Revision 0.0: July 14, 2005

MULTI-HAZARD MITIGATION PLAN

for

OLIVENHAIN
Municipal Water District

1966 Olivenhain Road
Encinitas, CA 92024
(760) 632-4647

Prepared By:

TRACER ENVIRONMENTAL SCIENCES & TECHNOLOGIES, INC.
970 Los Vallecitos Boulevard, Suite 100
San Marcos, California 92069
(760) 744-9611

Project No. RS-1701

RECORD OF REVISION

Revision #	Date	Date Entered	Name
Revision 0.0	July 14, 2005	July 14, 2005	Tracer ES&T

REVISION PAGE SUMMARY FORM

To all holders of the Olivenhain Municipal Water District Multi-Hazard Mitigation Plan document:

Revision Number:	0.0
Date:	July 14, 2005

Attached are revised pages of the Olivenhain Municipal Water District Multi-Hazard Mitigation Plan document of which you have a copy. Please remove the current pages in your book and replace them with the corresponding revised pages.

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1.0 OVERVIEW

1.1 INTRODUCTION

The Disaster Mitigation Act of 2000 (DMA2000) was promulgated in an effort to reduce the reconstruction costs associated with natural disasters by funding pre-disaster mitigation projects in state, local, and tribal communities. In order to ensure eligibility for hazard mitigation funding available through DMA 2000, jurisdictions are required to prepare a Multi-Hazard Mitigation Plan (MHMP). An approved mitigation plan includes an analysis of the range of natural hazards potentially affecting a jurisdiction, actions to mitigate these hazards, and a strategy to implement the mitigation actions identified. There are two major phases for completion of a Multi-Hazard Mitigation Plan: Risk Assessment and Mitigation Plan Development.

Risk Assessment
A jurisdiction's MHMP Risk Assessment requires an evaluation of the cost associated with potential natural disasters. For Olivenhain MWD, this process began with a determination of the natural hazards that could reasonably affect the district. The next step was to determine the possible impact of each disaster, which included a combination of determining the extent of a hazard, in addition to determining which of the district's assets are potentially affected by this hazard. This qualitative determination facilitates progressing to the next step of the assessment: estimating losses.

The estimation of losses resulting from each potential hazard required evaluating the fiscal losses associated with the damage, replacement, and displacement cost for every asset within each disaster's range of impact. The resulting estimation of losses for each potential hazard gave a monetary basis from which to develop a mitigation strategy.

Following completion of Olivenhain MWD's Risk Assessment phase, a report was prepared to document the process, methodology, and results of that phase of the project was created. The report was presented to the public, neighboring communities & agencies, etc. at an Olivenhain MWD Board Meeting (see Appendix G) and the report was made available to the public for review and comment thereafter.

Mitigation Plan Development
The results of the Risk Assessment phase directs the development of mitigation actions, which attempt to prevent, or ameliorate, the effect of the identified hazards. Following development of the mitigation actions, the results of the Multi-Hazard Hazard Mitigation Plan project were documented in this report. The report was reviewed by the MHMP Team (see Section 1.2) before the public, neighboring communities & agencies, etc. were again solicited for comment. Once all comments had been incorporated into the plan, the Olivenhain MWD Governing Board formally adopted the plan (see Appendix E) and the plan was deemed final.

The Multi-Hazard Mitigation Plan is comprised of four sections: the report begins with an overview of the project and a list of the personnel involved. Section 2 details the Risk Assessment phase, which includes a description of the methodology used and results formulated. Section 3 includes the mitigation actions proposed and a summary of the benefit-cost analysis. Section 4 outlines the ongoing plan maintenance procedures.

The Appendices contain a completed FEMA Region IX *Multi-Hazard Mitigation Plan Review Crosswalk*, meeting sign-in sheets, supporting data, the benefit-cost analysis for proposed mitigation actions, documented resolution for the adoption of the mitigation plan, the annual review summary form, the public hearing notices, and Tracer ES&T team member resumes.

1.2 TEAM MEMBERS

During the project kick-off meeting, the project leaders and representatives from Tracer ES&T established which Olivenhain MWD personnel were necessary for completion of the MHMP Project. Throughout the course of the project, team-member involvement was dynamically changed as participants were added/excused based upon their area of expertise and possible contribution to that phase of the project. The lists below delineate the names and titles of the participants in each step of the Risk Assessment phase.

(Note: Sign-in sheets for each meeting are included in Appendix B.)

Meeting 1 – Kick-off and Hazard Identification
Tom Kennedy, Olivenhain Municipal Water District, Operations Manager
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Rainy Selamat, Olivenhain Municipal Water District, Finance Manager
Kimberly Thorner, Olivenhain Municipal Water District, Assistant General Manager
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Meeting 2 – Hazard Profile I
Abe Gonzales, Olivenhain Municipal Water District, Operations Supervisor
Tom Kennedy, Olivenhain Municipal Water District, Operations Manager
Chuck Pollock, Olivenhain Municipal Water District, Operations Supervisor
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Ken Simmons, Olivenhain Municipal Water District, Engineering Supervisor
Kimberly Thorner, Olivenhain Municipal Water District, Assistant General Manager
Mark Weber, Olivenhain Municipal Water District, IT Supervisor
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Meeting 3 – Hazard Profile II
George Briest, Olivenhain Municipal Water District, Engineering Manager
Abe Gonzales, Olivenhain Municipal Water District, Operations Supervisor
Tom Kennedy, Olivenhain Municipal Water District, Operations Manager
Melissa Nickell, Olivenhain Municipal Water District, Human Resources Manager
Eric Phillips, Olivenhain Municipal Water District, Operations Supervisor
Chuck Pollock, Olivenhain Municipal Water District, Operations Supervisor
Joey Randall, Olivenhain Municipal Water District, Park Ranger
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Ken Simmons, Olivenhain Municipal Water District, Engineering Supervisor
Todd Torgerson, Olivenhain Municipal Water District, Risk/ Safety Compliance Coordinator
Mark Weber, Olivenhain Municipal Water District, IT Supervisor
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Meeting 4 – Estimation of Losses
Abe Gonzales, Olivenhain Municipal Water District, Operations Supervisor
Tom Kennedy, Olivenhain Municipal Water District, Operations Manager
Chuck Pollock, Olivenhain Municipal Water District, Operations Supervisor
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Todd Torgerson, Olivenhain Municipal Water District, Risk/ Safety Compliance Coordinator
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Risk Assessment Report – Draft Reviewers
Harry Ehrlich, Olivenhain Municipal Water District, Deputy General /Operations Manager
Abe Gonzales, Olivenhain Municipal Water District, Operations Supervisor
Karen Ogawa, Olivenhain Municipal Water District, Engineering Coordinator
Eric Phillips, Olivenhain Municipal Water District, Operations Supervisor
Chuck Pollock, Olivenhain Municipal Water District, Operations Supervisor
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Rainy Selamat, Olivenhain Municipal Water District, Finance Manager
Kimberly Thorner, Olivenhain Municipal Water District, Assistant General Manager
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Meeting 5 – Mitigation Planning
Harry Ehrlich, Olivenhain Municipal Water District, Deputy General /Operations Manager
Abe Gonzales, Olivenhain Municipal Water District, Operations Supervisor
Eric Phillips, Olivenhain Municipal Water District, Operations Supervisor
Chuck Pollock, Olivenhain Municipal Water District, Operations Supervisor
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Rainy Selamat, Olivenhain Municipal Water District, Finance Manager

