THREAT AND HAZARDS IDENTIFICATION AND RISK ASSESSMENT

CITY OF PALO ALTO

4/21/2017

2017 UPDATE

Table of Contents

List of Tables

List of Figures

1   Executive Summary

> The 2017 Update of the THIRA includes an updated threat and hazard assessment in Chapter 4 following the City's adoption of an updated Local Hazard Mitigation Plan (LHMP). [1] This community based planning process prompted the update to Intentional Hazards which included an assessment by a group of Bay Area public safety professionals and an analysis of recorded Part 1 and Part 2 crimes. Technological hazards were not changed. The body of the 2014 THIRA remains, and highlighted sections demonstrate where modifications were made.

To evaluate the City of Palo Alto's capabilities for addressing all hazard events, the City of Palo Alto Office of Emergency Services (OES) conducted a collaborative planning process in order to develop the City of Palo Alto 2014 Threat and Hazard Identification and Risk Assessment (THIRA). This assessment provides the outcomes of this process and is compliant with the U.S. Department of Homeland Security (DHS) Comprehensive Preparedness Guide (CPG) 201. This THIRA report will be used to inform ongoing planning efforts throughout the city.

Palo Alto OES established a Planning Team of key stakeholders to ensure development of a well-rounded, inclusive assessment of all relevant threats/hazards and the City's capabilities to address the five mission areas of prevention, protection, mitigation, response, and recovery.

The Planning Team met in person for two full day workshops and additionally provided input via virtual reviews conducted through email correspondence. Prior to the Planning Team workshops, the executive committee met to draft Desired Outcomes. This preliminary coordination by the leadership set the tone for the THIRA planning process and established guidelines for the Planning Team as they worked through each of the CPG 201 steps.

The two full day workshops were designed to follow CPG 201. Each workshop was facilitated to emphasize comprehensive discussion and integrate expertise by Planning Team members for relevant topics. The first workshop focused on confirming the threats and hazards of concern (CPG 201 Step 1) and developing context (CPG 201 Step 2) to help evaluate potential impacts.

The second workshop was a facilitated discussion to validate the potential impacts for each of the developed scenarios. The Planning Team developed Capability Targets based on the greatest estimated impact for each of the 31 Core Capabilities (CPG 201 Step 3). Once the Capability Targets were approved, the Planning Team examined each of the core capabilities against the Capability Target and identified gaps and recent advances in Planning, Organization, equipment, Training, and Exercise (POETE). For each of the identified gaps, subject matter experts identified initial recommendations on how to address these gaps (CPG 201 Step 4). As the City of Palo Alto moves forward with the results of the THIRA, it is recommended that the identified gaps be further discussed and analyzed in order to identify the root cause of the gap. Once the root cause is determined by the stakeholders, the identified recommendations should be revised, corrective actions determined and resource estimations be made in order to implement and prioritize the recommendations.

---

[1] The LHMP provides an empirical analysis of Natural Hazards and their likely impact to our community. See www.cityofpaloalto.org/lhmap for the current version.

2   Introduction

The City of Palo Alto is at risk to a variety of natural and non-natural hazards. Stanford University, located within the City's jurisdictional boundary, is also at risk to these same hazards. Preventing, protecting from, mitigating, responding to, and recovering from hazards and threats requires extensive coordination among City agencies and local partners, including Stanford. The City's Office of Emergency Services (OES) leads that coordination with the goal of "developing, maintaining, and sustaining a citywide, comprehensive, all hazard, risk-based emergency management program that engages the whole community"[2]. The Stanford University Department of Public Safety and the Stanford University Environmental Health & Safety (EH&S) Department partner with the City to enhance their emergency preparedness, mitigation, and response capabilities. Under separate contracts, the City provides all 911 Public Safety Answering Point (PSAP) dispatch services to Stanford, and is also the prime Fire and EMS provider to the University. Together, the City's OES and representatives from Stanford University supported the formulation of this plan.

To better understand and effectively prioritize risk reduction measures, OES conducted a collaborative planning process with an Executive Committee and a broader Stakeholder Group to evaluate current capabilities with regard to prevention, protection, mitigation, response and recovery. This Threat and Hazard Identification and Risk Assessment (THIRA) Report is the result of the collaborative planning process. It is compliant with the U.S. Department of Homeland Security (DHS) Comprehensive Preparedness Guide (CPG) 201, Second Edition, released in August 2013, which outlines a process to help communities identify capability targets and resource requirements necessary to address anticipated and unanticipated risks.

The result of the THIRA process is an organized evaluation of vulnerability and implementation measures based on the necessary capabilities to deal with the hazards/threats of most concern. This report should inform ongoing City and University planning efforts including, but not limited to, the following:

- Emergency Operations Plan
- Hazard Mitigation Plan
- Emergency Planning & Homeland Security Strategic Plan
- Operating Budget
- Capital Budget
- Office of Emergency Services Annual Report
- Comprehensive Plan

DHS requires annual THIRAs from States and Tier 1 Urban Area Security Initiative (UASI) organizations. The City of Palo Alto THIRA, as a local government assessment, may be shared as appropriate with the San Francisco Bay Area UASI and California Governor's Office of

---

[2] Office of Emergency Services (OES): Executive Summary (Rev. 8/24/12)

Emergency Services (Cal OES) to ensure consistency in vulnerability analyses. Both the California State THIRA and San Francisco Bay Area UASI THIRA were consulted in the preparation of this City of Palo Alto THIRA.

3 Goal Setting

Presidential Policy Directive 8: National Preparedness sets forth a national goal for "a secure and resilient Nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk"[3]. To achieve this, the National Preparedness Goal identifies 31 necessary core capabilities. The City of Palo Alto Executive Team reviewed the National Preparedness Goal and through discussion established a more refined set of desired outcomes for the City based on the 31 core capabilities.
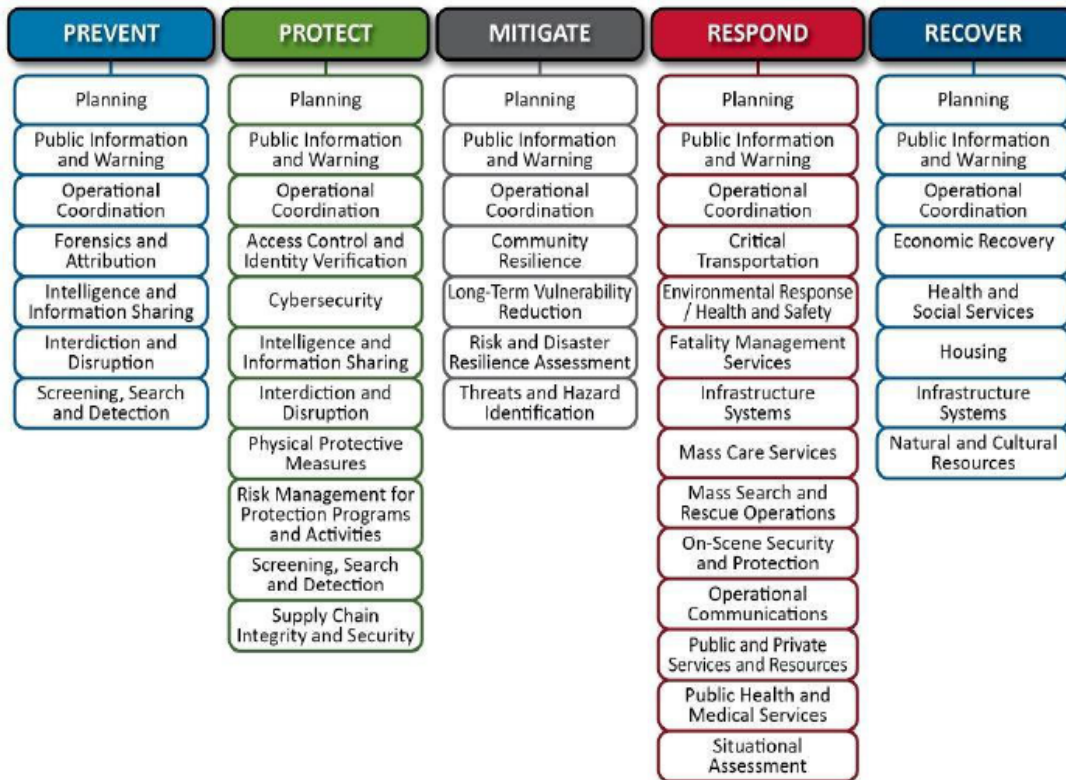
PREVENT	PROTECT	MITIGATE	RESPOND	RECOVER
Planning	Planning	Planning	Planning	Planning
Public Information and Warning	Public Information and Warning	Public Information and Warning	Public Information and Warning	Public Information and Warning
Operational Coordination	Operational Coordination	Operational Coordination	Operational Coordination	Operational Coordination
Forensics and Attribution	Access Control and Identity Verification	Community Resilience	Critical Transportation	Economic Recovery
Intelligence and Information Sharing	Cybersecurity	Long-Term Vulnerability Reduction	Environmental Response / Health and Safety	Health and Social Services
Interdiction and Disruption	Intelligence and Information Sharing	Risk and Disaster Resilience Assessment	Fatality Management Services	Housing
Screening, Search and Detection	Interdiction and Disruption	Threats and Hazard Identification	Infrastructure Systems	Infrastructure Systems
	Physical Protective Measures		Mass Care Services	Natural and Cultural Resources
	Risk Management for Protection Programs and Activities		Mass Search and Rescue Operations	
	Screening, Search and Detection		On-Scene Security and Protection	
	Supply Chain Integrity and Security		Operational Communications	
			Public and Private Services and Resources	
			Public Health and Medical Services	
			Situational Assessment	

Figure 3-3-1 National Preparedness Core Capabilities

The following statements represent an ideal condition of the whole community's capability to prevent, protect against, mitigate, respond to, and recover from the threats and hazards of most concern.

1. *Planning*

Conduct a consolidated, coordinated, integrated planning process to ensure participation by the whole community using an all hazards approach and defined planning cycles.

---

[3] National Preparedness Goal

2. *Public Information and Warning*

Provide information in a timely and appropriate manner to the affected population including those with functional needs. Information should be consistent with the threat or hazard and enable people to take appropriate actions or protective measures.

3. *Operational Coordination*

Establish and maintain a unified and coordinated operational Incident Command System (ICS) compliant structure and process that appropriately integrates all critical stakeholders to include private/public partners (e.g. hospitals, residents, ESV, schools, businesses, etc.) and supports the execution of core capabilities.

Prevention

4. *Forensics and Attribution*

Conduct investigation, evidence collection, and analysis for criminal prosecution as well as assist in preventing initial or follow-on terrorist acts.

5. *Intelligence and Information Sharing*

Interface with allied public safety agencies, regional planning entities, and other relevant stakeholders to collect, analyze, and disseminate timely, accurate, and actionable information.

6. *Interdiction and Disruption*

Coordinate with other agencies to facilitate interdiction of cargo and persons that could present a threat to the City of Palo Alto and Stanford University.

7. *Screening Search and Detection*

Screen and search cargo, packages, and persons if/when legally permissible and justified. For example, observe safety protocols with those entering Stanford Stadium for certain, security-risk events.

Protection

8. *Access Control and Identity Verification*

Establish verification of identity to authorize, grant, or deny physical and cyber access to critical infrastructure, key asset locations, and networks.

9. *Cybersecurity*

Protect against malicious activity directed toward critical infrastructure, key resources, and networks.

