County of Santa Cruz

Local Hazard Mitigation Plan

2010-2015

PART 1- INTRODUCTION AND ADOPTION 1
i. How to Use This Plan 1
ii. Introduction.....3
iii. Acknowledgements 4
iv. Summary.....6

CHAPTER 1 – ADOPTION BY BOARD OF SUPERVISORS 8

CHAPTER 2 – COMMUNITY PROFILE 9
Community Profile 10
Community Vision 14
Community Facilities.....15

PART 2 – THE PLANNING PROCESS

CHAPTER 3 – THE PLANNING PROCESS..... 19
The Purpose of the Plan 20
Planning Process 20
Documentation of the Planning Process 21
Local Capabilities Assessment and Integration 22
Community Participation 22

PART 3 – HAZARD IDENTIFICATION AND RISK ASSESSMENT.....24

Significant Risks

CHAPTER 4 – EARTHQUAKE AND LIQUEFACTION 28
4.3.0 Risk Assessment.....28
4.3.1 Identifying Earthquake Hazards 28
4.3.2 Profiling Earthquakes and Liquefaction Events.....31
4.3.3 Assessing Vulnerability: Overview 35
4.3.4 Assessing Vulnerability: Identifying Structures 35
4.3.5 Assessing Vulnerability: Estimating Potential Losses 43
4.3.6 Assessing Vulnerability: Analyzing Development Trends 45
4.4.0 Mitigation Strategy 45
4.4.1 Mitigation Goals 46
4.4.2 Identification and Analysis of Mitigation Actions 46

CHAPTER 5 – WILDFIRES 47
5.3.0 Wildfire Risk Assessment.....47
5.3.1 Identifying Wildfire Hazards 47
5.3.2 Profiling Wildfire Hazard Events.....47
5.3.3 Assessing Vulnerability: Overview 51
5.3.4 Assessing Vulnerability: Identifying Structures 51
5.3.5 Assessing Vulnerability: Estimating Potential Losses 52
5.3.6 Assessing Vulnerability: Analyzing Development Trends 53
5.4.0 Mitigation Strategy 53
5.4.1 Mitigation Goals 54
5.4.2 Identification and Analysis of Mitigation Actions 54

CHAPTER 6 – FLOODS AND ASSOCIATED COASTAL STORMS 56
6.3.0 Flood Risk Assessment..... 56
6.3.1 Identifying Flood Hazards 56
6.3.2 Profiling Flood Hazards..... 57
6.3.3 Assessing Vulnerability: Overview 64
6.3.4 Assessing Vulnerability: Identifying Structures 70
6.3.5 Assessing Vulnerability: Estimating Potential Losses 71
6.3.6 Assessing Vulnerability: Analyzing Development Trends 72
6.4.0 Mitigation Strategy 73
6.4.1 Mitigation Goals 74
6.4.2 Identification and Analysis of Mitigation Action 75

CHAPTER 7 – DROUGHT..... 78
7.3.0 Drought Risk Assessment..... 78
7.3.1 Identifying Drought hazards 78
7.3.2 Profiling Drought Hazards..... 81
7.3.3 Assessing Vulnerability: Overview 86
7.3.4 Assessing Vulnerability: Identifying Structures 87
7.3.5 Assessing Vulnerability: Estimating Potential Losses 87
7.3.6 Assessing Vulnerability: Analyzing Development Trends 88
7.4.0 Mitigation Strategy 90
7.4.1 Mitigation Goals 90
7.4.2 Identification and Analysis of Mitigation Actions 90
7.4.3 Implementation of Mitigation Actions 92

CHAPTER 8 – TSUNAMI..... 93
8.3.0 Tsunami Risk Assessment..... 93
8.3.1 Identifying Tsunami Hazards..... 93
8.3.2 Profiling Tsunami Hazard Events..... 93
8.3.3 Assessing Vulnerability: Overview 96
8.3.4 Assessing Vulnerability: Identifying Structures 96
8.3.5 Assessing Vulnerability: Estimating Potential Losses 97
8.3.6 Assessing Vulnerability: Analyzing Development Trends 98
8.4.0 Mitigation Strategy 98
8.4.1 Mitigation Goals 99
8.4.2 Identification and Analysis of Mitigation Actions 99

CHAPTER 9 – COASTAL EROSION 100
9.3.0 Coastal Erosion Risk Assessment 100
9.3.1 Identifying Coastal Erosion Hazards..... 100
9.3.2 Profiling Coastal Erosion Hazard Events 100
9.3.3 Assessing Vulnerability: Overview 102
9.3.4 Assessing Vulnerability: Identifying Structures 104
9.3.5 Assessing Vulnerability: Estimating Potential Losses 105
9.3.6 Assessing Vulnerability: Analyzing Development Trends 106
9.4.0 Mitigation Strategy 106
9.4.1 Mitigation Goals 107
9.4.2 Identification and Analysis of Mitigation Actions 107

CHAPTER 10 – DAM FAILURE 109
10.3.0 Dam Failure Risk Assessment 109
10.3.1 Identifying Dam Failure Hazards 109
10.3.2 Profiling Dam Failure Hazard Events 109
10.3.3 Assessing Vulnerability: Overview 112
10.3.4 Assessing Vulnerability: Identifying Structures 113
10.3.5 Assessing Vulnerability: Estimating Potential Losses 114
10.3.6 Assessing Vulnerability: Analyzing Development Trends 115
10.4.0 Mitigation Strategy 115
10.4.1 Mitigation Goals 116
10.4.2 Identification and analysis of Mitigation Actions 116

CHAPTER 11 – LANDSLIDE 117
11.3.0 Landslide Risk Assessment 117
11.3.1 Identifying Landslide Hazards 117
11.3.2 Profiling Landslide Hazard Events 118
11.3.3 Assessing Vulnerability: Overview 121
11.3.4 Assessing Vulnerability: Identifying Structures 121
11.3.5 Assessing Vulnerability: Estimating Potential Losses 122
11.3.6 Assessing Vulnerability: Analyzing Development Trends 123
11.4.0 Mitigation Strategy 123
11.4.1 Mitigation Goals 123
11.4.2. Identification and Analysis of Mitigation Actions 124

CHAPTER 12 – EXPANSIVE SOILS 125
12.3.0 Expansive Soils Risk Assessment 125
12.3.1 Identifying Expansive soils Hazards 125
12.3.2 Profiling Expansive Soils Hazard Events 125
12.3.3 Assessing Vulnerability: Overview 127
12.3.4 Assessing Vulnerability: Identifying Structures 127
12.3.5 Assessing Vulnerability: Estimating Potential Losses 128
12.3.6 Assessing Vulnerability: Analyzing Development Trends 129
12.4.0 Mitigation Strategy 129
12.4.1 Mitigation Goals 130
12.4.2 Identification and Analysis of Mitigation Actions 130

CHAPTER 13 – MULTI-HAZARD SUMMARY 131

PART 4 – MITIGATION STRATEGY 132

CHAPTER 14 – MITIGATION STRATEGY 133
4.4.0 Mitigation Strategy 133
4.4.1 Identification and Analysis of Mitigation Actions 135

PART 5 – PLAN MAINTENANCE PROCESS 157
CHAPTER 15 – PLAN MAINTENANCE PROCESS 157
15.5.1 Monitoring, Evaluating and Updating the Plan 158
15.5.2 Incorporation into Existing Planning Mechanisms 160
15.5.3 Continued Public Involvement 160

Appendices

A Hazards Not a Significant Risk to County of Santa Cruz
B Acronyms and Abbreviations
C Glossary of Terms
D Critical County Facilities
E Senior Residential Care Facilities and Hospitals
F Public Schools
G Private Schools
H Successful Programs and Projects
I Census Characteristics 2000
J Tsunami Response Plan – Concept of Operations
K Tsunami Map Preparation Methodology
L Urban Rural Boundary Map
M Hazard Maps in PDF
N Santa Cruz Commuter Maps
O Lockheed Fire Burn Severity Satellite Map

Maps and Figures

1	County of Santa Cruz Limits with General Plan Boundaries	6
2	Location of County of Santa Cruz within California	9
3	Key Transportation Routes	13
4	Critical Infrastructure Locations	16
5	Levee Flood Gates	17
6	Critical Facilities Not Owned by County	18
7	Fault Rupture	30
8	Liquefaction Areas	31
9	Isoseismal Map of 1989 Loma Prieta Earthquake	33
10	Earthquake Scenario N-9	37
11	Earthquake economic loss by county	38
12	Earthquake loss by census tract	39
13	Earthquake Scenario N-7	40
14	Santa Cruz Mountains building economic loss by county	41
15	Santa Cruz Mountains building economic loss by census tract	42
16	Generalized Critical Fire Hazard Areas	48
17	Recent wildfires in Santa Cruz County	50
18	Flood Zones within Santa Cruz County	57
19	Repetive Loss parcel map	60
20	Pajaro River Flood Risk map	66
21	Santa Cruz City Water Service Area	82
22	Water Agencies Service Areas map	83
23	Total Annual run-off San Lorenzo River	85
24	Tsunami Inundation Map	94
25	Coastal Erosion Areas	101
26	Newell Creek Dam inundation area	110
27	Slides and Earthflows	118
28	Landslide Hazard Areas	119
29	Expansive Soils map	126

Tables

2-1	Temperature Averages for County of Santa Cruz	11
2-2	County of Santa Cruz Demographics	11
A-1	Review of All Hazards	26
A-2	Hazard Screening for County of Santa Cruz	26
4-1	Modified Mercalli Scale	29
4-2	Ten Earthquake Scenarios	34
4-3	Earthquake Potential Loss Inventory	43
5-1	Previous Wildfires in County of Santa Cruz	49
5-2	Wildfire Potential Loss Inventory	52
6-1	FEMA Special Flood Hazard Area Zones & Definitions	59
6-2	Flood Probability Terms	64
6-3	Stream/River Flood Stages	68
6-4	Flood Potential Loss Inventory	71
7-1	List of Water Suppliers in County of Santa Cruz	78
7-2	Water Conservation Targets	79
7-3	Single Dry Year Water Supply & Demand	83
7-4	Multiple Dry Years Water Supply & Demand	84
7-5	Drought Probabilities	86
8-1	Tsunami Potential Loss Inventory	97
9-1	Coastal Erosion Potential Loss Inventory	105
10-1	Dams within and near County of Santa Cruz	111
10-2	Dam Failure Potential Loss Inventory	114
11-1	Landslide Potential Loss Inventory	122
12-1	Expansive Soils Potential Loss Inventory	128

HOW TO USE THIS PLAN

FEMA has defined very specific requirements for Local Hazard Mitigation Plans and this plan follows those guidelines. The organization of the Plan follows FEMA's structural requirements and includes the four following organizational levels:

Parts
Chapters
Sections
Subsections

This LHMP is organized into five primary parts and 15 chapters that follow the phases of the plan's development (and the FEMA LHMP checklist or "crosswalk") as follows:

Part 1 Prerequisites: introduction, acknowledgements, adoption, and summary
Part 2 The Planning Process
Part 3 Risk Assessment
Part 4 Mitigation Strategies
Part 5 Plan Implementation and Maintenance

The **Risk Assessment (Part 3**) is organized into specific hazards by chapter (Chapters 4-12.) Within each of these chapters all elements required by the FEMA crosswalk are addressed and the sections and subsections of each of these chapters follow the section numbering of the crosswalk. (e.g. Subsection *3.1 Identifying Risk Hazards* is §*7.3.1* in Chapter 7–Drought) Each of the specific hazard **Risk Assessment** chapters contains the following subsections:

3.0 Risk Assessment
3.1 Hazard Identification
3.2 Hazard Profile including subsections on location, extent, previous occurrences, and probability of future events.
3.3 Assessing Vulnerability
3.4 Identifying Structures
3.5 Estimating Potential Losses
3.6 Analyzing Development Trends

Mitigation Strategy (§4.0 through §4.2) is addressed briefly under each hazard chapter and covered comprehensively in Part 4. Goals and actions specific to a particular hazard are included within the hazard chapter and are labeled by hazard (e.g. Earthquake Goal 1). Goals, objectives and actions, which apply to one or more potential hazards, are listed in Part 4.

Goals, objectives and action items identified as part of the mitigation strategy were formulated in collaboration with the departments responsible for implementation of the actions. These goals and supporting actions are not new but have been taken from various plans adopted by the Board of Supervisors including the General Plan Safety Element, the 2005 Urban Water Management Plan, the Integrated Water Plan, the Emergency Management Plan and several fire safety plans.

Crosswalk sections that do not apply to the County of Santa Cruz such as multi-jurisdiction plan requirements are not included.

Each part of the LHMP includes required elements specified under Section 201.6 of Title 44 of the *Code of Federal Regulations* (44 CFR). Since one of the objectives established for the LHMP is to achieve compliance for the County of Santa Cruz under the DMA, the requirements specified for program compliance are often cited at the beginning of a subsection to illustrate

how that subsection attempts to comply with the requirement.

At the end of this LHMP are **Appendix A** through **Appendix O**. These appendices include vital information or explanations to support the main content of this plan. Technical terms, acronyms, and abbreviations are used throughout this document. To aid the reader, technical terms used are defined in the glossary. The list of acronyms and abbreviations defines all shortened forms used in hazard mitigation planning and/or this LHMP.

PART 1 — INTRODUCTION AND ADOPTION

People and property in Santa Cruz are at risk from a variety of hazards, which have the potential to cause widespread loss of life, damage to property, infrastructure, and the environment. Some hazards are natural, such as earthquakes, while others are natural hazards exacerbated by the use of land, such as building along a cliff and development within floodplains. A natural hazard can result in damages and hardships for an entire community for many years following the event. Flooding, drought, earthquakes and cliff retreat have all occurred in the County within the last fifty years. Flooding on the San Lorenzo River had caused the most severe damage in the County until 1989 when the Loma Prieta earthquake occurred. There is a very strong possibility of an earthquake equal to or larger than the Loma Prieta quake occurring in the Santa Cruz area. (Table 4-2) within the next 100 years.

The County of Santa Cruz is somewhat unique in that the water service is provided by the Soquel Creek Water District, Pajaro Valley Water District, San Lorenzo Water District, and the City of Santa Cruz, all of which are independent water agencies. Many rural properties supply their own water via wells.

Hazard Mitigation

The purpose of hazard mitigation is to implement and sustain actions that reduce vulnerability and risk from hazards, or reduce the severity of the effects of hazards on people and property. Mitigation actions include both short-term and long-term activities which reduce the impacts of hazards, reduce exposure to hazards, or reduce effects of hazards through various means including preparedness, response and recovery measures. Effective mitigation actions also reduce the adverse impacts and cost of future disasters.

The County of Santa Cruz developed this Local Hazard Mitigation Plan (LHMP) to create a safer community. The County of Santa Cruz LHMP represents the County's commitment to reduce risks from natural and other hazards, and serves as a guide for decision-makers as they commit resources to reducing the effects of potential hazards. The County of Santa Cruz LHMP serves as a basis for the State Office of Emergency Services (OES) to provide technical assistance and to prioritize project funding. (Code of Federal Regulations (CFR) §201.6.)

For disasters declared after November 1, 2004, the County of Santa Cruz must have an approved LHMP pursuant to CFR §201.6 in order to receive FEMA Pre-Disaster Mitigation (PDM) project grants or to receive post-disaster Hazard Mitigation Grant Program (HMGP) project funding. The LHMP is written to meet the statutory requirements of the Disaster Mitigation Act (DMA) 2000, enacted October 30, 2000 and Title 44 of the Code of Federal Regulations CFR Part 201–Mitigation Planning, Interim Final Rule, published February 26, 2002.

ACKNOWLEDGEMENTS

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Pat Jocius	At Large Community Member

Summary

The physical environment of Santa Cruz County is one of the most beautiful and diverse in California. The topography is varied, containing the redwood forests in the Santa Cruz Mountains in the north and northeast, the mid-County coastal terraces where a large portion of the County's population resides, and the alluvial plains of South County, which is predominantly in agricultural use. The central California coast location and the County's topographical features contribute to the ideal Mediterranean climate of Santa Cruz County.

FIGURE 1. COUNTY LIMITS OF SANTA CRUZ WITH GENERAL PLAN BOUNDARIES

Natural hazards that have affected Santa Cruz in the past and those that may affect it in the future can be identified with a high degree of probability. Flooding, earthquakes and cliff retreat have all occurred in the County within the past thirty-five years. The County is prone to reoccurring droughts and will periodically witness flood conditions. Until 1989, flooding on the San Lorenzo River had caused the most severe damage in the City. However, the Loma Prieta earthquake changed that history.

On October 17, 1989, the Loma Prieta earthquake, the largest earthquake to hit an urban area in California since the 1906 San Francisco earthquake, struck the County of Santa Cruz. The earthquake destroyed 674 dwellings, 32 mobile homes and 310 businesses within the county and the State Office of Emergency Services estimated monetary damages to residential buildings at $176 million and $98 million to commercial structures.[1]

While we cannot predict or protect ourselves against every possible hazard that may strike the community, we can anticipate many impacts and take steps to avoid or reduce the harm they will cause. This Local Hazard Mitigation Plan (LHMP) is part of an ongoing process to evaluate the risks that different types of hazards pose to Santa Cruz and will engage the County and the community in dialogue to identify the most important steps to pursue in order to reduce these risks.

The County of Santa Cruz and community members have been working together during the past several years to identify and address the risks posed by earthquakes, floods, fires and other potential hazards. Many measures such as vegetation management, a comprehensive water management plan, and seismic retrofits have significantly reduced the community's vulnerability to these hazards. Over time, this constant focus on disaster preparation will make the County a much safer and more sustainable community.

It is the intention of this plan to meet the requirements of the Federal Disaster Mitigation Act of 2000. Section 322 of the Act specifically addresses mitigation planning at the state and local levels. Following approval of this LHMP by FEMA, the County of Santa Cruz will be eligible to apply for mitigation grants before disasters strike.

Mitigation Plan Objectives and Actions

Santa Cruz strives to be a disaster-resistant county that can avoid, mitigate, survive, recover from, and thrive after a disaster while maintaining its unique character and way of life. County government should be able to provide critical services in the immediate aftermath of a devastating event of any kind. The people, buildings and infrastructure of Santa Cruz should be resilient to disasters. The County's overall objective is to have basic government services and commercial functions resume quickly after a damaging earthquake or other significant event.

This Plan has four primary goals for reducing disaster risk in Santa Cruz:

1. Avoid or reduce the potential for loss of life, injury and economic damage to Santa Cruz residents from earthquakes, wildfires, floods, drought, tsunami, coastal erosion, landslide and dam failure.
2. Increase the ability of the County government to serve the community during and after hazard events.
3. Protect Santa Cruz's unique character, scenic beauty and values from being compromised by hazard events.
4. Encourage mitigation activities to increase the disaster resilience of institutions, private companies and systems essential to a functioning Santa Cruz.

CHAPTER 1—ADOPTION BY COUNTY BOARD OF SUPERVISORS RESOLUTION

CHAPTER 2—COMMUNITY PROFILE

Sources: Santa Cruz County Comprehensive Economic Development Strategy (CEDS) 2008 Annual Update (Jan. 2009) **Figure 2**

Community Profile

The County of Santa Cruz is situated on the northern shore of Monterey Bay (see Figure 2). Our county is home to the Monterey Bay Marine Sanctuary and University of California at Santa Cruz (UCSC) Longs Marine Lab. The bay, beaches, and coastline are appreciated by the community as a valuable natural resource as well as a key economic resource. This location along the coast also presents several potential hazards to the community such as tsunami, coastal erosion, and flooding.

The County's mild weather, proximity to several northern California metropolitan centers, and scenic and recreation resources make it a popular day and extended-stay recreation area. As a result, the population is subject to large seasonal variations due to an influx of visitors during summer and other peak recreational periods. Planning for potential hazards in Santa Cruz must address the safety of its visitor population as well as residents, large student population, and workers within the community.

The County occupies a picturesque location along the coast of the Pacific Ocean, between the Monterey Bay and the Santa Cruz Mountains. It is a land of steep coastal bluffs, deep mountain canyons, redwood, oak and madrone forests, open meadows, and beaches. This picturesque location also contributes to the potential hazards. Parts of Santa Cruz County, such as the City of Santa Cruz downtown area, are located within a flood plain. There are only four bridges across the river connecting the two sides of the city. Past experience has shown that losing even one of these bridges in a disaster presents significant problems in addition to traffic impacts.

The County's Mediterranean climate is characterized by warm, dry summers and mild, rainy winters. Warm temperatures and low precipitation are the norm from approximately April through October. Cooler temperatures and heavy rains dominate November through March. Though winters are typically mild, colder winds from inland regions with more continental climates can result in short-term cold snaps. During the year the average temperature is approximately 56 degrees. The average high temperature is 69 degrees Fahrenheit and the average low temperature is 44 degrees Fahrenheit.[2] Because of this temperate climate, extreme heat is rarely a threat to the community. Both summer and winter temperatures are moderated by the marine influence and summer fog is a common occurrence. Winds are generally northwesterly and seldom reach severe intensities. The Santa Cruz Mountains form a natural barrier to winds from the north and from the hot interior valleys. Rainfall varies throughout the county, from approximately 80 inches per year in Bonny Doon, to approximately 22 inches per year in the Watsonville area. County wide over the past 25 years, it has ranged from 15 inches in 1989 to 59.8 inches in 1983 with an average 32 inches of rainfall annually.

TABLE 2-1. TEMPERATURE AVERAGES FOR SANTA CRUZ

Average High/Low Temperature	Average Rainfall
January 60°/38° F (15° /3° C)	January 6.16 inches (156 mm)
August 76°/51° F (24°/10°C)	August 0.07 inch (1.77 mm)

TABLE 2-2. COUNTY OF SANTA CRUZ POPULATION AND HOUSEHOLD GROWTH – 2000 CENSUS

Population	Number	Percent
Total Population	253,137	100%
Sex and Age		
Male	126,822	50.1%
Female	126,315	49.9%
Median Age (years)	37.0	
18 & Under	54,931	21.7%
65 years and older	26,326	10.4%
Disabled (5 years and older)	26,892	11.5%
Total Households	91,139	100%
Persons per household	2.71	
Median household income	$62,849	
Persons below poverty	26,832	10.6%
Housing Characteristics		
Total Housing Units	102,311	100%
Occupied Housing Units	93,518	91.4%
Vacant Housing Units	8,793	8.6%
Owner Occupied Housing Units	56,150	60%
Renter Occupied Housing Units	37,368	40%
Housing Units in multi-unit structures	20,986	20.4%

As noted in the table above, approximately 11.5% of county residents are disabled. Also, 10.4% of the county's population is age 65 or above. It is important to consider these special populations in creating a hazard mitigation plan, as they may need extra assistance during emergencies. The County's Emergency Management Plan (EMP) does address special population needs and this hazard plan was written with reference to the EMP.

The University of California at Santa Cruz (UCSC)

The County of Santa Cruz is home to the University of California at Santa Cruz (UCSC). The main University campus consists of over 2,000 acres on the northwest side of the City of Santa Cruz off High and Bay Streets. Approximately 53 percent of the campus, including most of the developed area, is located within the City of Santa Cruz limits, and the remainder of the campus lies in the unincorporated area of Santa Cruz County.

In addition to the main University campus, the University also has a Marine Lab Facility at the north side of the County situated along the coast.

Much of the University infrastructure and services are at least somewhat dependent on the City and County of Santa Cruz. UC Santa Cruz receives water and sewer treatment services from

the City of Santa Cruz. In normal and wet years, the water supply system is capable of meeting the needs of the current population, but even without population increases, the system is highly vulnerable to shortages in drought years. The City and the University are also linked through mutual aid agreements in areas such as fire services.

The University has a current enrollment of approximately 15,000 students supported by approximately 4,400 faculty and staff.

The University adopted its own Hazard Mitigation Plan in 2005. It also has an Emergency Response Plan that can be found online at: http://disaster.ucsc.edu. This plan provides details about hazard response, vulnerabilities and mitigation measures for the University community.

Cabrillo Community College

The county is also home to one of the highest rated community colleges in the state. Cabrillo Community College sits on 160 acres overlooking Monterey Bay. The main campus is located in Aptos, on the north side of Hwy 1. There are two satellite campuses, one in the City of Watsonville and the other in Scotts Valley. The college also owns seven acres in Bonny Doon for use of anthropology and archeology students.

The College has a current enrollment of approximately 17,000 students supported by 933 faculty and staff. The developed area (existing and approved) of the campus consists of 40 buildings with over 571,702 square feet.

There is no student housing on campus but there is a newly built student center, which includes a Health Center. The College contracts with the County Sheriff's Department to provide all law enforcement services. It is also dependent on the County of Santa Cruz for fire protection and other services such as water and sewer.

The College has developed an Emergency Response Plan (BP4330) as of Sept. 11, 1989. This plan clearly delineates areas of responsibility for staff and partner agencies and specifically addresses earthquake, fire, flood, storms, landslide and other hazards that might occur on campus. This policy also defines when a state of emergency should be declared on campus and the steps necessary to address said emergency.

California Polytechnic University

Swanton Pacific Ranch is a working ranch owned by Cal Poly. It has three distinct operations; FSC certified selective forestry, natural grass-fed beef and certified organic crops. Located on 3200 acres, the exceptional diversity of this property, and the greater Scotts Creek watershed, provide remarkable conditions for agriculture production, which support several unique educational programs and research opportunities based on site. The ranch was recently threatened by the Lockheed Fire in August 2009, but no damage occurred.

Household Income and Education

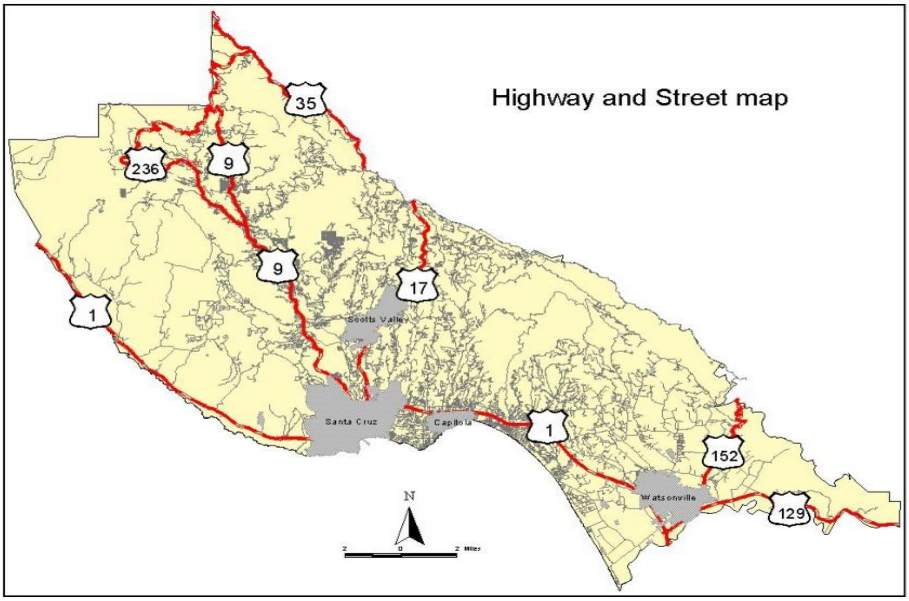
The median household income for the County of Santa Cruz in 2007 was an estimated $62,849, compared to $59,928 for the State of California. Residents of the County of Santa Cruz are highly educated, with more than 34 percent of residents over age 25 having achieved a bachelor's degree or higher by 2000.

Residents' Place of Work

In addressing potential hazards, it is significant that over 33,000 county residents commute to neighboring counties for work.[3] This represents approximately 26% of the total number of workers in the county. Over 21,000 commute to work in Santa Clara County, which is connected to Santa Cruz County by Hwy. 17, a winding, four-lane mountain pass prone to traffic accidents and small slides, especially during the rainy season. Approximately 5,100 county residents commute to Monterey County via Hwy.1, portions of which are two lanes and prone to accidents, which cause major traffic jams.

There are far fewer commuters into the county. Just over 14,300 workers commute to Santa Cruz, the vast majority of which (7,601) come from Monterey County via Hwy 1 (**Appendix N**). As previously mentioned, this can be problematic due to accidents, which tie up this main artery to the coast.

FIGURE 3. KEY TRANSPORTATION ROUTES TO AND WITHIN SANTA CRUZ COUNTY



Five major state highways connect Santa Cruz County with adjacent counties. Highway 1 leads along the coast from San Francisco south to the cities of Santa Cruz, Capitola and Watsonville and then on to Monterey. Highway 9 traverses the County from the City of Santa Cruz through the unincorporated towns of Felton, Ben Lomond, Brookdale and Boulder Creek, which are all located in the San Lorenzo Valley. Highway 17 also crosses the Santa Cruz Mountains into Santa Clara County passing through the City of Scotts Valley. Highways 129 and 152 join the City of Watsonville with neighboring Santa Clara County. The Santa Cruz Metropolitan Transit District (Metro) provides bus service throughout Santa Cruz County. Metro also operates bus service between the County of Santa Cruz and Santa Clara County. One small airport

accommodating private planes is located in Watsonville and a second small airport is maintained in Bonny Doon for the use of CalFire Dept.

Route 9 is the only viable access to the San Lorenzo Valley, serving the unincorporated communities. Bonny Doon is accessible via either Highway 9 or via Highway 1 and then inland near Davenport. Davenport and Watsonville, and indeed, most other mid county locations are all accessible from Highway 1.

The county maintains a distinction between urban and rural areas through the use of a stable Urban/Rural Boundary, consistent with the California Coastal Act of 1976 and measure J, a local growth management referendum of 1978. The Urban/Rural Boundary is represented by an Urban Services Line (USL) and a Rural Services Line (RSL).

Urban concentrations of development are located within the four incorporated cities of Scotts Valley, Santa Cruz, Capitola and Watsonville and in the unincorporated areas of Live Oak, Soquel, Aptos, and Freedom as defined by the USL (See **Appendix L**). It is basic county policy to direct a large share of the County's growth into the areas within the USL to facilitate the provision of services for future growth, preservation of the environment and hazard mitigation.

Economic Trends

The dominant economic activities are centered in the agricultural and food processing of the South County and in service and tourism in the North County. Other economic activities include high technology, quarrying, forestry, wood products, fishing and other manufacturing. As previously noted, there are two major educational institutions in our county: Cabrillo Community College located in mid-county and the University of California at Santa Cruz (UCSC) located in the north county area.

Santa Cruz County has seen a modest growth in key economic indicators over the past fourteen years such as retail sales, agricultural production and net job growth, to name a few[4]. The greatest job growth occurred in "natural resources, mining, and construction" categories (42.1%) and the government category (28.3%).[5] Information technology and manufacturing suffered the highest job losses during this same time period. While jobs in the agricultural sector decline 27.3%, the production value of local crops increased from $230 million dollars in 1998 to almost $500 million in 2007. This is an important consideration in hazard mitigation planning, as much of the unincorporated area of the county is agricultural land, some of which lies in the flood plain. Proper flood mitigation could save millions of dollars in lost crops.

While net job growth increased modestly from 1998 to 2007, the State Employment Development Department reported a decline of approximately 800 jobs between October of 2007 and October of 2008 and this decline is expected to continue through 2009.[6] Retail sales accounted for a large portion of revenue for the county, increasing 40.5% between 1998 and 2006[7]. This figure includes sales tax revenues from the entire county, including the cities of Watsonville, Scotts Valley, Capitola and Santa Cruz. The unincorporated area of the county experienced a 35.4% increase in sales tax revenue in the same time period.

Community Vision

The County of Santa Cruz General Plan includes a section on Public Safety, which addresses many of the potential hazards addressed in this plan. The overall goals guiding the Public

Safety Element of the General Plan are as follows:

- To protect human life, private property and the environment.
- To minimize public expenses by preventing inappropriate use and development or location of public facilities and infrastructures in those areas, which by virtue of natural dynamic processes or proximity to other activities, present a potential threat to the public health, safety and general welfare.

The Public Safety Element of the General Plan also identifies major hazards that may occur within our county, policies that address each hazard and mitigation factors. It provides information on all pertinent county policies relating to hazard mitigation, as well. The General Plan has informed this LHMP. Working with the Planning Department collaboratively on this LHMP supports a broader vision of what factors need to be considered in order to protect the health and welfare of our residents.

General Plan Guiding Principles

The overall goals and guiding principles for the Land Use Element of the General Plan, which needed to be considered in our Local Hazard Mitigation Plan, are as follows:

- **Population and Residential Growth Goals:** To provide an organized and functional balance of urban, rural, and agricultural land use that maintains environmental quality, enhances economic vitality, protects the public health, safety and welfare, and preserves the quality of life in the unincorporated areas of the county.
- **Rural Residential Siting and Density:** To achieve patterns of rural residential development that are compatible with the physical limitations of the land, the natural and cultural resources of the County, the availability of public services, and protection of the natural environment.
- **Village, Town, Community and Specific Plans:** To continue using village, town, community and specific plans to provide a planning framework to guide future public and private improvements in town centers and other concentrated urban and rural areas, to provide a higher level of planning detail and involvement.

Critical Structures Within Santa Cruz County

The County of Santa Cruz owns or leases a large number of facilities and critical infrastructures. These buildings, bridges, culverts etc. are used for various purposes including government administration, emergency services, public works, and recreation. After the 1989 Loma Prieta earthquake, many of these structures were examined for seismic safety.

A list of these facilities appears in Appendix D and maps of the location of these structures follows on the next pages (figure 4 & 5).

County of Santa Cruz Owned Infrastructure consists of the following elements:

- All sanitation pump stations and treatment plants
- All county maintained bridges and major culverts
- County rain and stream gauges
- Pajaro and Salsipuedes levee flood gates
- Public Works Yards
- Davenport Water Treatment Facility
- 38th Ave. Drainage Facility

FIGURE 4. COUNTY OWNED CRITICAL INFRASTRUCTURE LOCATIONS

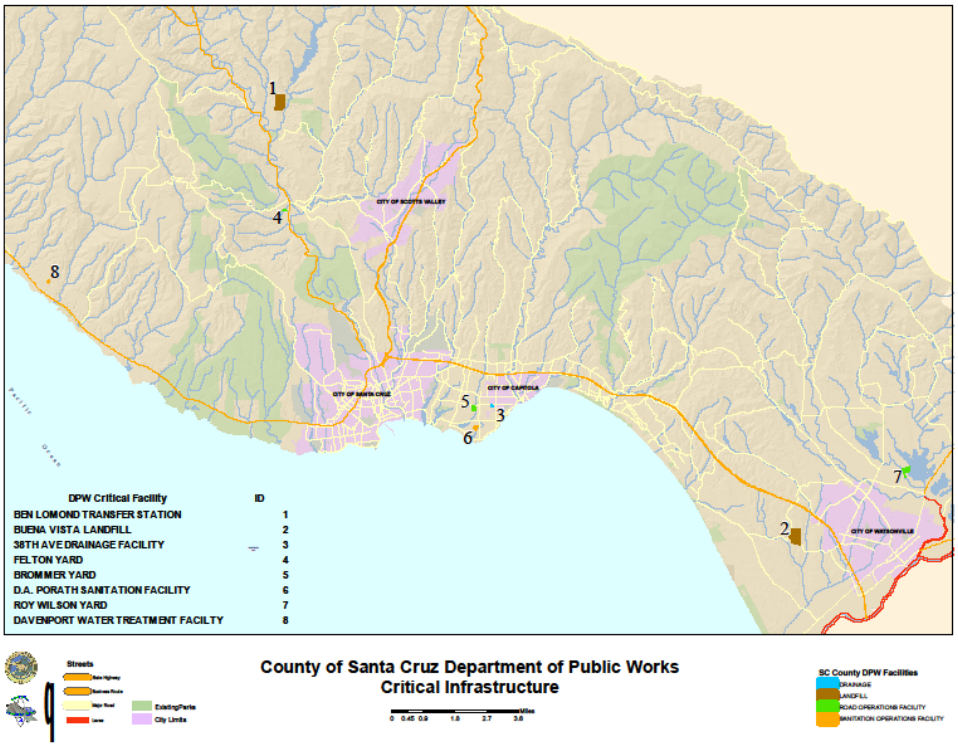
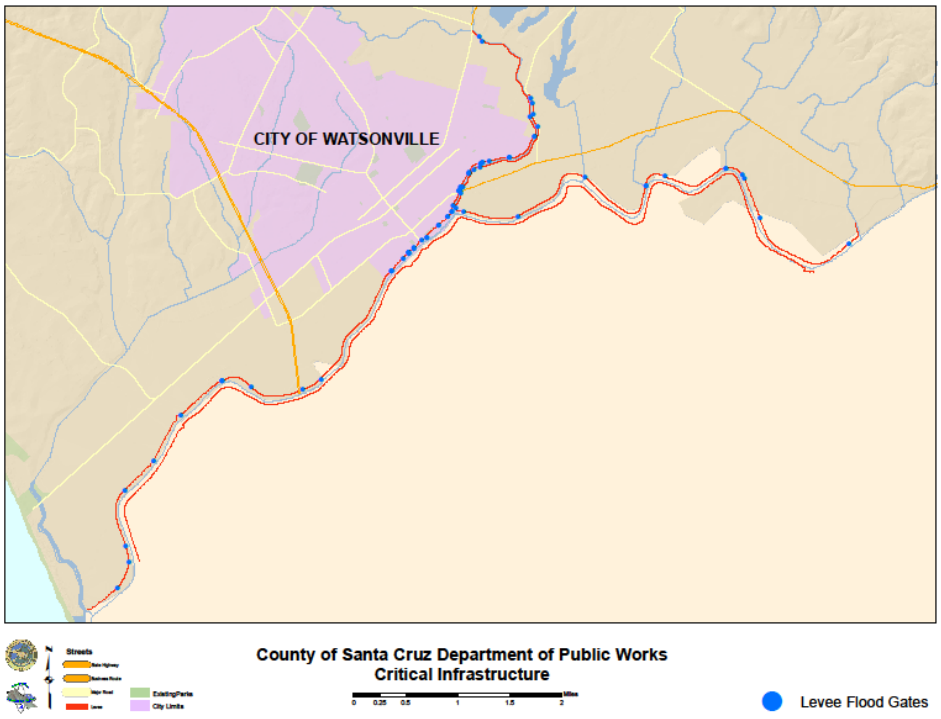


FIGURE 5. LOCATION OF LEVEE FLOOD GATES



Critical Facilities Not Owned by the County

Hospitals and schools are some of the critical facilities not owned by the County but designated as Disaster Medical Facilities or shelters in the Public Health Emergency Preparedness Plan. For a complete list, please see Appendices E, F and G.

There are three hospitals within the county limits: Dominican Santa Cruz Hospital, Watsonville Community Hospital, and Sutter Maternity and Surgery Center. Of the three, only Dominican and Watsonville have emergency rooms. All three hospitals are designated for use during Public Health emergencies.

There are also several skilled nursing facilities, rehabilitation centers, medical clinics, and long-term care facilities within the county.

The Santa Cruz County Office of Education (COE) oversees all schools within the county, some of which have been used in the past as emergency operation centers and emergency shelters. The COE has an Emergency Plan, which is incorporated within this LHMP.

FIGURE 6. CRITICAL FACILITIES NOT OWNED BY THE COUNTY OF SANTA CRUZ

Historical Structures

The Planning Department keeps an inventory of historic sites and properties within the county. A historic evaluation is provided for each site which provides the basis for classifying the properties. The evaluation and rating of these properties in this inventory is based upon guidelines published by the national Park Service for placement on the National Register of Historic Sites. A review of this list revealed that all of the properties are privately owned except for Wilder Ranch State Park, which is under the authority of the state government. There were no historic sites or properties under the authority of the county government.

PART 2 — THE PLANNING PROCESS

- The Purpose of the Plan
- The Planning Process
- Documentation of the Planning Process
- Local Capabilities Assessment and Integration
- Community Participation

CHAPTER 3 — THE PLANNING PROCESS

The Purpose of the Plan

The Federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390), commonly known as the 2000 Stafford Act Amendments, was approved by Congress on October 10, 2000. To implement the DMA 2000 planning requirements, FEMA prepared an Interim Final Rule, published in the Federal Register on February 26, 2002, which established planning and funding criteria for states and local communities. This act required state and local governments to develop hazard mitigation plans as a condition for federal grant assistance. For the Pre-Disaster Mitigation (PDM) program, local jurisdictions must have an approved mitigation plan to receive a project grant. Prior to 2000, federal legislation provided funding for disaster relief, recovery, and some hazard mitigation planning. The DMA improves upon the planning process by emphasizing the importance of community planning for disasters before they occur. Using this initiative as a foundation for proactive planning, the County of Santa Cruz developed this hazard mitigation plan in an effort to reduce future loss of life and property resulting from disasters. Through careful planning and collaboration among public agencies, stakeholders, and citizens, it is possible to avoid or minimize losses that can occur from disasters. Hazard mitigation is any action taken to permanently eliminate or reduce long-term risks to human life and property from natural hazards. Along with preparedness, response, and recovery, mitigation is an essential element in emergency management. Disasters can have significant impacts on communities. They can destroy or damage life, property, and infrastructure, local economies, and the environment.

This LHMP is intended to assist the County of Santa Cruz in reducing its risk from all hazards by identifying resources, information, and strategies for risk reduction. The plan will also help guide and coordinate mitigation activities throughout the County. Building on a tradition of progressive planning and past mitigation successes, the County of Santa Cruz planning team set out to develop a plan that would meet the objectives summarized below.

- The plan would meet or exceed program requirements specified under the DMA
- The plan would meet the needs of the County of Santa Cruz
- The plan would coordinate existing plans and programs so that high priority initiatives and projects to mitigate possible disaster impacts would be funded and implemented. The plan would also create a linkage between the LHMP and established plans such as the County's General Plan and Emergency Management Plan so that they will work together in achieving successful disaster mitigation. It should be noted that DMA compliance is not the sole purpose of this LHMP. Santa Cruz County has experienced a number of significant disasters, which has fostered a practice of proactive planning and program implementation. This practice is further enhanced by the development of this LHMP. Multiple objectives drive this planning effort, one of which is DMA compliance. Elements and strategies included in this plan were selected not only because they meet a program requirement but also because they meet the needs of the community.

PLANNING PROCESS

This section describes the process in which the plan was developed. This includes the federal requirement followed by the County's actions applied to this process.

DOCUMENTATION OF THE PLANNING PROCESS

2.1 Documentation of the Planning Process 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;

(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; and

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

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.

The County of Santa Cruz has developed a local hazard mitigation plan. The County Office of Emergency Services took on the initial responsibility for development of the plan. The initial phase of the planning process established a project team made up of representatives from various County government departments responsible for different aspects of the hazard mitigation plan including Planning and Building, Public Works, Fire, and Geographic Information Systems (GIS). From this group, project team leaders were identified. Team leaders included Paul Horvat, Emergency Operations Manager, Mark Deming, Planning Dept. Assistant Director and Laurie Lang, LHMP Coordinator. The project team was formed as a task group to develop the plan. Meeting dates were set based on progress and focus. The project team invited interested parties such as UCSC, Cabrillo College, the cities of Capitola, Watsonville, Scotts Valley and Santa Cruz, the local American Red Cross as well as scientific and technical specialists at the local, state, and national level to review the draft at various stages. The project team is listed under acknowledgements in Part 1 (pg. 4).

The plan was developed between May 2008 and December 2009. The project team leaders met once per week and the project team met approximately once per month from September 2009, through December 2009, and then as needed in 2010 until the draft plan was circulated for a 30-day public review on January 15, 2010. The project team leaders identified characteristics and potential consequences of natural hazards that are a potential threat to the County of Santa Cruz. With the understanding of the risks posed by the identified hazards, the team determined priorities and assessed various methods to avoid or minimize any undesired effects. Responsible departments were consulted at several points in the development of the goals, objectives and actions. As a result, the mitigation strategy, including goals, objectives and actions, was determined, followed by an implementation and monitoring plan. This monitoring plan included tracking of hazard mitigation projects, changes in day-to-day County operations, and continued hazard mitigation development.

Local Capabilities Assessment and Integration

2.2 Local Capabilities Assessment (State of OES Requested Information) Requirement §201.4(c)(3)(ii): Of the Federal Register Interim Final Rule Title 44 of the Code of Federal Regulations 44 CFR Parts 201 and 206 states, The **State** mitigation strategy **shall** include a general description and analysis of the effectiveness of local mitigation policies, programs and capabilities.

This assessment of the mitigation goals, programs and capabilities included a review of the following items:

1) Human and technical resources
2) Financial resources and funding sources
3) Local ordinances, zoning and building codes
4) On-going plans or projects

The LHMP was informed by The General Plan Safety Element, the Emergency Management Plan, the Urban Water Management Plan, the Santa Cruz City Water Department Water Conservation Plan, County ordinances, zoning and building codes and the Capital Improvement Program (CIP.) Consistency between these plans, programs and policies was reviewed by using these approved plans and policies as a foundation for the LHMP and by consulting with the departments responsible for the various plans and programs. In reviewing the effectiveness of local programs, **Appendix H** lists ***Successful Programs*** that have been implemented by the County. While these programs and the updated Emergency Management Plan have increased the County's hazard mitigation capabilities, funding availability is the limiting factor in the implementation of additional identified hazard mitigation programs.

The Project Team leaders met several times with county staff and members of the Planning Department to insure that the LHMP was consistent with the General Plan Safety Element. The project leaders met with county staff in the Environmental Health Dept. to incorporate hazard mitigation efforts identified by the various Water Departments within the county. Project leaders met with Fire Department staff to insure that the LHMP was consistent with the current and planned programs and fire safety plans. The project leaders also met with the County GIS coordinator to insure that maps were consistent with those in the General Plan and were accurate as of the draft publication date.

The County of Santa Cruz Emergency Services Manager, Paul Horvat, was part of the Project Team leadership and oversaw the review and incorporation of plans and studies for consistency with the LHMP. This included the county's Emergency Management Plan with the following appendices:

- Flood Management Plan
- Earthquake Hazard Plan
- Dam Inundation Hazard Plan
- Wildland Fire Hazard Plan
- Tsunami Hazard Plan

Community Participation

Public input during the development of the mitigation plan assisted in shaping plan goals and mitigations, and integrating the LHMP with the Safety Element of the General Plan Update. The

Local Hazard Mitigation Plan was a topic of discussion at three public meetings of the Emergency Management Council. When the draft was completed, a 30 day public comment period was initiated. A public notice was placed in the local paper to invite the public to review and comment on the draft plan. Copies of the plan were made available at the Aptos, Live Oak and Felton Branches of the Santa Cruz Public Library and in the General Services Department at the County Administrative Building. A draft of the plan was posted on the County's website with an interactive response option that provided an opportunity for interested members of the public to comment on the draft LHMP on the web. Those comments were incorporated into the final document.