Kimberly Thorner, Olivenhain Municipal Water District, Assistant General Manager
Todd Torgerson, Olivenhain Municipal Water District, Risk/ Safety Compliance Coordinator
Mark Weber, Olivenhain Municipal Water District, IT Supervisor
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

Multi-Hazard Mitigation Plan Report – Draft Reviewers
George Briest, Olivenhain Municipal Water District, Engineering Manager
Harry Ehrlich, Olivenhain Municipal Water District, Deputy General /Operations Manager
Melissa Nickell, Olivenhain Municipal Water District, Human Resources Manager
Mandy Rodriguez, Olivenhain Municipal Water District, Staff Analyst
Kimberly Thorner, Olivenhain Municipal Water District, Assistant General Manager
Todd Torgerson, Olivenhain Municipal Water District, Risk/ Safety Compliance Coordinator
Desmond O'Sullivan, Tracer ES&T, Project Manager
Jake Tilley, Tracer ES&T, Senior Engineer

2.0 RISK ASSESSMENT

To complete the Risk Assessment phase of Olivenhain Municipal Water District's Multi Hazard Mitigation Plan, the MHMP Team utilized planning guidelines[6] issued by FEMA. FEMA's guidelines include steps to evaluate the cost resulting from naturally occurring hazards such as floods, earthquakes, tsunamis, tornadoes, coastal storms, landslides, and wildfires. Additional hazards were considered by applying FEMA's methodology in an analogous framework.

2.1 HAZARD IDENTIFICATION

During the kick-off meeting, the project team outlined the project objectives and methodology, reviewed the proposed schedule, and began the risk assessment process by identifying which hazards pose reasonable threats to Olivenhain MWD's assets. Identifying hazards is a two-step process: firstly, historical records and operator experience were utilized to establish a list of natural hazards which could possibly affect Olivenhain MWD. This list was then scrutinized to determine which hazards had a reasonable probability of occurring and merited inclusion in the Multi-Hazard Mitigation Plan.

In their MHMP guidelines, FEMA has listed a range of possible natural hazards. The list, and each hazard's applicability, is included below:

Table 2-1 Hazard Identification

Hazard	Relevance	Comments
Avalanche	Excluded	Olivenhain MWD is not located in an area which experiences frequent or heavy snowfalls.
Coastal Erosion	Excluded	Although Olivenhain MWD assets span the San Diego County coastline from Oceanside to Cardiff, no asset lies within two miles of the coast. The erosion rate of the coastline in this area (Oceanside to Cardiff) has a maximum of 0.43 meters per year (see Appendix C), which does not present a threat to Olivenhain MWD assets.
Coastal Storm	Excluded	In the San Diego County region, a coastal storm constitutes heavy rainfall, strong winds, and coastal erosion. As coastal erosion was eliminated from the MHMP Study (see above) and the hazard events associated with heavy rainfall and strong winds were addressed under *Flooding* and *Windstorm*, the Olivenhain MWD MHMP Team decided to omit this hazard from further study.
Dam Failure	Included	See Hazard Profiling – Section 2.

Hazard	Relevance	Comments
Drought	Excluded	As Olivenhain MWD's water supply is the Colorado River, a drought in the San Diego County region would not directly affect the district's supply, but would increase demand. A drought affecting the water source, however, would not affect demand but would affect supply. In both scenarios, the district would ration water supply to its customers based upon availability and that customer's necessity to the community's critical operations. Due to the limited adverse impact of this hazard, the MHMP Team determined that this hazard-type does not warrant sufficient concern to merit further attention and was excluded from the study.
Earthquake	Included	See Hazard Profiling – Section 2.
Expansive Soils	Excluded	The majority of the area upon which the district's system is built does not experience sufficient soil expansion to disturb district operations. One exception has been a pipe-line near 'Jackie Lane', which has since been re-piped to ameliorate the problem. Due to the low probability of this hazard, the MHMP Team determined that this hazard-type does not warrant sufficient concern to merit further attention and was excluded from the study.
Extreme Heat	Excluded	Extreme climatic temperature rises would not adversely affect system piping or vessels, but may affect temperature sensitive instruments, such as computers and monitoring equipment. The vast majority of the district's buildings are equipped with air-conditioning, which prevents temperatures that could damage sensitive instruments. Annual heat-exhaustion prevention training is administered to field operators, who are equipped with wide-brimmed hats and sunscreen for operations to be performed without shade. In addition, all trucks are equipped with air-conditioning. Due to the low probability of this hazard, the MHMP Team determined that this hazard-type does not warrant sufficient concern to merit further attention and was excluded from the study.
Flood	Included	See Hazard Profiling – Section 2.
Hailstorm	Excluded	According to data provided by the Environmental Systems Research Institute (see Appendix C), there has not been a recorded hailstorm of significant magnitude in San Diego County.
Hurricane	Excluded	According to data provided by the Environmental Systems Research Institute (see Appendix C), there has not been a recorded hurricane of significant magnitude along the San Diego County coastline.
Land Subsidence	Excluded	The MHMP Team did not have any readily-available, lucid data from which to evaluate the potential impact of Land Subsidence. The team relied upon personal experience of the area and historical occurrences to identify which assets could be adversely affected by a landslide. The MHMP Team's knowledge of the area indicates that the consistency of the soil does not present any serious danger of Land Subsidence. Previous instances of land subsidence have been recorded in the area; however, these have been rare and unpredictable. As a result, the MHMP Team decided to omit this hazard from further study.
Landslide	Included	See Hazard Profiling – Section 2.

Hazard	Relevance	Comments
Severe Winter Storm	Excluded	In the San Diego County region, a severe winter storm constitutes heavy rainfall coupled with strong winds. As the hazard events associated with heavy rainfall and strong winds were addressed under *Flooding* and *Windstorm*, the Olivenhain MWD MHMP Team decided to omit this hazard from further study.
Tornado	Excluded	According to data provided by the Environmental Systems Research Institute (see Appendix C), there have been three recorded tornadoes (two prior to 1970 and one post 1980) in San Diego County. All three registered as a Level 1 on the Fujita scale. In addition, FEMA tornado guidelines [8] (see Appendix C) place San Diego county in the 'LOW' tornado hazard category. From the available data, the MHMP Team determined that this hazard-type does not warrant sufficient concern to merit further attention and was excluded from the study.
Tsunami	Excluded	To evaluate the possible effects of a Tsunami, the MHMP Team reviewed the San Diego County Tsunami Evacuation Planning Maps (see Appendix C) developed by the California Office of Emergency Services. The MHMP Team concluded that the maps indicate a plausible Tsunami (i.e., with a maximum water elevation of 12.8 meters) will not affect Olivenhain MWD assets.
Volcano	Excluded	There are no volcanoes in the vicinity of Olivenhain MWD.
Wildfire	Included	See Hazard Profiling – Section 2.
Windstorm	Included	See Hazard Profiling – Section 2.