10. ***Physical Protective Measures***

Protect people, structures, materials, products, and systems of key operational activities and critical infrastructure sectors against identified or perceived threats.

11. ***Risk Management for Protection Programs and Activities***

Complete and/or encourage risk assessments, using standardized methodologies/models, for critical infrastructure/key resources (CIKR) and assets.

12. ***Supply Chain Integrity and Security***

Accounting for reliance on digital technology and modern management practices, work with and encourage private sector to build resiliency in the supply chain and develop tangible and intellectual methods to protect it.

Mitigation

13. ***Community Resilience***

Engage the whole community in improving resilience through development and implementation of local risk management plans, techniques, strategies, training, and exercises.

14. ***Long–term Vulnerability Reduction***

Implement ongoing strategies to achieve measurable decreases in the long-term vulnerability of critical infrastructure, systems, and community features at risk to identified threats and hazards.

15. ***Risk and Disaster Resilience Assessment***

Maintain a risk assessment that includes identification and analysis of information about security gaps, localized vulnerabilities and risk consequences in City systems and facilities.

16. ***Threats and Hazards Identification***

Continually review/identify/maintain the assessment of identified threats and hazards.

Response

17. ***Critical Transportation***

Establish physical access through appropriate transportation corridors and deliver required resources in an effort to save lives and to meet the needs of disaster survivors.

18. ***Environmental Response/Health and Safety***

Conduct health and safety hazard and critical systems assessments, and disseminate guidance and resources, including the deployment of hazardous materials teams, to support environmental health and safety actions for response personnel and the affected population and

area. Conduct water sampling from established locations to determine potential access breach and/or contamination.

19. *Fatality Management Services*

Conduct operations to recover fatalities in coordination with Operational Area/regional/state, federal and NGO partners.

20. *Mass Care Services*

Move and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with access and functional needs and others who may be considered at-risk. Coordinate operations with government and NGO assistance partners.

21. *Mass Search and Rescue Operations*

Conduct search and rescue operations to locate and rescue persons in distress.

22. *On-Scene Security and Protection*

Establish a safe and secure environment for the affected area.

23. *Operational Communications*

Establish and maintain the capability and capacity for timely and sufficient integrated communications in support of security, situational awareness, and operations. This includes redundant capabilities and resilient systems and facilities.

24. *Public and Private Services and Resources*

Mobilize and coordinate governmental, nongovernmental, and private sector resources within and outside the affected areas to save lives, sustain lives, meet basic human needs, stabilize the incident, and transition to recovery.

25. *Public Health and Medical Services*

With operational area support as needed, complete triage and initial stabilization of casualties and begin coordination of transport to definitive care for those likely to survive their injuries.

26. *Situational Assessment*

Deliver information sufficient to inform City decisions, through collaboration with key partners, regarding immediate life-saving and -sustaining activities and engage governmental, private, and civic-sector resources within and outside of the affected area to meet basic human needs and stabilize the incident and maintain public services.

27. *Infrastructure Systems*

Decrease and stabilize immediate infrastructure threats to the affected population, following all City EOP procedures.

Recovery

28. *Economic Recovery*

Develop a plan with whole community partners, with a specified timeline for redeveloping community infrastructures to contribute to resiliency, accessibility, and sustainability.

29. *Health and Social Services*

Restore basic health and social services functions with support from Operational Area/state/federal and NGO partners.

30. *Housing*

Assess preliminary housing impacts and needs, identify currently available options for temporary housing, and plan for permanent housing in coordination with Operational Area/state/federal and NGO partners.

31. *Natural and Cultural Resources*

Mitigate impacts, stabilize natural and cultural resources, and conduct a preliminary assessment of the impacts to identify and implement protections during the various stages of incident management—from stabilization through recovery.

4 Hazard Identification and Prioritization

4.1 Identified Hazards and Threats

Several City and regional emergency management and planning documents were reviewed to identify a comprehensive list of hazards for consideration. These documents address both natural and human caused hazards that have the potential to impact Palo Alto and the Bay Area. Many of these documents estimate the impacts that result from the identified hazards. City policies that aid in emergency prevention, protection, mitigation, response, and recovery are highlighted in these documents. The reviewed documents which were integral in providing key information are listed below:

City of Palo Alto Emergency Operations Plan, June 2007

Palo Alto City Council Priority Update on Emergency Preparedness, September 2010

City of Palo Alto Terrorism Response Plan, 2001

City of Palo Alto Local Hazard Mitigation Plan, 2011

City of Palo Alto Energy Assurance Plan, July 2013

After Action Report Power Outage and Plane Crash, May 2010

After Action Report Winter Storm of December 23, 2012, February 2013

City of Palo Alto Emergency Planning Strategic Plan, November 2009

State of California THIRA Draft, December 2012

Bay Area Urban Area Security Initiative THIRA, December 2012

San Francisco THIRA, 2012

National Planning Scenarios (See table 4-1 below)

San Francisco Bay Area Regional Emergency Coordination Plan, March 2008

City of Palo Alto Comprehensive Plan, July 2007[4]; Land Use Designation Map, March 2011; Housing Element, November 2013; Updated version to be released in 2014/2015

In addition to the documents listed above, the Infrastructure Blue Ribbon Commission Final Report on Palo Alto's Infrastructure: Catching Up, Keeping Up, and Moving Ahead (December

---

[4] The City is in the process of updating the 1998-2010 Palo Alto Comprehensive Plan which will contain updated goals, policies, and programs relating to safety and natural hazards. The update is expected to be completed by the end of 2015 and will have an expected horizon year of 2030. The updated Comprehensive Plan will be consistent with this Threat and Hazard Identification and Risk Assessment.

2011) specifically helped to identify the City's critical facilities and infrastructure used in estimating impacts and assessing vulnerability.

Table 4-1 National Planning Scenarios

Scenario 1: Nuclear Detonation
Scenario 2: Biological Attack – Aerosol Anthrax
Scenario 3: Biological Disease Outbreak – Pandemic Influenza
Scenario 4: Biological Attack - Plague
Scenario 5: Chemical Attack – Blister Agent
Scenario 6: Chemical Attack – Toxic Industrial Chemicals
Scenario 7: Chemical Attack – Nerve Agent
Scenario 8: Chemical Attack – Chlorine Tank Explosion
Scenario 9: Natural Disaster – Major Earthquake
Scenario 10: Natural Disaster – Major Hurricane
Scenario 11: Radiological Attack – Radiological Dispersal Devices
Scenario 12: Explosives Attack – Bombing Using Improvised Explosive Devices
Scenario 13: Biological Attack – Food Contamination
Scenario 14: Biological Attack – Foreign Animal Disease (Foot and Mouth Disease)
Scenario 15: Cyber Attack

Table 3-2 Comprehensive List of Hazards and Definitions presents the comprehensive list of hazards as approved by the Executive Committee and considered by the Stakeholder Group.

Table 4-2 Comprehensive List of Hazards and Definitions

Natural Hazard	Definition
Earthquake	An earthquake is a phenomenon resulting from the sudden release of stored energy in the crust of the Earth in the form of seismic waves. They can devastate regions and destroy nearly any type of asset. They can cause injuries and death due to falling debris and broken glass. A major earthquake could trigger significant landslides, spark fires, and release toxic chemicals. If an earthquake occurred during the rainy winter season, landslides would be worsened and flooding could occur, exacerbated by damaged creek culverts and storm drains.
Extreme Heat	A heat wave is defined as prolonged periods of excessive heat, often combined with excessive humidity. Extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. The main concern in periods of extreme heat is the potential public health impact, such as heat exhaustion or heat stroke.

Flood/Winter Storm	A flood is any high flow, overflow, or inundation by water which causes or threatens damage. Flooding is often caused by winter storms in the City of Palo Alto. Flooding can contaminate potable water, wastewater, and irrigation systems, which may negatively affect the quality of the water supply and result in an increase of water and food borne diseases. Severe winter storms can cause flooding.
High Wind	Wind is associated with multiple natural hazards. In some hazards, wind is the primary cause of damage, while in others, wind plays a contributory or auxiliary role. Damaging wind is primarily associated with hurricanes, tornadoes, downbursts, severe thunderstorms, and winter storms. Wind plays a contributory role in wildfire generation and propagation and can exacerbate severe droughts as well as cause trees to fall on power lines.
Landslides	In a landslide, masses of rock, earth, or debris move down a slope. Landslides may be small or large, slow or rapid. They are activated by storms, earthquakes, fires, alternate freezing and thawing, and steepening of slopes by erosion or human modification.
Public Health Pandemic	The most readily apparent public health emergency is an outbreak of influenza pandemic although other public health emergencies are just as likely. An influenza pandemic is a worldwide outbreak of disease that occurs when a new influenza virus appears in human population, causes serious illness and then spreads easily from person to person worldwide. Pandemics are different from seasonal outbreaks of the flu. Since 2005, a high virulent strain of bird flu (H5N1), which developed in Asia, has steadily spread in birds to the Middle East, Africa, and Europe. The fatality rate of this particular strain is more than 50 percent. The Center for Disease Control and Prevention (CDC) has estimated that, in the US alone, a "minor" influenza pandemic could infect up to 200 million people and cause between 100,000-200,000 deaths. The potential financial impact on the US of this type of pandemic is estimated at $166 billion. Pandemics could continue for up to 24 months and cause major disruptions in supply chains for essential goods and services. Other outbreaks could include H1N1, Whooping Cough, Salmonella, E. coli, and Measles.
Tornado	A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour. Damage paths can be in excess of one

	mile wide and fifty miles long. Waterspouts are tornadoes that form over water.
Tsunami	A tsunami is a sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands.
Wildland Fire	A wildfire is an uncontrollable fire beginning in a wilderness area, typified by its large size, and ability to spread quickly or change direction suddenly. High temperatures and drought followed by an active period of vegetation growth provide the most dangerous conditions. Wildfires can affect any type of asset and may threaten major population centers when they break on the rural-urban fringe.
Technological Hazard	**Definition**
Airplane Accident	Aviation accidents may be caused by problems originating from mechanical difficulties, pilot error, or acts of terrorism. Airplane accidents can result from major aircraft experiencing trouble while in flight or from mid-air collisions between aircraft flying over or near Palo Alto since the City lies in the flight path of two international airports: San Jose and San Francisco. There is also the potential for this type of accident to occur over water.
Dam Failure	Flooding inundation areas in the event of dam failure extend across a wide region of northeastern Palo Alto. Reservoir failures that would affect Palo Alto include Felt Lake, Searsville Lake, and Foothills Park (Boronda Lake).
Financial Disruption	A situation where the markets cease to function in a regular manner, typically characterized by rapid and large market declines. Market disruptions can result from both physical threats to the stock exchange or unusual trading (as in a crash). In either case,

