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THESIS

EMERGENCY PREPAREDNESS COORDINATION CHALLENGES FOR METROPOLITAN TRANSPORTATION CENTERS

by

Marcia Raines

June 2018

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This thesis evaluates emergencies that are likely to occur in metropolitan transportation centers and the challenges emergency managers face when preparing for them. Specifically examining nine co-located transportation agencies in California's San Francisco Bay Area, the research identifies methods emergency managers can use to enhance preparedness coordination and collaboration across multiple transportation agencies where, despite their different governance structures and base locations, operations overlap. The author examined best practices among existing emergency preparedness documents and offers six recommendations that can enhance cross-agency coordination: 1) adopting an all-hazards approach, 2) defining a common method, 3) involving the "whole community" in preparedness activities, 4) enhancing resource-allocation techniques, 5) establishing a method for continuity of operations in a combined emergency operations center, and 6) hardening existing infrastructure.

Going forward, the nine agencies in the study area must establish a year-long pilot program to evaluate emergency preparedness methods, which should include regular table-top exercises and the eventual establishment of a regional transportation emergency operations center (RTEOC). These exercises will also help the agencies establish clear roles and responsibilities, which will provide the public with better protection during emergencies.

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EMERGENCY PREPAREDNESS COORDINATION CHALLENGES FOR METROPOLITAN TRANSPORTATION CENTERS

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Submitted in partial fulfillment of the
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ABSTRACT

This thesis evaluates emergencies that are likely to occur in metropolitan transportation centers and the challenges emergency managers face when preparing for them. Specifically examining nine co-located transportation agencies in California's San Francisco Bay Area, the research identifies methods emergency managers can use to enhance preparedness coordination and collaboration across multiple transportation agencies where, despite their different governance structures and base locations, operations overlap. The author examined best practices among existing emergency preparedness documents and offers six recommendations that can enhance cross-agency coordination: 1) adopting an all-hazards approach, 2) defining a common method, 3) involving the "whole community" in preparedness activities, 4) enhancing resource-allocation techniques, 5) establishing a method for continuity of operations in a combined emergency operations center, and 6) hardening existing infrastructure.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABAG	Association of Bay Area Governments
BART	Bay Area Rapid Transit
Cal OES	California Governor's Office of Emergency Services
Caltrain	California commuter rail line
Caltrans	California Department of Transportation
COW	Communication on Wheels
DHS	Department of Homeland Security
EOC	emergency operations center
FEMA	Federal Emergency Management Agency
JPA	joint powers agency
MTC	Metropolitan Transportation Commission
MTI	Mineta Transportation Institute
RTEOC	regional transportation emergency operations center
samTrans	San Mateo County Transit District
SFO	San Francisco International Airport
TC	transportation center
TSA	Transportation Security Administration
USGS	United States Geological Survey

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EXECUTIVE SUMMARY

This thesis evaluates emergencies that are likely to occur in metropolitan transportation centers and the challenges emergency managers face when preparing for them. With infrastructure and people concentrated in one area, an emergency event—such as an earthquake or terrorist attack—can be devastating. Specifically, this thesis argues that all the transportation facilities that operate in a concentrated area must coordinate and act as a joint facility for emergency preparedness purposes. Doing so will reduce inherent risk to the agencies and the surrounding region. Currently, agencies in the San Francisco Bay Area coordinate on some level, but if they strengthen collaboration efforts they can provide better protection to both human and infrastructure resources across the region.

Transportation has repeatedly been the target of manmade and terrorist threats.[1] The Critical Infrastructures Protection Act of 2001 defines critical infrastructure as "systems and assets … so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security [and] national economic security."[2] Further, the Patriot Act identifies the transportation sector as one of sixteen key sectors of critical infrastructure.[3] In 2003, Homeland Security Presidential Directive 5 addressed the need to enhance critical infrastructure resiliency through coordinated and collaborative efforts at various levels of operations in order to strengthen security and resilience.[4] Some related work has been done at the public safety level, but more work is needed at the administrative and operations level to ensure that transportation agencies are providing a safe environment for the surrounding agencies

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[1] Yuko Nakanishi et al., "Assessing Emergency Preparedness of Transit Agencies," *Transportation Research Record* 1822 (January 2003): 24–32, http://doi.org/10.3141/1822-04.

[2] White House, *Presidential Policy Directive—Critical Infrastructure Security and Resilience*, PPD-21 (Washington, DC: White House, 2013), https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil.

[3] USA Patriot Act, United States Public Law 107–56, *U.S. Statutes at Large* 115 (2001), https://www.gpo.gov/fdsys/pkg/STATUTE-115/pdf/STATUTE-115-Pg272.pdf.

[4] Department of Homeland Security (DHS), *Management of Domestic Incidents*, Homeland Security Presidential Directive-5 (Washington, DC: DHS, 2003).

and communities. With the San Francisco Bay Area as its main example, this thesis recommends enhancing emergency preparedness by improving coordination and collaboration between agencies that work in close proximity to each other. Doing so will enhance emergency preparedness and reduce inherent risk to the agencies and the surrounding region.

Millions of transportation system customers and tons of cargo routinely pass through a particular regional transportation center in the Bay Area. Operations must run smoothly and uninterrupted at all times. Nine agencies operate a variety of modes of transportation, serving a wide range of customers—from international travelers, to local commuters, to cargo. Several of the Bay Area transportation agencies examined in this thesis already work together in some fashion, but they do not fully coordinate emergency preparedness activities. Each agency has a distinct governing board, finance requirements, and regulatory standards that govern their operations, and varying levels of government oversee these agencies. During emergencies, many of these agencies need resources that are housed outside the immediate area; some are located a great distance away and are potentially not accessible in emergency conditions. The agencies, their passengers, and the community will benefit from advance collaborative planning that will help allocate critical resources during an emergency.

To evaluate overall emergency preparedness, this thesis reviews existing open-source emergency documents from nine Bay Area transportation agencies, as well as best practices used to protect transit infrastructure both in other U.S. cities and internationally. Based on best practices, the thesis offers recommendations the Bay Area agencies can implement to enhance the regional transportation system's emergency preparedness. The recommendations fall into six categories: 1) adopting an all-hazards approach to emergency planning, 2) establishing single channels of communication, 3) approaching emergency preparedness as a "whole community" effort, 4) coordinating resource allocation, 5) establishing continuity of operations over extended periods of time, and 6) hardening infrastructure.