The draft LHMP was also sent to members of a technical committee, which consisted of national, state and local scientists and experts for review prior to creation of the Public Draft. Comments received were incorporated into the final draft LHMP.

LHMP Meetings	Date	Type
Project Team Leaders	July 1, 2009	In house
Subject Matter Expert	July 21, 2009	In house - Flood
Subject Matter Expert	July 28, 2009	In house – City of Santa Cruz
Consultant	July 29, 2009	In house – Civil Engineering
Project Team Leaders	August 3, 2009	In house
Consultant	September 2, 2009	In house – Civil Engineering
EMC Presentation and adoption of goals and objectives	September 3, 2009	Public
Consultant	October 8, 2009	In house
Project Team Leaders & GIS	October 13, 2009	In house
Project Team	October 15, 2009	In house
Project Team (CRS Team)	October 29, 2009	In house
Emergency Management Council – section review	November 5, 2009	Public
Project Team Crosswalk Review	December 9, 2009	In house
Project Team	December 16, 2009	In house
EMC Presentation of draft plan	January 7, 2010	Public
Project Team Leaders	January 11, 2010	In house

PART 3 — HAZARD IDENTIFICATION AND RISK ASSESSMENT

Significant Risks

Earthquakes and Liquefaction
Wildfires
Floods and Associated Coastal Storms
Drought
Tsunami
Coastal Erosion
Landslides

Less Significant Risks

Dam Failure
Expansive Soils

Unknown Risk

Climate change

Multi-Hazard Summary

IDENTIFICATION AND PROFILING OF HAZARDS

Risk Assessment of Hazards in Santa Cruz

3.0 Risk Assessment: §201.6(c)(2): The plan **shall** include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

It is important for a community's risk assessment, mitigation and preparedness efforts to be founded on accurate information about the types and scale of damage hazards pose to the community. This section of the Plan contains a description of those hazards identified as potential significant threats to Santa Cruz – earthquakes, wildfires, floods, drought, tsunami, coastal erosion, and landslide as well as the lesser threats of dam failure and expansive soils – and the exposure and vulnerability of the County to these hazards. These risks have been identified based on historical information of hazard events including researching past disaster declarations in the County, input from geologic, climatic, and wildfire specialists and organizations as well as public comments and newspaper articles. Probable damage and the consequences to the county's quality of life are described.

The County of Santa Cruz has expanded and updated its GIS database, mapping critical facilities and hazard risk areas. Data from this mapping was used to determine hazards that present the greatest risk to the County.

Each hazard type was mapped as a GIS layer. In some cases, the hazard layers were developed and provided by outside agencies. Estimated loss is based on assessment improvement values associated with the Assessment Roll dated 10/13/2009. The assessment improvement values were joined to the county's parcel layer. The unincorporated parcels were queried out (which excluded the city parcels in the analysis). For each hazard type, the unincorporated parcels that fell within the hazard type were selected and the assessment improvement values were totaled. Valuation of parcels is based on improvement values as they appear on the Assessment Roll. They do not reflect potential sale or replacement value. ESRI's ArcGIS software was used to develop the hazard layers and conduct the analysis.

TABLE A-1. A REVIEW OF ALL HAZARDS WITHIN THE COUNTY OF SANTA CRUZ

Hazard	Risk	Why/Why Not
Avalanche	No	The county is not in an avalanche area
Climate Change	Unknown	Ongoing Research
Coastal Erosion	**Major**	**Past history indicates probability is high, potential for loss of life is low - potential for economic and infrastructure loss is high**
Coastal Storm	**Included**	**Included in Flood Plan**
Dam Failure	**Lesser**	**Past history indicates that probability is low but potential loss of life is high**
Drought	**Major**	**Past history indicates probability is high**
Earthquake	**Major**	**Past history indicates probability is high**
Expansive soils	**Major**	**Past history indicates probability is high**
Extreme Heat	No	Past history indicates probability is low
Flood	**Major**	**Past history indicates probability is high**
Hailstorm	No	Past history indicates probability is low
Hurricane	No	Past history indicates probability is low
Land subsidence	No	Past history indicates probability is low
Landslide	**Major**	**Past history indicates probability is high**
Liquefaction	**Included**	**Included with earthquake**
Winter Snow Storm	No	Past history indicates probability is low
Tornado	No	Past history indicates probability is low
Tsunami	**Major**	Past history (200 Years) indicates probability is low but potential for loss of life and property could be high
Volcano	No	Does not affect county
Wildfire	**Major**	**Past history indicates probability is high**

3.1 Identifying Hazards - §201.6(c)(2)(i): The risk assessment **shall** include a description of the type of all natural hazards that can affect the jurisdiction.

TABLE A-2. HAZARD SCREENING FOR COUNTY

Risk	Affected Areas
Very Significant Risk	
Earthquake (including liquefaction)	Entire County
Wildfire	Wildland/urban interface areas
Flood (including coastal storms)	San Lorenzo River floodplain Pajaro River floodplain Soquel Creek in Soquel Village
Drought	Entire County
Tsunami	Coastal Areas
Coastal Erosion	Coastal Areas
Landslide	Various areas (see map)

Lesser risk	Affected Areas
Dam Failure	San Lorenzo Valley
Expansive Soils	Various areas (see map)

The County of Santa Cruz is exposed to a number of natural hazards that vary in their potential intensity and impact. This mitigation plan addresses six high-risk natural hazards, selected because of the likelihood of occurrence or the potential consequences, as well as two additional hazards that present either less risk of occurrence or extent of damage. The natural hazards: floods, earthquake, and tsunami are of great concern because they can occur independently, or in combinations that can trigger secondary hazards such as dam failure. Another high-risk hazard, drought, can exacerbate the potential for wildfires.

The natural hazards included in this plan were identified through a community-based process including input from scientific experts in various fields and in conjunction with the update of the General Plan including the Safety Element. The Local Hazard Mitigation Plan (LHMP) was the result of a number of public meetings, project team meetings, scientific expert and community input as well as suggestions submitted by community members of the county. Key contributors included members of the Project Team, the Emergency Management Council, Gary Griggs of the University of California at Santa Cruz, and county staff members who worked on programs and research that were incorporated in the General Plan and Safety element. Other natural hazards that are extremely rare or non-existent in the county are not included in this plan but are listed in Appendix A.

The worst potential disaster that the County of Santa Cruz might face involves multiple hazards occurring at the same time. A major earthquake could trigger tsunamis, wildfires or floods, which would be exacerbated by damage to dams, stream culverts and storm drains. The County of Santa Cruz plans for and responds to emergency events in accordance with the Santa Cruz County Operation Area Memorandum of Understanding (MOU). The Emergency Management Plan describes the role and operation of the County departments and personnel during a major emergency. In addition to researching each hazard individually, this Plan explores how the hazards interact, and how mitigation activities for each hazard impact the overall disaster risk in Santa Cruz.

CHAPTER 4 - EARTHQUAKES AND LIQUEFACTION

4.3.0 Risk Assessment

4.3.1 Identifying Earthquake Hazards

3.1 Identifying Hazards–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.

An earthquake is a sudden release of energy in the earth's crust. Caused by movement along fault lines, earthquakes vary in size and severity. The focus of an earthquake is found at the first point of movement along the fault line, and the epicenter is the corresponding point above the focus at the earth's surface. The size of an earthquake has been measured in various ways, the most familiar being the now obsolete Richter magnitude scale, which determines the amount of ground displacement or shaking that occurs near the epicenter. The Richter magnitude scale has now been replaced by the Moment Magnitude scale for medium and large sized earthquakes. While this scale attempts to characterize the amount of energy released by an earthquake, another scale - the Modified Mercalli Intensity Scale - measures ground shaking intensity in terms of perception and damage and takes into account localized earthquake effects (see Table 4-1).

TABLE 4-1. MODIFIED MERCALLI INTENSITY SCALE

Intensity	Severity	Level of Damage
1-4	Instrumental to Moderate	No damage.
5	Rather Strong	Damage negligible. Small, unstable objects displaced or upset; some dishes and glassware broken.
6	Strong	Damage slight. Windows, dishes, glassware broken. Furniture moved or overturned. Weak plaster and masonry cracked.
7	Very Strong	Damage slight-moderate in well-built structures; considerable in poorly built structures. Furniture and weak chimneys broken. Masonry damaged. Loose bricks, tiles, plaster, and stones will fall.
8	Destructive	Structure damage considerable, particularly to poorly built structures. Chimneys, monuments, towers, elevated tanks may fail. Frame houses moved. Trees damaged. Cracks in wet ground and steep slopes.
9	Ruinous	Structural damage severe; some will collapse. General damage to foundations. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground; liquefaction.
10	Disastrous	Most masonry and frame structures/foundations destroyed. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Sand and mud shifting on beaches and flat land.
11	Very Disastrous	Few or no masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Rails bent. Widespread earth slumps and landslides.
12	Catastrophic	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted

Damage from earthquakes varies with the local geologic conditions, the quality of construction, the energy released by the earthquake, the distance from the earthquake's focus, and the type of faulting that generates the earthquake. Ground motion is the primary cause of damage and injury during earthquakes and can result in surface rupture, liquefaction, landslides, lateral spreading, differential settlement, tsunamis, building failure and broken utility lines, leading to fire and other collateral damage. Typically, areas underlain by thick, water-saturated, unconsolidated material will experience greater shaking motion than areas underlain by firm bedrock, but in some cases relief may intensify shaking along ridge tops.

Fires and structural failure are the most hazardous results of ground shaking. Most earthquake-induced fires start because of ruptured power lines and gas or electrically powered stoves and equipment, while structural failure is generally the result of age and type of building construction.

Liquefaction is the transformation of loose, water-saturated granular materials (such as sand or silt) from a solid to a liquid state. Liquefaction commonly, but not always, leads to ground

failure. Liquefaction potential varies significantly and site-specific analysis is needed to accurately determine liquefaction potential in earthquake prone areas.

Fault rupture and earthquake related Ground Cracking could occur in several locations within the County of Santa Cruz (see Figure 7 below). Several fault zones cross Santa Cruz County, and movement along these faults can cause fault-related surface deformation (e.g., surface fault rupture) where the fault reaches the surface of the ground. Both the County of Santa Cruz and the State of California have identified zones where the San Andreas and other active faults have and can cause fault-related surface deformation. Within these zones it is likely that movement along these faults will damage structures, roads, utilities, and other fixed facilities.

In addition to these zones, other ground cracking was observed during the Loma Prieta earthquake and the San Francisco earthquake of 1906. Many of these ground cracks can be attributed to movement or consolidation of large and moderate sized landslides while other ground cracks were most likely related to ridge spreading. Although much of the ground cracking was found near the fault zones and in the Summit area of the county, other ground cracking was found on ridge tops throughout the County of Santa Cruz.

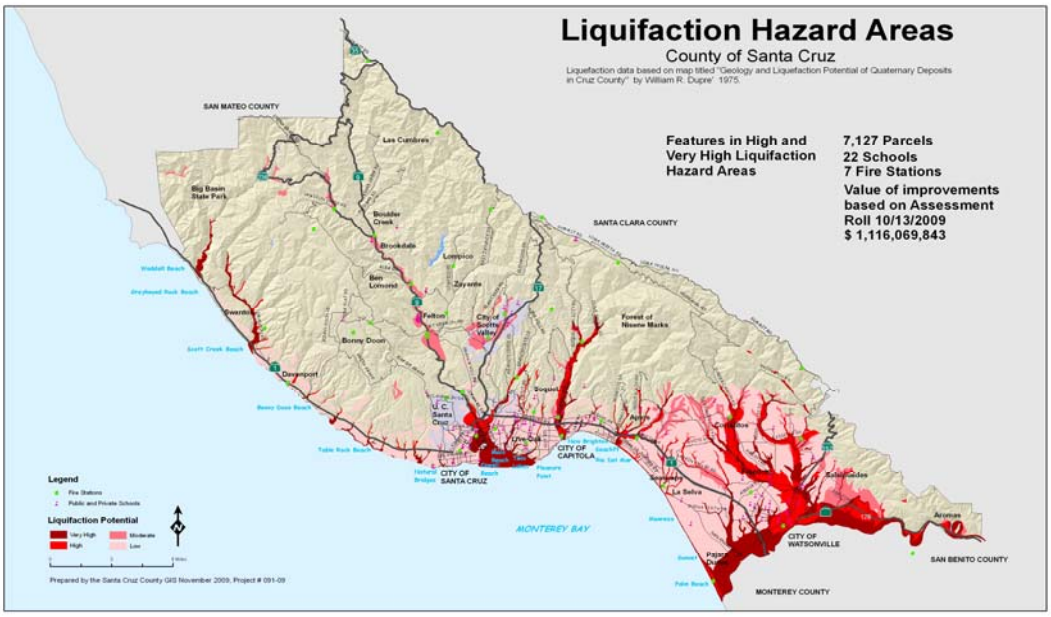
FIGURE 7. FAULT ZONES WITHIN COUNTY OF SANTA CRUZ

4.3.2 Hazard Profile – Earthquakes and Liquefaction

3.2 Profiling Hazards – 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.

A. Location

FIGURE 8. LIQUEFACTION AREAS WITHIN SANTA CRUZ COUNTY



Past experience has shown that the entire county is vulnerable to earthquake. Within Santa Cruz County there are several active and potentially active faults. These include the San Andreas, San Gregorio, Zayante, the Monterey Bay Fault Zone, as well as numerous fault complexes and branches of these major faults.

B. Extent: Magnitude or Severity

Several of the faults located in Santa Cruz County are considered to be active (showing signs of recent geologic movement, within the last 10,000 years), or potentially active (showing evidence of Pleistocene or younger movement). Faults where movement has not occurred

during the Pleistocene are inactive and are not considered to pose a risk to any but the most critical structures.

The most significant threat to the county is the San Andreas Fault zone, which passes through the Santa Cruz Mountains along the northern portion of the county. Based on records from the 1906 San Francisco earthquake, it is estimated that the maximum credible earthquake likely to occur along the San Andreas Fault would equal 8.3 M, which represents more than 30 times the energy released by the 1989 Loma Prieta Earthquake. Santa Cruz County was one of the hardest hit counties during that earthquake.

C. Previous Occurrences

The following is a list of previous events, dates, severity, level of damage, duration, sources of information used, and maps (where available) to show areas affected. While Santa Cruz has sustained numerous earthquakes throughout its history, the two most destructive ones were the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake.

Moderate Sized Earthquakes before 1906: Four moderate sized earthquakes (estimated Richter magnitude 6 to 6.5) were recorded in Santa Cruz before the April 18, 1906 earthquake: a Richter Magnitude 6 earthquake on February 26, 1864 centered somewhere in the southern Santa Cruz Mountains, a 6.5 Richter Scale earthquake on October 8, 1865 centered in the Santa Cruz Mountains, a 6 Richter magnitude earthquake on March 26, 1884 centered in the Santa Cruz Mountains, and a 6.25 Richter magnitude earthquake in the Pajaro Gap on April 24, 1890. All of these together indicate that a pattern of earthquakes nearly the same size of the Loma Prieta earthquake have occurred in the recent past. Each of these earthquakes caused some damage, and would cause damage to homes today (N.B. all magnitudes cited are estimates based on descriptions of the damage which occurred).

April 18, 1906: (Richter Magnitude: 8.3) There were no recorded deaths in Santa Cruz but the old courthouse partially collapsed and about 1/3 of the chimneys within the city of Santa Cruz were destroyed or damaged. Landsliding was observed throughout the Santa Cruz Mountains, and fault rupture was nearly continuous along the San Andreas fault zone, and nearby fault zones in the county of Santa Cruz. Infrastructure, including bridges, was destroyed, and broken mains and pipes shut off the water supply.

October 1926: (Richter Magnitude: 6.1) Two large earthquakes occurred during this year. Three of the aftershocks cracked plaster in Santa Cruz, almost bringing down the chimneys of numerous buildings. It broke plate glass windows along Pacific Avenue. The city water main broke at Laguna Creek and articles fell from shelves at stores.

October 17, 1989 (Richter Magnitude: 7.1) At 5:04 p.m., a magnitude 7.1 earthquake rocked the Monterey Bay and San Francisco Bay regions. The initial quake lasted only 22 seconds, although in the following two weeks, more than 4000 aftershocks were recorded, with 20 of these greater than magnitude 5 on the Richter Scale. The epicenter of the Loma Prieta earthquake was about 10 miles east-northeast of the city of Santa Cruz in the Aptos planning area on the San Andreas Fault. The Loma Prieta earthquake was the largest to strike California since 1906, causing 62 deaths and 3757 injuries. More than 12,000 people were left homeless and transportation, utilities and communications were disrupted. There was more than $6 billion in property damage.

FIGURE 9. ISOSEISMAL MAP[8] ILLUSTRATING INTENSITY AND MAGNITUDE OF THE 1989 LOMA PRIETA EARTHQUAKE IN SANTA CRUZ

D. Probability of Future Events

There are at least six major faults and fault systems within or near the County of Santa Cruz, placing it in an area of high seismic risk. Because earthquakes can cause severe damage over a long distance, the Santa Cruz area remains at risk from continued seismic activity along the many faults in the greater San Francisco Bay region. The reduction of seismic stresses that occurred in the Loma Prieta earthquake did nothing to relieve, and possibly increased, stresses within other faults, including other sections of the San Andreas Fault.

To clarify the extent of future earthquake risk, a partnership of the United States Geologic Service, The California Geologic Survey, and the Southern California Earthquake Center was formed in September 2004 to provide a uniform forecast. Known as the Working Group on California Earthquake Probabilities[9], this group evaluated and systemized currently available historic and paleoseismic information to produce a probabilistic seismic hazards analysis to indicate the type of future earthquakes. One product of this analysis is a method of estimating the probability of ground shaking. The 30-year probability of an M ≥ 6.7 earthquake on the northern segment of the San Andreas Fault is 21% and on the San Gregorio Fault is 6%. Other faults within the region can also cause damage in the county, including the Hayward-Rogers Creek Fault that has a 31% probability of having an M ≥ 6.7 earthquake in the next thirty years[10].

TABLE 4-2. TEN MOST LIKELY DAMAGING EARTHQUAKE SCENARIOS IN CALIFORNIA

Ten most likely damaging Earthquake scenarios	30-year probability	Magnitude
Rodgers Creek	15.2%	7.0
Northern Calaveras	12.4%	6.8
Southern Hayward (possible repeat of 1868 earthquake)	11.3%	6.7
Northern + Southern Hayward	8.5%	6.9
Mt. Diablo	7.5%	6.7
Green Valley-Concord	6.0%	6.7
San Andreas: Entire N. CA segment (possible repeat of 1906 earthquake)	4.7%	7.9
San Andreas: Peninsula segment (possible repeat of 1838 earthquake)	4.4%	7.2
Northern San Gregorio segment	3.9%	7.2
San Andreas: Peninsula + Santa Cruz segment	3.5%	7.4

Because the ten most likely future earthquakes in the Bay area occur on faults throughout the region, the impact and potential losses reported here reveal significant risk for the entire Bay area region including the County of Santa Cruz.

4.3.3 Assessing Vulnerability: Overview

3.3 Assessing Vulnerability: Overview - 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.

A. Overall Summary of Vulnerability to Earthquake

The vulnerability of a community to earthquake hazard is based on a variety of factors including proximity to active and inactive faults, the age of structures, the density of the population and development, the value of property and infrastructure, the construction materials used in residential and non-residential buildings, and the location of critical facilities in a community. Recent history indicates that Santa Cruz has a very high vulnerability to earthquakes due to proximity to faults, density of population and development within the floodplains of the many creeks and rivers, which are subject to liquefaction.

One or more moderate to large sized earthquake will likely shake the entire County of Santa Cruz during the life span of most residents. Older homes will be most affected by their age, structural design, and materials. Modern homes will normally fare better in earthquakes but 1989 showed that this isn't necessarily the case. Some older homes fared better than newer ones due to location and design.

A great earthquake on the San Andreas Fault will:

- Damage roads, bridges, and critical structures, and could severely damage most homes in the County.
- Liquefaction will occur along alluvial areas such as Pajaro Valley, parts of Capitola and Santa Cruz, and along streams such as Corralitos Creek, the San Lorenzo River, and other streams throughout the County of Santa Cruz.
- Fault Rupture will occur near the major faults as zoned by the County and State, and Ground Cracking will occur through the hillslopes and near the Fault Zones.
- As indicated in the sections on landsliding and coastal erosion, earthquakes can reactivate landslides and cause coastal bluff retreat, and also contribute to the initiation of other landslides and bluff failures.

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4.3.4 Assessing Vulnerability: Identifying Structures

A. Types & Numbers of Existing Buildings, Facilities & Infrastructure

Past experience has shown that the entire county is vulnerable to earthquake. The entire downtown commercial area in the city is in a liquefaction hazard area. The remainder of the town is at risk for severe ground shaking as indicated by the maps below showing the probability of earthquake impacts to the Santa Cruz area within the next 50 years. These estimates were formulated using ESRI's ArcGIS software. The earthquake hazard was mapped as a GIS layer. Estimated loss is based on assessment improvement values associated with the Assessment Roll dated 10/13/2009. The assessment improvement values were joined to the County's parcel layer. The unincorporated parcels were queried out (which excluded the city parcels in the analysis). The unincorporated parcels that fell within the earthquake hazard areas were selected and the improvement values were totaled. They are

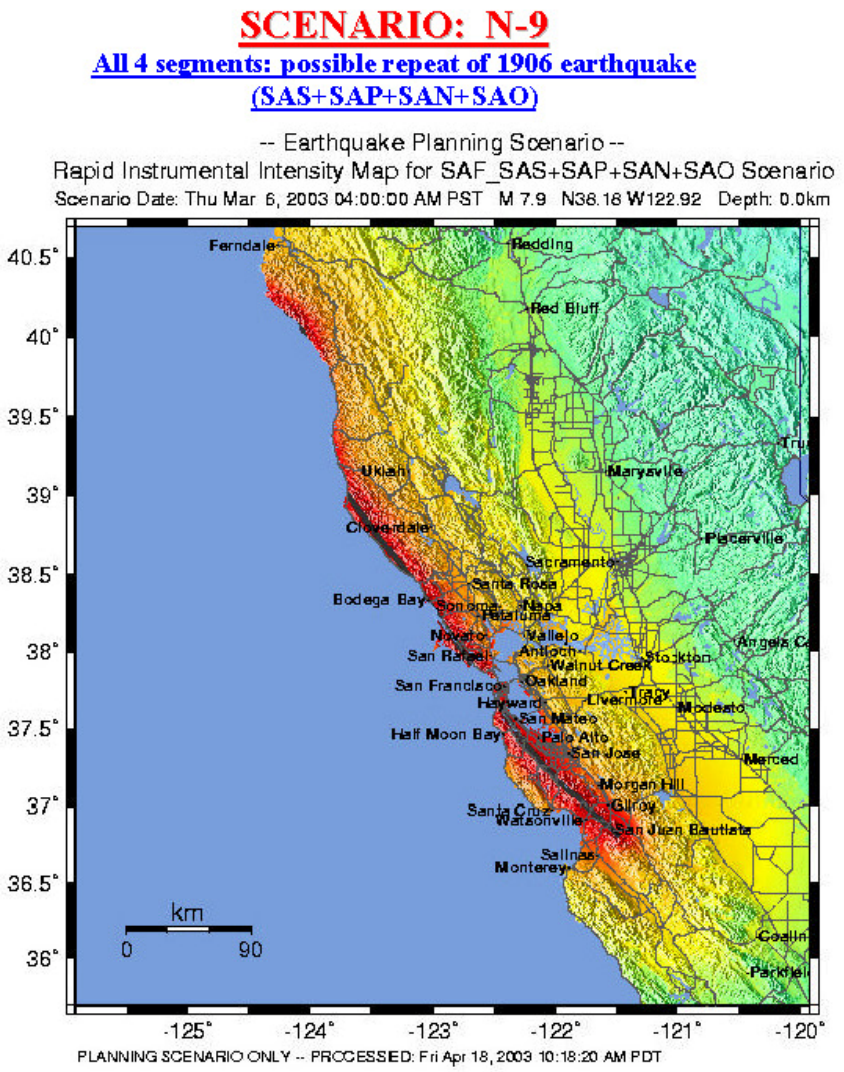
limited to ground motion-induced losses to buildings only. In other words, the losses to other elements of the built environment, such as transportation, lifeline and communication facilities are not reported. Furthermore, the losses reported are only the direct economic losses due to building damage, which consist of capital stock loss and income loss.

This survey reviews 34 potential earthquake scenarios. Two of the ten most likely earthquake scenarios most damaging to Santa Cruz are shown on the following maps.

Scenario N-9 shows a possible repeat of the 1906 San Francisco Earthquake and the intensity and potential damage to the County of Santa Cruz. The map indicates that the intensity would be up to IX or X, which represents violent or extreme perceived shaking and very heavy potential damage. The next map shows the peak ground acceleration for this earthquake and the following two maps show the estimated building damage and economic loss as a result of the Scenario-9 earthquake.

Scenario N-7 shows the projected impacts of an earthquake along the Santa Cruz Mountains + Peninsula + North Coast and the potential damage to the County of Santa Cruz. The map indicates that the intensity would be VIII or IX, which represents severe to violent perceived shaking and moderate to heavy damage. The next map shows peak ground acceleration for this earthquake scenario and the following two maps show the estimated building damage and economic loss as a result of the Scenario-7 earthquake.

FIGURE 10. SCENARIO N-9 REPEAT OF 1906 EARTHQUAKE



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+

FIGURE 11. SCENARIO N-9 REPEAT OF 1906 EARTHQUAKE—BUILDING ECONOMIC LOSS BY COUNTY

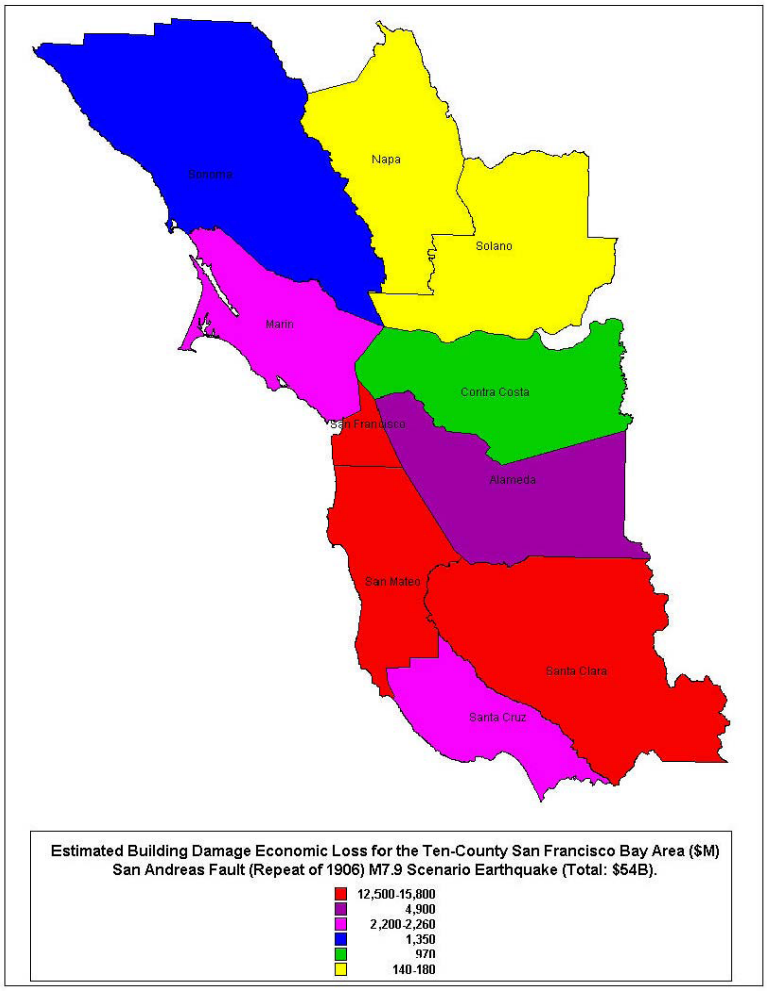


FIGURE 12. SCENARIO N-9 REPEAT OF 1906 EARTHQUAKE LOSS BY CENSUS TRACT

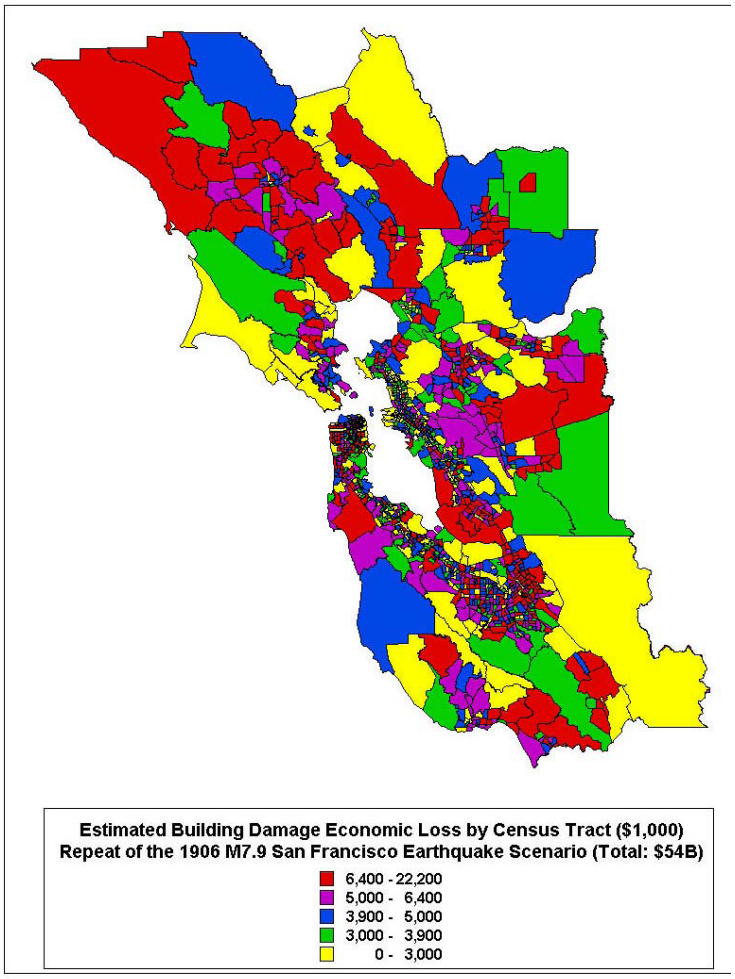
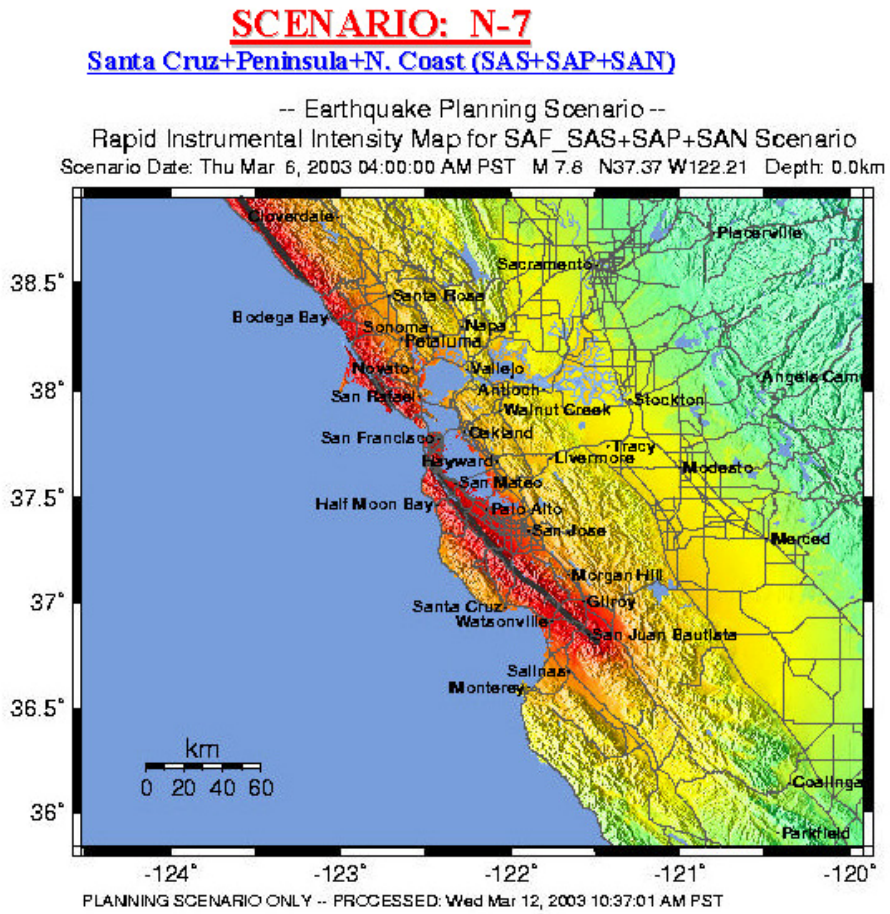


FIGURE 13. SCENARIO N-7 SANTA CRUZ MOUNTAINS



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+

FIGURE 14. SCENARIO N-7 SANTA CRUZ MOUNTAINS BUILDING ECONOMIC LOSS BY COUNTY

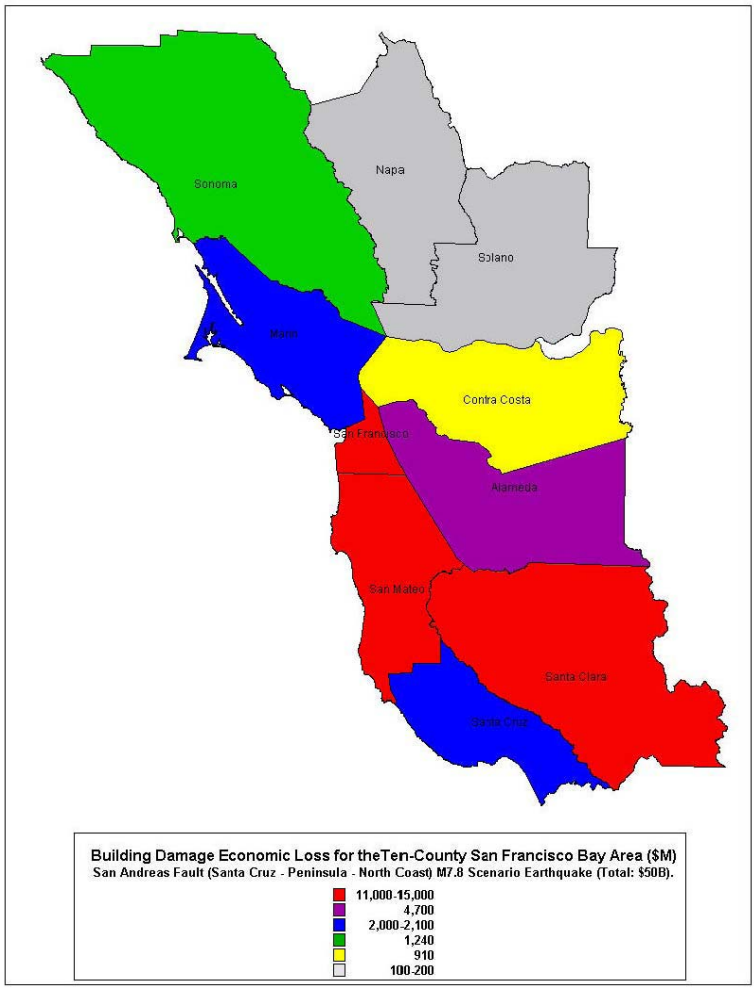
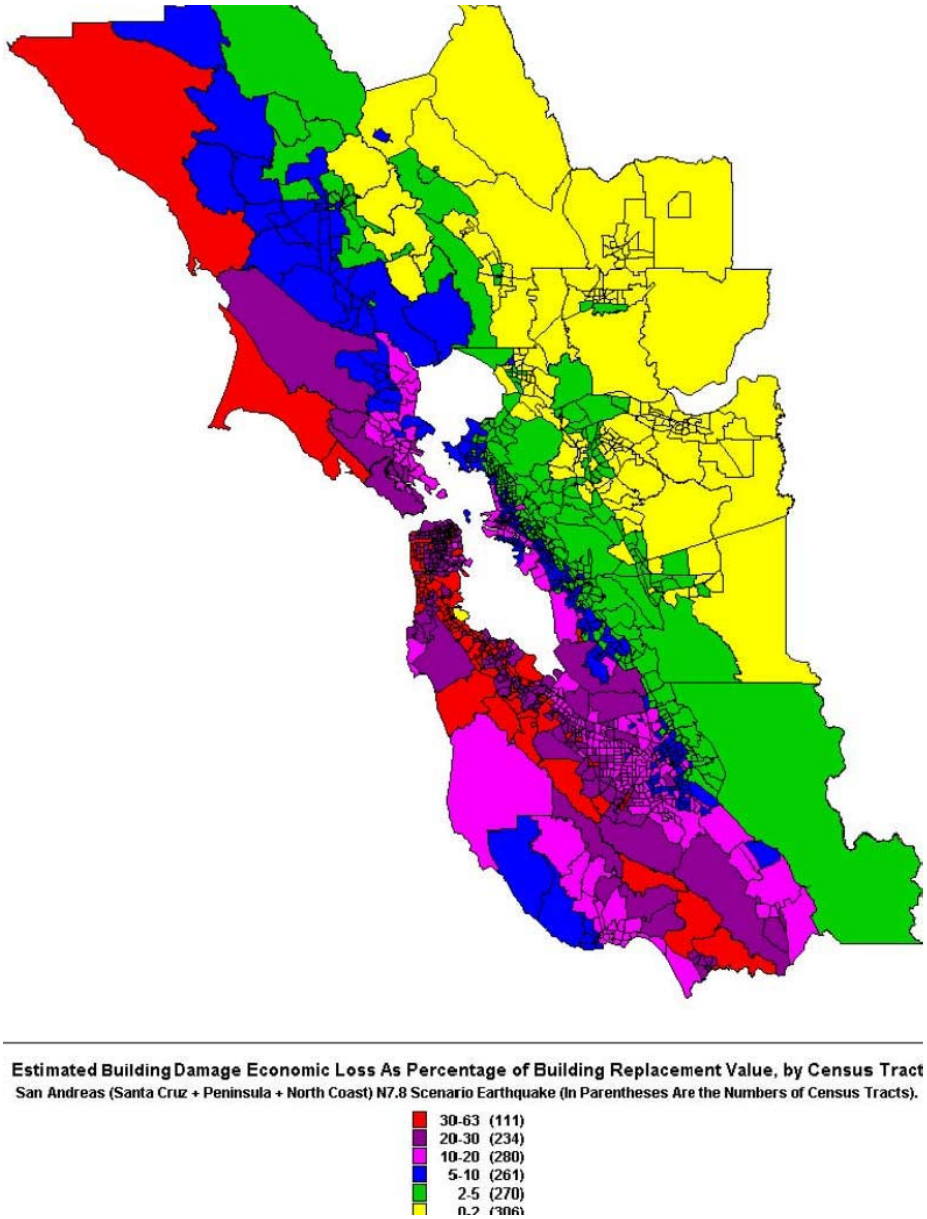


FIGURE 15. SCENARIO N-7 SANTA CRUZ MOUNTAINS BUILDING ECONOMIC LOSS BY CENSUS TRACT



4.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses: Requirement §201.6©(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Potential Dollar Losses to Vulnerable Structures

TABLE 4-3. EARTHQUAKE POTENTIAL LOSS INVENTORY

Fault Zones
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use Type	Number of Parcels Total	Number of Structures Total	Loss in Value $ Total
Agricultural	1,601	2,938	$226,819,374
Commercial	1,398	2,359	$475,412,013
Government	1,676	1,317	$249,122
Industrial	215	473	$104,713,461
Institutional	174	397	$185,873,022
Miscellaneous	12,478	2,381	$16,039,420
Residential	43,024	52,604	$7,721,059,332
Utilities	515	195	$1,357,002
Total	61,081	62,664	$8,731,522,746

	Total Unincorporated
Population	133,891

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County
Loss is based on assessment improvement values
Government parcels, public schools and most utilities are not assessed

Methodology Used to Prepare Estimate of Loss

Parcel Valuation
Valuation of parcels is based on improvement values as they appear on the Assessment Roll. They do not reflect potential sale or replacement value.

Population
The population count is based on the 2000 Census.

B. Methodology Used to Prepare Estimate

Parcel Valuation

Valuation of parcels within a hazard is based on improvement values only as collected by appraisers with the County of Santa Cruz assessor's office. They don't reflect sale value or replacement value. If a parcel intersected a hazard, the entire improvement value of that parcel was used.

Population

Census population blocks were reduced to center points. If a hazard intersected a center point, that population was counted.

Estimates from the most recent California Geological Survey presented by Rowshandel, M. Reichle, C. Wills, T. Cao, M. Petersen, D. Branum, and J. Davis in a paper titled Estimation of Future Earthquake Losses in California are limited to ground motion-induced losses to buildings only. In other words, the losses to other elements of the built environment, such as transportation, lifeline and communication facilities are not reported. Furthermore, the losses reported are only the direct economic losses due to building damage, which consist of capital stock loss and income loss. Indirect economic losses, representing the losses due to various forms of post-earthquake socioeconomic disruptions (such as employment and income, insurance and financial aids, construction, production and import-export of goods and services) are not included in the estimates reported. This is because of the higher level of uncertainty associated with the indirect losses, as compared to the direct losses. Therefore, it is expected that once the indirect building economic losses, the economic losses to non-building facilities, and the contributions of all earthquake hazards are taken into account, the estimated economic losses would be several times the numbers presented.[11]

The analyses of the estimated losses are calculated in three forms: losses in dollars for individual counties, losses in dollars for individual census tracts, and Loss Ratios (LR) - the loss as a percentage of the building replacement value. Detailed results for all scenario earthquakes and for the statewide annual losses are available on the CGS website.[12]

Among the 34 scenario earthquakes of the San Francisco Bay Area (SFBA), a repeat of the 1906 earthquake results in the largest economic loss for the ten SFBA counties. It would rupture four segments of the San Andreas fault and would cause approximately $54 billion economic loss due to building damage. A number of other earthquakes on the San Andreas fault, rupturing different combinations of these four segments are also feasible. Should one occur, it would result in an estimated loss ranging from a few billion dollars to $50 billion. Other potentially damaging earthquakes in the SFBA are: a magnitude 6.9 event rupturing the entire Hayward fault causing $23 billion in losses; and a magnitude 7.3 earthquake rupturing the entire Hayward fault and the Rodgers Creek fault causing $34 billion in losses.

Estimates were calculated using the latest version of the HAZUS software package, Service Release 2 (SR2) for the estimation of the damage and economic loss. The earthquake hazard data, obtained from the scenario shake-maps or the Probabilistic Seismic Hazards Assessment (PSHA) maps, and the liquefaction data (for the case of annualized loss) were then analyzed and supplied into the HAZUS package. HAZUS-SR2 default data was used for the information on the built environment and the demographics. This information in HAZUS-SR2 is, for the

most part, derived from 1990 national census data. Using this process the most severe potential earthquake near Santa Cruz estimates a loss of over 2.2 billion dollars for the County.

4.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends 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.

Description of Land Uses & Development Trends

The County of Santa Cruz has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As dictated by the 1978 Growth Management Ordinance[13], most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs has resulted in the need to provide higher density housing. In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

Growth management policies prevent development from occurring where hazards are present and, in most cases, require substantial setbacks from these hazards. Seismic safety standards are a requirement for all building permits. As infrastructure is repaired or replaced updated seismic safety standards are incorporated.

4.4.0 Mitigation Strategy

4.0 Mitigation Strategy – Requirement §201.6(c)(3): The plan **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.

The primary mitigation strategy to avoid or reduce damage from earthquake is continuation of design review and code enforcement to meet current seismic standards, including adequate geologic engineering and geotechnical monitoring protocols to insure structural integrity. Current policies that assist in meeting these standards include:

- Continued Enforcement of the Geologic Hazards Section of the County of Santa Cruz Code: Chapter 16.10 of the County Code requires the assessment of geologic hazards by the County Geologist and/or private engineering geologists for all new development projects. The geologic hazards identified through this assessment process are then mitigated by avoidance or through measures designed by civil engineers using the California Building Code.
- Continued rigorous enforcement of the California Building Standards with regards to seismicity including requiring engineering and liquefaction studies for all affected development.
- Continuing to encourage development adjacent to urban areas: By encouraging development in areas with urban services, the exposure of the population to areas

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where earthquakes may damage roadways and other utilities is reduced.

- Encourage the State's re-mapping of the County of Santa Cruz through the Seismic Hazards Zonation Program. Consider sharing the cost of the preparation of these new maps.

4.4.1 Mitigation Goals

4.1 Local 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.

Earthquake Goals:

Earthquake 1 - Avoid or reduce the potential for life loss, injury, property or economic damage to Santa Cruz from earthquakes.

Earthquake 2-Encourage retrofitting and other mitigation activities that increase disaster resilience to earthquake.

Earthquake 3 - Encourage further investigation and evaluation of faults in and near the County of Santa Cruz, and incorporate new information into the County of Santa Cruz site and building design requirements.

4.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Earthquake Mitigation Actions:

Earthquake is one of the most significant threats to the County of Santa Cruz. The following actions are critical to the future safety of residents of the County of Santa Cruz:

- Coordinate preparedness efforts with other agencies. (A-1)
- Upgrade roadways, sewer, water and other infrastructure to withstand seismic shaking. (B-1)
- Promote seismic safety upgrade of all emergency use and critical structures. (C-1)
- Review all new and replacement critical structures to require that they be designed to standards of the California Building and County Geologic Hazards codes. (C-2)
- Train appropriate plan check staff on seismic requirements for structures. (C-3)
- Encourage zoning in geologically constrained areas that reflect the nature and extent of the hazard. (C-4)

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Wildfires

5.3.0 Wildfire Risk Assessment

5.3.1 Identifying Wildfire Hazards

3.1 Identifying Hazards – 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 wildland fire may be defined as any unwanted fire involving outdoor vegetation. This may be perceived as only occurring in forests, rangelands or agricultural fields, but it might also occur in vacant lots, highway medians, parks, golf courses and rural residential areas. The term Wildland Urban Interface (WUI) describes many of these areas. The nature of wildland fire has changed with incidents in the WUI. The potential for both life and property losses in the WUI is exponentially higher then non-populated wildlands. In addition, human influence has greatly increased the number and variety of potential sources of ignition.