	the disruption typically causes panic and results in disorderly market conditions.
Food/Water Contamination	A water system can become contaminated as a result of flooding or by saltwater intrusion. Food contamination refers to the presence in food of harmful chemicals and microorganisms which can cause consumer illness.
Hazardous Materials Spill	The release of a hazardous material to the environment could cause a multitude of problems. Although these incidents can happen almost anywhere, certain areas of the city are at higher risk, such as near roadways that are frequently used for transporting hazardous materials and locations with industrial facilities that use, store, or dispose of such materials. Areas crossed by railways, waterways, airways, and pipelines also have increased potential for mishaps. Hazards can occur during production, storage, transportation, use, or disposal. Communities can be at risk if a chemical is used unsafely or released in harmful amounts into the environment. Hazardous materials can cause death, serious injury, long-lasting health effects, and damage to buildings, the environment, homes, and other property.
Oil Spill	An oil spill is the release of a liquid petroleum hydrocarbon into the environment due to human activity or technological error. The term is usually applied to marine oil spills, but spills can also occur on land. Spills may be due to releases of oil from tankers, offshore platforms, and drilling rigs and wells. An oil spill represents an immediate fire hazard and can contaminate drinking water supplies. Contamination can also have an economic impact on tourism and marine resource extraction industries. Clean up and recovery is time and cost consuming.
Power Blackout/Energy Shortage/Utilities Failure	Energy disruptions are considered to be a form of Lifeline System Failure. This can be the consequence of any of the other hazards identified or as a primary hazard, absent of an outside trigger. A failure could involve the City's potable water system, power system, natural gas system, wastewater system, communication system, or transportation system.
Train Accident	Most train accidents are caused by human error, often relating to communications, speed limits, and braking. Train accidents also can occur because of equipment failure. Rail accidents include

	derailment, collisions, railroad grade crossing, obstruction, explosion, or fire/violent rupture.
Urban Fire	In addition to the areas within the City limits considered to be in the Wildland Urban Interface (WUI), the more densely built "flatlands" are also at risk. The City has over 25,000 housing units and a significant business base. The proximity of structures to each other within the City creates additional exposure to widespread urban fire. Localized, single-structure fires sometimes occur in Palo Alto. Major uncontrolled events are a possibility, but rarely occur.
Human Caused Hazard	**Definition**
Agro-Terrorism	Agro-terrorism is the use of a biological or chemical agent against crops, livestock, or poultry. The agent could be any of a wide range of pathogens or toxins. Agro-terrorism may be used to endanger public heath, to reduce the food supply, or as a strategic economic weapon.
Aircraft as a weapon	Aircraft as a weapon (AAW) is a suicide attack using an airplane to target an asset. The primary explosive is the airplane's fuel supply. Aircraft include but are not limited to large commercial passenger craft, cargo craft, small single or double engine private craft, gliders, helicopters, and lighter-than-aircraft.
Biological Attack (contagious and non-contagious)	A contagious biological attack is an attack on a population using a communicable, infectious disease. Effects occur after an incubation period which varies with the biological strain in use. They can quickly infect large populations. Bioterrorism can cause mass panic and societal disruption.
Chemical Agent/Toxic Inhalation Release	Chemical weapons kill by attacking the nervous system and lungs, or by interfering with a body's ability to absorb oxygen. Some are designed to incapacitate by producing severe burns and blisters. These include such agents as mustard, tabun, sarin (GB), and nerve gas. Chemical agents could be introduced through an HVAC system or air inlets in buildings such as apartments, commercial offices, or public facilities.
Civil Disorder	Civil disorder refers to unrest caused by a group of people and may include terrorist activities. Public demonstrations have the potential to lead to looting and rioting. There are many potential

	causes for civil disorder including: animal rights, labor disputes, civil rights, campus related issues, abortion rights, neighboring jurisdictions, political issues, events (sports, music, etc.), and spontaneous miscellaneous events. Potential consequences from acts of civil disorder include: disruptions of police and city services, closure of roads, rioting, property damage, and injuries to protesters, police officers, and uninvolved parties.
Conventional Attack	Light armed attack (small arms (ballistics) which include guns and rockets, or stand-off weapons such as rocket propelled grenades or mortars) with one or more people acting for a terrorist group, anti-government/anti-political group, etc.
Major Crime	A major criminal incident (shooting, homicide, kidnapping) including multiple suspects or multiple victims with an ongoing threat to the community.
Cyber Attack	A cyber terrorist can infiltrate many institutions including banking, medical, education, government, military, and communication and infrastructure systems. The majority of effective malicious cyber-activity has become web-based. Recent trends indicate that hackers are targeting users to steal personal information and moving away from targeting computers by causing system failure.
Hostage/Assassin	A hostage situation includes a person or group of people seized or held as security for the fulfillment of a condition. An assassin is a person who murders an important person in a surprise attack for political or religious reasons.
IED	Improvised Explosive Devices (IEDs) are constructed using conventional explosives and flammable materials. There are a variety of detonation methods. Conventional explosives include, but are not limited to: ammonium nitrate and fuel oil, TATP, TNT, RDX, PETN, C4, Semtex, or Dynamite. Flammable materials include, but are not limited to: gasoline, kerosene, alcohol, iodine crystals, magnesium, glycerin, or aluminum powder. An IED is likely to cause localized consequence primarily in the form of casualties and economic impact.
Nuclear Attack/Acts of War	The detonation of a nuclear weapon meets the US DODs definition of a Weapon of Mass Destruction, which includes any weapon or device that is intended or has the capability to cause death or serious bodily injury to a significant number of people through the release of toxic or poisonous chemicals or their precursors, a disease organism, or radiation or radioactivity. A nuclear bomb

	attack could occur without warning and cause mass devastation within seconds. Radiation can exist in the atmosphere and in the ground for years after an event. A nuclear attack would cause more damage in a metropolitan area.
Radiological Dispersion Device (RDD)	RDDs (commonly known as "dirty bombs") consist of radioactive materials wrapped in conventional explosives, which upon detonation release deadly radioactive particles into the environment.
Sabotage/Theft	Sabotage is a deliberate action aimed at weakening another entity through subversion, destruction, obstruction, or destruction. The result of sabotage could be the destruction or damage of a vital facility. Some criminals have engaged in sabotage for reasons of extortion. Political sabotage is sometimes used to harass or damage the reputation of a political opponent.
Terrorism	Terrorist activities include bombings, kidnappings, shootings, and hijackings. 80% of terrorist activity is perpetrated through the use of explosives, and the other 20% is a combination of arson, vandalism, and assassination. The actual use of terrorist chemical, nuclear, and biological weapons has occurred less than a handful of times in the last 50 years. The common kinds of terrorist situations (explosions, fires, vandalism, and shootings) are the same kind of critical incidents first responders handle on a daily basis. Terrorist activity can be conducted by an active shooter, an individual actively engaging in killing or attempting to kill people in a confined and populated area using a firearm. Targets of an armed attack vary; however, in recent history, schools, office buildings, federal/state owned buildings, religious institutions, military installations, and large public areas have all been subject to armed attacks. An active shooter may be a disgruntled student or group of students, an employee, or an anti-government/anti-political/extremist citizen or group.
Vehicle Born IED	Vehicle Born Improvised Explosive Devices (VBIEDs) are constructed using conventional explosives and flammable materials. VBIEDs involve the use of cars, trucks, and other vehicles as the package/container to deliver explosive payloads to a target. Larger vehicles enable larger amounts of explosives, resulting in a greater impact. Functioning of devices can vary within the same methods as the package types and can have the same common characteristics as other IEDs. Some examples in the U.S. include the 1993 World Trade Center bombing (a precursor to 9/11) and the Murrah Federal Building in Oklahoma City.

Workplace Violence	Workplace violence is violence or the threat of violence against workers. It includes any act or threat of physical violence, harassment, intimidation, or other threatening disruptive behavior that occurs at the worksite. It can occur at or outside the workplace and can range from threats and verbal abuse to physical assaults and homicide. It can affect and involve employees, clients, customers, and visitors. Workplace violence includes locations such as churches, malls, etc. and may be the result of a person acting alone.

The Stakeholder Group, through a facilitated exercise reviewed the comprehensive list of hazards/threats and prioritized them to identify those of most concern. The prioritization methodology is presented in the following sections.

4.2   Natural Hazard Prioritization[5]

The Palo Alto LHMP rated natural hazards through a qualitative analysis of probability and impact to people and property based on the scale of the hazard. The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

• High—Hazard event is likely to occur within 25 years (Probability Factor = 3).
• Medium—Hazard event is likely to occur within 100 years (Probability Factor =2).
• Low—Hazard event is not likely to occur within 100 years (Probability Factor =1).
• No exposure—There is no probability of occurrence (Probability Factor = 0).

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

• People—Values were assigned based on the percentage of the total *population exposed* to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  o   High—50 percent or more of the population is exposed to a hazard (Impact Factor = 3).
  o   Medium—25 percent to 49 percent of the population is exposed to a hazard (Impact Factor = 2).
  o   Low—25 percent or less of the population is exposed to the hazard (Impact Factor = 1).
  o   No impact—None of the population is exposed to a hazard (Impact Factor = 0).

• Property—Values were assigned based on the percentage of the total *property value exposed* to the hazard event:

---

[5] Santa Clara County Local Hazard Mitigation Plan 2017, Volume 1, pp.5-2 – 5-3.

- High—30 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3).
- Medium—15 percent to 29 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2).
- Low—14 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1).
- No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0).

• Economy—Values were assigned based on the percentage of the total *property value vulnerable* to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total replacement value of the property exposed to the hazard. For some hazards, such as wildfire, landslide and severe weather, vulnerability was considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates were generated for the earthquake and flood hazards using Hazus.

- High—Estimated loss from the hazard is 20 percent or more of the total exposed property value (Impact Factor = 3).
- Medium—Estimated loss from the hazard is 10 percent to 19 percent of the total exposed property value (Impact Factor = 2).
- Low—Estimated loss from the hazard is 9 percent or less of the total exposed property value (Impact Factor = 1).
- No impact—No loss is estimated from the hazard (Impact Factor = 0).

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1.

The final total risk ranking of Natural Hazards is summarized in Table 3.3.

Table 3-3. Natural Hazards Risk Ranking[6]

Rank	Hazard Type	Risk Rating Score (Probability x Impact)	Category
1	Earthquake	48	High
2	Flood	42	High
3	Severe Weather	33	Medium
4	Wildfire	15[a]	Medium
4	Dam and Levee Failure	15[a]	Medium
5	Drought	9	Low
6	Landslide	0	None

[6] Palo Alto Local Hazard Mitigation Plan Annex 2017, p. 1-15.

4.3   Technological Hazard Prioritization

No Changes were made in the 2017 update to Technological Hazards.

Each technological hazard was reviewed for its potential to occur. The Stakeholder Group shared knowledge, concerns, and other pertinent information to come to a consensus on rating each technological hazard as low, medium, high, or very high.

Table 4-4 Technological Hazards Rating Criteria

Technological Hazards Ranking Criteria	Rating
An event is imminent. Experts have confirmed potential for occurrence.	Very High
An event is expected/probable. Experts have confirmed potential for occurrence.	High
An event is possible. Potential for occurrence is assumed but not verified.	Medium
An event is unlikely. Potential for occurrence is extremely limited.	Low

Table 4-5 Technological Hazard Rating Results

Technological Hazard	Rating
Airplane Accident	High
Dam Failure*	Low
Financial Disruption	Low
Food/Water Contamination	Medium
Hazardous Materials Spill	High
Oil Spill	Medium
Power Blackout/Energy Shortage/Utilities Failure	Medium
Train Accident	Medium
Urban Fire	High

* Rating results shown have been considered as independent hazards and do not include secondary or cascading events. Dam failure includes technological failure risk (engineering) and does not include secondary risk from an earthquake.

4.4   Human Caused Threat Prioritization

For the 2017 Update, planners convened a select group of Bay Area public safety professionals who routinely participate in a monthly intelligence sharing forum to provide qualitative input on human caused hazards. This information was then compared to Law Enforcement Part 1 and Part 2 crime reports for a more precise quantitative assessment of risk.