Ultimately, this thesis argues that in order to optimally prepare for emergencies, multiple co-located agencies must move beyond their independent authorities and

establish enhanced collaboration and coordination on a system-wide scale. The recommendations suggest mechanisms that can improve operational protocols used to protect the agencies, their employees, nearby residents, and commuters. It is also recommended that the Bay Area agencies establish a year-long pilot program to implement a regional transportation–oriented emergency operations center to evaluate the benefits of this collaborative approach. This proof-of-concept effort will give the various agencies much-needed time to develop methods for working more closely in emergency scenarios. These efforts will also likely lead to longer-term solutions, will help the agencies establish resource-sharing agreements, and will allow them to form a regional transportation emergency operations center (RTEOC).

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I. INTRODUCTION

> We know we cannot underestimate the importance of emergency planning in our region, nor can we assume we'll have ample warning time. If an earthquake or terrorist attack hits, we won't necessarily have advance alerts or opportunities to double- and triple-check our plans.
>
> —California Bay Area Representative Ellen Tauscher[1]

Millions of commuters and tons of cargo routinely pass through a Bay Area regional transportation center (TC) located adjacent to the San Francisco International Airport. The TC's operations must run smoothly at all times; an interruption to any one of the services can disrupt transportation systems regionally, statewide, nationwide, and internationally. While each individual agency's emergency preparedness is important, it is also critical for multiple agencies to coordinate and collaborate during emergencies to ensure continued operation of the regional TC. Successful collaboration requires well-planned and exercised emergency preparedness activities.

This thesis examines methods that can enhance emergency preparedness coordination and collaboration between multiple transportation agencies that have varying governance structures, co-located operation bases, and differing modes of transportation. The thesis reviews the relationship between the San Francisco Bay Area's transportation modes and makes recommendations for improved collaboration based on best practices. Additionally, the thesis develops a framework for establishing a jointly operated regional transportation emergency operations center (RTEOC).

A. RESEARCH QUESTION AND PROBLEM STATEMENT

In his work on critical infrastructure, Ted Lewis asserts that resilience informs decision-making.[2] This thesis focuses on resilience by suggesting methods to enhance

[1] "Ellen Tauscher Quotes," Brainy Quote, accessed April 4, 2018, https://www.brainyquote.com/quotes/ellen_tauscher_362456.

[2] Ted G. Lewis, *Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation* (Hoboken, NJ: Wiley, 2015), 163.

emergency preparedness coordination and collaboration. The main research questions are:

- How can contiguous transportation agencies enhance their emergency preparedness coordination and collaboration?
- Can related findings regarding the San Francisco Bay Area be applied to any metropolitan area where multiple transportation agencies—or agencies from other sectors—are located in close proximity to each other?

By examining the Bay Area TC's co-located transportation agencies, this work provides a template for enhancing agency coordination and collaboration during emergencies.

Transportation agencies must be prepared for all types of service interruptions—including those caused by manmade disasters and terrorist acts. Robust public transportation can help neighborhoods recover faster from disasters; in areas where it is easy to use public transit, people can still get around even if they cannot use their personal vehicles. Public transportation agencies historically have served a critical role for emergency response by providing mobility and evacuation resources before, during, and after disasters. To help those in harm's way, public transportation often maintains service during crises when it is safe to operate—public transportation can help evacuate people from threatened areas, rescue vulnerable populations and people with disabilities, and transport emergency personnel during fires, floods, hurricanes, windstorms, and winter storms. According to the Federal Transit Administration, 30,000 people were evacuated by public transit systems during Hurricanes Harvey and Irma.[3]

U.S. transportation agencies also operate critical infrastructure that is key to the security and prosperity of communities, regions, states, and the nation. Because the many transportation nodes are interconnected, they must coordinate with each other to ensure security. Traditionally, when it comes to emergency preparedness, transportation

[3] Security Risk Management Working Group, *Recommended Practice for the Development and Implementation of a Security and Emergency Preparedness Plan (SEPP)*, APTA SS-SRM-RP-001-09, Rev. 1 (Washington, DC: American Public Transportation Association, 2012), http;//www.apta.com/resources/standards/Documents/APTA-SS-SRM-RP-001-09.pdf.

providers develop individual plans that are specific to each agency. While these emergency plans place emphasis on coordination of public safety efforts, they do not give much focus to, and often do not even mention, operational and administrative functions. Under normal circumstances, these individual agencies have limited need to coordinate services, and each reports to a different level of government, with separate governing structures. However, in an emergency, these varying levels of government, representing multiple modes of transportation and occupying the same geographic space, need to work together to protect the public, adjacent communities, and all the agencies' assets. This thesis identifies methods that can enhance coordination and collaboration between these agencies.

Different transportation agencies, just like agencies in all sectors, may engage in a variety of emergency preparedness efforts.[4] Because plans are also drafted over time, they are likely to lack consistent or standardized material. As mentioned, current emergency preparedness efforts focus more on public safety than on transit agencies' operations and management, or on cross-agency coordination. Without coordination at all levels, there are problems with allocation of available resources (including personnel and equipment), inefficient communication, and duplicated efforts. Coordinated plans for continuity of operations between transit agencies are needed to help people travel to and from the area during emergencies. The region, and adjacent communities, should be concerned about the necessary flow of goods and services to an area impacted by an emergency. To improve these operations, all segments of the community should be involved in emergency planning.

B. LITERATURE REVIEW

This literature review first examines available information about terrorist threats that target transportation. It then examines the current state of emergency management collaboration and coordination in general (not specific to transportation agencies).

[4] San Mateo County Sheriff's Office of Emergency Services, "County of San Mateo Emergency Operations Plan: Basic Plan" (planning document, San Mateo County Sheriff's Office, 2015), http://hsd.smcsheriff.com/sites/default/files/downloadables/1%20-%20Emergency%20Operations%20Plan.pdf.

