses water conditions based upon annual averages of snowpack, precipitation, and reservoir storage.

Location

Drought can occur regionally across Orange County. Droughts are a recurring feature of California's climate, but climate change is projected to increase the frequency, intensity, and duration of droughts. For current information on drought conditions in California, visit: https://water.ca.gov/Current-Conditions. The U.S. Drought Monitor is a map released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4). As depicted in Map 10 below, the majority of California continues to be in various stages of drought, and Orange County is no exception[20].

[19] https://psl.noaa.gov/eddi/

[20] http://droughtmonitor.unl.edu/

Extent/Severity

Drought severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. The magnitude of drought is usually measured in time and the severity of the hydrologic deficit. Drought can also be further affected by environmental restrictions.

Several resources are available to evaluate drought status and estimate future expected conditions. The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning. The NIDIS maintains the U.S. Drought Portal (www.drought.gov), a web-based access point to several drought related resources.

A number of indices measure how much precipitation for a given period has deviated from historically established norms.

The primary indicator for the U.S. Drought Monitor and U.S Seasonal Drought Outlook for the western United States is the Palmer Drought Severity Index (PDSI). PDSI is a commonly used index that measures the severity of drought for agriculture and water resource management. It is calculated from observed temperature and precipitation values, and estimates soil moisture. While U.S. Department of Agriculture uses the PDSI to determine when to grant emergency drought assistance, it is not considered consistent enough to characterize the risk of drought on a nationwide basis (FEMA, 1997) nor is it well suited to the dry, mountainous areas in the western U.S.

For western states with mountainous terrain and complex regional microclimates, it is useful to supplement the PDSI values with other indices such as Surface Water Supply Index and Standardized Precipitation Index (SPI). The Surface Water Supply Index takes snowpack and other unique conditions into account. The National Drought Mitigation Center (NDMC) uses the SPI to identify emerging drought months sooner than the PDSI. It is computed on various time scales to monitor moisture supply conditions. The SPI is the number of standard deviations that precipitation value would deviate from the long-term mean.

The Vegetation Drought Response Index, or VegDRI, is a bi-weekly depiction of vegetation stress across the contiguous United States. VegDRI is a fine resolution index based on remote sensing data, and incorporates climate and biophysical data to determine the cause of vegetation stress. Development of the VegDRI map and associated products is a joint effort by the NDMC, the USGS National Center for Earth Resources Observation and Science (EROS), and the High Plains Regional Climate Center (HPRCC).

Previous Occurrences

Historically, California has experienced severe drought conditions. In the last century, the most significant statewide droughts occurred from 1929 to 1934, from 1975 to 1977, from 1987 to 1992, and from 2012 to 2017. The 2012-2017 drought was one of extreme proportions, with record-high temperatures and record-low levels of snowpack and precipitation. The approved 2018 State Hazard Mitigation Plan (SHMP) includes comprehensive statewide statistics on these droughts and related emergency proclamations. Orange County has been included in two emergency proclamations: 2002 and 2012-2017. For the most

recent incident, the Governor issued a statewide emergency proclamation which, when it was lifted in April 2016, retained clauses that prohibit wasteful practices and advances measures to make conservation a way of life. During the 2012-2017 drought, statewide reservoir storage was down significantly and impacts of multiple dry years in a row caused significant water delivery issues in California. Allocations for contractors of Department of Water Resources State Water Project (SWP) and the U.S. Bureau of Reclamation's (USBR's) Central Valley Project (CVP) such as Municipal Water District of Orange County decreased below requested amounts.

Large-scale droughts occurring in other regions have impacted Orange County as well. For example, the great drought of the 1930s, coined the "Dust Bowl," was geographically centered in the Great Plains yet ultimately caused water shortages in California. The drought conditions in the Plains resulted in a large influx of people to the West Coast. Approximately 350,000 people from Arkansas and Oklahoma immigrated mainly to the Great Valley of California. As more people moved into California, increases in intensive agriculture led to overuse of Santa Ana River watershed and groundwater resulting in regional water shortages.

Probability

Short-term drought probability is assessed by the National Weather Service Climate Prediction Center which publishes Seasonal Drought Outlook Statements[21]. At the time of this revision, much of California is enduring its second consecutive dry winter, with most areas below 75% of normal snowpack for this time of year. Moderate drought will expand over areas of southern California, including Orange County where drought is beginning to develop again after a fairly dry winter.

Long-term, according to most climatologists, the planet is starting to experience shifts in climate patterns and increased frequency of extreme weather events at both the global and local levels. Over the next century, increasing atmospheric greenhouse gas concentrations are expected to cause a variety of changes to local climate conditions, including extended periods of drought. Scientists currently speculate that North America has already begun to enter mega-drought conditions[22] which may continue with global warming. On multiyear timescales, the occurrence of extreme droughts based on 3-year SPEI below the historical fifth percentile, similar to that experienced during the 2012–2016 drought across the region, is projected to increase 3–15 times by late century.[23]

Community Impacts

Drought is one of the few hazards that has the potential to directly or indirectly impact all Orange County community members, as well as adversely affect the local economy. Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical

[21] https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php

[22] https://science.sciencemag.org/content/368/6488/314

[23] https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2020EF001736

drought. This complexity exists because water is integral to our ability to produce goods and provide services.

The impacts of drought can be categorized as economic, environmental, or social.

Economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region.

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well. Population out-migration is a significant problem in California's Central Valley, as agricultural jobs are reduced. Migration is usually to urban areas within the stressed area or to regions outside the drought area. However, when the drought has abated, these persons seldom return home, depriving agricultural areas of valuable human resources necessary for economic development. For the urban area to which they have immigrated, they place ever-increasing pressure on the social infrastructure, possibly leading to greater poverty and social unrest.

Overall Summary of Vulnerability

Orange County remains vulnerable to drought. Susceptibility to damage and loss from droughts ranges from individuals to infrastructure. Vulnerabilities can be either direct or indirect. They include reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat. For example, a reduction in crop, rangeland and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs.

Existing Mitigation Activities

In the long-term, the County of Orange must continue to focus on mitigation actions to enhance local water storage, recycle water projects, increased water conservation programs, and looking at environmental erosion control projects without causing a significant economic disruption. Drought mitigation has a cascading effect and impact on other natural hazards including flooding and wildland fire.

Other economic losses occur for water utilities and small groundwater well owners. Income loss for water retail agencies can result in the need to increase water rates in order to cover fixed operational costs. As groundwater becomes unavailable, agencies or properties are required to drill deeper wells or identify alternate sources that are often more expensive and sometimes limited. Some water utilities are having to adjust their treatment processes or supply based on availability, resulting in higher operating costs and, at times, damage to their filters over long periods of time.

Regulatory Environment

Federal

In October 2020, a Presidential Executive Order[24] created the Interagency Water Subcabinet (a.k.a. Water Policy Committee), co-chaired by the Secretary of the Interior and the Administrator of the Environmental Protection Agency, and including the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Energy, the Secretary of the Army. Two of the Water Cabinet goals are to implement:

- The "Priority Actions Supporting Long-Term Drought Resilience" document issued on July 31, 2019, by the National Drought Resilience Partnership; and
- Actions identified in the "Federal Action Plan for Improving Forecasts of Water Availability" issued on October 18, 2019, by the Department of the Interior and the Department of Commerce pursuant to section 3 of the Presidential Memorandum of October 19, 2018 (Promoting the Reliable Supply and Delivery of Water in the West).25

[24] https://www.whitehouse.gov/presidential-actions/executive-order-modernizing-americas-water-resource-management-water-infrastructure/

[25] https://www.whitehouse.gov/presidential-actions/presidential-memorandum-promoting-reliable-supply-delivery-water-west/

These activities include coordinating drought activities through the National Integrated Drought Information System (https://www.drought.gov). Within this framework the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA) leads monitoring. Agencies such as the U.S. Geological Survey and National Aeronautics and Space Administration (NASA) contribute data. The U.S. Department of Agriculture leads drought response efforts, and the Environmental Protection Agency (EPA) regulates water quality.

State: California

Additional sources of California-specific information include the 2018 California Water Plan[26], 2018 Safeguarding California Plan: California's Climate Adaptation Strategy[27], 2014-2018 California Water Action Plan Implementation Report[28], and 2020 California's Most Significant Droughts: Comparing Historical And Recent Conditions[29].

The 2015 California Drought Contingency Plan was prepared in conjunction with the California Water Plan and both documents are updated every five years. The purpose of the plan is to minimize drought impacts by improving agency coordination, enhancing monitoring and early warning capabilities, conducting water shortage impact assessments, and implementing preparedness, response, and recovery programs. The California Water Plan presents strategic plan elements including a vision, mission, goals, guiding principles, and recommendations for current water conditions, challenges, and activities. The plan includes future uncertainties and climate change impacts, scenarios for 2050, and a roadmap for improving data and analytical tools.

Local: Orange County

Localized regulations for drought are mentioned in local municipal codes. The County of Orange, Code of Ordinances Section 3 provides the definition of a drought emergency. Section 7 defines use of water and landscaping during conservation times under the state model, and Article 1 outlines water conservation and the governance over well water use in Orange County. All retail water utilities have drought ordinances that specify use of drinking water during the various phases of drought.

[26] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/California-Water-Plan-Update-2018.pdf

[27] https://resources.ca.gov/CNRALegacyFiles/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

[28] https://resources.ca.gov/CNRALegacyFiles/wp-content/uploads/2019/01/CWAP_Implementation_Report_Finalpdf.pdf

[29] https://water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Drought-Mitigation/Files/Publications-And-Reports/a6022_CalSigDroughts19_v9_ay11.pdf

3.8 Tsunami

Nature of Hazard

A tsunami (seismic sea wave) is a series of waves most commonly caused by an earthquake beneath the sea floor or by a large undersea landslide. In the open ocean, tsunami waves travel at speeds of up to 600 miles per hour but their wave height is generally too small to be observed. As the waves enter shallow water, they slow down and may rise to several feet or, in rare cases, tens of feet. There are two types of tsunamis defined:

- **Local tsunami (also called near-source):** If a large earthquake or undersea landslide occurs at or near the California coast, the first waves may reach coastal communities within minutes. There may be little or no time for authorities to issue a warning. An offshore earthquake or landslide with a magnitude of 6.8 has the potential to create a local source tsunami, which could reach the Orange County coast in 15 minutes.

- **Distant tsunami (also called distant-source):** Very large earthquakes in other areas of the Pacific Rim may also cause tsunamis, which could impact California's coast. The first waves would reach Orange County's coastline many hours after the earthquake occurred.

Local tsunamis could be generated by the Catalina fault, the Newport Inglewood fault, and Channel Islands thrust faults, or by the force of a subaerial or submarine landslide, such as offshore areas near Goleta, Palos Verdes, Monterey Canyon, and Coronado Canyon. Tsunamis originating in the Cascadia subduction zone may have significant impact on Southern California, similar to those experienced in Crescent City after the 1964 Alaskan earthquake, since the distance between Cascadia and Southern California is about the same as the distance from Alaska to Crescent City.

Location and Extent

Risk is considered high along the north coast of California, from Crescent City to Cape Mendocino; moderate south of Cape Mendocino to north of Monterey; high south of Monterey to Palos Verdes; and moderate south of Palos Verdes to San Diego.

Map 11 depicts the areas of Orange County at risk from tsunamis.

Known risk areas include, but are not limited to:

- City, County and State Beaches.
- All buildings and apartments to the west of Pacific Coast Highway (PCH).
- Buildings that are on the inland side of PCH facing the ocean.
- Vehicles and pedestrians on PCH in low-lying areas.
- Harbor areas.
- Low-lying areas adjacent to the coast.

County facilities with greatest exposure to tsunami hazards are affiliated with the three harbor areas maintained by County agencies. A land annexation by the City of Huntington Beach in 2011 greatly reduced the unincorporated county area's exposure to the tsunami threat.

Previous Occurrences

Though infrequent, California has experienced local tsunamis in the past and paleotsunami evidence show major tsunami impact in the recent geologic past. Since 1812, the California coast has had 14 tsunamis with wave heights higher than three feet; six of these were destructive. The Channel Islands were hit by a damaging tsunami in the early 1800s. The worst tsunami recorded impacting Orange County resulted from the 1964 Alaskan earthquake and, in northern California, caused 12 deaths and at least $17 million in damage.

On February 27th, 2010, a magnitude 8.8 earthquake off Chile generated a tsunami that produced 3 foot high waves in Orange County 13 hours later, including breakers that hit storm runoff in the Santa Ana River, briefly producing small, frothy rapids.

On March 11, 2011, a 9.0 earthquake near Tohoku, Japan generated a two foot run up in Huntington Beach and Dana Point and a one foot run up in Newport Beach. Damages were minor with a boat pulled off its mooring and a pylon damaged when hit by a boat.

Probability of Future Occurrence

Deterministic and probabilistic approaches are used to assess tsunami hazard. The deterministic (scenario-based) approach uses a particular source scenario to calculate the ensuing tsunami impact. The products of this method consist of maps depicting the wave height, the coastal inundation and the flow velocity.

The probabilistic approach estimates the likelihood of tsunami impact taking into consideration a broad range of near- and far-field potential sources as well as a treatment of the uncertainties on the hazard assessment. Probabilistic tsunami hazard analysis (PTHA) provides analysis of average return periods (ARPs) for 475-year, 975-year, and 2475-year scale. California statewide tsunami planning is based on inundation limits corresponding to a 975-year ARP.

In both methods, the probability of a significant or mega tsunami is low. Several poorly documented local tsunamis caused some damage to southern California communities in the 1800s. Historic records suggest that three tsunamis produced flooding in the Santa Barbara area during this period.

Impact

Tsunamis can cause great loss of life and property damage where they come ashore. The first wave is almost never the largest; successive waves may be spaced tens of minutes or longer apart and continue arriving for many hours. Field surveys and modeling (1992-1996) by Professor Costas Synolakis of the University of Southern California have projected a 4 meter (13 feet) tsunami that would cause extensive damage and flooding along flat coastlines such as those in Santa Monica Bay or in Orange and San Diego Counties. Communities that are sandwiched between the ocean and other bodies of water such as wetlands, river inlets, or salinas are at very high risk due to the possible overland flow and simultaneous tsunami attacks from multiple directions.

Coastal communities are densely populated, making evacuations especially difficult. Local jurisdictions must determine the number of residents who will require evacuation. Other factors impacting evacuation include the time of day, the time of year, road conditions, tourist population, and sporting and social events. The impact could cause loss of life, destroy thousands of homes, greatly affect coastal businesses, and impact tourism. Even if all residents and visitors were safely evacuated, the damage to property in this densely populated, high property value area would still be tremendous.

There is concern that an event originating in the Cascadia subduction zone may have significant impact on Southern California, similar to those experienced in Crescent City after the 1964 Alaskan earthquake, since, as stated earlier, the distance between Cascadia and Southern California is about the same as the distance from Alaska to Crescent City. The 2009 Orange County Essential Facilities Risk Assessment project ran detailed models on a tsunami coastal flood hazard affecting Orange County. That data can be found in Attachment B – OCEFRA HAZUS Report. In addition, an updated assessment of the total tsunami threat is available in the Quantitative Exposure Analysis section at the end of this chapter.

3.9 Landslide

Nature of Hazard

Landslide is a general term for a falling mass of soil or rocks; vertical movement of small pieces of soil. They are described on the basis of the type of material involved and the type of movement. Material in a landslide mass is either rock or soil (or both). The type of movement describes the mechanics of how the landslide mass is displaced: fall, topple, slide, spread, or flow. Thus landslides are descriptively named: rockfall, debris flow, etc.[30] Orange County also uses the term debris flow, usually in regard to risk of surface soil movement in areas recently burned by wildfire. Since this term is used in official planning documents for such occurrences, it is included here.

Landslides and debris flows are generally associated with rainfall or water saturation. As a general rule in Southern California non-wildfire burn areas, at least 10 inches of seasonal rainfall are needed to make hillsides susceptible to debris flows. Once the seasonal rainfall exceeds 10 inches, intense rainfall—more than 2 inches in 6 hours in the lowlands or more than 4 inches in 6 hours in the mountains—can trigger debris flows. Although the likelihood of debris flows begins to decline after a day or more of dry weather, deeper, generally slow-moving landslides can occur days, weeks, or months after a period of prolonged rainfall has ended.[31]

Landslides can also be caused by earthquakes or human causes.

Location and Extent

Information related to mapped landslide areas is available at the California Department of Conservation web page: http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=landslides. By selecting any mapped landslide area, one can download historical reports.

Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills.
- Steep road-cuts or excavations.
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground).
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels.
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.
- Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.

[30] USGS, The Landslide Handbook - A Guide to Understanding Landslides, accessed 3/29/2021, https://pubs.usgs.gov/circ/1325/pdf/C1325_508.pdf,

[31] USGS, Southern California Landslides—An Overview, accessed 3/26/2021, https://pubs.usgs.gov/fs/2005/3107/pdf/FS-3107.pdf

Map 12 below depicts slope instability across Orange County, using both landslide susceptibility and past landslide areas.

Previous Occurrences

The following landslide accounts comprise only a fraction of the Southern California landslide history. These are provided as a sample for mitigation planning.

1978 Bluebird Canyon, Orange County Landslide

Cost, $52.7 million (2000 dollars) 60 houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the 1978 slide area was approximately 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.

1980 Southern California Landslides

$1.1 billion in damage (2000 dollars). Heavy winter rainfall in 1979-80 caused damage in six Southern California counties. In 1980, the rainstorm started on February 8th. A sequence of 5 days of continuous rain and 7 inches of precipitation fell by February 14th. Slope failures were beginning to develop by February 15th and then very high-intensity rainfall occurred on February 16. As much as 8 inches of rain fell in a 6 hour period in many locations.

1983 (March) San Clemente, Orange County Landslide

On March 1, 1983 a massive storm caused $65 million (2000 dollars) in damage to California Highway 1. Litigation associated with this landslide ultimately cost approximately $43.7 million (2000 dollars).

1983 (December) San Clemente, Orange County Landslide

47 homes damaged, including 10 destroyed, during slide that involved four acres of land on the western side of Verde Canyon.

1993 San Clemente and Dana Point, Orange County Landslide

In February of 1993, 44,000 tons of coastal bluff in San Clemente gave way, sliding 5 homes into Dana Point. Railroads and Pacific Coast Highway (PCH) were blocked; PCH remained closed for 10 months.

1994 Northridge, California Earthquake Landslides

As a result of the magnitude 6.7 Northridge, California, earthquake, more than 11,000 landslides occurred over an area nearly 4,000 square miles. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. They destroyed dozens of homes, blocked roads, and damaged oilfield infrastructure.

1998 Laguna Niguel, Orange County, Landslide

During the 1997/1998 El Nino Season heavy rainfall increased movement on the site of an ancient landslide in Laguna Niguel. The storms in December 1997 had accelerated its movement and in early 1998, a crumbling hillside forced the evacuation of 10 hilltop homes and more than 10 condominium units resting below. Ultimately four of the hilltop homes collapsed, falling down hillside into the void created by the slide area. The condominium complex has since been demolished and the site sits as open space.

Other 1997-1998 Landslides

On December 6, 1997, four homes were condemned and evacuated due to a mud flow and rockfall in Silverado Canyon. Floods and mud flows were reported in Costa Mesa, Irvine, Lake Forest, San Juan Capistrano, and Laguna Beach. mud flows occurred in Black Star, Baker, and Santiago Canyons. Many road closures were reported along the Santa Ana Freeway at Laguna Freeway, Laguna Canyon Road, Pacific Coast Highway in Newport Beach and in Huntington Beach.

On February 6, 1998, a mud flow crushed two cars in Newport Beach. On February 8, high tide and rain caused damage to shoreline properties; nine homes at a mobile home park were damaged in San Clemente. One of these houses was condemned. In Dana Point, the Holiday Inn Express was evacuated when a mud flow flowed into the underground parking structure. Cars flowed out of the building into the street with the mud. In Brea a rock and mud flow closed the Carbon Canyon Road. Other road closures occurred at Pacific Coast Highway, Laguna Canyon Road, and El Toro Road.