Each human caused threat was reviewed for its potential to occur. The Stakeholder Group shared knowledge, concerns, and other pertinent information to come to a consensus on rating each human caused threat as low, medium, high, or very high.

Table 4-6 Human Caused Threat Rating Criteria

Human Caused Threat Ranking Criteria	Rating
The likelihood of a threat, weapon, and tactic being used against a site or building is **imminent**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is credible*.	Very High
The likelihood of a threat, weapon, and tactic being used against a site or building is **expected**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is credible*.	High
The likelihood of a threat, weapon, and tactic being used against a site or building is **possible**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is known, but is not verified*.	Medium
The likelihood of a threat, weapon, and tactic being used in the region or against the site or building is **negligible**. Internal decision makers and/or external law enforcement and intelligence agencies determine *the threat is non-existent or extremely unlikely*.	Low

Table 4-7 Human Caused Threat Rating Results

Human Caused Threat	Rating
Agro-Terrorism	Low
Aircraft as a weapon	Low
Biological Attack	Low
Chemical Agent/Toxic Inhalation Release	Low
Civil Disorder	High

Human Caused Threat	Rating
Conventional Attack	Medium
Major Crime	Very High
Cyber Attack	Very High
Hostage/Assassin	Low
IED	Medium
Nuclear Attack/Acts of War	Low
Radiological Dispersion Device	Low
Sabotage/Theft	Medium
Terrorism	Medium
Vehicle Born IED	Medium
Workplace Violence	Very High

4.5 Threats and Hazards of Most Concern

The prioritization process resulted in a pared down listing of natural, technological, and human caused hazards/threats of most concern to the City of Palo Alto and its local partners. These are presented in Table 3-8 Summary of All Hazards Prioritization.

To complete the THIRA process, we researched each of these hazards/threats to develop a more complete understanding of their characteristics. Section 5 presents detailed hazard and threat profiles.

Table 4-8 Summary of All Hazards Prioritization

Threats and Hazards of Most Concern		
Natural	Technological	Intentional (Human-caused)
Earthquake	Airplane Accident	Major Crime
Flood	Hazardous Waste/ Materials Spill	Cyber Attack
Severe Storm	Urban Fire	Workplace Violence
		Civil Disorder

5 Hazard Profiles

In this chapter of the 2017 Update, changes are highlighted to reflect new or modified information.

This section contains profiles detailing the characteristics of the hazards of most concern.

5.1 Non-Natural Hazard Profile Structure

Technological and human caused threats and hazards require a different approach to evaluating likelihood and potential impacts as compared to natural hazards. With natural hazards, as done in the local hazard mitigation planning process, an evaluation is based on past occurrences, weather patterns, geography, and other relevant earth science. Technological and human caused threats and hazards are not dependent upon earth science and do not occur with regular patterns. For that reason, a modified approach is appropriate for evaluating the potential of technological and human caused threats and hazards.

Each technological or human caused hazard profile contains the following components:

Application Mode: describing the human act(s) or unintended event(s) necessary to cause the hazard to occur.

Duration: the anticipated length of time the hazard is present on the target. For example, the duration of an earthquake may be just seconds, but a chemical warfare agent such as mustard gas, if un-remediated, can persist for days or weeks under the right conditions.

Dynamic/Static Characteristic: describing the hazard's tendency, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space. For example, the physical destruction caused by an earthquake is generally confined to the place in which it occurs, and it does not usually get worse unless there are aftershocks or other cascading failures; in contrast, a cloud of chlorine gas leaking from a storage tank can change location by drifting with the wind and can diminish in danger by dissipating over time.

Mitigating Conditions: characteristics of the target and its physical environment that can reduce the effects of a hazard. For example, earthen berms can provide protection from bombs; exposure to sunlight can render some biological agents ineffective; and effective perimeter lighting and surveillance can minimize the likelihood of someone approaching a target unseen.

Exacerbating Conditions: characteristics that can enhance or magnify the effects of a hazard. For example, depressions or low areas in terrain can trap heavy vapors, and proliferation of street furniture (trash receptacles, newspaper vending machines, mail boxes, etc) can provide concealment opportunities for explosive devises.

5.2 Earthquake Hazard Summary

Past land use decisions in Palo Alto have not always taken hazards into consideration. Moreover, older buildings and infrastructure reflect the construction and engineering standards of their era, which in most cases fall short of current standards for seismic safety. As a result, a portion of the City, including 130 soft story structures, would be at some risk in the event of a major earthquake. The greatest hazards are associated with fault rupture and ground shaking, although liquefaction hazards are significant in the area east of Highway 101 due to the porous nature and high water content of the soil. Landslides, a hazard that is common in the foothills of Palo Alto, may result from heavy rain, erosion, removal of vegetation, or human activities. Settlement and subsidence due to groundwater withdrawal has historically been a problem in the southern and eastern areas of the City of Palo Alto, but has been largely halted by groundwater recharge efforts and reduced pumping. Seismically-induced flooding is a hazard due to the possibility of dam failure at Felt Lake and Searsville Lake and the potential for levee failure near the San Francisco Bay.

To help mitigate the damages that may result from a potential earthquake, Palo Alto strictly enforces uniform building code seismic safety restrictions and provides incentives for seismic retrofits of structures in the University Avenue/Downtown area. The City also allows development rights achieved through seismic upgrading of specified sites to be transferred to designated eligible receiver sites per Program N - 71 in the Comprehensive Plan and per the Palo Alto Municipal Code, Section 18.18.080. Palo Alto has completed seismic improvements to facilities and critical infrastructure as part of its mitigation planning, including City Hall, library buildings, the Art Center, and water reservoirs among others. The City will also benefit from the San Francisco Public Utilities Commission Water System Improvement Program that is 80 percent complete and will provide seismic upgrades to the water distribution system serving Palo Alto (http://www.sfwater.org/index.aspx?page=114).

Some parts of Palo Alto are at greater risk during a natural disaster than others. These areas could be zoned or otherwise regulated to reduce their development potential and require detailed geologic and engineering studies prior to development. The City already requires geologic and soils investigations for development southwest of Interstate 280. Similar requirements should be explored in other areas of the City prone to severe geologic hazards.

5.3 Flood Hazard Summary (Inclusive of Severe Storms)

Flood hazards, including tidal flooding from overtopping of coastal levees during extreme high tide events in the Bay and fluvial flooding from creeks overflowing their banks, are likely to continue to occur in Palo Alto. Severe storms, which generate large amounts of rain and heavy winds, can result in flooding.

As noted in the 2017 LHMP, the City minimizes exposure to flood hazards through its participation in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). FEMA makes NFIP flood insurance available to Palo Alto residents and businesses as a result of the City's adoption of required floodplain management regulations into its Municipal Code (Chapter 16.52) that promote public health, safety and general welfare and minimize damages due to flood conditions. City staff reviews proposed development in flood prone areas and enforces the floodplain management regulations for specified building

activity in Special Flood Hazard Areas, as depicted on FEMA's Flood Insurance Rate Maps (FIRMs). In 1990, the City created an independent enterprise fund to fund needed improvements to the storm drain system with revenue generated through user fees and developed a Storm Drain Master Plan in 1993 to identify and prioritize a set of projects to increase system capacity and reduce the incidence of street flooding. Property owners approved a ballot measure in 2005 to increase the City's monthly storm drain fee and thereby provided funding to implement a set of seven high-priority capital improvement projects to upgrade the storm drain system.   All of the storm drain capital improvement projects specified in the ballot measure will be completed by the end of FY 2017. Also, the City updated the Storm Drain Master Plan in FY 2015 to identify and prioritize a new set of storm drain capital improvement projects to address remaining capacity deficiencies in the City's storm drain system.

The City has long been a partner with the Santa Clara Valley Water District (SCVWD) who constructed channel upgrades (100-year flood protection) in the 1980's and 1990's to reduce flood risks from Adobe, Matadero, and Barron Creeks. San Francisquito Creek remains a substantial flood risk to the community, along with tidal flooding during extreme high tide events. Following the historic 1998 flood, five local agencies from two counties (the cities of Palo Alto, Menlo Park, and East Palo Alto, the County of San Mateo Flood Control District, and the Santa Clara Valley Water District) formed the San Francisquito Creek Joint Powers Authority (SFCJPA) to plan, design, and implement flood, environmental, and recreational projects. Specifically, the San Francisquito Creek Joint Powers Authority is developing a comprehensive regional plan for the San Francisquito Creek watershed that will improve the level of flood protection to Palo Alto and surrounding communities. The SFCJPA's initial capital project, currently under construction in conjunction with the City of Palo Alto, is designed to increase creek flow capacity to protect people and property from fluvial flooding along a critical urban section of the creek between Highway 101 and San Francisco Bay.

Several other flood control projects are also planned upstream of this creek to further reduce riverine flood risks. These projects are also listed in the 2017 LHMP as mitigation actions.

Palo Alto, along with the entire Bay Area, is also subject to increasing flood risk as a result of rising sea levels, requiring city planners to collaborate with regional organizations and projects, such as the SCVWD, SFCJPA, the US Army Corps of Engineers' South San Francisco Bay Shoreline Study, and the State Coastal Conservancy Salt Pond Restoration Project, who have each initiated studies on impacts of sea level rise in the vicinity of Palo Alto.

Palo Alto is also partnering with the SFCJPA in the Strategy to Advance Flood protection, Ecosystems and Recreation along San Francisco Bay (SAFER Bay) to evaluate infrastructure alternatives to protect Menlo Park, East Palo Alto, and Palo Alto against extreme tides with sea level rise, and enhance shoreline habitat and trails. The initial feasibility study is underway on this project.

5.4   Airplane Accident Profile

Aircraft accidents in Palo Alto can result from an aircraft experiencing trouble or from mid-air collisions between aircraft flying over or near Palo Alto as they approach the three Bay Area Airports (San Francisco, Oakland, and San Jose), as well as Moffett Field. In February 2010, a

small aircraft left the Palo Alto Airport and collided with power lines, causing a City-wide power outage. The Palo Alto electrical utility feedpoint to PG&E (and the grid) is a single point, near the airport. The City is exploring a secondary connection.

Application mode: Aviation accidents may be caused by problems originating from mechanical difficulties, pilot error, or acts of terrorism. Extreme weather conditions may also increase the potential of an accident. Airplane accidents can result from major aircraft experiencing trouble while in flight or from mid-air collisions between aircraft flying over or near Palo Alto. There is also the potential for this type of accident to occur over water.[7]

Duration: An airplane accident can occur in an instant and without notice, or could be reported but not remediated, lasting a few hours. Clean up after an accident could take days to weeks. Longer term actions include repairing any buildings and infrastructure that may have been damaged due to the accident and investigating the cause of the incident.

Dynamic/static characteristics: The number of fatalities/injuries and the area damaged by the aircraft accident can vary depending on the type and magnitude of the accident. While damage may be concentrated to the location of the incident, secondary impacts from the accident, such as explosion and fire, as well as debris and hazardous materials, could spread from the initial area of impact.

Mitigating conditions: The City's Emergency Operations Plan (EOP) outlines a response plan to airplane accidents. The EOP also notes that consequences of an airplane accident from a small aircraft associated with Palo Alto airport would be low. Issues in responding to the February 2010 incident were identified in an After Action Report. These issues have been addressed to provide better response to a potential future incident.