In addition to the hazards proposed in FEMA's guidance, the MHMP Team supplemented the list based upon personal knowledge of the district and operator experience. The following hazards were included in the project and are expanded upon in Section 2.2:

- Man-made Hazards (e.g., sabotage, vandalism, IT, etc.)
- Pestilence

2.2 HAZARD PROFILE

Hazard profiling includes a determination of the effect of each hazard retained from the Hazard Identification phase, i.e., an evaluation of each hazard's possible impact and the corresponding vulnerability of Olivenhain MWD assets. This phase of the project required two assemblies of the MHMP team. Historical records and scientific data were scrutinized to assess the possible effect, where available; knowledge of the district by its employees was included to compliment the scientific data.

Note: The hazards are listed in the order in which they were addressed by the MHMP Team.

Flood

The MHMP Team utilized FEMA's *Flood Insurance Rate Map (FIRM)* to determine which of the district's assets lay within the 100-year flood plain. The following Olivenhain MWD assets were identified as potentially susceptible to flood damage and their locations were compared to the

appropriate FIRM (the number in parenthesis following each asset references the applicable FIRM 'parcel' that contains that asset – see Appendix C):

- Thornton Pump Station (06073C1042F)
- District Head Quarters (06073C1053F)
- Water Treatment Plant (06073C1059F)
- Cielo Pump Station (06073C1066F)
- Maryloyd Pump Station (06073C1059F)
- Wastewater Treatment Plant (06073C1088F)
- Rancho Lakes Pump Station (06073C1331F)
- Hydro Electric Plant (N/A – No FIRM Parcel)

Note: All of the above assets were found to lie outside of the 100-year flood plain, based upon a detailed examination of the corresponding FIRMs.

The district's reservoirs were not considered susceptible to flooding as all reservoirs are located in elevated locations. Also, the effect of flooding on the distribution system piping was not entertained, as the piping is waterproof by design. However a number of Olivenhain MWD's pipelines do cross creeks and rivers (Encinitas Creek, Escondido Creek, and the San Dieguito River). As a result, the pipeline could be submerged and then impacted by flood debris.

Finally, the MHMP Team also identified the trees in the Elfin Forest Reserve and the bridge to the reserve as historical victims of flooding. Following flood damage, OMWD has re-planted numerous oaks, sycamores, and willows in the reserve.

Dam Failure

There is one dam located within the district – Olivenhain Dam (formerly Mount Israel Dam). A comprehensive report detailing the effects of a failure of this dam are documented in the *Olivenhain Municipal Water District: Mount Israel Raw Water Storage Project – Dam Failure Inundation Study*. A copy of the report is included in Appendix C. The report includes figures displaying the calculated inundation zones resulting from a failure of the Olivenhain Dam. Although there are Olivenhain MWD Assets (the Water Treatment Plant and some pipelines) located on these parcels of land, it should be noted that there have been no residential structures constructed in the inundation zone, nor will any structures be constructed in the inundation zone. Finally, the Lake Hodges Dam, although located outside the district, would affect the Del Dios Pump Station in the event of a failure.

Landslides

The MHMP Team did not have any readily available, lucid data from which to evaluate the potential impact of Landslides. The team relied upon personal experience of the area and historical occurrences to identify assets which would be adversely affected by a landslide.

The Wiegand, Wanket, and Extension 21 Reservoirs were identified as Olivenhain MWD assets which could be destroyed by a landslide; however, the probability of failure was deemed low as there is no current indication of landslide damage, nor has there been any historical incidents. The Elfin Forest Reserve has, in previous years, experienced frequent damage due to landslide events and is the only potential landslide victim included in this report.

Windstorm

Historically, the area in which the Olivenhain MWD is located has not (see discussion of Tornadoes – Section 2.1) been subject to windstorms of sufficient ferocity to inflict structural damage; however, the MHMP Team identified one asset as vulnerable to the effects of lower velocity winds: the cover of the Gaty 1 Reservoir is prone to experiencing aerodynamic lift during modestly powerful windstorms. There is a potential for damage to the covering, in addition to the Reservoir's equipment, in the event of a sufficiently powerful gust of wind.

Earthquake

The Olivenhain Municipal Water District is not located in the immediate vicinity of any known faults[4]. Historically, San Diego County has periodically experienced low magnitude earthquakes. According to the *USGS/CGS Probabilistic Seismic Hazard Assessment Model 2002*[4] (see Appendix C), the Olivenhain MWD is located within an area which has a 10% probability of exceeding a 0.3g ($g=9.8\ ms^{-2}$) peak ground acceleration every 50 years.

Although an earthquake could potentially impact all Olivenhain MWD assets, the distribution systems (i.e., system piping), the pressure control systems, and interconnects were eliminated from further study as the cost of repairing earthquake damage to the system was considered to be negligible.

In addition, all reservoirs constructed after 1988 were assumed to be resistant to earthquake due to the seismic requirements of the 1988 Uniform Building Code. All reservoirs built prior to 1988 were assumed to require 100% reconstruction costs in the event of an earthquake resulting in a peak ground acceleration of 0.3g. These reservoirs include:

- Berk
- Denk
- Gaty I
- Gaty II
- Maryloyd
- Palms I
- Palms II

- Wanket
- Wiegand
- Zorro I
- Roger Miller

Wildfires

Historically, the San Diego County area has experienced periodic wildfires; however, as a result of the maritime climate and extensive land development, the San Diego County Coastal areas have not been susceptible to extreme damage due to wildfire in recent years. Moreover, the district's water distribution system consists, primarily, of vessels and pipelines, which can withstand temperatures far in excess of the maximum temperatures experienced in wildfires, or are located underground and, hence, protected from the effects of a wildfire.

In addition, the district's treatment plants and office buildings are either in developed areas or are surrounded by areas that have been cleared of wildfire fuel, thus eliminating them as potential wildfire victims. The Gaty Reservoir, however, is not such an asset – the reservoir cover presents the primary concern for wildfire damage. The reservoir is located in an area which i) perennially experiences between 2 to 7 days of critical fire weather [7], ii) has less than 40% grade, and iii) is surrounded by light wildfire fuel. This places the reservoir in an area of medium wildfire hazard severity (source: *Urban Wildfire Interface Code 2000* – see Appendix C).

Finally, the Elfin Forest Reserve has, in previous years, experienced frequent damage due to wildfire events. The reservoir is located within an area which i) perennially experiences between 2 to 7 days of critical fire weather [7], ii) has less than 40% grade, and iii) is surrounded by light wildfire fuel. This places the reservoir in an area of medium wildfire hazard severity (source: *Urban Wildfire Interface Code 2000* – see Appendix C). (Note: Although the Water Treatment Plant is located within the Elfin Forest Reserve, it is constructed of metal and block and its immediate surroundings have been cleared of all wildfire fuels. The MHMP Team determined that the potential damage to the Water Treatment Plant to be negligible.)

Pestilence

Olivenhain MWD district has experienced widespread tree damage due to Red Gum Lurp Psyllid (commonly known as 'lurp') infestation. The lurp attach to the leaves of the eucalyptus, and although the lurp will not kill the tree directly, large densities will cause the tree to shed its leaves. As a result, the district has been forced to periodically remove infected eucalyptus trees in order to prevent damage due to falling leaves. All eucalyptus trees are scheduled for removal within the next five years by Olivenhain MWD staff.