On February 23, 1998, the storm forced the evacuation of eight to ten residents in Holy Jim Canyon near the Orange - Riverside County line; a half-dozen other residents declined to move despite the growing slide threat. One home was endangered in Silverado Canyon. On February 24, Carbon Canyon Road was closed in Brea, after a hillside slid across half of the road at the La Vida Hot Springs Resort. On March 3, a landslide forced the evacuation of four homes in the 300 block of Paseo de Cristobal in San Clemente, piled dirt and large boulders onto the railroad tracks and cut off rail service.

2005 Bluebird Canyon Landslide

The Bluebird Canyon landslide in Laguna Beach, California, consisted of a bedrock mass that was sixty to eighty feet deep. Five injuries were confirmed and twenty-eight homes were either destroyed or severely damaged; over 375 homes were directly affected. Rainfall in typical years leading up to the landslide averaged about 12.6 inches of rain, but from July 1, 2004, up until the landslide, there was twice as much rainfall—27.85 inches. Additionally, there were allegations that a home under construction at the time may have contributed to the landslide. Private property damage was estimated between $15 million and $23 million. Over 500 feet of roadway and parallel utilities were destroyed. Waterlines, sewers and storm drains were destroyed.

2007-2008 Post-Santiago Fire Debris Flows

After the Santiago Fire stripped the vegetation bare in the canyon communities of Orange County, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas. There were several cases of mud flows that damaged homes in the Modjeska Canyon area.

2008-2009 Post Freeway Complex Fire Debris Flows

After the Freeway Complex fire stripped the vegetation bare in communities of Yorba Linda and Brea, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas. There were several cases of debris flows the following winters in Yorba Linda and Brea.

2010 Winter Storm Mud Flows

In December 2010, a series of storms passed over Orange County, dropping several inches of rain and triggering a series of mud and debris flows in Orange County canyon and coastal areas. While not specifically associated with a fire or other event, these slides tended to occur in areas already identified as being prone to such activity.

2014-2016 Post Silverado Fire Debris Flows

Following the Silverado Fire in 2014, similar conditions were generated in the Silverado Canyon area of Orange County. There were several cases of small debris and mud flows in canyon areas for the next two winters.

2017-2018 Post Canyon 2 Debris Flows

Following the Canyon 2 Fire in 2017, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas and impacts to Anaheim, Orange and unincorporated areas. There were several cases of small debris and mud flows over the next two winters.

2018-2019 Post Holy Fire Debris Flows

Following the Holy Fire in 2018, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas and impacts to the Trabuco canyon areas. Several significant debris flows occurred in the winter months of 2018-2019 in area of Trabuco Creek.

2020-2021 Post Bond Fire Debris Flows

Following the Bond Fire in 2020, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas and impacts to the Silverado, Williams, and Modjeska Canyon areas. A few small debris and mud flows occurred in the canyon areas from subsequent storms.

Probability of Future Occurrence

Given both the wide geographic extent of the threat and numerous past occurrences discussed above, the probability of future occurrence of landslides in Orange County is likely. Furthermore, the nature of landslides as often being cascade impacts of other hazards such as fire, earthquake, and heavy rain, means they often occur during or after other emergency events that can complicate response efforts.

Impact

The primary effects of landslides can include:

- Abrupt depression and lateral displacement of hillside surfaces over distances of up to several hundreds of feet.
- Disruption of surface drainage.
- Blockage of flood control channels and roadways.
- Displacement or destruction of improvements such as roadways, buildings, and water wells.

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.

Identification of Community Assets and Critical Infrastructure

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include 911 centers, emergency operations centers, police and fire stations, public works facilities, communications centers, sewer and water facilities, hospitals, bridges and roads, and shelters. Critical and essential facilities are those facilities vital to the continued delivery of key government services or having significant impact on the public's ability to recover from an emergency. Map 13 below gives an overview of County-owned facilities. For a complete list, see Attachment C.

County Facility Inventory

Using an inventory list provided by the County Executive Office, Office of Risk Management the HMWG has identified County owned or leased properties and buildings (See Attachment C). The list includes the property or building name, address, city or county, operating organization, year built, gross area, real and personal property value, and any pertinent notes on the property/building. Included in these figures are critical facilities since the County maintains numerous critical facilities vital to the safety and operation of the county area.

The County's property insurance schedule was used to provide values for real property (building). Maintaining the County's property inventory is an ongoing process and the County is continuously working on updates and improvements with the involvement of multiple County agencies. A current list is maintained by the County Executive Office Office of Risk Management.

OCFA Building Inventory

For the 2020 LHMP update, OCFA provided a property list that includes buildings and other assets with building description, address, occupancy type, size, year of construction, and building value. A complete list of OCFA properties is available in Attachment C.

Hospitals

The County of Orange does not own and/or operate hospitals. With the exception of the University of California, Irvine Medical Center, owned and operated by the University of California, all hospitals within Orange County are privately owned and operated. There are no hospitals in the unincorporated area of Orange County.

Vulnerability Assessment

Requirement §201.6(c)(2)(ii): [The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.

Qualitative vulnerability assessments are included in the individual hazard profiles in sections 3.1 to 3.9. Certain hazards, including drought, climate change and epidemic, are considerably more difficult to model and analyze, based on available data. As additional information becomes available, the County of Orange and the Orange County Fire Authority hope to expand exposure analysis and assessment efforts.

Quantitative Exposure Analysis

Based on data availability, a quantitative exposure analysis is possible for most hazards. The County parcel layer, as well as County of Orange and OCFA property inventories were used to assess the potential impact of flood events, wildfires, landslides, tsunami, the failure of Prado Dam, and an earthquake on the San Andreas Fault defined by the USGS ShakeOut scenario. Census blocks from the 2010 Census were used to approximate exposed population estimated. The tables below display the results of these assessments.

☐ **Table 9 – Vulnerability Analysis for Unincorporated Orange County**

Hazard Type	Exposed Population Estimate(2010)	Exposed Residential Parcels	All Other Exposed Developed or Developable Parcels
M7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)	70,902	14,296	563
Wildland Fire (Very High Hazard Area)	53,060	5,753	3,680
500 Year Flood Event	48,884	8,753	274
Landslide	41,961	2,378	2,264
Prado Dam Inundation	36,479	7,162	191
100 Year Flood Event	15,646	127	484
Sea Level Rise (Coastal Flooding)	6,156	1,237	59
Tsunami	547	16	38
Sea Level Rise (MHHW)	348	8	19

☐ **Table 10 – Vulnerability Analysis for Orange County (with City and Unincorporated Areas)**

Hazard Type	Exposed Population Estimate (2010)	Exposed Residential Parcels	All Other Exposed Developed or Developable Parcels
M7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)	1,930,459	350,248	40,770
500 Year Flood Event	1,371,111	218,523	25,525
Prado Dam Inundation	1,254,726	223,158	22,895

Hazard Type	Exposed Population Estimate (2010)	Exposed Residential Parcels	All Other Exposed Developed or Developable Parcels
100 Year Flood Event	384,135	28,300	6,577
Landslide	343,288	26,815	7,389
Wildland Fire (Very High Hazard Area)	280,953	55,733	12667
Sea Level Rise (Coastal Flooding)	182,079	38,414	3,201
Tsunami	79,398	21,549	2,144
Sea Level Rise (MHHW)	59,940	9,774	1,038

☐ **Table 11 -- Vulnerability Analysis for County Facilities**

Hazard Type	Exposed County Facilities	Potential Exposure for County Properties
7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)	332	$1,794,803,157
500 Year Flood Event	180	$1,408,100,598
Prado Dam Inundation	176	$734,550,378
Wildland Fire (Very High Hazard Area)	135	$55,221,235
100 Year Flood Event	113	$40,079,485
Tsunami	81	$125,119,630
Landslide	22	$12,219,590
Sea Level Rise (Coastal Flooding)	21	$63,422,907
Sea Level Rise (MHHW)	5	$1,990,088

☐ **Table 12 – Vulnerability Analysis for OCFA Facilities**

Hazard Type	Exposed OCFA Facilities	Potential Exposure for OCFA Properties
7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)	44	$84,096,717
Prado Dam Inundation	28	$44,691,938
500 Year Flood Event	26	$46,939,258
Wildland Fire (Very High Hazard Area)	11	$22,338,885
100 Year Flood Event	5	$3,015,008
Landslide	2	$5,089,453
Tsunami	1	$920,434
Sea Level Rise (MHHW)	1	$4,801,716
Sea Level Rise (Coastal Flooding)	0	$0

Chapter 4 Hazard Mitigation Strategy

Requirement §201.6(c)(3): *[The hazard mitigation strategy **shall** include a] mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

Hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. This section provides information on the process used to develop the mitigation strategy, based on goals and action items that pertain to the hazards addressed in this LHMP. It also describes the framework that focuses the LHMP on developing successful mitigation strategies.

The plan goals describe the overall direction that Orange County agencies, organizations, and residents can take to minimize the impacts of natural hazards. The goals serve as stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items and help to guide direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items. For the 2020 revision, the HMWG reviewed these goals and reaffirmed they reflect the intended direction of hazard mitigation planning for the County of Orange and the Orange County Fire Authority.

In addition, Orange County residents were asked to weigh in on the value of the individual goals as a component of the public engagement survey conducted during the planning phase of the 2020 LHMP update. Between 94% and 99% of residents surveyed ranked existing goals as being somewhat important or very important.

- **Protect Life and Property**
    - Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to natural hazards.
    - Reduce losses and repetitive damage for chronic hazard events, while promoting insurance coverage for catastrophic hazards.
    - Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.
- **Public Awareness**
    - Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
    - Provide information on tools, partnership opportunities, and funding resources to assist

in implementing mitigation activities.

- **Natural Systems**
  - Balance watershed planning, natural resource management, and land use planning with natural hazard mitigation to protect life, property, and the environment.
  - Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.
- **Partnerships and Implementation**
  - Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in implementation.
  - Encourage leadership within public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities.
- **Emergency Services**
  - Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.
  - Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
  - Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Changes in Priorities

While the goals above remained unchanged from the 2015 LHMP, there were several material changes to the threat landscape in Orange County identified by the HMWG since the last update that influenced their priorities during the planning process. Consideration of these shifts are both reflected in the changes to mitigation action items below and will likely continue to be major factors in the 2025 LHMP Update. They include:

- Orange County, along with most of the world, continues to be engaged in the response to the COVID-19 pandemic. The ongoing nature of the response as of May 2021 has left little time for proper accounting of lessons learned, but it is clear the pandemic will have a fundamental and ongoing impact on all phases of emergency management, but particularly in terms of efforts to mitigate the next epidemic in Orange County.
- Since 2015, Orange County has seen a marked increase in the frequency and severity of wildland fires. In addition, the relationship between wildland fire, debris flow, hot, dry and windy weather and utility considerations like public safety power shutoffs has resulted in increased incident complexity even for smaller events.
- New state regulations following the 2017 Oroville Dam incident have led to a new focus on dam failure planning and mitigation, including inundation mapping and the collaborative development of Dam Emergency Action Plans (EAPs).
- Orange County continues to augment its ability to monitor and understand climate change, especially as a modifier for other existing hazards. This is reflected in the integration of climate change into the hazard analysis and mitigation action item matrix.

Hazard Mitigation Plan Action Items

The action items are a listing of activities in which County agencies and residents can be engaged to reduce risk. The LHMP identifies short- and long-term action items developed through data collection and research, and the public participation process. Mitigation plan activities may be considered for funding through Federal and State grant programs, and when other funds are made available through the County. Action items address multi-hazard and hazard specific issues. To help ensure activity implementation, each action item includes information on the time line and coordinating organizations. Upon implementation, the coordinating organizations may look to partner organizations for resources and technical assistance. A description of the partner organizations is provided in the Resource Directory of this plan.

The process to identify mitigation initiatives for the original plan and this plan update were prepared in a similar manner. Each HMWG member represented their agency and was responsible for gathering and coordinating the information required for their initiatives. Emergency management staff provided planning partners a variety of data to support the development of their mitigation initiatives:

- County of Orange and Orange County Operational Area Unified Emergency Operations Plan, 2019
- County of Orange General Plan, 2005
- County of Orange Comprehensive Annual Financial Report, 2020
- Orange County Essential Facilities Risk Assessment Project Report, 2009
- Anaheim/Santa Ana UASI THIRA, 2019
- California Multi-Hazard Mitigation Plan, 2018
- Southern California Catastrophic Earthquake Response Plan, 2010
- The ShakeOut Scenario (USGS Open File Report 2008-1150), 2008
- Overview of the ARkStorm Scenario (USGS Open File Report 210-1312), 2010
- National Flood Insurance Program Community Rating System Coordinator's Manual, 2013
- Local Mitigation Plan Review Guide, 2011
- Local Mitigation Planning Handbook, 2013
- Integrating Disaster Data into Hazard Mitigation Planning, 2015
- Plan Integration: Linking Local Planning Efforts, 2015
- Mitigation Planning and the Community Rating System Key Topics Bulletin, 2018
- California Adaptation Planning Guide, 2020
- Benefit cost review worksheets and instructions
- Local mitigation initiative template with instructions

The process for evaluating vulnerabilities and identifying a range of alternative mitigation actions to reduce actual and potential hazard exposures varied among agencies depending upon their capabilities and resources. In general, HMWG members collaborated with staff and/or committees within their jurisdictions that were most familiar with their infrastructural systems, facilities, assets, services, or the geographic area being addressed. Local planning partners referenced a variety of materials such as their risk assessment, comprehensive plans, strategic plans, emergency management plans, capital facility plans, after action review debriefings, and other planning documents. The identification processes

considered existing initiatives from the 2015 LHMP and initiatives identified in a different planning process such as a storm water utility capital facilities plan.

Previous Action Items

Requirement §201.6(d)(3)): *A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.*

Many of the items listed in the 2015 plan have been completed, removed or continued due to various reasons. Some continuing projects, particularly where the Orange County Fire Authority is the lead agency, have also been shifted due to changing priorities. 2015 projects and their statuses are listed below.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCPW1	**OCPW1**	Santa Ana River Channel Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, OCFCD, as the sole local sponsor for Prado Dam, is working on acquiring lands, easements, rights-of-way, etc. to enable construction of the Mainstem Project. Work on the Design Documentation Report phase for Santiago Creek (part of the original authorized project) resumed in late 2020. Dredging of the Santa Ana River near the ocean outlet is planned for the future.
OCPW2	**OCPW2**	East Garden Grove-Wintersburg Channel (Facility No. C05) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, Six projects within the 7-Year Flood Control Capital Improvement Plan are undergoing various stages of study or design. These reaches are also part of a major feasibility study where OCPW and USACE are partners. The study was completed in mid-2020. OCPW is committed to continue with projects if there is no Congressional authorization.
OCPW3	**OCPW3**	San Juan Creek Channel (Facility No. L01) Project, Lower Reach - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, Three Capital Improvement Projects were completed in 2019 that include Phases 4, 5, & 6 totaling 8,200 LF of levee protection. An ongoing study to determine ultimate facility improvements that includes the entire system is in progress.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCPW4	**OCPW4**	Trabuco Creek Channel (Facility No. L02) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** Improvements to the reach from 300' downstream of Del Obispo to 2,300 ft. upstream of Del Obispo are planned for the future.
OCPW5	**OCPW5**	Westminster Channel (Facility No. C04) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** The Westminster Watershed Study, completed by the partnership of OCFCD/County and USACE, was completed in July 2020 with a Chief's Report. The recommended federal project was authorized in December 2020 and includes reaches of the Westminster Channel.
OCPW6	**OCPW6**	Santa Ana-Delhi Channel (Facility No. F01) Project, Lower Reach - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, The lower reach including the bridge to Mesa Drive is in preliminary design that includes geotechnical investigation, and work with regulatory agencies and right-of-way acquisition from many stakeholders including a municipal golf course.
OCPW7	**OCPW7**	Oceanview Channel (Facility No. C06) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, This facility is part of a major feasibility study where OCPW and USACE are partners. The study was completed in mid-2020. OCPW is committed to continue with projects if there is no Congressional authorization. USACE completed repairs and minor improvements to restore concrete lining to one reach. OCPW also has an ongoing project as part of the I-405 widening project.
OCPW8	**N/A**	San Diego Creek Channel (Facility No. F05) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Completed**
OCPW9	**OCPW8**	Lane Channel (Facility No. F08) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** The reach from Jamboree to Main Street has been completed, and improvements to other reaches are planned for the future.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCPW10	**OCPW9**	Carbon Creek Channel (Facility No. B01) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, A complex system-wide facility study has been underway to determine needed ultimate improvements. Recommended concepts will be applied to project reaches from upstream of Gilbert Street to Euclid Street and other future project reaches. The study should be completed by the end for 2021.
OCPW11	**OCPW10**	Brea Creek Channel (Facility No. A02) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** Improvements at the Beach Boulevard bridge are planned for the future.
OCPW12	**OCPW11**	Fullerton Creek Channel (Facility No. A03) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, The reach from Western Avenue to downstream of Beach Blvd was completed in 2019. The reach from Beach Blvd. to I-5 Freeway is under construction, with expected completion in summer 2021.
OCPW13	**OCPW12**	Santa Ana-Santa Fe Channel (Facility No. F10) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** Improvements in the reach from confluence with Peters Canyon Channel to Newport Avenue are planned for the future.
OCPW14	**OCPW13**	Santa Ana Gardens Channel (Facility No. F02) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing,** Improvements in the reach from downstream Alton Avenue to Segerstrom Avenue are planned for the future.
OCPW15	**OCPW14**	Bolsa Chica Channel (Facility No. C02) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, Portions of the channel between upstream of SR-22/I-405 Freeways to downstream of Katella Avenue (approximately 0.25 miles of channel) are slated for maintenance repair projects. Work consists of major repair and/or replacement of rock and earthen slopes