Finally, it reviews collaboration and coordination practices specific to transportation center emergency preparedness, including current practices in the San Francisco Bay Area.

As terrorist threats in the United States increase, terrorists have evolved from targeting mainly air travel to targeting other modes of transportation as well.[5] This gives us good cause to enhance emergency preparedness, especially as many transportation operations are co-located. In his 2005 work, Brian Taylor, director of the Institute of Transportation at UCLA, indicates that terrorists have targeted transportation critical infrastructure in order to exact economic impact and attract attention.[6] A study by RAND furthermore shows that without standardization of readiness, emergency preparedness suffers.[7] Other emergency management sectors, such as law enforcement, provide examples of interagency coordination in preparedness efforts. The Seattle and Houston metro areas have recently studied information sharing between law enforcement and non–law enforcement entities during emergency incidents.[8] While these examples do not discuss operators and administrators for transportation agencies, they provide useful formats for coordination during emergency incidents.[9] The California Office of Emergency Services (Cal OES) also publishes after-action reports and other documents about regional emergency preparedness. These documents, too, do not speak to transportation operations; they focus on preparing individual agencies or providers. Within a single operational region, materials for emergency preparedness training vary—

[5] Mineta Transportation Institute, "Transit Is a Terrorist Target," Mass Transit, June 1, 2016, http://www.masstransitmag.com/press_release/12215001/transit-is-a-terrorist-target.

[6] Brian D. Taylor, *Designing and Operating Safe and Secure Transit Systems: Assessing Current Practices in the United States and Abroad*, MTI Report 04-05 (San Jose, CA: Mineta Transportation Institute, 2005).

[7] Lois M. Davis et al., *When it Comes to Terrorism, How Prepared Are Local and State Agencies?* (Santa Monica, CA: RAND, 2006).

[8] Noor Elmitiny, Shankar Ramasamy, and Assam Radwan, "Emergency Evacuation Planning and Preparedness of Transit Facilities: Traffic Simulation Modeling," *Transportation Research Record* 1992 (January 2007): 121–26, http://doi.org/10.3141/1992-14.

[9] Anthony Spangler, "Fort Worth, Texas, Leaders Question Value of Terror Alerts to Cities," HighBeam Research, May 11, 2002, http://www.highbeam.com/doc/1G1-92744925.html?refid=easy_hf.

some use standardized formats while others are individualized, agency-specific after-action reports.

According to the Federal Emergency Management Agency (FEMA), enhanced emergency preparedness requires planning, coordination with adjacent agencies, and collaboration with similar agencies. Cal OES reports provide a format for standardization in after-action reporting.[10] However, the standardization for Cal OES appears only to occur within individual agencies. During emergency events, all the agencies that operate in a single location could collaborate more effectively if they used a single standardized framework. Lessons learned from national and international incidents at transportation centers do not appear to routinely trickle down into regional-level training.

The U.S. Department of Transportation has reported lessons learned from transportation-affecting attacks in the eastern United States.[11] The department provides planning guidelines for individual agencies that lack coordination across multiple transportation modes. The guidance also suggests minimizing the number of agencies responsible for transportation and providing coordinating authority. None of the research, however, provides specific guidance for multiple modes or agencies that have drastically different responsibilities, which is the focus of this research. Taylor's work, *Designing and Operating Safe and Secure Transit Systems*, assesses both U.S. and international practices, providing examples of methods that can be used to coordinate emergency services.[12] His work, however, is somewhat dated; it was completed just a few years after 9/11 and, as such, predates some of the recent transportation system attacks in the United States and Europe. Following 9/11, homeland security efforts focused on public safety methods to improve emergency preparedness. This thesis examines emergency preparedness coordination among agencies beyond the public safety level and helps identify gaps.

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[10] "After Action-Corrective Action Reporting," California Office of Emergency Services (Cal OES), accessed August 13, 2017, http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/after-action-corrective-action-reporting.

[11] National Research Council, *Improving Surface Transportation Security, A Research and Development Strategy* (Washington, DC: National Academies Press, 1999).

[12] Taylor, *Safe and Secure Transit Systems*.

C. RESEARCH DESIGN

The study area selected for this thesis is located adjacent to the San Francisco International Airport, in the Bay Area. This thesis, in Chapter II, briefly describes the relationship between the area's nine agencies, the location of each agency's headquarters, and the services that each provides. The thesis also examines the agencies' planning documents for information about coordination and collaboration; by examining current protocols and best practices in tandem, the research identifies emergency preparedness gaps between these agencies, which have never been scrutinized together, as a group. Additionally, the thesis reviews case studies of cities across the United States and on the international stage in order to provide further recommendations.

Currently, when agencies conduct emergency drills, public safety personnel move freely across lines of access; management and operations staff, however, have difficulty gaining access to emergency operations sites. Drills often focus on public safety but do not include all community stakeholders, such as those from the business community, local government representatives, utility operations volunteers, non-profit workers, food service workers, and representatives from other local sectors. When multiple agencies occupy the same space or operate adjacent to each other, emergency planning should be coordinated and should encompass all levels of the various agencies.

For data and evidence, this thesis reviews documents from the Bay Area agencies, regional emergency operations center (EOC) plans, and state- and federal-level emergency preparedness plans. In addition, the research discusses practices at both the national and international level to determine what has worked for transportation facilities during emergencies in the last decade. When after-action reports or documentation is missing, this is also considered evidence. Research also extends to information about best practices available online.[13] All the reviewed information is open source, and includes emergency planning reports in a variety of formats.

[13] Chris Ansell, Arjen Boin, and Ann C. Keller, "Managing Transboundary Crises: Identifying the Building Blocks of an Effective Response System," *Journal of Contingencies and Crisis Management* 18, no. 4 (December 2010): 195–207, https://ssrn.com/abstract=1708305.

As far as analysis, the research compares the different ways personnel, equipment, and resources are used for emergency response. A matrix compares factors, such as mechanisms for coordinating operations and identifying gaps in operations. The research also seeks to determine if standardizing emergency practices would improve agencies' preparedness and outcomes during incidents. Metrics of analysis include FEMA's standards for emergency preparedness, among others. In addition to the agency analysis, this work examines the extent to which the agencies coordinate with adjacent communities and how well the resources available in those communities have been optimized for use during emergency incidents. When an emergency situation unfolds within this complex matrix of government and authorities, each individual agency's readiness affects all the other agencies in the area, as well as transportation users and adjacent communities.