Exacerbating conditions: The City of Palo Alto lies between two international airports, San Jose and San Francisco. Within the boundaries of Palo Alto, Santa Clara County operates the Palo Alto Municipal Airport, a general aviation airport. There is potential for an accident to occur in the air or on the ground near these locations as well as over water in Palo Alto's jurisdiction. The City currently does not have a water rescue team to respond to this type of accident and would need to rely on outside response resources. An accident occurring in a residential neighborhood and/or highly dense area of the City exacerbates consequences because of the possible increase in fatalities and damage to structures in these areas as opposed to in more rural or open spaces.

5.5   Hazardous Waste/Materials Spill Profile

Hazardous waste/materials are widely used or created at facilities such as hospitals, wastewater treatment plants, universities and industrial/manufacturing warehouses. Several household products such as cleaning supplies and paint are also considered hazardous materials and can be found in households and stores. Hazardous materials include:

- Explosives;

---

[7] City of Palo Alto EOP (2007)

- Flammable, non-flammable, and poison gas;

- Flammable liquids;

- Flammable, spontaneously combustible, and dangerous when wet solids;

- Oxidizers and organic peroxides;

- Poisons and infectious substances;

- Radioactive materials; and

- Corrosive materials.[8]

The release of a hazardous material to the environment could cause a multitude of problems. Although these incidents can happen almost anywhere, certain areas of the City are at higher risk, such as near roadways that are frequently used for transporting hazardous materials and locations with industrial facilities that use, store, or dispose of such materials. Areas crossed by railways, waterways, airways, and pipelines also have increased potential for mishaps. Incidences can occur during production, storage, transportation, use, or disposal of hazardous materials. Communities can be at risk if a chemical is used unsafely or released in harmful amounts into the environment. Hazardous materials can cause death, serious injury, long-lasting health effects, and damage to buildings, the environment, homes, and other property.[9]

Application mode: Hazardous waste/materials spills may be accidental or intentional, and may occur at fixed facilities or on vehicles.

Accidental Hazardous Waste/Materials Spill

Hazardous materials accidents can range from a chemical spill on a highway to groundwater contamination by naturally occurring methane gas to a household hazardous materials accident.[10] Potential hazards can occur during any stage of use from production and storage to transportation, use or disposal. Production and storage occurs in chemical plants, gas stations, hospitals, and many other sites. There are many reasons an unintentional hazardous waste/materials spill may occur. Some of these include:

- Malfunction of equipment

- Natural disaster

---

[8] National Archives and Records Administration, "Code of Federal Regulations Title 49: Transportation" (July 1 2012), http://ecfr/gpoaccess.gov/cgi/t/text/text-idx?c=ecfr;sid=54f867044f1c9e1af52443eb305e1360;rgn=div5;view=text;node=49%3A2.1.1.3.7;idno=49;cc=ecfr

[9] City of Palo Alto EOP; Santa Clara County 2011 LHMP

[10] University of Idaho Cooperative Extension System, http://www.uiweb.uidaho.edu/disaster/haz/hazmat.html

- Accidents caused by humans[11]

Intentional Fixed Facility Hazardous Waste/Materials Spill

Hazardous material spills at fixed facilities may be internal or external to the facility. External releases may involve industrial storage, fires, or malicious acts. External releases may create airborne plumes of chemical, biological, or radiological elements that can affect a wide area and last for hours or days. Internal releases occur inside buildings and can be caused by a chemical spill or release of a biological or radiological agent. Internal releases can affect all occupants of a building, particularly if the material is distributed throughout the building through the heating/ventilation system.[12]

Intentional hazardous material releases at fixed facilities might include:

- Deliberate release of a hazardous substance by an employee of a facility that stores or uses hazardous materials or produces hazardous waste;

- Deliberate release of a hazardous substance into the water supply

- Detonation of a "dirty bomb" – an explosive device containing radiological or biological substances that are released into the air upon explosion;

- Redirection of toxic waste into water supply or ventilation system; and

- Delivery or placement of a hazardous material inside a building.

Intentional Mobile Hazardous Waste/Materials Spill

Intentional mobile releases may include:

- Release of a chemical, biological, or radiological agent from a moving vehicle or train;

- Use of a vehicle as a dirty bomb, i.e. crashing a vehicle filled with hazardous materials into a structure or building or exploding the vehicle;

- Targeting commercial/industrial chemical containers transported in bulk by both road and rail;

- Release of hazardous materials from airplanes over densely populated areas; and

- Release of hazardous materials into water from a boat.

Duration: Accidental hazardous waste/materials spills can be reported immediately following the spill, thus reducing the amount of time the spill is left uncontained. Most hazardous

---

[11] Innovateus, "What is a Chemical Spill?", http://www.innovateus.net/earth-matters/what-chemical-spill
[12] US Air Force, "Protective Actions for a Hazardous Material Release", (22 October 2001), Http://emc.ornl.gov/CSEPPweb/data/Reports/Misc.%20Reports/HAZMAT.pdf

waste/materials spills occur with little or no warning, and can be difficult to detect until symptoms present themselves to those affected.[13] External releases may create airborne plumes of chemical, biological, or radiological elements that can affect a wide area and last for hours or days. Internal releases will most likely require evacuation of a facility for hours to days. Both external and internal releases require extensive clean-up efforts, lasting from days to months depending on the type and magnitude of the spill.

Dynamic/static characteristics: Both mobile and external hazardous materials releases can spread and affect a wide area, through the release of plumes of chemical, biological or radiological elements, or leaks, or spills. Conversely, internal releases are more likely to be confined to the structure the material is stored in.

Chemicals may be corrosive or otherwise damaging over time. A hazardous materials release could also result in fire or explosion. Contamination may be carried out of the incident area by people, vehicles, wind, and water.[14]

Hazardous material releases are dynamic and may vary depending on the following factors:

- Type and amount of agent released;

- Environmental conditions – The micro-meteorological effects of the buildings and terrain can influence the travel of agents[15];

- Location of release (urban vs. rural, water vs. air); and

- Remediation time, dependent on a locality's or facility's hazardous material release preparedness programs.

Mitigating conditions: Facilities that store hazardous materials are reported to local and federal governments. Security measures at these facilities can be heightened. Many facilities have their own hazardous materials guides and response plans, including transportation companies who transport hazardous materials.

The City's EOP includes an annex identifying the actions and agencies involved in responding to a hazardous materials incident. The City of Palo Alto Fire Department administers the County's hazardous materials emergency planning and community right-to-know program. They also maintain Hazardous Materials Business Plans for every business in the City that handles a hazardous material in quantities above the State's reporting threshold. The City inspects and issues annual permits to approximately 500 businesses with annual hazardous materials permits that necessitate monitoring and inspection.

---

[13] US Air Force, "Protective Actions for a Hazardous Material Release", (22 October 2001), Http://emc.ornl.gov/CSEPPweb/data/Reports/Misc.%20Reports/HAZMAT.pdf
[14] FEMA, "Primer to Design Safe School Projects in Case of Terrorist Attacks," FEMA 428, http://www.fema.gov/pdf/plan/prevent/rms/428/fema428_ch1.pdf
[15] FEMA, "Primer to Design Safe School Projects in Case of Terrorist Attacks," FEMA 428, http://www.fema.gov/pdf/plan/prevent/rms/428/fema428_ch1.pdf

In addition, the City of Palo Alto provides safe hazardous waste disposal for residents and small businesses at a specified Household Hazardous Waste (HHW) Station. Their HHW Program educates the public about the safe use, storage, disposal, and alternatives to hazardous products.

Exacerbating conditions: Palo Alto has the potential for a variety of incidents involving hazardous materials. There are two major areas of high-tech businesses and numerous small businesses that use hazardous materials. The two major areas of high-tech businesses include the Stanford Research Park (about one mile square in area) just south of Stanford University, and the industrial area (about ¼ mile square in area) adjacent to US 101 in south Palo Alto. The Fire Department keeps information on the materials used in these areas. Accidental releases from any user could occur; this presents a danger due to the close proximity of some users to neighborhoods, schools, and other sensitive populations. Staff is currently working on enhancements to existing notification plans and systems. Stanford University, surrounded on three sides by Palo Alto, also uses a variety of hazardous materials in its many labs. The Palo Alto Fire Department provides fire suppression and paramedic services under contract to the University. However, Santa Clara County administers the hazardous materials management plan for the University. Information on these labs is kept on location outside each lab.

Within the City there are two freeways and a railroad that may be used to transport hazardous materials. Areas and people within one mile of a highway, railroad, or industrial area are considered potentially at risk from a hazardous materials release. This includes everyone in Palo Alto except for a few homes in the remote foothills. Palo Alto's two major freeways are US 101 to the east and Interstate 280 to the west. US 101 carries the most commercial traffic. The railroad runs between these freeways through the heart of the City. The Palo Alto Airport, the potential for the aerial spraying of pesticides, and the high volume of air traffic in the area also place Palo Alto at a potential risk from a hazardous materials incident involving aircraft.

Although Palo Alto does not use wells for its primary drinking water, pollution of the aquifer is also a concern.

5.6 Urban Fire Profile

The entire City of Palo Alto is at risk to major fires impacting a section of the City or a large complex. The City has over 25,000 housing units and a significant business base. The proximity of structures to each other within the City creates additional exposure to widespread urban fire. Localized, single-structure fires sometimes occur in Palo Alto. As of November 2013, the City had experienced three urban fires during the previous three months. Major uncontrolled fires are a possibility, but rarely occur.[16]

Application mode: Urban fires can be accidentally caused through human error including cooking accidents, smoking, or unsafe use of woodstoves or space heaters. Malfunctioning electrical equipment is also a major cause of fire in urban areas.[17] Fires originating in the Wildland-Urban Interface (WUI) also pose a threat as they can spread toward more developed areas and cause significant damage to structures, residents, and natural resources. Arson, or the

---

[16] City of Palo Alto EOP (2007)

[17] National Fire Protection Association, (29 January 2013), Urban Fire Safety, http://www.nfpa.org/safety-information/for-consumers/populations/urban-fire-safety

deliberate burning of property, is also a possibility within City limits. Arson attacks may be imposed upon structures, motor vehicles, wildland areas, or other "nonstructural" properties.

Duration: The duration of an urban fire is dependent on weather conditions, the magnitude of the fire, and fire suppression resources. Structural fires could burn for several hours before being fully contained.

Dynamic/static characteristics: Weather conditions (wind and warm, dry temperatures) and the presence of fire fuel can cause fires to spread away from their source.

Mitigating conditions: In the event of a major urban fire, auto-aid and mutual-aid agreements (with Cal FIRE) will be utilized, as outline in the Palo Alto Emergency Operations Plan. The City strives to minimize exposure to wildland and urban fire hazards through rapid emergency response, a sufficient water supply, proactive fire code enforcement, public education programs, and adequate emergency management preparation.

To ensure a sufficient water supply, an emergency water supply and storage project, initiated in 2007, was primarily completed by the City in late 2013/early 2014. This project provides Palo Alto with a self-sustaining emergency water supply through rehabilitating five City wells, constructing three new wells, constructing a new 2.5 million gallon reservoir and associated pump station and well, and upgrading an existing pump station (Mayfield Reservoir Pump Station).