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCPW16	**OCPW15**	Peters Canyon Channel (Facility No. F06) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, The City of Tustin constructed the reach from Warner Ave. to Edinger Ave, and the project was completed in 2020. Another project for F06 is currently included in the CIP.
OCPW17	**OCPW16**	Laguna Canyon Channel (Facility No. I02) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Ongoing**, Implementing a permanent solution for repairing the channel that failed in a storm event on February 14, 2019.
OCPW18	**N/A**	Greenville-Banning Channel (Facility No. D03) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Completed**
OCPW19	**N/A**	Barranca Channel (Facility No. F09) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Completed**
OCPW20	**N/A**	Los Alamitos Channel (Facility No. C01) Project - Design and Construction of Flood Control Improvements	Orange County Public Works	**Completed**
OCSD1	**N/A**	Replace Cooling Towers at Theo Lacy Jail Facility	Orange County Sheriff's Department	**Completed**
OCSD2	**N/A**	Replace Emergency Generator at Sheriff Headquarters Facility	Orange County Sheriff's Department	**Completed**
OCSD3	**N/A**	Replace Emergency Generator at Brad Gates Facility	Orange County Sheriff's Department	**Closed,** OCPW assessed the current generator and felt it would continue to handle the needs of the facility.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCSD4	**OCSD1**	Seismic retrofit, ADA compliance upgrade and hazardous material abatement and remediation renovation to HQ	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.
OCSD5	**N/A**	Replace Fire Pumps – Loma Ridge Emergency Operations Center	Orange County Sheriff's Department	**Closed,** a major maintenance refurbishment project was completed and equipment replacement was not required.
OCSD6	**OCSD2**	Brad Gates Building: Replace and Upgrade the Existing UPS System	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.
OCSD7	**OCSD3**	Emergency Operations Center Communications Redundancy Project	Orange County Sheriff's Department	**Ongoing,** this project is currently in design phase. Construction is unfunded at this time.
OCSD8	**OCSD4**	Emergency Operations Center Uninterruptible Power Supply capabilities and coverage	Orange County Sheriff's Department	**Ongoing,** design is 95% complete. Funding is available for construction.
OCSD9	**OCSD5**	Replace Screw Type Chillers at the Coroner Facility	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding. Please note that a major maintenance project was completed to extend the life of the equipment while awaiting funding for equipment replacement.
OCSD10	**OCSD6**	Replace Emergency Generator at Theo Lacy Facility	Orange County Sheriff's Department	**Ongoing,** design has been completed. Construction contract has been awarded.
OCSD11	**OCSD7**	Install Waterless Urinals in all Administrative Areas	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCSD12	**OCSD8**	Install Electro-Mechanical Valves in all Jail Facility Showers and Lavatories	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.
OCSD13	**N/A**	Replace Skins on the JAMF North Compound Inmate Housing Tents	Orange County Sheriff's Department	**Closed,** this facility has been vacated while construction of a new jail underway. It is not likely that inmates will be housed in the tent facilities in the future.
OCSD14	**OCSD9**	Emergency Operations Access Road Widening	Orange County Sheriff's Department	**Ongoing,** this project is in design and will be funded through the County road fund.
OCSD15	**OCSD10**	Complete Seismic Assessments for Sheriff Facilities	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.
OCSD16	**OCSD11**	Bring Sheriff-Coroner Essential Facilities up to Current Essential Building Standards	Orange County Sheriff's Department	**Ongoing,** this project is on the Capital Improvement Project (CIP) prioritization list awaiting funding.
OCSD17	**OCSD12**	Geographic Information Systems Data and Analysis	Orange County Sheriff's Department	**Ongoing**, OCSD Emergency Management Division Continues to leverage the GIS technology and expertise of County GIS team housed within OC Public Works, with ongoing projects using GIS to better understand the hazards that Orange County face and to help integrate the various systems used within the County'e emergency management and Emergency Operations Center functions.
OCSD18	**OCSD13**	Dam Inundation Mapping	Orange County Sheriff's Department	**Ongoing**, Dam Inundation Studies and Emergency Action Plans have been prepared for all OCFCD dams having classifications of "Extremely High", "High" or "Significantly High" Hazard. One study has been approved by DSOD (Villa Park Dam)- and nine are nearing approval. One other is in draft form and the recommendation will be for a lower classification.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCSD19	**OCSD14**	Mass Notification	Orange County Sheriff's Department	**Ongoing,** Orange County continues to refine its multi-system mass notification strategy, including the use of IPAWS, EAS, WEA and other emerging technologies.
OCCR1	**OCCR1**	Niguel Shores Revetment Rehabilitation	OC Parks	**Ongoing**, A permit from the Coastal Commission was denied on February 13, 2020. A revised revetment repair plan is in development.
DPH1	**N/A**	Quay Wall	Dana Point Harbor	**Closed**, Dana Point Harbor Partners, LLC is now responsible for the Quay Wall through their 66-year lease with the County.
OCCR2	**N/A**	Drought Mitigation - Develop a water management plan in the County park and facility system to conserve and efficiently manage water usage.	OC Parks / Facility Operations	**Completed**, OC Parks implemented water conservation signage, increased reclaimed water usage, developed systems to capture rainwater and replaced water intensive landscapes to drought tolerant landscapes.
OCFA1	**OCFA1**	Implementation of a real-time remote sensing and fire monitoring platform to increase the ability to view, respond to, and monitor wildland areas in Orange County AlertWildfire	Orange County Fire Authority	**Ongoing,** A 40 foot Rohn tower was installed to support a remote weather station (RAWS) in Chino Hills State Park which provides early indication of Santa Ana winds and improves situational awareness for Operations. A camera will be installed on the same platform in the next few months. Discussions are underway for a camera in Laguna Beach, and additional areas may be identified to improve this early detection tool.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCFA2	**OCFA2**	Increase communication, coordination and collaboration between Wildland-Urban Interface (WUI) property owners, local and county planners and fire prevention crews and officials to address risk, existing mitigation measures and federal assistance programs	Orange County Fire Authority	**Ongoing**, Legislative changes, code development and the production of the Community Wildfire Protection Plan (CWPP) assist us in engaging everyday business development dealings.
OCFA3	**OCFA3**	Reduce the amount of combustible fuels within identified at-risk communities. This includes outreach, education, and projects to address the infestations of invasive tree pests (ISHB and GSOB) within Orange County	Orange County Fire Authority	**Ongoing**, The OCFA Pre-Fire and Wildland Management Sections continue to coordinate strategic vegetation management projects and develop and expand the READY! SET! GO! Program which is the single point comprehensive wildfire prevention program to accomplish this effort. In addition, OCFA Wildland Section helps to protect communities with strategic vegetation management projects throughout the County with a seasonal handcrew. OCFA heavy equipment continues maintenance of dirt roads within OC to allow access to wildlands for remote rescues, slow progression of wildfires, and help protect communities.
OCFA4	**OCFA4**	Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability	Orange County Fire Authority	**Ongoing**, OCFA has entered into work agreements, partnerships and MOU's with landowners (both public and private) to improve access and reduce hazardous fuel loading. A prescribed burn is planned for the Spring of 2021 with multiple partners conducting studies (ecosystem, diversity, etc.) to further future prescribed burns.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCFA5	**OCFA5**	Evaluate and implement roadway hardening measures on identified high risk roadways in wildland areas in Orange County	Orange County Fire Authority	**Ongoing,** The County of Orange Area Safety Task Force (COAST) has created a map or roadside ignitions and is in continual discussion on best practices for the identified areas. Roadway hardening projects are being discussed. One such project is with cactus planting along Laguna Canyon Road thereby creating a native grass fuel break.
OCFA6	**N/A**	Enhance outreach and education programs aimed at mitigating Wildland-Urban Interface (WUI) hazards thereby reducing the exposure of stakeholders (public and private) to these hazards	Orange County Fire Authority	**Completed,** This is no longer a standalone priority. It has been absorbed into other priorities or actions.
OCFA7	**N/A**	Establish a countywide wildland fire prevention education "Task Force"	Orange County Fire Authority	**Closed**. Lack of staff to implement.
OCFA8	**OCFA6**	Enhance efficiency of Wildland-Urban Interface/Intermix response and recovery activities	Orange County Fire Authority	**Modified and Ongoing**, There is now the Red Flag Firewatch program established and operational throughout the county. As an added tool, the AlertWildfire network can be monitored during wind events. OCFA assists with the training and provides notification to the groups based on weather forecasts from the National Weather Service. Alert OC is in place but is not coordinated by OCFA. Evacuation is a Law Enforcement function.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCFA9	**OCFA7**	Development and dissemination of maps relating to the fire hazard to help educate and assist builders and home owners in being engaged in wildland/urban mitigation activities and to help guide emergency services during response	Orange County Fire Authority	**Ongoing**, OCFA has developed a mapping and inspection application to fulfill this mission. Developed by the OCFA GIS and Wildland Pre-Fire Sections, the OCFA Wildland App is used internally as well as for outreach and education with landowners during inspections. The application has been expanded to include additional information needed during incidents by the Operations section.
OCFA10	**OCFA8**	Seismic Reinforcement for Structural Strengthening of Facilities	Orange County Fire Authority	**Ongoing,** Awaiting grant funding before further work is done to plan details of the seismic reinforcement project. Seismic retrofitting would be conducted on a case by case/station by station basis to determine requirements and cost. Costs would need to include temporary stations as crews would be displaced during project construction. Costs also contingent on decision to meet State's Essential Facility Codes and Standards or minimum requirements for seismic reinforcement.
OCFA11	**OCFA9**	Inventory alternative firefighting water sources and encourage the development of additional sources	Orange County Fire Authority	**Ongoing**, OCFA is working with MWDOC to identify all helicopter accessible water points and is working with GIS Unit on a layer in new mapping system. Working to create additional water sources at Rancho Mission Viejo. Exploring building water points into new park designs. OCFA currently has an MOU with Irvine Water District for helicopter water training activities at Irvine Lake.
OCFA12	**OCFA10**	Educate agency personnel on federal cost-share and grant programs, Fire Protection Agreements and other related federal programs	Orange County Fire Authority	**Ongoing**, Efforts currently underway. Several meetings held with OCFA staff to identify, coordinate and prioritize grant programs and cost-share options.

2015 Plan Project Number	2020 Plan Project Number	Mitigation Action Item	Coordinating Organization	Status
OCHCA1	**N/A**	Enhance detection and reporting of outbreaks and increases in absenteeism in schools.	Orange County Health Care Agency	**Closed,** project no longer a priority.

National Flood Insurance Program

Requirement: §201.6(c)(3)(ii): *[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

In 1968, the US Congress created the National Flood Insurance Program (NFIP). Community participation is voluntary; however, in order to receive funding from the Federal Emergency Management Agency (FEMA), it is a requirement for all communities to participate in the program. OCPW is a long time participant in the program and administers the floodplains within the unincorporated areas of the County. Within the incorporated areas, Orange County cities administer their floodplains. Since the creation of NFIP, OCPW has worked cooperatively with cities in Orange County to reduce the floodplain within the County of Orange by constructing flood control facilities that provide 100-year flood protection. Such facilities typically traverse through the cities and ultimately outlet into the Pacific Ocean.

The County participates in the National Flood Insurance Program (NFIP) that is conducted under the auspices of Federal Emergency Management Agency (FEMA).

Ordinance No. 09-008, of the County of Orange, California, amending sections 7-9-113 through 7-9-113.10 and adding sections 7-9-113.11 and 7-9-113.12 of the codified ordinances of the County of Orange regarding floodplain district regulations was adopted on November 24, 2009.

Orange County worked closely with Region IX in the FEMA Map Modernization process which resulted in digital Federal Insurance Rate Maps (FIRM) dated December 3, 2009. The County worked with FEMA to reach other cities within Orange County.

The Community Rating System (CRS) is an NFIP program that governs the rate of flood insurance for the unincorporated areas of Orange County and consists of certain flood prevention activities. As a condition of membership in good standing, OC Public Works is required to be certified each year that it continues to conduct those activities as part of the CRS program by signing of Form AW-214, CRS Annual recertification of the following activities:

1. Activity 310 – Elevation Certificates
2. Activity 320 – Map Information Service
3. Activity 330 – Outreach Projects

4. Activity 340 – Hazard Disclosure
5. Activity 350 – Flood Protection Information
6. Activity 360 – Flood Protection Assistance
7. Activity 370 – Flood Insurance Promotion
8. Activity 420 – Open Space Preservation
9. Activity 430 – Higher Regulatory Standards
10. Activity 450 – Stormwater Management
11. Activity 440 – Flood Data Maintenance
12. Activity 502 – Repetitive Losses
13. Activity 510 – Floodplain Management Planning
14. Activity 540 – Drainage System Maintenance
15. Activity 610 – Flood Threat Recognition System
16. Activity 630 - Dams

Recertification requires certain documentation from Operations and Maintenance Section in order to complete annual recertification for the CRS activities.

Orange County (unincorporated) as a community is in full compliance with the minimum National Flood Insurance Program requirements as specified in Title 44, Code of Federal Regulations, Section 59, 60.3 through 60.6. Projects that maintain continued compliance with NFIP were also given heavy weight during the prioritization process.

The Orange County Fire Authority is not eligible for the National Flood Insurance Program and has no repetitive loss structures.

For more information on Orange County's exposure to the flood threat, see the vulnerability assessment section in Chapter 3.

Repetitive Loss Structures

Requirement §201.6(c)(2)(ii): *[The risk assessment]* ***must*** *also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.*

According to the National Flood Insurance Program (NFIP), a repetitive loss structure is an insured building that has had two or more losses of at least $1,000 each being paid under the NFIP within any 10-year period since 1978. Within unincorporated Orange County, there are only three structures that currently fit this definition: one in Silverado, one in North Tustin, and one in Cowan Heights. These locations are highlighted on map 14.

Prioritization

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section* ***shall*** *include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization* ***shall*** *include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

The mitigation action items were prioritized by the HMWG. After discussion over several meetings, the members reached consensus on prioritizing action items using the new hazard analysis in Chapter Three of this document. Like the shift away from numeric scoring for the hazards themselves, the HMWG sought to simplify the prioritization for the mitigation items by moving to a clearer three-tiered system based on the hazard being addressed. All projects included in the LHMP are high priority projects.

The 2020 Mitigation Action prioritization tiers are as follows:

2020 LHMP Mitigation Action Prioritization		
Tier One	**Tier Two**	**Tier Three**
• Earthquake • Flood-Storm • Wildland and Urban Fire • Climate Change	• Dam Failure • Epidemic • Drought	• Tsunami • Landslide

☐ **Table 13 -- 2020 LHMP Mitigation Action Prioritization**

FEMA requires local governments to analyze the benefits and costs of range of mitigation actions that can reduce the effects of each hazard within their community. An LHMP must demonstrate that a process was employed that emphasized a review of benefits and costs when prioritizing the mitigation actions. The benefit-cost review must be comprehensive to the extent that it can evaluate the monetary as well as the non-monetary benefits and costs associated with each action. The benefit-cost review should at least consider the following questions:

- How many people will benefit from the action?
- How large an area is impacted?
- How critical are the facilities that benefit from the action (which is more beneficial to protect, the fire station or the administrative building)?
- Environmentally, does it make sense to do this project for the overall community?

The severity of hazards and their impacts vary among the county's agencies due to the varying range of resources and services that they are responsible for providing their customers. As such, their range of mitigation actions for the same hazard will differ substantially. Each plan partner has to consider their agency's exposure, their capabilities, their resources, and select an appropriate process to evaluate the benefits and costs of various mitigation actions.

For the LHMP update process, the HMWG selected a benefit-cost review method known as STAPLEE. STAPLEE is an acronym for the following criteria that are scored according to benefits or costs of any proposed initiative: social, technical, administrative, political, legal, economic, and environmental. The STAPLEE method is outlined in FEMA's how-to guide, *Developing the Mitigation Plan (FEMA 386-3, 2003).* HMWG members were provided a worksheet and instructions for conducting this process. The worksheet provided general criteria but agencies could elect to modify the criteria to fit their needs. Agency staff

scored each mitigation initiative or alternative action according to its benefit (positive score) or cost (negative score) as follows:

Benefit			Cost		
Low, +1	Moderate, +2	High, +3	Low, -1	Moderate, -2	High, -3

The worksheet allowed members to score multiple alternatives mitigation actions to address a particular vulnerability or a hazard, and compare the relative benefits and costs of each of the alternative actions. A final score is tallied for each alternative mitigation initiative by summing the score assigned to each alternative across the criteria. The greater the score, the greater the project benefit. Agencies could use this rating to select a preferred alternative and/or prioritize mitigation actions.

Mitigation Action Item Summary

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

Mitigation action items below represent the combined effort of HMWG members, Orange County Sheriff's Department Emergency Management Division staff and other Orange County subject matter experts and are a result of the process outlined above. Note that many projects mitigate risk from multiple hazards, some of which may not be explicitly listed. For sorting purposes, the primary hazard being addressed is used. Mitigation actions with a connection to climate change impacts are identified in the "Climate Change Impacts" column.

Complete project worksheets are available in Attachment D.

Priority	2020 Status	Project Number	Hazard	Climate Change Impacts	Project Name	Agency
Tier One	Existing	**OCFA8**	Earthquake	No	Seismic Reinforcement for Structural Strengthening of Facilities	OCFA
Tier One	Existing	**OCSD10**	Earthquake	No	Complete Seismic Assessments for Sheriff Facilities	OCSD
Tier One	Existing	**OCSD11**	Earthquake	No	Bring Sheriff-Coroner Essential Facilities up to Current Essential Building Standards	OCSD
Tier One	Existing	**OCPW1**	Flood	Yes	Santa Ana River Channel Project	OCPW
Tier One	Existing	**OCPW2**	Flood	Yes	East Garden Grove-Wintersburg Channel (Facility No. C05) Project	OCPW
Tier One	Existing	**OCPW3**	Flood	Yes	San Juan Creek Channel (Facility No. L01) Project, Lower Reach	OCPW
Tier One	Existing	**OCPW4**	Flood	Yes	Trabuco Creek Channel (Facility No. L02) Project	OCPW
Tier One	Existing	**OCPW5**	Flood	Yes	Westminster Channel (Facility No. C04) Project	OCPW
Tier One	Existing	**OCPW6**	Flood	Yes	Santa Ana-Delhi Channel (Facility No. F01) Project, Lower Reach	OCPW
Tier One	Existing	**OCPW7**	Flood	Yes	Oceanview Channel (Facility No. C06) Project	OCPW
Tier One	Existing	**OCPW8**	Flood	Yes	Lane Channel (Facility No. F08) Project	OCPW
Tier One	Existing	**OCPW9**	Flood	Yes	Carbon Creek Channel (Facility No. B01) Project	OCPW
Tier One	Existing	**OCPW10**	Flood	Yes	Brea Creek Channel (Facility No. A02) Project	OCPW
Tier One	Existing	**OCPW11**	Flood	Yes	Fullerton Creek Channel (Facility No. A03) Project	OCPW
Tier One	Existing	**OCPW12**	Flood	Yes	Santa Ana-Santa Fe Channel (Facility No. F10) Project	OCPW
Tier One	Existing	**OCPW13**	Flood	Yes	Santa Ana Gardens Channel (Facility No. F02) Project	OCPW
Tier One	Existing	**OCPW14**	Flood	Yes	Bolsa Chica Channel (Facility No. C02) Project	OCPW
Tier One	Existing	**OCPW15**	Flood	Yes	Peters Canyon Channel (Facility No. F06) Project	OCPW
Tier One	Existing	**OCPW16**	Flood	Yes	Laguna Canyon Channel (Facility No. I02) Project	OCPW
Tier One	New	**OCPW17**	Flood	Yes	Huntington Beach Channel (Facility No. D01) and Talbert Channel (Facility No. D02) Project	OCPW
Tier One	New	**OCPW18**	Flood	Yes	Houston Storm Channel (Facility No. A03S02) Project	OCPW
Tier One	New	**OCPW19**	Flood	Yes	Gisler Storm Channel (Facility No. D03S03) Project	OCPW
Tier One	New	**OCPW20**	Flood	Yes	Paularino Channel (Facility No. F03) Project	OCPW
Tier One	Existing	**OCCR1**	Flood, Landslide	Yes	Niguel Shores Revetment Rehabilitation	OCCR
Tier One	Existing	**OCFA10**	Multi-Hazard	Yes	Educate agency personnel on federal cost-share and grant programs, Fire Protection Agreements and other related federal programs	OCFA
Tier One	New	**OCSD15**	Multi-Hazard	Yes	Develop a comprehensive and accessible multi-hazard public education campaign	OCSD

Priority	2020 Status	Project Number	Hazard	Climate Change Impacts	Project Name	Agency
Tier One	Existing	**OCSD2**	Multi-Hazard, including Earthquake	Yes	Brad Gates Building: Replace and Upgrade the Existing and UPS System	OCSD
Tier One	Existing	**OCSD6**	Multi-Hazard, including Earthquake	Yes	Replace Emergency Generator at Theo Lacy Facility	OCSD
Tier One	Existing	**OCSD1**	Multi-Hazard, including Earthquake and Wildland Fire	No	Seismic retrofit, ADA compliance upgrade and hazardous material abatement and remediation renovation to HQ	OCSD
Tier One	Existing	**OCSD3**	Multi-Hazard, including Earthquake and Wildland Fire	Yes	Emergency Operations Center Communications Redundancy Project	OCSD
Tier One	Existing	**OCSD4**	Multi-Hazard, including Earthquake and Wildland Fire	Yes	Emergency Operations Center Uninterruptible Power Supply capabilities and coverage	OCSD
Tier One	Existing	**OCSD12**	Multi-Hazard, including Flood, Dam Failure, Landslide and Tsunami	Yes	Geographic Information Systems Data and Analysis	OCSD
Tier One	Existing	**OCSD9**	Multi-Hazard, including Landslide and Wildland Fire	Yes	Emergency Operations Access Road Widening	OCSD
Tier One	Existing	**OCSD14**	Multi-Hazard, including Tsunami, Wildland Fire and Dam Failure	Yes	Mass Notification	OCSD

Priority	2020 Status	Project Number	Hazard	Climate Change Impacts	Project Name	Agency
Tier One	Existing	**OCFA1**	Wildland Fire	Yes	Implementation of a real-time remote sensing and fire detection platform to increase the ability to detect, respond to, and monitor wildland areas in Orange County.	OCFA
Tier One	Existing	**OCFA2**	Wildland Fire	Yes	Increase communication, coordination and collaboration between Wildland-Urban Interface (WUI) property owners, local and county planners and fire prevention crews and officials to address risk, existing mitigation measures and federal assistance programs.	OCFA
Tier One	Existing	**OCFA3**	Wildland Fire	Yes	Reduce the amount of combustible fuels within identified at-risk communities	OCFA
Tier One	Existing	**OCFA4**	Wildland Fire	Yes	Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.	OCFA
Tier One	Existing	**OCFA5**	Wildland Fire	Yes	Evaluate and implement roadway hardening measures on identified high risk roadways in wildland areas in Orange County	OCFA
Tier One	Existing	**OCFA6**	Wildland Fire	Yes	Enhance efficiency of Wildland-Urban Interface/Intermix response and recovery activities.	OCFA
Tier One	Existing	**OCFA7**	Wildland Fire	Yes	Development and dissemination of maps relating to the fire hazard to help educate and assist builders and home owners in being engaged in wildland/urban mitigation activities and to help guide emergency services during response.	OCFA
Tier One	Existing	**OCFA9**	Wildland Fire	Yes	Inventory alternative firefighting water sources and encourage the development of additional sources	OCFA
Tier Two	New	**OCHCA1**	Epidemic	No	Enhance detection and reporting of C. auris in Long-Term Care Facilities	OCHCA
Tier Two	Existing	**OCSD13**	Dam Failure	Yes	Dam Inundation Mapping	OCSD
Tier Two	Existing	**OCSD5**	Drought	Yes	Replace Screw Type Chillers at the Coroner Facility	OCSD
Tier Two	Existing	**OCSD7**	Drought	Yes	Install Waterless Urinals in all Administrative Areas	OCSD
Tier Two	Existing	**OCSD8**	Drought	Yes	Install Electro-mechanical Valves in all Jail Facility Showers and Lavs	OCSD

Chapter 5 Plan Maintenance

Requirement §201.6(c)(4)(i): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

Coordinating Body

The County of Orange HMWG will be responsible for coordinating implementation of LHMP action items and undertaking the formal review process. The HMWG will coordinate with the Emergency Management Council (Orange County's Disaster Council) and the Emergency Management Council Subcommittee to facilitate annual review and updates. The Orange County Fire Authority is a participant in both oversight bodies.