Other than the Bay Area TC agencies specifically discussed within the thesis, this research may also be of interest to FEMA, the Federal Transportation Agency, homeland security practitioners, the Federal Aviation Agency, Cal OES, and other EOCs in San Francisco and San Mateo County. The result of this research is recommendations for coordination among the involved agencies in advance of an emergency incident.[14] When protocols are established before emergencies occur, they result in coordinated, planned exercises and drills.[15] This work provides special districts with a model that can help them analyze and improve emergency preparedness between co-located agencies.

This research does not examine such modes of transportation as water, bicycles, or pedestrians. It also does not explore if, or how often, best practices are exercised.

D. CHAPTER OVERVIEW

Following this introduction, Chapter II defines the Bay Area TC framework and describes barriers that currently prevent coordination and collaboration. Chapter III

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[14] "State Safety Oversight (SSO) Program," Federal Transit Administration, updated June 19, 2017, https://www.transit.dot.gov/regulations-and-guidance/safety/state-safety-oversight-sso-program.

[15] Frances L. Edwards and Daniel C. Goodrich, *Emergency Management Training and Exercises for Transportation Agency Operations*, MTI Report 09-17 (San Jose, CA: Mineta Transportation Institute, 2010).

compares the nine agencies' emergency planning documents, while Chapter IV examines case studies in the United States and abroad. Findings, conclusions, and recommendations for enhanced preparedness are presented in Chapter V, and Chapter VI outlines a path forward for establishing a regional transportation emergency operations center.

II. THE BAY AREA FRAMEWORK

This chapter examines the Bay Area transportation center (TC) and its nine co-located agencies. The facilities that these agencies operate provide the Bay Area with key links to the region, the nation, and the world.

The San Francisco Bay Area, located in northern California, has a population of more than 7 million and an employment market of nearly 3.5 million jobs, making it the fourth largest employment region in the country.[16] The Bay Area encompasses nine counties that each touch the San Francisco Bay; the counties comprise 100 cities and more than 7,000 square miles of land connected by at least eight bridges. "The region boasts nearly 20,000 miles of local streets and roads, 1,400 miles of highway, five public ports and three major commercial airports. More than two dozen public transit agencies operate in the region, and passengers make more than 2 million trips a day in 4,000-plus transit vehicles … placing this region among the top transit markets in the nation."[17] Figure 1 shows the regional location of the study area adjacent to San Francisco International Airport (SFO) and its relationship to the metropolitan Bay Area.

The nine Bay Area TC agencies located in close proximity to each other include the BART commuter train service, California High Speed Rail, Caltrain regional commuter train service, Caltrans state highway system, adjacent local roads in both the City of Millbrae and the City of San Bruno, samTrans regional bus system, SFO, and Union Pacific national cargo train service. Figure 2 shows the area in San Francisco where the agencies are located. This complex network of agencies located within a nine-square-mile area has multiple trains, rapid transit vehicles, personal vehicles, and buses cross through it every hour. Included in this discussion are modes of travel serving local, regional, and international travelers who travel by air, bus, commuter and cargo rail, and

[16] Cynthia Kroll, "Preliminary Regional Forecast Numbers, ABAG Administrative Committee Agenda Item 5A," Association of Bay Area Governments, October 6, 2015, https://abag.ca.gov/planning/research/memos/Memo_PBA_Draft_Regional_Forecast_1.pdf.

[17] "Nine Bay Area Counties," Metropolitan Transportation Commission (MTC), accessed April 11, 2018, https://mtc.ca.gov/about-mtc/what-mtc/nine-bay-area-counties.

surface vehicles. These various modes of transportation have been grouped into three modes for analysis in this work: air, rail, and surface travel.