As part of the City's emergency management preparation for wildland and urban fires, they designed and implemented the Palo Alto Foothills Fire Management Plan. This plan pertains to the Palo Alto Foothills area west of the Foothills Expressway and Junipero Serra Boulevard, which represents a Wildland Urban Interface (WUI) area.   The plan addresses a broad range of integrated activities and planning documents to identify and mitigate the impacts of fire hazards in the Palo Alto Foothills Area. Fire mitigation project areas include the boundaries of Foothills Park and Pearson-Arastradero Preserve.

In urban areas, arsonists may target abandoned buildings. Limiting the number of abandoned buildings or providing security near these buildings may deter arsonists. Both structure and wildland arson data can be analyzed to depict trends in copy cat arsonists as well as in weather and fuel conditions. Documenting these trends in a reporting system may assist in mitigating future cases.

Exacerbating conditions: Increasing development in the wildland-urban interface can exacerbate the spread of a wildfire into developed areas, making these areas vulnerable. While planning and mitigation to reduce the risk of fire in Palo Alto's WUI area is controlled through the Palo Alto Foothills Fire Management Plan, there is still potential a fire in this area could impact the City's public safety, cultural and economic activities, and environmental and natural resource management.

5.7   Major Crimes
Major criminal incidents include shooting, homicide, and kidnapping crimes that include multiple suspects or multiple victims and are considered an ongoing threat to the community.

These types of crime have an ability to impact the community in such a way that can undermine the quality of life within the Palo Alto community.

Application mode:

In the period between April 2014 and April 2016 Palo Alto recorded 3469 Part One offenses and 5737 Part Two offenses. The overall Part One and Part Two crime percentages during this period are very similar to the preceding 2013 reporting period.
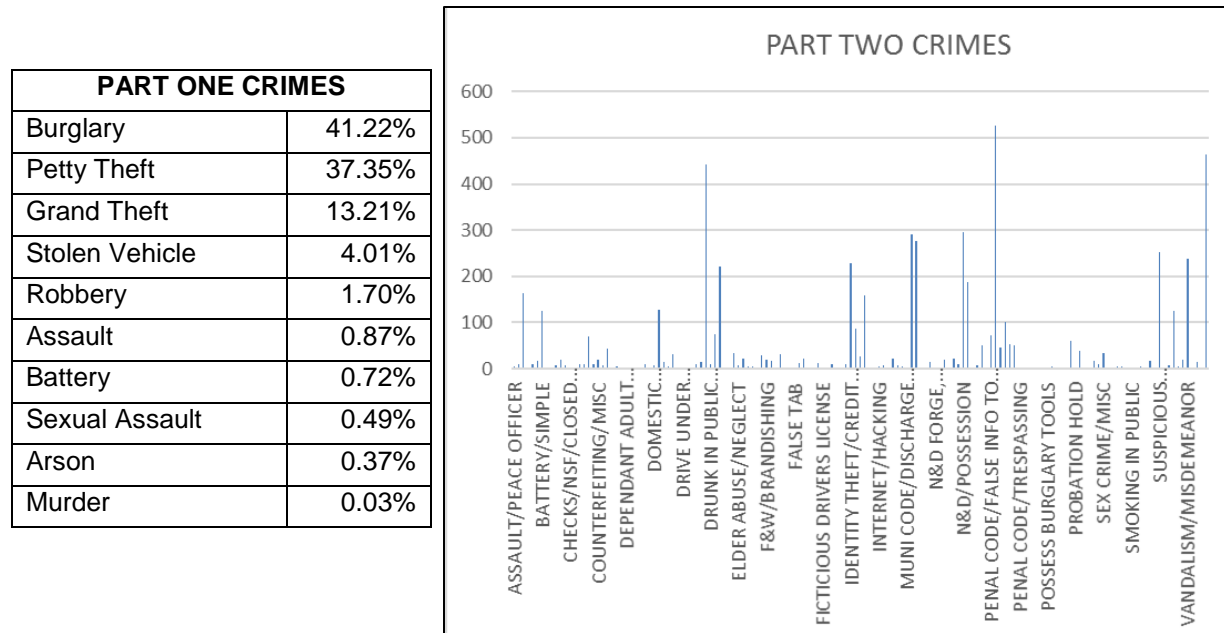
PART ONE CRIMES	
Burglary	41.22%
Petty Theft	37.35%
Grand Theft	13.21%
Stolen Vehicle	4.01%
Robbery	1.70%
Assault	0.87%
Battery	0.72%
Sexual Assault	0.49%
Arson	0.37%
Murder	0.03%

Figure 5-5-1 Statistics of Part I and Part II Crimes in Palo Alto April 2014-2017

For reporting purposes, criminal offenses are divided into two major groups: Part I offenses and Part II offenses per the DOJ and FBI. Part I crimes comprise two categories: violent and property crimes. Aggravated assault, forcible rape, murder, and robbery are classified as violent, while arson, burglary, larceny-theft, and motor vehicle theft are classified as property crimes. Part I crimes are collectively known as Index crimes, this name is used because the crimes are considered quite serious, tend to be reported more reliably than others, and are reported directly to the police. In Part II, the following categories are tracked: simple assault, curfew offenses and loitering, embezzlement, forgery and counterfeiting, disorderly conduct, driving under the influence, drug offenses, fraud, gambling, liquor offenses, offenses against the family, prostitution, public drunkenness, runaways, sex offenses, stolen property, vandalism, vagrancy, and weapons offenses.

This categorization is informative as it links to Palo Alto Police Department's Fiscal Year 2013 Annual Report. "Crime in Palo Alto has seen an overall decrease in the past five years. Violent crimes have continued to decrease, while property crimes have increased. The most notable is

the increase in Residential and Auto Burglaries. Fiscal Year 2013 saw a sharp increase in residential burglaries. The Police Department responded with a directed enforcement campaign, and an increased presence in high risk areas. A total of 79 suspects were arrested for burglary, attempted burglary and other associated charges."
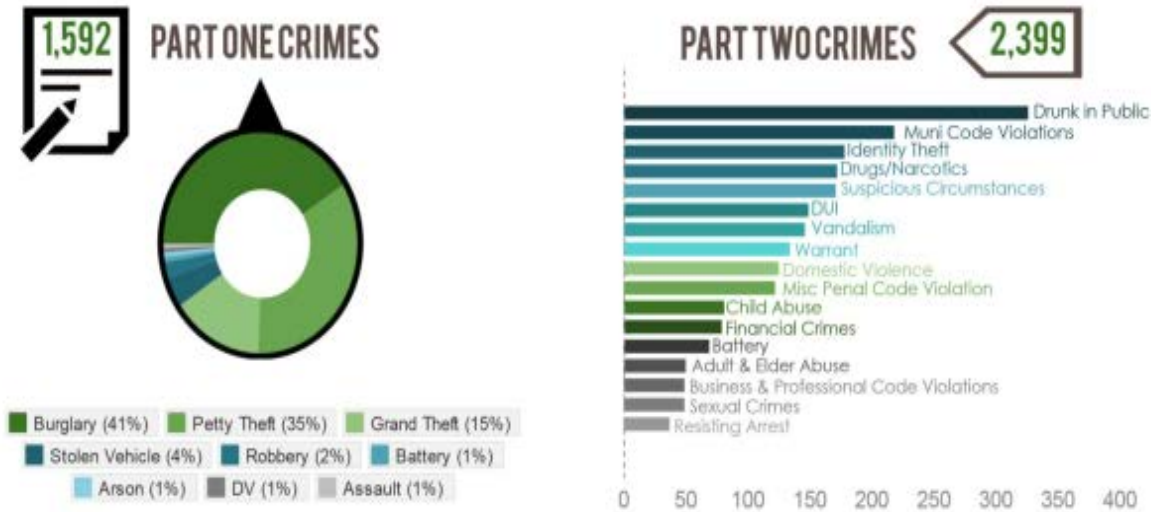

Figure 5-2 Statistics of Part I and Part II Crimes in Palo Alto from the PaloAlso FIscal Year 2013 Annual Report

Duration: A major crime may occur in a short amount of time, from seconds to hours, and it usually occurs without immediate notice.

Dynamic/static characteristics: Major crimes can occur anywhere in the community.

Mitigating conditions: The Palo Alto Police Department and Stanford Department of Public Safety participate in mutual aid and regional organizations to share information, capabilities, and other resources to prevent major crimes from occurring. Additionally, increased 2013 staffing and effective training of Palo Alto Police Department personnel will likely have deterrent effects.

Exacerbating conditions: Palo Alto businesses and residences are perceived as a soft target resulting in increased property crimes by criminals who live outside Palo Alto. The increase of such events increases the probability of a robbery going wrong resulting in a shooting or homicide event.

5.8   Cyber Attack Profile

A cyber terrorist can infiltrate many institutions including banking, medical, education, government, military, and communication and infrastructure systems. The majority of effective malicious cyber-activity has become web-based. Recent trends indicate that hackers are

targeting users to steal personal information and moving away from targeting computers by causing system failure.[18]

Application mode: Common types of cyber attacks are summarized in Table 4-1 Common Types of Cyber Attacks[19]

Table 5-1 Common Types of Cyber Attacks

Type of Attack	Description
Denial of service	A method of attack from a single source that denies system access to legitimate users by overwhelming the target computer with messages and blocking legitimate traffic. It can prevent a system from being able to exchange data with other systems or use the internet.
Botnet	A collection of compromised machines (bots) under (unified) control of an attacker (botmaster).
Distributed denial of service	A variant of the denial-of-service attack that uses a coordinated attack from a distributed system of computers rather than from a single source. It often makes use of worms to spread to multiple computers that can then attack the target.
Exploit tools	Publicly available and sophisticated tools that intruders of various skill levels can use to determine vulnerabilities and gain entry into targeted systems.
Logic bombs	A form of sabotage in which a programmer inserts code that causes the program to perform a destructive action when some triggering event occurs, such as terminating the programmer's employment.
Phishing	The creation and use of e-mails and Web sites—designed to look like those of well-known legitimate businesses, financial institutions, and government agencies—in order to deceive Internet users into disclosing their personal data, such as bank and financial account information and passwords. The phishers then take that information and

---

[18] Symantec, "Internet Security Threat Report" Volume 17 (2011), www.symantec.com/threatreport

[19] United States Government Accountability Office, "Critical Infrastructure Protection: Department of Homeland Security Faces Challenges in Fulfilling Cybersecurity Responsibilities", Report #GAO-05-434 (May 2005), www.gao.gov/new.items/d05434.pdf

Type of Attack	Description
	use it for criminal purposes, such as identity theft and fraud.
Sniffer	Synonymous with packet sniffer. A program that intercepts routed data and examines each packet in search of specified information, such as passwords transmitted in clear text.
Trojan horse	A computer program that conceals harmful code. A Trojan horse usually masquerades as a useful program that a user would wish to execute.
Virus	A program that infects computer files, usually executable programs, by inserting a copy of itself into the file. These copies are usually executed when the infected file is loaded into memory, allowing the virus to infect other files. Unlike the computer worm, a virus requires human involvement (usually unwitting) to propagate.
War dialing	Simple programs that dial consecutive telephone numbers looking for modems.
War driving	A method of gaining entry into wireless computer networks using a laptop, antennas, and a wireless network adaptor that involves patrolling locations to gain unauthorized access.
Worm	An independent computer program that reproduces by copying itself from one system to another across a network. Unlike computer viruses, worms do not require human involvement to propagate.