Convener

The Orange County Sheriff's Department Emergency Management Division will serve as the convener to facilitate the HMWG meetings, and will assign tasks such as updating and presenting the LHMP to the members of the committee. Plan implementation and evaluation will be a shared responsibility among all HMWG members. The Orange County Sheriff's Department Emergency Management Division will conduct annual reviews of the LHMP as well as facilitate formal plan updates every five years.

Adopting, Monitoring, and Updating the Hazard Mitigation Plan

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

The LHMP is monitored and evaluated on an annual basis to determine the effectiveness of programs, and to assess changes in land development or programs that may affect mitigation priorities. The evaluation process includes a firm schedule and timeline, and identifies the local agencies and organizations participating in LHMP evaluation. The Orange County Sheriff's Department, Emergency Management Division, will be responsible for contacting HMWG members and organizing the annual meeting in August of each year, usually in coordination with the Emergency Management Council. HMWG members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the LHMP.

The HMWG will review the goals and action items, public feedback, and changes in State or Federal policy, to ensure they are addressing current and expected conditions. The HMWG will also review the risk assessment portion of the Plan to determine if it requires updates, given any newly available data. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and any necessary revisions. Orange County Public Works will also ensure that a Project Status Report is completed annually for each mitigation project listed (See Attachment D for Project Status Reports). These updates will be approved by the Emergency Management Council as part of the annual update process as an attachment to the LHMP.

The Orange County Sheriff's Department, Emergency Management Division will assign the duty of updating the LHMP to one or more of the HMWG members. The designated members will have 30 days to make appropriate changes to the LHMP before submitting it to the HMWG, and presenting it to the County Emergency Management Council for approval. All updates within the five year revision cycle will be adopted by the County Emergency Management Council. The HMWG will also notify all holders of the LHMP when changes have been made. Every five years, the updated LHMP will be submitted to the State Hazard Mitigation Officer by the County Emergency Manager. The California Office of Emergency Services will then submit the LHMP to the Federal Emergency Management Agency (FEMA) for review. Once approved by

FEMA, the updated LHMP is adopted by the County Board of Supervisors and the Orange County Fire Authority Board of Directors.

Incorporating Mitigation Into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): *[The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Each agency will be responsible for implementation of their individual mitigation action items based on agency priorities and the availability of funding and other resources. The mechanism for implementation through existing programs will vary between agencies and departments.

Orange County addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans, and County Building and Safety Codes. Each of these processes involves and requires public notification and involvement. The LHMP provides a series of recommendations--many of which are closely related to the goals and objectives of existing planning programs. Orange County Public Works will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

OCFA will incorporate data and recommendations from the Local Hazard Mitigation Plan into its operational plans, standard operating procedures and capital improvement plan, as appropriate, as well as the Unit Strategic Fire Plan and Countywide Community Wildfire Protection Plan. OCFA will integrate the information and actions from the LHMP into its existing planning processes and structures, including its collaboration with partner agencies as the local, state and federal level. In addition, it will leverage existing planning and mitigation programs with landowners and other private sector partners to implement the mitigation strategies and actions described in the Plan.

The LHMP has been incorporated into the Safety Element of the General Plan by the County Board of Supervisors, as required by state law. The County/OA EOP is also a partner document and uses much of the vulnerability assessment information available in the LHMP. These comprehensive plans are updated regularly, as required by various state and federal laws.

Orange County Public Works is responsible for administering Building and Safety Codes. In addition, the HMWG will work with other agencies at the state level to review, develop and ensure Building and Safety Codes that are adequate to mitigate or present damage by natural hazards. This is to ensure that life-safety criteria are met for new construction. While the County of Orange is also responsible for adopting Fire Codes, the Orange County Fire Authority is responsible for implementation and enforcement in the County's unincorporated areas.

The goals and action items in the LHMP may be achieved through activities recommended in the County's Capital Improvement Projects (CIP). Various County departments develop plans, and review them on an annual basis. Upon annual review of the Capital Improvement Projects, the HMWG will work with the County departments to identify areas where the LHMP action items are consistent with CIP planning goals and integrate them where appropriate. Many of the action items listed in the LHMP are directly related to CIP.

Within six months of formal adoption of the LHMP, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the County level. The meetings of the HMWG will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into County

planning documents and procedures. The HMWG will also keep the Emergency Management Council apprised of progress and recommendations related to hazard mitigation at its quarterly meetings, and elsewhere as appropriate. Serving as the County's Disaster Council, the EMC includes representation from County agencies and the Orange County Fire Authority.

Flood Event Post-Disaster Policies and Procedures / Action Items

The Community will identify the operations and strategies to allow more effective post-disaster recovery. Much of the County's most vulnerable areas, as mentioned in Section 3.1, include areas within the cities of Westminster, Garden Grove, Fountain Valley, Huntington Beach, Seal Beach, San Juan Capistrano, and Laguna Beach. The most vulnerable areas within unincorporated Orange County include the canyon areas which will be the focus of post-disaster action items.

To reduce long-term vulnerability and to become more resilient in future disasters, mitigation actions such as effective building code adoption and enforcement, will be applied in the post-disaster recovery activities by our community. A post-disaster planning committee should be formed that includes representatives of all affected communities where flooding had occurred.

Individuals that may be needed for post disaster activities should be trained, made aware of their potential assignments, review mutual aid agreements for negotiation and approval for fire and police departments.

Repairs to buildings located within the 100-year floodplain will comply with the local laws for floodplain development, which specify that structures that are substantially damaged (cost of restoring the structure to its before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred) will only be rebuilt if they are brought into compliance with the latest floodplain development standards.

Plan Review and Update

Following a major flood event or any other major hazard event, the LHMP will be reviewed and revised as necessary to reflect lessons learned or to address specific issues and circumstances arising from the event. It will be the responsibility of the Floodplain Administrators to reconvene the Post-Disaster Planning Committee and to ensure that appropriate stakeholders are invited to participate in the revision and update process following any emergency or disaster events. In addition, the Committee should evaluate which actions from the LHMP may be appropriate for implementation during the post-disaster period as resources and needs become clear.

Flood Event Post-Disaster Action Items

Activity	*Agency/Department*	*Timeframe*
Review the mutual aid agreements between the County and communities regarding post disaster actions and revise as appropriate to include code enforcement departments, planning departments and public information officers.	Emergency Management Departments from affected Municipalities	3 months
Prepare brochures or fliers that address post disaster actions by property owners. Disseminate information about flood-proofing, building elevation, relocation, and other property	Public Information Officers (PIOs) -Multi-agency	6 months

Activity	*Agency/Department*	*Timeframe*
protection measures. Many publications are available from State and Federal agencies. Prepare and distribute notices to property owners and renters, advising them of the types of insurance available. Ensure the public is aware of actions it should be taking to mitigate damages as well as encouraging property owners and renters to work with their insurance agents to help cover their losses		
Conduct preliminary damage assessment to include creation of a map that provides locations and collected data with photos identifying all damaged structures	Affected Cities and OC Public Works	4 months
Advise code enforcement (CE) departments of areas affected by the flood for further evaluation by CE. Determine the extent of damages, including whether the structures are substantially damaged as defined in the ordinances of each affected community	Affected Cities, County Emergency Managers and OC Public Works Building & Safety	3 months
Evaluate the suitability of rebuilding damaged structures in unincorporated Orange County and make recommendations to property owners.	OC Public Works	3 months
Review the LHMP to determine if any revisions are needed.	Hazard Mitigation Working Group	Within 6 months of Presidential or state declared disaster
Provide outreach to the affected communities informing them of the risks of floods and how to prepare for future events	OC Public Works	3 months
Ensure that residents have the proper permits before repairing structures and ensuring that the repair is completed according to Orange County codes	OC Public Works	As Needed (within 5 years)

Activity	*Agency/Department*	*Timeframe*
Determine appropriate mitigation actions given the extent of damages. Consider redevelopment of standards and determine whether any temporary permit and construction moratoriums need to be established. Determine whether necessary to modify the LHMP or to revise/modify codes or ordinances.	OC Public Works	1 year
Determine funding that is available to assist the owners in mitigating future damages. Identify potential opportunities to pursue Section 406 mitigation projects under the FEMA Public Assistance Grant Program	OC Public Works	1 year
Determine extent of damages (system-wide or isolated reach) to OCFCD flood control channels, roadways and bridges and other county facilities and study to repair or replace/improve facility.	Affected County Agencies and OC Public Works	1 month
Extensive replacement/improvements to County public facilities require incorporation into respective CIP's or alternative funding. Seek grant opportunities through DWR and FEMA and apply for grants as appropriate and develop project applications as appropriate.	Affected County Agencies and OC Public Works	2 to 5 years
Work with the State and FEMA to collect important flood data like high water marks	OC Public Works	6 months
Evaluate the need to update FIRMs for the areas that flooded	OC Public Works	3 years

Continued Public Involvement

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.*

The Orange County Emergency Management Council (EMC) is committed to continued public involvement and education. The EMC meets quarterly in a public meeting to discuss emergency management related issues, including hazard mitigation. It will be important that natural hazards mitigation continues to be integrated into existing programs and is part of the way jurisdictions make decisions about land use and facilities planning. As mentioned in the preceding section, General Plan amendment processes as well as capital improvement planning both have elements of public notification and involvement. These local plans require updating regularly with an associated public process. These processes will

provide a venue that promotes public dialogue regarding the importance of hazard mitigation.

As was the case during this LHMP update, every plan update will include a review of the County's General Plan and Capital Improvement Plans to assure consistency between all planning efforts. It will be important to identify where and how hazard mitigation planning initiatives have been integrated in the General Plan and Capital Improvement Plans.

The Emergency Management Council will also need to encourage its governmental entities to combine the natural hazards plan elements into existing emergency preparedness activities and information in order to continue to educate the public on the importance of managing the risk for natural hazards. If there are efforts to re-write emergency preparedness public information (such as brochures), integration of natural hazards mitigation information will be considered. The County/OA EOP will continue to integrate hazard mitigation planning into that document and associated public education efforts.

There is constant public engagement with the county residents through emergency management staff participation at public safety and preparedness fairs, the annual Orange County Fair, community preparedness meetings, Orange County Fire Authority town hall meetings, and other opportunities as they arise.

The public will also continue to have the opportunity to provide feedback about the LHMP. Copies of the LHMP will be catalogued and kept at the Orange County Hall of Administration and at all County-operated public libraries. The LHMP also includes the address and the phone number of the Orange County Sheriff's Department Emergency Management Division, responsible for keeping track of public comments on the LHMP. In addition, copies of the LHMP and any proposed changes will be posted on the Orange County Sheriff's Department Emergency Management website. This site will also contain an email address to which the public can direct their comments and concerns.

Since 2015, the Emergency Management Division has continued to foster public involvement in the hazard mitigation process, both through existing meetings with stakeholders, like the Orange County Emergency Management Organization, Collaborating Organizations Active in Disasters, and the Disabilities and Access and Functional Needs Working Group, and through direct outreach to the public through the Emergency Management Division's digital presence and at public events. This process has continued to yield constructive feedback and participation in ongoing Orange County hazard mitigation planning.

Moving forward, the Emergency Management Division will continue to augment its efforts to maximize public engagement in the mitigation process. Due to the ongoing COVID-19 pandemic, the HMWG's ability to engage and solicit feedback from members of the public during the 2020 revision cycle was limited to digital means. While the public provided excellent feedback through our digital survey and document review requests via social media, there is no substitute for in-person interaction and engagement, especially with such a diverse set of unincorporated areas. When able, the County will develop and execute a strategy to re-engage the public as a key partner in hazard mitigation, beyond the socially distanced methods available through most of 2020 and 2021. This work will be coordinated through the HMWG and the Emergency Management Council.

Chapter 6 Local Capability Assessment

Planning and Regulatory Resources – County of Orange

Plan/Regulation	Yes/No	Comments
General Plan	Yes	General Plan (2005, with Amendments)
Safety Element of General Plan	Yes	Last Updated, 2013. Currently under active revision by OCPW Development Services. Update will include section on climate change and supports the implementation of mitigation actions.
Zoning Ordinance	Yes	Section 7-9-2 of the Orange County Code of Ordinances - The Comprehensive Zoning Code, Ordinance 20-006 approved July 2020
Subdivision Ordinance	Yes	Section 7-9-3 of the Orange County Code of Ordinances - The Subdivision Code. Ordinance 15-021 approved December 2015
Building Code	Yes	Ordinance 19-006: Adopting California Building Code 2019 Edition
Fire Code	Yes	Ordinance 19-010: Adopting California Fire Code 2019 Edition
OC Public Works and Community Resources Seven Year Capital Improvement Program	Yes	Approved on May 25, 2021 by County Board of Supervisors. Mitigation actions may involve construction of new or upgraded County facilities and infrastructure.
Orange County Five-Year Capital Improvement Plan	Yes	Capital Improvement Plan is component of County Strategic Financial Plan, last updated 2020
Storm Water Management Plan	Yes	Drainage Area Management Plan, Updated in 2011
Unified County of Orange and Orange County Operational Area Emergency Operations Plan (County/OA EOP)	Yes	Last Updated 2021
Flood Annex to the County/OA EOP	Yes	Last Updated 2019
Disease Outbreak Response Annex to the County/OA EOP	Yes	Last Updated 2017, the Disease Outbreak Response Annex to the Unified County and OA EOP consolidates the dynamic and changing guidance and procedures that support the County's preparedness and response efforts for a major outbreak of disease. As of May 2021, this document is currently being revised to reflect the lessons learned from the ongoing COVID-19 pandemic and will be critical in guiding and improving the County's mitigation activities for the next epidemic.
Tsunami Annex to the County/OA EOP	Yes	Last Updated 2018
Threat and Hazard Identification and Risk Assessment	Yes	Last Updated 2020
Orange County Fire Authority ISO Rating	Yes	Rating: 1-3, varies by Geographic Division

Planning and Regulatory Resources – Orange County Fire Authority

Plan/Regulation	Yes/No	Comments
Fire Code	Yes	Ordinance 19-010: Adopting California Fire Code 2019 Edition (Adopted by County Board of Supervisors,

		enforcement in unincorporated areas by the Orange County Fire Authority) Mitigation actions that pertain to new or remodeled structures can be adopted into the Fire code.
Orange County Fire Authority ISO Rating	Yes	Rating: 1-3, varies by Geographic Division

Administrative and Technical Resources – County of Orange

Resource /Tool	Comments
Orange County Health Care Agency (OCHCA)	https://www.ochealthinfo.com/
OCHCA Health Emergency Management	Coordinates the agency's emergency response functions and preparedness activities for all hazards
OCHCA Public Health Services	Provides information and services related to communicable diseases, immunizations, and public health nursing
OCHCA Environmental Health Division	Provides information and services related to food safety, water quality, and hazardous waste
Orange County Public Works (OCPW)	https://ocpublicworks.com/
OCPW Geospatial Services	Manages County's Geographic Information Systems (GIS) resources
OCPW Watershed & Coastal Resources	Protects property and promotes public safety
OCPW Development Services	Oversees the planning and development entitlement requirements for private and public projects within the County's unincorporated areas
OCPW Environmental Resources	Provides near real-time rainfall accumulations for Orange County
OCPW Infrastructure Programs (IP)	Engineering for roadways in unincorporated areas and regional and sub-regional flood control facilities.
OCPW IP Flood Programs	Provides data and prepares studies related to OCFCD flood control facilities: hydrology including post fire flows, facility capacity, compliance with regulatory requirements for dam inundation and levees accreditation.
OCPW Department Operations Center ("Storm Center")	Activated when heavy to extreme rainfall is predicted or occurs and/or when storm run-off conditions are such that there is a probability of flood damage
OCPW Agricultural Commissioner	Enforces state-mandated agricultural regulations, including pest and disease prevention and weed and vegetation abatement
Orange County Planning Commission	Recommend, hear and approve plans and amendments to General Plan, Zoning Code, zoning map, specific plans, area plans and other documents
Orange County Assessor	Maintains property and parcel information and reports, produces property tax assessment rolls
Orange County Waste & Recycling	https://oclandfills.com/
Municipal Solid Waste & Disaster Debris Disposal	OC Waste & Recycling serves the County's solid waste disposal needs by accepting municipal solid waste at three active landfills. OCWR has established procedures to request an emergency waiver from the local enforcement agency allowing the acceptance of non-hazardous disaster debris generated by a disaster.
Household Hazardous Waste Disposal	OC Waste & Recycling serves the County's household hazardous waste disposal needs by operating four Household Hazardous Waste Collection Centers, which provide a convenient and free means for County residents to safety dispose of household hazardous waste.
Orange County Sheriff's Department (OCSD)	https://www.ocsheriff.gov/
OCSD Emergency Management Division (EMD)	Provides emergency management and preparedness services to Orange County and supports the implementation

	of mitigation actions through coordination with County agencies and other partners.
AlertOC	Orange County's Mass Notification System

Administrative and Technical Resources – Orange County Fire Authority

Resource /Tool	Comments
OCFA Emergency Planning and Coordination	Oversees emergency management coordination and mutual aid agreements
OCFA Community Risk Reduction	Adopts and enforces codes and ordinances relative to fire and life safety issues. Mitigation actions related to wildfire preparedness and enforcing and educating about applicable fire codes and ordinances can be implemented by OCFA Community Risk Reduction.