Man Made

In November 2003, Olivenhain MWD prepared a comprehensive Security & Vulnerability Analysis (SVA) to comply with the *Public Health Security and Bioterrorism Response Act of 2002*. In

accordance with the particulars of that Act, the results of the vulnerability analysis are to remain confidential and are not to be disseminated to the public due to the sensitive nature of the analysis.

The security and vulnerability assessment evaluated Olivenhain MWD's susceptibility to acts of terrorism and industrial sabotage. The SVA team used the results of this assessment to establish action items to mitigate or prevent the realization of these scenarios. The action items were also prioritized by the possible severity of each threat.

Thus, the SVA process takes an analogous approach to hazard identification, profiling, and mitigation as the MHMP process. In accordance with the *Public Health Security and Bioterrorism Response Act of 2002,* the details and results of the analysis will not be divulged. As the possible adverse impacts resulting from man-made hazards have been addressed in a previous report, the MHMP Team decided not to include a redundant analysis in this study.

The results of the Hazard Profiling phase of the project is summarized in the following table. Each of the district's assets are listed and the hazards that could, based upon the MHMP Team's analysis, potentially cause fiscal losses are appropriately checked.

Table 2-2: Assets Affected (by Hazard Type)

Asset ↓	Flood	Dam Failure	Land-slides	Wind-storm	Earth-quake	Wildfire
Water Treatment Plant		X			X	
Wastewater Treatment Plant					X	
Hydro Electric Plant					X	
District Headquarters					X	
Elfin Forest Reserve	X[1]		X			X
Pressure Control Systems (70)						
Water Pump Stations (4)					X	
Wastewater Pump Stations (7 large)					X	
Wastewater Pump Stations (15 small)		X[3]			X	
Reservoirs (17)				X[4]	X[5]	X[6]
Distribution System (361 miles approx.)	X[2]					
Interconnects (32)						
Recycled Water Reservoir (Steel)					X	
Recycled Water Reservoir (Concrete)					X	

Asset ↓	Flood	Dam Failure	Land-slides	Wind-storm	Earth-quake	Wildfire
Recycled Water Distribution System (15 miles approx.)						
Recycled Water Pressure Control Systems (2)						
Recycled Water Pump Stations (2)					X	

Notes:

1. The Elfin Forest Reserve Bridge and trees have been historical victims of flood events.
2. The pipelines which cross Encinitas Creek, Escondido Creek, and the San Dieguito River, were identified as susceptible to impact by debris during flooding.
3. The Del Dios Pump Station was identified as susceptible to destruction in the event of dam failure (Olivenhain Dam).
4. The cover of the Gaty 1 Reservoir was highlighted as susceptible to strong gusts.
5. Reservoirs constructed prior to 1988 were deemed susceptible to damage from earthquakes. This includes the following reservoirs: Berk, Denk, Gaty I & II, Maryloyd, Palms I & II, Wanket, Wiegand, Zorro I, Roger Miller, and the 4S Reservoir.
6. The cover of the Gaty 1 Reservoir was highlighted as susceptible to damage by a wildfire.

2.3 ESTIMATION OF LOSSES

Estimation of losses included a calculation of the approximate monetary impact of each hazard profiled in Section 2.2. This required estimation of the structural and content replacement costs, in addition to any displacement and/or functional costs incurred by providing continuing water service to the district's customers. The district's Master Plan and the expertise of the district's financial, engineering, and operational employees were utilized to provide estimates of all assets; FEMA's Multi-Hazard Mitigation Plan Guidance was used to estimate each hazard's potential cost as a function of its range of impact and the affected assets' values.

The following table summarizes Olivenhain MWD assets and their estimated replacement, functional, and displacement costs.

Table 2-3: Asset Inventory

Asset ↓	**Structural Replacement Cost ($)**	**Content Replacement Cost ($)**	**Daily Functional Cost ($) (Loss of Revenue)**	**Daily Displacement Cost ($) (Cost of Temp Facilities)**
Water Treatment Plant	24,000,000	36,000,000	6,000	5,000
Wastewater Treatment Plant	25,000,000	15,000,000	1,000	5,000
Hydro Electric Plant	600,000	900,000	0	0
District Headquarters – Building A	4,250,000	4,250,000	0	1,000
District Headquarters – Building B	4,000,000	4,000,000	0	1,000
Elfin Forest Reserve Bridge and Trees	150,000	0	0	0
Pressure Control Systems (70)	*Hazard impact negligible (see Section 2.2) – excluded from further study.*			
Water Pump Stations (7)	800,000 per unit - 5,600,000 total	1,200,000 per unit – 8,400,000 total	5,000	5,000
Wastewater Pump Stations (7 large)	1,400,000 per unit - 9,800,000 total	2,100,000 per unit - 14,700,000 total	4,000	5,000
Wastewater Pump Stations (15 small)	200,000 per unit - 3,000,000 total	300,000 per unit - 4,500,000 total	5,000	5,000
Reservoirs (17)	5,500,000 per unit[1] – 96,000,000 total	0	0	0
Distribution System (361 miles approx.)	325 per foot[2] – 618,500,000 total	0	0	0
Interconnects (32)	*Hazard impact negligible (see Section 2.2) – excluded from further study.*			
Recycled Water Reservoir (Steel)	2,000,000	0	0	0
Recycled Water Reservoir (Concrete)	4,500,000	0	0	0
Recycled Water Distribution System (15 miles approx.)	*Hazard impact negligible (see Section 2.2) – excluded from further study.*			
Recycled Water Pressure Control Systems (2)	*Hazard impact negligible (see Section 2.2) – excluded from further study.*			

Asset ↓	Structural Replacement Cost ($)	Content Replacement Cost ($)	Daily Functional Cost ($) (Loss of Revenue)	Daily Displacement Cost ($) (Cost of Temp Facilities)
Recycled Water Pump Stations (2)	1,200,000 per unit - 2,400,000 total	1,800,000 per unit - 3,600,000 total	1,000	1,700
Totals	852,832,000	91,350,000	TBD	TBD

Notes:
1. The cost of structural replacement per reservoir was calculated by dividing the total estimated cost of replacing all district reservoirs by the total number of reservoirs in the district.
2. The cost of structural replacement per unit foot of piping was calculated by dividing the estimated cost of replacing all district piping by the total linear distance of piping in the district.
3. Due to system redundancy, the individual loss of many of the above assets would not result in functional and/or displacement costs.

Flood

For pipelines impacted by flood debris (i.e., the pipelines crossing the Encinitas Creek, Escondido Creek, and the San Dieguito River), complete destruction of the pipe spanning the creek/river was assumed.

Escondido Creek Pipeline Estimated Losses:

- Structural & Content Replacement Costs - $325 per/foot x 1,760ft = $572,000
- Displacement & Functional Loss – Not Applicable
- Total Estimated Losses - $572,000.