Wildland fires are influenced by three factors: fuel, weather and topography. Wildfire spread depends on the type of fuel involved (grass, brush and trees). Weather influences wildland fire behavior with factors such as wind, relative humidity, temperature, fuel moisture and possibly lightning. Several of these factors can modify the rate the fire will burn. Topography is the biggest influence on fire severity.

In wildland fire, the priorities of the fire service are:

- Life
- Property
- Natural Resources

Lower priorities are only protected when higher priorities have been confirmed safe.

5.3.2 Profiling Wildfire Hazard Events

A. Location

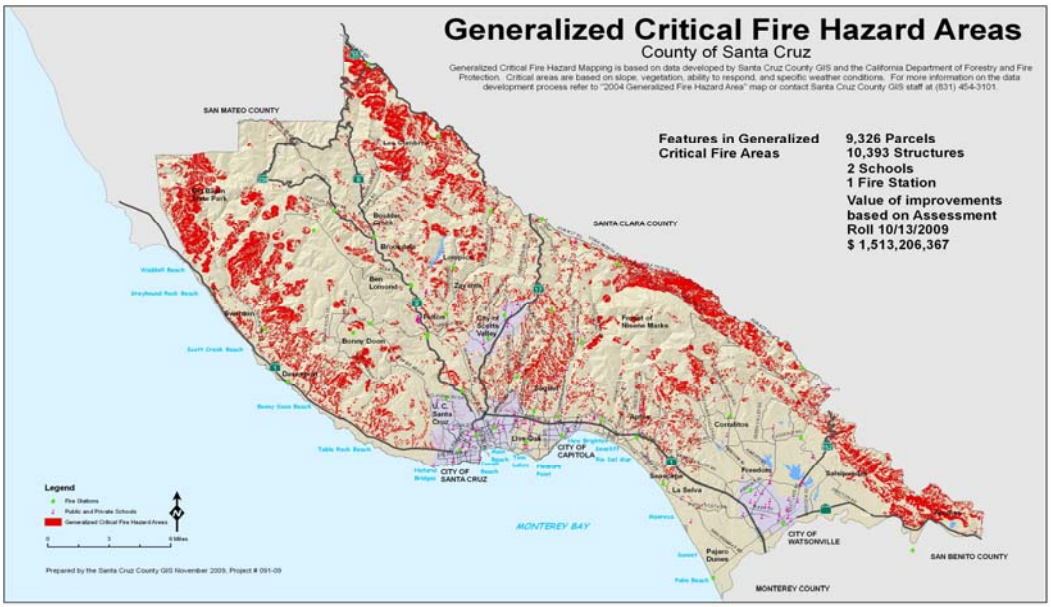
In Santa Cruz County there are numerous WUI areas and several areas designated as mutual threat zones. Mutual threat zones are defined as areas where a wildfire would threaten property within the Santa Cruz County Fire jurisdiction as well as property covered by another fire protection service. For major emergencies that require more resources than can be provided by a single agency, Santa Cruz County Fire, the University of California at Santa Cruz, other Fire Districts and the State of California (CALFIRE) have an extensive mutual aid and emergency coordination system. This system allows departments and districts to share personnel and equipment as needed to address and control emergencies.

These geographic areas are described as non-State Responsibility Areas (SRA) in which any fire is considered a threat to adjacent SRA. These geographic areas are designated because of development that has occurred adjacent to vegetation that is considered significant.

Other areas have been mapped as Wildfire Hazard Areas due to accumulations of wildfire

prone vegetation, steep and dry slopes and the presence of structures vulnerable to wildland fires. These areas are generally situated in the steeper higher elevations of the county. Most of these areas are along the border of Santa Clara County or in the Coastal ridges between Highway 9 and Highway 1.

FIGURE 16. CRITICAL FIRE HAZARD AREAS WITHIN COUNTY OF SANTA CRUZ



B. Extent: Magnitude or Severity

The potential magnitude or severity of future fires could be predicted from experience gained from the recent fires of 2008/2009. In those fires, spotting exceeding 1 mile, torching of conifers, flame lengths exceeding 100', area ignition and sheeting were all observed. In 2008, over 75 structures were destroyed on 3 fires alone. Similar fuels (Manzanita/Knobcone, Eucalyptus, chaparral, and mixed conifer forestland), topography and weather conditions are expected to be encountered in future fires creating a repeat of extreme fire behavior exhibited in recent large local fires.

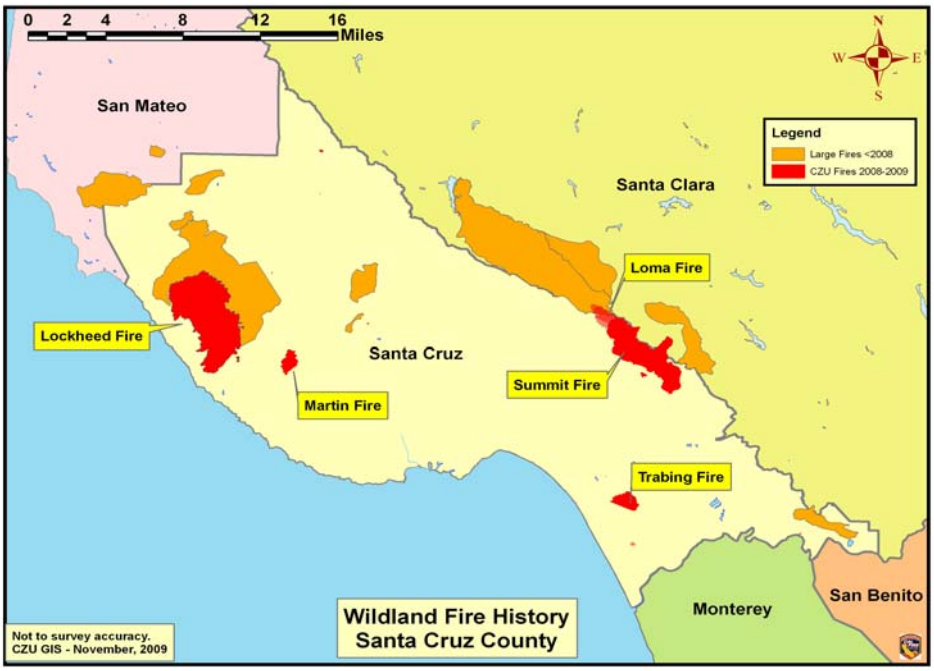
While normal weather conditions in the Santa Cruz Mountains can be categorized as cold and damp with extensive marine influence (fog), several times each year conditions are created where fuel moisture levels have been measured below 5% with temperatures above 90º, and north winds greater then 45 mph.

C. Previous Occurrences

Table 5-1. Previous Wildfires within Santa Cruz County

Fire Name	Year	Acres Burned
Pine Mountain	1948	15,893
Newell Creek	1954	166
Newell Creek #2	1959	1,326
Austrian Gulch	1961	9,067
Lincoln Hill	1962	3,234
Big Basin #7	1980	378
Big Basin	1982	300
Rocha #2	1984	1,239
Lexington	1985	13,122
Croy Fire	2002	3,006
Summit Fire	2008	4,270
Martin Fire	2008	520
Trabing Fire	2008	630
Lockheed Fire	2009	7,819
Loma Fire	2009	485

FIGURE 17. RECENT WILDFIRES IN COUNTY OF SANTA CRUZ



During the past 2 fire seasons over 13,000 acres have burned in 5 major fires in Santa Cruz County. Each of these fires has burned structures and all have endangered life. Suppression costs alone for these fires have exceeded $60 million. The county endures over 200 wildland fires each year on the average but the past 2 years has brought this issue to the public's attention.

D. Probability of Future Events

Given the continuation of 4 years of drought, it is likely that dry fuel conditions will remain. Areas identified as likely to have a wildland fire are spread out across the county. Most of these areas are associated with the higher dryer elevations with fuels consisting of Manzanita, chamise and knobcone pine. Even with the large acreages burned over the past two years, it was estimated that less then 10% of the higher hazard areas have been recently burned resulting in reduced fuel loads. The increasing trend of developing rural residences in these hazardous areas combined with continued recreational and transient uses of these remote locations have exacerbated the situation.

A fire threat will always exist in the WUI. There will always be flammable vegetation, structures and human activities creating a situation where it is not "if" but "when" the next large fire occurs in the county.

5.3.3 Assessing Wildfire Vulnerability: Overview

3.3 Assessing Vulnerability: Overview 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.

A. Overall Summary of Vulnerability to Wildfires

Santa Cruz County is ranked 9th among 413 western state counties for percentage of homes along the WUI and 14th in California for fire risk.[14] During the preparation of the countywide Community Wildfire Protection Plan (CWPP), numerous assets at risk were identified. These include thousands of residences, several schools including a State University, several youth camps, and numerous commercial facilities. There are 5 local public water systems with extensive infrastructure situated within high hazard areas. Three state highways and 3 major power transmission Rights of Way cross through vulnerable areas. Due to topography and limited access, both the protection plus potential reconstruction of these assets will be hampered.

The impact of wildfire on a community is far-reaching (See Appendix O for Lockheed Fire Burn Severity). The most significant impacts would be loss of life, environmental damage and loss of property. Air quality is also a major issue, which can force the closure of schools and businesses as well as limit human activity. Damage to infrastructure such as culverts, roads and bridges can be difficult to locate and repair in a timely manner. During the rainy season, burned-over areas are subject to mud slides and debris torrents which can be exacerbated by infrastructure damage. Sedimentation due to winter rains can destroy fish habitats, which can have a catastrophic effect on the eco-system.

5.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

A. Types and Numbers of Existing Buildings, Facilities and Infrastructure

By definition WUI areas are adjacent to residential and open space areas. Only a few public buildings are immediately threatened by wildland fires. As part of this evaluation, Critical Fire Hazard Areas were assessed. Contained within these critical areas are over 10,000 structures including two schools and one fire station.

5.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Potential Dollar Losses to Vulnerable Structures

The Potential Loss Inventory for Santa Cruz County Unincorporated areas is attached. This summary indicates that over $1.5 billion of improvements are vulnerable to Wildfires in the Critical areas. See Table 5-2.

TABLE 5-2. WILDFIRE POTENTIAL LOSS INVENTORY

Fire
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	666	2,938	1,212	$226,819,374	$94,888,961
Commercial	1,398	65	2,359	315	$475,412,013	$45,676,490
Government	1,676	386	1,317	276	$249,122	$0
Industrial	215	24	473	150	$104,713,461	$13,227,067
Institutional	174	21	397	79	$185,873,022	$13,946,600
Miscellaneous	12,478	2,793	2,381	503	$16,039,420	$5,508,828
Residential	43,024	5,283	52,604	7,817	$7,721,059,332	$1,339,936,776
Utilities	515	88	195	41	$1,357,002	$21,645
Total	61,081	9,326	62,664	10,393	$8,731,522,746	$1,513,206,367

	Total Unincorporated	Hazard Area
Population	133,891	9,156

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County
Hazard Number of parcels, structures and value of improvements within the defined unincorporated hazard areas
Loss is based on assessment improvement values
Government parcels, public schools and most utilities are not assessed

Methodology Used to Prepare Estimate of Loss

Parcel Valuation
Valuation of parcels within a hazard area is based on improvement values as they appear on the Assessment Roll. They do not reflect potential sale or replacement value
If any part of a parcel intersected a hazard, the entire improvement value of the parcel was used.

Population
Census blocks were reduced to center points. If the center points intersected a hazard, that population was counted. The population count is based on the 2000 Census.

5.3.6 Assessing Vulnerability: Analyzing Development Trends

As demand for housing increases, residential construction has spread out into all of the different vegetative cover and topographic types throughout the county. Access to small rural residential clusters is governed by topography and ownership trends. Many clusters have only one access, which is usually limited to long stretches of narrow winding mountain roads. When these roads are blocked all access is blocked to these clusters.

Santa Cruz County covers a large area made up of numerous remote areas with small rural residences. This makes patrolling and protecting the county from wildfire difficult. The county might be relatively small, but poor access and remoteness of many of the small rural residential clusters result in long response times for suppression equipment.

Illegal camping, unpermitted home construction and a relatively large homeless population combined with a large population of urban residents living in a wildland environment have created a high risk of fire starts. Over the past 2 years this has resulted in several large (400 to 8,000 acre) wildland fires that have resulted in FMAG activation by FEMA.

For future buildings, growth management policies prevent new development from occurring outside of the urban and rural services lines.

5.4.0 Mitigation Strategy

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

The various agencies responsible for protecting Santa Cruz County from losses due to Wildland Fires have implemented a number of mitigation programs over the years. They are as follows:

- Implementation and use of a Reverse 911 style community notification and warning system.
- Comprehensive mutual aid system for fire protection.
- Routine and frequent training by local and state fire jurisdictions.
- Annual Residential Defensible Space education and enforcement programs.
- Collaborative and cross jurisdiction Vegetation Management Programs including fuel reduction and shaded fuel break programs.
- Preparation of a countywide Community Wildfire Protection Plan (CWPP) using Federal Grant funding.
- Implementation of new County building codes addressing WUI related issues including building materials, construction requirements, water systems/supply and code enforcement.
- Promotion of built-in fire extinguishing, alarms and water systems per new fire code requirements.

5.4.1 Mitigation Goals

4.1 Local Hazard Mitigation Goals – Requirement §201.6(c)(3)(i): Local Hazard Mitigation Goals – The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Wildfire Goals:

Wildfire 1 - Avoid or reduce the potential for injury, loss of life, property, and economic and environmental damage to Santa Cruz County from wildfire.

Wildfire 2 - Collaborate with other local fire districts and departments in mutual aid fire protection efforts.

5.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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 building and infrastructure.

Wildfire Mitigation Actions:

Wildfire mitigation strategy includes the following actions:

Strategy	Priority
Establish and maintain cooperative fire protection and fire prevention agreements with other agencies.	A
Early notification/warning of residents by technology based applications.	A
Increased visibility and reduced response times with proper road and address markings.	A
Enhanced support for interoperability communications systems with local, state and federal emergency services both inside and around the County.	A
Reduction of fire risk in urban/wildland interface (WUI) through improved building materials and appropriate code enforcement including defensible space programs.	B
Promotion of fuel reduction programs including strategic but environmentally compatible fuel break programs.	B
Creation and maintenance of a proactive hazard abatement program including residential chipper and inspection programs.	B
Maintain adequate Fire Suppression and Prevention staffing levels to meet the need of the county population and development trends.	B
Implementation of additional Fire Prevention programs including school, institution and commercial inspections and educational programs.	B
Creation and implementation of wildland hazard abatement programs.	B
Implementation of education and code enforcement programs for proper road	B

and residential address marking.	
Promotion of built-in fire extinguishing systems and fire alarm system.	C
Land use planning to reduce incidence of human caused wildfires especially in very high fire hazard areas.	C
Appropriate road and secondary access improvement and creation program.	C

Mitigation Action Table

#	Action	Hazard	Responsible	Timeline
A-12	Establish and maintain cooperative fire protection and fire prevention agreements with other agencies.	Multi-Hazard	Fire, OES	ongoing
A-10	Early notification/warning of residents by technology based applications.	Multi-Hazard	Fire, OES	ongoing
A-13	Increased visibility and reduced response times with proper road and address markings.	Multi-Hazard	Fire	ongoing
A-14	Enhanced support for interoperability communications systems with local, state and federal emergency services both inside and around the County.	Multi-Hazard	Fire, OES	ongoing
B-3	Reduction of fire risk in urban/wildland interface (WUI) through improved building materials and appropriate code enforcement including defensible space programs, fuel reduction and residential chipper programs, and inspections.	Wildfire	Fire, Planning	ongoing
B-4	Maintain adequate Fire Suppression and Prevention staffing levels to meet the need of the county population and development trends.	Multi-Hazard	Fire, OES	ongoing

CHAPTER 6 — FLOODS AND ASSOCIATED COASTAL STORMS

6.3.0 Flood Risk Assessment

6.3.1 Identifying Flood Hazards

3.1 Identifying Hazards – 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.

Flooding and coastal storms present similar risks and are usually related types of hazards in the County of Santa Cruz.

Coastal storms can cause increases in tidal elevations (called storm surge), wind speed, coastal erosion, and debris flows, as well as flooding.

During a flood, excess water from rainfall or storm surge accumulates and overflows onto the banks, beaches, and adjacent floodplains. Floodplains are lowlands adjacent to rivers, lakes and oceans that are subject to recurring floods. Several factors determine the severity of floods, including rainfall intensity and duration, creek and storm drain system capacity, and the infiltration rate of the ground.

A flood occurs when a waterway receives a discharge greater than its conveyance capacity. Floods may result from intense rainfall, localized drainage problems, tsunamis or failure of flood control or water supply structures such as levees, dams or reservoirs. Floodwaters can carry large objects downstream with a force strong enough to destroy stationary structures such as homes and bridges and break utility lines. Floodwaters also saturate materials and earth resulting in the instability, collapse and destruction of structures as well as the loss of human life.

Floods usually occur in relation to precipitation. Flood severity is determined by the quantity and rate at which water enters the waterway, increasing volume and velocity of water flow. The rate of surface runoff, the major component to flood severity, is influenced by the topography of the region as well as the extent to which ground soil allows for infiltration in addition to the percent of impervious surfaces. It is important to note that a stream can crest long after the precipitation has stopped.

As storms arrive onto land from the Pacific and rise over the mountains and ridges that border the eastern boundaries of the County, the air associated with those storms cools and that cooling results in large amounts of precipitation. The topography provides fairly steep and well-defined watershed areas to funnel the falling rain into runoff tributaries. Periods of very heavy rainfall are common throughout fall and winter months and the two rivers in the County, along with several creeks and streams, can rise to flood stage in a short period of time. Settlement and habitation in the County, from the historic Ohlone Indian camps through the founding of the Santa Cruz Mission in 1791, and subsequent logging communities throughout the 1800's, tended to acknowledge the floodplain areas of the rivers and streams, building on the higher ground. However, as the population grew, particularly in the middle 1900's, low lying areas near virtually every waterway were encroached upon for housing, business, or agricultural development.

Climatologists point out that the period between 1920 and 1970, the years of most significant growth in Santa Cruz County, was a “dry cycle” for most of central California. Only one or two instances of serious winter weather in the 1950’s highlighted the consequence of development in low-lying areas. Over time, land that had previously been avoided was developed for both commercial and residential use in the floodplains of the San Lorenzo and Pajaro Rivers, Soquel and Aptos Creeks, and along the beaches.

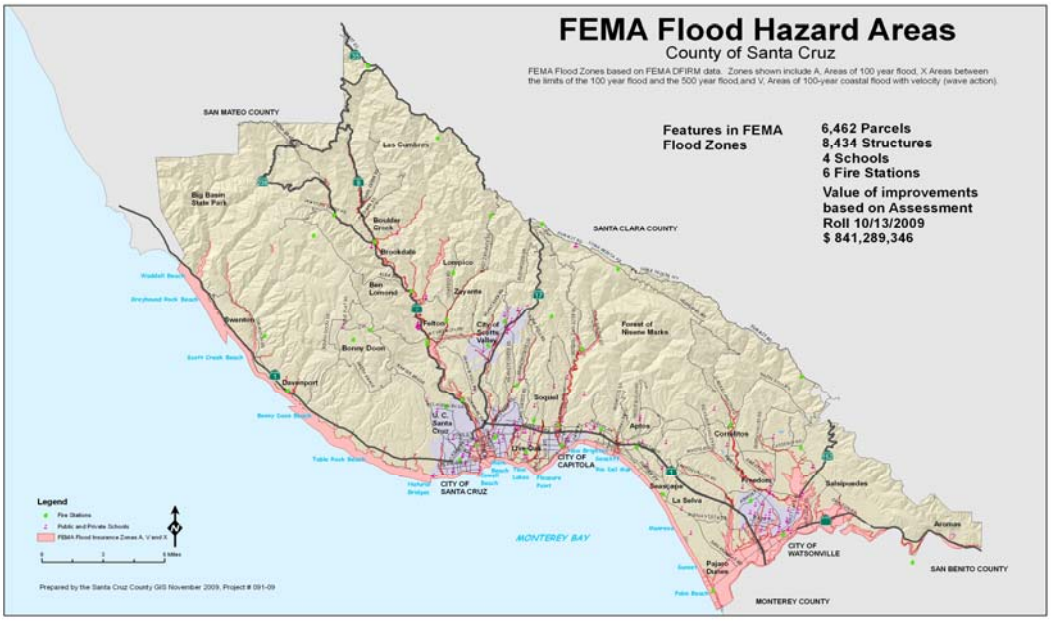
As a consequence, substantial portions of the City of Santa Cruz and the City of Watsonville have been flooded, houses and businesses in the San Lorenzo Valley have been damaged or destroyed by floodwaters, and there have been losses along Soquel Creek, Aptos Creek, and in beach areas on multiple occasions over the past half-century.

6.3.2 Profiling Flood Hazard Events

3.2 Profiling Hazards – 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.

A. Location

Figure 18. Flood Zones within Santa Cruz County



Most of the known floodplains in the United States have been mapped by FEMA, which

administers the National Flood Insurance Program (NFIP). Information about floodplains in the County of Santa Cruz can be found in FEMA's most recent Flood Insurance Study (FIS) and on the Flood Insurance Rate Maps (FIRM). A small-scale version of all the FIRM panels for the County is provided above.

Within the County of Santa Cruz there are numerous areas subject to flooding due to rivers, creeks or coastal storms.

The two main rivers in the County that are subject to flooding are the Pajaro River and the San Lorenzo River. The Pajaro River and its floodplain runs through agricultural lands within the Pajaro Valley and, downstream, through downtown Watsonville. The San Lorenzo River runs through the heavily populated San Lorenzo Valley and into downtown Santa Cruz, where a 2002 levee project has significantly reduced the flood risk for downtown residents, merchants, and landowners.

Other major creeks in Santa Cruz County adjacent to rural and urban development that are subject to flooding include Aptos Creek, Trout Creek, Valencia Creek, Salsipuedes Creek, Corralitos Creek, Soquel Creek, and their tributaries. The steepness of many of these creek canyons and the surrounding mountain areas contribute to the speed that flood water can accumulate and move resulting in relatively short warning times, increasing the hazard for those at risk. There are also many smaller creeks and tributaries throughout the County that are subject to flooding. Most of these are tributaries to the major creeks and rivers noted above.

Areas of low-density development characterize the creeks along the North Coast of Santa Cruz County. Flooding of developed areas from storm surges is unlikely in this area, since development has occurred mainly on cliffs and inland of the coastal flood areas. While flooding is still a risk in these areas, there are no occurrences of repetitive loss (explained on pg. 59) from flooding along the North Coast.

Coastal flooding along the heavily developed Monterey Bay coastline of Santa Cruz County may occur with the simultaneous occurrence of large waves and storm swells during the winter. Storm centers from the southwest direction produce the type of storm pattern most commonly responsible for the majority of severe coastline flooding. The strong winds combined with high tides that create storm surges are usually accompanied by heavy rains. When storms occur simultaneously with high tides, flood conditions, particularly flooding at the mouth of the Pajaro River and Aptos Creek, are exacerbated.

B. Extent: Magnitude or Severity

Flood hazard areas identified on the Flood Insurance Rate Map are identified as Special Flood Hazard Areas (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. SFHAs are labeled as Zone A, Zone AO, Zone AH, Zone AE, Zone A99, Zone AR, Zone V, and Zone VE. See Table 6-1 on the following page for an explanation of these zones. Moderate flood hazard areas, labeled Zone X (shaded), are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled Zone C or Zone X (unshaded).

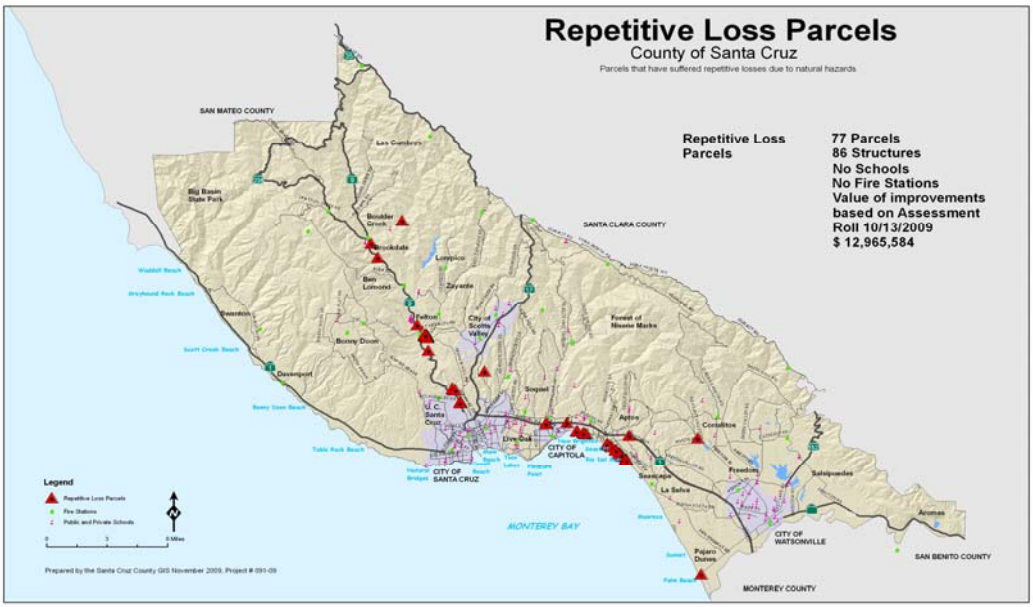
TABLE 6-1. FEMA Special Flood Hazard Area Zones and Definitions

Flood Zone	Definition
A	Areas subject to inundation by the 1-percent-annual-chance flood event. Base Flood Elevations or flood depths not determined.
AE	Areas subject to inundation by the 1-percent-annual chance flood event. Base Flood Elevations determined.
AH	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base Flood Elevations determined.
AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths determined.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection
A99	Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes.
V	Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Base Flood Elevations not determined.
VE	Areas subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. Base Flood Elevations determined.
X (Shaded on FIRM)	Areas of 0.2-percent-annual-chance flood; areas of 1-percent-annual-chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1-percent-annual-chance flood.
X (not shaded on FIRM)	Areas determined to be outside the 0.2-percent-annual-chance flood.

Repetitive Loss Properties

FEMA records indicate that the County of Santa Cruz currently has 80 repetitive loss properties, which are NFIP-insured structures that have had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978. Flood insurance claim payments on these properties alone total over $3.4 million dollars. Repetitive loss properties are concentrated in the San Lorenzo River corridor and the Aptos beach area (see map on next page; only 77 parcels have been shown as three could not be verified). The County of Santa Cruz is classified as a Category C Repetitive Loss Community under the Community Rating System (CRS). Category C Communities are those with more than 10 repetitive loss properties.

FIGURE 19. REPETITIVE LOSS PARCELS WITHIN COUNTY OF SANTA CRUZ



C. Previous Occurrences

Flooding in Santa Cruz County has occurred in each of the primary drainages and will continue to do so in the future given the right set of meteorological conditions. Previous occurrences are well documented for all primary drainages with the exception of Aptos Creek, which is not gauged. The known occurrences are detailed below.

Summary of Historical Floods in Santa Cruz County

Major storms and associated flooding are known to have occurred during March 1899, December 1937, February 1940, November 1950, January 1952, December 1955, April 1958, January 1963, January 1967, January 1973, and January 1982. The December 1955 and January 1982 storms were the most severe in recent times. Below is a summary of the historic flooding for the major rivers, creeks, and beaches in Santa Cruz County.

Aptos, Trout and Valencia Creeks

Aptos Creek drainage basin is of small size and limited flood problems. It includes the drainage areas of Valencia Creek, Trout Creek, Bridge Creek and Mangles Gulch. Floods are known to have occurred in 1955, 1963 and 1982, however little information is available prior to 1955.

During the four-day period ending December 22, 1955, heavy rains fell over the basin causing Aptos and Valencia Creeks to slightly exceed bank full stages at several points in the lower basin. Agricultural damage was primarily due to scour and erosion of first shelf lowlands planted to pasture, a few orchard crops and idle croplands. The peak flow was measured at 3,500 cfs and approximately 140 acres were inundated, of which 20 acres were cropland. Non-cropland damages were generally very minor, consisting of eroded private roads and washed out culverts. County roads and bridges experienced relatively heavy damages at the Valencia Road crossing. The bridge on Aptos Creek just below the confluence of Aptos and Valencia Creeks sustained a washout of cribbing endangering the bridge structure. Four homes along Moosehead Drive, downstream from the village of Aptos, experienced flooding. The Southern Pacific Railroad sustained minor damage due to undermining of the roadbed at Aptos, which resulted in a seven-day interruption of rail service. The local telephone company sustained minor damages to the undermining of facilities in the floodplain (United States Army Corps of Engineers [USACE], Floodplain Information, Aptos, Trout, and Valencia Creeks, 1973).

The January 1982 flood had a peak flow of 3,950 cfs and corresponded to a 40-year recurrence interval based upon stream gauge data in Aptos Creek. Heavy damage occurred from this storm. At least seven homes along Moosehead and Spreckels Drive between Highway 1 and the Spreckels Drive Bridge suffered major damage (Department of Earth Sciences, 1982). Further downstream damage resulted to major portions of two streets paralleling Aptos Creek.

Pajaro River, Salsipuedes Creek, and Corralitos Creek

During December 21 through 24, 1955, and April 2 through 4, 1958, the Pajaro Valley experienced flooding. These floods are the two largest on record for the Pajaro River. The associated discharges for these events were 24,000 cfs and 23,500 cfs, respectively, at the Chittenden gauge (USACE, 1963). The estimated recurrence intervals for floods of these magnitudes are 27 years and 26 years, respectively. In comparison, the estimated discharge at Chittenden for a 100-year flood is 43,000 cfs. (FEMA Flood Insurance Study March 2, 2006).

In the December 1955 flood, the Pajaro River was maintained within the levees in the Watsonville area, but the levees were breached 2.1 miles upstream of the confluence with Salsipuedes Creek (USACE, 1963). Although no lives were lost, 972 people were evacuated and $1.12 million damage incurred. Included in these costs were monies spent to repair levees damaged by erosion. Additional levee repairs were required because of the April 1958 flood; however, no other significant damage resulted (USACE, 1963). Significant flooding along Corralitos and Salsipuedes Creeks also occurred in December 1955 and April 1958. Peak discharges for Corralitos Creek at Green Valley Road have been estimated from high-water elevations (USACE, 1956). The estimated discharges for the 1955 and 1958 floods are 3,620 cfs and 2,680 cfs, which correspond to recurrence intervals of 12 and 7 years, respectively. The overflow of Corralitos Creek upstream of the leveed section on Salsipuedes Creek flooded 29 blocks within the City of Watsonville during the December 1955 flood (USACE, 1963).

The Pajaro Valley experienced only minor damage from the January 1982 flood. (FEMA Flood Insurance Study March 2, 2006).

In 1995, a major flood event breached the Pajaro River levees and the Town of Pajaro was flooded.

San Lorenzo River

The San Lorenzo River basin is the largest drainage basin contained entirely within the County. Few records exist of flooding in the San Lorenzo Basin (outside of the City limits) prior to 1940. However damaging storms are known to have occurred in 1940, 1955, 1958, and 1982.

In January 1862, within the City limits, land was consumed and buildings along the riverbanks were destroyed.

January 1890 saw the largest river level recorded to this date.

In January 1895, a storm caused flooding of basement, yards and lots in the City of Santa Cruz.

In March 1907, floodwaters were higher than previous floods.

February 1940 and 1941, saw continued episodes of flooding.

December 1955 was the highest historic flood along the San Lorenzo River and had a peak discharge of 30,400 cfs, which equates to approximately a 30-year recurrence interval. The most intensive rainfall fell during a four-day period from December 21-24. In the central part of the basin, known as the Ben Lomond area, the San Lorenzo River exceeded bank full stage. Local reports indicate previous maximum stages of record were exceeded along Kings, Boulder, Two Bar, and Zayante Creeks in the upper basin. Overflows occurred from the headwaters to the mouth, resulting in the maximum flood of record. The heavy rains and overflows loosened and scoured out large trees, and floated them downstream where they became lodged at channel points of constriction, impounding flow, causing extremely severe local flooding. The numerous log jams and other channel obstructions diverted the high velocity flows, causing the streams to change from the normal alignment, undercut and scour out numerous bridges, road fills, channel dams and private developments. It is estimated that at least 388 acres were flooded. Seven people (5 within the Santa Cruz City limits, 2 outside) lost their lives as a result of the flood. It is estimated that 390 people outside the City limits were displaced by the floodwaters. Numerous houses, roads, parks, and commercial properties were damaged or destroyed in the Boulder Creek, Ben Lomond, Felton and Paradise Park areas. (USACE, 1973)

Comment [md1]: Were what?

The April 1958 flood was minor in comparison to the 1955 flood, but still saw erosion, creek bank failures and damage and loss of houses.

The magnitude of the January 1982 flood was similar to the December 1955 flood and had a peak discharge of 19,700 cfs. Damage upstream of the City of Santa Cruz was extensive. The damage was most extensive in the area between the upstream limits of Felton and in the areas of Paradise Park, Gold Gulch and Felton Grove. In the Felton Grove area, floodwaters in the overbanks reached 3 to 7 feet and inundated 50 homes and cabins. An additional 60-70 homes were flooded between Felton and Ben Lomond. It is estimated that the 1982 flood had a recurrence interval along the San Lorenzo River of

approximately 30 years. (FEMA Flood Insurance Study March 2, 2006).

Soquel Creek

Storms of flood-producing magnitude occurred during March 1899, December 1937, February 1940, January 1943, November 1950, January 1952, December 1955, April 1958, October 1962, January 1963, January 1967, and January 1982. The December 1955 storm is the most severe storm of recent times, its seventy-two hour rainfall interval was equivalent to about 35 percent of the normal annual rainfall.

During the flood of 1955, a major logjam occurred at the Soquel Avenue Bridge, causing a severe backwater condition. In Soquel, eight city blocks were inundated displacing 359 persons (USACE, 1956). Just upstream of the confluence with Hinkley Creek, floodwaters in the overbanks reached depths of five to six feet. The peak flow for Soquel Creek at the Soquel gauge indicated a peak flow of 15,800 cfs, which is a recurrence interval of 70 years (FEMA Flood Insurance Study March 2, 2006).

During the 1982 flood, the Soquel Creek basin experienced major flooding in the vicinity of the Soquel Avenue Bridge. A massive logjam diverted flow down the main street of the town of Soquel. The floodwaters rose rapidly along Soquel Creek and caused major damage to two mobile home parks adjacent to the stream. The estimated peak flow was 9,700 cfs, which equates to an estimated recurrence interval of approximately 16 years.

Beach / Coastal Flooding

Flooding along the Pacific coast of Santa Cruz is typically associated with the simultaneous occurrence of high tides, large waves, and storm swells during the winter. As a result, ocean front development has not been compatible with the natural instability of the shoreline and intense winter weather conditions. (FEMA FIS, March 2, 2006).

Significant storms, with associated damage, strike the Monterey Bay communities with a frequency of one large storm every 3 to 4 years (Ott Water Engineers, Inc., 1984).

The most severe storms on record to hit the California coast occurred in 1978 and 1983 when high water levels were accompanied by very large storm waves (FEMA FIS, March 2, 2006).

In 1978, a series of storms emanated from a more southerly direction, than normal. Consequently, some of the more protected beaches were damaged. Jetties and breakwater barriers were overtopped and in some cases undermined. Direct wave damage occurred to many beachfront homes and seawalls, especially in the more populated beachfront areas such as at Seacliff Beach and Rio Del Mar Beach. (FEMA FIS, March 2, 2006).

In 1983 a similar storm hit the Santa Cruz Coast. During this storm a new 3,500-foot seawall was destroyed and in Seacliff Beach 19 of 21 homes were significantly damaged when the existing riprap protection was overtopped. (FEMA FIS, March 2, 2006).

The Pajaro Dunes area of the County that is fronted by dunes has also been subject to severe damage to structures as well as rapid beach retreat in 1968, 1969, 1978 and also

in 1983. (FEMA FIS, March 2, 2006).

D. Probability of Future Events

Significant storms and associated damage from flooding strike the Monterey Bay communities with a frequency of one large storm every three to four years. A 100-year flood has a one percent probability of occurring in any given year and while considered to be a severe flood, it still has a reasonable possibility of regular occurrence. For the purposes of the protection of property, life and safety, floods of other magnitudes and occurrence intervals should also be considered in mitigation efforts.

Floods are gauged by their cresting elevation, the area of inundation or damages and either the size of the event or the probability of occurrence. The size and depth of the floodplain area is computed using mathematical models of precipitation, slope, runoff, soil type and cross-section. Flood depths are calculated at intervals along a stream or channel corridor and then mapped and interpolated between sections. This results in the floodplain map.

The probability of occurrence is expressed in a percentage of the chance of a flood of a specific extent occurring in any given year. The most widely adopted design and regulatory standard for floods in the United States is the 1-percent annual chance flood, and this is the standard formally adopted by FEMA. The 1-percent annual flood is also commonly referred to as the "100-year flood," leading to the misconception that it should occur only once every 100 years. In fact, a 100-year flood may occur in any year, regardless of the time that has passed since the last one. It is the probability that smaller floods occur more often than larger floods that compels the percentage.

TABLE 6-2. FLOOD PROBABILITY TERMS

Flood Occurrence Intervals	Percent Chance of Occurrence Annually
10 years	10.0%
50 years	2.0%
100 years	1.0%
500 years	0.2%

6..3.3 Assessing Flood Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

A. Overall Summary of Flood Vulnerability

Riverine flooding is a risk for many parts of the communities of Boulder Creek, Ben Lomond, Brookdale, Felton, Zayante, Paradise Park, unincorporated Santa Cruz, unincorporated Scotts Valley, Live Oak, Soquel, Rio Del Mar, Aptos, and unincorporated Watsonville. Coastal flooding is a risk for many homes along Live Oak, Aptos, Seascape, and unincorporated Watsonville beaches. Many homes, apartments, hotels, shops, and critical facilities have been built in these

areas to accommodate resident and tourist needs. Properly protecting these structures from flooding is essential to preventing loss of human life and protecting the local economy.

Under a widespread heavy rain scenario (accumulation of .30 inches of rain per hour or more), severe flooding is likely in low-lying areas within a basin. Based on the 100 year flood plain (FEMA Zone A), 11% of the developed parcels (8,359) 5% of roads (103 miles), 25% of the sheriff's facilities (3), 30% of the fire stations (7), 9% of schools (16) and approximately 15% of the churches (32) are located within or intersected by the 100 year flood plain.

Summary of Flood Protection Measures and Future Vulnerability

Flood protection measures implemented in the unincorporated areas of Santa Cruz County have included nonstructural and structural measures. The nonstructural measures include floodplain zoning ordinances that regulate building within the floodplain as well as protection of riparian areas that further limits impacts of flooding on structures. Structural measures implemented in the County have been limited primarily to the Pajaro Valley.

Although dozens of houses in the flood prone areas of the County have been elevated above the 100-year flood or wave run-up elevation over the past decade, areas previously inundated by flooding will continue to do so in the future, with potentially substantial impacts to property, lives and infrastructure.

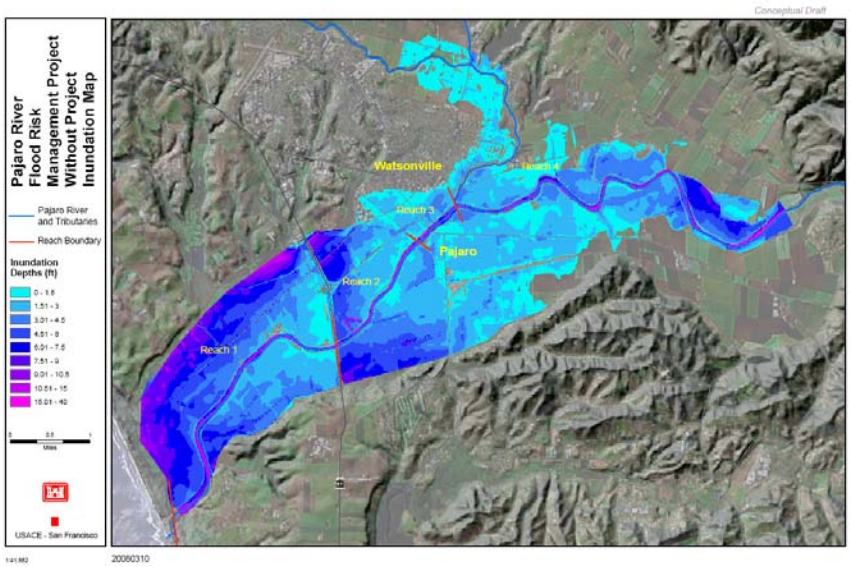
Flows in excess of approximately 10,000 cfs caused flooding on the lower Pajaro River before completion of the Federal levee project (USACE, 1963). After the floods of 1938 and 1941, the USACE designed levees for the Pajaro River and Salsipuedes Creek.

Levees were completed along the Pajaro River by the USACE in 1949. Levees along the north bank begin just upstream of the mouth at the Pacific Ocean and continue to approximately River Mile 11.8 (Murphy Road); levees along the south bank begin just upstream of the mouth and continue to River Mile 10.6. The levees increased the capacity of the Pajaro River to 22,000 cfs downstream of Salsipuedes Creek, equivalent to a 25-year flood. In the same year, levee construction on Salsipuedes Creek from the confluence with the Pajaro River to River mile 2.5 on the west bank to River Mile 1.7 on the east bank was also completed (USACE, 1963). The addition of the levees increased the capacity of Salsipuedes Creek to 10,000 cfs (USACE, 1963).

In 1963, the USACE performed additional studies and recommended that the levees along the Pajaro River and along Salsipuedes and Corralitos Creeks be modified to provide additional protection (USACE, 1963). Construction was authorized in the Flood Control Act of 1966 and the project proceeded to the advanced stages of design, but local support in Watsonville was withdrawn and the project was placed in a deferred status (USACE, 1978; and USACE, 1974).

However, in recent years, studies on the Pajaro River levees have indicated that they may fail under a roughly 8-year event (approximate flow of 18,000 cfs). The County of Santa Cruz and the U.S. Army Corps of Engineers are currently working together to come up with a solution to enhance the levees and increase the level of flood protection. See Figure 20 on the next page for Pajaro River Flood Risk map.

FIGURE 20. PAJARO RIVER FLOOD RISK MAP



Comment [p2]: Bruce LaClergue has this map

No major flood control projects have been constructed in the Aptos Creek, Soquel Creek, or the Santa Cruz County portion of the San Lorenzo River basins. Local interests have provided non-continuous bank protection constructed of various materials including concrete, timber, and riprap. A multiple-purpose reservoir on Soquel Creek, approximately 5 miles upstream from Monterey Bay, was found to be economically justified, but has not been implemented. A major flood control project, which includes levees and channel improvements, was constructed on the San Lorenzo River. These improvements, however, are located within the Santa Cruz City limits and not in the unincorporated portion of the county.

Residents and municipalities of northern Monterey Bay have spent hundreds of thousands of dollars on flood protection measures to prevent coastal flood damage. Permanent structures such as seawalls, boulder-sized riprap, timber, and concrete bulkheads have been installed. Severe storms in January of 1983 overtopped many of the structures. Protection varied by site. At Seacliff State Beach, repeated storms have destroyed reconstruction efforts, while at New Brighton State Beach, damage was minor.

At Seacliff State Beach in January 1983, high waves associated with high tides overtopped a rock rubble mound to cause major damage to 19 of 21 homes. Of the 9.5 miles of northern Monterey Bay coastline, over half is protected by seawalls or riprap.

After the major flood in December 1955, a flood-control project was constructed by the USACE to provide protection against a flow of 53,000 cfs at the mouth of the San Lorenzo River. The flood-control project included improvements on the San Lorenzo River as well as Branciforte Creek.

On the San Lorenzo River, the project extended from the Southern Pacific Railroad (SPRR) bridge near the mouth to the city's concrete weir diversion works. Between the SPRR bridge and the State Highway 1 bridge, the project included levees, channel improvements, and bank protections; upstream of State Highway 1, only channel improvements were made. The modified channel was wider with a lower invert than the natural channel. Channel improvements were designed to provide 3 feet of freeboard and to carry 53,000 cfs downstream of the confluence with Branciforte Creek and 46,800 cfs between the confluence and the State Highway 1 bridge. On Branciforte Creek, a rectangular concrete channel was constructed and extended upstream 1 mile from the confluence with the San Lorenzo River at the Soquel Avenue bridge.

Nonstructural measures employed by the City of Santa Cruz include a logjam removal procedure and flood plain zoning ordinances. The zoning ordinances regulate development in the flood plain areas (City of Santa Cruz, 1975).

Impact of Hazards

Flooding in the various river basins impact public health and safety, critical facilities and infrastructure, as well as the community's economy.

When floods hit the community, as shown by past history, public health and safety issues (including loss of life and property as well as the overall health of the community) can be widespread. Recognition of these hazards has led the County of Santa Cruz to work with FEMA, in recent years, to assist property owners in funding elevation of homes above the base flood elevation (Felton Grove) and to develop a plan to improve levee safety (Pajaro River). Additionally, the County of Santa Cruz has improved rain and stream gauging in the San Lorenzo River, Soquel Creek, Corralitos Creek and Pajaro River watersheds. The improved gauging includes real-time monitoring of rainfall and stream levels that are monitored 24 hours a day during storm event. See Watershed Flood Monitoring Table 6-3, on the following page.

This monitoring is coordinated with the County Public Works Department, the County Emergency Operations Center, the National Weather Service in Monterey, NOAA, and the USGS. In the Pajaro River watershed, monitoring coordination also includes the Santa Clara Water District, and the counties of San Benito and Monterey. Close coordination has allowed an alert system to be developed through the use of a reverse 911 system. This system may not save fixed structures, but it can save lives. Coordination with other agencies has also helped to time releases from reservoirs (Santa Clara Water District), so that releases do not coincide with peak flows. Following is a table of Santa Cruz County Stream / River Flood Stages that has been developed to assist flood control staff in their monitoring of flooding.