One of the difficulties of malicious cyber activity is that its origin could be virtually anyone, virtually anywhere. Table 4-2 Common Sources of Cybersecurity Threats summarizes common sources of cybersecurity threats.[20]

Table 5-2 Common Sources of Cybersecurity Threats

Threat	Description
Bot-network operators	Bot-network operators are hackers; however, instead of breaking into systems for the challenge or bragging rights,

---

[20] United States Government Accountability Office, "Critical Infrastructure Protection: Department of Homeland Security Faces Challenges in Fulfilling Cybersecurity Responsibilities", Report #GAO-05-434 (May 2005), www.gao.gov/new.items/d05434.pdf

Threat	Description
	they take over multiple systems in order to coordinate attacks and to distribute phishing schemes, spam, and malware attacks. The services of these networks are sometimes made available on underground markets (e.g., purchasing a denial-of-service attack, servers to relay spam or phishing attacks, etc.).
Criminal groups	Criminal groups seek to attack systems for monetary gain. Specifically, organized crime groups are using spam, phishing, and spyware/malware to commit identity theft and online fraud. International corporate spies and organized crime organizations also pose a threat to the United States through their ability to conduct industrial espionage and large-scale monetary theft and to hire or develop hacker talent.
Foreign intelligence services	Foreign intelligence services use cyber tools as part of their information-gathering and espionage activities. In addition, several nations are aggressively working to develop information warfare doctrine, programs, and capabilities. Such capabilities enable a single entity to have a significant and serious impact by disrupting the supply, communications, and economic infrastructures that support military power—impacts that could affect the daily lives of U.S. citizens across the country.
Hackers	Hackers break into networks for the thrill of the challenge or for bragging rights in the hacker community. While remote cracking once required a fair amount of skill or computer knowledge, hackers can now download attack scripts and protocols from the Internet and launch them against victim sites. Thus, while attack tools have become more sophisticated, they have also become easier to use. According to the Central Intelligence Agency, the large majority of hackers do not have the requisite expertise to threaten difficult targets such as critical U.S. networks. Nevertheless, the worldwide population of hackers poses a relatively high threat of an isolated or brief disruption causing serious damage.
Insiders	The disgruntled organization insider is a principal source of computer crime. Insiders may not need a great deal of knowledge about computer intrusions because their knowledge of a target system often allows them to gain

Threat	Description
	unrestricted access to cause damage to the system or to steal system data. The insider threat also includes outsourcing vendors as well as employees who accidentally introduce malware into systems.
Phishers	Individuals, or small groups, that execute phishing schemes in an attempt to steal identities or information for monetary gain. Phishers may also use spam and spyware/malware to accomplish their objectives.
Spammers	Individuals or organizations that distribute unsolicited e-mail with hidden or false information in order to sell products, conduct phishing schemes, distribute spyware/malware, or attack organizations (i.e., denial of service).
Spyware/malware authors	Individuals or organizations with malicious intent carry out attacks against users by producing and distributing spyware and malware. Several destructive computer viruses and worms have harmed files and hard drives, including the Melissa Macro Virus, the Explore.Zip worm, the CIH (Chernobyl) Virus, Nimda, Code Red, Slammer, and Blaster.
Cyber-Terrorists	Cyber-Terrorists seek to destroy, incapacitate, or exploit critical infrastructures in order to threaten national security, cause mass casualties, weaken economies or target businesses, and damage public morale and confidence. Cyber-Terrorists may use phishing schemes or spyware/malware in order to generate funds or gather sensitive information.

Given its location in Silicon Valley, Palo Alto is home to many large companies that could be subject to a cyber attack.

Duration: The duration of a cyber attack is dependent on the complexity of the attack, how widespread it is, how quickly the attack is detected, and the resources available to aid in restoring the system.

Dynamic/static characteristics: A cyber attack could be geared toward one organization, one type of infrastructure and/or a specific geographical area. The affected area could range from small to large scale.

Cyber attacks generated toward large corporations can negatively affect the economy.   The Congressional Research Service study (2008) found the economic impact of cyber attacks on businesses has grown to over $226 billion annually.[21]

Attacks geared toward critical infrastructure and hospitals can result in the loss of life and the loss of basic needs, such as power and water, to the general public. Cyber attacks can also lead to the loss of operational capacity.

Mitigating conditions: Palo Alto has three levels of security to prevent cyber attacks:

> 1. A Symantech anti-virus protection for desktops and laptops;
> 2. Malware Protection Systems for Web and email systems; and
> 3. A Barracuda Firewall for the IT Network.

In addition, the City is in the process of deploying a vulnerability management system to better protect the IT network.

Access control to buildings, such as ID cards and badges, can help regulate the people who have access to an agency's or corporations' cyber network. Palo Alto information technology network locations include access control measures to prevent unauthorized access to these controlled areas.

The City has an Energy Assurance Plan that focuses on minimizing energy interruptions during emergencies. This plan could be updated to include a contingency plan for keeping energy lifelines online given a cyber attack. Currently, the North American Electric Reliability Corporation (NERC) is responsible for ensuring energy industry compliance with Critical Infrastructure Protection (CIP) standards. These rules require organizations that deliver bulk electricity to the North American power grid to identify and protect critical cyber assets. In addition, bulk power suppliers must define methods, processes, and procedures for securing critical cyber assets. "Cyber assets" are loosely defined as all "programmable electronic devices and communication networks including hardware, software, and data.[22]

Exacerbating conditions: Humans are the weakest link in a chain of cyber security. It remains difficult to continuously monitor and manage human/operator vulnerability. However, to address this weakness the City has deployed an online security training program which all employees are required to complete annually.

5.9   Workplace Violence Profile

Workplace violence is violence or the threat of violence against workers. It includes any act or threat of physical violence, harassment, intimidation, or other threatening disruptive behavior that occurs at the worksite. It can occur at or outside the workplace and can range from threats and verbal abuse to physical assaults and homicide. It can affect and involve employees, clients,

---

[21] *Defense Tech.* http://defensetech.org/2008/10/20/the-cyber-attack-danger/
[22] *NextLabs.* http://www.nextlabs.com/html/?q=nerc-and-ferc-cyber-security-standards

customers, and visitors. Workplace violence includes locations such as churches, malls, etc. and may be the result of a person acting alone.[23]

Application mode: Workplace violence can range from threats and verbal abuse to physical assaults and homicide. These incidents can be caused by fellow employees, by employers, or by external clients.

Duration: Acts of workplace violence could be a onetime incident or could occur repetitively over time, lasting weeks to years.

Dynamic/static characteristics: Workplace violence can occur at or outside the workplace.

Mitigating conditions: Many companies have established workplace violence prevention programs and offer trainings on workplace violence including how to identify it and mitigate it. Providing a secure workplace that has video surveillance, extra lighting, and alarm systems may minimize access to outsiders.

Exacerbating conditions: Some workers are at increased risk to workplace violence. Among them are workers who exchange money with the public; deliver passengers, goods, or services; or work alone or in small groups, during late night or early morning hours, in high-crime areas, or in community settings and homes where they have extensive contact with the public. As with sabotage, social media such as Twitter and Facebook may be a means of exacerbating workplace bullying and violence.

5.10 Civil Disorder

Civil disorder refers to unrest caused by a group of people and may include terrorist activities. Public demonstrations have the potential to lead to looting and rioting. There are many potential causes for civil disorder including: animal rights, labor disputes, civil rights, campus related issues, abortion rights, neighboring jurisdictions, political issues, events (sports, music, etc.), and spontaneous miscellaneous events. Potential consequences from acts of civil disorder include: disruptions of police and city services, closure of roads, rioting, property damage, and injuries to protesters, police officers, and uninvolved parties.

Application mode: Over the past two years, Palo Alto has seen a number of civil disturbances spawned by events from across the Country including the 2014 Ferguson, Missouri riots, internationally motivated riots against Hewlett Packard, and the 2016 National Elections and Inauguration. These incidents were primarily peaceful however some had disruptive impacts on the community.

Duration: Civil disturbances typically last for several hours, but the duration can be extended to days.

Dynamic/static characteristics: Civil disturbances can occur anywhere in and around Palo Alto and are usually outside established facilities.

---

[23] US Department of Labor, Occupational Safety and Health Act, www.OSHA.gov

Mitigating conditions: No long-term mitigation actions can attempt to reduce the occurrence or impacts from future civil disturbances. However, proactive situational awareness to identify planned events can lead to proactive and beneficial dialogue with event planners to minimize the impacts on the community.

Exacerbating conditions: Manmade facilities, such as homes, businesses, and other essential infrastructure, such as dams, utilities sites, and other public common areas are vulnerable to civil disturbance because civil violence, by its very nature, is most often directed at objects that reflect civil values - property, industry, and services. As such, the manmade environment would receive a high impact and vulnerability rating. Palo Alto houses many high-profile international corporations, which could be potentially targeted.

6 Conclusion

The City of Palo Alto and its local partners should be commended for the tremendous capabilities currently available to prevent, protect against, mitigate, respond to, and recover from hazards and threats. One invaluable strength of the City's emergency management program is the ongoing coordination with local partners. Emergency planning, training, and exercises are conducted in partnership with Stanford University, Stanford Hospital, neighboring jurisdictions, community members, and other pertinent organizations such as the American Red Cross.

Communications technology within the City is fairly robust. Mass notification systems are in place. Responders and emergency managers will use the highest level of communication technology available during/immediately following an incident. Communications and notification systems are both for public safety agencies and the general public. There are a wide range of communications options. Stanford University employs an Outdoor Warning System (PA and sirens) for emergency alerts/notifications, but such a system does not exist in Palo Alto. Stanford University and the City of Palo Alto have interoperable dispatch systems. A Mobile Emergency Operations Center (MEOC) is available to enable communication coordination should the primary EOC be compromised. Social media will be an asset for receiving information from the public regarding attacks and impacts. KZSU, the Stanford radio station, is an available resource that can be taken over from Palo Alto City Hall to provide supplemental information, beyond and more-local than what might be available on other broadcast stations via the Emergency Alert System (EAS). Certain businesses have two-way radio communications within their neighborhood and to the City EOC. WebEOC enables efficient dissemination of incident management information across local government agencies throughout the Operational Area. Finally, the growth of social media tools is a resource to Palo Alto and Stanford.

Opportunities for residents and members of the public to contribute to the City's resiliency are bountiful. The Emergency Services Volunteer program provides supplemental resources to the professional first responders and facilitates means for neighbors to help neighbors (including businesses and other entities). This organization includes several City-sponsored emergency preparedness volunteer programs:

- Neighborhood and Block Preparedness Coordinator program
- Palo Alto CERT Program
- Palo Alto Auxiliary Communications Services: ARES/RACES
- Palo Alto Medical Reserve Corps

In addition to these formal opportunities for community members to receive training and assist through specific roles, "see something, say something" campaigns are helpful in maintaining vigilance throughout the City. Public education occurs via the Office of Emergency Services presence on the web (www.cityofpaloalto.org/publicsafety), providing emergency preparedness presentations to the "whole community", and through the use of semi-annual utility bill inserts. The City of Palo Alto conducts an annual community exercise to educate the public on disaster preparedness and how to make a plan of action.

Several policies and organizational processes are in place for the City government to achieve long term resiliency. Examples include the zoning ordinance and building code enforcing safe development. Critical Infrastructure and Key Resources (CIKR) sites are tagged in the new Computer Aided Dispatch (CAD) system for Palo Alto, Stanford University Campus, Los Altos & Mountain View. Current planning efforts include an update to the Comprehensive Plan, a recent Hazard Mitigation Plan, and this THIRA report. The established THIRA Executive Committee may prove to be helpful in ongoing planning efforts beyond regular updates of this report.