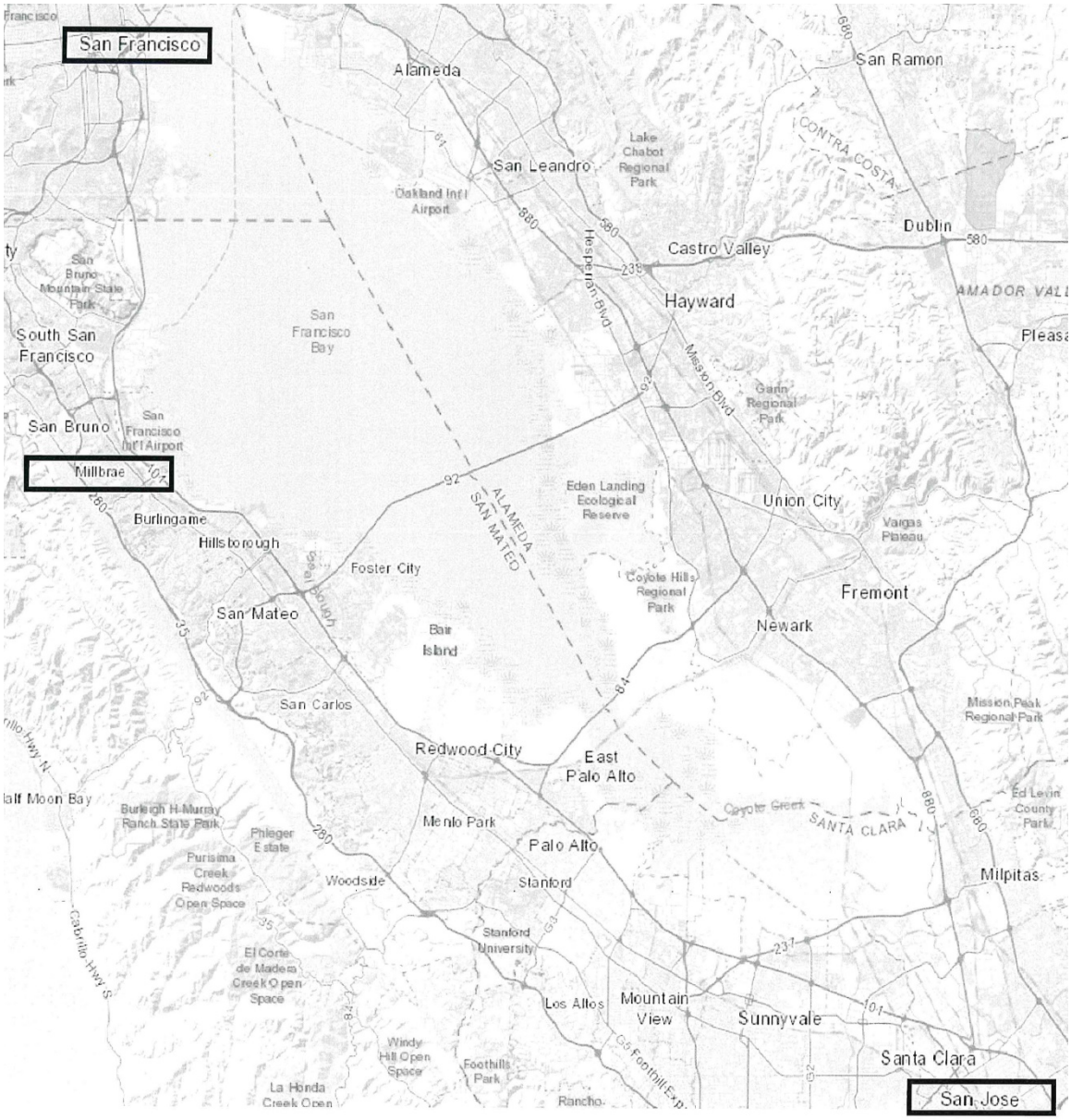

Image adapted from Google Maps.

Figure 1. California Bay Area

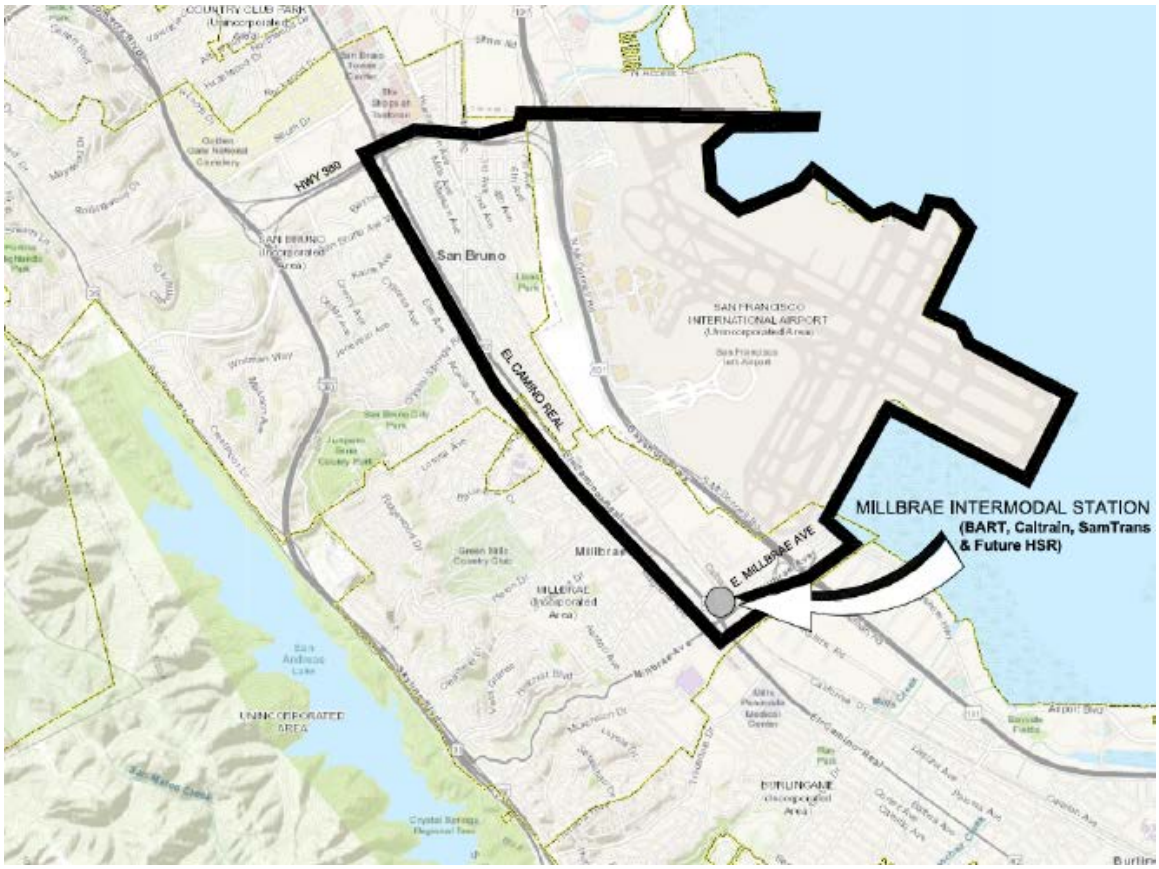

Image adapted from Google Maps.

Figure 2. Transportation Agency Locations

The Bay Area is a strategically located transportation node that is an integral part of the transportation system of systems for northern California. The structures and facilities that support this massive network are vulnerable to emergency incidents. With so many agencies sharing responsibility in this area, emergency coordination is challenging at best. The system is vulnerable to both manmade and natural emergencies, and service disruptions could significantly disrupt the region. Table 1 shows how significant this area's TC is by comparing it to other northern California transportation nodes.

Table 1. Transportation Agencies by Location

Transit Center	Transportation Agencies							
	Rapid Transit	High Speed Rail	Commuter Train	State Highway	Local Roadways	Regional Bus	International Airport	Freight Train
Millbrae	BART	State	Caltrain	Caltrans	City of Millbrae; City of San Bruno	samTrans	SFO	Union Pacific
San Francisco	BART	State	Caltrain	Caltrans	City of San Francisco	Misc.	--	Union Pacific
Oakland	BART	--	--	Caltrans	City of Oakland	Misc.	OAK	Union Pacific
San Jose	--	State	Caltrain	Caltrans	City of San Jose	Misc.	SJC	Union Pacific

Millbrae and San Francisco fall within the study area TC, while Oakland and San Jose do not. When compared to other areas in northern California, the TC studied in this thesis has significantly more transportation modes and agencies working in the same general area.