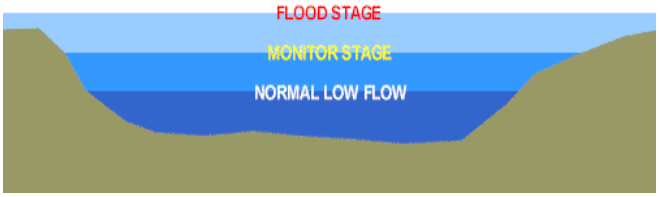
TABLE 6-3 SANTA CRUZ COUNTY STREAM/RIVER FLOOD STAGE

LARC (computer voice msg - stream levels)

SLR @ Big Trees: 33 5-9365

Stream & Location	Datum 0 =	Today's Levels	Flood Watch Stage	Flood Monitor Stage	Initial Overflow Areas	Flood Warning Stage
San Lorenzo R. Big Trees, Felton	227.0' NGVD		10.0'	14.0'	Felton Grove, Gold Gulch, and Paradise Park	18.0'
Soquel Creek Bridge St.	21.4' NGVD		8.0'	11.5'	Heart of Soquel, Old Mill Mobile Home Park, Areas west of Porter St.	14.5'
Corralitos Cr Green Valley Rd.	89.4' NGVD		9.0'	9.0'	Orchard Park Subdivision, College Rd. Flood Watch & Monitor Stages at the same level due to fast rising water	11.5'
Salsipuedes Cr Hwy 129			25.0'	32.0'	2.4-mi down-stream from Corralitos Cr., Orchard Park, College Rd (Drew Lake) Top of levee at 37.5'	34.5'
Pajaro River @ Chittenden	81.9' NGVD		23.0'	25.0'	Area along channel extending 2.5-miles upstream from confluence of Pajaro R. & Salsipuedes Cr. Top of levee at 34.5'	32.0'
Pajaro River @ Main St	0' NGVD		23.0'	27.5'		31.0'

NON-LEVEED STREAMS

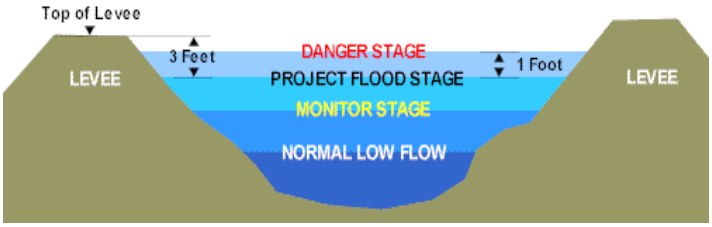


Flood Watch Stage: The Stage at which current or developing conditions pose a threat of flooding but it is NOT certain or imminent.

Flood Monitor Stage: The Stage at which initial action must be taken by concerned interests (livestock warning, removal of equipment from lowest overflow areas, or simply general surveillance of the situation). This level may produce overbank flows sufficient to cause minor flooding of low-lying lands and local roads.

Flood Warning Stage: The Stage at which overbank flows are of sufficient magnitude to cause considerable inundation of land and roads and/or threat of significant hazard to life and property.

LEVEED STREAMS



Flood Monitor Stage: The Stage at which patrol of flood control project levees by the responsible levee maintaining agency becomes mandatory, or the Stage at which flow occurs into bypass areas from project overflow weirs.

Project Flood Stage: The Stage at which the flow in a flood control project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plain"). At this level there is a minimum freeboard of 3 feet to the top of levees.

Danger Stage: The Stage at which the flow in a flood control project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure. This is generally 1 foot above project flood stage.

6.3.4 Assessing Flood Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Types and Numbers of Existing buildings, Facilities and Infrastructure

Table 6.4 on the following page identifies the number of parcels that intersect the flood plain. All of the structures on those parcels have been included as potential losses in that table. However, a more detailed analysis, recently completed for the FEMA Biennial Report, assessed whether specific habitable structures on those parcels were located within the floodplain. This data shows that there are over 2,000 1-4 unit residential structures and over 200 other habitable structures in the flood hazard areas of Santa Cruz County. Approximately 3,200 permanent year-round Santa Cruz County residents live flood hazard areas.

6.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Potential Dollar Losses to Vulnerable Structures

Approximately 6400 parcels lie within the flood zone areas with the majority of these parcels categorized as residential. Within the residential areas, there are over 5700 structures. The population in the flood zone is 15,110. The potential loss in residential areas alone tops $683 million. When all types of land use are considered, the potential loss is over $841 million.

TABLE 6-4. FLOOD POTENTIAL LOSS INVENTORY

Flood
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	379	2,938	918	$226,819,374	$38,957,033
Commercial	1,398	307	2,359	672	$475,412,013	$79,383,388
Government	1,676	295	1,317	498	$249,122	$50,741
Industrial	215	40	473	173	$104,713,461	$15,522,751
Institutional	174	27	397	51	$185,873,022	$21,820,801
Miscellaneous	12,478	1,032	2,381	307	$16,039,420	$1,529,219
Residential	43,024	4,333	52,604	5,788	$7,721,059,332	$683,701,425
Utilities	515	49	195	27	$1,357,002	$323,988
Total	61,081	6,462	62,664	8,434	$8,731,522,746	$841,289,346

	Total Unincorporated	Hazard Area
Population	133,891	15,110

Improvement value based on Assessment Roll 10/13/2009

B. Methodology Used to Prepare Estimate

Parcel Valuation

Valuations of parcels within a hazard area are based on improvement values only as collected by appraisers with the Santa Cruz County Assessor's Office. They do not reflect sale value or replacement value. If a parcel intersected a hazard, the entire improvement value of that parcel was used.

Population

Census population blocks were reduced to center points. If a hazard intersected a center point, that population was counted.

Flood Analysis

Since FEMA flood data is mapped on the federal level, the data is somewhat coarse in horizontal accuracy. The data is a rough estimate of expected flood elevations and loss areas.

Estimating flood losses is an established process. If a "100 year" flood occurred in our county,

meaning that the flood has a 1% chance of occurring in any given year, it would impact approximately 8400 structures to various degrees. This was determined by intersecting the county's database of structures with the FEMA-developed maps of the 100-year floodplain. Structures within the floodplain vary in construction, size and materials, ranging from single-family homes to multi-family to commercial.

6.3.6

Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses and Development Trends

The County of Santa Cruz has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As mandated by the 1978 Growth Management Ordinance, most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs have resulted in the need to provide higher density housing. In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

Growth Management policies prevent development from occurring where hazards are present and, in most cases, require substantial setbacks from these hazards.

6.4.0 Mitigation Strategy

4.0 Mitigation Strategy: Requirement §201.6(c)(3): The plan **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.

Programs Currently in Effect

The County of Santa Cruz currently addresses land use within the floodplain in the General Plan as well as actively enforcing related building, zoning, and resource planning codes, and other land use regulations concerning development within the 100-year floodplain. The 2007 California Building Code has several new enforceable provisions for development in flood hazard areas, which should be incorporated into County building and resource planning codes.

The County participates in a number of ongoing mitigation actions to avoid or reduce the threats of flood. Actions include:

- The County is the lead agency in an early warning flood forecasting system for evacuation of areas susceptible to flooding.
- Continual improvements to the early warning system are being planned and implemented, especially as they relate to the Upper Pajaro watershed, the San Lorenzo watershed and in the severely burned areas of recent fires.
- Regulations on development and alteration of flood plains, stream channels and protective barriers that accommodate overflow are in place.
- Encouragement of property owners, potential buyers and residents living in floodplains and coastal inundation areas to participate in the National Flood Insurance Program (NFIP).
- Rehabilitation of remote culverts and storm drainage systems to reduce flooding caused by inadequate storm drainage.

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Annual Flood Control Maintenance on the Pajaro River by the Public Works Department. This work is required by the U.S. Army Corps of Engineers and consists primarily of managing in-stream riparian vegetation to encourage geomorphic form and function. The vegetation management plan is identified in the Final EIR for the Pajaro River and Salsipuedes and Corralitos Creeks and requires vegetated buffer zones to be generally maintained at 10-feet at the toe of the levees and 5-feet along the wetted edge of the river. The vegetation management is required in order for winter flows not to exceed the design capacity of the Pajaro River levees.

Future Plans

The County will take the necessary steps to apply for and be accepted into the Community Rating System (CRS). The CRS is a voluntary incentive program that is part of the National Flood Insurance Program (NFIP). The program recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements (FEMA 2002). As a result, flood insurance premium rates will be discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses
- Facilitate accurate insurance rating
- Promote awareness of flood insurance

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For communities participating in the CRS, flood insurance premium rates are discounted in increments of 5 percent, with the lowest class communities receiving the highest discount. For example, a Class One community would receive a 45 percent premium discount, and a Class Nine community would receive a 5 percent discount. A Class Ten community, which is the current designation for Santa Cruz County, does not participate in the CRS and receives no discount. The CRS classes for local communities are based on 18 creditable activities organized under the following four categories:

- Public Information
- Mapping and Regulations
- Flood Damage Reduction
- Flood Preparedness

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Currently, approximately 1,000 communities nationwide receive flood insurance premium discounts based on implementation of local mitigation, outreach, and educational activities that go well beyond minimum NFIP requirements.

Assigning Priority to Mitigation Actions

Priority levels have been assigned to each of the mitigation actions. Highest priority has been given to those actions that are relatively inexpensive to implement, are required as part of other programs (e.g. NFIP), and/or will reduce the costs of flood damage to the County and the costs of flood insurance to the public.

Project Feasibility

It should be noted that there are many items that are infeasible at this time due to current County budget cuts and recent and possible future layoffs. These items include installing gauges on Aptos and Valencia Creeks, expansion of drainage system monitoring, and construction of the Soquel Creek Reservoir. In addition to limited funding for implementing these programs, there is very little staff time to devote to applying for financial assistance. As the economic climate improves, these programs can be integrated into future iterations of this report.

6.4.1 Mitigation Goals

4.1 Local 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.

The County of Santa Cruz has developed several flood hazard mitigation goals to create a more flood-resistant community.

Flood Goals

Flood 1	Avoid or reduce the potential for life loss, property and economic damage from flooding
Flood 2	Enhance emergency management tools
Flood 3	Protect critical facilities, schools, and utilities from flooding
Flood 4	Promote public awareness of flood hazards, mitigation measures and flood insurance
Flood 5	Preserve open space in the flood hazard area

6.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Flood Mitigation Actions

High Priority Items

1. The County will create a policy interpretation for calculating "Substantial Improvement" more effectively in the floodplain (A-2).

2. The County will apply for and participate in the Community Rating System to improve floodplain management and reduce insurance costs for residents. Steps required include: (A-3)
   a. Conduct analyses of Repetitive Loss Areas and create action plans for each area detailing the necessary steps to prevent future losses.
   b. Prepare for, schedule, and complete a Community Assistance Visit (CAV) with FEMA staff.
   c. Establish clear criteria for requiring Elevation Certificates.
   d. Create and maintain an online database of Elevation Certificates.

3. The County shall evaluate the effectiveness of current policies and ordinances designed to limit storm water runoff and flooding and, if needed, recommend revisions to improve the effectiveness of these policies and codes. (A-4)

4. The County shall evaluate the effectiveness of current drainage plan requirements to ensure that storm water runoff from impervious surfaces does not contribute to flooding and, if needed, revise permit conditions of approval to better achieve this result. (A-5)

5. The County shall review and, if needed, revise its California Environmental Quality Act (CEQA) Initial Study checklist to ensure that storm water runoff is fully considered and mitigated to the extent practicable. (B-2)

6. The County shall develop a “Storm Water Facilities Master Plan” for Flood Control Districts 5 & 6, which include portions of Live Oak, Soquel, Aptos, Seacliff and Rio Del Mar areas. This will include an inventory of existing facilities, development of hydraulic and hydrologic modeling of these facilities, development of a prioritized Capital Improvement Program list, hydro-modification analysis and development of generic best management practices and design standards. (A-6)

Lower Priority Items

1. The County will seek funding to develop, adopt, update and revise the Geologic Hazards Ordinance. The ordinance will incorporate new flood hazard area development standards that exceed the minimum requirements of FEMA. This will require significant staff time and adoption of the new ordinance by the Board of Supervisors. At least one public hearing will be required. (B-5)

2. The County will pursue elevation of structures, in which a house is raised above the level of the 100-year flood. Elevation is a relatively simple mitigation for flood hazards, involving the use of hydraulic jacks to elevate the house, much in the same manner as jacking a car to change a tire. However, it is expensive, since it requires technical studies, the use of special equipment, professional experience, insurance and materials. Once elevated, a new cast in place concrete foundation is built, and supporting walls and beams installed. The house is then lowered onto the new base, perhaps as much as 10’ higher than it previously sat. Requiring elevation of existing structures will be facilitated by the policy interpretation described under High Priority Action Item 1. (B-6)

Acquisition, or buying out a homeowner, is an alternative method of mitigating flood hazards, but has been proven too expensive in Santa Cruz County due to high real estate prices. Relocation is similarly prohibitive, since it involves finding a similar parcel, purchasing it, and moving the house to that location. Vacant lots are expensive and hard to find in Santa Cruz County.

3. The County will continue to maintain drainage system infrastructure. The Department of Public Works Road Operations crews will seek funding to expand its existing inspection and maintenance of the drainage systems within the County-maintained roads during the rainy season. Problem spots with more recurrent flooding occurrences will be monitored frequently to remove any drainage system blockage and minimize flooding. Drainage Operations crews maintain drainage channels as well as County-maintained drainage systems outside the County’s right of way. (C-9)

In preparation for the winter rains, starting in July or as allowed by permitting agencies, Drainage Operations crews will obtain permits to inspect and clear vegetation, remove silt and sand bars if needed in drainage channels, creeks and rivers. Clean up will continue during the year and specifically after rainstorms to remove debris, logs and large items from the channels. Areas in flood plains will be monitored frequently during rainstorms to prevent flooding as much as possible. Countywide logjam removal programs will be active year round and specifically before the rainy season and after rainstorms.

4. The County will continue to enforce requirements for on-site retention of storm water runoff from impervious surfaces for all new development in the Ground Water Recharge Zone and the Water Supply Watershed zone on site. These Zones cover over 50 percent of the County where the soils have high permeability rates. The County will continue to require on-site

percolation system design as well as best management practices to increase storm water retention and decrease flash floods, although it will be equally important that downstream capacity be maintained to insure that the storm drain system can handle peak flows. (B-7)

5. The County will seek grants to develop public education materials both in print- and web-based formats. The County will also maximize opportunities to work collaboratively with community groups, non-governmental organizations and the local media. (C-10)

6. Through its application of the Geologic Hazards Ordinance and Open Space Preservation policies, the County will regulate development in flood zones to optimize preservation of open space. (C-11)

7. County staff will continue to limit development and monitor conditions of development and grading permits as well as illegal unpermitted activities to prevent sedimentation in natural channels and wetlands. (C-12)

Public Works Design Criteria continue to require runoff retention system details to be submitted with permit applications. Erosion and sediment control measures will be monitored in the field, evaluated, and improved upon when deficiencies are identified.

Implementation and Evaluation

A Flood Mitigation Planning Committee will be created and will consist of the Floodplain Manager and key Planning Department, Office of Emergency Services, and Department of Public Works staff members. The County will convene regular meetings of the Committee to assess and evaluate progress on the goals and action items in the Plan. Additionally, the Committee will work with responsible agencies to promote the goals and action items in their annual budgets and work programs. The Committee will prepare an Annual Evaluation Report and distribute the report to the Board of Supervisors, the Community Rating System Coordinator for inclusion in the annual Community Rating System Report, the local news media and the public.

References

This flood plan was prepared by County of Santa Cruz planning and engineering staff with input from the County Department of Public Works and the County Office of Emergency Services.

Preparation of this Chapter of the LHMP included a review of the following documents for information and to define the County's needs, goals, and plans:

- 2002 County of Santa Cruz Flood Hazard Mitigation Plan
- County of Santa Cruz Flood Insurance Study
- County of Santa Cruz Geographic Information Systems data
- County of Santa Cruz census data
- County of Santa Cruz 2007-2008 Biennial Report

7.3.0 Drought Risk Assessment

7.3.1 Identifying Drought Hazards

3.1 Identifying Hazards – 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 drought is a period of dry weather that persists long enough to cause serious problems such as crop damage and/or water supply shortages. Droughts may not be predictable, but they should be expected. They occur with some regularity and varying levels of severity. The magnitude and duration of a drought is something that can be predicted based on historical records and should be taken into account in water resources planning. In recent history, Santa Cruz County experienced 3 drought periods: 1976-77, 1987-1992, and most recently in 2007-09. It is expected that the effects of climate change will result in more severe droughts of longer duration.

Water supply in Santa Cruz County is provided by a number of independent water agencies, as shown in the table below. Fifty-seven percent of the County population is served by the two largest jurisdictions, the cities of Santa Cruz and Watsonville, with substantial parts of their service areas outside of the city limits. 37% of the Santa Cruz customers (32,500 people) and 20% of the Watsonville customers (12,000 people) are outside the city limits. Almost all of the jurisdictions are experiencing some kind of water supply shortfall, as indicated, either due to overdraft of the groundwater basin from which they derive supply, inadequate supply during a drought, or inadequate facilities to meet current demands. 46% of County population is served by water agencies that get more than 50% of their supply from surface water. It is those sources that are most susceptible to drought impacts.

TABLE 7-1. WATER SUPPLIERS WITHIN COUNTY OF SANTA CRUZ

Water Supplier	Connections	Pop.	Water Use (acre-feet/yr)	Ground	Surface	Current Shortfall?
Santa Cruz City Water Dept.	25,000	**95,000**	11,800	4%	96%	Drought
Watsonville City Water Dept	15,000	63,700	9,300	89%	11%	Overdraft
Soquel Creek Water District	15,000	49,000	5,400	100%		Overdraft
San Lorenzo Valley (SLVWD) - Northern	5,300	**16,500**	1,500	40%	60%	Drought
SLVWD Southern	785	2,500	400	100%		Overdraft
SLVWD-Felton	1,300	**4,000**	455		100%	Drought
Scotts Valley Water District	3,600	11,300	1,700	100%		Overdraft
Central Water District	800	2,700	600	100%		OK
Lompico Creek Water	500	**1,300**	70	20%	80%	Drought

District						
Big Basin Water Company	580	**1,500**	240	15%	85%	?
Mount Hermon Association	530	1,400	250	100%		Overdraft
Forest Lakes Mutual Water Company	330	900	140	100%		Facilities
130 Smaller Water Systems (5-199 connections)*	5000	14,000	3500	95%	5%	OK
Individual Users*	8000	20,800	6000	95%	5%	OK
Pajaro Agriculture			48,000	100%		Overdraft
*Values are Estimates	81,725	284,600	89,355			

Each water supply agency that serves more than 3000 connections is required to prepare and maintain an urban water management plan, which among other things, outlines the susceptibility of the supply to drought. Those plans have been completed by all the large agencies.

Groundwater supplies are not as susceptible to drought impact as groundwater represents a large reserve that can be pumped more heavily during a short- term drought period. However, almost all of the groundwater basins in Santa Cruz County are in overdraft and current average pumping levels cannot be sustained on a long-term basis. Water conservation is a key strategy of all county water agencies, and during the recent drought all agencies sought consumption reductions of 15-20% through voluntary or mandatory measures, as indicated below.

TABLE 7-2. WATER CONSERVATION TARGETS

Measure	City of Santa Cruz	Watsonville	San Lorenzo Valley	Soquel Creek	Scotts Valley
System-wide Reduction Target	15%		20%	15%	10%
Mandatory conservation	X		X	Voluntary	X
No watering between 9:00 a.m. and 6:00 p.m.	between 10:00-5:00	X	X	Voluntary between 10:00-5:00	X
Outdoor watering limited to 2 days per week *	X				
15 minute time limits on automatic overhead spray irrigation systems	X				
Sweeping of paved areas instead of washing down/ Prohibit washing of any outdoor impervious surface	X	X	X	X	X
Car washing must be done with a bucket and hose with shut-off nozzle	X	X	X	X	X
Water upon request only in public restaurants and linen service in hotels and motels by request only	X		X	X	X
Display by restaurants and hotels of water conservation signs.	X			X	X

Swimming pools may not be initially filled, or drained and refilled	X				
All hoses must have shut-off nozzles	X	X	X	X	X
Waste of water due to broken or defective plumbing, sprinklers and watering/irrigation systems is prohibited.	X	X	X	X	X
Bulk water sales not available for construction use.					X

Santa Cruz County has no direct authority over the entities that provide water supply to county residents. The two largest suppliers are governed by the city councils elected by city residents. Independently elected Boards govern the other public entities. The California Public Utilities Commission oversees the privately owned water systems to some extent. All water systems are governed by state and federal safe drinking water regulations. The larger systems with more than 200 connections are regulated directly by the California Department of Public Health.

The County serves as an agent of the state, ensuring compliance with the state regulations for 130 small water systems with 5-199 connections. The County also permits individual water systems to serve new homes in rural areas. Typically these are on wells. Although well yield standards for new development are conservative, it is possible that individual wells and older wells serving small water systems may experience diminished yield or go dry during an extended drought. The County has no ongoing oversight of water use for individual water systems after the initial development permit is approved.

The City of Santa Cruz, which supplies water for 36% of the County's population, is the county water agency that is most susceptible to drought impacts, given that only about 4% of its supply comes from groundwater. Santa Cruz relies on surface water in coastal streams and the San Lorenzo River for most of its annual water supply needs. The yield of these sources in any given year is directly related to the amount of rainfall received and runoff generated during the winter season. Water stored in Loch Lomond Reservoir is used mainly in the summer and fall seasons when the flows in the coast and river sources decline and additional supply is needed to meet dry season demands.

The problem of supply reliability stems primarily from two factors: the wide range in the yield of surface water sources from year to year and limited storage capacity. In normal and wet years when rainfall and runoff are abundant, base flows in the coast and river sources are restored by winter rains, and Loch Lomond Reservoir is typically replenished to full capacity with runoff from the Newell Creek watershed.

The water system, however, is highly vulnerable to shortage in drought years when the San Lorenzo River and coast stream sources run low. In single dry years, the system relies more heavily on water stored in Loch Lomond to satisfy demand, which draws down the reservoir level lower than usual and depletes available storage. In multi-year or critical drought conditions, the combination of very low surface flows in the coast and river sources and depleted storage in Loch Lomond reservoir reduces available supply to a level which cannot support average dry season demands. Compounding the situation is the need to reserve some amount of storage in Loch Lomond in the event drought conditions continue into the following

year. The highest priorities of the City during a drought are domestic uses, sanitation, and fire protection.

7.3.2 Profiling Drought Hazard Events

3.2 Profiling Hazards – 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.

A. Location

The areas of the county most susceptible to impacts of drought are those areas served primarily by surface water sources: the City of Santa Cruz and the San Lorenzo Valley. The Santa Cruz water system includes the entire City as well as outlying areas as far away as parts of Capitola and unincorporated areas of the north coast and the DeLaveaga area. A map of the water system coverage area is shown in Figure 21 and Figure 22 on the following pages.

FIGURE 21. WATER SERVICE AREA CITY OF SANTA CRUZ

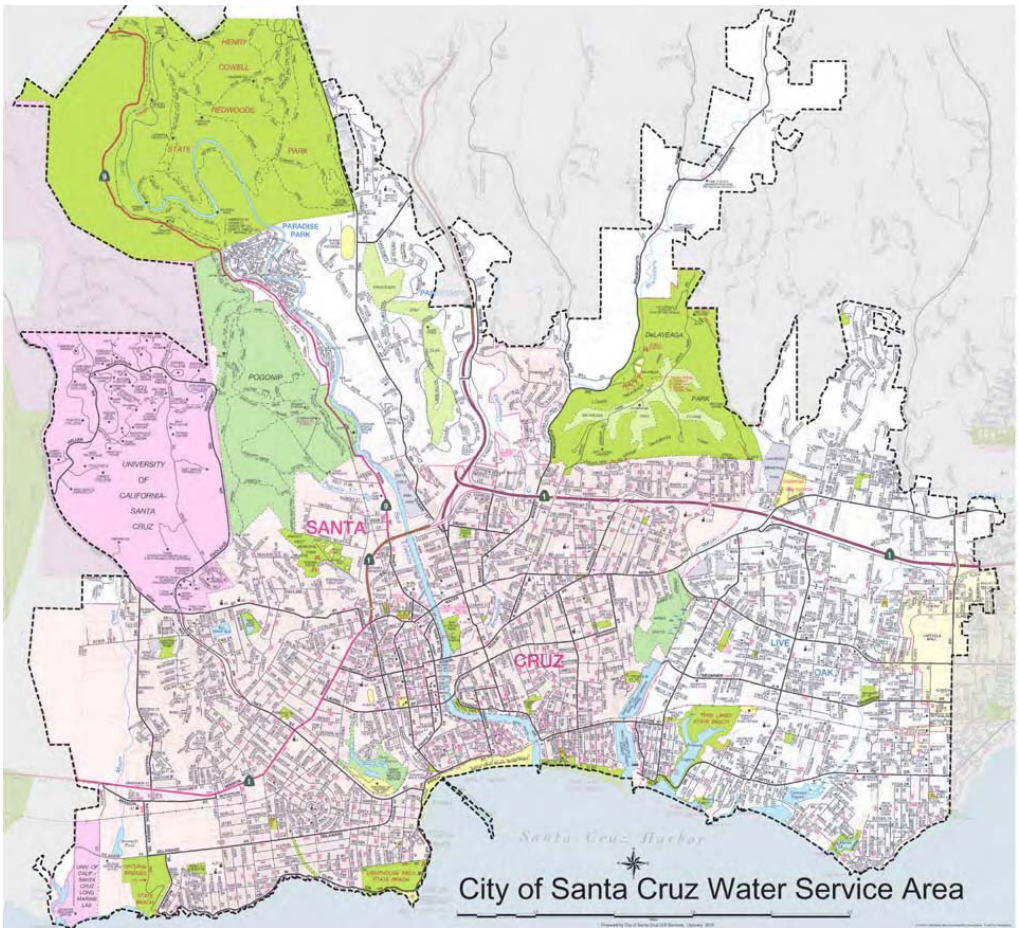
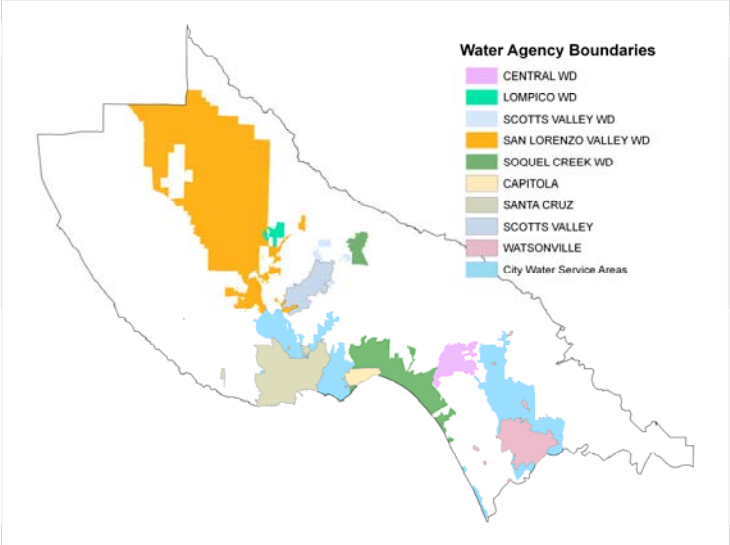


FIGURE 22. MAP OF WATER AGENCIES COVERAGE AREA IN SANTA CRUZ COUNTY



B. Extent: Magnitude or Severity

There is a significant difference in severity between a single dry year and multiple dry years in Santa Cruz. As can be seen from the history of drought in Santa Cruz in **Figure 23** taken from the **City of Santa Cruz 2005 Urban Water Management Plan (**UWMP**),**[15] there have been at least five multi-year dry periods since 1921.

Single Dry Year: The total water supply estimated to be available to the City in single dry years is 3,800 million gallons (mg) or about 12% less than is available in normal years. **Table 7-3,** taken from the UWMP, shows that there would be a relatively small supply deficit in single dry years under current demand conditions, which will increase as demand increases over time.

TABLE 7-3. SINGLE DRY YEAR SUPPLY AND DEMAND ASSESSMENT (MILLION GALLONS)

	2005	2010	2015	2020	2025	2030
Supply Totals	3,800	3,800	3,800	3,800	3,800	3,800
Demand Totals	3,900	3,952	4,154	4,345	n/a	n/a
Difference	(100)	(152)	(354)	(545)	--	--

Multiple Dry Years: In an extreme two-year drought similar to the 1976-77 event, the estimated water supply available to the City in the second year of that event is 2,700 mg or about 37% less on an annual basis than is available in normal water years. **Table 7-4** shows that there

would be a severe water supply shortage under current demand conditions, which will grow worse as demand increases over time. The shortfall is also expressed in **Table 7-4** as the percent of supply available to meet demand during the peak season between April and October, since this is the period of year that would be most affected by a supply shortage. Under such conditions, the water system is barely able to meet half of normal requirements of the water service area.

TABLE 7-4. MULTIPLE DRY YEAR SUPPLY AND DEMAND ASSESSMENT (MILLION GALLONS)

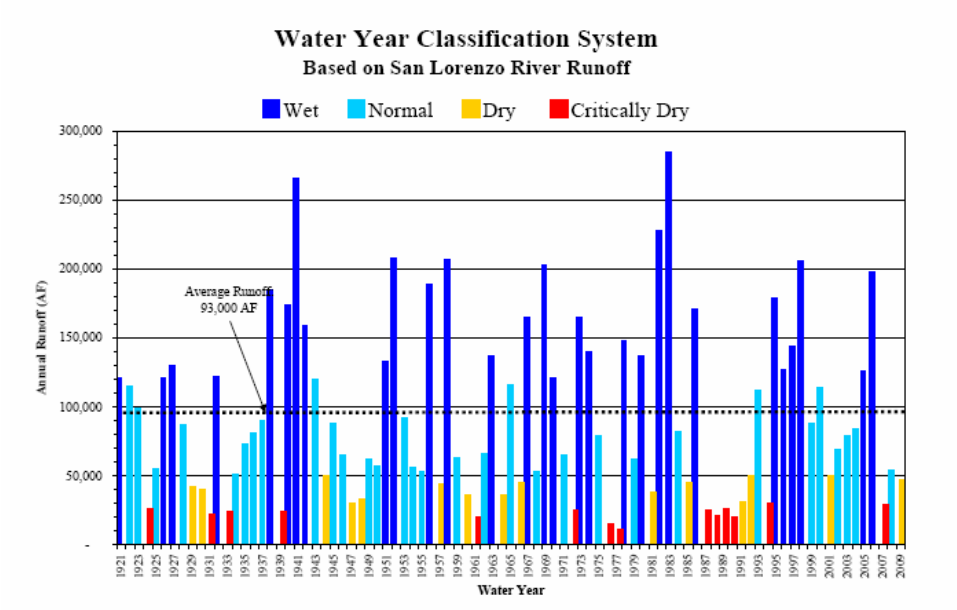
	2005	2010	2015	2020	2025	2030
Supply Totals	2,700	2,700	2,700	2,700	2,700	2,700
Demand Totals	3,900	3,952	4,154	4,345	n/a	n/a
Difference	(1,200)	(1,252)	(1,454)	(1,645)	--	--
Peak Season Deficit	46%	47%	52%	56%		

C. Previous Occurrences

The City of Santa Cruz, which is the service area most impacted by drought, uses a water year classification system as an index of water supply conditions for operations studies, to forecast river flows, and to communicate its water supply status to the public. The system is based on total annual runoff in the San Lorenzo River. Under this classification system, the water year (October 1- September 30) is designated as one of four types: wet, normal, dry, or critically dry, depending on the total annual river discharge **(Figure 23).**

Figure 23 also shows the total annual runoff for the San Lorenzo River over the 84-year period from 1921 to 2009 and the classification for each water year[16].

FIGURE 23. TOTAL ANNUAL RUNOFF IN THE SAN LORENZO RIVER (ACRE FEET)



The graph illustrates the dramatic variation in discharge from year to year. Average runoff during this period is about 93,000 acre-feet or 30 billion gallons[17]. The least amount of runoff, 9,500 acre-feet, occurred in the drought of 1977. The maximum recorded discharge was over 280,000 acre-feet in 1983, one of the wettest years on record in California.

Over this relatively brief hydrologic record, about two-thirds of all years are classified as wet or normal and the other one-third is classified as dry or critically dry. From 1995 to 2006, water conditions were mostly normal or wet. 2007 was the first year of the state's current 3-year drought. During this period, 2007 was classified as critically dry, 2009 was classified as dry, and 2008 was just slightly wetter than the dry classification. Water use restrictions were imposed during 2007 and 2009 in the city of Santa Cruz, and throughout other parts of the county during all 3 years. 2010 may also be a dry year.

D. Probability of Future Events

One approach to evaluating probability of future events focuses on the magnitude of the worst-case drought, because it is the degree of shortfall that determines what actions the community would have to take and the resulting hardships the public would face.

It should also take into account, though, the chance of that event occurring before a solution is achieved. The amount of time that elapses before new supply can be developed is an important consideration because it also has a bearing on the degree of risk faced by water customers; the longer the delay, the greater the risk. As with the threat of other natural hazards

like a flood or an earthquake, the probability of a severe drought in any one-year may be comfortably low. For instance, the drought on record of 1977 has a recurrence interval of 1 in 59 years. This means the probability of such an event is 1/59 or 0.017, which is the same as a 1.7% chance of occurrence in any one year. But the percent probability of occurrence, or chance, of a shortage occurring over a longer time frame is considerably higher, which changes the perception of the significance of risk. The following Table 7-5 presents the chance of various shortfalls occurring within the existing City of Santa Cruz water system over a specified period of time:

TABLE 7-5. RELATIONSHIP OF WATER SHORTAGES WITH VARIOUS RECURRENCE INTERVALS TO PROBABILITY OF OCCURRENCE OVER TIME

Shortage Magnitude	Recurrence Interval	Percent Probability of Occurrence over:			
		5 years	10 years	20 years	30 years
10% or more	7 in 59	47	72	92	98
20% or more	4 in 59	30	51	76	88
30% or more	1 in 59	8	16	29	40

To address the estimated shortages, construction of a desalination plant has been recommended. If the recommended desalination plant could be built in the next five years, the odds are about even of experiencing a moderate water shortage over this time and there is only an 8 percent chance of experiencing a critical drought like the 1977 event between now and then. On the other hand, if the project were delayed or rejected, and the earliest another project realistically could be commissioned was twenty years out, the chance of experiencing a moderate shortage over this time rises to over 90 percent and nearly 30 percent for a critical drought, which exposes the community to a much greater risk.[18]

The expected effects of climate change will also increase the risk of drought. Numerous climate models have been run with various predictions for the Santa Cruz County area.[19] Although it is unclear whether the average amount of rainfall will increase, it is apparent that the timing and intensity of rainfall will change, which will lead to more severe extended droughts. More intense rainfall will contribute to relatively diminished groundwater storage, which will reduce groundwater storage and dry season stream baseflows, which will have adverse impacts on water supply. The projected increase in temperatures will also lead to an increase in water demand for irrigation, particularly in the inland parts of the county that are less influenced by coastal fog. The county water agencies are currently pursuing more detailed assessments, which will help to better quantify the expected impacts of climate change.

7.3.3 Assessing Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

A. Overall Summary of Vulnerability to Drought

Vulnerability to drought varies with the different water agencies and their sources. Agencies

with a greater reliance on surface water are more vulnerable than those that rely entirely on groundwater. County water agencies are considering plans now to provide more interties among jurisdictions to be able to exchange water in the event of an emergency or shortage.

The City of Santa Cruz System is the most vulnerable to a drought. The City does not presently have access to outside water sources should local supply be inadequate to meet demands during dry years. As a closed, isolated system, the City is highly vulnerable to shortage in drought years when the San Lorenzo River and coast sources run low. In single dry years, the system relies more heavily on water stored in Loch Lomond to satisfy demand, which draws down the reservoir level lower than usual and depletes available stored reserves. In multi-year or critical drought conditions, the combination of very low surface flows in the coast and river sources and depleted storage in Loch Lomond reservoir reduces available supply to a level which cannot support average dry season demands.

If water shortages as a result of drought do occur, rationing would go into effect. Conservation programs, curtailment programs, and plans to increase water supply are all components that will decrease the vulnerability of the community to drought.

7.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

A. Types and Numbers of Existing Buildings, Facilities and Infrastructure

Structures and facilities are not vulnerable to drought. Physical losses would probably be limited to public and private landscaping. However, the impacts to the landscaping, which occur as the result of severe drought conditions, also increase the risk of wildfire and subsequent damage to structures as a result.

7.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Potential Dollar Losses to Vulnerable Structures

While structures are not at risk, significant losses may occur as a result of severe rationing during a water shortage. One of the County's major industries is tourism. The vulnerability to drought (or more specifically water shortages as a result of drought) reaches its peak during the summer tourism season. Restaurants, hotels, amusement parks and other tourist serving businesses would all be at risk of closing or severe restrictions during a critical drought. This is critical to funding ongoing County services because of the County's reliance on the Transient Occupancy Tax (TOT). Other industries such as agriculture, food processing, contractors, landscapers, nurseries, golf courses, public landscaping and school grounds would all experience losses, and other water dependent businesses would suffer economic damages.

These economic losses have not been calculated.

B. Methodology Used to Prepare Estimate

While potential economic losses have been considered, they have not been calculated; therefore, there is no loss estimate.

7.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses & Development Trends

The greater Santa Cruz area is a compact urban area surrounded by mountains, greenbelt and the Pacific Ocean. The sizes of the water service areas are generally fixed by the city limits and the County's urban services line. Water service areas for all jurisdictions have generally remained constant over time due to policies limiting water main extensions to unserved areas. The only extensions of service or agency boundaries have involved incorporating an existing developed area into a larger district, which has better capabilities for providing reliable water service. Accordingly, any growth and redevelopment that does happen going forward is expected to be concentrated within the confines of the existing service area boundaries.

Within the City of Santa Cruz, the San Lorenzo Valley, and other areas only a relatively small amount of land remains undeveloped. Because of the relative scarcity of raw buildable land, the majority of future growth in the area is likely to be achieved through redevelopment, remodeling, infill, and increased density on underutilized land, along with new construction on the little amount of vacant land remaining. In other words, the service areas are relatively fixed[20] and not growing outward. There has not been a residential subdivision in rural areas of the county since the adoption of Measure J, the County's growth management plan, in the late 1970's. Both the City of Watsonville and the City of Santa Cruz have also established urban growth boundaries.

The housing elements of the County and the cities have recently been updated to address the required regional fair share housing needs established by AMBAG. These documents set forth goals and objectives for housing production, rehabilitation, and conservation. The plans identify generally where sites are available for housing to be built and describe programs to facilitate new housing opportunities, but this does not necessarily mean such housing actually will be constructed.

The City of Santa Cruz Water system currently serves approximately 95,000 people and is anticipated to grow to 100,000 by 2030[21]. The city system has additional capacity of 300-400 million gallons per year (MGY) during normal years. By 2025 or 2030 (depending on growth rates), this surplus is expected to be fully utilized by additional growth within the service area, including planned University growth. Although this growth in demand can be accommodated during normal years (7 years out of 10), the growth in demand will exacerbate the current shortfall during dry years. In a worst case scenario, (second drought year with year 2030

demand after 0.8% yearly growth) total demand would exceed supply by 38% (1656 MGY). Most of this deficit is attributed to existing users (72%), followed by University growth (6%) and other new demand in the city service area.

7.4.0 Mitigation Strategy

4.0 Mitigation Strategy: Requirement §201.6(c)(3): The plan **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.

Water agencies have developed Urban Water Management Plans, Integrated Water Plans, and groundwater management plans that include elements to overcome potential drought impacts. The agencies are now working together to update and implement the 2005 Santa Cruz Integrated Regional Water Management Plan, which will coordinate and prioritize the actions of all the agencies to address water resource needs including development of additional sustainable supplies and improved management of existing supplies to reduce drought impacts for individual agencies.

7.4.1 Mitigation Goals

4.1 Local 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.

Given that the County does not have any direct authority over water supply, the County is limited in the actions it can take to mitigate drought, other than to support the efforts of various water supply entities to address drought. Goals to reduce the impacts of drought are contained in the various plans described above. For example, the goals of the City of Santa Cruz 2005 Urban Water Management Plan and the Integrated Water Plan (IWP) include:

Drought Goals:

Drought –1 Reduce near-term drought shortages

Drought –2 Provide a reliable supply that meets long-term needs while insuring protection of public health and safety

7.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Drought Mitigation Actions:

- Implement water conservation to maximize the use of existing water resources. (A-7)
- Support the development of additional water supplies (A-8)
- Promote more effective use of groundwater storage through increased groundwater recharge and conjunctive use among agencies. (A-9)

- Promote drought planning by the 130 small water systems under County jurisdiction. (C-13)

Water Conservation. Both the state water law and the County's General Plan call for a strong emphasis on water conservation and elimination of water waste to stretch existing sources, minimize the need for new water sources, and protect the environment. Most of the water agencies have strong conservation programs, which are supported by the County. The County will be considering additional measures to provide tougher regulations and an overdraft impact fee, which would be paid by new development in overdrafted basins, to fund reduction of water use by existing users.

Additional Water Supply. The City of Santa Cruz and Soquel Creek Water District are pursuing the construction of a desalination plant which would consist of a seawater intake system using an existing abandoned wastewater outfall, building a new desalination plant with an initial capacity of 2.5 mgd, installing the associated pipelines and pumping stations for delivering treated water to the Bay Street Reservoir, and conveying seawater concentrate to the City's wastewater facilities where it would be blended with municipal wastewater flows and disposed via the deep ocean outfall. The purpose of this initial phase of desalination capacity is for drought protection. Accordingly, the desalination plant would only be used by the City intermittently during the dry seasons of dry and critically dry years when existing supplies fall short. It would be used at other times by Soquel Creek Water District to allow reduction of groundwater pumping and increased groundwater storage.

Groundwater Storage, Recharge and Conjunctive Use. County staff are supporting the efforts of the water agencies to evaluate more possibilities for water exchanges and conjunctive use options which would have the potential to utilize more surface water during wet periods, increase use of recycled water, increase groundwater storage, increase stream baseflow, and potentially make more groundwater available to surface water users during drought periods.

County staff is also pursuing various methods to increase groundwater recharge through projects and policies to restore and maintain storm water infiltration.

Drought Planning for Small Water Systems. Staff will review existing information and state requirements and determine if there would be a significant benefit to require additional drought planning by small water systems. Some systems may have already developed plans, and some may be limited by lack of technical expertise and financial capability. The costs and benefits of such a program will be considered and discussed with state regulators. At a minimum, systems could be sent a mailer encouraging them to plan ahead.

B. Actions and Projects to Reduce the Effects of Hazards on New Buildings

Drought does not present a direct hazard to buildings.

C. Actions & Projects to Reduce Effects of Hazards on Existing Buildings

Drought does not present a direct hazard to buildings.

Proper maintenance and weed abatement including removal of dead landscape vegetation adjacent to buildings will reduce the threat of structure fire during dry years.

7.4.3 Implementation of Mitigation Actions

4.3 Implementation of Mitigation Actions – Requirement §201.6©(3)(iii): The mitigation strategy section shall include an action plan describing how the actions identified in section ©(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 assorted costs.

A. Discussion of Process and Criteria Used to Prioritize Mitigation Actions

Individual water supply master plans, groundwater management plans, and urban water management plans were developed with a process for technical review and public review, which resulted in a prioritization of recommendations for each water supply agency. The Santa Cruz Integrated Regional Water Management Plan compiled the recommended projects from the various plans prepared by the water supply agencies. Projects were prioritized based on the ability to meet multiple Plan objectives.

B. Implementation and Administration of Mitigation Actions

Implementation of agency plans is in progress. Proposition 50 funds were secured to implement 15 priority projects in the IRWMP:

- Abandoned Well Destruction
- Conjunctive Use Plan for Lower San Lorenzo Watershed
- Aptos Drainage Master Plan
- Storm water Pollution Prevention
- Groundwater Recharge Projects
- New Brighton Sewer Relocation
- Desalination Project Intake Evaluation
- Polo Grounds Well and Treatment Plant
- Polo Grounds Monitoring Well
- Davenport Drinking Water Treatment Upgrade
- Watsonville Slough Wetland Restoration
- Integrated Watershed Restoration Program
- Scotts Valley Recycled Water Main Extensions
- Coordinated Monitoring
- Update of the Santa Cruz Integrated Regional Water Management

In addition, County staff are preparing a package of water conservation measures to take to the Board of Supervisors for adoption, including water efficient landscaping, prohibition on inefficient use of water, groundwater overdraft impact fee, and an update of the requirement for the retrofit of water efficient toilets and showerheads upon property transfer. Additional measures to encourage drought planning among small water systems will be considered.

Emphasis on the Use of Cost–Benefit Review

The County did not use a formal cost benefit analysis. Costs were carefully considered when determining goals and objectives but there was not an emphasis on cost benefit review to maximize benefits.