San Dieguito River Pipeline Estimated Losses:

- Structural & Content Replacement Costs - $325 per/foot x 700ft = $227,500
- Displacement & Functional Loss – Not Applicable
- Total Estimated Losses - $227,500.

Elfin Forest Reserve Bridge & Reserve (includes trees & fencing) Estimated Losses:

- Structural & Content Replacement Costs - $150,000
- Displacement & Functional Loss – Not Applicable
- Total Estimated Losses - $150,000.

Dam Failure

For assets located within the Dam Failure inundation zones, complete destruction was assumed.

Water Treatment Plant Estimation of Losses:
It was estimated that it would require 550 days (18 months) to rebuild the water treatment plant.

- Structural & Content Replacement Costs - $60,000,000
- Displacement & Functional Cost - $11,000 per day x 550 days = $6,050,000
- Total Estimated Losses - $66,050,000

Del Dios Wastewater Pump Station:
It was estimated that it would require 365 days to rebuild the Del Dios Wastewater Pump Station.

- Structural & Content Replacement Costs - $500,000
- Displacement & Functional Cost - $9,000 per day x 365 days = $3,285,000
- Total Estimated Losses - $3,785,000

San Dieguito River Pipeline Estimated Losses:

- Structural & Content Replacement Costs - $325 per foot x 700ft = $227,500
- Displacement & Functional Loss – Not Applicable
- Total Estimated Losses - $227,500.

Landslides
In previous years, the Elfin Forest Reserve has experienced frequent damage due to landslide events. The costs of restoration following landslide damage in the reserve have averaged $40,000 per mile of fencing and trails. There are 12 miles of fencing and trails in the reserve which could be affected by landslides; hence, the total estimated restoration costs would amount to $480,000. There are displacement or functional losses associated with the Elfin Forest Reserve.

Windstorm
The cover for the Gaty Reservoir was identified as susceptible to destruction resulting from a Windstorm. In this scenario, 100% destruction of the reservoir cover was assumed. However, Olivenhain MWD decided that, in the event of destruction of the cover, it would not be replaced.

Gaty Reservoir Cover Estimated Losses:

- Structural & Content Replacement Costs - $0
- Displacement & Functional Loss - $0
- Total Estimated Losses - $0.

Earthquake
According to the *USGS/CGS Probabilistic Seismic Hazard Assessment Model 2002*[4] (see Appendix C), the Olivenhain MWD is located within an area which has a 10% probability of exceeding a 0.3g ($g=9.8ms^{-2}$) peak ground acceleration every 50 years.

FEMA's guidance for estimation of loss resulting from earthquakes categorizes assets by structure type and materials of construction. Although many of the Olivenhain MWD structures did not correlate exactly with the model, the MHMP Team used the structure and materials of construction

definition they believed that corresponded most exactly. The seismic design level was chosen based upon the year of construction and if there have been any seismic retrofits.

District Headquarters' Building A Estimation of Losses:
District Headquarters Building A most closely resembles the definition of a residence of wood frame construction. For a peak ground acceleration (PGA) of 0.3 and a moderate seismic design level, this corresponds[6] to a Building Damage Ratio of 3.9 and a Loss of Function of 10 days.

- Structural & Content Replacement Costs - $8,500,000 x 3.9% = $331,500
- Displacement & Functional Cost - $1,000 per day x 10 days = $10,000
- Total Estimated Loss - $341,500

District Headquarters' Building B Estimation of Losses:
District Headquarters Building B most closely resembles the definition of a residence of reinforced masonry construction. For a peak ground acceleration (PGA) of 0.3 and a moderate seismic design level, this corresponds[6] to a Building Damage Ratio of 6.1 and a Loss of Function of 46 days.

- Structural & Content Replacement Costs - $8,000,000 x 6.1% = $488,000
- Displacement & Functional Cost - $1,000 per day x 46 days = $46,000
- Total Estimated Loss - $534,000

Pump Stations' Estimation of Losses:
The district's Pump Stations most closely resemble the definition of a light industrial facility. For a peak ground acceleration (PGA) of 0.3 and a moderate/high seismic design level, this corresponds[6] to a Building Damage Ratio of 7.7/6.1 and a Loss of Function of 17/7 days.

Water Pump Stations:

- Structural & Content Replacement Costs per Station - $2,000,000 x 7.7% = $154,000
- Displacement & Functional Cost per Station - $10,000 per day x 17 days = $170,000
- Total Estimated Losses per Station - $324,500
- Total Estimated Losses for all Stations - $324,500 x 7 = $2,271,500

Wastewater Pump Stations (Large):

- Structural & Content Replacement Costs per Station - $3,500,000 x 6.1% = $213,500
- Displacement & Functional Cost per Station - $9,000 per day x 7 days = $63,000
- Total Estimated Losses per Station - $276,500
- Total Estimated Losses for all Stations - $276,500 x 7 = $1,935,500

Wastewater Pump Stations (Small):

- Structural & Content Replacement Costs per Station - $500,000 x 6.1% = $30,500
- Displacement & Functional Cost per Station - $10,000 per day x 7 days = $70,000
- Total Estimated Losses per Station - $100,500

- Total Estimated Losses for all Stations - $100,500 x 15 = $1,507,500

Recycled Water Pump Stations:

- Structural & Content Replacement Costs per Station - $3,000,000 x 6.1% = $183,000
- Displacement & Functional Cost per Station - $2,700 per day x 7 days = $18,900
- Total Estimated Losses per Station - $201,900
- Total Estimated Losses for all Stations - $201,900 x 2 = $403,800

Treatment Plant's Estimation of Losses:

The district's Treatment Plants most closely resemble the definition of a light industrial facility. For a peak ground acceleration (PGA) of 0.3 and with a high seismic design level, this corresponds[6] to a Building Damage Ratio of 6.1 and a Loss of Function of 7 days.

Water Treatment Plant:

- Structural & Content Replacement Costs - $60,000,000 x 6.1% = $3,660,000
- Displacement & Functional Cost - $11,000 per day x 7 days = $77,000
- Total Estimated Losses - $3,733,000

Wastewater Treatment Plant:

- Structural & Content Replacement Costs - $40,000,000 x 6.1% = $2,440,000
- Displacement & Functional Cost - $10,000 per day x 7 days = $70,000
- Total Estimated Losses - $2,510,000

Reservoirs

As a result of an earthquake, the district's reservoirs will either be completely destroyed, or suffer negligible damage. The list of reservoirs susceptible to damage from an earthquake include:

- Berk
- Denk
- Gaty I
- Gaty II
- Maryloyd
- Palms I
- Palms II
- Wanket
- Wiegand
- Zorro I
- Roger Miller

Notes: i) All the above reservoirs service the potable water system.
ii) The Zorro I reservoir was previously retrofitted to high seismic design.

Water Reservoir:

- Structural & Content Replacement Costs - $5,500,000
- Displacement & Functional Loss - $0 per day x 182 days = $0
- Total Estimated Losses - $5,500,000.

Wildfires

The cover for the Gaty Reservoir was identified as susceptible to destruction resulting from a Wildfire. In this scenario, 100% destruction of the reservoir cover was assumed. However, Olivenhain MWD decided that, in the event of destruction of the cover, it would not be replaced.