Financial Resources – County of Orange

Financial Resource	Access/Eligibility	Comments
Capital improvements project funding	Yes	Orange County Property taxes collected bi-annually as Special District
Authority to levy taxes for specific purposes	Yes	Orange County Flood Control Act
Impact fees for new development	Yes	
Incur debt through general obligation bonds and/or special tax bonds	With voter approval	
Community Development Block Grant	Yes	
Hazard Mitigation Grant Program	Yes	HMGP provides funding to take critical mitigation measures to reduce the risk of loss of life and property from future disasters during the reconstruction process following a disaster. This funding presents opportunities to expand hazard mitigation activities.
Pre-Disaster Mitigation Grant	Yes	
Flood Mitigation Assistance	Yes	FMA assists communities in planning and executing mitigation activities to reduce the risk of flood damage to NFIP insurable structures.
Emergency Management Performance Grant	Yes	
Fire Management Assistance Grant	Yes	
USACE Federal Appropriations	Yes	Funding for Santa Ana River and possibly other projects
CA Dept. of Water Resources Grants	Yes	Proposition 84 and others

Financial Resources – Orange County Fire Authority

Financial Resource	Access/Eligibility	Comments
OCFA General Fund	Yes	Primary operating fund for OCFA
OCFA Capital Projects Funds	Yes	Funds for capital outlays, including the acquisition or construction of major capital facilities and other capital assets
Hazard Mitigation Grant Program	Yes	Mitigation actions identified in the LHMP may be eligible for financial support from the HMGP
Fire Management Assistance Grant	Yes	

Education and Outreach Resources – County of Orange

Program/Organization	Yes/No	Comments
Radio Amateur Civil Emergency Service (RACES)	Yes	Supported by the Orange County Sheriff's Department, RACES is a group of licensed volunteer radio operators that who provide support and expertise during emergencies, exercises and other events.
Disabilities and Access and Functional Needs Working Group	Yes	Planning and advisory body supported by the Emergency Management Division that provides input and expertise that aids in making Orange County's emergency management program more inclusive of people with disabilities and access and functional needs through partnerships with community organizations and service providers. Collaboration with the DAFN WG can be used to leverage community resources to improve inclusive mitigation actions.
Collaborating Organizations Active in Disaster	Yes	COAD-OC focuses on coordinating between the private sector, nonprofit and community-based organizations, and government agencies to support response and recovery operations through use of volunteer and material resources, and to assist with long-term recovery by identifying emerging and unmet needs of the community. Coordination with COAD member organizations can aid in expanding expertise and labor resources available to expand available mitigation actions.
Orange County Citizen Corps Council	Yes	The Orange County Citizen Corps Councils, which bring together leaders from law enforcement, fire, emergency medical and other emergency management, volunteer organizations, local elected officials, the private sector, and other community stakeholders to organize public education on disaster mitigation and preparedness.
StormReady Certification	Yes	The StormReady program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.
TsunamiReady Certification	Yes	TsunamiReady is a voluntary community recognition program that promotes tsunami hazard preparedness as an active collaboration among federal, state/territorial and local emergency management agencies, community leaders and the public.

Education and Outreach Resources – Orange County Fire Authority

Program/Organization	Yes/No	Comments
Firewise Communities	Yes	Orange County is home to multiple Firewise Communities. This program provides a collaborative framework to help neighbors in a geographic area to get organized, find direction, and take action to increase the ignition resistance of their homes and community and to reduce wildfire risks at the local level.
County of Orange Area Safety Task Force (COAST)	Yes	COAST is coalition of public agencies, local jurisdictions, landowners, land managers and other organizations impacted by wildfire in Orange County. Mitigation actions can be implemented by or coordinated

		with COAST partners for maximum effectiveness and to expand capabilities.
Ready, Set, Go! Program	Yes	This public education program helps community members be *Ready* with preparedness understanding, be *Set* with situational awareness when fire threatens, and to *Go*, acting early when a fire starts.

Chapter 7 Appendices

Appendix A: List of Acronyms

Appendix B: List of Maps

Appendix C: List of Figures

Appendix A – List of Acronyms

Acronym	Definition
A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
AASHTO	American Association of State Highway and Transportation Officials
AB	Assembly Bill (State of California)
ACOE	US Army Corps of Engineers
ALERT	Automated Local Evaluation in Real Time
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ARP	Accidental Risk Prevention
ATC	Applied Technology Council
ATC20	Applied Technology Council Form 20
ATC21	Applied Technology Council Form 21
ATWC	Alaska Tsunami Warning Center
B/CA	Benefit/Cost Analysis
BCP	Budge Change Proposal
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BMP	Best Management Practices
BNSF	Burlington Northern Santa Fe Railway
BOS	Board of Supervisors
BSA	California Bureau of State Audits
BSSC	Building Seismic Safety Council
CAER	Community Awareness & Emergency Response
CAL TECH	California Institute of Technology
ALARP	California Accidental Release Prevention
CALBO	California Building Officials
Cal OES	California Office of Emergency Services
CALEPA	California Environmental Protection Agency
CALREP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
CALTRANS	California Department of Transportation
CBA	Cost Benefit Analysis
CBO	Community Based Organization
CBSP	Commuter Bikeways Strategic Plan
CD	Civil Defense
CDBG	Community Development Block Grant
CDEC	California Data Exchange Center (DWR)
CAL FIRE	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEO	Chief Executive Officer
CEPEC	California Earthquake Prediction Evaluation Council
CERT	Community Emergency Response Team
CESRS	California Emergency Services Radio System
CFR	Code of Federal Regulations
CFS	Cubic Feet Per Second
CHIP	California Hazardous Materials Identification Program
CHMIRS	California Hazardous Materials Incident Reporting System
CHP	California Highway Patrol
CIP	Capital Improvement Projects
CIWMB	California Integrated West Management Board
CLETS	California Law Enforcement Telecommunications System
CRS	Community Rating System
CSTI	California Specialized Training Institute
CUEA	California Utilities Emergency Association
CUPA	Certified Unified Program Agency
DAC	Disaster Application Center
DAD	Disaster Assistance Division (of Cal OES)
DAE	Disaster Assistance Employee
DAMP	Drainage Area Management Plan
DCO	Defense Coordinating Officer
DFO	Disaster Field Office
DGS	California Department of General Services
DHS	Department of Homeland Security (US Government)

DHSRHB	California Department of Health Services, Radiological Health Branch
DMA	Disaster Mitigation Act
DMG	California Division of Mines and Geology
DO	Duty Officer
DOC	Department Operations Center
DOE	Department of Energy (US)
DOF	California Department of Finance
DOJ	California Department of Justice
DPA	California Department of Personnel Administration
DPIG	Disaster Preparedness Improvement Grant
DR	Disaster Response
DSA	Division of the State Architect
DSR	Damage Survey Report
DSW	Disaster Service Worker
DWR	California Department of Water Resources
EAP	Emergency Action Plan
EAS	Emergency Alerting System
EDA	Economic Development Administration
EDC	Economic Development Commission (Orange County)
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EICC	Emergency Information Coordination Center (FEMA)
EM	Emergency Management
EMA	Emergency Management Assistance
EMD	Emergency Management Division (OCSD)
EMC	Emergency Management Council (Orange County)
EMI	Emergency Management Institute
EMMA	Emergency Managers Mutual Aid
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency (US)
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ER	Emergency Relief
ERT	Emergency Response Team
ESC	Emergency Services Coordinator
ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FAST	Field Assessment Team
FAY	Federal Award Year
FCO	Federal Coordinating Officer (FEMA)
FDAA	Federal Disaster Assistance Administration
FEAT	Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FHWA	Federal Highway Administration
FIR	Final Inspection Reports
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Studies
FMA	Flood Mitigation Assistance (FEMA Program)
FP	Flood Plan
FRP	Federal Response Plan
FSR	Feasibility Study Report
FTE	Full Time Equivalent
FY	Fiscal Year
GIS	Geographic Information System
GMA	Growth Management Act
GNS	Institute of Geological and Nuclear Science (International)
GSA	General Services Administration
HAD	Housing and Community Development (alternate - see HCD)
HAZMAT	Hazardous Materials
HAZMIT	Hazardous Mitigation
HAZUS	Hazards US
HCA	Health Care Agency
HCD	Housing and Community Development (alternate - see HAD)
HEICS	Hospital Emergency Incident Command System
HEPG	Hospital Emergency Planning Guidance
HIA	Hazard Identification and Analysis Unit
HMEP	Hazardous Mitigation Emergency Preparedness

HMG	Hazard Mitigation Grant
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPG	Hazard Mitigation Program Grant
HMWG	Hazard Mitigation Plan Working Group (Orange County)
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (US)
IA	Individual Assistance
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IDE	Initial Damage Estimate
IFG	Individual & Family Grant (program)
IHMT	Interagency Hazard Mitigation Team
IPA	Information and Public Affairs (Cal OES)
IRG	Incident Response Geographic Information System
LAMS	Los Angeles Metropolitan Statistical Area
LAN	Local Area Network
LEA	Local Enforcement Agency
LEMMA	Law Enforcement Master Mutual Aid
LEPC	Local Emergency Planning Committee
LHMP	Local Hazard Mitigation Plan
LIP	Local Implementation Plan
LUPIN	California Land Use Planning Information Network
M	Magnitude
MARAC	Mutual Aid Regional Advisory Council
MEP	Maximum Extent Practicable
MH	Multi-Hazard
MHID	Multi-Hazard Identification
MOU	Memorandum of Understanding
MSL	Meters above Sea Level
NAWS	National Warning System
NBC	Nuclear, Biological, Chemical
NCDC	National Climate Data Center
NDAA	National Disaster Assistance Act
NEMA	National Emergency Management Association
NEMIS	National Emergency Management Information System
NEXRAD	Next Generation of Radar
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	National Hazard Mitigation Plan (AKA 409 Plan)

NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPP	Nuclear Power Plant
NPS	National Park Service
NRCS	National Resources Conservation Service
NSF	National Science Foundation
NTS	Natural Treatment System
NWS	National Weather Service
OA	Operational Area
OAEX	Operational Area Executive Board
OASIS	Operational Area Satellite Information System
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OCEMO	Orange County Emergency Management Organization
OCFA	Orange County Fire Authority
OCHCA	Orange County Health Care Agency
OCPW	OC Public Works
OCSD	Orange County Sheriff's Department
OCTA	Orange County Transportation Authority
OCWR	OC Waste and Recycling
OEP	Office of Emergency Planning
OSD	Operations Support Division (Sheriff's Department)
OSFM	Office of State Fire Marshal
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PCH	Pacific Coast Highway
PDA	Preliminary Damage Assessment
PDMGP	Post Disaster Mitigation Grant Program
P-DMGP	Pre-Disaster Mitigation Grant Program
PDSD	Planning & Development Services Division
PEW	Project Evaluation Worksheet
PIO	Public Information Office
POST	Police Officer Standards and Training

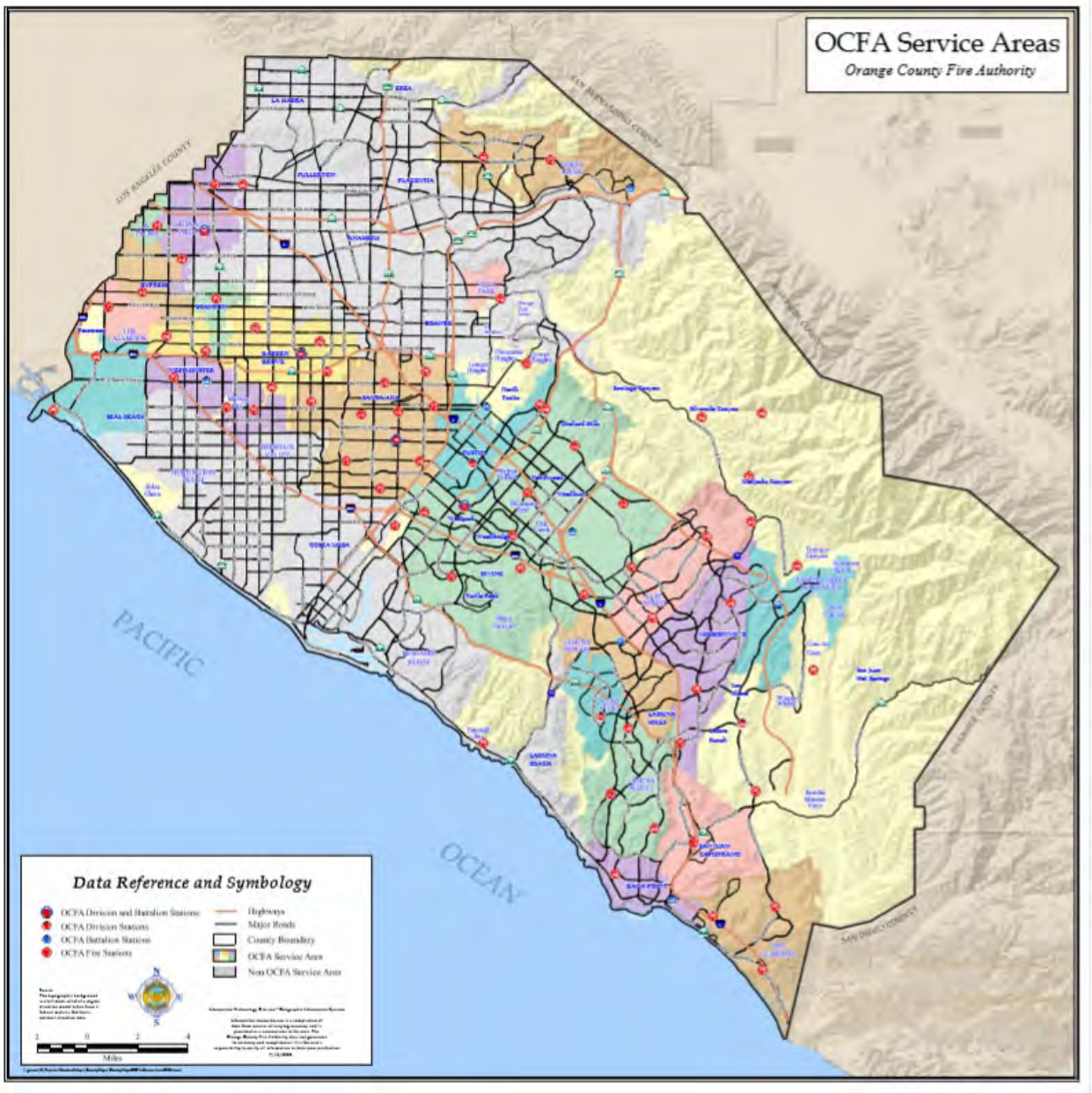
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
PSTRG	Private Sector Terrorism Response Group
PTAB	Planning and Technological Assistance Branch
PTR	Project Time Report
RA	Regional Administrator (Cal OES)
RADEF	Radiological Defense (program)
RAMP	Regional Assessment of Mitigation Priorities
RAPID	Railroad Accident Prevention & Immediate Deployment
RDMHC	Regional Disaster Medical Health Coordinator
RDO	Radiological Defense Officer
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information
RES	Regional Emergency Staff
RMP	Risk Management Plant
RPU	Radiological Preparedness Unit (Cal OES)
RRT	Regional Response Team
SAM	State Administration Manual
SARA	Superfund Amendments & Reauthorization Act
SARS	Severe Acute Respiratory Syndrome
SAVP	Safety Assessment Volunteer Program
SB	Senate Bill (State of California)
SBA	Small Business Administration
SCEC	Southern California Earthquake Center
SCO	California State Controller's Office
SEAO	Structural Engineers Association of Oregon
SEPIC	State Emergency Public Information Committee
SFHA	San Francisco Housing Authority
SHMO	State Hazard Mitigation Officer
SLA	State and Local Assistance
SLE	St. Louis Equine Encephalitis
SNV	Sin Nombre Virus
SOC	Storm Operations Center
SONGS	San Onofre Nuclear Generating Station
SOP	Standard Operation Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TOR	Transfer of Development Rights
TRU	Transuranic
TTT	Train the Trainer
UCI	University of California Irvine
UCLA	University of California Los Angeles
UCSB	University of California Santa Barbara
UGB	Urban Growth Boundary
UPA	Unified Program Account
UPRR	Union Pacific Rail Road
UPS	Uninterrupted Power Source
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USAR	Urban Search and Rescue
USBR	United States Bureau of Reclamation
USC	University of Southern California
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WAN	Wide Area Network
WC	California State Warning Center
WEE	Western Equine Encephalomyelitis
WEROC	Water Emergency Response of Orange County
WGA	Western Governors' Association
WIPP	Waste Isolation Pilot Project
WNV	West Nile Virus
WSSPC	Western State Seismic Policy Council

Appendix B - Maps

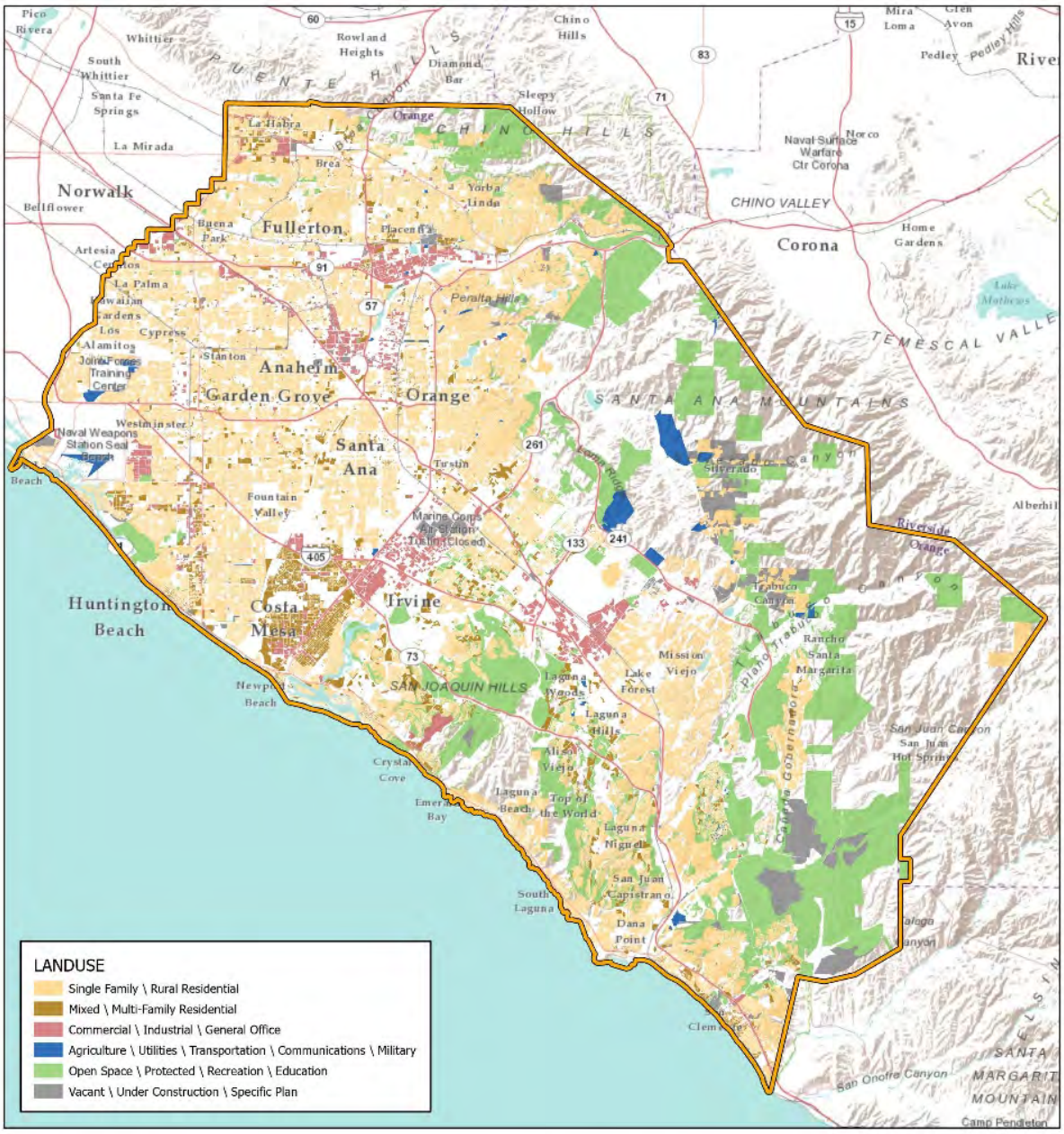
Orange County Geomatics developed many of the maps included in this plan. The contributions from this department were essential in illustrating the extent and potential losses associated with the natural hazards affecting the County. The information on the maps in this plan was derived from the Orange County Public Works, Geomatics Office. Care was taken in the creation of these maps, but they are provided "as is." Orange County cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products (the maps). Although information from Land Surveys may have been used in the creation of these products, in no way does this product represent or constitute a Land Survey. Users are cautioned to field verify information on this product before making any decisions.