CHAPTER 8 — TSUNAMI

8.3.0 Tsunami Risk Assessment

8.3.1 Identifying Tsunami Hazards

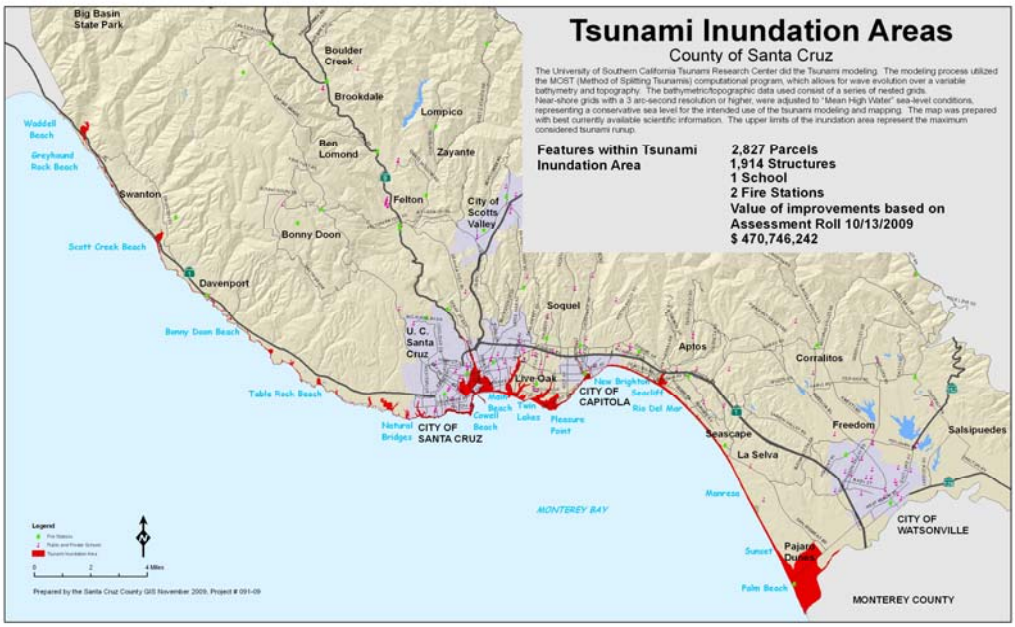
3.1 Identifying Hazards – Requirement § 201.6(c)(2)(i): The risk assessment **shall** include a description of the type of all natural hazards that can affect the jurisdiction.

A tsunami is a series of waves generated by an impulsive disturbance in a large body of water such as an ocean or large lake. Tsunamis are produced when movement occurs on faults in the ocean floor, usually during very large earthquakes. Sudden vertical movement of the ocean or lake floor by a fault, landslide or similar movement displaces the overlying water, creating a wave that travels outward from the source. The waves can travel across oceans and maintain enough energy to damage distant shorelines. The hazard posed by tsunamis came to the attention of the world during the 2004 Indian Ocean tsunami that killed as many as 300,000 people who lived more than a thousand miles from the source of the earthquake. An earthquake anywhere in the Pacific Ocean can cause tsunamis around the entire Pacific basin, including offshore of Santa Cruz County. Since the Pacific Rim is highly seismically active, tsunamis are not uncommon, but historically have been only a few meters in height. Correspondingly there has been minimal damage and loss of life in Santa Cruz from tsunamis during recorded history. However, the historic record is short, and may not reflect the true tsunami hazard to the County. The potential outcome of a tsunami could be significant damage and loss of life.

8.3.2 Profiling Tsunami Hazard Events

3.2 Profiling Hazards – 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.

FIGURE 24. TSUNAMI INUNDATION MAP



A. Location

The County of Santa Cruz is located on Monterey Bay. Several active and potentially active earthquake faults are located within or near the County of Santa Cruz. An earthquake occurring in or near any of the nearby faults could result in local source tsunamis from submarine landsliding in Monterey Bay. Additionally, distinct source tsunamis from the Cascadia Subduction Zone to the north, or Teletsunamis from elsewhere in the Pacific Ocean are also capable of causing significant destruction.

B. Extent: Magnitude or Severity

A local source tsunami generated by an earthquake on any of the faults affecting the County of Santa Cruz could arrive just minutes after the initial shock. The lack of warning time from such a nearby event would result in higher causalities than if it were a distant tsunami where the Tsunami Warning System for the Pacific Ocean could warn threatened coastal areas in time for evacuation. Past experience has not resulted in extensive damage from tsunamis, but proximity to faults does create the possibility as a result of future quakes.

C. Previous Occurrences

Tsunamis have affected the County of Santa Cruz several times in recorded history. The first

recorded tsunami was a teletsunami that initiated from an earthquake near Japan on June 15, 1896. In Japan, the death toll was approximately 20,000 people, but in Santa Cruz the tsunami was only a meter and a half high and there is little record of damage. A more significant tsunami occurred on April 1, 1946 when a magnitude 7.8 earthquake in the Aleutian Islands produced a 115-foot wave, which destroyed the Scotch Cap lighthouse killing five Coast Guardsmen. It was 56 feet high in Hawaii killing 173 people. The wave was observed all along the west coast. In Santa Cruz County, a man drowned and minor damage was done by 10-foot waves. It should be noted that scientific observations place the 1946 Tsunami run up at 1.5 meters. Santa Cruz County was hit by a similar sized tsunami generated by the Good Friday Earthquake of March 27, 1964. Reports vary indicating heights between 1.5 meters and 3.3 meters. After the Loma Prieta Earthquake, a small tsunami, or seiche, was observed at the Santa Cruz Harbor.

California is at risk from both local and distant source tsunamis. Eighty-two possible or confirmed tsunamis have been observed or recorded in California during historic times. Most of these events were small and only detected by tide gages. Eleven were large enough to cause damage and four events resulted in deaths.

D. Probability of Future Events

Tsunami Hazard

Anticipating the extent of future tsunami hazard is difficult because the historic record is limited, as is our understanding of the source mechanisms and influence of offshore geometry on the impact of tsunami in Santa Cruz County.

Studies have recently been undertaken by Richard K. Eisner, Jose C. Borrero and Costas E. Synolakis through the Governor's Office of Emergency Services and the Department of Civil Engineering at the University of Southern California, Los Angeles. In Inundation Maps for the State of California, the authors clarify that the results are based on worst-case scenario events and the maps are only to be used for emergency preparedness and evacuation planning. Pre-1994 inundation computations underestimated inundation height. Newer inundation models are now capable of modeling extreme events more accurately. These new inundation models (known as MOST) permit quantitative evaluation of inundation from nearfield tsunamis, provided accurate regional tectonic models and high-resolution bathymetry exist. Even using state of the art inundation prediction tools, California presents unique challenges in assessing tsunami hazards because:

- There is an extremely limited historic record of tsunamis in the state. In California there are no known records before the 19th century. Some paleo-seismic investigations have revealed evidence of pre-historic tsunamis, but not in the County of Santa Cruz.
- Most of the geologic work in the state has concentrated on identifying the risks associated with onshore faults and there is scant available information on offshore faults or landslide and slump scars suggestive of past submarine mass failures.
- Earlier estimates of tsunami hazards relied almost entirely on farfield sources and used pre-1980's technology, creating the impression among planners and the public that the tsunami hazard was small.
- Nearshore seismic events may trigger tsunamis arriving within less than 20 minutes from peroration, allowing little time for evacuation.
- Shorelines and shoreline platforms vary significantly throughout the state, which

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modify tsunami run up and the corresponding potential damage.

8.3.3 Assessing Tsunami Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

A. Overall Summary of Vulnerability to Tsunami

There are two primary types of tsunami vulnerability in Santa Cruz County. The first is a teletsunami or distant source tsunami from elsewhere in the Pacific Ocean. This type of tsunami is capable of causing significant destruction in Santa Cruz County. However, this type of tsunami would usually allow time for the Tsunami Warning System for the Pacific Ocean to warn threatened coastal areas in time for evacuation.

The more vulnerable risk to the County of Santa Cruz is a tsunami generated as the result of an earthquake along one of the many earthquake faults in the region. Even a moderate earthquake could cause a local source tsunami from submarine landsliding in Monterey Bay. A local source tsunami generated by an earthquake on any of the faults affecting Santa Cruz County would arrive just minutes after the initial shock. The lack of warning time from such a nearby event would result in higher causalities than if it were a distant tsunami.

8.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

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~~A.~~Types and Numbers of Existing Buildings, Facilities and Infrastructure

Among every type of land use within the county, approximately 2800 parcels lie within the tsunami inundation zone. The number of structures on these parcels is 1914. Expected loss in value would be $470,746,242.

8.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Potential dollar Losses to Vulnerable Structures

TABLE 8-1. TSUNAMI POTENTIAL LOSS INVENTORY

Tsunami
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	41	2,938	32	$226,819,374	$11,948,671
Commercial	1,398	83	2,359	22	$475,412,013	$11,901,244
Government	1,676	146	1,317	35	$249,122	$0
Industrial	215	5	473	1	$104,713,461	$742,779
Institutional	174	4	397	0	$185,873,022	$1,677,485
Miscellaneous	12,478	281	2,381	50	$16,039,420	$602,904
Residential	43,024	2,255	52,604	1,773	$7,721,059,332	$443,557,992
Utilities	515	12	195	1	$1,357,002	$315,167
Total	61,081	2,827	62,664	1,914	$8,731,522,746	$470,746,242

	Total Unincorporated	Hazard Area
Population	133,891	4,160

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County
Hazard Number of parcels, structures and value of improvements within the defined unincorporated hazard areas
Loss is based on assessment improvement values

B. Methodology Used to Prepare Estimate

Parcel Valuation

Valuation of parcels within a hazard area is based on improvement values only as collected by appraisers with the County of Santa Cruz assessor's office. They don't reflect sale value or replacement value. If a parcel intersected a hazard the entire improvement value of that parcel was used.

Population

Census population blocks were reduced to center points. If a hazard intersected a center point, that population was counted.

Tsunami Flood Analysis

Tsunamis create many risks similar to riverine and coastal flooding and the Tsunami and Flood inundation areas are similar. However, tsunamis also produce a run up that can be much more extensive than the run up that occurs with typical coastal flooding. In determining the extent of

tsunami damage an estimate must be made of the extent of the flooding. Current mapping of tsunami flooding and damage is not meant to be measured against parcel level information and therefore is a rough estimate of damage and loss in a worst-case scenario.

8.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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

A. Description of Land-Uses and Development Trends

As was described previously, the County of Santa Cruz has compact urban areas as well as large expanses of agricultural and forested land. Most development is now infill or reuse development,[22] although development of existing rural parcels continues. As discussed under Flood Hazards, new development is not allowed within the 100-year floodway, and must meet flood hazard regulations within the remainder of the floodplain. Reconstruction of existing structures within these areas must meet the flood elevation requirements for habitable space dictated by the FEMA guidelines and regulations. Although FEMA flooding regulations may indirectly protect against some tsunamis, these standards are inadequate as tsunami have a different direction of force and energy, and can inundate areas that are not affected by riverine or coastal flooding.

8.4.0 Mitigation Strategy

4.0 Mitigation Strategy – Requirements §201.6(c)(3): The plan **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.

The County's current tsunami mitigation strategy is based upon notification and evacuation (see Appendix J). The strategy also includes continuation of an up-to-date Emergency Management Plan, an effective public information program and continuing collaborative efforts with the cities, agencies and community organizations to facilitate collaborative efforts in providing up-to-date tsunami mapping, preparation, information, warning dissemination and education.

Mapping of tsunami inundation areas in Santa Cruz County, including the map used in this plan, is inadequate. This map should be viewed as an estimate of a worst-case scenario for planning purposes only. More accurate mapping of potential tsunami outcomes based on simulations of specific geologic events has been identified as an important component in preparing updates to this Hazard Mitigation Plan.

8.4.1 Mitigation Goals

4.1 Local Hazard Mitigation Goals – Requirements §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.

Tsunami Goals

Tsunami 1 Avoid or reduce the potential for life loss, injury, property and economic damage to Santa Cruz County from tsunami events.

Tsunami 2 Continue to enhance emergency management systems including a defined public information process that includes an early warning system for evacuation prior to a tsunami event.

Tsunami 3 Pursue unification of the County of Santa Cruz evacuation plan with those of the cities of Watsonville, Capitola, and Santa Cruz.

8.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Tsunami Mitigation Actions

- Coordinate a communication system with other agencies and cities, including evacuation operations for homes and businesses within specific areas. (A-10)
- Management of the early warning system including a defined public information process including establishing a reverse 911 system that will notify all homes and businesses within the tsunami inundation areas, and a public address protocol to have local and regional radio, TV and cable outlets announce evacuation notifications to the community. (B-8)
- Update tsunami maps (B-9)
- Encourage investigation of the tsunami threat to the County of Santa Cruz, and update development regulations based upon this investigation. (C-14)

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CHAPTER 9 — COASTAL EROSION

9.3.0 Coastal Erosion Risk Assessment

9.3.1 Identifying Coastal Erosion Hazards

3.1 Identifying Hazards – 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.

Coastal erosion is the wearing away of coastal land. It is commonly used to describe the horizontal retreat of the shoreline along the ocean. Erosion can be measured as a rate, with respect to either a linear retreat (feet of shoreline recession per year) or volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year).[23]

Erosion rates are not uniform, and vary over time at any single location. Annual variations are the result of seasonal changes in wave action and water levels. Erosion is caused by coastal storms and flood events, changes in the geometry of tidal inlets and bays and man-made structures and human activities such as shore protection structures and dredging.

Coastal erosion includes both cliff or bluff erosion and beach erosion, and is a result of both winter wave attack as well as constant wave action. Local residents will notice that beaches change seasonally in response to changes in wave conditions. Winter storm waves are larger, steeper and contain more energy, and typically move significant amounts of sand from the beaches to offshore bars, creating steep, narrow beaches. In the summer, lower, less energetic waves return the sand, widening beaches and creating gentle slopes. During the winter months when beaches are narrow, or absent altogether, the storm waves attack the cliffs and bluffs more frequently. There are many factors involved in coastal erosion, including human activity, sea-level rise, seasonal fluctuations and climate change, and sand movement will not be consistent year after year in the same location.

Wind, waves, and the long-shore currents are some of the driving forces behind coastal erosion. The removal and deposition of sand creates long-term changes to beach shape and structure. Sand may be transported to landside dunes, deep ocean trenches, other beaches and deep ocean bottoms.

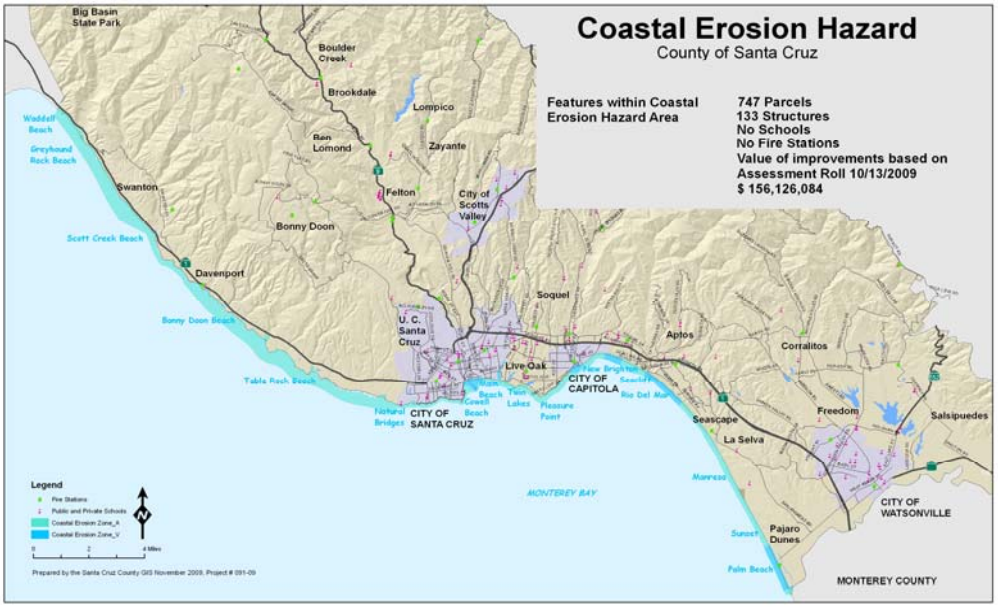
Coastal erosion such as cliff and bluff erosion is also a result of processes related to the land such as rainfall & runoff, weathering and earthquakes.

9.3.2 Profiling Coastal Erosion Hazard Events

3.2 Profiling Hazards – 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.

A. Location:

FIGURE 25. COASTAL EROSION WITHIN COUNTY OF SANTA CRUZ



The County of Santa Cruz is bounded on one side by the Pacific Ocean. The entire coastal edge of the county is affected by coastal erosion.

On the north coast, where there are few structures near the coastline, the risk to structures and infrastructure is less than the coastline in the middle and southern portions of the County where homes and some businesses, as well as roads and related infrastructure are located very close to the shoreline.

B. Extent: Magnitude or Severity

Most of the significant cliff, bluff and dune erosion occurs in the area of the County from Live Oak to the southern County line during major winter storms at times of very high tides. The north coast area of the County also experiences coastal erosion, however, to a lesser degree. All of the cliffs along the ocean experience some degree of coastal erosion.

The north coast area of the County (from the City of Santa Cruz to the Santa Cruz/San Mateo County line) is underlain by the geologically older Santa Cruz Mudstone formation, which is less susceptible to coastal erosion than areas in the County to the south.

The bluffs in the Live Oak area and eastward to Rio Del Mar are underlain by the younger Purisima formation capped by terrace deposits which have been estimated to be retreating at a rate of six inches to one to two feet per year.

Eolian deposits that are also sensitive to coastal erosion underlie the areas south of Rio Del

Mar.

C. Previous Occurrences

Approximately 85 percent of the California coast is actively eroding due to complex oceanographic and geologic conditions, and to human activities that affect the delivery and movement of sand along the coast.[24]

Bluff failure takes place through processes related to the sea (mainly those that affect wave action) and to the land (rainfall and runoff, weathering, earthquakes), although the terrestrial processes are less often appreciated than the marine processes. Wave attack during periods of high tides or otherwise elevated sea level (e.g. El Niño or storm surge) is one of the most common mechanisms of episodic cliff failure. El Niño increases storm frequency, elevated sea levels, wave height and rainfall. Studies have been performed on El Niño, storm frequency, and coastal erosion history for the central California coast from 1910-1995 (Storlazzi and Griggs). This research indicated that the majority of documented coastal erosion occurred during El Niño storms that originated from the southwest.

During the severe El Niño winters of 1983 and 1997-98, sea levels were further elevated and storm damage along the coastal area was extensive. Wave attack combined with a global rise in sea level over the past 18,000 years has led to the continued migration of the shoreline. At the end of the last Ice Age, about 18,000 years ago, the coastline at Santa Cruz was about 10 miles offshore. As the ice sheets and glaciers melted, sea level gradually rose and continues to rise today.

Over the past several decades it has been discovered that coastal wave climate and storm frequency are related to larger scale climatic oscillations that affect the entire Pacific Ocean. During the time period from about 1945 to 1978, the California coast was characterized by a fairly calm climate, few large storms, less rainfall and less coastal erosion and storm damage. Beginning in 1978 and continuing until 1998, California experienced a period of more frequent and severe El Niño events with associated elevated sea levels, large waves, heavier rainfall and more extensive coastal storm damage and cliff and beach erosion.

D. Probability of Future Events

While the sea level rose a little less than a foot over the past century, most scientists are concerned that due to the increase in greenhouse gases from human activity, warming will accelerate. As a result, glaciers will continue to retreat and the rate of sea level rise will increase, with the best estimate being about three feet higher by 2100. Given this estimate, the probability of future coastal erosion is very high.

9.3.3 Assessing Coastal Erosion Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

A. Overall Summary of Vulnerability to Coastal Erosion

Much of the Santa Cruz County coastline, particularly in the developed areas, has some level of armoring (walls, riprap, etc.). The majority of the protection structures have been installed within the last 40 years, and they have varying levels of adequacy and performance. While these protection structures help protect buildings and infrastructure during storms, they are still vulnerable to failure during larger storm events and may not provide full protection. Riprap structures along the coastline are particularly vulnerable to failure and require more maintenance and upgrading over time than the concrete seawalls.

While the entire Santa Cruz coast is subject to coastal erosion, the primary locations vulnerable to coastal erosion are the areas from the Santa Cruz Harbor eastward toward Pleasure Point, the area from Pleasure Point to Opal Cliffs, and the area south of New Brighton Beach to the southern Santa Cruz County line.

The area from the Santa Cruz Harbor to Pleasure Point contains numerous homes on the coastal bluff as well as roads and other infrastructure, particularly near the coastal lagoons, that are vulnerable to coastal erosion. There are also several sea caves that may affect the integrity of homes and infrastructure in this area as well. The primary type of coastal armoring in this area is riprap. It is not uncommon for East Cliff Drive to be closed or damaged where it crosses Schwann Lake, Corcoran Lagoon and Moran Lake during large winter storms. Many of the homes that exist along the coast in this area, although somewhat protected, may be subject to further coastal erosion as sea levels rise, earthquakes occur, and waves and rainfall impact the coast.

The area from Pleasure Point to Opal Cliffs also contains numerous homes on the costal bluff as well as roads and other infrastructure that are vulnerable to coastal erosion. The coastal armoring in this area is a mix of riprap, concrete seawalls and a combination of both. Currently a seawall is being constructed in the Pleasure Point area along East Cliff Drive that should greatly reduce potential damage from coastal erosion to East Cliff Drive as well as the homes on the other side of the road. Many of the homes that exist along the coast in this area, although somewhat protected, may be subject to further coastal erosion as sea levels rise, earthquakes occur, and waves and rainfall impact the coast.

The area south of New Brighton Beach to the southern Santa Cruz County line contains numerous homes on the bluffs, at the base of the bluffs and on the beach. There is also infrastructure and several County roads on the beach and bluffs that may be affected by coastal erosion. Many of the homes along and above both Las Olas Drive and Beach Drive will experience the continuing effects of coastal erosion. There are also several other communities (including Seascape, La Selva Beach, Sunset Beach and Pajaro Dunes) that are vulnerable to coastal erosion. Many of the homes that exist along the coast in this area, although somewhat protected, may be subject to further coastal erosion as sea levels rise, earthquakes occur, and waves and rainfall impact the coast.

Along the north coast of the County of Santa Cruz, regulations have limited development and structures have been constructed in very limited locations.

Although seawalls reduce or delay coastal erosion processes as long as they remain functioning, ultimately coastal erosion continues and the best seawalls need maintenance. While seawalls remain in place, they modify coastal erosion through the reduction of wave

erosion energy, or reflection or refraction of wave energy. Focused erosion can occur at the ends of the seawalls. While seawalls are helpful in protecting against coastal erosion, proper setbacks from the brow of bluffs, drainage control, and special construction are all necessary to protect structures, roadways, and utilities from damage.

9.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

A. Types and Numbers of Existing Buildings, Facilities and Infrastructure

There are approximately 550 residential parcels affected by coastal erosion. Of this number, 104 are structures with a potential loss of $141,482,428.

9.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Potential Dollar Losses to Vulnerable Structures – See table on following page

TABLE 9-1. COASTAL EROSION POTENTIAL LOSS INVENTORY

Coastal Erosion
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	11	2,938	0	$226,819,374	$10,852,744
Commercial	1,398	4	2,359	0	$475,412,013	$3,151,490
Government	1,676	91	1,317	17	$249,122	$0
Industrial	215	1	473	0	$104,713,461	$30,489
Institutional	174	1	397	0	$185,873,022	$600,675
Miscellaneous	12,478	84	2,381	12	$16,039,420	$8,258
Residential	43,024	550	52,604	104	$7,721,059,332	$141,482,428
Utilities	515	5	195	0	$1,357,002	$0
Total	61,081	747	62,664	133	$8,731,522,746	$156,126,084

	Total Unincorporated	Hazard Area
Population	133,891	35

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County
Hazard Number of parcels, structures and value of improvements within the defined unincorporated hazard areas
Loss is based on assessment improvement values
Government parcels, public schools and most utilities are not assessed

Methodology Used to Prepare Estimate of Loss

Parcel Valuation
Valuation of parcels within a hazard area is based on improvement values as they appear on the Assessment Roll. They do not reflect potential sale or replacement value
If any part of a parcel intersected a hazard, the entire improvement value of the parcel was used.

Population
Census blocks were reduced to center points. If the center points intersected a hazard, that population was counted. The population count is based on the 2000 Census.

B. Methodology Used to Prepare Estimate

Assessor's valuations were used. Potential dollar losses also include replacement of roads and paths, including property acquisition.

9.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses & Development Trends

Every coastal community in California is dealing with the issues of sea level rise and shoreline retreat armoring is becoming an increasingly controversial and contentious issue. Since seawalls now protect so much of the developed portion of the County of Santa Cruz coastline, the controversy now centers on improving these walls and their impacts. Coastal erosion poses many problems to coastal communities in that valuable property is frequently lost to this dynamic beach-ocean system. Additionally, human activity may modify the process of coastal erosion with uncertain results. Thus, issues of beach restoration and erosion control are at the forefront in coastal communities. The County of Santa Cruz's shoreline is now part of the Monterey Bay Marine Sanctuary, which will also influence development trends along the Santa Cruz coast.

The majority of the undeveloped areas along the coastline are farmland or other areas currently protected from development. The current trend in development along the coastline in Santa Cruz County is in-fill within the developed areas and reconstruction of existing structures and infrastructure. The County of Santa Cruz's Geologic Hazards Ordinance Section 16.10.070(h) requires development on coastal bluffs and beaches to be reviewed by the County Geologist. The ordinance requires development to be setback at least 25 feet from the top of a coastal bluff, or the distance required to provide 100-year stability, whichever is greater. Shoreline protection structures are also subject to the County's Geologic Hazards Ordinance and review by the County Geologist. Most current seawall permits are for maintenance and improvement of existing walls, which allows the County of Santa Cruz to require modifications that reduce the walls' impacts.

9.4.0 Mitigation Strategy

4.0 Mitigation Strategy – Requirement §201.6(c)(3): The plan **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.

9.4.1 Local Hazard Mitigation Goals

4.1 Local 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.

Coastal Erosion Goals:

Coastal Erosion 1	Avoid or reduce the potential for life loss, injury, property and economic damage to the County of Santa Cruz from coastal erosion.
Coastal Erosion 2	Protect and preserve natural resources.
Coastal Erosion 3	Protect and preserve current infrastructure.

9.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Coastal Erosion Mitigation Actions

- Protect and preserve the coastline through permit review and continue to review coastal development for conformance with the County's Geologic Hazards ordinance. (B-10)
- Encourage the replacement of existing seawalls with better-designed walls that result in less of an impact. (B-11)
- Protect and preserve the coastline and infrastructure through restoration efforts (C-15)

Minimizing Hazards from Coastal Erosion

Much of the urban coastline in the County has boulder riprap or concrete seawalls to minimize the energetic wave impacts that drive cliff erosion and to protect residences and infrastructure. Because these structures have finite life spans and can have adverse effects on other parts of the coast, engineering solutions can be very expensive in both the short-term and long-term. In other cases, the solution is to leave the coastline relatively undeveloped and to allow erosion to occur naturally. This option preserves the normal input of sand into the littoral drift system, perhaps lessening erosion at neighboring beaches.

The three primary management strategies that may be used to plan for and respond to coastal erosion are hazard avoidance, relocation, and coastal protection. The maximum potential efficacy and acceptability of these strategies can best be determined with multi-disciplinary project planning, design, monitoring and evaluation.

Hazard Avoidance – A Commonsense Approach

The most logical method for preventing potential damage to new development in the coastal zone is to avoid building where coastal erosion will impact such development. This concept, known as hazard avoidance, could circumvent many subsequent permitting and legal challenges. Hazard avoidance has proven effective when used in a number of ways including designing public infrastructure to discourage development in high geologic hazard areas along the coast.

Relocation – Moving Development Out of Harm's Way

In some instances, development is sited in unstable, erosion-prone areas that may be damaged or destroyed by natural processes acting on the coast. Relocating existing public or private development away from erosion-prone areas may be the most effective long-term option when responding to the eventual or imminent threat of damage. While relocating coastal development away from hazardous areas would be the most direct way to eliminate the risk of damage and the need for coastal protection, this response may not be technically, financially or legally feasible. Another approach to consider under certain circumstances is the concept of "managed retreat," that is the gradual removal or abandonment of development from areas of high geologic hazard. In the context of coastal management, the concept of managed retreat acknowledges the natural erosive processes at work along the coast.

Coastal Protection

In situations where hazard avoidance and relocation are not viable options, coastal protection strategies can be used to reduce the potential for beach loss and coastal erosion. There are two general types of coastal protection, hard and soft. A "hard" protection device utilizes concrete or rock in a variety of configurations to absorb or dissipate storm wave energy, generally in the form of seawalls, revetments or bulkheads. "Soft" protection primarily involves dune or beach restoration or enhancement to reduce the chances of storm waves from reaching the backshore. A hard protection device differs substantially from most soft erosion response alternatives in that it does not add sand to the system of sediment.

CHAPTER 10 — DAM FAILURE

10.3.0 Dam Failure Risk Assessment

10.3.1 Identifying Dam Failure Hazards

3.1 Identifying Hazards – 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.

Dam failure can occur as a result of earthquakes, seiches, structural instability, or intense rain in excess of design capacity. Timber, rock, concrete, earth, steel or a combination of these materials may be used to build a dam. Dams must have spillway systems to safely convey normal stream and flood flows over, around, or through the dam. Spillways are commonly constructed of non-erosive materials such as concrete. Dams also have a drain or other water-withdrawal facility to control the reservoir level and to lower or drain the reservoir for normal maintenance and emergency purposes.

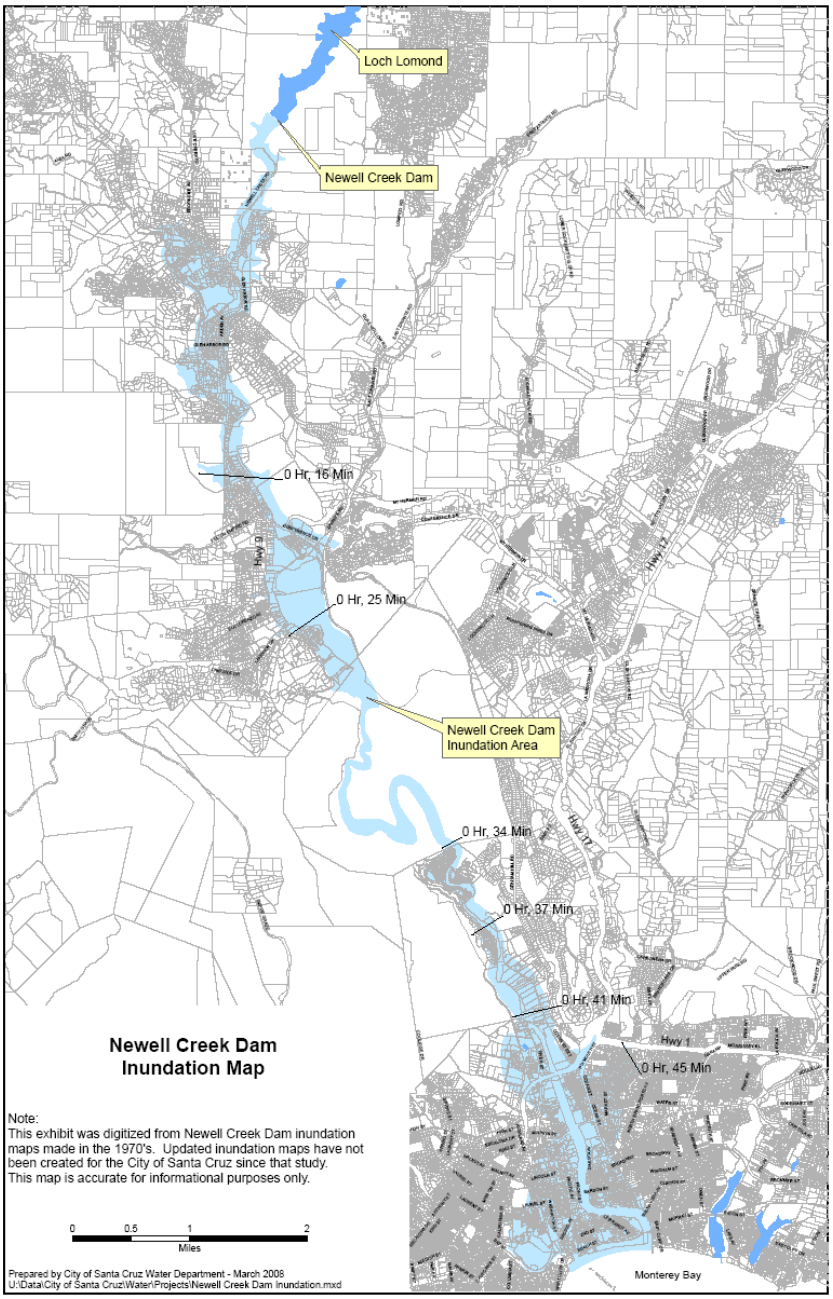
10.3.2 Profiling Dam Failure Hazard Events

3.2 Profiling Hazards – 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.

A. Location

As reflected in table 10-1 on the following page, there are six dams located within the County of Santa Cruz that, based on their size, are regulated by the State Division of Safety of Dams. Two of these, the Bay Street Reservoir and Newell Dam, are within the jurisdiction of the City of Santa Cruz. The remaining four include: 1) Mill Creek Dam at the Lockheed facility near the end of Empire Grade in northern Santa Cruz County, 2) Sempervirens Dam within Big Basin Redwoods State Park, 3) Oak Site Dam found near the Lockheed facility, and 4) Soda Lake located along Highway 129 in southeastern Santa Cruz County. None of these dams are owned or operated by the County of Santa Cruz, but are the responsibilities of other state agencies or private entities. The reservoirs range in size from 20 acre-feet to over 10,000 acre-feet, with the oldest dam being constructed in the late 1890s and the newest in 1985.

FIGURE 26. INUNDATION AREA FOR NEWELL CREEK DAM FAILURE



Three additional State-regulated dams, located in neighboring counties, also have the potential to affect Santa Cruz County residents and properties should they be compromised or fail. These include Elmer J Chesbro Dam and Uvas Dam in Santa Clara County and the San Justo Dam in San Benito County. The Santa Clara Valley Water District is responsible for Elmer J Chesbro and Uvas reservoirs, while San Justo reservoir is the responsibility of the San Benito County Water District under contract with the Federal Bureau of Reclamation. Programs to ensure ongoing dam safety are implemented by these agencies.

TABLE 10-1. LIST OF DAMS WITHIN AND ADJACENT TO COUNTY OF SANTA CRUZ

Name	Owner	County	Stream	Year Built	Capacity (Ac-ft)	Res. Area (Acres)
Mill Creek	Lockheed Missiles and Space Co.	Santa Cruz	Mill Creek	1889	223	12
Oak Site	State Dept of Forestry	Santa Cruz	Tr. Big Creek	1969	20	2
Sempervirens	California Dept of Parks and Recreation	Santa Cruz	Sempervirens Creek	1951	78	4
Soda Lake	Granite Rock Co.	Santa Cruz	Tr. Pajaro River	1978	1,983	72
Bay Street Reservoir	City of Santa Cruz	Santa Cruz	Offstream	1924	112	5
Newell	City of Santa Cruz	Santa Cruz	Newell Creek (SLR)	1960	8,991	172
Elmer J Chesbro	Santa Clara Valley Wd	Santa Clara	Llagas Creek (PR)	1955	8,086	328
Uvas	Santa Clara Valley Wd	Santa Clara	Uvas Creek (PR)	1957	10,000	280
San Justo	Bureau of Reclamation	San Benito	Offstream	1985	10,300	202

There are also a total of eight mining operations in Santa Cruz County that utilize ponds to hold processing plant wash water and storm water. These ponds are constructed using both artificial and natural barriers depending on whether the pond is created by a levee or dam, or excavation below grade. Because of limited dam height or storage capacity none of these ponds is within the jurisdiction of the State of California Division of Safety of Dams. In some cases quarry ponds are non-jurisdictional because they are created by excavation, which means there is no artificial barrier that would qualify as a “dam” under State law.

There are an unknown number of other dams in the County associated with agriculture, small water systems and private ponds. These facilities are likely non-jurisdictional. Santa Cruz County Planning Department files may contain documentation for some of these dams while a number of others are undocumented.

B. Extent: Magnitude or Severity

Given their location, a major dam failure at either the Bay Street Reservoir or Newell Creek Dam could result in extensive property damage or loss of life in the San Lorenzo Valley and the City of Santa Cruz. A dam failure at either the Mill Creek, Oak Site or Sempervirens dams could affect people and property in northern Santa Cruz County, to the east of the community

of Boulder Creek. Soda Lake is a storage facility for fine-grained material or “fines” from the Wilson Quarry in San Benito County. Failure of the Soda Lake levees could potentially release this material and impact one or more nearby residences and encroach upon Highway 129. Although located in neighboring counties, a failure of the Elmer J Chesbro, Uvas, or San Justo dams could potentially impact people and properties along the Pajaro River in Santa Cruz County.

Given their location, failure of a non-jurisdictional dam or levee at a quarry pond could affect a limited amount of people or property in downstream areas. For an unknown number of dams, which are likely non-jurisdictional, the extent of the dam failure hazard is unknown at this time.

C. Previous Occurrences

There have been no reported dam failures for either the Bay Street Reservoir or Newell Creek facility. There have been no reported failures at the Mill Creek, Oak Site or Sempervirens dams. Because the Elmer J Chesbro, Uvas and San Justo dams are located in adjacent counties, information is not readily available regarding previous dam failures, if any.

After the Loma Prieta Earthquake, an extensive set of cracks was observed at the crest of the Soda Lake west embankment and adjacent areas on the levee’s interior face. The west levee was excavated to bedrock and reconstructed in 1997 with the approval of the California Division of Safety of Dams. Additional stability issues involving the north levee tie-in to the hillside have been addressed by the Division of Safety of Dams in a letter to Graniterock Company dated September 20, 2000.

According to Planning Department records there have been no dam failures at any of the mines in Santa Cruz County. There have been rare events involving uncontrolled releases of water due to natural and human causes, but none of these events involved dam failure.

Previous occurrences of dam failure affecting Santa Cruz County are not known for any other dams.

D. Probability of Future Events

Currently available information gives no indication that any of the dams would fail or otherwise sustain damage under any circumstance (This does not include man-made disaster). A stability issue involving a quarry pond is being addressed with the quarry operator. The Division of Safety of Dams is aware of the issue involving the north levee of Soda Lake.

10.3.3 Assessing Dam Failure Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – Requirements §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.

A. Overall Summary of Vulnerability to Dam Failure

The losses to life and property associated with complete dam failure would be high. Given the

monitoring protocol at the Newell Creek and Bay Street reservoirs, the probability of dam failure is very low.

10.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

A. Types and Numbers of Existing Buildings, Facilities and Infrastructure

Up-to-date information on numbers of existing buildings, infrastructure and critical facilities is not available at this time. A Seismic Safety Element was prepared for the County of Santa Cruz General Plan in 1975. This document contains inundation maps for the Newell Creek, Bay Street and Sempervirens dams, which have not been updated.

In the event of a dam or levee failure at a quarry pond, significant environmental impacts and property damage could occur. Environmental impacts would likely be limited to temporary impacts on water quality and erosion. Property damage would likely be limited to impacts on downstream drains, culverts, roads and bridges.

10.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

A. Dollar Losses to Vulnerable Structures

As the following table illustrates, the majority of structures within the inundation area are residential. For this land use category alone, the loss would be approximately $171 million dollars.

TABLE 10-2 . DAM FAILURE POTENTIAL LOSS INVENTORY

Inundation
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	8	2,938	29	$226,819,374	$1,684,105
Commercial	1,398	87	2,359	128	$475,412,013	$19,854,730
Government	1,676	47	1,317	52	$249,122	$50,741
Industrial	215	1	473	16	$104,713,461	$611,202
Institutional	174	18	397	23	$185,873,022	$5,700,596
Miscellaneous	12,478	276	2,381	49	$16,039,420	$12,274
Residential	43,024	1,437	52,604	1,498	$7,721,059,332	$171,239,716
Utilities	515	17	195	3	$1,357,002	$0
Total	61,081	1,891	62,664	1,798	$8,731,522,746	$199,153,364

	Total Unincorporated	Hazard Area
Population	133,891	3,244

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County
Hazard Number of parcels, structures and value of improvements within the defined unincorporated hazard areas
Loss is based on assessment improvement values
Government parcels, public schools and most utilities are not assessed

Methodology Used to Prepare Estimate of Loss

Parcel Valuation
Valuation of parcels within a hazard area is based on improvement values as they appear on the Assessment Roll. They do not reflect potential sale or replacement value
If any part of a parcel intersected a hazard, the entire improvement value of the parcel was used.

Population
Census blocks were reduced to center points. If the center points intersected a hazard, that population was counted. The population count is based on the 2000 Census.

B. Methodology Used to Prepare Estimate

Valuation of parcels within the hazard area are based on improvement values only as collected by the County of Santa Cruz Assessor's Office. They do not reflect sale or replacement value. If a parcel intersected a hazard, the entire improvement value of that parcel was used.

10.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses and Development Trends

The County of Santa Cruz has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As dictated by the 1978 Growth Management Ordinance, most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs have resulted in the need to provide higher density housing.[25] In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

There is limited potential for significant expansion of mining activities in Santa Cruz County. As quarry resources are depleted, the sites are reclaimed. Reclamation will include elimination of unnecessary water impoundments and eliminating any danger to public health and safety from failure of any remaining dams or levees.

10.4.0 Mitigation Strategy

4.0 Mitigation Strategy – Requirement §201.6(c)(3): The plan **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.

The primary mitigation strategy is the continuation of monitoring protocols for structural integrity. The City of Santa Cruz is responsible for monitoring of both the Bay Street Reservoir and the Newell Creek Dam.

The Santa Cruz County Planning Department regulates mining operations in the County. All quarry ponds have been reviewed for geotechnical stability and hydrologic capacity as part of the permitting process for each mine. In addition, mine sites are inspected on a regular basis, which includes verifying the current conditions of ponds and conformance with approved plans. As a result, any necessary remedial measures identified during the permit process, or ongoing inspections, are addressed as part of the quarry inspection process.

The mitigation strategy for other dams in Santa Cruz County would involve documentation and site inspection to determine what, if any, further documentation or remedial actions may be needed.

10.4.1 Mitigation Goals

4.1 Local 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.

Dam Failure Goal

Avoid or reduce the potential for life loss, injury, property or economic damage to Santa Cruz from dam failure.

10.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Dam Failure Mitigation Actions

- Develop an event protocol with the State Division of the Safety of Dams. (B-12)
- Update dam inundation maps. (C-16)
- Review Planning Department files and other available information for the purpose of locating any other dams in Santa Cruz County to determine the extent of possible damage. (C-17)

CHAPTER 11 — LANDSLIDE

11.3.0 Landslide Risk Assessment

11.3.1 Identifying Landslide Hazards

3.1 Identifying Hazards – 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.

Landsliding is a general term that describes a wide variety of mass downslope movements of soil and rock in response to gravity. Landsliding occurs as falls, topples, slides, spreads, flows, and a combination of these categories, and may change from one form failure to another during their movement.

Factors causing landsliding include the rock strength and orientation of elements on the slope, erosion, weathering, high rainfall, steepness of slopes, and human activities such as the removal of vegetation and inappropriate grading.

Landslides occur throughout the world, but Santa Cruz County's unique geologic conditions make large portions of the County particularly susceptible to many forms of landsliding. Factors that contribute to landsliding in Santa Cruz County include:

- storms
- earthquakes
- fires
- freezing and thawing
- erosion
- vegetation removal, grading and other human activities.

Landslide problems can also be caused by land mismanagement, particularly in mountain, canyon, and coastal regions. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. The deterioration of old timber harvest roads may also result in concentration of drainage that induces landsliding. The County of Santa Cruz's General Plan[26], along with Chapter 16.10 of the County Code set standards to reduce damage from landslides through avoidance of hazardous areas and/or mitigation. These County standards, along with the California Building Code and good engineering practices minimize many landslide problems, but don't eliminate them.

Landsliding occurs throughout Santa Cruz County, but is centered primarily along the steeper slopes in the hills and mountains, along stream corridors, and along coastal bluffs and inlets. Large areas of the County are subject to several forms of landsliding as indicated in Figures 27 and 28, but isolated sliding occurs throughout the County. The types of landsliding that occur in Santa Cruz can be summarized as follows:

- **Coastal Bluffs**: Shallow landslides, debris flows and topples
- **Rivers and streams**: Shallow landslides, rotational landslides, and lateral spreading
- **Hillslopes**: Large deep composite landslides, and debris flows.

11.3.2 Profiling Landslide Hazard Events

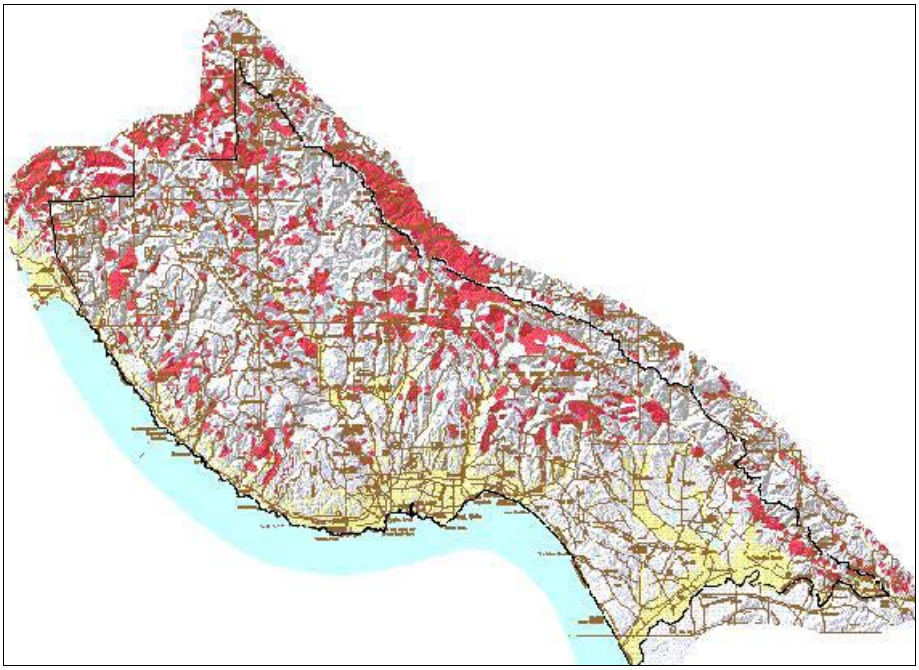
3.2 Profiling Hazards – Requirement §201.6(c)(2)(i): The risk assessment **shall** include a description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard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

A. Location

SUMMARY DISTRIBUTION OF SLIDES & EARTH FLOWS IN SANTA CRUZ COUNTY[27]

By Carl M. Wentworth, Scott E. Graham, Richard J. Pike, Gregg S. Beukelman, David W. Ramsey, and Andrew D. Barron

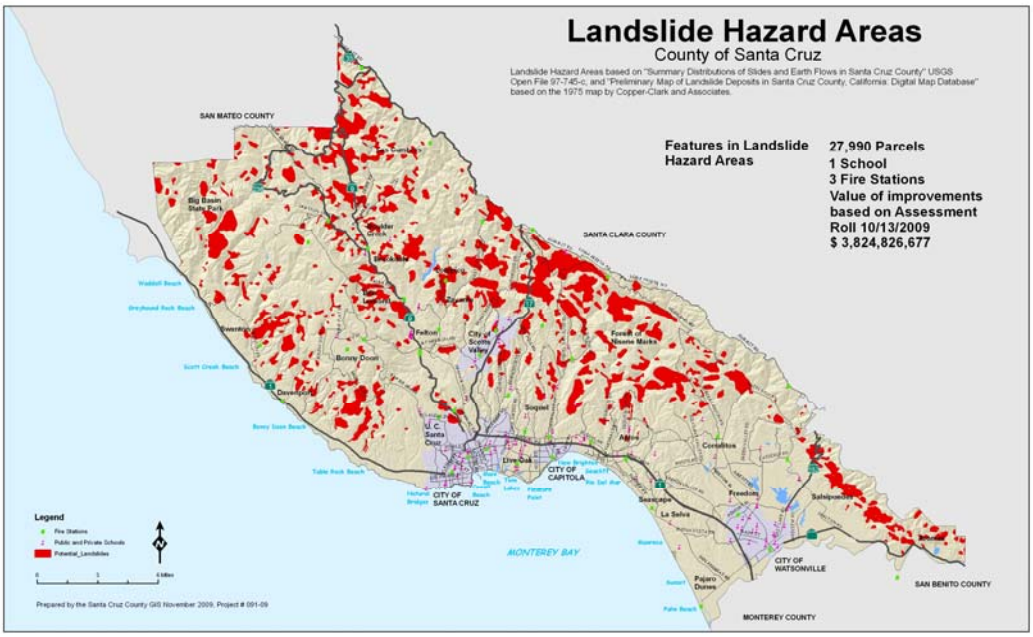
FIGURE 27. SLIDES & EARTHFLOWS IN SANTA CRUZ COUNTY



MAP UNITS	
Mostly Landslide - consists of mapped landslides, intervening areas typically narrower than 1500 feet, and narrow borders around landslides; defined by drawing envelopes around groups of mapped landslides.	Many Landslides - consists of mapped landslides and more extensive intervening areas than in 'Mostly Landslide'; defined by excluding areas free of mapped landslides; outer boundaries are quadrangle and County limits to the areas in which this unit was defined.