Gaty Reservoir Cover Estimated Losses:

- Structural & Content Replacement Costs - $0
- Displacement & Functional Loss - $0
- Total Estimated Losses - $0.

Elfin Forest Reserve Estimated Losses:

In previous years, the Elfin Forest Reserve has experienced frequent damage due to wildfire events. The costs of restoration following wildfire damage in the reserve have averaged at $20,000 per acre. There are 600 acres in the reserve which could be affected by wildfire; hence, the total estimated restoration costs would amount to $12,000,000. There would be no displacement or functional losses associated with the Elfin Forest Reserve.

Pestilence

Over the past number of years, the cost to Olivenhain MWD assets resulting from damage by falling eucalyptus leaves, in addition to the cost of removing the debris, has averaged $30,000 per year. The rate of damage has increased, however, and the district's landscaping department estimates that approximately $40,000 damage will be experienced per annum in the coming years. There are neither displacement nor functional losses associated with pestilence.

Manmade

The estimated losses resulting from manmade hazard events were developed in Olivenhain MWD's Security & Vulnerability Analysis – see Section 2.2.

2.4 LOSS SUMMARY

The following table compares the estimated losses associated with each hazard:

Table 2-4 Loss Summary

Hazard	Total Loss ($)
Flood	949,500
Dam Failure	70,062,500
Landslides	480,000
Earthquake	68,236,800
Wildfires	12,000,000
Pestilence	40,000 per annum

It should be noted that the probability of each hazard varies; for example, even though Dam Failure may have more estimated losses relative to Floods, the increased probability of Floods suggests that that hazard event merit closer attention when establishing mitigation goals/actions.

3.0 MITIGATION STRATEGY

3.1 MITIGATION GOALS, OBJECTIVES, AND ACTIONS

The results of the Risk Assessment process form a basis from which to continue to the next step of the hazard mitigation process: mitigation planning. The MHMP Team studied the estimated losses for each hazard event and each impacted asset. The Team began by establishing the following mitigation goal:

'To reduce or eliminate loses to current and future Olivenhain Municipal Water District assets from hazard events by establishing cost-effective mitigation projects.'

The MHMP Team further specified the intent of the mitigation goal by developing the following mitigation objectives:

1. To protect or relocate pipelines potentially affected by flood damage.
2. To reduce the effect or probability of a dam failure.
3. To prevent or mitigate the effect of landslides.
4. To strengthen the district's assets from seismic events.
5. To prevent wildfire damage in the Elfin Forest Reserve.
6. To reduce costs associated with damage to eucalyptus trees from lurp.
7. To ensure future construction projects consider the findings of the Multi-Hazard Mitigation Plan.

Using the above mitigation objectives, the MHMP Team reviewed each hazard event studied in the Risk Assessment phase and developed specific actions to mitigate or prevent the potential losses. To comply with the requirement of DMA2000, alternate mitigation actions are required to be considered.

<u>Flood</u>
Assets potentially impacted by flood damage (see Section 2) are listed below:

- Escondido Creek Pipeline
- San Dieguito River Pipeline
- Elfin Forest Reserve Bridge & Reserve

Using Mitigation Objective 1, the MHMP Team formulated the following Mitigation Actions:
M01: Elevate the pipeline crossing the Escondido Creek above the 100-year floodplain.
M02: Bury the pipeline crossing the Escondido Creek below the creek bed.
M03: Elevate the pipeline crossing the San Dieguito River above the 100-year floodplain.
M04: Bury the pipeline crossing the San Dieguito River below the river bed.
M05: Relocate the Reserve Bridge outside of the floodplains.

M06: Elevate the Reserve Bridge above the 100-year floodplain.
M07: Increase the structural strength of the park restrooms to withstand flood events.
M08: Relocate the restrooms in the Reserve above the 100-year floodplain.

Dam Failure

Assets potentially impacted by dam failure (see Section 2) are listed below:

- Wastewater Treatment Plant
- Del Dios Wastewater Pump Station
- San Dieguito River Pipeline

Using Mitigation Objective 2, the MHMP Team formulated the following Mitigation Actions:
M09: Relocate the Wastewater Treatment Plant outside of the Dam Inundation Zone.
M10: Relocate the Del Dios Pump Station outside of the Dam Inundation Zone.
M11: Relocate the San Dieguito River Pipeline outside of the Dam Inundation Zone.
M12: Install a siren at the dam to forewarn any employees working in the inundation zone of a failure.

Landslides

The Reserve was the only asset identified as potentially impacted by landslides (see Section 2).

Using Mitigation Objective 3, the MHMP Team formulated the following Mitigation Actions:
M13: Implement erosion control in the Elfin Forest Reserve to protect against landslide damage.
M14: Strengthen the slopes in the Elfin Forest Reserve to protect against landslides.

Earthquake

Assets potentially impacted by earthquake (see Section 2) are listed below:

- District Headquarters
- Water Pump Stations
- Wastewater Pump Stations
- Recycled Water Pump Stations
- Water Treatment Plant
- Wastewater Treatment Plant
- Reservoirs

Using Mitigation Objective 4, the MHMP Team formulated the following Mitigation Actions:
M15: Retrofit and strengthen District Headquarters Building A to current building seismic codes.
M16: Rebuild District Headquarters Building A.
M17: Retrofit and strengthen District Headquarters Building B to current building seismic codes.
M18: Rebuild District Headquarters Building B.
M19: Retrofit and strengthen the Wastewater Pump Stations to current building seismic codes.
M20: Rebuild the Wastewater Pump Stations.
M21: Retrofit and strengthen the Water Pump Stations to current building seismic codes.

M22: Rebuild the Water Pump Stations.
M23: Retrofit and strengthen the Recycled Water Pump Stations to current building seismic codes.
M24: Rebuild the Recycled Water Pump Stations.
M25: Retrofit and strengthen the Water Treatment Plant to current building seismic codes.
M26: Rebuild the Water Treatment Plant.
M27: Retrofit and strengthen the Wastewater Treatment Plant to current building seismic codes.
M28: Rebuild the Wastewater Treatment Plant.
M29: Retrofit and strengthen the Reservoirs to current building seismic codes.
M30: Rebuild the Reservoirs.

Wildfire

The Elfin Forest Reserve Trails and Ancillary Facilities are the only assets potentially impacted by wildfire (see Section 2). Using Mitigation Objective 5, the MHMP Team formulated the following Mitigation Actions:

M31: Expand the fire hydrant network to the Elfin Forest Reserve.
M32: Create firebreaks surrounding the Elfin Forest Reserve to protect it from wildfire damage.

Pestilence

The eucalyptus trees are the only assets potentially impacted by pestilence (see Section 2). Using Mitigation Objective 6, the MHMP Team formulated the following Mitigation Actions:

M33: Remove the Eucalyptus Trees and replace with non-vulnerable species.
M34: Exterminate and prevent the lurp infestations.

Future Projects

Using Mitigation Objective 7, the MHMP Team formulated the following Mitigation Action:

M35: Ensure future construction projects incorporate the findings of the Multi-Hazard Mitigation Plan.

3.2 BENEFIT-COST ANALYSIS

To ensure the viability of the mitigation actions proposed by the Mitigation Team, a benefit cost analysis was performed for each action. A model based upon the FEMA BCA Toolkit was used to estimate costs and benefits associated with the mitigation actions.