List of Maps

☐ **Map 1- Orange County Base Map (Unincorporated Areas in Green)**

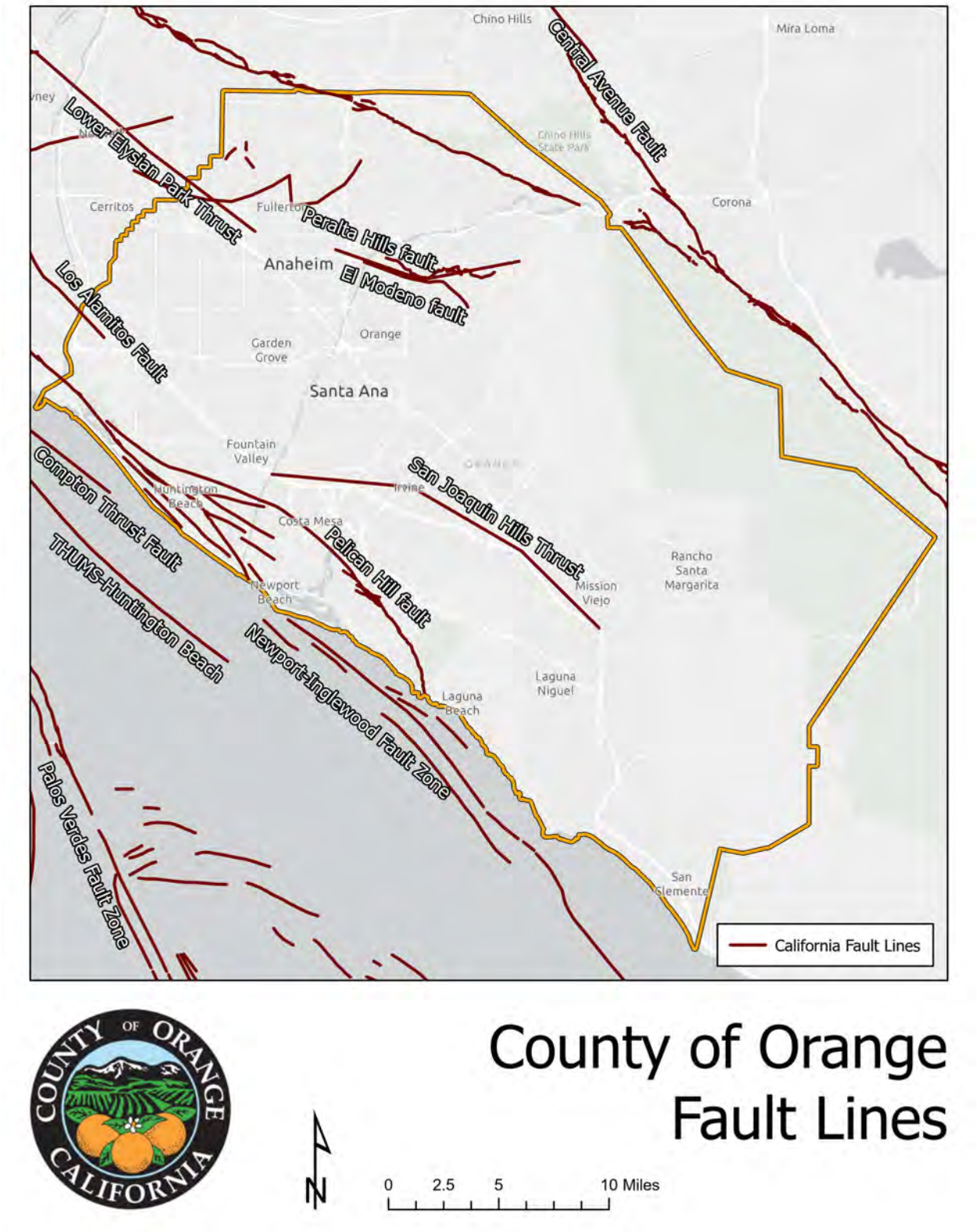


☐ **Map 2– Orange County Fire Authority Service Area (July 2020)**

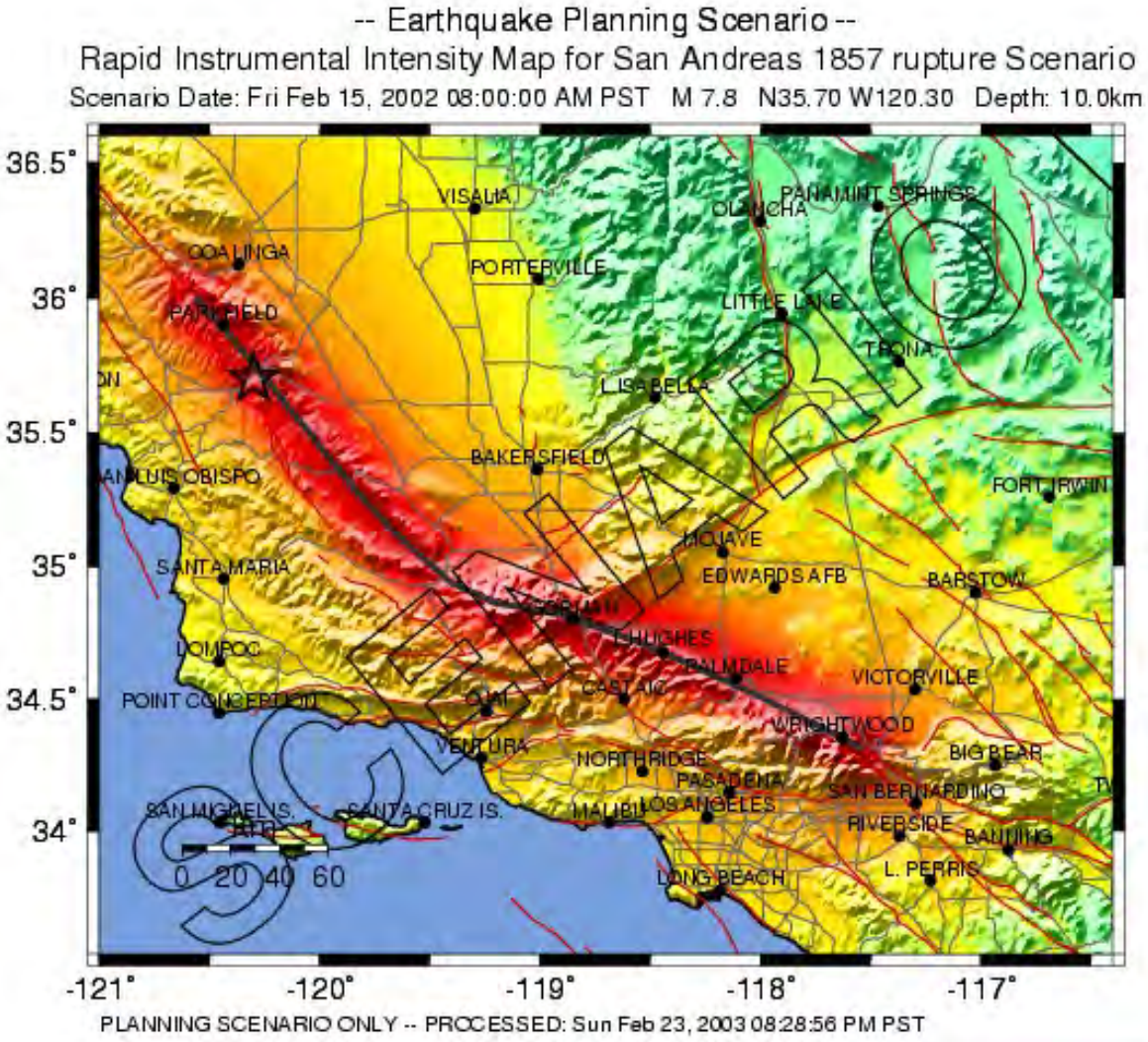


County of Orange Zoning

☐ **Map 3 - Zoning for Orange County**

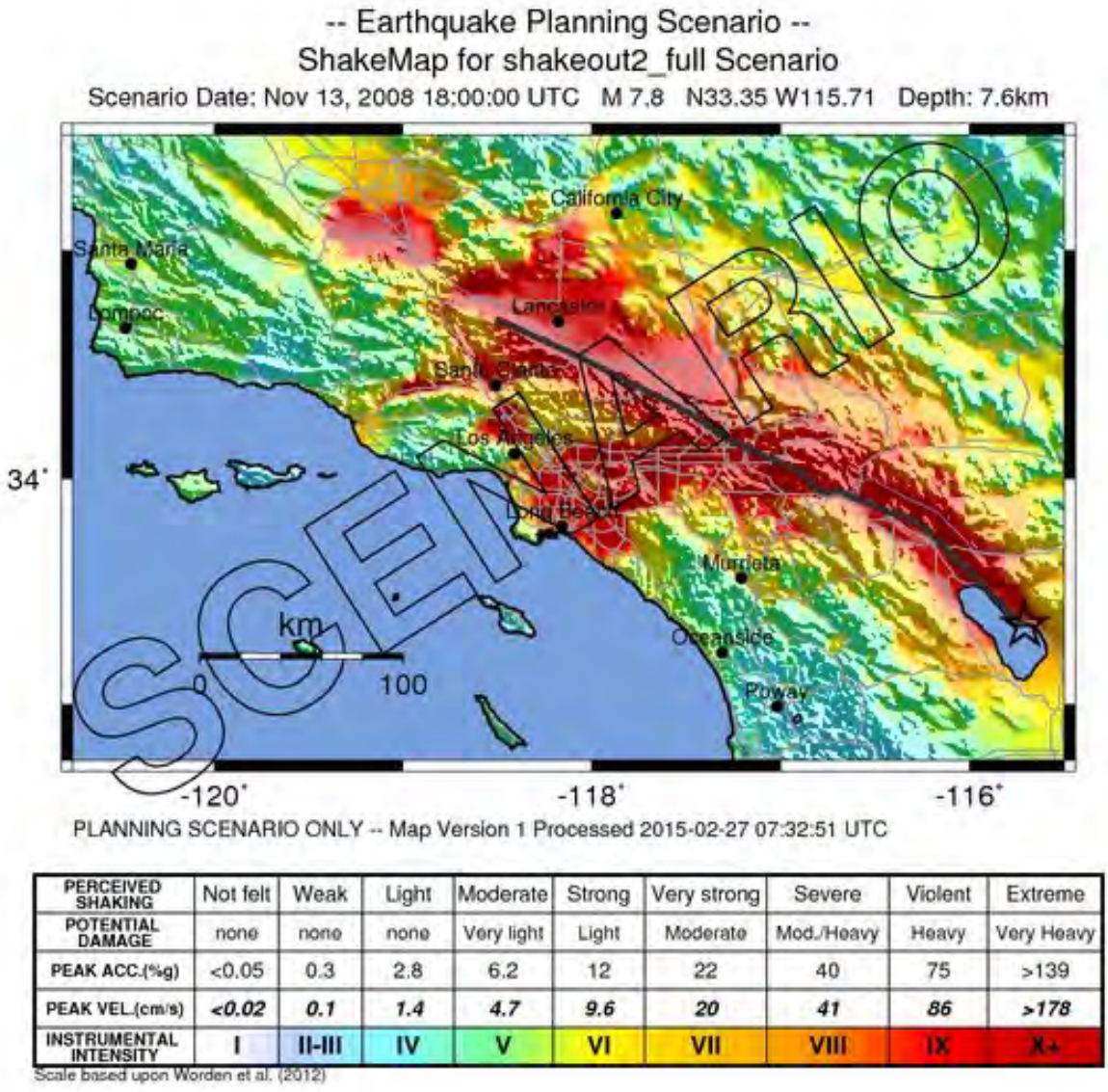


☐ **Map 4 --- Earthquake Faults**



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

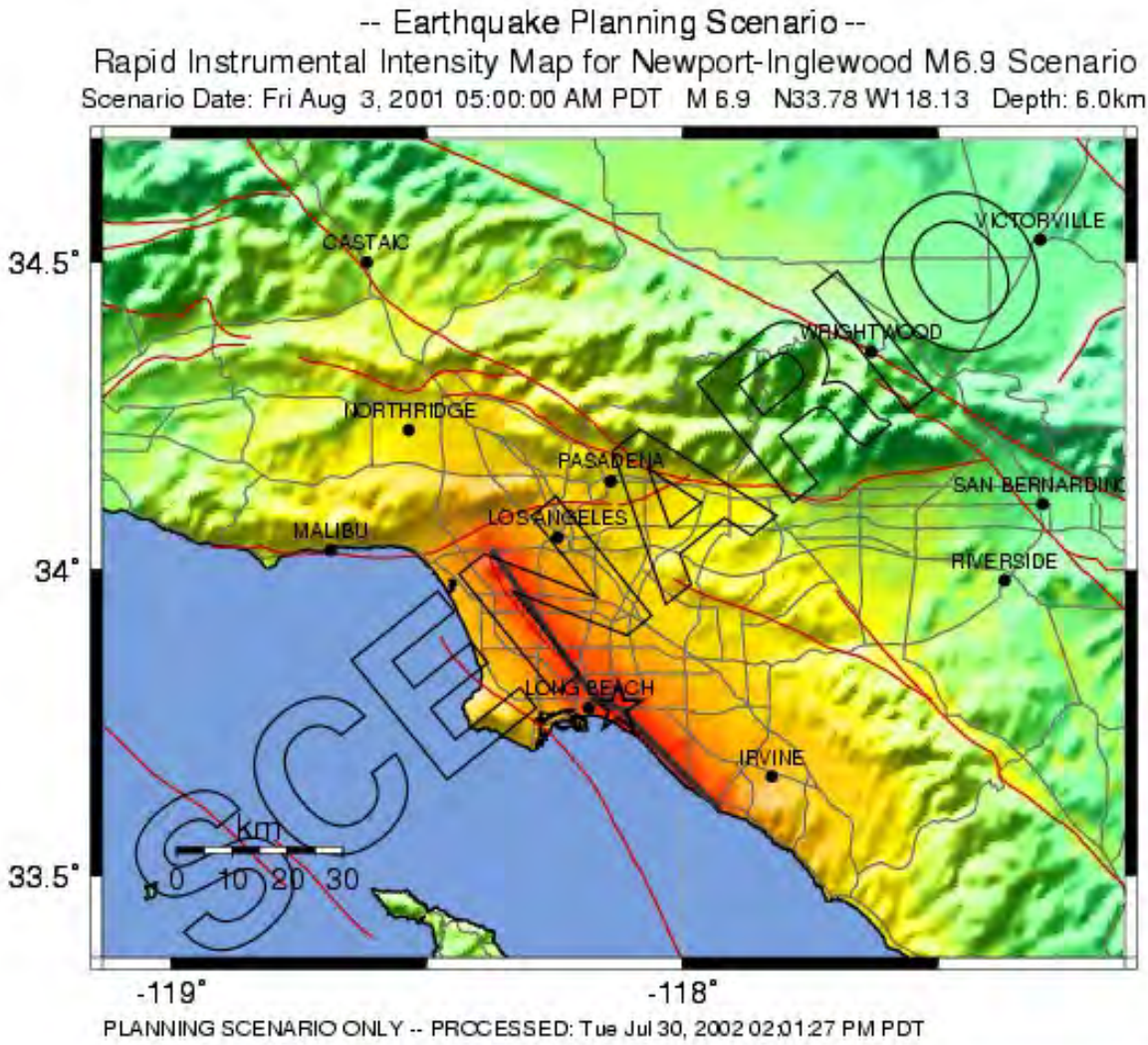
☐ **Map 5 - Scenario ShakeMap for a M 7.8 Earthquake on the San Andreas Fault: Repeat of 1857 Fort Tejon Earthquake (USGS)**



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

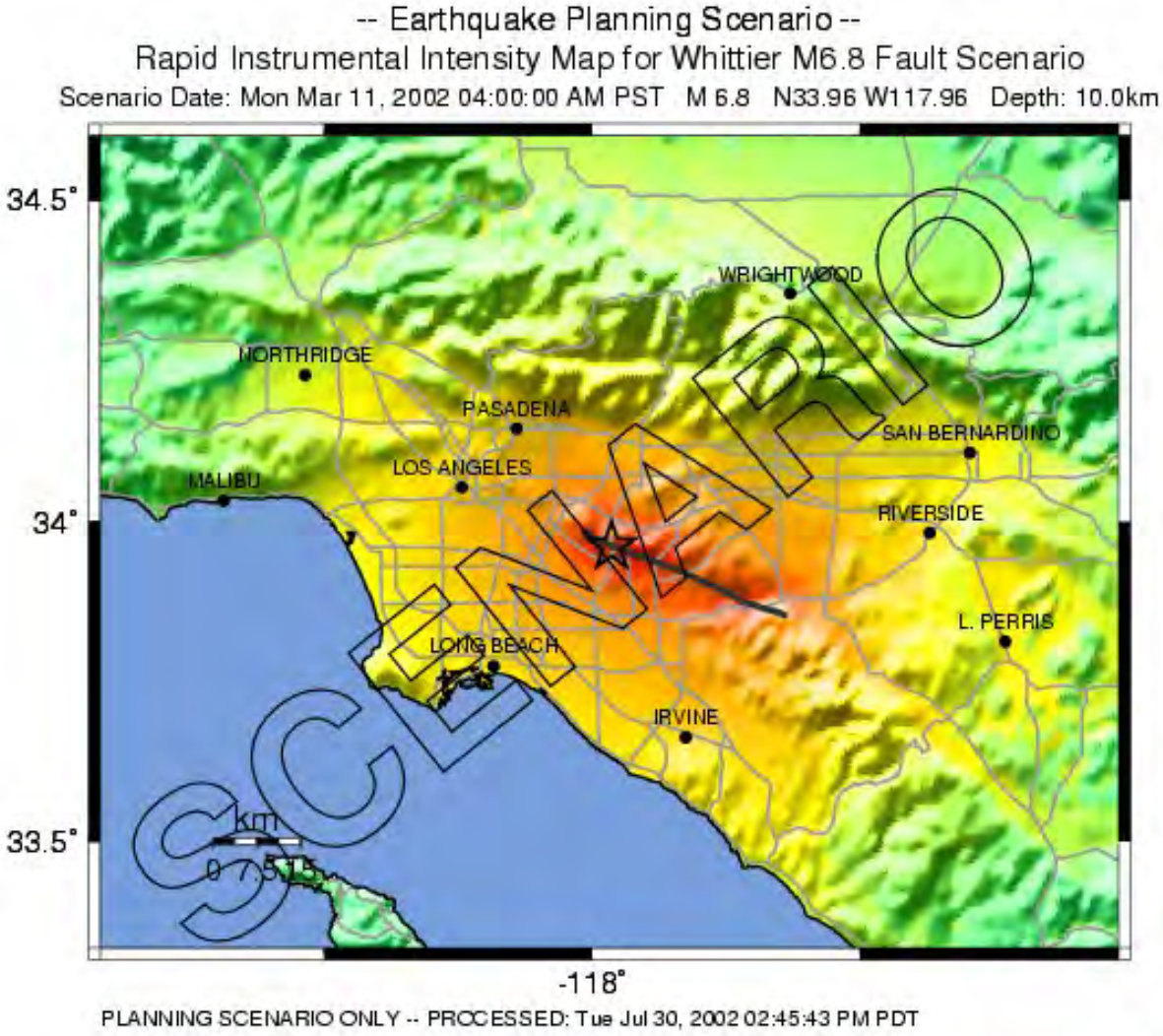
Scale based upon Worden et al. (2012)