Few Landslides - contains few, if any, large mapped landslides, but locally contains scattered small landslides and questionably identified larger landslides; defined in most of the region by excluding groups of mapped landslides but defined directly in areas containing the 'Many Landslides' unit by drawing envelopes around areas free of mapped landslides.	Flat Land - areas of gentle slope at low elevation that have little or no potential for the formation of slumps, translational slides, or earth flows except along stream banks and terrace margins; defined by the distribution of surficial deposits (Wentworth, 1997).

FIGURE 28. POTENTIAL SLIDE THREATS TO SANTA CRUZ COUNTY



B. Extent: Magnitude or Severity

Landslides are a common occurrence in the Santa Cruz Mountains. Our intense winter storms, high rainfall amounts, especially during El Nino weather patterns, and steep terrain are conducive to landsliding. Earthquake activity contributes to this landsliding, as illustrated by the 1906 earthquake, which set off dozens of large landslides in the Santa Cruz Mountains, some of which claimed human lives. The 1989 Loma Prieta earthquake produced a similar pattern of landsliding. The potential for loss of life and property is much greater today due to the increase in population residing in areas of possible instability.

Most recent landslides in the Santa Cruz Mountains have been caused by a combination of human activity and natural factors. Human activities that act to further destabilize slopes, are old timber harvest roads and skid trails, conversion of land from forest to residential and agricultural uses, road building, grading and other housing construction and any activity that alters normal drainage patterns. The likelihood that any of these factors will contribute to

landsliding is dependent upon the existing conditions and also on the care with which activities are conducted in these locations. County Code Section 16.10 in combination with the California Building Code require careful consideration of landslide factors by both engineering geologists, soils engineers, and civil engineers. However, even with proper care, there remains a higher than normal potential for damage from landsliding in many areas of the County.

C. Previous Occurrences

Several periods of landsliding have occurred in Santa Cruz County in recent history. Some of the better-documented landslides are:

Mount Hermon Landslide: The Mountain Hermon landslide moved in the late 1950's after the El Nino year of 1957 –1958. This landsliding occurred in an area of suspected older landsliding and the new movement extended from the Kaiser Quarry to the bottom of Bean Creek blocking Mount Hermon Road, and is one of the reasons for construction of the Mount Hermon bypass. At the time of the landsliding there was some concern that the quarry (and a small earthquake) may have contributed to the re-initiation of the landslide.

Rain Storms of January 1982: Severe storms caused multiple landslides throughout the Bay Area and especially in the Santa Cruz Mountains. One very large composite landslide along Love Creek, west of Loch Lomond Reservoir, killed ten people. This landslide was and continues to be an indicator of the potential severity of landslide activity and the need for observation and/or mitigation. Other landslides, including debris flows, destroyed homes killing several other people. In addition to damage to homes, widespread landslide damage occurred to roadways, driveways, and stream channels.

Loma Prieta Earthquake October 17, 1989: Landslides occurred throughout the County of Santa Cruz during and after the October 17, 1989 Loma Prieta earthquake. Most of these larger landslides moved only during the actual shaking, but others continue to the present. Smaller landslides occurred along coastal bluffs and along ridge-tops.

El Nino Winter Storms of 1986, 1998, and 2005: These storms caused multiple landslides, particularly debris flows, throughout the Santa Cruz Mountains. During the 1998 winter, many homes were affected by landsliding and several roadways were damaged including Highway 9, Branciforte Road, and Amesti Road. Winter rains also induced landsliding within the quarries throughout the County.

D. Probability of Future Events

Landsliding will continue to affect the County, especially during El Nino weather patterns. Most of the critical structures within the County of Santa Cruz are located away from landslides, but many homes and roadways are located in and around landslides. El Nino weather patterns will continue approximately every seven years, and the San Andreas Fault, as well as other faults, will generate earthquakes, which will contribute to the formation of landslides.

11.3.3 Assessing Landslide Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

Past experience has shown that many areas of the County are susceptible to the effects of landslides. Most of the damage caused by landslides will be to privately owned structures although a fair number of County maintained roads are also at risk.

A. Overall Summary of Vulnerability to Landslide

The County of Santa Cruz terrain, weather, and seismicity increase the likelihood of landsliding. Homes built before 1989 are particularly vulnerable to landslides as some of these were constructed without the benefit of engineering or engineering geologic investigations. Most of the roadways were constructed many years ago with little consideration to slope stability, and will likely be affected by landsliding in the future. Because utilities follow these roads, damage to roads will often disrupt sewers, water systems, gas and electricity, and cable and telephone utilities.

Areas that have experienced landsliding include:

1. The steep hillslopes throughout the County of Santa Cruz, especially near the Zayante and San Andreas fault zones, and within the San Lorenzo Valley and Eureka Canyon.
2. The river channels along major streams, and along the edges of the broader alluvial Pajaro River and Corralitos Creek.
3. Along coastal bluffs, especially above Beach and Las Olas drives, and above Sunset Beach in the Seacliff Beach area.

11.3.4 Assessing Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Landslides threaten relatively few public buildings, but over 16,000 residences are potentially at risk, with over 21,000 structures on these parcels. This represents over 3 billion dollars worth of property. See Table 11-1 for the type of structures and their value.

Types and Numbers of Existing Buildings, Facilities and Infrastructure

TABLE 11-1. LANDSLIDE POTENTIAL LOSS INVENTORY

Landslide
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	1,186	2,938	2,345	$226,819,374	$181,914,734
Commercial	1,398	376	2,359	967	$475,412,013	$182,330,036
Government	1,676	1,114	1,317	1,010	$249,122	$0
Industrial	215	63	473	237	$104,713,461	$28,748,471
Institutional	174	66	397	205	$185,873,022	$98,923,351
Miscellaneous	12,478	8,781	2,381	1,411	$16,039,420	$11,202,964
Residential	43,024	16,123	52,604	21,221	$7,721,059,332	$3,320,396,597
Utilities	515	281	195	99	$1,357,002	$1,310,524
Total	61,081	27,990	62,664	27,495	$8,731,522,746	$3,824,826,677

	Total Unincorporated	Hazard Area
Population	133,891	17,202

Improvement value based on Assessment Roll 10/13/2009
Total number of parcels, structures and values within the unincorporated areas of the County

11.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Once again, we see that residential structures are the ones most impacted by landslide danger. Over 16,000 residential parcels have been identified as under threat from landslide. There are over 21,200 structures on these parcels, which represent a value of over $3 billion dollars.

B. Methodology Used to Prepare Estimate

County of Santa Cruz Tax Assessor's valuations were used to prepare this report. Potential dollar losses also include replacement of roads, paths and property acquisition.

11.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses and Development Trends

The County of Santa Cruz has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As dictated by the 1978 Growth Management Ordinance, most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs have resulted in the need to provide higher density housing. In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

Growth management policies prevent development from occurring where hazards are present and, in most cases, require substantial setbacks from these hazards.[28]

11.4.0 Mitigation Strategy

4.0 Mitigation Strategy – Requirement §201.6(c)(3): The plan **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.

The County's over-all strategy to mitigate landslide hazards is to: 1) require the involvement of qualified experts in identifying specific landslide hazards, 2) maintain records of the types and locations of these hazards, 3) require that new development avoid landslide areas whenever possible, and 4) ensure that building plans incorporate all reasonable mitigation measures for structures that must be sited in or near hazard areas.

11.4.1 Mitigation Goals

4.1 Local 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.

Landslide Goals

Landslide 1 Avoid and reduce the potential for life loss, injury, property and economic damage from landslide hazards

11.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Landslide Mitigation Actions

- Continue to require that the County Geologist review development in areas of suspected landsliding and require engineering geology reports when landsliding is identified or suspected. (C-18)
- Continue to require that an engineering geologist and/or geotechnical engineer investigate the site of any proposed construction near landsliding and require mitigation of landslide hazards before issuing any building or grading permits. (C-19)
- Continue to require that an engineering geologist and/or a geotechnical engineer investigate any landslide damage to homes or roadways before repair of the landslide and reuse of the homes or roadways. (C-20)

CHAPTER 12 — EXPANSIVE SOILS

12.3.0 Expansive Soils Risk Assessment

12.3.1 Identifying Expansive Soils Hazards

3.1 Identifying Hazards – 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.

Expansive soils are generally clays or sedimentary rocks derived from clays, which experience volume changes as a result of moisture variation.

The hazard that expansive soils create can be significant. Many of the expansive soils do not create large areas of destruction; however, they can disrupt supply lines (i.e. roads, power lines, railways, and bridges) and damage structures. The effects on structures can be dramatic if expansive soils supporting structures are allowed to become too wet or too dry. Lightly loaded one-story or two-story buildings, warehouses, residences, and pavements are especially vulnerable to damage because these structures are less able to suppress the differential heave of the swelling foundation soil than heavy, multistory structures. Patios, driveways and walkways may also crack and heave as the underlying expansive soils become wet and swell.

Expansive soils do not change size quickly; observing damage in real-time can sometimes be difficult. Although the damage might not occur in a matter of minutes, it still has the potential to severely damage structures and roads over a matter of time if not sufficiently mitigated.

Many areas of Santa Cruz County are underlain by expansive soils. However, expansive soil doesn't cause problems unless poorly designed structures are built on it. A house built on expansive soil will probably move if the foundation was not designed to take this soil type into account. Movement occurs because the soils expand so forcefully, the foundation actually moves. Different parts of the house can move at different rates and distances, thus cracking the foundation. Significant cracks often appear at the corners of windows and doors, in walls, garage slabs, walkways, and driveways. Doors and windows may become jammed. The integrity, design, value and use of a home could be affected. During extreme drought conditions, even homes that are not normally affected by expansive soil problems may experience slight cracking.

12.3.2 Profiling Expansive Soils Hazard Events

3.2 Profiling Hazards – 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.

A. Location

The general areas of expansive soils within the County of Santa Cruz are known. The National Resource Conservation Service's (NRCS) Soil Survey of Santa Cruz County mapped various soils types throughout the County. In addition, soils reports performed over the years throughout the County for building permits have corroborated the locations of expansive soils. The primary soil types mapped by NRCS as expansive are Watsonville Loam, Clear Lake Clay, Diablo Clay, Fagan Loam, Los Osos Loam, Mocho Silt Loam, Pinto Loam, Felton Sandy Loam, Cropley Silty Clay, Danville Loam and Lompico Varient Loam. The general locations of expansive soils are in the coastal terraces in Live Oak, Seacliff and Rio Del Mar and in South County near Watsonville. However, smaller pockets of expansive soils may exist throughout the County.

FIGURE 29. EXPANSIVE SOILS WITHIN COUNTY OF SANTA CRUZ

B. Extent: Magnitude or Severity

Each year in the United States, expansive soils cause billions of dollars in damage to buildings, roads, pipelines, and other structures. This is more damage than that caused by floods, hurricanes, tornadoes, and earthquakes combined (FEMA 1997).

It is estimated that the County of Santa Cruz has thousands of homes built on expansive soils. Typically, the structures that experience problems with expansive soils are older homes, but newer homes (built within the last 15 years) may also experience problems due to expansive soils. The types of problems associated with expansive soils are generally not catastrophic, but the effects result in cracked foundations, cracked walls, cracked concrete slabs, cracks around

windows and doors, as well as jammed windows and doors. Cracks to foundations may lead to additional problems if other catastrophic events were to occur (such as earthquakes).

C. Previous Occurrences

Each year the Building Department reviews many permit applications to fix problems associated with expansive soils. The number of occurrences is difficult to measure, since property owners may consider the effects of expansive soils to be minor and therefore choose not to do anything about it.

D. Probability of Future Events

Structures in the County of Santa Cruz will continue to experience problems with expansive soils on a yearly basis as moisture conditions in soils fluctuate.

Recent revisions to the Building Codes (2007 California Building Code (CBC) Section 1802 and the 2006 International Building Code) have provided local jurisdictions with new tools to request soils reports for building permits in areas where expansive soils are suspected and have detailed procedures to determine when soils are considered expansive. In addition, Section 1805.8 of the 2007 CBC provides requirements for design for expansive soils. Therefore, over time we expect to see fewer problems with structures due to expansive soils.

12.3.3 Assessing Expansive Soils Vulnerability: Overview

3.3 Assessing Vulnerability: Overview – 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.

A. Overall Summary of Vulnerability to Expansive Soils

It is estimated that the County of Santa Cruz has over 13,000 homes built on expansive soils. Typically, the structures that experience problems with expansive soils are older homes, but newer homes (built within the last 15 years) may also experience problems due to expansive soils. The types of problems associated with expansive soils are generally not catastrophic, but the effects result in cracked foundations, cracked walls, cracked concrete slabs, cracks around windows and doors, as well as jammed windows and doors. Cracks to foundations may lead to additional problems if other catastrophic events were to occur (such as earthquakes).

12.3.4 Assessing Expansive Soils Vulnerability: Identifying Structures

3.4 Assessing Vulnerability: Identifying Structures – Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

A. Types and Numbers of Existing Buildings, Facilities and Infrastructure

Due to its unique geologic makeup, expansive soils are located mainly in the coastal areas and in agricultural areas in the southern portion of the County. Approximately 16,100 parcels are estimated to be located on expansive soils with 18,462 structures built on these parcels. These areas represent some of the most expensive real estate in the county and the estimated loss in value comes to $2,786,254,269. The majority of the loss in value is in residential areas. See table 12-1 below for specific information on the types of properties located on expansive soils.

12.3.5 Assessing Vulnerability: Estimating Potential Losses

3.5 Assessing Vulnerability: Estimating Potential Losses – Requirement §201.6(c)(2)(ii)(B): The plan **should** describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Potential Dollar Losses to Vulnerable Structures

While over 13,200 residential parcels have been identified as threatened by expansive soils, there are only 612 structures on these parcels. However, since the majority of these structures are close to the ocean, they represent a loss in value of over $2.25 billion dollars.

TABLE 12-1. EXPANSIVE SOILS POTENTIAL LOSS INVENTORY

Expansive Soils
Potential Loss Inventory
Santa Cruz County Unincorporated Areas

Land Use	Number of Parcels		Number of Structures		Loss in Value $	
Type	Total	Hazard	Total	Hazard	Total	Hazard
Agricultural	1,601	502	2,938	68	$226,819,374	$76,994,323
Commercial	1,398	553	2,359	579	$475,412,013	$248,592,243
Government	1,676	328	1,317	811	$249,122	$0
Industrial	215	112	473	330	$104,713,461	$60,850,594
Institutional	174	78	397	128	$185,873,022	$121,592,972
Miscellaneous	12,478	1,228	2,381	147	$16,039,420	$2,312,825
Residential	43,024	13,206	52,604	612	$7,721,059,332	$2,275,589,359
Utilities	515	93	195	15,734	$1,357,002	$321,953
				53		
Total	61,081	16,100	62,664	18,462	$8,731,522,746	$2,786,254,269

	Total Unincorporated	Hazard Area
Population	133,891	40,655

B. Methodology Used to Prepare Estimate

Parcel Valuation

Valuations of parcels within a hazard area are based on improvement values only as collected by appraisers with the County of Santa Cruz Assessor's Office. They don't reflect sale value or

replacement value. If a parcel intersected a hazard, the entire improvement value of that parcel was used.

Population

Census population blocks were reduced to center points. If a hazard intersected a center point, that population was counted.

12.3.6 Assessing Vulnerability: Analyzing Development Trends

3.6 Assessing Vulnerability: Analyzing Development Trends – 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.

A. Description of Land-Uses and Development Trends

The County of Santa Cruz has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As dictated by the 1978 Growth Management Ordinance, most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs have resulted in the need to provide higher density housing. In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

Since expansive soils exist both within and outside of the urban services line, mitigation of expansive soils must be looked at on a countywide basis with a focus on the areas of known expansive soils.

12.4.0 Mitigation Strategy

4.0 Mitigation Strategy: Requirement §201.6(c)(3): The plan **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.

Mitigation strategy includes:

- Continuation of review of building permit applications to require identification and mitigation of expansive soils as required per the 2007 California Building Code.
- Pursue an effective public information program and continuing collaborative efforts with the cities, agencies and community organizations to facilitate collaborative efforts in providing expansive soil mapping, information, and education.

12.4.1 Mitigation Goals

4.1 Local 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.

The County of Santa Cruz has developed several expansive soils mitigation goals to decrease the problems associated with expansive soils.

Expansive Soils 1 – Education and Awareness

Train building plan check staff on expansive soils. Provide public information and education/awareness to all residents of the County concerning expansive soil areas and mitigation efforts.

Expansive Soils 2 – Preventative and Implementation

Develop and implement activities to protect properties and infrastructure.

Expansive Soils 3 – Funding And Partnerships

Seek partnerships in funding and resources for future mitigation efforts.

12.4.2 Identification and Analysis of Mitigation Actions

4.2 Identification and Analysis of Mitigation Actions – 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.

Expansive Soils Mitigation Actions

The County participates in a number of ongoing mitigation actions to avoid or reduce the effects of expansive soils. These measures are listed under the Part 4 Mitigation Strategy. Actions include:

- Continue to require soils reports as part of the building permit process (B-13)
- Develop design criteria for expansive soils properties (C-21)

CHAPTER 13 — MULTI-HAZARD SUMMARY

Any of the hazards that threaten Santa Cruz County could happen in combination with another hazard. In fact, there is a high likelihood that a major earthquake on the San Andreas or other faults would unleash secondary hazards that could be as disastrous to Santa Cruz as the earthquake itself. A reference point for the Bay Area is the devastating fire in 1906 that burned down San Francisco, causing significantly more destruction than the earthquake that sparked it.

Earthquake shaking can start fires in numerous ways, such as tipping over appliances with pilot lights or damaging electrical equipment leading to sparks. Ruptured gas lines, both underground and where they connect to houses, or spilled flammable chemicals can cause post-earthquake fires to spread quickly. Efforts to fight fires after an earthquake are often severely hampered by non-functional water systems, damaged electrical systems that are needed to provide energy to pump water, or roads blocked by debris or landslides. These problems coincide with fire personnel being required for search and rescue activities and other disaster response activities.

Santa Cruz County may also experience landslides during the next earthquake, particularly if the earthquake occurs during rainy winter months. Small aftershocks could continue to cause slides for weeks after a quake, blocking roads and damaging homes. In addition, the next earthquake may cause significant damage to the county's water supply (some of which is located in a mountainous slide prone area) and storm drain systems.

Although the risk is very low, an earthquake has the potential to cause dam failure. Breaks in the dams, levees and stream culverts could lead to catastrophic flooding in areas that have not seen floodwaters previously.

Drought increases the risk of wildfires, and wildfires increase the risk of landslide and flood. When all supporting vegetation is burned away, hills become destabilized and prone to erosion. The charred surface of the earth becomes hard and absorbs less water during rainfall, leading to increased runoff resulting in more rapid coastal erosion.

Many mitigation activities reduce risk from more than one hazard. However, there are some mitigation activities that reduce risk from one possible threat while increasing it from another. One example is placing utility lines underground. Underground utilities are less damaged by a major fire than those aboveground. In an earthquake, under-ground utilities in areas prone to landslides or liquefaction are susceptible to damage and are more costly and time-consuming to repair than aboveground utilities. Another example of a mitigation activity with positive and negative impacts is vegetation removal for wildfire risk reduction. Trees and other established plants play a key role in securing hillsides and reducing landslide risk. They also reduce erosion and slow rain runoff time, which reduces flood peaks. It is important to remember all of the implications of any risk reduction steps when planning mitigation activities.

PART 4 – MITIGATION STRATEGY

Mitigation Strategy

- Goals
- Objectives
- Actions

CHAPTER 14 — MITIGATION STRATEGY

4.4.0 MITIGATION STRATEGY

4.0 Mitigation Strategy: Requirement §201.6(c)(3): The plan **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.

The County of Santa Cruz endeavors to be a disaster-resistant community that can survive and recover from a disaster while preserving the diversity and quality of its natural and built environments. The community strives to offer excellent cultural and community services as well as maintain and improve infrastructure, community safety and emergency preparedness. This Local Hazard Mitigation Plan (LHMP) is a part of this effort.

The County of Santa Cruz has developed a range of policies and programs to act as a "blueprint" for the Hazard Mitigation Strategy. Strategies include "everyday operations" that also contribute to reducing the impact of future hazards as well as specific hazard mitigation projects. While County efforts are focused on evaluation and improvement of County owned structures, particularly those identified as critical facilities, the plan also encourages the establishment of standards to encourage private property owners to upgrade the hazard resistance of their own properties. Finally, the County is actively engaged with other local and regional organizations to collaboratively work towards mitigation actions that meet the County of Santa Cruz's objective of being a disaster resistant community while striving to preserve the quality of its natural and built environments.

This plan focuses on mitigation goals and actions, meaning activities that occur prior to a hazard event that reduce or avoid damage when disasters strike. Damage prevention includes structural improvements to existing buildings, land use decisions that will minimize damage and ongoing programs such as vegetation reduction in wildland/urban interface areas. This plan does not include emergency response activities. The County of Santa Cruz has an Emergency Management Plan (EMP) to help coordinate information and resources for disasters or threat of disasters. As a part of the EMP annual training, critical information updates and drills are conducted to protect people and property. However, the EMP does inform this Hazard Mitigation Plan and can be accessed at http://sccounty01.co.santa-cruz.ca.us/oes/plans.htm.

Goals

Goals are general guidelines that explain what is to be achieved. They are broad-based, policy-type statements, which are long-term, and represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the LHMP, once implemented, should be measured by the degree to which its goals have been met.

The County of Santa Cruz LHMP team held several meetings to review the identified risks and developed goals, objectives and actions based on the risk assessment. Goals which provided the greatest benefit in hazard reduction were identified as primary goals.

Additional goals, specifically related to each identified potential hazard are presented under

each hazard heading.

The Local Hazard Mitigation Plan has four primary mitigation goals:

1. Avoid or reduce the potential for life loss, injury and economic damage to Santa Cruz residents from hazard events;
2. Increase the ability of the county government to serve the community during and after hazard events;
3. Protect the unique character, scenic beauty and values in the natural and built environment from being compromised by hazard events;
4. Encourage mitigation activities to increase the disaster resilience of institutions, private companies and systems essential to a functioning County of Santa Cruz.

Objectives

The LHMP team selected the objectives listed below to meet multiple goals. The objectives serve as a stand-alone measurement of a mitigation action rather than as a subset of a goal. Achievement of the objectives is a measure of the effectiveness of a mitigation strategy. The objectives are also used to help establish priorities.

Objectives are defined as short-term aims which, when combined, form a course of action to meet a goal. Unlike goals, objectives are specific and measurable.

The County of Santa Cruz Local Hazard Mitigation Team identified this list of objectives:

1. Consider the impacts of hazards on future land use decisions in the County of Santa Cruz by coordinating with other planning mechanisms including the General Plan and land use code developments.
2. Protect and sustain reliable local emergency operations and communication facilities during and after a disaster.
3. Develop new or enhance existing early warning response systems.
4. Seek to enhance emergency response capabilities through improvements to infrastructure and County programs.
5. Seek mitigation projects that provide the highest degree of hazard protection at the least cost.
6. Seek to update information on hazards, vulnerabilities, and mitigation measures by coordinating planning efforts and creating partnerships with appropriate local, state and federal agencies.
7. Seek to implement codes, standards, and policies that will protect life, property and quality of life including environmental, historic and cultural resources from the impacts of hazards within the County of Santa Cruz.
8. Educate the community on preparedness for and mitigation of potential impacts of hazards to the County of Santa Cruz.
9. Encourage retrofit, purchase, or relocation of structures in high hazard areas, including those known to be repetitively damaged.

Identification and Analysis of Mitigation Actions

Identification of Actions

The Local Hazard Mitigation Goals were enumerated above. In support of those goals, the County of Santa Cruz has identified a number of hazard mitigation actions. This set of actions was developed through an inclusive community process. The LHMP team, with input from the County of Santa Cruz General Plan Update, the Emergency Management Plan, the Capital Improvement Program, the 2005 Urban Water Management Plan and the Santa Cruz Integrated Water Plan as well as other agencies and community members, has selected the following actions as the most beneficial for the County of Santa Cruz. These actions represent the highest priority mitigation actions identified for each hazard or for a multi-hazard event**.**

These mitigation actions have proven effective in reducing or eliminating hazard risk. Each of these actions directly meets an objective or goal listed in the County of Santa Cruz Hazard Mitigation Strategy. These actions are not meant to be exhaustive but rather to inspire thought and provide each department of the County of Santa Cruz with a role in hazard mitigation and a baseline of actions backed by a planning process, consistent with the goals and objectives and within the capabilities of the County. The County departments were not bound to the list of alternatives presented. They were given the opportunity to edit the list. Actions not included in the action plan were eliminated based on the following:

- Action is currently outside the scope of the defined priority rankings
- County's jurisdiction is not vulnerable to the hazard
- Action has already been implemented
- Estimated cost exceeded estimated benefit

Prioritization of Actions

This Plan promotes 49 action items. The list below summarizes all of the actions, identifies the hazard(s) each one addresses, and indicates the assigned priority level of the action. The actions were prioritized in the same way that they were identified. The team leaders proposed an initial prioritization system, dividing the actions into categories of ***Very High Priority, High Priority,*** and ***Important***. County staff, committee and community members were given an opportunity to review these categorizations.

Many factors were considered when assigning priorities. First, only those actions with strong community support were given Very High or High priority ratings. Second, those hazards presenting the highest risk to Santa Cruz County were given priority. The loss estimates presented in section five of this Plan show that earthquakes, floods and tsunami's have the most potential to cause great economic and human losses. Water is essential to the survival of the County so drought and threats to the water system were also ranked as High or very High Priority. Finally, availability of funding (identified in the Capital Improvement Program or other source) was a determining factor in priority determination.

Section 201.c.3.iii of Title 44 of the *Code of Federal Regulations* requires that an action plan describe how actions identified were prioritized. The planning team has developed a prioritization methodology for the action plan that meets the needs of the County while at the same time meeting the requirements of Section 201.6 of Title 44 of the *Code of Federal*

Regulations. The mitigation strategies identified were prioritized according to the criteria defined below.

Very High Priority

- A project that meets multiple plan objectives
- Benefits exceed cost
- Has strong community support
- Addresses those hazards presenting the highest risk
- Funds are identified or potentially available
- Project can be completed in one to five years once project is funded.

High Priority

- Project meets at least one plan objective
- Benefits exceed costs
- Funding has not been secured
- Project can be completed in one to five years once project is funded

Important

- Project mitigates the risk of a hazard
- Benefits exceed costs
- Funding has not been identified and/or timeline for completion is considered long-term (five to ten years)

A formal cost benefit analysis has not been done. However, in reviewing the mitigation actions proposed, the costs and benefits of each action were considered under the following rating :

Cost Ratings

High:	Existing funding levels are not adequate to cover the costs of the proposed project and would require an increase in revenue through an alternative source (e.g. bonds, grants, and fee increases) to implement.
Medium:	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low:	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.

Benefit Ratings

High:	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium:	Project will have a long-term impact on the reduction of risk exposure to life and property or project will provide an immediate reduction in the risk exposure to property.
Low:	Long-term benefits of the project are difficult to quantify in the short-term.

In recent years, and in response to the 1989 Loma Prieta earthquake, the County of Santa Cruz has made significant progress through efforts to reduce risk in public buildings, fire stations, major municipal facilities and public schools. This plan will continue these efforts and expand them throughout the community. These efforts will protect future generations from the

devastation of natural hazards experienced by the residents of Santa Cruz County in the past.

The County will pursue the implementation of these actions to meet the goals set out above. The Very High and High priority actions will be conducted actively over the next three to five years as funding becomes available.

Very High Priority

A= Very High Priority Action

#	Action	Hazard	Responsible Department	Timeline
A-1	Coordinate preparedness efforts with other agencies and cities within the county	All Hazards	OES	Ongoing
A-2	Create a policy interpretation for calculating "Substantial Improvement" more effectively in the floodplain	Flood	Planning Dept.	2009-10 fiscal year
A-3	Apply for and participate in the Community Rating system to improve floodplain management	Flood	Planning Dept.	2010-2011
A-4	Evaluate the effectiveness of current policies and ordinances designed to limit storm water runoff and recommend revisions to improve the effectiveness of these policies.	Flood	Planning Dept.	2010-2011
A-5	Evaluate the effectiveness of current drainage plan requirements	Flood	Planning Dept. Dept. of Public Works	2010-2011
A-6	Develop a "Stormwater Facilities Master Plan" for Flood control Districts 5 & 6	Flood	Dept. of Public Works	2010-2012
A-7	Implement water conservation efforts to maximize the use of existing water resources	Drought	Environmental Health	Ongoing
A-8	Support the development of additional water supplies	Drought	Environmental Health	Ongoing
A-9	Promote more effective use of groundwater storage through increased groundwater recharge and conjunctive use among agencies	Drought	Environmental Health	Ongoing
A-10	Coordinate a communication system with other agencies and cities, including evacuation operations, for homes and businesses within specific areas	Multi-hazards	OES	2010-2012
A-11	Update dam inundation maps	Dam failure	Planning	2010-2011
A-12	Establish and maintain cooperative	Wildfires	CalFire	2011-2012

	fire protection and fire prevention agreements with other agencies			
A-13	Improve road signs and address marking to increase visibility and reduce response times	Wildfires	CalFire	Ongoing
A-14	Enhance support for interoperability communications system with local, state and federal emergency services	All hazards	OES	Ongoing

High Priority

B = High Priority Action

#	Action	Hazard	Responsible Department	Timeline
B-1	Upgrade roadways, sewer, water and other infrastructure to withstand seismic shaking	Earthquake	Dept. of Public Works	Ongoing
B-2	Review and revise California Environmental quality Act (CEQA) Initial Study checklist to ensure storm water runoff is fully mitigated	Flood	Planning	2010-2015
B-3	Reduce fire risk in urban/wildland interface (WUI) by advocating use of improved building materials and appropriate code enforcement, including defensible space and fuel reduction programs	Wildfire	CalFire	Ongoing
B-4	Maintain adequate Fire Suppression and Prevention staffing levels to meet the needs of the county residents and development trends	Wildfire	CalFire	Ongoing
B-5	Seek funding to develop, adopt, update and revise the Geologic Hazards Ordinance	Flood	Planning Dept.	2010-2015
B-6	Pursue elevation of structures to raise them above the 100-year flood level	Flood	Planning Dept.	Ongoing
B-7	Continue to enforce requirements for on-site retention of storm water runoff from impervious surfaces for all new development in the Groundwater Recharge Zone and the Water Supply Watershed Zone	Flood	Dept. of Public Works	Ongoing
B-8	Management of early warning system	Tsunami	OES.	Ongoing
B-9	Update tsunami maps	Tsunami	Planning	2011
B-10	Protect and preserve the coastline through permit review and continue	Coastal Erosion	Planning Dept.	Ongoing

	to review coastal development for conformance with the County's Geologic Hazards ordinance			
B-11	Encourage the replacement of existing seawalls with shoreline protection structures which meet current engineering practice	Coastal Erosion	Planning Dept.	Ongoing
B-12	Develop an event protocol with the State Division of Safety of Dams	Dam Failure	Planning Dept.	2010-2012
B-13	Continue to require soils reports as part of the building permit process	Expansive Soils	Planning Dept.	Ongoing

Important

C= Important Action

#	Action	Hazard	Responsible Department	Timeline
C-1	Promote seismic safety upgrade of all emergency use and critical structures	Earthquake	Planning Dept.	2011-2012
C-2	Require all new and replacement critical structures be designed to standards of the California building Code and County Geologic Hazard Code	Earthquake	Planning Dept.	Ongoing
C-3	Train appropriate plan check staff on seismic requirements for structures	Earthquake	Planning Dept.	Ongoing
C-4	Encourage zoning in geologically constrained areas that reflect the nature and extent of the seismic hazard	Earthquake	Planning Dept.	Ongoing
C-5	Implement additional fire prevention programs through inspections and education	Wildfire	CalFire	Ongoing
C-6	Promotion of built-in fire extinguishing systems and fire alarm systems	Wildfire	CalFire	Ongoing
C-7	Promote land use planning which will reduce incidence of human caused wildfires especially in very high hazard areas	Wildfire	CalFire	Ongoing
C-8	Advocate for creation of secondary road access improvement	Wildfire	CalFire	Ongoing
C-9	Continue to inspect and maintain drainage system infrastructure	Flood	Public Works	Ongoing
C-10	Develop public education materials on flood protection and mitigation by working collaboratively with	Flood	Planning	2010-2015

	community groups, non-governmental organizations and the local media			
C-11	Regulate development in flood zones to optimize preservation of open space through the application of the Geologic Hazards Ordinance and Open Space Preservation policies	Flood	Planning	Ongoing
C-12	Limit development and monitor conditions of development and grading permits near natural channels and wetlands to prevent sedimentation.	Flood	Planning and Dept. of Public Works	Ongoing
C-13	Promote drought planning by the 130 small water systems under county jurisdiction	Drought	Environmental Health	Ongoing
C-14	Encourage investigation of tsunami threat to the county and update development regulations based upon the best available information	Tsunami	Planning	Ongoing
C-15	Protect and preserve the coastline and infrastructure through restoration efforts	Coastal Erosion	Planning Dept. and Dept. of Public Works	Ongoing
C-16	Update dam inundation maps	Dam Failure	Planning Dept.	2010-2015
C-17	Review dam evaluation files to determine the extent of potential dam failures	Dam Failure	Planning Dept.	2010-2015
C-18	Continue to require that the County Geologist review development in areas of suspected landsliding and require engineering geology reports when landsliding is identified or suspected	Landslide	Planning Dept.	Ongoing
C-19	Continue to require that an engineering geologist and/or geotechnical engineer investigate the site of any proposed construction near landsliding and require mitigation of landslide hazards before issuing any building or grading permit	Landslide	Planning	Ongoing
C-20	Continue to require that an engineering geologist and a geotechnical engineer investigate any landslide damage to homes or roadways before repair of the landslide and reuse of the homes or roadways	Landslide	Planning	Ongoing

C-21	Develop design criteria for areas of known expansive soils	Expansive Soils	Planning	Ongoing
C-22	Plan for climate change	Multi-hazards	Public Health, Planning, OES	Ongoing

Very High Priority Actions	
A-1	**Emergency Preparedness Coordination**
Proposed Activity	Continue to participate in the Emergency Management Council by planning, implementing and evaluating pre-event activities including ongoing training for county staff
Hazard	All
Environmental Concerns	None
Lead Dept.	Office of Emergency Services
Timeline	Ongoing
Resources Required	Staff time
Funding Source	General Fund
Priority	Very High

A-2	**Flood Policy Change**
Proposed Activity	Create a policy interpretation for calculating “Substantial Improvement” more effectively n the floodplain
Hazard	Flood
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time
Funding Source	General Fund
Priority	Very High

A-3	**Community Rating System Application**
Proposed Activity	Apply for and participate in the Community Rating System to improve floodplain management
Hazard	Flood
Environmental Concerns	Riverine and wetlands
Lead dept.	Planning
Timeline	2010-2011
Resources Required	Staff Time
Funding source	General Fund
Priority	Very High

A-4	**Stormwater Policy and Ordinance Evaluation**
Proposed Activity	The County shall evaluate the effectiveness of current policies and ordinances designed to limit storm water runoff and flooding and, if needed, recommend revisions to improve effectiveness of these policies and codes
Hazard	Flood
Environmental Concerns	Riverine areas and ocean
Lead Dept.	Planning and Public Works
Timeline	2010-2011
Resources Required	Staff time
Funding Source	General Fund
Priority	Very High

A-5	**Drainage Plan Evaluation**
Proposed Activity	The county shall evaluate the effectiveness of the current drainage plan requirements to ensure that storm water runoff from impervious surfaces does not contribute to flooding and, if needed, revise permit conditions of approval
Hazard	Flood
Environmental Concerns	Riverine areas and ocean
Lead Dept.	Planning
Timeline	2010-2011
Resources Required	Staff Time
Funding Source	General Fund
Priority	Very High

A-6	**Stormwater Control**
Proposed Activity	Develop a “Stormwater Facilities Master Plan” for Flood control Districts 5 & 6
Hazard	Flood
Environmental Concerns	None
Lead Dept.	Dept. of Public Works
Timeline	2010-2012
Resources Required	Staff Time
Funding Source	Staff Budget
Priority	Very High

A-7	**Water Conservation**
Proposed Activity	Implement water conservation programs to maximize the use of existing water resources
Hazard	Drought
Environmental Concerns	None
Lead Dept	Environmental Health
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	Very High

A-8	**Develop Additional Water Supplies**
Proposed Activity	Support the development of additional water supplies and promote more effective use of groundwater storage through increased groundwater recharge and conjunctive use among agencies
Hazard	Drought
Environmental Concerns	Agricultural and community concerns
Lead Dept.	Environmental Health
Timeline	2010-2015
Resources Required	Staff time
Funding Source	Staff budget
Priority	Very high

A-9	**Drought Protection**
Proposed Activity	Promote more effective use of groundwater storage through increased groundwater recharge
Hazard	Drought
Environmental Concerns	None
Lead Dept.	Environmental Health
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	Very High

A-10	**Early Notification\ Warning Systems**
Proposed Activity	Coordinate a communication system with other agencies and the cities of Santa Cruz, Watsonville and Capitola, including evacuation operations, for homes and businesses in specific hazard areas
Hazard	Multi-Hazards
Environmental Concerns	None
Lead Dept.	OES, CalFire
Timeline	2010-2015
Resources Required	Staff time
Funding Source	Federal and state grants
Priority	Very High

A-11	**Protection from Dam Failure**
Proposed Activity	Update dam inundation maps
Hazard	Dam Failure
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2011
Resources Required	Staff time
Funding Source	Staff budget
Priority	Very High

A-12	**Fire Protection and Prevention**
Proposed Activity	Establish and maintain fire protection and prevention agreements with other agencies
Hazard	Wildfire
Environmental Concerns	None
Lead Dept.	CalFire, OES
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	Very High

A-13	**Reduction of Emergency Response Times**
Proposed Activity	Improve road signage visibility and address markings
Hazard	Multi-Hazard
Environmental Concerns	None
Lead Dept.	CalFire, Dept. of Public Works
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget, general fund
Priority	Very High

A-14	**Communications Interoperability**
Proposed Activity	Enhance support for interoperability of communications system with local, state and federal emergency services
Hazard	All Hazards
Environmental Concerns	None
Lead Dept.	OES, CalFire
Timeline	Ongoing
Resources Required	Staff time, new equipment
Funding Source	State and Federal grants
Priority	Very High

High Priority Actions	
B-1	**Infrastructure Upgrades**
Proposed Activity	Upgrade roadways, sewer, water and other infrastructure to withstand seismic shaking
Hazard	Earthquake
Environmental Concerns	Geologic and hydrologic
Lead Dept.	Dept. of Public Works
Timeline	Ongoing
Resources Required	External funding required, consultants, staff time
Funding Source	Federal and State grants, General Fund
Priority	High

B-2	**Review Stormwater Runoff Regulations**
Proposed Activity	Review and revise California Environmental Quality Act (CEQA) Initial Study checklist to ensure that storm water runoff is fully considered and mitigated to the extent possible
Hazard	Flood
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2011
Resources Required	Staff time
Funding Source	Staff budget
Priority	High

B-3	**Wildfire Hazard Abatement**
Proposed Activity	Reduce fire risk in wildland/urban interface (WUI) by advocating use of improved building materials and appropriate code enforcement, including defensible space and fuel break and reduction programs
Hazard	Wildfire
Environmental Concerns	Stream sedimentation
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget and additional grants
Priority	High

B-4	**Adequate Staffing**
Proposed Activity	Maintain adequate Fire Suppression and Prevention staffing levels to meet the needs of the county
Hazard	Wildfire
Environmental Concerns	None
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Additional staff
Funding source	Unknown
Priority	High

B-5	**Geologic Hazards Ordinance Update**
Proposed Activity	Seek funds to update and revise the Geologic Hazards Ordinance
Hazard	Multi- Hazard
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time, consultants
Funding Source	Federal and State Grants
Priority	High

B-6	**Elevation of Structures in Floodplain**
Proposed Activity	Continue to pursue elevation of structures above level of 100-year flood
Hazard	Flood
Environmental Concerns	Sedimentation
Lead Dept.	Planning, OES
Timeline	Ongoing
Resources Required	Staff time, technical studies, building materials
Funding Source	Federal and State grants, permit application fees
Priority	High

B-7	**Stormwater Management**
Proposed Activity	Continue to enforce requirements for on-site retention of storm water
Hazard	Flood
Environmental Concerns	Sedimentation
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Permit application fees
Priority	High

B-8	**Management of Early Warning System**
Proposed Activity	Define public information process including establishing a reverse 911 system that will notify all homes and businesses within tsunami inundation areas and develop media protocol for evacuation notices
Hazard	Tsunami
Environmental Concerns	Water inundation of homes, businesses and resulting losses of life and property, sedimentation, contamination of water channels
Lead Dept.	OES, multiple agencies
Timeline	Ongoing
Resources Required	Staff time
Funding Sources	FEMA Grant funds
Priority	High

B-9	**Minimize Risk from Tsunami**
Proposed Activity	Update tsunami inundation maps
Hazard	Tsunami
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time
Funding Source	Staff budget
Priority	High

B-10	**Protect and Preserve Coastline**
Proposed Activity	Protect and preserve coastline through permit review process
Hazard	Coastal Erosion
Environmental Concerns	Coastal Commission review, community concerns
Lead Dept	Planning, Dept. of Public Works
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	High

B-11	**Protect Coastline and Infrastructure**
Proposed Activity	Encourage replacement of existing seawalls with shoreline protection structures which meet current engineering standards
Hazard	Coastal Erosion
Environmental Concerns	Coastal Commission, community concerns
Lead Dept.	Planning, Public Works
Timeline	2010-2015
Resources Required	Staff time, consultants
Funding Source	Federal and State grants
Priority	High

B-12	**Minimize Risk from Dam Failure**
Proposed Activity	Develop an event protocol with the State Division of Safety of Dams
Hazard	Dam Failure
Environmental Concerns	Flooding
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff Time
Funding Source	Staff budget
Priority	High

B-13	**Minimize Risks from Expansive soils**
Proposed Activity	Continue to require soils reports as part of the building permit process
Hazard	Expansive soils
Environmental Concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	High

Important Actions	
C-1	**Protection of Critical Structures**
Proposed Activity	Promote seismic safety upgrade of all emergency use and critical structures
Hazard	Earthquake
Environmental Concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time and outside consultants
Funding Source	Staff budget and unknown grants
Priority	Important

C-2	**Critical Structural Safety**
Proposed Activity	Require all new and replacement critical structures be designed to standards of the California building code and the county's Geologic Hazards Code
Hazard	Earthquake
Environmental Concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding source	Staff budget
Priority	Important

C-3	**Training for Planning Staff**
Proposed Activity	Train appropriate plan check staff on seismic requirements for structures
Hazard	Earthquake
Environmental Concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time, training consultant
Funding Source	Staff budget, unknown grants
Priority	Important

C-4	Seismic Zoning
Proposed Activity	Encourage zoning in geologically constrained areas that reflect the nature and extent of the seismic hazard
Hazard	Earthquake
Environmental Concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding source	Staff budget
Priority	Important

C-5	Fire Safety and Prevention Programs
Proposed Activity	Implement additional fire prevention programs in schools, institutions, and commercial buildings through inspections and education
Hazard	Wildfire
Environmental Concerns	None
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget, grants
Priority	Important

C-6	Promote Alarm and Fire Retardant Systems
Proposed Activity	Promote installation, inspection, and testing of built-in fire alarm and sprinkler systems
Hazard	Wildfire
Environmental Concerns	None
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Permit Fees
Priority	Important

C-7	WUI Land Use Planning
Proposed Activity	Promote land use planning to reduce incidence of human-caused wildfires
Hazard	Wildfire
Environmental Concerns	None
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Staff Time
Funding Source	Staff budget
Priority	Important

C-8	**Emergency Personnel Road Access**
Proposed Activity	Advocate for creation of secondary road access improvement
Hazard	Wildfire
Environmental Concerns	Code compliance
Lead Dept.	CalFire
Timeline	Ongoing
Resources Required	Staff time
Funding source	Staff budget
Priority	Important

C-9	**Drainage system Infrastructure Integrity**
Proposed Activity	Continue to inspect and maintain drainage system infrastructure
Hazard	Flood
Environmental Concerns	Sedimentation, property damage
Lead Dept.	Public Works
Timeline	Ongoing
Resources Required	Staff time, consultant, repair funds
Funding Source	Federal and State grants
Priority	Important

C-10	**Flood Mitigation Education**
Proposed Activity	Develop public education materials by working collaboratively with community groups, non-governmental organizations and the local media
Hazard	Flood
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time
Funding Source	Federal and State grants
Priority	Important

C-11	**Open Space in Flood Zones**
Proposed Activity	Regulate development in flood zones to optimize preservation of open space
Hazard	Flood
Environmental Concerns	Community concerns
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	Important

C-12	Flood Zone Development Regulation
Proposed Activity	Limit development and monitor conditions of development and grading permits near natural channels and wetlands to prevent sedimentation
Hazard	Flood
Environmental concerns	Sedimentation
Lead Dept.	Planning, Public Works
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Permit fees
Priority	Important

C-13	Promote Drought Planning
Proposed Activity	Promote drought planning by the 130 small water systems under county jurisdiction
Hazard	Drought
Environmental Concerns	None
Lead Dept.	Environmental Health
Timeline	Ongoing
Resources Required	Staff time, consultant
Funding Source	Federal and state grants
Priority	Important

C-14	New Regulations in Tsunami Inundation Areas
Proposed Activity	Encourage investigation of the tsunami threat to the county and update development regulations based upon this investigation
Hazard	Tsunami
Environmental concerns	None
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Federal and state grants
Priority	Important

C-15	Restoration of Coastline
Proposed Activity	Protect and preserve the coastline and infrastructure through restoration efforts
Hazard	Coastal Erosion
Environmental Concerns	Coastal Review Commission, community concerns
Lead Dept.	Public Works
Timeline	Ongoing
Resources Required	Staff time, consultant, repair costs unknown
Funding Source	Federal and State grants
Priority	Important

C-16	**Update Inundation Maps**
Proposed Activity	Update dam inundation maps
Hazard	Dam Failure
Environmental Concerns	Flooding
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time
Funding Source	Staff budget
Priority	Important

C-17	**Review Dam Hazards**
Proposed Activity	Review dam evaluation files to determine the extent of potential dam failures
Hazard	Dam Failure
Environmental concerns	Flooding
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time
Funding source	Staff budget state grants
Priority	Important

C-18	**Minimize Landslide Risk**
Proposed Activity	Continue to require that the county geologist review development in areas of suspected landsliding and require engineering reports when landsliding is identified or suspected
Hazard	Landslide
Environmental Concerns	Loss of property and life
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget
Priority	Important

C-19	Landslide Regulations
Proposed Activity	Continue to require that an engineering geologist and/or geotechnical engineer investigate the site of any proposed construction near landsliding and require mitigation of landslide hazards before issuing any building or grading permits
Hazard	Landslide
Environmental Concerns	Loss of property and life
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Staff budget, permit fees
Priority	Important

C-20	Landslide Inspections
Proposed Activity	Continue to require that an engineering geologist and/or a geotechnical engineer investigate any landslide damage to homes or roadways before repair of the landslide and reuse of the homes or roadways
Hazard	Landslide
Environmental Concerns	Loss of property and life
Lead Dept.	Planning
Timeline	Ongoing
Resources Required	Staff time
Funding Source	Permit fees
Priority	Important

C-21	Minimize Damage from Expansive Soils
Proposed Activity	Develop design criteria for areas of known expansive soils
Hazard	Expansive soils
Environmental Concerns	None
Lead Dept.	Planning
Timeline	2010-2015
Resources Required	Staff time, consultant
Funding Source	General Fund, Federal and state grants
Priority	Important

C-22	**Climate Change**
Proposed Activity	Address climate change in Public Health Preparedness Plan Update, General Plan Update and other pertinent plans in order to implement policies and programs to reduce impact of climate change
Hazard	Multi-Hazards
Environmental concerns	Carbon footprint, communicable diseases
Lead Dept.	Public Health, Planning, OES
Timeline	Ongoing
Resources Requested	Staff time
Funding Source	Federal and state grants
Priority	Important

PART 5 – PLAN MAINTENANCE PROCESS

- Monitoring, Evaluating and Updating the Plan
- Incorporation into Existing Planning Mechanisms
- Continued Public Involvement

15.5.1 Monitoring, Evaluating and Updating the Plan

5.1 Identification and Analysis of Mitigation Actions – 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.

Title 44 of the *Code of Federal Regulations* (CFR) Section 201.6(c)(4)(i) requires a hazard mitigation plan to include a plan maintenance process that includes the following:

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
- 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.
- A discussion on how the community will continue public participation in the plan maintenance process.