Each mitigation action's benefit-cost ratio (BCR) is an estimation of the viability of the project – BCRs of greater than 1.0 are viable mitigation projects; BCRs of lower than 1.0 are not. The following table delineates the results of the Benefit-Cost Analysis (See Appendix D).

Note: The Benefit-Cost Analysis contained in this document is a preliminary analysis used to examine the viability of the proposed mitigation actions. A more rigorous benefit-cost analysis may be required for approval of mitigation funding.

Table 3-1 Proposed Mitigation Actions

No.	Mitigation Action	Benefit-Cost Ratio	Viable Project
Flood			
M01	Elevate the pipeline crossing the Escondido Creek above the 100-year floodplain.	0.11	No
M02	Bury the pipeline crossing the Escondido Creek below the creek bed.	0.14	No
M03	Elevate the pipeline crossing the San Dieguito River above the 100-year floodplain.	0.11	No
M04	Bury the pipeline crossing the San Dieguito River below the river bed.	0.14	No
M05	Relocate the Reserve Bridge outside of the flood plains.	0.17	No
M06	Elevate the Reserve Bridge above the 100-year flood plain.	N/A	No
M07	Increase the structural strength of the park restrooms to withstand flood events.	0.05	No
M08	Relocate the restrooms in the Reserve above the 100-year floodplain.	0.06	No
Dam Failure			
M09	Relocate the Wastewater Treatment Plant outside of the Dam Inundation Zone.	0.01	No
M10	Relocate the Del Dios Pump Station outside of the Dam Inundation Zone.	0.02	No
M11	Relocate the San Dieguito River Pipeline outside of the Dam Inundation Zone.	0.01	No
M12	Install a siren at the dam to forewarn any employees working in the inundation zone of a failure.	N/A	No
Landslide			
M13	Implement erosion control in the Elfin Forest Reserve to protect against landslide damage.	1.27	Yes
M14	Strengthen the slopes in the Elfin Forest Reserve to protect against landslides.	1.02	Yes
Earthquake			
M15	Retrofit and strengthen District Headquarters Building A to current building seismic codes.	0.01	No
M16	Rebuild District Headquarters Building A.	0.00	No
M17	Retrofit and strengthen District Headquarters Building B to current building seismic codes.	0.03	No
M18	Rebuild District Headquarters Building B.	0.00	No
M19	Retrofit and strengthen the Wastewater Pump Stations to current building seismic codes.	N/A	No

No.	Mitigation Action	Benefit-Cost Ratio	Viable Project
M20	Rebuild the Wastewater Pump Stations.	N/A	No
M21	Retrofit and strengthen the Water Pump Stations to current building seismic codes.	0.02	No
M22	Rebuild the Water Pump Stations.	0.00	No
M23	Retrofit and strengthen the Recycled Water Pump Stations to current building seismic codes.	N/A	No
M24	Rebuild the Recycled Water Pump Stations.	N/A	No
M25	Retrofit and strengthen the Water Treatment Plant to current building seismic codes.	N/A	No
M26	Rebuild the Water Treatment Plant.	N/A	No
M27	Retrofit and strengthen the Wastewater Treatment Plant to current building seismic codes.	N/A	No
M28	Rebuild the Wastewater Treatment Plant.	N/A	No
M29	Retrofit and strengthen the Reservoirs to current building seismic codes.	0.79	No
M30	Rebuild the Reservoirs.	0.03	No
Wildfire			
M31	Expand the fire hydrant network to the Elfin Forest Reserve.	N/A	Yes
M32	Create firebreaks surrounding the Elfin Forest Reserve to protect it from wildfire damage.	N/A	No
Pestilence			
M33	Remove the Eucalyptus Trees and replace with non-vulnerable species.	0.43	No
M34	Exterminate or prevent the lurp infestations.	N/A	No
Future Projects			
M35	Ensure future construction projects incorporate the findings of the Multi-Hazard Mitigation Plan.	N/A	Yes

3.3 MITIGATION ACTIONS FOR MAN-MADE HAZARDS

The results of Olivenhain MWD's Security and Vulnerability Assessment [3] will not be duplicated in this report (see Section 2.2 & 2.3). In the interest of district security, specific Mitigation Actions addressing the results of the Security and Vulnerability Assessment will not be detailed in this report. However, funding for mitigation projects addressing man-made hazards may be requested by Olivenhain Municipal Water District, at which time a benefit-cost analysis will be included in the application.

3.4 MITIGATION PROJECTS

The following table delineates the viable mitigation projects and the parties responsible for overseeing each project's implementation. Olivenhain MWD seeks to procure Disaster Mitigation Funding through DMA2000 to meet 75% of the projects' budgets, with the balance to be provided from the district's annual budget. The time frame for each project represents the estimated project-completion time from the provision of funds until project completion. The projects were prioritized based upon the benefit-cost ratios derived from the preliminary benefit-cost analysis (see Table 3-1 above).

Table 3-2 Mitigation Projects

No.	Projects	Responsible Parties	Time Frame
P01	Implement erosion control in the Elfin Forest Reserve to protect against landslide damage.	General Manager or designee	Ongoing
P02	Expand the fire hydrant network to the Elfin Forest Reserve.	General Manager or designee	12 months
P03	Ensure future construction projects incorporate the findings of the Multi-Hazard Mitigation Plan.	General Manager or designee	6 months

Note: Although both M13 and M14 resulted in viable mitigation actions, the mitigation project with the higher BCR was chosen as both actions achieve the same goal.

4.0 MITIGATION PLAN MAINTENANCE

4.1 MULTI-HAZARD MITIGATION PLAN UPDATES

Per DMA 2000 requirements, the Multi-Hazard Mitigation Plan will be reviewed and updated every five years. The General Manager will be responsible for convening a MHMP Team with as many members of the previous team as possible. New team members will be added, if necessary. Following any updates to the Multi-Hazard Mitigation Plan, the public will again be involved in the project by soliciting opinion through public meetings, media advertisements, or similar forms of communication. Each update will occur within five-years of the date of the most recent update.

In addition to the five-year update, the General Manager will continuously monitor how district activities affect the plan and (on an annual basis) will formally review the plan for discrepancies. The review form in Appendix F may be used for this process.

In addition, the results of the Multi-Hazard Mitigation Plan will be incorporated into future district construction projects (see Mitigation Project No. 2 – section 3.3). This entails evaluating future construction sites for the susceptibility to damage due to the hazard events identified in this study.

REFERENCES

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2. Mount Israel Raw Water Storage Project – Dam Failure Inundation Study, Boyle Engineering Company, July 1991

3. Vulnerability Assessment for Olivenhain Municipal Water District, Tracer ES&T, November 2003.

4. Seismic Evaluation for Olivenhain Municipal Water District, Tracer ES&T, November 2002.

5. USGS/CGS Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (revised April 2003).

6. State and Local Mitigation Planning: How-to-guide, Federal Emergency Management Agency, September 2002.

7. Information provided by the Fire Weather Coordinator of the National Weather Service – San Diego.

8. Taking Shelter from the Storm: Building a Safe Room Inside Your House, Federal Emergency Management Agency, March 2004.