This area not only has a large number of facilities, but also provides large-scale facilities such as SFO, a large international airport. SFO, when compared to the other airports in the study area, operates on a significantly higher level of service delivery. The TC, located adjacent to Millbrae, provides the most concentrated variation of transportation modes in a single location found in the Bay Area.

A disruption in any one of these agencies' services has the potential to affect all the others. For example, in 2015, a construction-related accident caused Caltrans-operated Highway 101 to close for three days. When this agency's facilities closed, it also curtailed access to SFO, BART, Caltrain, samTrans, City of Millbrae roads, City of San Bruno roads, and the rest of the Bay Area. SFO was accessible from only one direction. Access to San Francisco from the south was severely restricted. Only Union Pacific, which operates through traffic without citizen access, continued service through this period.[18] At the same time, the area is highly susceptible to terrorist threats and natural disasters. Coordinated planning for a collaborative response to any incident will strengthen each individual agency's operations and make the entire region more resilient.

[18] Sergio Quintana and Melanie Woodrow, "All Lanes of Hwy 101 in Burlingame Closed Due to Downed Wires," ABC7 News, August 28, 2015, http://abc7news.com/traffic/all-lanes-of-hwy-101-in-burlingame-closed-due.../961574/.

This chapter examines services provided by each agency, the agencies' relationships with each other, and the unique and common types of threats facing this area. This thesis suggests developing a framework to enhance emergency preparedness in this location; however, the suggested framework can also be used in similar metropolitan areas.

Out of 10 large metropolitan regions in the United States, the Bay Area has the fifth highest number of daily commuter trips (see Figure 3).[19] Although the number of trips applies to the entire Bay Area—not just the study area, which covers only nine square miles of the Bay Area—it is significant to show how the area compares to other large metropolitan regions throughout the United States.

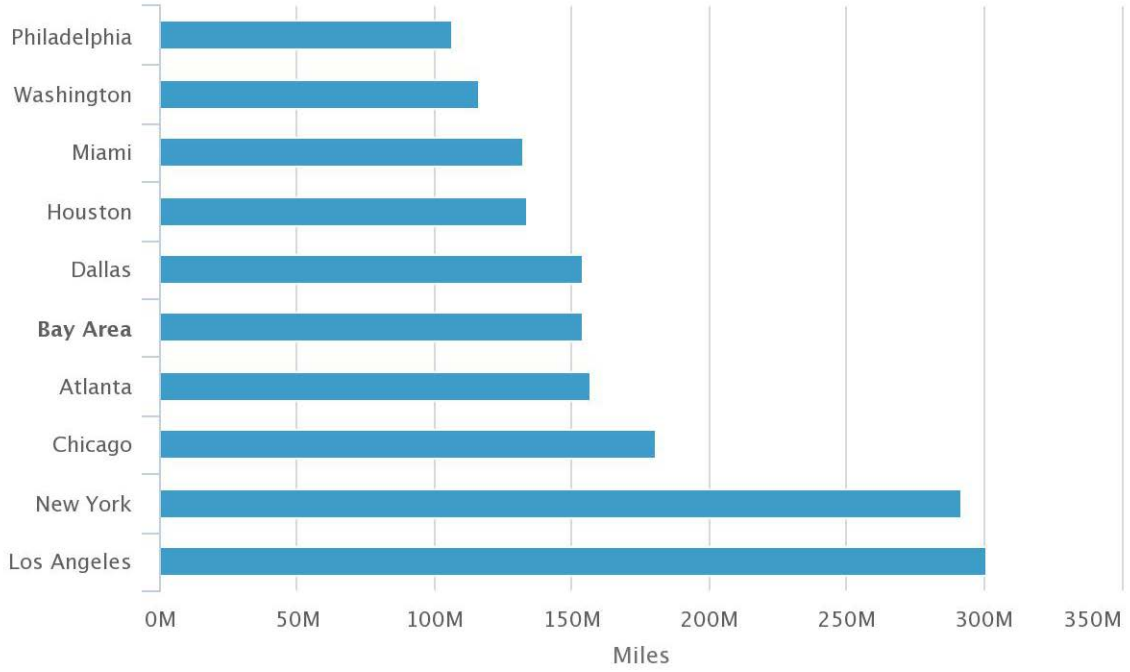

Figure 3. Metro Area Comparison: Daily Miles Traveled in 2015[20]

[19] "Daily Miles Traveled," Vital Signs, September 2017, http://www.vitalsigns.mtc.ca.gov/daily-miles-traveled.

[20] Source: Vital Signs.

A large part of the reason the Bay Area's daily commuter numbers are so high is because of the BART system. Daily trips from BART alone are equal to the total percent of daily trips in Philadelphia or Washington (approximately 100,000 daily trips).[21]

The Bay Area transportation providers derive authority from a variety of federal, state, regional, and local agencies. Local municipalities have regular lines of communication established with each other, with the agencies in the region, and with local residents. Agencies such as the County Transportation Authority, the City/County Association of Governments, and various professional agencies hold regular business meetings to discuss items of mutual concern. However, the meeting agendas show that emergency management is not a typical topic of discussion.[22] To enhance emergency preparedness and provide support for emergency responders during significant emergency events, emergency management should be discussed during these meetings.

A. TYPES OF TRANSPORTATION LOCATED IN THE TC

As mentioned, the study area's nine transportation agencies provide three major types of transportation: air, rail, and surface. For the purposes of this review, Table 2 shows the overlap between service delivery types. The table identifies a single form of air service that ranges from local to international, four rail service operators encompassing regional commuter and national cargo service, and five surface transportation operation providers. The transportation customers travel both locally and internationally and, as also previously discussed, a disruption to any one of the operations can be devastating to them all.