The plan maintenance section of this document details the formal process that will ensure that the County of Santa Cruz hazard mitigation plan (LHMP) remains an active and relevant document. The LHMP maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how the County will integrate public participation throughout the plan maintenance and implementation process. Finally, this chapter explains how the County intends to incorporate the mitigation strategies outlined in this LHMP into existing planning mechanisms and programs, such as the County General Plan, Capital Improvement Program, as well as building code enforcement and implementation. The LHMP's format allows the County to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a plan that will remain current and relevant to the County of Santa Cruz.

Evaluation of the Plan

The minimum task of the ongoing annual hazard mitigation planning team meeting will be the evaluation of the progress of the LHMP and incorporating the actions into other plans. This review will include the following:

- Summary of any hazard events that occurred during the prior year and their impact on the community.
- Review of successful mitigation initiatives identified in the LHMP.
- Brief discussion about why targeted strategies were not completed.
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short- term project because of funding availability).
- Recommendations for new projects.
- Changes in or potential for new funding options (grant opportunities).
- Integration of new data such as GIS data and mapping used to inform the Plan.
- Impact of any other planning programs or initiatives within the County that involve hazard mitigation.

The planning team will create a template to guide the LHMP committee in preparing a progress report. The planning team will also prepare a formal annual report on the progress of the LHMP. This report will be used as follows:

- Distributed to Department Heads for review.
- Posted on the County website on the page dedicated to the LHMP.
- Provided to the local media through a press release.
- Presented in the form of a board report to the Board of Supervisors.
- Provided as part of the Community Rating System (CRS) annual re-certification package once the County receives its CRS Rating (currently in progress). *The CRS program requires an annual recertification to be submitted every year*. To meet this recertification timeline, the planning team will strive to complete this progress report prior to the CRS recertification.

Method and Schedule for Updating the Plan within 5 years

Section 201.6.(d)(3) of Title 44 of the *Code of Federal Regulations* requires that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under the Disaster Mitigation Act (DMA). The County of Santa Cruz intends to update the LHMP on a five-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts the County of Santa Cruz.
- A hazard event that causes loss of life.

It will not be the intent of this update process to start from scratch and develop a new complete hazard mitigation plan for the County of Santa Cruz. Based on needs identified by the planning team, this update will, at a minimum, include the elements below:

- The update process will be convened through a committee appointed by the Planning Director and will consist of at least one member of the General Plan Update committee or staff to insure consistency between plans.
- The hazard risk assessment will be reviewed and updated using best available information and technologies on an annual basis.
- The evaluation of critical structures and mapping will be updated and improved as funding becomes available.
- The action plan will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new county policies identified under other planning mechanisms, as appropriate (such as the General Plan).
- The draft update will be sent to appropriate agencies for comment.
- The public will be given an opportunity to comment prior to adoption.
- The Santa Cruz County Board of Supervisors will adopt the updated plan.

Implementation Through Existing Programs

The effectiveness of the County's non-regulatory LHMP depends on the implementation of the plan and incorporation of the outlined action items into existing County plans, policies, and programs. The LHMP includes a range of action items that, if implemented, would reduce loss from hazard events in the County of Santa Cruz. Together, the action items in the LHMP provide the framework for activities that the County can choose to implement over the next five years. The planning team has prioritized the plan's goals and identified actions that will be implemented (resources permitting) through existing plans, policies, and programs.

The Planning Department has taken on the responsibility for overseeing the plan's implementation and maintenance through the County's existing programs. The Director of Planning or designated appointee will assume lead responsibility for facilitating LHMP implementation and maintenance meetings. Although the Planning Department will have primary department responsibility for review, coordination, and promotion, plan implementation and evaluation will be a shared responsibility among all departments identified as lead departments in the mitigation action plan. The Planning Department will continue to work closely with the Emergency Operations Manager to insure consistency in Plans.

15.5.2 Incorporation into Existing Planning Mechanisms

5.2 Identification and Analysis of Mitigation Actions – 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 the comprehensive or capital improvement plans when appropriate.

A. Planning Mechanisms for Incorporating the Requirements of the Plan

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best information and technology available at the time the LHMP was prepared. As previously stated, the County's general plan is considered to be an integral part of this plan. The County, through adoption of its 1994 General Plan (safety element) goals, has planned for the impact of natural hazards. The LHMP process provided the County with the opportunity to review and expand on policies contained within the general plan. The County views the General Plan and the LHMP as complementary planning documents that work together to achieve the ultimate goal of the reduction of risk exposure to the citizens of Santa Cruz. Many of the ongoing recommendations identified in the mitigation strategy are programs recommended by the General Plan, the Urban Water Management Plan, the Capital Improvement Program and other adopted plans.

The County will coordinate the recommendations of the LHMP with other planning processes and programs including the following:

- County Emergency Management Plan
- Capital Improvement Program
- County of Santa Cruz Building Codes
- Community design guidelines
- Water conservation guidelines
- Storm Water Management Program

Most action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of educational programs, continued interdepartmental and interagency coordination, or improved public participation.

15.5.3 Continued Public Involvement

5.3 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 public will continue to be apprised of LHMP actions through the County website and by providing copies of the annual progress reports to the media. Copies of the LHMP will be distributed to the Santa Cruz Library System. Upon initiation of the LHMP up-date process, a new public involvement strategy will be initiated based on guidance from the committee. This strategy will be based on the needs and capabilities of the County at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area and the County's website.

END NOTES

[1] County of Santa Cruz General Plan, Chapter 6, pg. 4.

[2] National Oceanic and Atmospheric Administration web site: http://www.weather.gov/climate/local

[3] California Employment Development Dept., Labor Market Information Division, Current Economic Statistics Group, http://www.calmis.ca.gov/file/Commute-Maps/ScruzCommute.pdf

4 "Santa Cruz County Community Assessment Project, Year 14." Jan 2009. Applied Survey Research. 11 Aug 2009. http://www.appliedsurveyresearch.org/projects/cap.html#list.

5 Ibid

6 Santa Cruz County Comprehensive Economic Development Strategy, 2008 Annual Update, Applied Development Economics

7 Ibid

8 Seismicity of the United States, 1568-1989 (Revised) by Carl W. Stover and Jerry L. Coffman, U.S. Geological Survey, Professional Paper 1527, U.S. Government Printing Office, Washington: 1993

9 2007 Working Group on California Earthquake Probabilities, 2008, The Uniform California Eathquake Rupture Forecast, Version 2 (UCERF 2): U.S. Geological Survey Open-File Report 2007-1437 and California Geological Survey Special Report 203 [http;//pubs.usgs.gov/of/2007/1437/].

10 Ibid

11 Estimation of Future Earthquake Losses in California

12 http://www.consrv.ca.gov/CGS/rghm/loss/index.html

13 http://www.codepublishing.com/ca/santacruzcounty/

[14] Headwaters Economics 2008 study, http://www.headwaterseconomics.org/wildfire/

15 2005 Urban Water Management Plan, City of Santa Cruz, February 2006 (page 5-3)

16 Actual period of record for e gauge on the San Lorenzo River began in 1936. Synthesized flow records generated for earlier modeling studies were used to extend the record back to 1921

17 One acre-foot equals 325,851 gallons; 3.07 acre-feet equals one million gallons

18 2005 Urban Water Management Plan, City of Santa Cruz, February 2006, Santa Cruz Integrated Water Plan Final Program EIR

[19] Lorrie and Alan Flint, USGS, California Water Science Center, "Climate Change & Hydrology in Watersheds of Santa Cruz County", Power Point presentation, 2009

20 City of Santa Cruz Urban Water Management Plan, February 2006, page2-7

21 Ibid

22 California Coastal Commission ReCAP Pilot Project Findings and Recommendations: Monterey Bay Region

23 Evaluation of Erosion Hazards – Heinz Center Coastal Erosion Mapping and Management – Journal of Coastal Research

24 Draft Review of California Coastal Erosion Planning and Response: A Strategy for Action, Gary D. Nichols, California Resources Agency, March 2003

25 California Coastal Commission ReCAP Pilot Project Findings and Recommendations: Monterey Bay Region

26 County of Santa Cruz General Plan, http://www.sccoplanning.com/html/policy/general_plan.htm

27 USGS Open File 97-745 C, Sheet 9 of 11

28 County of Santa Cruz General Plan, http://www.sccoplanning.com/html/policy/general_plan.htm.

List of Appendices

	Appendix Title
A	HAZARDS NOT A RISK TO SANTA CRUZ
B	ACRONYMS AND ABBREVIATIONS
C	GLOSSARY OF TERMS
D	CRITICAL COUNTY FACILITIES
E	SKILLED NURSING FACILITIES & HOSPITALS
F	PUBLIC SCHOOLS
G	PRIVATE SCHOOLS
H	SUCCESSFUL PROGRAMS AND PROJECTS
I	CENSUS CHARACTERISTICS 2000
J	TSUNAMI RESPONSE PLAN – CONCEPT OF OPERATIONS
K	TSUNAMI MAP PREPARATION METHODOLOGY
L	URBAN/RURAL BOUNDARY MAP
M	HAZARD MAPS IN PDF
N	COMMUTER MAPS (PDF) FOR SANTA CRUZ COUNTY
O	LOCKHEED FIRE BURN ANALYSIS

APPENDIX A

HAZARDS THAT ARE DETERMINED NOT A SIGNIFICANT RISK TO SANTA CRUZ

AVALANCHE

An avalanche is defined as a mass of loosened snow, ice, or earth suddenly and swiftly sliding down a mountain. In general practice this is assumed to be a snow avalanche unless another term such as ice, rock, mud, etc, is used. The Sierra Nevada Mountains which are over 200 hundred miles from Santa Cruz County are the nearest area with a risk of avalanche. This is not considered a significant hazard risk.

www.avalanche-center.org/Bulletins/Calif/

EXTREME HEAT

Exposure to excessive heat can cause illness, injury and death. Approximately 400 people die each year in the United States from exposure to heat due to weather conditions, and many more people die from health conditions that are exacerbated by exposure to excess heat. Most heat-related deaths occur during the summer months. The elderly, very young, and people with chronic health problems are most at risk. Air conditioning is the leading protective factor against heat-related illness and death.

On the coast, the small range in temperature from day to night and from winter to summer produces an unusually equable regime. Santa Cruz County is at about 36.98°N 122.01°W. Average maximum temperatures range from 75°F to 77° F in August and September, the hottest months of the year. The highest temperature ever recorded in Santa Cruz was 108 in 1900 and 1904. The most recent high was 107 in September 1971. No deaths were attributed to heat.

Sources:
www.worldclimate.com/cgi-bin/
www.hurricane.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals
www.nws.noaa.gov
www.ncdc.noaa.gov/oa/climate/extremes/2000/august/augustext2000.html
Department of Health and Human Services Center for Disease Control and Prevention

HURRICANES, TYPHOONS AND COASTAL STORMS

A hurricane is a severe tropical storm that forms in the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean east of 160°. Hurricanes need warm tropical oceans, moisture and light winds above them. If the

right conditions last long enough, a hurricane can produce violent winds, incredible waves, torrential rains and floods. In other regions of the world, these types of storms have different names. This is called a typhoon when they occur in the Northwest Pacific. A tropical storm becomes a hurricane when winds reach 74 mph. When hurricanes move onto land, the heavy rain, strong winds and heavy waves can damage buildings, trees and cars. The heavy waves are called a storm surge. Storm surges are very dangerous as they threaten low-lying coastal lands with inundation.

Coastal storms in Santa Cruz consist of precipitation, occasional high winds and heavy waves. Because the County is not in an area subject to hurricanes, the risks from coastal storms are generally limited to flooding and coastal erosion, which are discussed separately.

Source:
National Oceanic & Atmospheric Administration U.S. Department of Commerce
http://hurricanes.noaa.gov/
NOAA Coastal Storm events www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms
www.nsc.org/ehc/ew/disaster/hurrican.htm

LAND SUBSIDENCE

Land subsidence is defined as a settling, compaction, or caving in of land caused by subsurface mining, ground-water withdrawal, or pumping of oil and gas. Land subsidence occurs in Santa Cruz only in conjunction with severe coastal storms and earthquake and is addressed under those topics.

USGS Science Topics Land Subsidence
NNOAA Satellite & Information Service National Geophysical Data Center
U.S. Geological Survey (USGS)

WINTER STORMS and HAILSTORMS

Severe winter storms and weather include extreme cold, heavy snowfall, ice storms, winter storms, and/or strong winds. In addition, winter storms may result in other hazards such as flooding, severe thunderstorms, tornadoes or extreme winds.

Snow has been reported in nearly every part of California, but it is very infrequent west of the Sierra Nevada except at high elevations of the Coast Range and the Cascades. The County of Santa Cruz is in a mild coastal area without risk of heavy snowfall or ice storms.

Source: U.S. Climate Normal's at National Climatic Data Center
NOAA Satellite and Information Service
www.hurricane.ncdc.noaa.gov/cgi- bin

TORNADOS

A tornado is a violently rotating column of air extending between, and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as a funnel cloud. On a local-scale, tornadoes are the most intense of all atmospheric circulations with wind that can reach destructive speeds of more than 300 mph.

Since 1950, 292 tornadoes have occurred in 42 counties throughout California resulting in 103 injuries. However, since 1950, no deaths caused by tornadoes have been recorded in California. A search of NOAA Satellite and Information Service shows three minor tornadoes in Santa Cruz on record since 1965. There were no deaths and only minor property damage.

Source:
NOAA Satellite and Information Service National Climatic Data Center
www.ncdc.noaa.gov/oa/climate/severeweather/tornadoes.html

VOLCANOES

Volcanoes are described as a vent in the Earth's crust through which molten or hot rock, steam, and ash reach the surface, including the cone built by the eruptions. According to the NOAA the only two volcanoes in California which have erupted in the last six hundred years are Mono Lake and Mt. Lassen.* Santa Cruz is over 300 miles from either of these volcanic sites. While there is always a possibility that as a result of an eruption some ash might drift as far as Santa Cruz. At this distance and given the history of eruption, the risk appears to be negligible for Santa Cruz.

Volcano Title	Volcano Type	Eruption Code
Lassen Volcanic Center	Stratovolcano Historical	D2
Mono Craters	Lava Domes Radiocarbon	D6
Mono Lake Volcanic Field	Cinder Cones	D4

The Last Known Eruption Codes:
D1 = Last known eruption 1964 or later
D2 = Last known eruption 1900-1963

D3 = Last known eruption 1800-1899
D4 = Last known eruption 1700-1799
D5 = Last known eruption 1500-1699
D6 = Last known eruption A.D. 1-1499

Source: www.noaa.gov/volcanoes.html
www.ngdc.noaa.gov/seg/hazard/stratoguide/glossary.html

APPENDIX B

ACRONYMS AND ABBREVIATIONS

BFE	Base flood elevation
CAGS	California Geological Survey
CBC	California Building Code
CCR	California Code of Regulations
CDF	California Department of Forestry
CERT	Community Emergency Response Team
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CFS	Cubic feet per second
CIP	Capital improvement Program
CRS	Community Rating System
DHS	U.S. Department of Homeland Security
DMA	Disaster Mitigation Act (Public Law 106-390)
DOF	Depth of flooding
EIR	Environmental impact report
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
Ft	Feet
GIS	Geographical information system
HMGP	Hazard Mitigation Grant Program
IBC	International Building Code
Km	Kilometer
M	Magnitude
MCE	Maximum credible earthquake
MH	Multi-hazard
ML	Local magnitude
Mph	Miles per hour
NA	Not applicable
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NFIRS	National Fire Incident Reporting System
NOAA	National Oceanic and Atmospheric Administration
OES	California Governor's Office of Emergency Services
PDM	Pre-Disaster Mitigation Grant Program
RCRA	Resource Conservation and Recovery Act
SEMS	Standardized Emergency Management System
SFHA	Special flood hazard area
SHELDUS	Spatial Hazard Events and Losses Database for U.S.

UBC	Uniform Building Code

APPENDIX C

GLOSSARY OF TERMS

100-Year Flood	The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).
Acre-Foot	An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre-foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.
Action	Program, project or specific act taken to promote goal, in this case the goal of hazard mitigation.
Asset	An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.
Base Flood Elevation (BFE):	The BFE is the water surface elevation of a 100-year flood event (a flood that has a 1 percent chance of occurring in any given year as defined by the NFIP). The base flood is a statistical concept used to ensure that all properties subject to NFIP are protected to the same degree against flooding.
Basin:	A basin is the area within which all surface water – whether from rainfall, snowmelt, springs, or other sources – flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit:	A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.
Benefit/Cost Analysis	A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.
Building:	A building is defined as a structure that is walled and roofed, principally above the ground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.
Capability Assessment	A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified.
Community Rating System (CRS)	The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.
Critical Facility	A critical facility is vital to the City's ability to provide essential services and protect life and property. Loss of a critical facility would result in a severe economic or catastrophic impact; Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers needed for disaster response before, during, and after hazard events; Public and private utilities and infrastructure vital to maintaining or restoring normal services to areas damaged by hazard events; Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event
Dam	A dam is any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure	Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, earthquakes, and intentional destruction.
Debris	Debris refers to the scattered remains of assets broken or destroyed during the occurrence of a hazard. Debris caused by wind or water hazards can cause additional damage to other assets.
Depth of Flooding (DOF)	The DOF is the difference between regulatory flood elevation (RFE) and the elevation of the lowest grade adjacent to a structure.
Disaster Mitigation Act of 2000 (DMA)	The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.
Drought	Drought is a period of time without substantial rainfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.
Duration	Duration is defined as the length of time that a hazard occurs. For example, the duration of a tornado can be minutes, but release of a chemical warfare agent such as mustard gas can persist for hours or weeks if unremediated.
Earthquake	An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.
Exposure	Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent:	The extent is the size of an area affected by a hazard.
(FEMA)	An independent agency (now part of the Department of Homeland Security) created in 1978 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery.
Fire Behavior	Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).
Flash Flood	A flash flood occurs with little or no warning when water levels rise at an extremely fast rate.
Flooding	Flooding is a general and temporary condition of rising and overflowing water resulting in partial or complete inundation of normally dry land areas. Floods result from: (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation of runoff of surface water from any source, and (3) mudflows or the sudden collapse of shoreline land.
Flood Depth	Flood depth is the height of the floodwater surface above the ground surface.
Flood Elevation	Flood elevation is the height of water surface above an established datum (for example, the National Geodetic Vertical Datum of 1929 [NGVD], North American Vertical Datum of 1988, or mean sea level).
Flood Insurance Rate Map (FIRM)	FIRM is the official map of a community for which FEMA has delineated the special flood hazard area (SFHA) and the risk premium zones applicable to the community.
Flood Insurance Study	A flood insurance study is published for a community by the Federal Insurance and Mitigation Administration in conjunction with the community's FIRM. The study contains background data such as base flood discharges and water surface elevations that were used to prepare the study.

Floodplain	A floodplain is any land area that becomes inundated with water during a flood or from any other source. Floodplain can be defined in different ways but is commonly defined as the area that is also called the 100-year floodplain.

Floodway	A floodway is an area within a floodplain reserved for the purpose of conveying flood discharge without increasing the BFE by more that 1 foot. Generally speaking, no development is allowed in floodways because any structures there would block the flow of floodwater.
Frequency	For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.
General Plan	California state law requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The plan must consist of an integrated and internally consistent set of goals, policies, and implementation measures. In addition, the plan must focus on issues of the greatest concern to the community and be written in a clear and concise manner. City actions, such as those relating to land-use allocation, annexations, zoning, subdivision and design review, redevelopment, and capital improvements, must be consistent with such a plan. The City of Santa Cruz's general plan serves these purposes. The General Plan Advisory Committee is now in the process of reviewing this plan and will submit its recommendations to the City Council in 2007.
Goal	A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of the RHMP, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).
GIS	GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.
Hazard	A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage. Natural hazards include floods, tsunamis, and earthquakes. Man-made hazards include acts of terrorism and hazardous material spills.

HMGP	**Hazard Mitigation Grant Program** Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.
Hazard Mitigation Plan	A hazard mitigation plan is a collaborative document that identifies hazards that could affect a community, assesses vulnerability to hazards, and represents consensus decisions reached on how to minimize or eliminate the effects of hazards.
HAZUS-MH	**Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program** is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUSMH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards.
Hydraulics	Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.
Hydrology	Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.
Intensity	Intensity refers to the measure of the effects of a hazard.
Inventory	The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other community resources.
Landslide	A landslide refers to the sliding movement of masses of loosened rock and soil down a hillside or slope under the force of gravity. Fundamentally, slope failure occurs when the strength of soils forming the slope is exceeded by pressure acting upon the soils

	(caused by factors such as weight or saturation).
Liquefaction	Liquefaction is the failure of soils when soils lose shear strength and flow horizontally during earthquakes. Liquefaction is most likely to occur in fine-grained sands and silts with high water content. Liquefaction undermines the ground's ability to solidly support building structures. Foundations on liquefiable soils can lose their ability to support load and can experience settlement on the order of several inches or more. This situation is extremely hazardous and may result in extreme property damage and threats to life and safety. Differential settlement can cause significant damage to buildings, lifelines, and transportation structures with partial or total collapse.
Magnitude	Magnitude is the measure of the strength of an earthquake, typically measured by the Richter Scale. Magnitude is most commonly measured by local magnitude (ML) used by the Richter Scale or by Mercalli Intensity. In the Richter Scale, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.
Mitigation Actions	Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.
NFIP	**National Flood Insurance Program (NFIP)**: In 1968, Congress created the NFIP in response to the rising cost of taxpayer-funded disaster relief for flood victims and the increasing amount of damage caused by floods. The Mitigation Division is the FEMA section that manages the NFIP and oversees the floodplain management and mapping components of the program. Nearly 20,000 communities across the United States and its territories participate in NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.
Objective	An objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration	Peak ground acceleration is a measure of the highest amplitude of ground shaking that accompanies an earthquake based on a percentage of the force of gravity.
Preparedness	Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.
Presidential Disaster Declaration	These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.
Probability of Occurrence	The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.
Recovery	Recovery refers to actions taken by an individual or community after a catastrophic event to restore order and community lifelines.
Repetitive Loss Property	A repetitive loss property is any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced any of the following: • Four or more paid flood losses exceeding $1,000 each • Two paid flood losses exceeding $1,000 each within any 10-year period since 1978 • Three or more paid losses that equal or exceed the current value of the insured property
Risk	Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of

	a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.
Risk Assessment	Risk assessment is the process of measuring potential loss of life, personal injury, economic injury and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on 1. hazard identification; 2. impacts of hazards on physical, social, and economic assets; 3. vulnerability identification; and 4. estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking	This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on the people, property, and economy of Santa Cruz. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation: **Risk Ranking = Probability + Impact (people + property + economy)**
Riverine	Riverine refers to anything of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.
Stafford Act	The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.
Tornado	A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. Tornadoes are the most intense of all atmospheric circulations. Winds can reach speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.
Vulnerability	Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.
Watershed	A watershed is an area that drains down gradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.
Wildfire or Wildland Fire	These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.
Windstorm	Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage.

APPENDIX D

CRITICAL COUNTY FACILITIES

A critical facility is vital to a community's ability to provide essential services and protect life and property. Loss of a critical facility would result in a severe economic or catastrophic impact. Under the Santa Cruz County Local Hazard Mitigation Plan definition, critical facilities include the following: Fire stations, vehicle and equipment storage facilities, and the emergency operation center.

Facility	Location	Information
Sheriff's Office	701 Ocean St., Santa Cruz	City of Santa Cruz
Aptos-LaSelva Fire Station	6934 Soquel Dr., Aptos	
Ben Lomond Fire Dept.	9430 Hwy 9, Ben Lomond	
Boulder Creek Fire Station	13230 Central Ave., Boulder Creek	
Branciforte Fire Protection District	2711 Branciforte Dr., Santa Cruz	Unincorporated Area
Central Fire Station	930 17th Ave., Santa Cruz	Unincorporated Area
Felton Fire Station	131 Kirby St., Felton	
Zayante Fire Dept.	7700 East Zayante Rd., Felton	
UC Santa Cruz Fire Station	1156 High St., Santa Cruz	City of Santa Cruz
Big Creek Fire Station	240 Swanton Rd., Davenport	CalFire
Burrell Fire Station	25050 Highland Way, Los Gatos	CalFire
Corralitos Fire Station	120 Eureka Canyon Rd., Corralitos	Cal Fire
Felton Fire Station	6059 Hwy 9, Felton	CalFire
Jamison Creek Fire Station	16115 Jamison Creek Rd., Boulder Creek	Calfire
Pajaro Dunes fire Station	2661 Beach Rd., Watsonville	CalFire
Saratoga Summit Fire Station	12900 Skyline Blvd., Los Gatos	CalFire
Soquel Fire Station	4750 Old San Jose Rd., Soquel	CalFire
County Governmental Center	701 Ocean St., Santa Cruz	City of Santa Cruz
Ben Lomond Transfer Station	9835 Newell Creek Rd., Ben Lomond	Unincorporated Area
Buena Vista Landfill	1231 Buena Vista Dr., Watsonville	Unincorporated Area
38th Ave Drainage Facility	38th Ave., Santa Cruz	Unincorporated Area
Felton Yard	207 Hihn St., Felton, 95018	Unincorporated Area
Brommer Yard	2700 Brommer St., Santa Cruz, 95062	Unincorporated Area
D.A. Porath Sanitation Facility	2750 Lode St., Santa Cruz, 95062	Unincorporated Area
Roy Wilson Yard	198 Grimmer Rd., Watsonville	
Davenport Water Treatment Facility	3rd Ave., Davenport, 95017	Unincorporated Area
Emergency Operations Center	495 Deer Park Dr., Santa Cruz	County OES located in City of Santa Cruz
Harbor Master HQ	135 5th Ave., Santa Cruz	Unincorporated Area

Appendix E

In addition to the critical facilities owned by the county, there are a number of other facilities that serve populations which may require special services and assistance during hazard events such as hospitals, skilled nursing facilities, senior and disabled housing, and schools. The following lists name these facilities.

Senior Residence and Care Facilities

Agency	Address	City	State	Zip
Aegis Assisted Living	125 Health Terrace	Aptos	CA	95003
Capitola Care Center	1098 38th Ave.	Santa Cruz	CA	95062
Cresthaven Nursing Home	740 17th Ave.	Santa Cruz	CA	95062
De Un Amor	460 Eureka Canyon Rd.	Corralitos	CA	95076
Dominican Oaks	3400 Paul Sweet Rd.	Santa Cruz	CA	95062
Dominican Restorative Care Unit	610 Frederick Street	Santa Cruz	CA	95061
Driftwood Convalescent Hospital	675 24th Ave.	Santa Cruz	CA	95062
Oak Tree Villa	100 Lockwood Lane	Scotts Valley	CA	95066
Pacific Coast Manor	1935 Wharf Rd.	Capitola	CA	95010
Pleasant Care Rehab & Nursing	2990 Soquel Ave.	Santa Cruz	CA	95062
Santa Cruz Health Care Center	1115 Capitola Rd.	Santa Cruz	CA	95062
Sunshine Villa	80 Front St.	Santa Cruz	CA	95060
Valley Convalescent Hospital	919 Freedom Blvd.	Watsonville	CA	95076
Watsonville Nursing & Rehabilitation Center	525 Auto Center Drive	Watsonville	CA	95076
Sunbridge Care Center	535 Auto Center Dr.	Watsonville	CA	95076
Alexandria Victoria Assisted Living	226 Morrissey Blvd	Santa Cruz	CA	95062
Brommer Residential Care	2000 Brommer Street	Santa Cruz	CA	95062
Chanticleer Home	2266 Chanticleer Ave.	Santa Cruz	CA	95062
Chateau Retirement Home	1340 17th Ave.	Santa Cruz	CA	95062
Darwin House	707 Darwin Street	Santa Cruz	CA	95062
Flor's	1106 Darlene Drive	Santa Cruz	CA	95062
Golden Age Convalescent	523 Burlingame Ave.	Capitola	CA	95010
Hanover Guest House	813 Hanover Street	Santa Cruz	CA	95062
La Posada	609 Frederick Street	Santa Cruz	CA	95062
Maple House	410 Pennsylvania Ave.	Santa Cruz	CA	95062
Molina Guest Home*	109 Behler Rd.	Watsonville	CA	95066
Mystic Oaks*	163 Glenwood Drive	Scotts Valley	CA	95062
Oliveira's Guest Home	919 Summer Street	Santa Cruz	CA	95062
Opal Cliffs	4795 Opal cliffs Drive	Santa Cruz	CA	95062
Paloma House	321 Beach Street	Watsonville	CA	95076
Rillera's Guest Home*	40 Fletcher Ct.	Watsonville	CA	95076
Seaview Guest Home #1	7321 Mesa Drive	Aptos	CA	95003
Seaview Guest Home #2	7364 Mesa Drive	Aptos	CA	95003
Shady Rest Manor**	1836 16th Ave.	Santa Cruz	CA	95062
Soquel Leisure Villa*	4101 Fairway Drive	Soquel	CA	95073
The Mansion	1906 Glen Canyon Rd.	Santa Cruz	CA	95060
Transition House	3035 Prather Lane	Santa Cruz	CA	95065

Twilight Manor	2155 17th Ave.	Santa Cruz	CA	95062
Valley Haven Care Home	157 Herman Avenue	Watsonville	CA	95076
Valley Haven Care Home II	99 Airport Blvd.	Watsonville	CA	95076
Villa Cruz Guest Home	127 Laurent Street	Santa Cruz	CA	95062
Watsonville Manor Residential Care	311 Montecito Ave.	Watsonville	CA	95076
Wesley House #2, #3, & #4	121-123 La Selva Drive	La Selva Beach	CA	95076

Hospitals

Dominican Santa Cruz Hospital 1555 Soquel Dr., Santa Cruz

Sutter Maternity and Surgery Center 2900 Chanticleer Ave., Santa Cruz

APPENDIX F

Public Schools – All schools listed are in the unincorporated area of the County

School	Address
Bonny Doon Elementary	1492 Pine Flat Rd., Bonny Doon
Happy Valley Elementary	3125 Branciforte Dr., Santa Cruz
Del Mar Elementary	1959 Merrill St., Santa Cruz
Green Acres Elementary	966 Botswick Lane, Santa Cruz
Live Oak Elementary	1916 Capitola Rd., Santa Cruz
Ocean Alternative Education	984-6 Botswick Lane, Santa Cruz
Tierra Pacifica Charter School	986 Botswick Lane, Santa Cruz
Shoreline Middle School	855 7th Ave., Santa Cruz
Cypress Charter High School	2039 Merrill St., Santa Cruz
Mountain Elementary	3042 Old San Jose Rd., Soquel
Pacific Elementary	50 Ocean St., Davenport
Freedom Elementary	25 Holly Dr., Freedom
Mar Vista elementary	6860 Soquel Dr., Aptos
Rio Del Mar Elementary	819 Pinehurst Dr., Aptos
Valencia Elementary	250 Aptos School Rd., Aptos
Aptos Junior H.S.	1001 Huntington Dr., Aptos
Aptos H.S.	100 Mariner Way, Aptos
Boulder Creek Elementary	400 Lomond St., Boulder Creek
San Lorenzo Valley Elementary	7155 Hwy 9, Felton
San Lorenzo Valley Middle School	7179 Hacienda Way, Felton
San Lorenzo Valley H.S.	7105 Hwy 9, Felton
Main St. Elementary	3400 N. Main St., Soquel
Santa Cruz Gardens Elementary	8005 Winkle Ave., Santa Cruz
Soquel Elementary	2700 Porter St., Soquel
Cabrillo Community College	6500 Soquel Dr., Aptos

Appendix G

Private Schools*

School	Address
Good Shepard School	2727 Mattison Lane, Santa Cruz
Magic Apple School	2120 Trout Gulch Rd., Aptos
Merit Academy	2392 North Rodeo Gulch Rd., Soquel
Monterey Bay Academy	783 San Andreas Rd., La Selva Beach
Salesian Elementary and Jr. High	605 Enos Lane, Corralitos
Santa Cruz Montessori	6230 Soquel Dr., Aptos
St. Lawrence Academy	6184 Hwy 9, Felton
Tara Redwood	5810 Prescott Rd., Soquel
The Prince Academy	15435 Two Bar Rd., Boulder Creek
Twin Lakes Christian	2701 Cabrillo College Dr., Aptos
VHM Christian	427 Capitola Rd., Santa Cruz

- source: California Dept. of Education http://www.cde.ca.gov/ds/si/ps/documents/privat08.xls
- These schools are listed in the California Dept. of Education data base if they have 6 or more students on their attendance affidavit

APPENDIX H

Successful Programs and Projects

Wildfire Mitigation

- Implementation and use of a reverse 911 community notification and warning system
- Comprehensive mutual aid system for fire protection
- Routine and frequent training by local and state fire jurisdictions
- Annual Residential Defensible space education and enforcement programs
- Collaborative and cross jurisdiction Vegetation management programs including fuel reduction and shaded fuel break programs
- Preparation of a countywide Community Wildfire Protection Plan (CWPP)
- Implementation of new county building codes addressing WUI related issues including building materials, construction requirements, water system/supply and code enforcement
- Promotion of built-in fire extinguishing alarms and water systems
- Public Works Dept. roadside drainage ditch inspection and clearing, culvert inspection, cleaning and debris removal programs
- "Large Woody Material Management Program" for streams in Dept. of Public Works and Environmental Health Dept.

Flood and Coastal Erosion Mitigation

- Multi-year sediment study downstream from burned wildfire areas initiated by Flood Control and Water Conservation District
- Real-time flood control gauge installed by Flood control and Water Conservation District off Ormsby Rd. in the heart of the burn area.
- Avenues (32nd to 37th) Drainage Project (phases 1 & 2)
- Mission Dr. drainage improvements
- Winkle Ave/Prather Lane Park drainage
- Thurber Lane drainage project
- 14th Ave. to Bonita Lagoon drainage
- Venice Dr. drainage improvements
- Soquel Dr.-Bargetto Bridge replacement
- East cliff Dr. emergency crib wall repair
- Repetitive loss properties foundation raising program

Earthquake Mitigation

- "Brace for the Quake" program – seismic retrofits for 1524 housing units

APPENDIX I

Census Characteristics 2000 – Profile of General Demographic Characteristics*

Total population	**255,602**	**100.0**
SEX AND AGE		
Male	127,579	49.9
Female	128,023	50.1
Under 5 years	15,544	6.1
5 to 9 years	17,077	6.7
10 to 14 years	17,630	6.9
15 to 19 years	19,939	7.8
20 to 24 years	20,948	8.2
25 to 34 years	36,728	14.4
35 to 44 years	42,087	16.5
45 to 54 years	40,673	15.9
55 to 59 years	11,669	4.6
60 to 64 years	7,820	3.1
65 to 74 years	12,347	4.8
75 to 84 years	9,295	3.6
85 years and over	3,845	1.5
Median age (years)	35.0	(X)
18 years and over	194,861	76.2
Male	96,358	37.7
Female	98,503	38.5
21 years and over	180,520	70.6
62 years and over	29,805	11.7
65 years and over	25,487	10.0
Male	10,255	4.0

Female	15,232	6.0
RACE		
One race	244,431	95.6
White	191,931	75.1
Black or African American	2,477	1.0
American Indian and Alaska Native	2,461	1.0
Asian	8,789	3.4
Asian Indian	925	0.4
Chinese	1,969	0.8
Filipino	2,272	0.9
Japanese	1,897	0.7
Korean	662	0.3
Vietnamese	360	0.1
Other Asian [1]	704	0.3
Native Hawaiian and Other Pacific Islander	382	0.1
Native Hawaiian	165	0.1
Guamanian or Chamorro	48	0.0
Samoan	70	0.0
Other Pacific Islander [2]	99	0.0
Some other race	38,391	15.0
Two or more races	11,171	4.4
Race alone or in combination with one or more other races [3]		
White	201,777	78.9
Black or African American	3,771	1.5
American Indian and Alaska Native	5,296	2.1
Asian	11,916	4.7
Native Hawaiian and Other Pacific Islander	1,054	0.4
Some other race	43,921	17.2

HISPANIC OR LATINO AND RACE		
Total population	**255,602**	**100.0**
Hispanic or Latino (of any race)	68,486	26.8
Mexican	58,290	22.8
Puerto Rican	572	0.2
Cuban	232	0.1
Other Hispanic or Latino	9,392	3.7
Not Hispanic or Latino	187,116	73.2
White alone	167,464	65.5
RELATIONSHIP		
Total population	**255,602**	**100.0**

HOUSEHOLDS BY TYPE		
Total households	**91,139**	**100.0**
Family households (families)	57,132	62.7
With own children under 18 years	29,111	31.9
Married-couple family	43,790	48.0
With own children under 18 years	21,174	23.2
Female householder, no husband present	9,270	10.2
With own children under 18 years	5,605	6.1
Nonfamily households	34,007	37.3
Householder living alone	22,905	25.1
Householder 65 years and over	7,449	8.2
Households with individuals under 18 years	31,665	34.7
Households with individuals 65 years and over	18,173	19.9
Average household size	2.71	(X)
Average family size	3.25	(X)

***U.S. Census Bureau American Fact Finder Quick Tables**
http://factfinder.census.gov/servlet/QTTable?_bm=n&_lang=en&qr_name=DEC_2000_SF1_U_DP1&ds_name=DEC_2000_SF1_U&geo_id=05000US06087

Appendix J – Tsunami Response Plan Concept of Operations

CONCEPT OF OPERATIONS

Special Case: Local Source Tsunami

Should an event produce a potential tsunami that could impact the County within two hours, public warning and evacuation operations will take place immediately. Warning and evacuation will not be delayed by information gathering or threat assessment.

Alert

Upon receipt of a Tsunami Watch or Warning from the California State Warning Center, NETCOM will notify all agencies as per the Tsunami Alert Notification Procedure (Attachment C).

The OES staff will evaluate the threat and recommend many – if not all – of the following actions to the County Sheriff (Or Alternate):

- Conduct public warning in the Tsunami Inundation Area
- Notify all Operational Area public safety agencies and organizations
- Move all public safety resources out of the Tsunami Inundation Area
- Activate Operational Area EOC
- Hold over all public safety personnel at the end of current shift
- Stage additional safety resources outside of the Tsunami Inundation Area
- Begin Emergency Public Information efforts

Warning

In the event of a Tsunami Warning, population in the designated risk areas will be warned and advised to voluntarily evacuate to higher ground or safe refuge areas. The public will be instructed to move by the quickest method available to a point no less than 50 feet above sea level. The expected arrival time of the tsunami will also be provided if available. After warning the general public, alerting and moving institutional populations such as schools or convalescent care facilities has the highest priority.

Evacuation

The Santa Cruz County Sheriff's Office will lead and direct the tsunami evacuation effort. In each incident area, fire agencies, Public Works, and CERT through field divisions. Resources will report to the Incident Commander and assist in the public warning and evacuation efforts. Evacuations are voluntary.

Public safety agencies will evacuate the tsunami inundation area at least thirty minutes prior to the expected arrival of the first wave. The public will remain outside the tsunami inundation area until the All Clear is sounded.

Traffic Control/Security

Law Enforcement will establish traffic control along evacuation routes and perimeter security operations at selected points. See Attachment B, Tsunami Evacuation Routes and Control Measures. Evacuated residents and sight-seers will be prohibited from entering the Tsunami Inundation Area under the authority of California Penal Code 409.5.

Two Tsunami Observation Posts will be established to monitor the arrival of the initial and any subsequent tsunami waves. Observers will maintain contact with NETCOM and report all activity. See Attachment B, Tsunami Evacuation Routes and Control Measures.

Search and Rescue

For the purpose of coordinating emergency rescue operations, the Santa Cruz coast areas may be

organized into six incidents:

- Watsonville
- Los Olas/Rio Del Mar
- Capitola
- New Brighton Beach
- Wharf/Boardwalk/Downtown Santa Cruz
- North Coast Beaches

Each incident will establish an Incident Command Post and will be resources with fire, law, EMS, public works, and communication assets. Each incident will establish Unified Command and an incident command team. Communications assets will be allocated to and coordinated within each incident prior to re-entering the inundation area.

Initial Incident Objectives:

- Conduct Search and Rescue
- Identify and Isolate Hazards
- Conduct Recovery Operations
- Conduct Security Operations

Damage Assessment

The Damage Assessment Unit at the Operational Area EOC will coordinate all damage assessment teams. Information will be forwarded to the Operational Area EOC Planning Section for evaluation and consolidation.

Emergency Public Information

The Public Information Officer (PIO) at the Operational Area EOC will coordinate all public information activities and will supervise field PIOs assigned to each incident. The PIO may recommend establishing a Joint Information Center (JIC) closer to the scene of the incident. The PIO may also recommend activating an Emergency Public Information Hotline.

Inundation Area Re-entry Policy

Tsunamis may produce several waves with subsequent waves larger than the first. Once public safety personnel and equipment have evacuated the inundation area, they will not re-enter the area until the "All Clear" message has been transmitted by NETCOM.

REFERENCES

Local Planning Guidance on Tsunami Response, Second Edition; A Supplement to the Emergency Planning Guidance for Local Governments. California Governor's Office of Emergency Services, May 1998.

Local Guidelines for Controlling Movement of People and Property During an Emergency. California Governor's Office of Emergency Services, July 1999.

Legal Guidelines for Flood Evacuation. California Governor's Office of Emergency Services, November 1997.

Tsunami Warning Systems and Procedures; Guidance for Local Officials. Oregon Emergency Management and the Department of Geology and Mineral Industries, 2001.