9. San Diego County Tsunami Evacuation Planning Maps, California Governor's Office of Emergency Services

APPENDIX A

LOCAL HAZARD MITIGATION PLAN CROSSWALK

APPENDIX B

SIGN-IN SHEETS

APPENDIX C

SUPPORTING DATA

COASTAL EROSION

DAM FAILURE

EARTHQAUKE

FLOOD

HAILSTORM

HURRICANE

PESTILENCE

TORNADO

TSUNAMI

WINDSTORMS

APPENDIX D

BENEFIT-COST ANALYSIS

APPENDIX E

OLIVENHAIN MWD GOVERNING BOARD RESOLUTION

To be included in final plan

APPENDIX F

ANNUAL REVIEW SUMMARY FORM

MULTI-HAZARD MITIGATION PLAN ANNUAL REVIEW SUMMARY

OLIVENHAIN MUNICIPAL WATER DISTRICT
1966 OLIVENHAIN ROAD
ENCINITAS, CALIFORNIA

Date:

Meeting attended by:	Title:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Risk Assessment Review

List of Identified Hazards Requires Updating (Yes/No) _____

List of Impact Assets Requires Updating (Yes/No) _____

Estimated Losses Requires Updating (Yes/No) _____

Mitigation Action Review

Possible Additional Mitigation Actions (Yes/No) _____

List of Mitigation Actions Requires Updating (Yes/No) _____

Summary

Plan Requires Updating (Yes/No) _____

Update assigned to: _____

To be completed by: _____

APPENDIX G

PUBLIC HEARING NOTICES

APPENDIX H

TRACER ES&T TEAM MEMBER RESUMES

Jake Tilley — Senior Engineer

B.S. Engineering — *Harvey Mudd College, Claremont, California*

Mr. Tilley is a Senior Engineer at Tracer Environmental Sciences & Technologies, Inc. (Tracer). His primary responsibilities include co-managing and serving as lead project engineer for the Risk Management and Safety Group, and supporting other groups such as Tracer Studies.

As a co-leader of the Risk Management and Safety Group, Mr. Tilley has supervised the successful completion of over 50 projects to address the handling of regulated substances. This includes outlining project scopes, detailing budgets, and coordinating the efforts of appropriate staff. He is also the leader of the Quality Assurance Program for the Risk Management and Safety Group.

Mr. Tilley's main area of expertise lies in risk and safety management. Specifically, he serves as lead project engineer to assist facilities that handle hazardous materials in addressing EPA's Risk Management Program (RMP) and OSHA's Process Safety Management (PSM). On a local level, he has played a key role in some of the first projects to be accepted under the California Accidental Release Prevention (CalARP) program. His range of experience includes all facets of developing risk management programs for various types of facilities throughout the country such as: dairy and other perishable goods processing, cold storage distribution and logistics, geothermal power generation, and water / wastewater treatment.

The specific areas to which Mr. Tilley has made significant contributions are numerous. These include preparing detailed piping and instrumentation diagrams (P&IDs) from field observations, report documentation, participating in Process Hazard Analysis (PHA) studies both as the recorder and facilitator, preparing qualitative risk assessments, conducting off-site consequence analyses, providing implementation training sessions, and conducting audits of risk management programs. Mr. Tilley has worked closely with client contacts, including both corporate representatives and field personnel, to produce a quality product that is practical for the facility and acceptable by the regulating agencies.

Mr. Tilley has also played a supporting role in atmospheric tracer studies including one with the County Sanitation Districts of Los Angeles County. The study sought to determine whether air transport can occur from a landfill waste site to a neighboring residential community. This is accomplished by releasing tracer chemicals (that do not naturally occur) into the atmosphere while simultaneously collecting air samples at specified downwind locations. He was responsible for pre-test preparation of sampling equipment, taking field measurements, and report generation.

Recent Project Experience (2003-04):

≅ *Safeway Inc. Environmental Affairs* (Lead Project Engineer - Annual Program Reviews, CalARP, SOP Certifications, 3 Year Compliance Audits, PSM/RMP for multiple facilities)

- ≅ *Costco Wholesale*, 8 facilities (Project Manager - PSM/RMP/CalARP development, Compliance Audits, PHA Revalidations)
- ≅ *US Foodservice*, Risk Management Training Session, (Project Manager - PSM/RMP/CalARP Program Updates)
- ≅ *Padre Dam Municipal Water District* (Project Manager - CalARP Development, EPA Vulnerability Assessment)
- ≅ *Super Store Industries*, 3 facilities (PSM/RMP/CalARP Compliance Audits)
- ≅ *City of Pasadena Water & Power Department* (RMP/CalARP development for multiple sites, Public Meeting)
- ≅ *Steamboat Geothermal, Inc.* (P&ID development, Process Hazard Analysis studies)
- ≅ *Sysco Food Services 3 facilities* (Compliance Audit, PSM/RMP and CalARP development)
- ≅ *P&O Cold Logistics 3 facilities* (P&ID development, PSM/RMP development)

Desmond P. O'Sullivan — Project Manager

B.Sc. Mathematics and Applied Mathematics	*University College Cork, Cork, Ireland*
M.S. Aerospace Engineering	*University of California, San Diego*

Mr. Desmond O'Sullivan is a staff engineer at Tracer Environmental Science & Technologies, Inc. The main focus of his work is risk analysis. He is responsible for the documentation of Process Safety Management Programs (PSM) / Risk Management Programs (RMP) / California Accidental Release Prevention Programs (CalARP) for regulated facilities using hazardous materials. This work includes preparing all necessary documentation for compliance with the PSM/RMP/CalARP regulations, developing Piping and Instrumentation Diagrams, and modeling the potential off-site consequences of an ammonia or a chlorine release.

Mr. O'Sullivan's experience in risk management ranges from nationwide distribution corporations to local municipal water districts. Some of his previous, and ongoing, risk and safety projects include the following:

- Safeway: Developed management programs and piping and instrumentation diagrams for numerous Safeway facilities nationwide.
- P&O - Carson: Developed management programs for P&O Cold Logistics' existing ammonia refrigeration systems in their Salt Lake City, Utah, Dallas, Texas, & Boston, Massachusetts warehouses and a new refrigeration system constructed in Carson, California.
- City of Corona: Prepared a complete PSM/RMP Program for the City of Corona, City Park Pool facility. Also assisted in the implementation of the PSM/RMP program addressing the chlorine system.
- C&S Refrigeration: Assumed the role of liaison between federal regulatory agency and facility personnel in addressing findings of a federal RMP audit. Coordinated the preparation and documentation of the facilities Five-year Process Hazard Analysis Revalidation.

Mr. O'Sullivan's experience with Environmental Fluid Mechanics ranges from plume evolution to coastal gravity currents and from general ocean circulation to small-scale turbulent mixing. Prior to joining Tracer, Mr. O'Sullivan was awarded his Masters in Mechanical and Aerospace Engineering from the University of California at San Diego. This was preceded by a Bachelor of Science, taken in a Joint Honors program of Mathematics and Applied Mathematics at University College Cork, in Cork, Ireland.