☐ **Map 6 - Scenario ShakeMap for a M 7.8 Earthquake on the Southern San Andreas Fault – "ShakeOut" Scenario (USGS, 2008)**



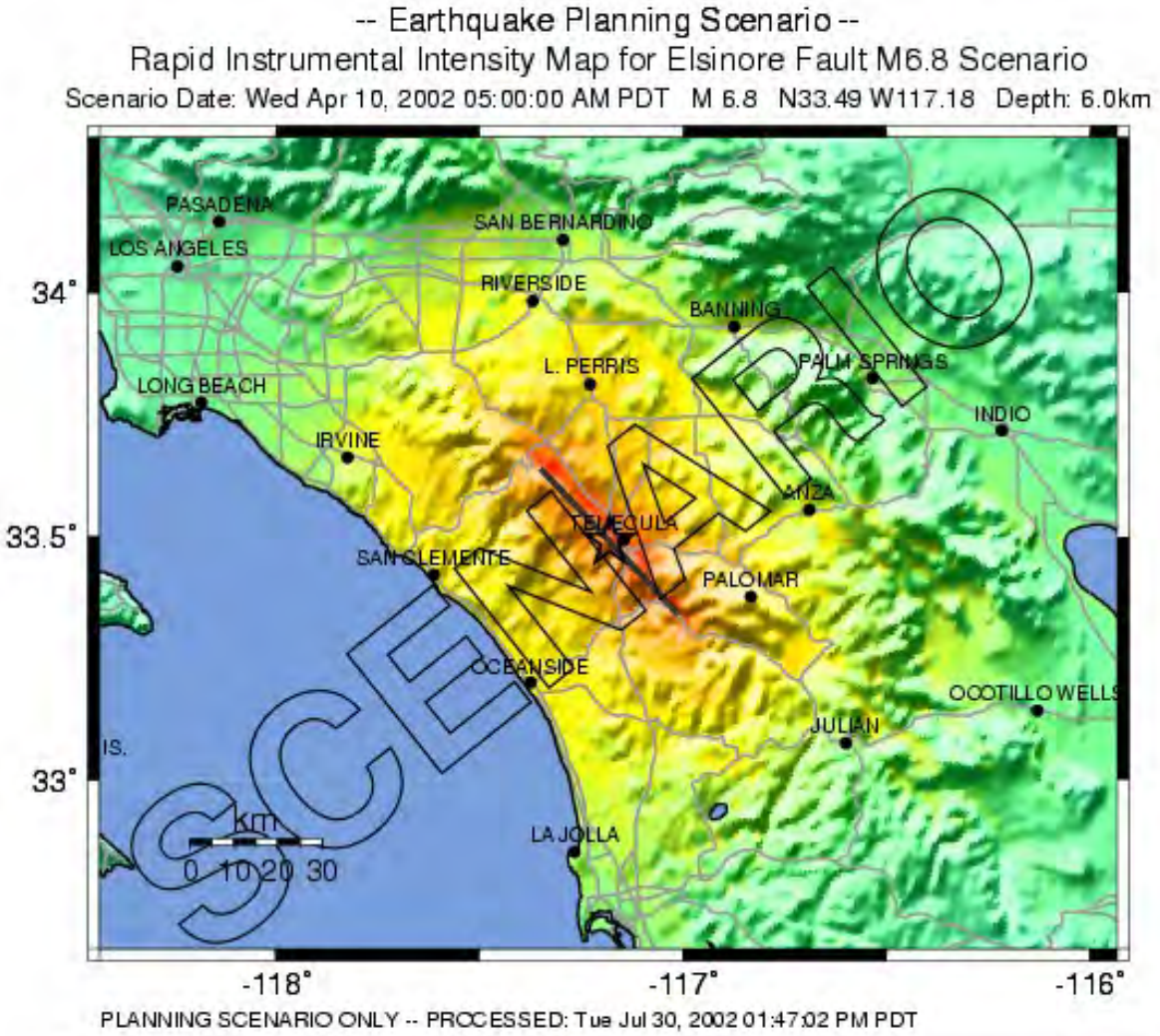
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

☐ **Map 7 - Scenario for a M 6.9 Earthquake on the Newport-Inglewood Fault (USGS, 2001)**



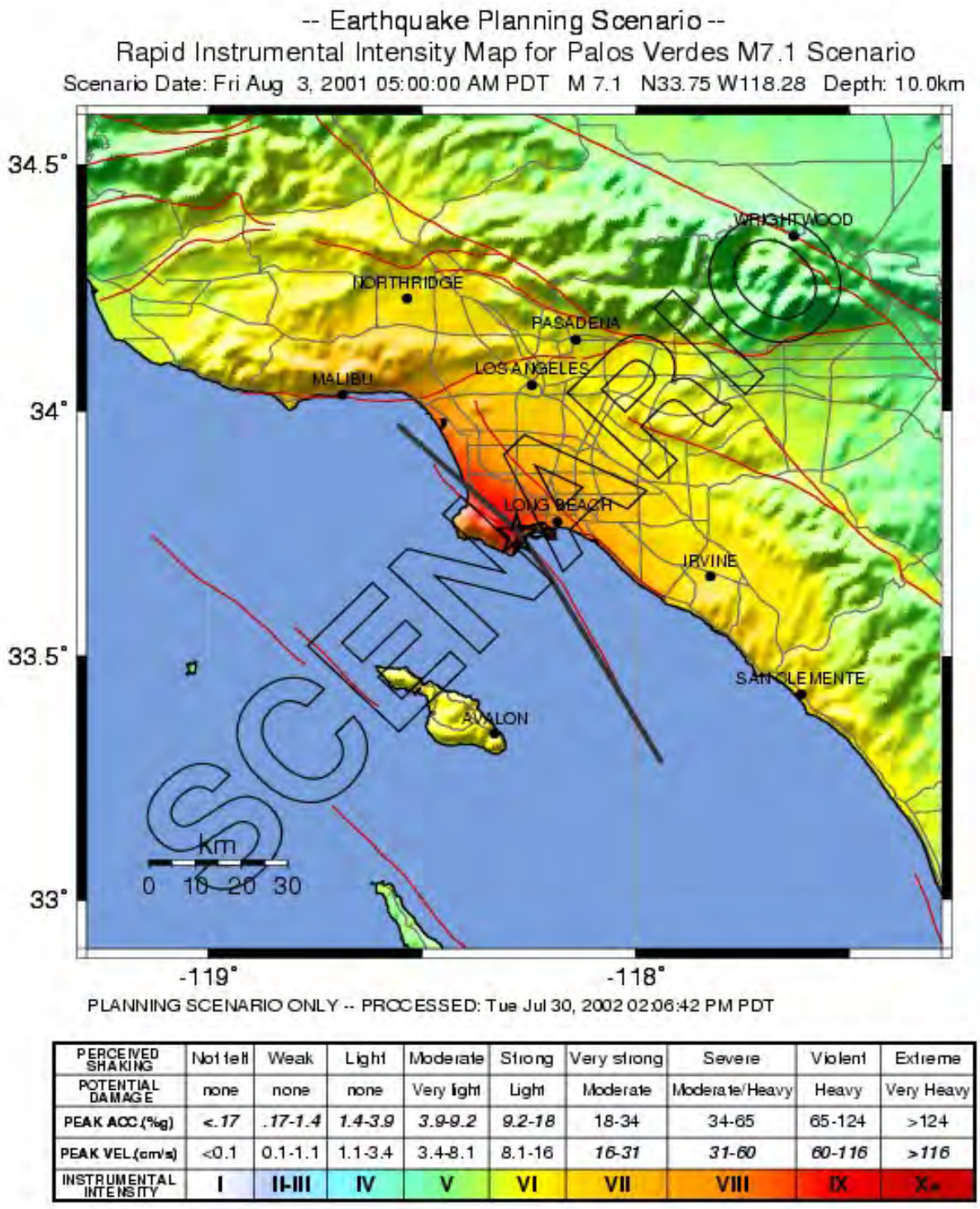
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

☐ **Map 8 - Scenario ShakeMap for a M 6.8 Earthquake on the Whittier Fault (USGS, 2002)**



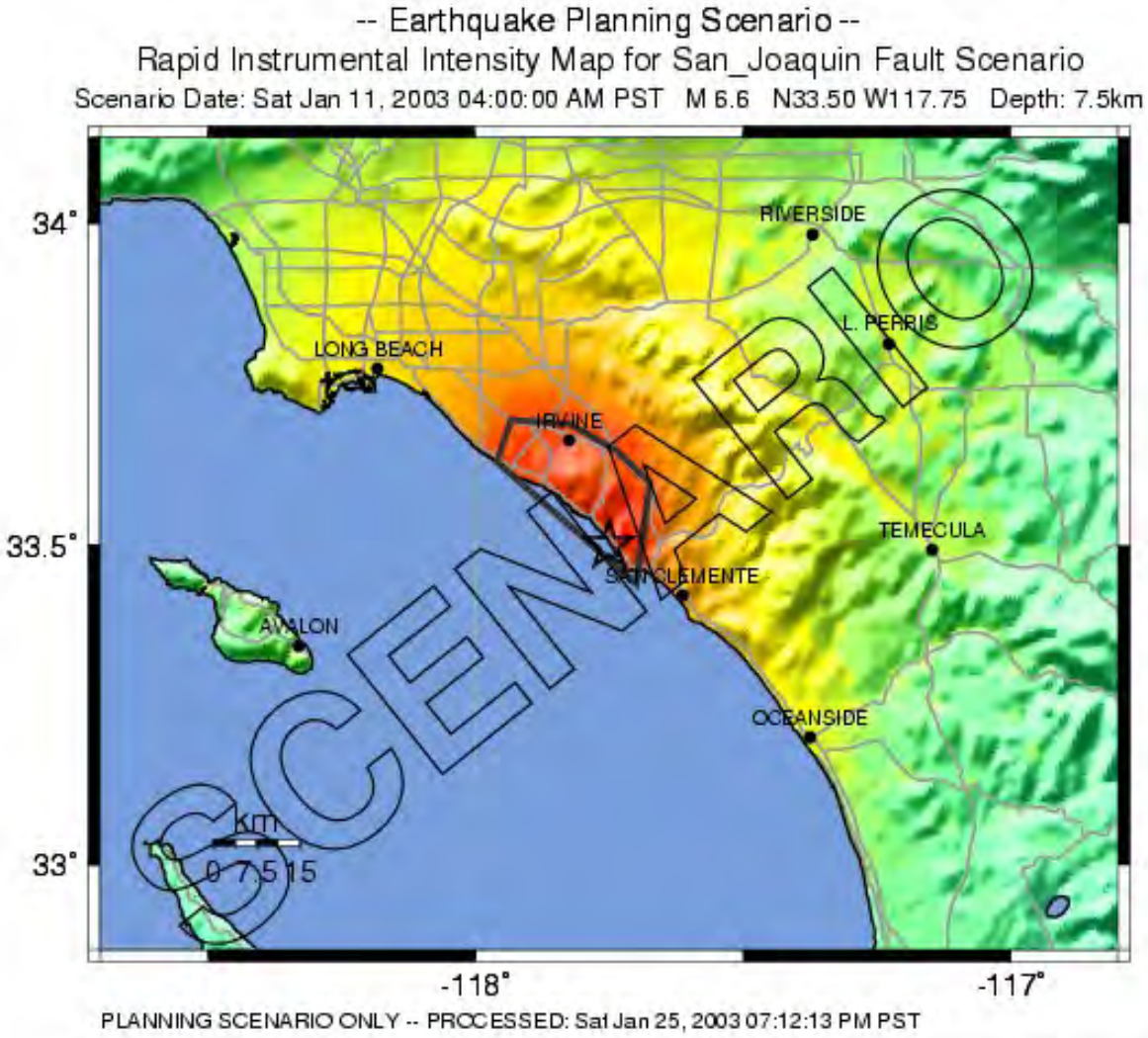
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

☐ **Map 9 - Scenario ShakeMap for a M 6.8 Earthquake on the Elsinore Fault (USGS, 2002)**



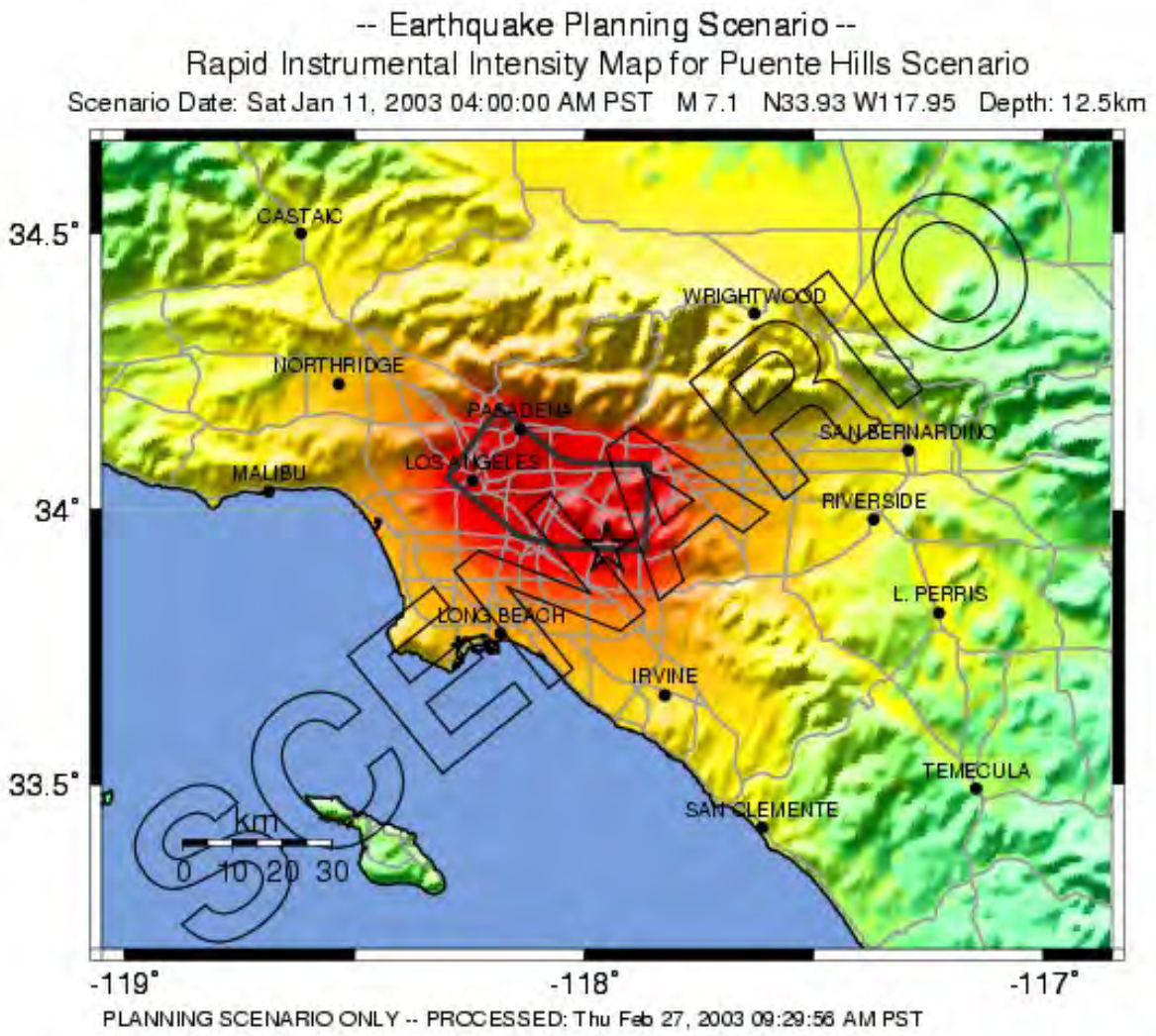
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Map 10- Scenario ShakeMap for a M 7.1 Earthquake on the Palos Verdes Fault (USGS, 2001)



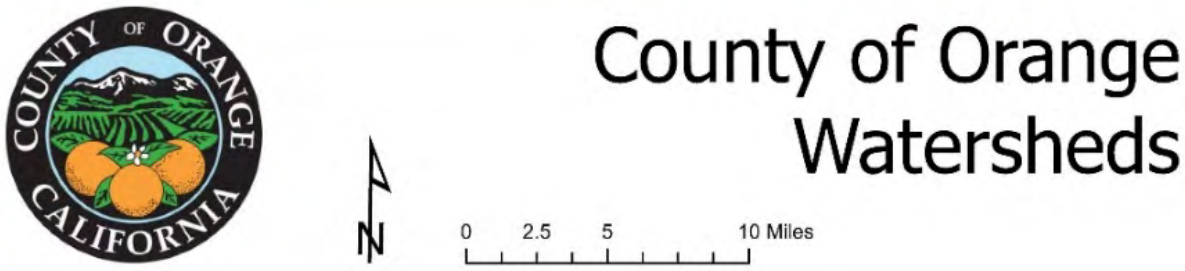
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

☐ **Map 11 - Scenario ShakeMap for a M 6.6 Earthquake on the San Joaquin Hills Fault (USGS)**



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

☐ **Map 12 - Scenario ShakeMap for a M 7.1 Earthquake on the Puente Hills Fault (USGS, 2003)**