[21] "BART 2017 Factsheet," BART, June 2017, https://www.bart.gov/sites/default/files/docs/BARTfactsheet_June17_0.pdf.

[22] "SMCTA Board Calendar/Meetings," San Mateo County Transportation Authority, accessed April 10, 2018, http://www.smcta.com/about/boardofdirectors/boardofdirectorscalendar.html; "Board of Directors," City/County Association of Governments of San Mateo County, accessed April 10, 2018, http://ccag.ca.gov/committees/board-of-directors/.

Table 2. Types of Transportation Modes in the TC

Agency	Air	Rail	Surface
SFO	X		X*
BART		X	
Caltrain		X	
Union Pacific		X	
Caltrans			X
samTrans			X
CA High Speed Rail		X	
City of Millbrae			X
City of San Bruno			X

* SFO maintains airport-related roadways.

1. Air Transportation

The study area has one mode of air transportation, San Francisco International Airport (SFO). "SFO is a Category X airport that handles over 40-million passengers each year, making it the tenth largest in the United States and one of the world's 30 busiest airports."[23] A Category X status is reserved for larger airports that may be vulnerable to terrorism.[24] Although SFO is located in San Mateo County, the airport is owned and operated by the City and County of San Francisco and, as such, is governed by a different entity than the county in which it is located. This factor potentially complicates communications during emergencies.

According to a Bloomberg article, "commercial passenger airliners and cargo aircraft have been the subject of plots or attacks by bombs and fire since near the start of air travel."[25] The same article indicates that early bombings were aimed at achieving money from insurance claims. Further, the Bloomberg article points to recent airline-related terrorist attacks that have religious and political motives. In addition to terrorism, airline flights have also been brought down by gunfire and missile attacks. Acts that

[23] "SFO Expands Airport Identity Management Solution," Quantum Secure, February 7, 2017, https://www.quantumsecure.com/sfo-expands/.

[24] Quantum Secure.

[25] Jeanna Smialek, "Here's How Much Terrorist Attacks Cut into Air Travel," Bloomberg, January 31, 2017, https://www.bloomberg.com/news/articles/2017-01-31/here-s-how-much-terrorist-attacks-cut-into-air-travel.

target airports have become more frequent and deadly in the past decade. The number of people killed increases exponentially during airline accidents when compared to other modes of travel, which shows how important it is to develop new approaches to emergency preparedness. Air terrorism has been found to have a trickle-down effect on the overall economy; terrorism involving long-haul routes such as those from SFO has the most significant effect on the economy.[26]

2. Rail Transportation

Bay Area TC service providers, for both commuters and cargo, include California High Speed Rail, BART, Caltrain, and Union Pacific. The California High Speed Rail project is still in the planning stages and will eventually co-locate with BART, Caltrain, and Union Pacific. BART lines run along the west edge of SFO and provide service directly into the airport. System-wide BART services circle the bay and connect the study area with other regions. Currently, BART lines are co-located with Caltrain and Union Pacific. Caltrain is a commuter services that serves the peninsula from Santa Clara County to San Francisco, and Union Pacific is a cargo service that uses the same lines as Caltrain.

The Transportation Security Administration (TSA) considers passenger railroads to be "high consequence targets in terms of potential loss of life and economic disruption as they carry large numbers of people in a confined environment."[27] According to work by Barkakati and Maurer, hundreds of terrorist acts targeting passenger rail systems between 2004 and 2008 killed or injured over 10,000 people worldwide.[28] This regional rail network is critical to the Bay Area way of life. In *Preparedness for Mass Transit and Passenger Rail Emergencies*, the Department of Homeland Security (DHS) states that

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[26] Smialek.

[27] Steven Polunsky, "Texas Should Adapt Homeland Security Standards for High-Speed Rail," *Homeland Security Affairs* XIV (2018), https://www.hsaj.org/articles/9298.

[28] Nabajyoti Barkakati and David Maurer, *Technology Assessment: Explosives Detection Technologies to Protect Passenger Rail* (Washington, DC: Government Accountability Office, 2010).

"passenger rail systems face a dynamic landscape of potential natural disasters, accidents, and terrorist attacks."[29]

3. Surface Transportation

The study area's surface transportation agencies include: public roads on the SFO airport property, samTrans bus service, Caltrans highways (including bridges and interchanges), and the City of Millbrae and City of San Bruno local roads and bridges.

In August 2015, a construction accident closed Interstate Highway 101, adjacent to and south of SFO, for three days (over a weekend). The accident occurred on an off-ramp that provides access to SFO, BART, and Caltrain, which means it affected three legs of the nine major transportation links in the study area. Several agencies had to temporarily modify operations in order to continue providing service. Fortunately, loss of life was not an issue; however, the disruption deeply affected commuters, and the agencies had to implement staffing changes and service changes, and reorient access to facilities. The disruption also caused flight delays and massive highway backups. The agencies were able to successfully enact emergency plans and implement continuity of operations plans.[30]

B. EMERGENCY MANAGEMENT

Planning, effective leadership, and access to the right tools can be the difference between an effective response and a disaster.[31] "Despair is most often the offspring of ill-preparedness …. We cannot stop natural disasters but we can arm ourselves with knowledge: so many lives wouldn't have to be lost if there was enough disaster preparedness. Preparedness, when properly pursued, is a way of life, not a sudden,

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[29] DHS Officer of the Inspector General, *TSA's Preparedness for Mass Transit and Passenger Rail Emergences*, OIG-10-68 (Washington, DC: DHS, 2010), 2, https://www.oig.dhs.gov/assets/Mgmt/OIG_10-68_Mar10.pdf.

[30] Quintana and Woodrow, "Hwy 101."

[31] Dennis Adonis, "Local Government Crisis Communications Leadership: Building Credibility and Confidence through Effective Information Exchange," whispir, accessed March 13, 2018, www.whispir.com/news/local-government-crisis-communications-leadership.

spectacular program."[32] Terrorism and natural disaster incidents are possible threats to the agencies operating in the Bay Area TC.