Appendix K

Tsunami Inundation Map Preparation Methodology

Title: Tsunami Inundation Map for Emergency Planning

Method of Preparation:
Initial tsunami modeling was performed by the University of Southern California (USC) Tsunami Research Center funded through the California Emergency Management Agency (CalEMA) by the National Tsunami Hazard Mitigation Program. The tsunami modeling process utilized the MOST (Method of Splitting Tsunamis) computational program (Version 0), which allows for wave evolution over a variable bathymetry and topography used for the inundation mapping (Titov and Gonzalez, 1997; Titov and Synolakis, 1998).

The bathymetric/topographic data that were used in the tsunami models consist of a series of nested grids. Near-shore grids with a 3 arc-second (75- to 90-meters) resolution or higher, were adjusted to "Mean High Water" sea-level conditions, representing a conservative sea level for the intended use of the tsunami modeling and mapping.

A suite of tsunami source events was selected for modeling, representing realistic local and distant earthquakes and hypothetical extreme undersea, near-shore landslides
(Table 1). Local tsunami sources that were considered include offshore reverse-thrust faults, restraining bends on strike-slip fault zones and large submarine landslides capable of significant seafloor displacement and tsunami generation. Distant tsunami sources that were considered include great subduction zone events that are known to have occurred historically (1960 Chile and 1964 Alaska earthquakes) and others which can occur around the Pacific Ocean "Ring of Fire."

In order to enhance the result from the 75- to 90-meter inundation grid data, a method was developed utilizing higher-resolution digital topographic data (3- to 10-meters resolution) that better defines the location of the maximum inundation line (U.S. Geological Survey, 1993; Intermap, 2003; NOAA, 2004). The location of the enhanced inundation line was determined by using digital imagery and terrain data on a GIS platform with consideration given to historic inundation information (Lander, et al., 1993). This information was verified, where possible, by field work coordinated with local county personnel.

The accuracy of the inundation line shown on these maps is subject to limitations in the accuracy and completeness of available terrain and tsunami source information, and the current understanding of tsunami generation and propagation phenomena as expressed in the models. Thus, although an attempt has been made to identify a credible upper bound to inundation at any location along the coastline, it remains possible that actual inundation could be greater in a major tsunami event.

This map does not represent inundation from a single scenario event. It was created by combining inundation results for an ensemble of source events affecting a given region (Table 1). For this reason, all of the inundation region in a particular area will not likely be inundated during a single tsunami event.

References:

Intermap Technologies, Inc., 2003, Intermap product handbook and quick start guide: Intermap NEXTmap document on 5-meter resolution data, 112 p.

Lander, J.F., Lockridge, P.A., and Kozuch, M.J., 1993, Tsunamis Affecting the West Coast
of the United States 1806-1992: National Geophysical Data Center Key to Geophysical Record Documentation No. 29, NOAA, NESDIS, NGDC, 242 p.

National Atmospheric and Oceanic Administration (NOAA), 2004, Interferometric Synthetic Aperture Radar (IfSAR) Digital Elevation Models from GeoSAR platform (EarthData):
3-meter resolution data.

Titov, V.V., and Gonzalez, F.I., 1997, Implementation and Testing of the Method of Tsunami
Splitting (MOST): NOAA Technical Memorandum ERL PMEL – 112, 11 p.

Titov, V.V., and Synolakis, C.E., 1998, Numerical modeling of tidal wave runup: Journal of Waterways, Port, Coastal and Ocean Engineering, ASCE, 124 (4), pp 157-171.

U.S. Geological Survey, 1993, Digital Elevation Models: National Mapping Program, Technical Instructions, Data Users Guide 5, 48 p.

Purpose of this map:

This tsunami inundation map was prepared to assist cities and counties in identifying their tsunami hazard. It is intended for local jurisdictional, coastal evacuation planning uses only. This map, and the information presented herein, is not a legal document and does not meet disclosure requirements for real estate transactions nor for any other regulatory purpose.

The inundation map has been compiled with best currently available scientific information. The inundation line represents the maximum considered tsunami runup from a number of extreme, yet realistic, tsunami sources. Tsunamis are rare events; due to a lack of known occurrences in the historical record, this map includes no information about the probability of any tsunami affecting any area within a specific period of time.

Please refer to the following websites for additional information on the construction and/or intended use of the tsunami inundation map:

State of California Emergency Management Agency, Earthquake and Tsunami Program:
http://www.oes.ca.gov/WebPage/oeswebsite.nsf/Content/B1EC51BA215931768825741F005E8D80?OpenDocument

University of Southern California – Tsunami Research Center:
http://www.usc.edu/dept/tsunamis/2005/index.php

State of California Geological Survey Tsunami Information:
http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/index.htm

National Oceanic and Atmospheric Agency Center for Tsunami Research (MOST model):
http://nctr.pmel.noaa.gov/time/background/models.html

Map base:
Topographic base maps prepared by U.S. Geological Survey as part of the 7.5-minute Quadrangle Map Series (originally 1:24,000 scale). Tsunami inundation line boundaries may reflect updated digital orthophotographic and topographic data that can differ significantly from contours shown on the base map.

Disclaimer:
The California Emergency Management Agency (CalEMA), the University of Southern California (USC), and the California Geological Survey (CGS) make no representation or warranties regarding the accuracy of this inundation map nor the data from which the map was derived. Neither the State of California nor USC shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

APPENDIX L

URBAN AND RURAL SERVICE LINES

County of Santa Cruz

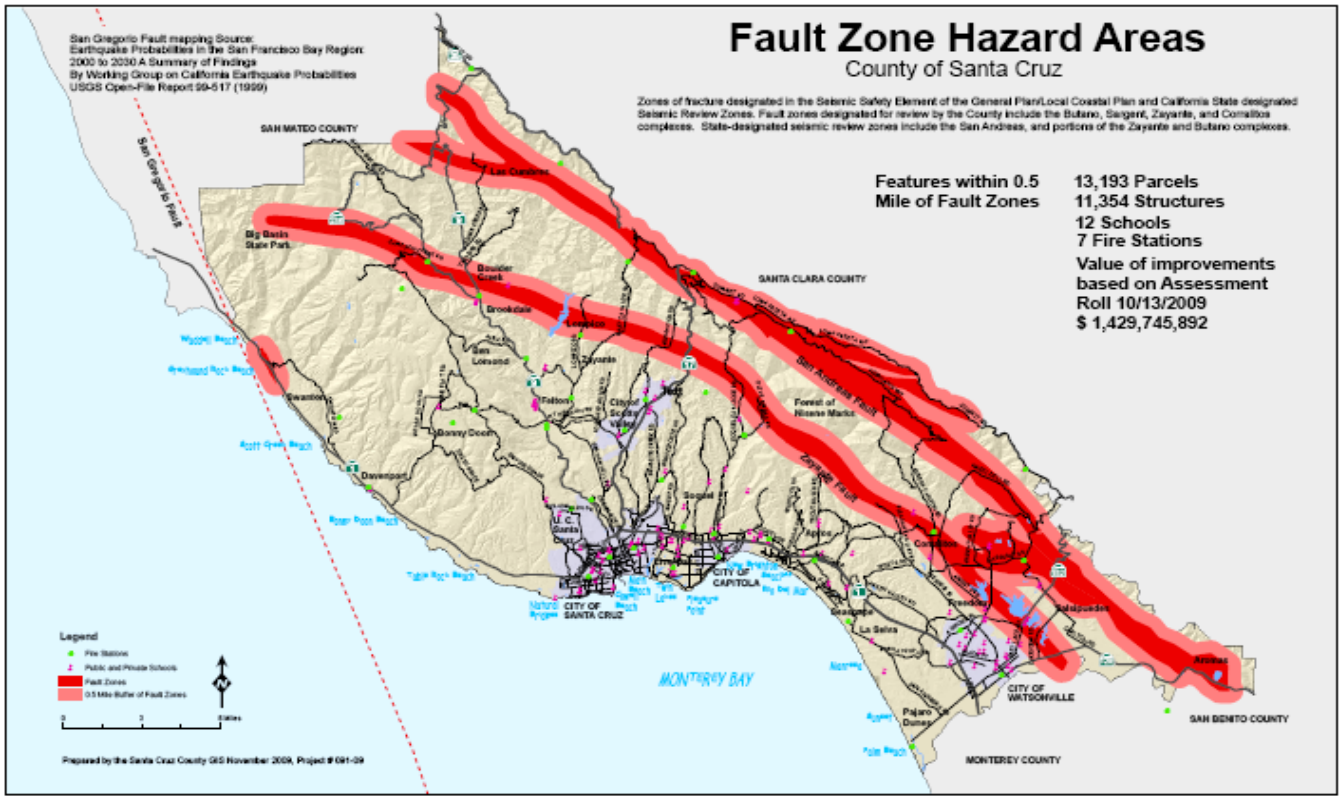
Legend

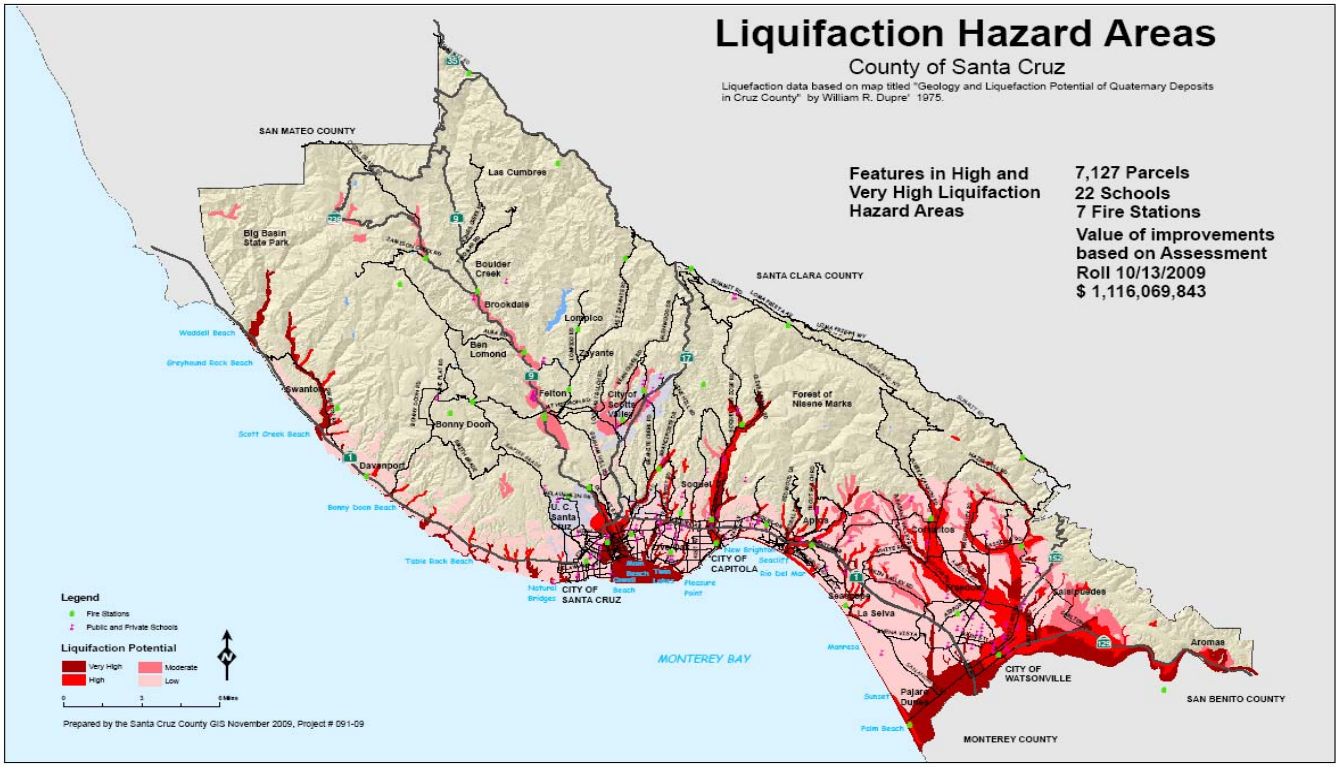
- Fire Stations
- Public and Private Schools
- Rural Services Boundary
- Urban Services Boundary
- City Limits

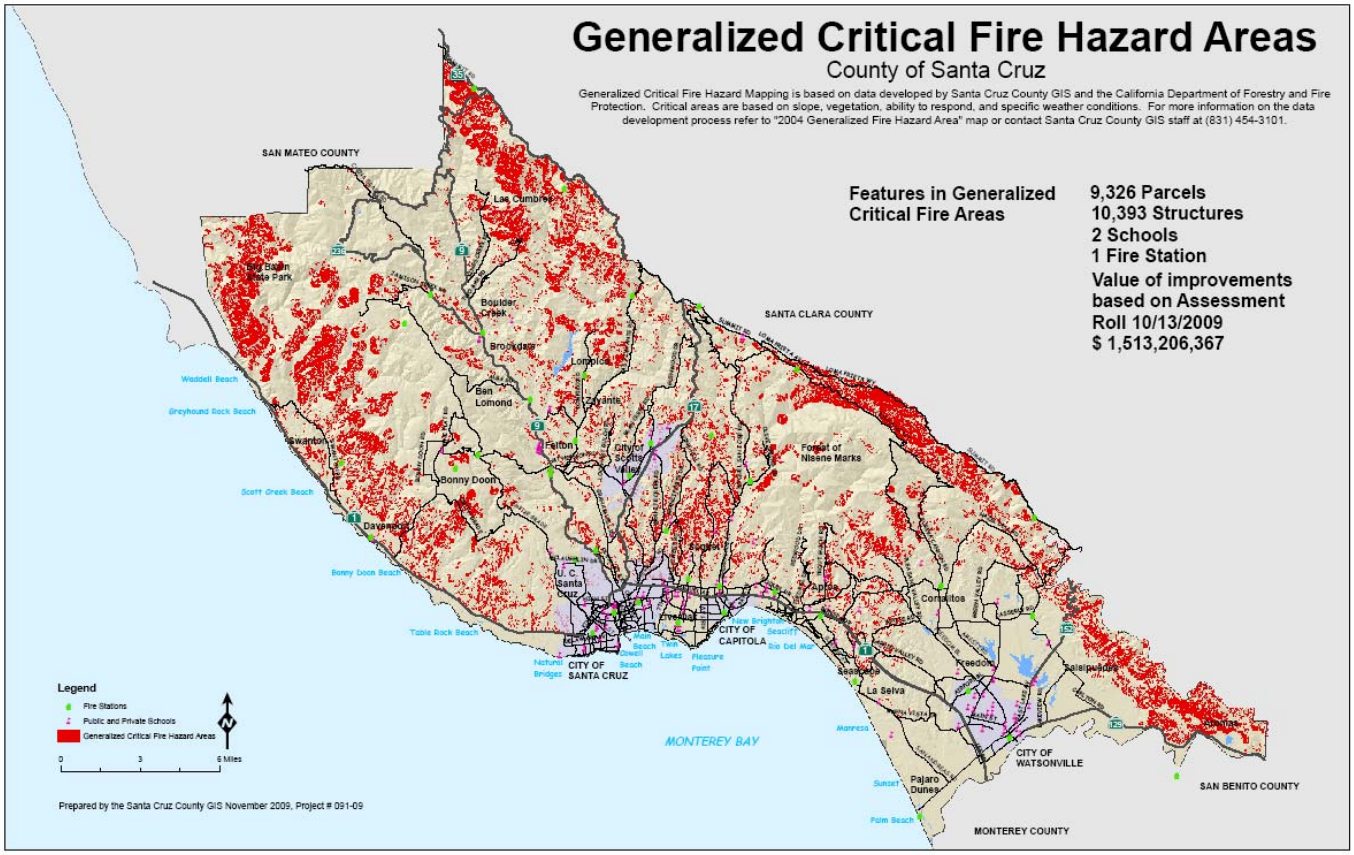
0 3.5 7 Miles

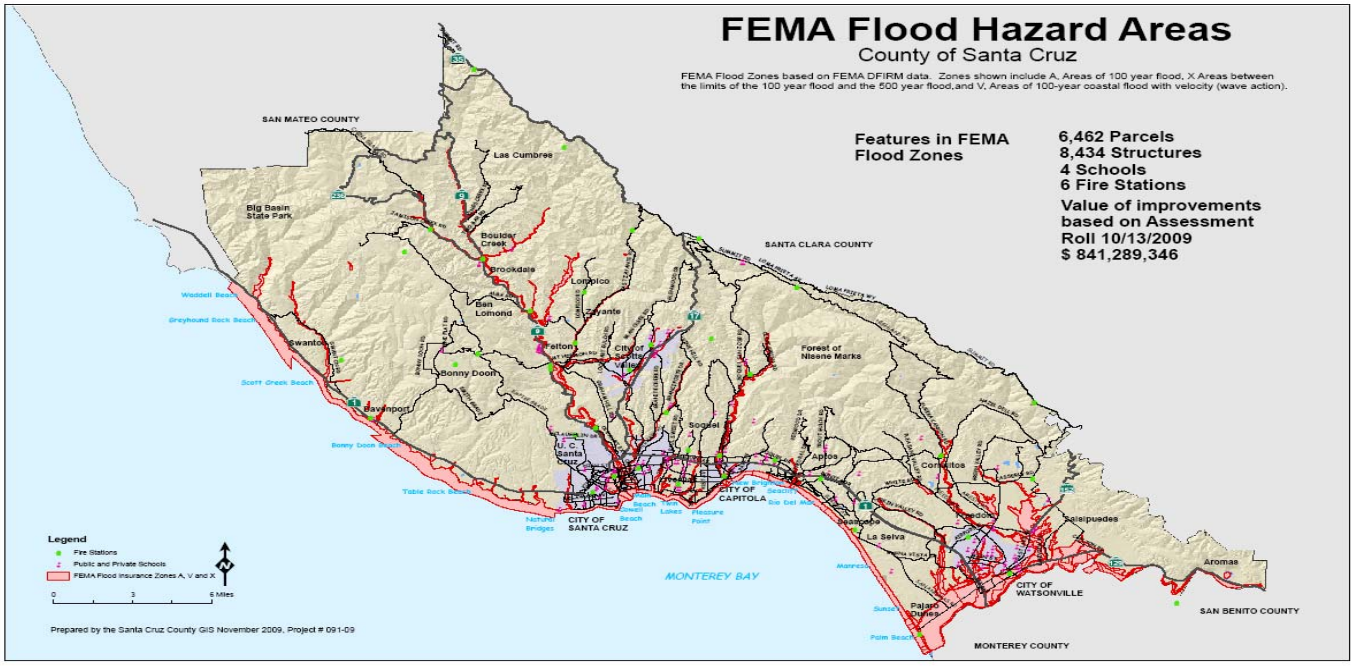
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09

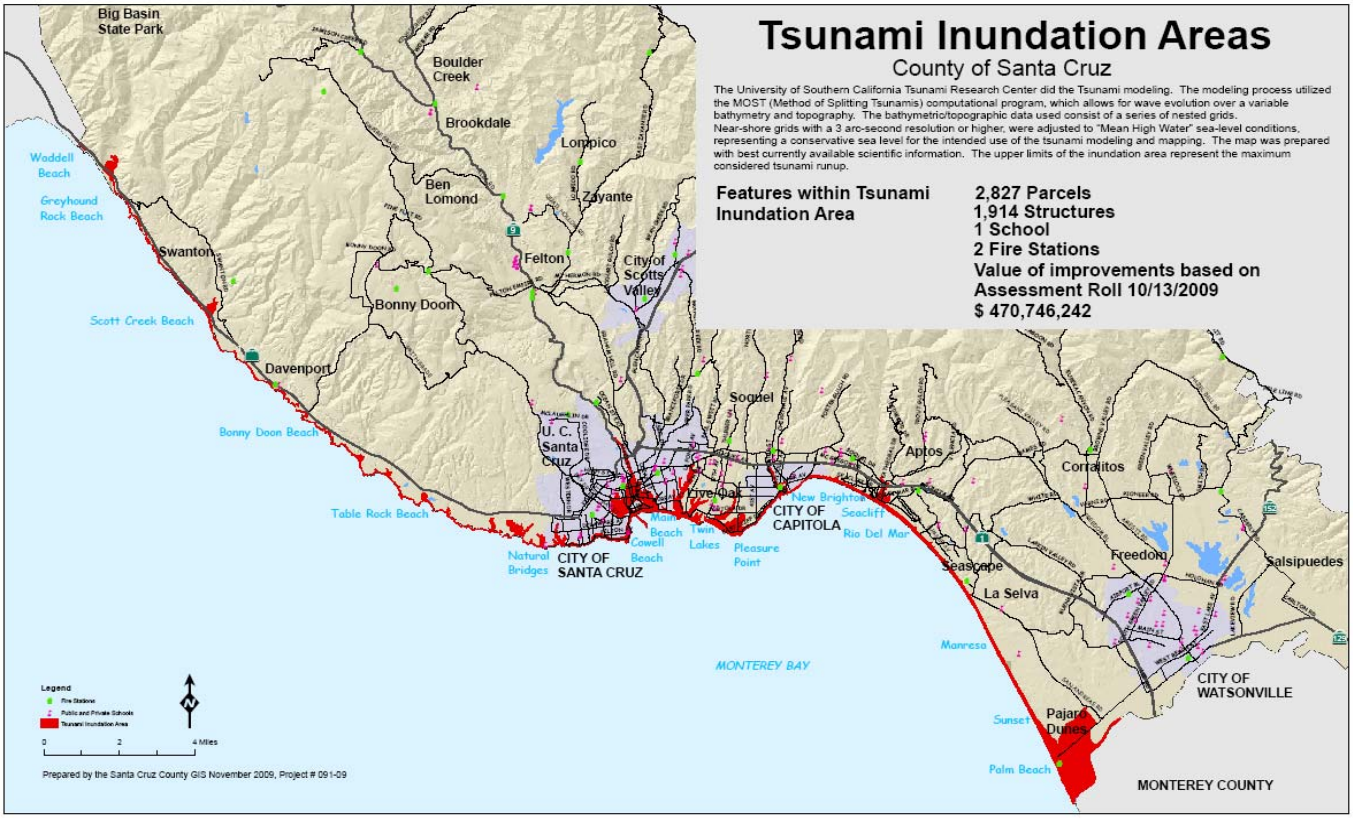
APPENDIX M – Maps in PDF

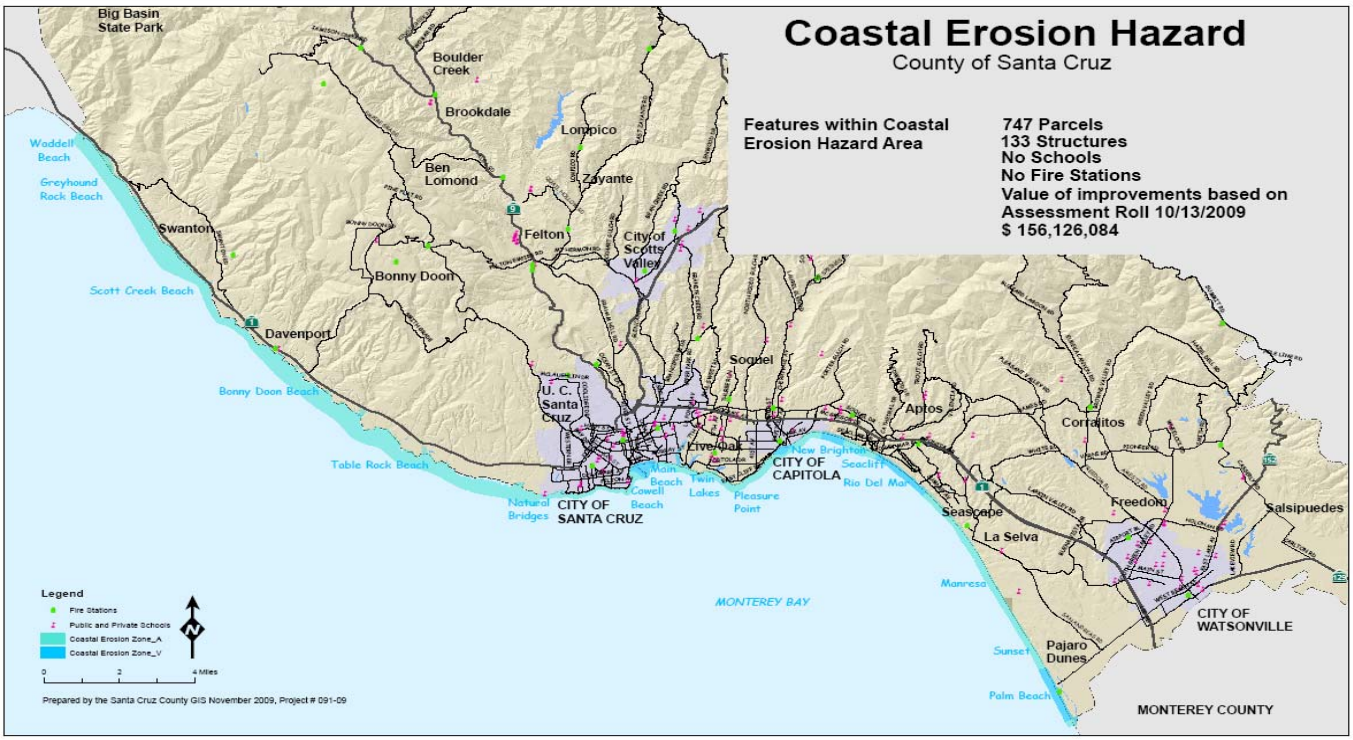


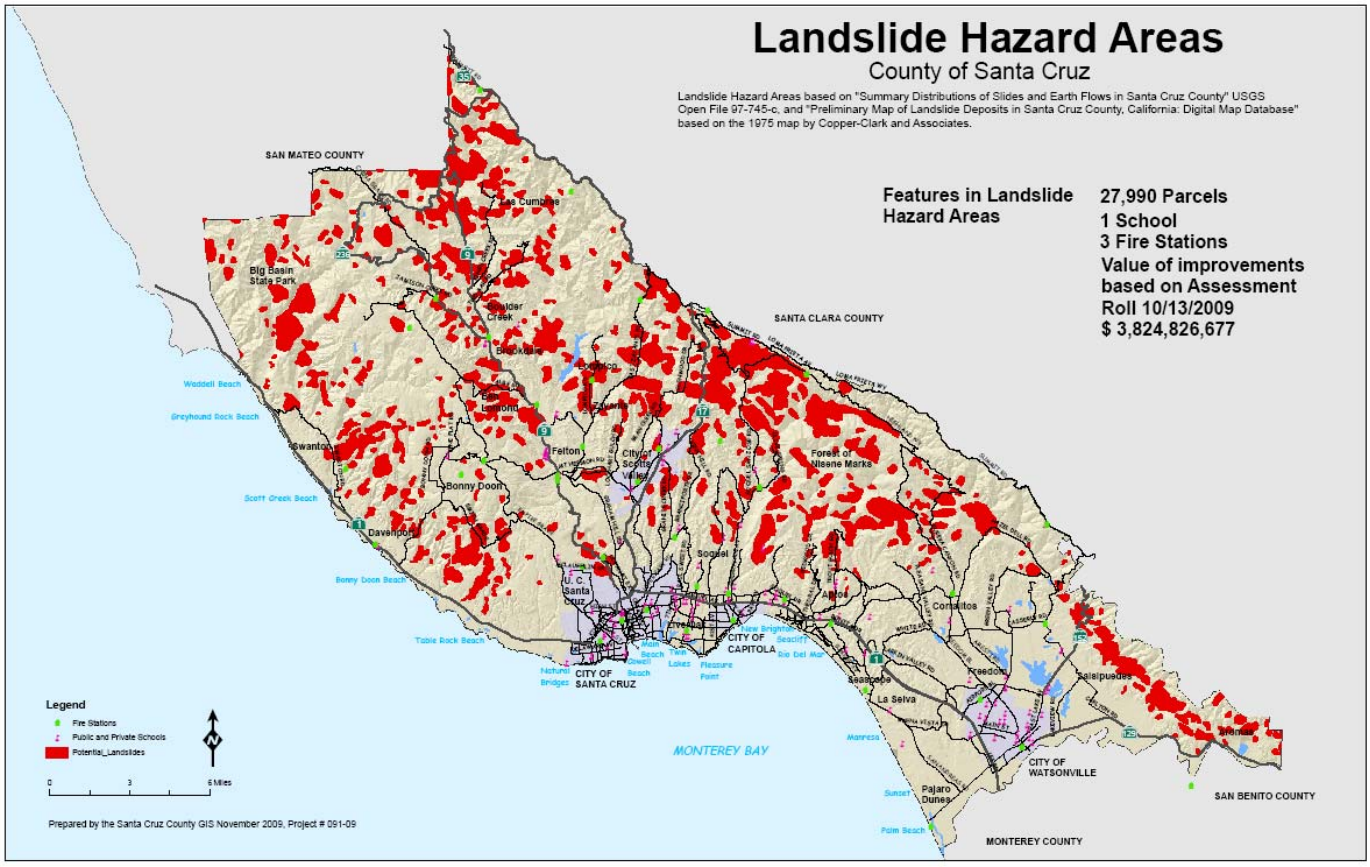


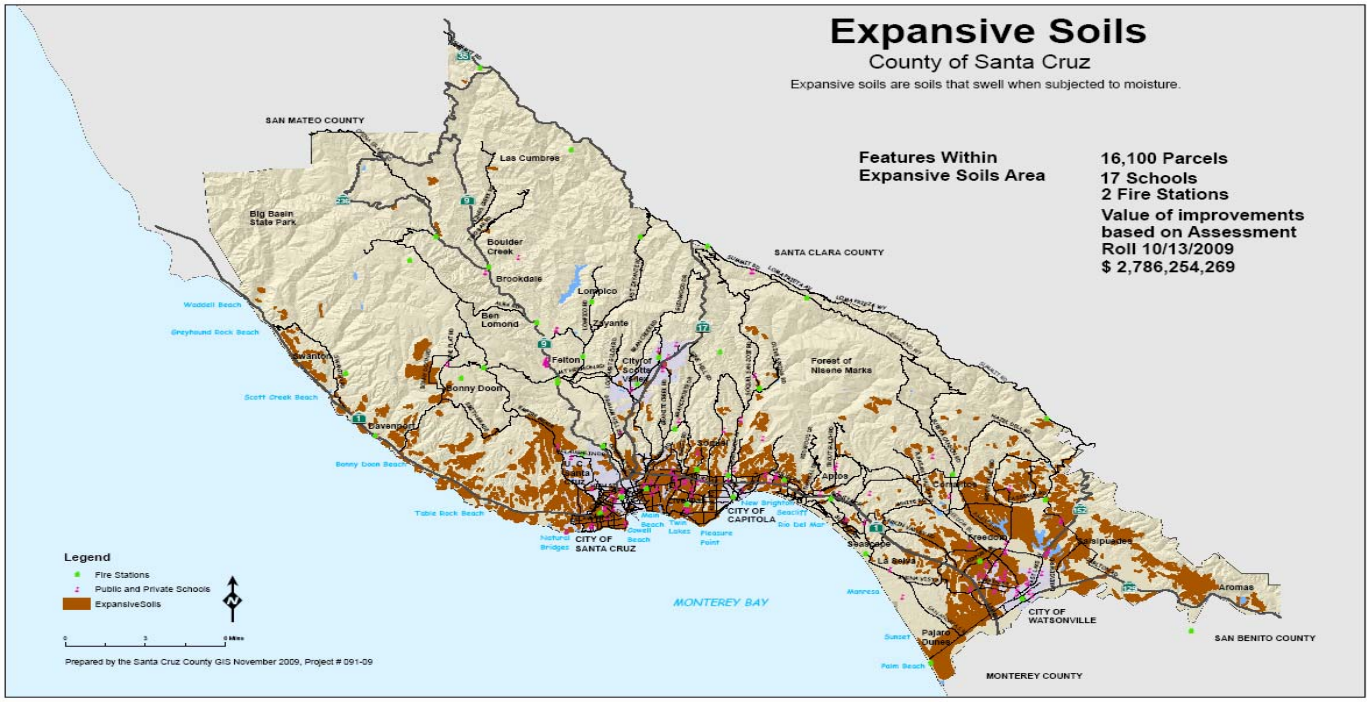

Generalized Critical Fire Hazard Areas
County of Santa Cruz
Generalized Critical Fire Hazard Mapping is based on data developed by Santa Cruz County GIS and the California Department of Forestry and Fire Protection. Critical areas are based on slope, vegetation, ability to respond, and specific weather conditions. For more information on the data development process refer to "2004 Generalized Fire Hazard Area" map or contact Santa Cruz County GIS staff at (831) 454-3101.
Features in Generalized Critical Fire Areas
9,326 Parcels
10,393 Structures
2 Schools
1 Fire Station
Value of improvements based on Assessment Roll 10/13/2009
$ 1,513,206,367
SAN MATEO COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
CITY OF SANTA CRUZ
CITY OF CAPITOLA
CITY OF WATSONVILLE
Legend
Fire Stations
Public and Private Schools
Generalized Critical Fire Hazard Areas
0
3
6 Miles
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09


FEMA Flood Hazard Areas
County of Santa Cruz
FEMA Flood Zones based on FEMA DFIRM data. Zones shown include A, Areas of 100 year flood, X Areas between the limits of the 100 year flood and the 500 year flood,and V, Areas of 100-year coastal flood with velocity (wave action).
Features in FEMA Flood Zones
6,462 Parcels
8,434 Structures
4 Schools
6 Fire Stations
Value of improvements based on Assessment Roll 10/13/2009
$ 841,289,346
SAN MATEO COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
CITY OF SANTA CRUZ
CITY OF CAPITOLA
CITY OF WATSONVILLE
Legend
Fire Stations
Public and Private Schools
FEMA Flood Insurance Zones A, V and X
0
3
6 Miles
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09


Tsunami Inundation Areas
County of Santa Cruz
The University of Southern California Tsunami Research Center did the Tsunami modeling. The modeling process utilized the MOST (Method of Splitting Tsunamis) computational program, which allows for wave evolution over a variable bathymetry and topography. The bathymetric/topographic data used consist of a series of nested grids. Near-shore grids with a 3 arc-second resolution or higher, were adjusted to "Mean High Water" sea-level conditions, representing a conservative sea level for the intended use of the tsunami modeling and mapping. The map was prepared with best currently available scientific information. The upper limits of the inundation area represent the maximum considered tsunami runup.
Features within Tsunami Inundation Area
2,827 Parcels
1,914 Structures
1 School
2 Fire Stations
Value of improvements based on Assessment Roll 10/13/2009
$ 470,746,242
Big Basin State Park
Boulder Creek
Brookdale
Lompico
Ben Lomond
Zayante
Felton
City of Scotts Valley
Bonny Doon
Swanton
Davenport
Waddell Beach
Greyhound Rock Beach
Scott Creek Beach
Bonny Doon Beach
Table Rock Beach
Natural Bridges
CITY OF SANTA CRUZ
U. C. Santa Cruz
Cowell Beach
Main Beach
Twin Lakes
Pleasure Point
Live Oak
CITY OF CAPITOLA
New Brighton
Seacliff
Rio Del Mar
Soquel
Aptos
Corralitos
Freedom
Salsipuedes
Seascape
La Selva
Manresa
MONTEREY BAY
CITY OF WATSONVILLE
Sunset
Pajaro Dunes
Palm Beach
MONTEREY COUNTY
Legend
Fire Stations
Public and Private Schools
Tsunami Inundation Area
0
2
4 Miles
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09

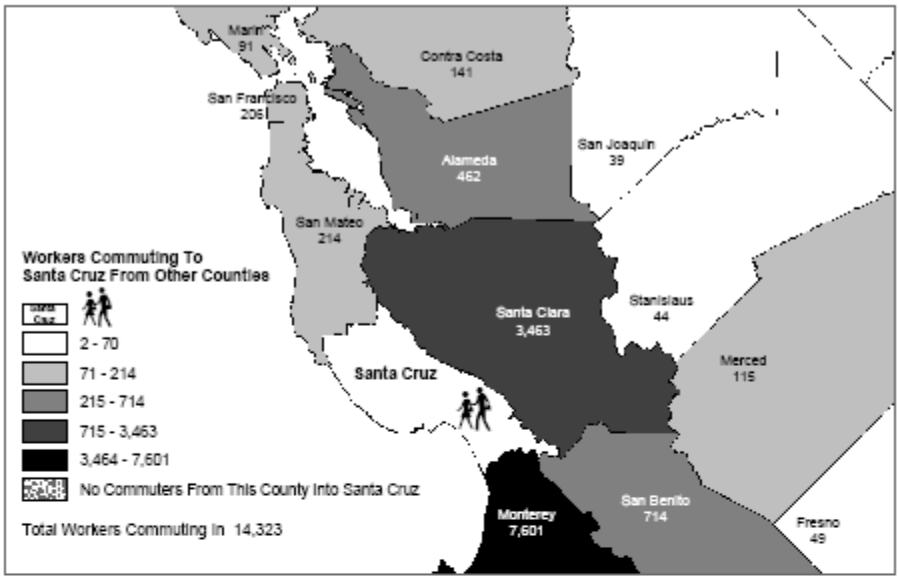

Coastal Erosion Hazard
County of Santa Cruz
Features within Coastal Erosion Hazard Area
747 Parcels
133 Structures
No Schools
No Fire Stations
Value of improvements based on Assessment Roll 10/13/2009
$ 156,126,084
Big Basin State Park
Boulder Creek
Brookdale
Lompico
Ben Lomond
Zayante
Felton
City of Scotts Valley
Bonny Doon
Swanton
Davenport
Waddell Beach
Greyhound Rock Beach
Scott Creek Beach
Bonny Doon Beach
Table Rock Beach
Natural Bridges
CITY OF SANTA CRUZ
U. C. Santa Cruz
Cowell Beach
Main Beach
Twin Lakes
Pleasure Point
Live Oak
CITY OF CAPITOLA
New Brighton
Seacliff
Rio Del Mar
Soquel
Aptos
Corralitos
Freedom
Salsipuedes
Seascape
La Selva
Manresa
MONTEREY BAY
CITY OF WATSONVILLE
Sunset
Pajaro Dunes
Palm Beach
MONTEREY COUNTY
Legend
Fire Stations
Public and Private Schools
Coastal Erosion Zone_A
Coastal Erosion Zone_V
0
2
4 Miles
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09

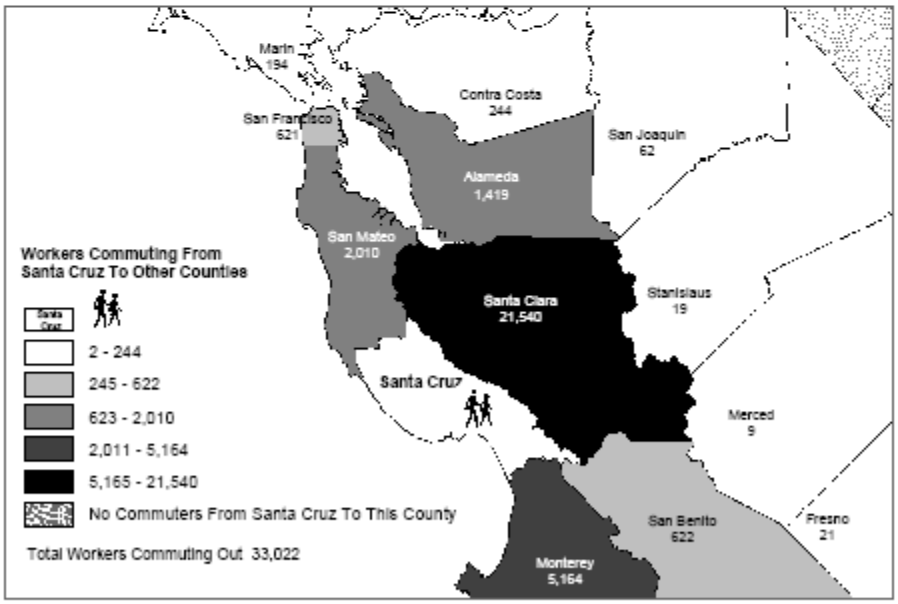

Landslide Hazard Areas
County of Santa Cruz
Landslide Hazard Areas based on "Summary Distributions of Slides and Earth Flows in Santa Cruz County" USGS Open File 97-745-c, and "Preliminary Map of Landslide Deposits in Santa Cruz County, California: Digital Map Database" based on the 1975 map by Copper-Clark and Associates.
Features in Landslide Hazard Areas
27,990 Parcels
1 School
3 Fire Stations
Value of improvements based on Assessment Roll 10/13/2009
$ 3,824,826,677
SAN MATEO COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
Las Cumbres
Big Basin State Park
Boulder Creek
Brookdale
Lompico
Ben Lomond
Zayante
Felton
City of Scotts Valley
Bonny Doon
Davenport
Swanton
Forest of Nisene Marks
Soquel
Aptos
Capitola
Corralitos
U. C. Santa Cruz
CITY OF SANTA CRUZ
CITY OF CAPITOLA
Freedom
Salsipuedes
La Selva
Aromas
CITY OF WATSONVILLE
Pajaro Dunes
Waddell Beach
Greyhound Rock Beach
Scott Creek Beach
Bonny Doon Beach
Table Rock Beach
Natural Bridges
Twin Lakes
Pleasure Point
Seacliff
Rio Del Mar
Manresa
Sunset
Palm Beach
Legend
Fire Stations
Public and Private Schools
Potential_Landslides
0
3
6 Miles
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09


Expansive Soils
County of Santa Cruz
Expansive soils are soils that swell when subjected to moisture.
Features Within Expansive Soils Area
16,100 Parcels
17 Schools
2 Fire Stations
Value of improvements based on Assessment Roll 10/13/2009
$ 2,786,254,269
SAN MATEO COUNTY
SANTA CLARA COUNTY
SAN BENITO COUNTY
MONTEREY COUNTY
MONTEREY BAY
Las Cumbres
Big Basin State Park
Boulder Creek
Brookdale
Lompico
Ben Lomond
Zayante
Felton
City of Scotts Valley
Bonny Doon
Davenport
Swanton
Forest of Nisene Marks
Soquel
Aptos
Capitola
Corralitos
U. C. Santa Cruz
CITY OF SANTA CRUZ
CITY OF CAPITOLA
Freedom
Salsipuedes
La Selva
Aromas
CITY OF WATSONVILLE
Pajaro Dunes
Legend
Fire Stations
Public and Private Schools
ExpansiveSoils
Prepared by the Santa Cruz County GIS November 2009, Project # 091-09

Appendix N – Commuter Maps for County of Santa Cruz

Santa Cruz
County to County Commuting

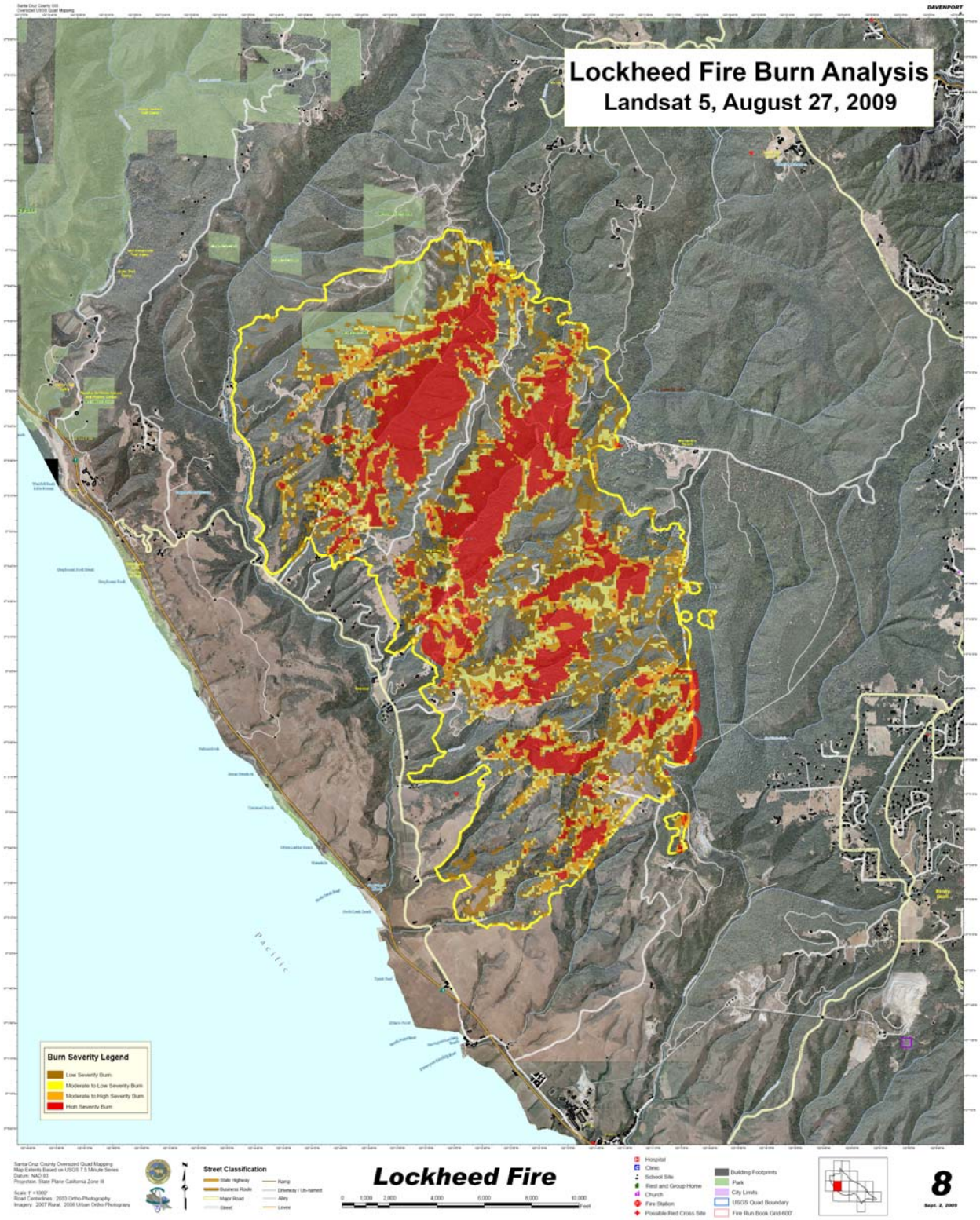




Total Workers That Live And Work In Santa Cruz 93,084

Data Source: U.S. Census 2000

Cartography by
Current Economic Statistics Group
Labor Market Information Division
California Employment Development Department
www.labormarketinfo.edd.ca.gov

Appendix O

Lockheed Fire Burn Analysis