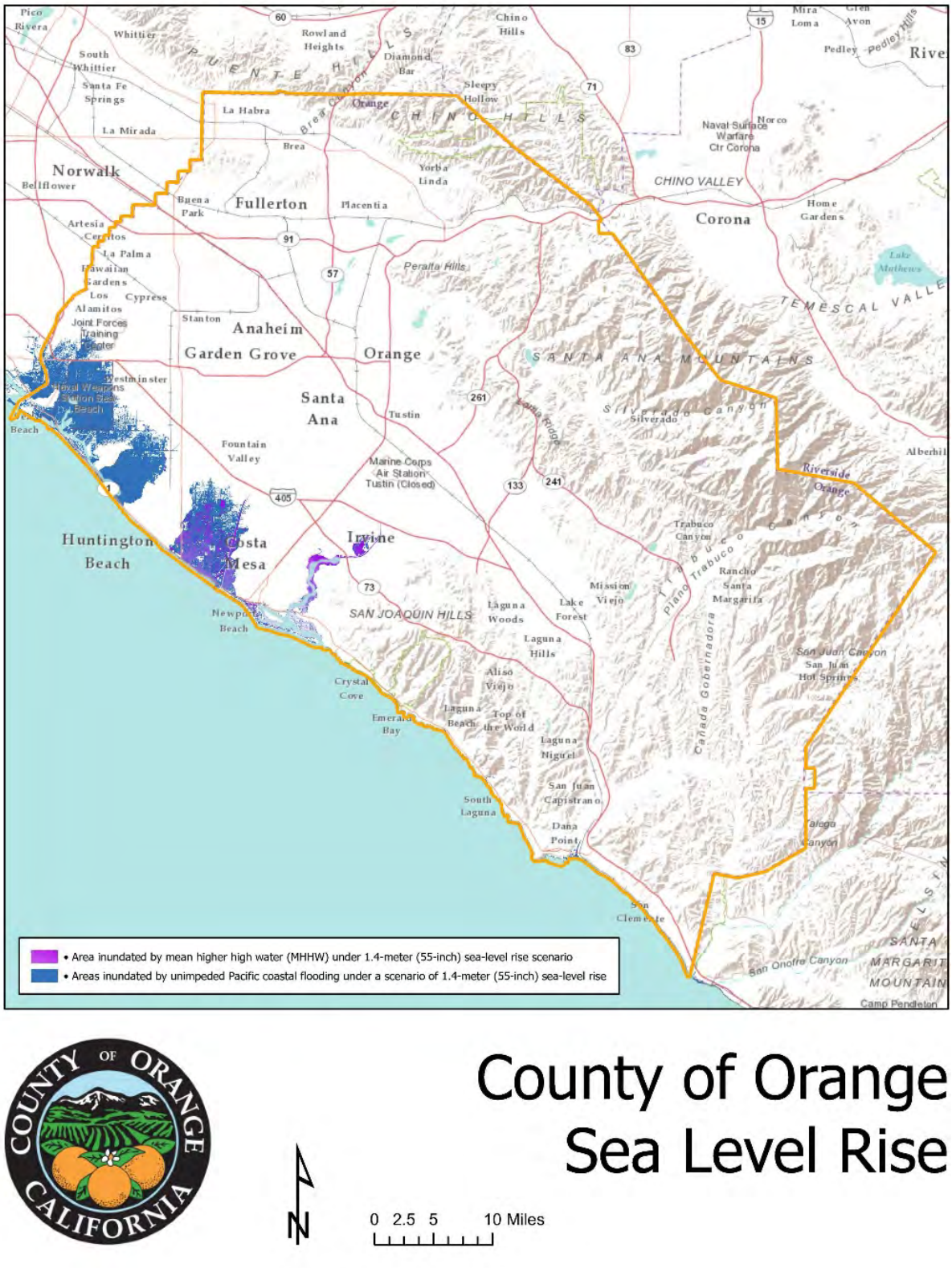


☐ **Map 13 -- County of Orange Watersheds**

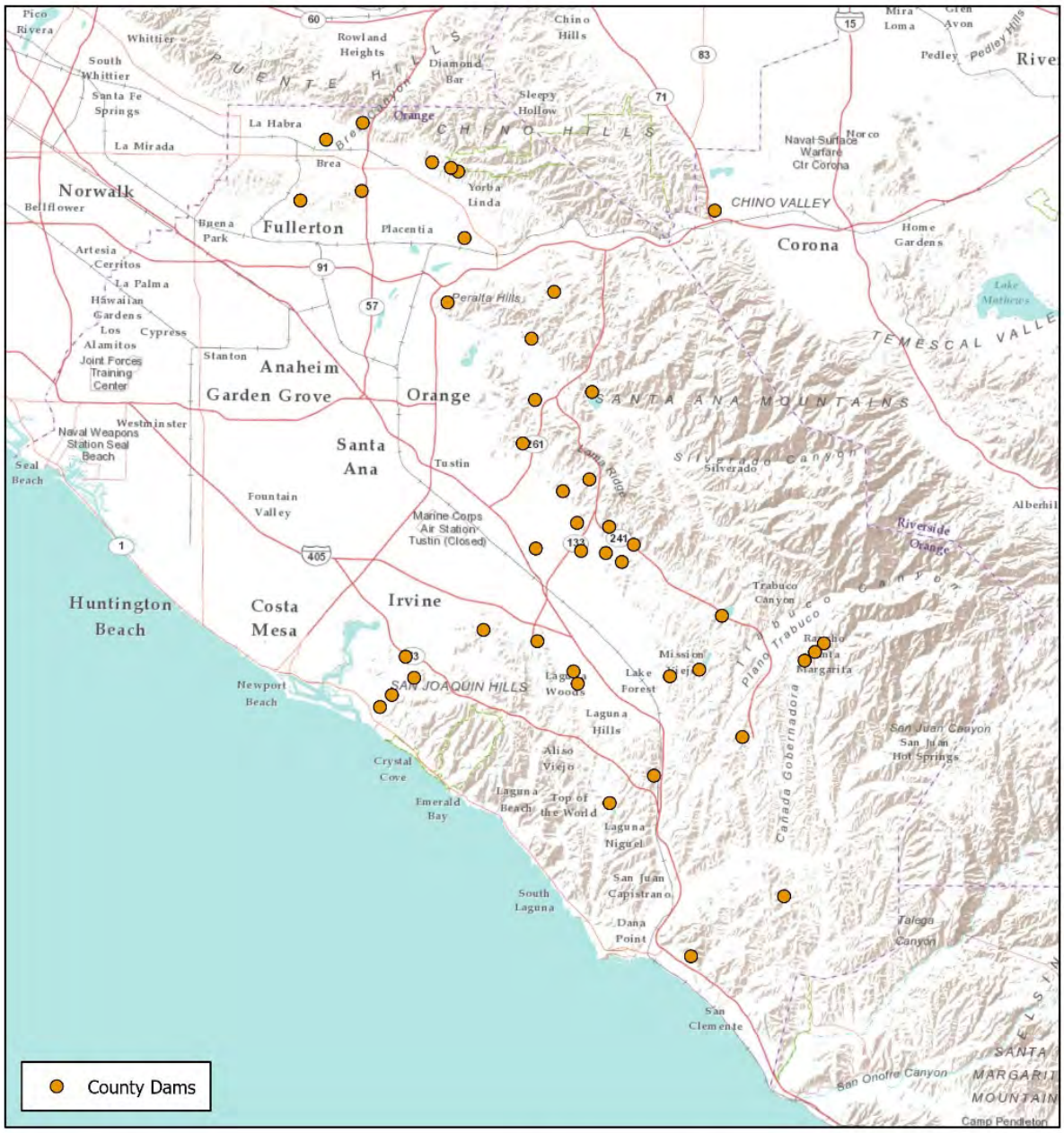
County of Orange Floodplains

☐ **Map 14 – County of Orange Floodplains**

☐ **Map 15 – Orange County Very High Fire Hazard Severity Zones**

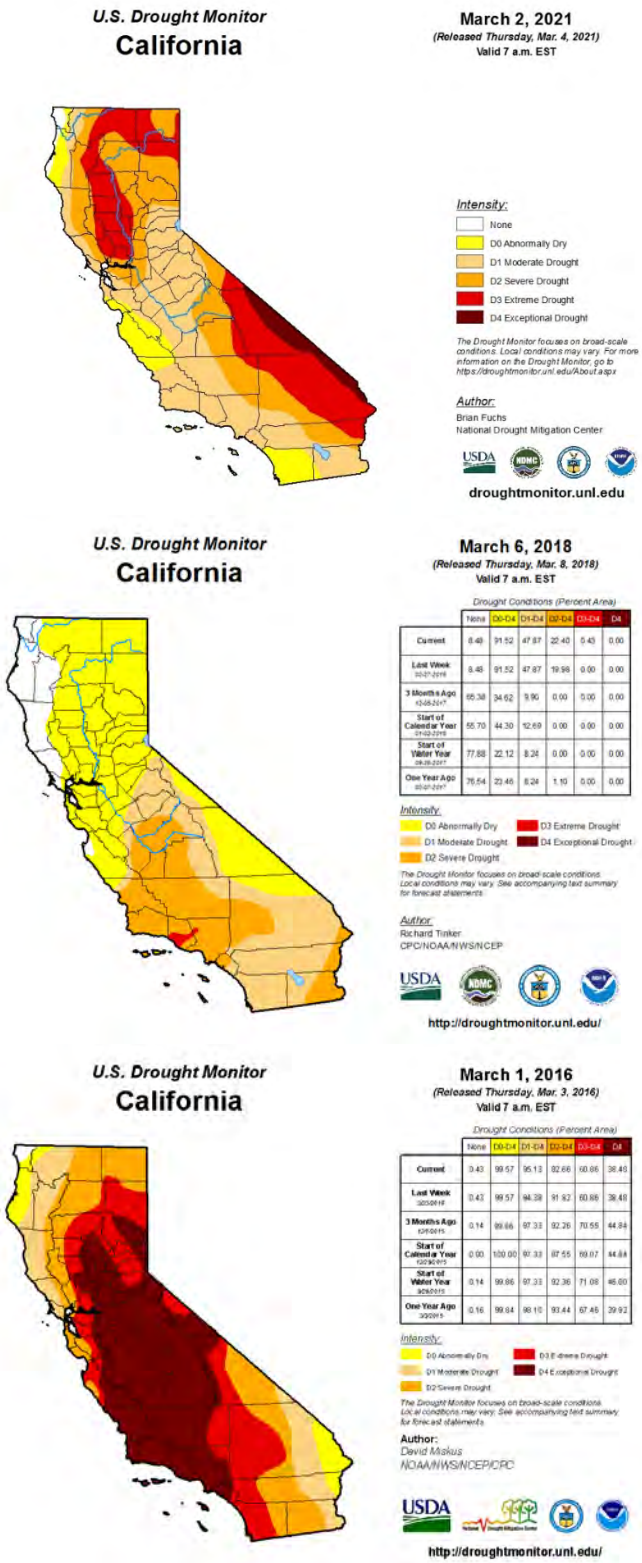


☐ **Map 16 -- Projected Extent of Sea Level Rise Impacts on Coastal Orange County**



County of Orange Dams & Inundation

☐ **Map 17 -- Orange County Dams**



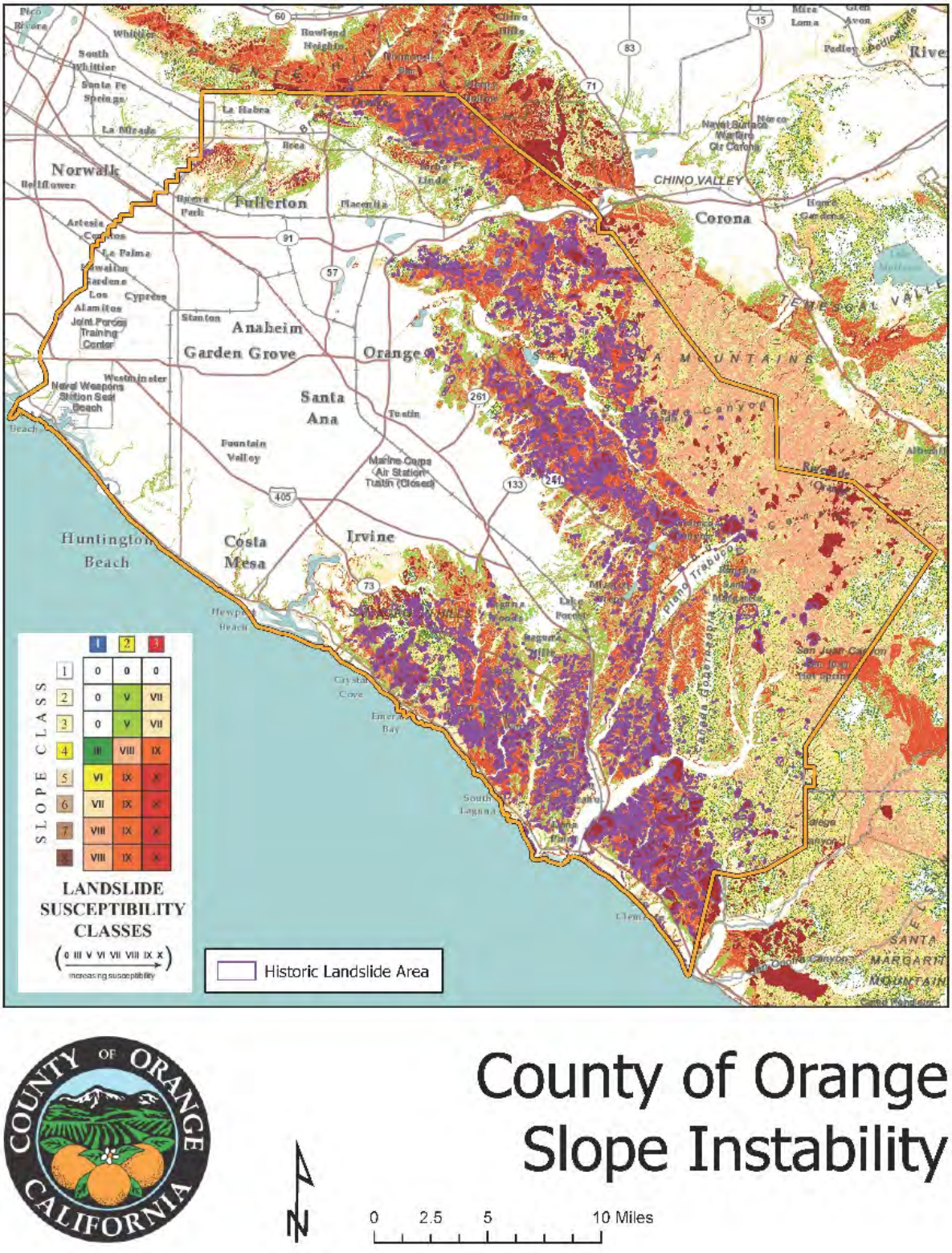
☐ **Map 18 – U.S Draught Monitor for California (as of March 2016, 2018, and 2021)**

County of Orange
Tsunami Inundation

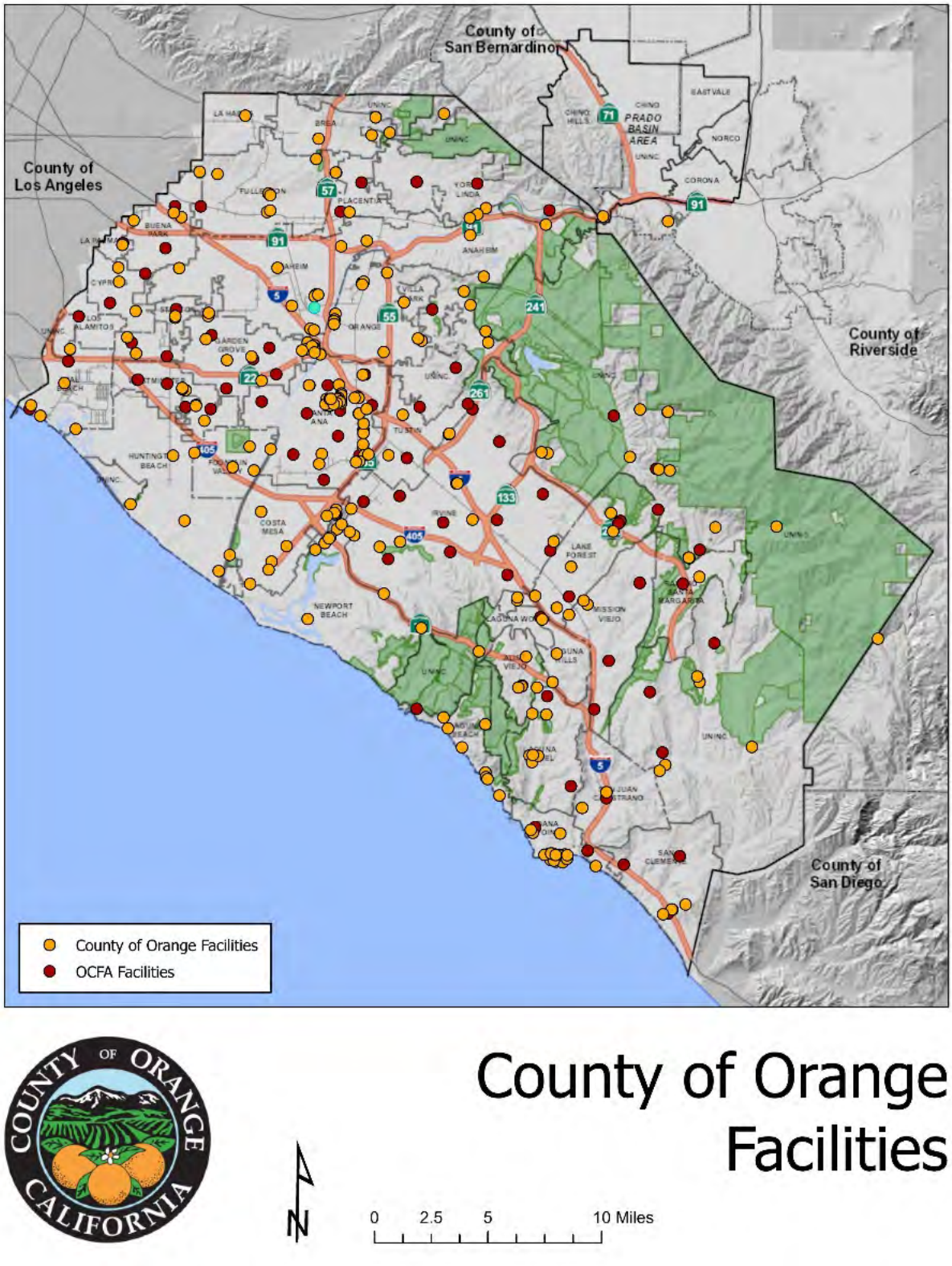
N

0 2.5 5 10 Miles

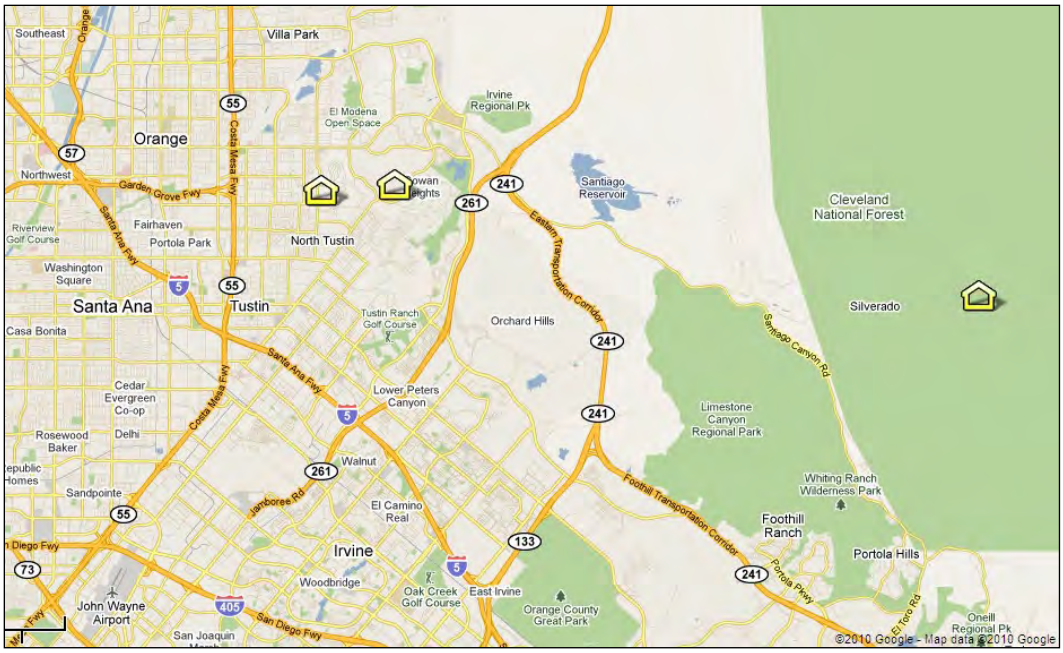
☐ **Map 19 – Orange County Tsunami Inundation Zone**



☐ **Map 20 – Orange County Landslide Susceptibility and Historic Landslide Areas**



☐ **Map 21 – Orange County Critical Facilities**



☐ **Map 22 - Repetitive Loss Structures**

Appendix C - List of Tables

Chapter 8 Attachments

Attachment A: Hazard Mitigation Working Group Planning Documentation

Attachment B: GIS Methodology and Orange County Essential Facilities Risk Assessment Project Report

Attachment C: County of Orange and Orange County Fire Authority Property Schedule

Attachment D: Mitigation Action Item Project Worksheets