Logistical resources available to the City include a small airport owned and operated by the City, Moffett Federal Airfield, Stanford University Medical Center, schools, community centers, etc. The Silicon Valley region is considered resource-rich with regard to the anticipated availability of food in residences as well as skilled and willing volunteers to assist with recovery. Established Mutual Aid may be called upon for additional resources. Points of Distribution sites are established and exercised throughout Santa Clara County.

Much of the City's resiliency and preparedness relies on actions taken by non-City agencies. For example, schools are trained to handle active shooter situations. The Chamber of Commerce is a strong resource for coordinating with small businesses. Stanford University Medical Center conducts an annual hazard vulnerability analysis and maintains a mass fatality plan. The Stanford Research Park follows protocols to alert/notify constituents of hazardous material releases. Private sector Emergency Response Teams are established at many businesses in Palo Alto. Caring residents and non-profit organizations serve as stewards of open space preserves. The Palo Alto Historical Association has a listing of historical buildings.

Despite all of the commendable strengths in emergency management and community resiliency, the THIRA Stakeholder Group identified numerous challenges toward further improvement. For example, staff at key institutions such as Stanford University Medical Center and other businesses may not be available following a catastrophic event due to transportation system failure or the need to care for their families. That same problem, of course, may affect City staff.

Resources to respond to a significant event (including first responder professionals, and city staff such as building inspectors) are severely limited. The current contracts and blanket purchase orders are non-exclusive and may result in overlapping needs by multiple jurisdictions/agencies. Following a significant event, personnel resources will be needed for protecting medical supplies, routing traffic safely, etc.

Personal preparedness throughout the whole community can be improved. The City's OES faces a challenge of engaging new members of the community in emergency preparedness and volunteer programs, in some part due to cultural differences and language barriers.

The Stakeholder Group identified that the business community should be more engaged in emergency/resiliency planning. The local economy is susceptible to impacts from events such as cybersecurity attacks or failure/breach of the fiber ring.

There is strong concern regarding infrastructure failure throughout the City including power, telecommunications, water/wastewater distribution, and electric distribution. The Public Safety

Building, housing the Emergency Operations Center and the 911 Center for Palo Alto and Stanford, is of key concern, due to its long-known susceptibility to potential earthquake damage.

The neighboring counties and Stanford University use different alert systems and protocols for disseminating information which creates a challenge for ensuring consistency in messaging for the public following an event that crosses jurisdictional boundaries. Other concerns regarding communications following an event include:

- Not all stakeholders have an easy way to report activities.

- Because of social media, the velocity of information, including false information/rumors, is likely to outstrip local governments' ability to stay on top of it.

- Communication systems that public safety relies upon may not be functional.

There is no current risk management system in place. Limited resources such as video cameras and license plate readers are available for monitoring for security and protection of CIKR. The City has access control systems for various city facilities but would benefit from improvements to these current systems.

The City's Office of Emergency Services has limited staffing resources to manage and maintain the desired robust emergency management program. All identified hazards are not fully evaluated in the City's EOP or LHMP (e.g. Cyber Attack, Hostage/Assassin, Sabotage/Crime/Theft, and Workplace Violence). It requires significant staff time to adequately pre-plan for prevention, protection, mitigation, response and recovery including coordination with numerous local, state, and federal agencies as well as whole community partners.

6.1   Recommendations for Action

Throughout the THIRA process, the Stakeholder Group and Executive Committee identified many actions to improve capabilities for prevention, protection, mitigation, response, and recovery. These recommendations are captured in Table 8-1. The list below has been modified to summarize clear actionable items the City may prioritize and incorporate into ongoing planning and budgeting processes.

Planning

- Update the City of Palo Alto Emergency Operations Plan and incorporate the identified hazards as evaluated in this THIRA.

- Develop a detailed inventory of Critical Infrastructure and Key Resources (CIKR) among Palo Alto and Stanford University that will foster improved planning for critical infrastructure protection. Implement a plan to document risks to specified CIKR and develop a strategy to mitigate these risks. This plan could include a template for CIKR managers to conduct and document risk assessments for submission to the City of Palo Alto.

- Explore sustainable solutions for energy assurance, including alternate energy for critical facilities.

- Promote Utilities Infrastructure improvements that mitigate/improve resiliency (power, water, wastewater, gas).

- Continue to collaborate with regional planning efforts to mitigate impacts of sea level rise / climate change.

- Implement an Infrastructure Management System – identified by IBRC.

- Conduct an updated assessment on the vulnerabilities of public safety communication technologies and capabilities.

  o Develop alternate communications capabilities to reduce reliance on commercial carriers.

  o Incorporate a city-wide public safety communications infrastructure assessment and survey (including Stanford University and Stanford Hospital) to provide a baseline capability to connect key facilities and nodes.

- Develop a Continuity of Operations/Continuity of Government Plan.

- Develop an emergency information technology plan, including business continuity and disaster recovery (BCDR).

- Develop a supporting plan in conjunction with the Operational Area plan for mortuary affairs, mass casualty, mass sheltering, points of distribution and points of dispensing (mass prophylaxis) and other such regional activities.

- Encourage owners of CIKR to develop all hazard response plans and coordinate, where applicable, support requirements with appropriate service providers.

- Develop a City of Palo Alto recovery plan including:

  o pre-identified locations for FEMA trailers and field hospital/medical treatment areas.

  o plans for restoring basic health and social services functions following a catastrophic event pre-identified alternative housing solutions for use following a catastrophic event.

  o an evaluation of options for expediting building permits following a catastrophic event.

  o resources available from the City of Palo Alto airport.

- Convene THIRA executive committee annually to review and update the THIRA.

Organization

- Maintain an OES staff that is trained to develop, manage, and coordinate the implementation of the Palo Alto family of emergency plans (EOP, COOP, HMP, THIRA, etc.).

- Use the *Threat and Hazard Identification and Risk Assessment* (THIRA) report to help guide decisions related to prevention, protection, mitigation, response and recovery related to threats that could affect the City.

- Implement a Joint Information System with North County stakeholders that will improve public messaging during times of crises. Maintain trained staff to serve as local alerting authorities consistent with the Integrated Public Alert and Warning system (IPAWS).

- Maintain Palo Alto Emergency Services Volunteer , Stanford University volunteer programs, Corporate Emergency Response Teams, and similar programs throughout the community.

- Maintain participation in regional efforts to address remaining flood concerns, e.g., SFC JPA, SCVWD, South San Francisco Bay Shoreline Study, Salt Pond Restoration Project.

- Implement a Multi-Agency Coordination (MAC) structure for storms/floods, public works mutual aid, etc. Evaluate and improve coordination protocols within the Operational Area, and with appropriate state and federal agencies.

- Bolster participation in the Northern California Regional Intelligence Center (NCRIC), the Terrorism Liaison Officer (TLO) program, the Urban Area Security Initiative (UASI), and other means to share information among agencies, businesses, and partner organizations.

- Establish an emergency resource directory and put in place advanced contracts for key commodities or services identified during the planning, training, exercise process .

Equipment/Facilities

- Construct new Palo Alto Public Safety Building.

- Develop an Emergency Operations Staging Area (EOSA) to serve as a North County staging area resource and to shelter the Palo Alto Mobile Emergency Operations Center and other critical supplies.

- Improve video monitoring throughout the City of Palo Alto through collaboration and coordination with privately owned video systems and city owned video systems.

- Increase access controls / physical security at critical city owned and operated facilities.

- Maintain at a high level of readiness emergency response vehicles and specialized equipment required to respond to the threats and hazards listed in this report.

- Acquire alternative energy and energy efficient equipment that will reduce fuel requirements and ease overall logistical burdens.

- Upgrade creek stormwater monitoring systems to provide improved situational awareness during storm events.

- Evaluate and implement a thermal sensors/camera network to cover the Wildland Urban Interface (WUI).

- Coordinate with appropriate organizations to install battery backup systems on traffic signals that increase public safety following a power outage scenario.

- Improve connectivity to partner EOCs and 911 PSAPs such as fiber, microwave, etc.

- Explore Video Teleconferencing (VTC) capabilities to link government and nongovernment partners.

- Upgrade command and control software systems that improve communications, collaboration, and situational awareness.

- Acquire base camp supplies and materials to sustain small response operations (30-50 responders) for events that occur in or around Palo Alto.

- Continue to participate in UASI CBRNE and HAZMAT equipment evaluation and selection.

- Continue to evaluate feasibility of Regional Command Center at Moffett Field.

Training and Exercise

- Collaborate and regularly exercise with agencies/organizations referenced in the City's Emergency Operations Plan: Federal, State, agencies with a regional presence; Mutual Aid Jurisdictions, Schools and Universities, Private Sector businesses, Not for Profit organizations (Faith Based, Community Service); Hospitals & Health Care Facilities.

  o Conduct training with other government agencies such as the FBI, State Dept., Secret Service, etc. to ensure collaborative processes and work through specific scenario variables.

  o Conduct collaborative planning, training and exercises with Caltrain and other rail carriers operating in the area.

  o Train and exercise road block/traffic diversion procedures such as in the vicinity of Stanford Hospital and Stanford University.

- Conduct training and exercises with private sector entities such as Stanford Industrial Park, Stanford Shopping Center, etc.

- Regularly conduct ICS and EOC staff training per the Palo Alto EOC Staff Development Program prioritizing high threat hazards

- Conduct employee information technology security and awareness training and exercise a cyber security response effort with the information technology department as the operations lead.

- Routinely conduct mass care and shelter training in coordination with American Red Cross and City of Palo Alto partners.

Community Readiness

- Cultivate a culture of preparedness and community connection through efforts such as outreach to public and private schools, Citizen Corps Council, City Staff and Volunteer Disaster Service Worker training, and other "whole community" stakeholders.

  o Continue to engage the business sector to improve their mitigation and preparedness efforts; educate small businesses on the importance of resiliency planning.

  o Establish a goal for each family and business within the community to have an adequate supply of water, food, etc.

  o Pre-identify/establish public messaging campaigns that remind the community of appropriate actions to a variety of potential hazard events (e.g. shelter in place, evacuate, earthquake, flooding, etc.)

  o Continue and improve promotion of family and business readiness to mitigate service needs such as sheltering and mass care.

- Evaluate the potential for establishing a coordinating group for private airplane pilots (a model exists in southern Santa Clara County) that could improve small-scale disaster logistics operations.

6.2 THIRA Maintenance

The Palo Alto Office of Emergency Services (OES) will be responsible for reviewing this THIRA report quarterly to make note of progress and/or items to update. Annually, the THIRA Executive Committee will convene to discuss the progress and/or circumstances requiring changes to the stated priorities. The annual Executive Committee meeting will culminate in a summary memo prepared by OES and submitted to the City Council for consent as a matter of public record.

Every two years the THIRA report will be updated and re-issued as a new version. On an ongoing basis the THIRA report shall inform updates to the City's Emergency Operations Plan.

The THIRA report is For Official Use Only and is not available in its entirety to the public. Questions regarding this report may be directed to OES at 650-617-3197.

7   Appendices

7.1   Appendix A: Planning Process

This THIRA report was developed through a comprehensive planning process which engaged key City of Palo Alto and Stanford University leadership as well as a broader stakeholder group representing the whole community. Following are summaries of the participants, meetings, and workshops. Future updates to the THIRA may warrant expansion of the stakeholder roster and modification of the planning process.