1. Terrorism

Transportation operators bear first-line responsibility for securing the facilities they operate.[33] In fiscal year 2017, FEMA's Transit Security Grant Program set aside $88 million to fund programs that "enhance security and resilience of surface transportation infrastructure."[34] Additionally, the TSA provides guidance, research, and training to assist surface transportation system operators.[35]

Transportation systems in the Bay Area have not been a major target of terrorism to date; however, similar metropolitan transportation systems have repeatedly been targeted around the world. Bay Area transportation agencies' security measures are not as intensive as the United Kingdom's, presumably due to the perceived threat level.[36] It is worth noting that the Bay Area *has* increased security measures in recent years, which could be mitigating serious threats. Regardless, transportation is an inviting target for terror groups.[37] The Mineta Transportation Institute (MTI) recently examined the number and increasing severity of attacks on transportation. Brian Jenkins, director of MTI's Safety and Security Center, testified before Congress that "between 9/11 and the end of 2015, fatalities caused by attacks on surface transportation killing 25 or more were the equivalent of nine airplane losses."[38] He further noted that "the comparable number

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[32] Quotes from Don Williams, Jr., and Petra Nemcova. See "Disaster Preparedness Quotes," Wellbeck Survival and Emergency Preparedness, accessed April 10, 2018, wellbeck.com/disaster-preparedness-plan/disaster-preparedness-quotes/.

[33] "Fiscal Year 2017 Transit Security Grant Program," FEMA, last updated June 2, 2017, https://www.fema.gov/fiscal-year-2017-transit-security-grant-program.

[34] FEMA.

[35] "TSA's Successes and Challenges of Risk-Based Security," TSA, March 26, 2012, https://www.tsa.gov/news/testimony/2012/03/26/tsas-successes-and-challenges-risk-based-security.

[36] A search of relevant material shows no incidents of terrorism against Bay Area transportation.

[37] Alan Levin, "Terror Stalks Commuters as Foiled Plots Show Transit Is the Target," Bloomberg, May 16, 2016, http://www.bloomberg.com/news/articles/2016-05-16/terror-stalks-commuters-as-foiled-plots-show-transit-is-target.

[38] "Transit Is a Terrorist Target," Mineta Transportation Institute (MTI), May 31, 2016, http://transweb.sjsu.edu/press/Transit-Terrorist-Target.

of attacks against airliners and the airports that serve them is around two losses, a stunning comparison."[39]

With current technology, surface transportation systems cannot feasibly screen passengers the way airports do; because the volume of people using surface transportation is so large, this type of screening would cause untenable service delays. The large volume of customers also means that an attack can result in significant fatalities. For example, New York Penn Station's peak hourly passenger volume during the morning rush hour is comparable to approximately 60 hours of travel at Chicago O'Hare International Airport.[40] Airport screening is challenging; by comparison, however, screening during peak hours at major surface transportation facilities is a vastly greater challenge. Screening would result in large crowds and lengthy delays that could invite terrorist plots. Consequently, according to MTI, surface transportation is more difficult to secure than air transportation, and therefore far more likely to be the target of a terrorist attack.[41]

Because the study area's transportation services are concentrated in a small area and serve so many customers—particularly during rush hour—they offer a potential easy-access target. Information about passenger concentration during certain times of the day, and at certain locations, is readily available through public sources. Additionally, travelers can exit an airport and enter a mass-transit rail car without screening checkpoint requirements. Transportation systems also house large crowds, which make them likely targets; in the 2017 Manchester, England, bombings, a lone-wolf terrorist set off a suicide bomb at the entrance to a transportation facility, in a public area where people can gather without going through security.

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[39] MTI.

[40] Brian Michael Jenkins and Bruce R. Butterworth, *Selective Screening of Rail Passengers*, MTI Report 06-07 (San Jose, CA: MTI, 2007), http://transweb.sjsu.edu/sites/default/files/MTI-06-07.pdf.

[41] Brian Michael Jenkins and Joseph Trella, *Carnage Interrupted: An Analysis of Fifteen Terrorist Plots against Public Surface Transportation*, Report 11-20 (San Jose, CA: MTI, 2012), http://transweb.sjsu.edu/sites/default/files/2979-analysis-of-terrorist-plots-against-public-surface-transportation.pdf.

Examining Bay Area transportation threats, MTI says, "Given scarce resources and relatively low levels of public concern … questions are always a part of the public policy matrix and not easily answered."[42] The fact that this area has not been targeted may be a result of the security measures already in place, but it may also simply be a matter of time. It is therefore prudent for the Bay Area to consider preparedness activities by transportation agencies in similar settings.

2. Natural Disasters

The 1989, 6.9-magnitiude Loma Prieta earthquake permanently changed the San Francisco Bay Area and dramatically affected the area's transportation system. As a result of the earthquake, portions of three major roads were closed for extended periods of time: Interstate 880 in Oakland, and Interstates 480 and 280 in San Francisco—all of which provide access to the major transportation services located in the study area. Since Loma Prieta, the Bay Area has prioritized retrofitting and hardening highways and bridges.[43] According to the United States Geological Survey (USGS), there is a high probability that an earthquake of similar magnitude will occur in the Bay Area in the next 30 years.[44] There is a fault line that runs along Interstate 280, just over a mile away from the study area, which makes major highway corridors from SFO that provide access to the north toward San Francisco and Marin County more vulnerable.[45] According to the Association of Bay Area Governments (ABAG), a Loma Prieta–magnitude quake would disrupt service on most of the roads in this study area.[46] The ABAG identifies at least 12 interchanges or bridges within the study area—along the north, west, and south edges—

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[42] Brian Michael Jenkins and Larry N. Gersten, *Protecting Public Surface Transportation against Terrorism and Serious Crime: Continuing Research on Best Security Practices*, MTI Report 01-07 (San Jose, CA: MTI, 2001), 4, https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/terrorism_final.pdf.

[43] "Loma Prieta, the 1989 San Francisco Earthquake," United States History, accessed April 10, 2018, www.u-s-history.com/pages/h2828.html.

[44] "Earthquake Hazards of the Bay Area Today," United States Geological Survey (USGS), accessed April 10, 2018, https://earthquake.usgs.gov/earthquakes/events/1868calif/virtualtour/modern.php.

[45] USGS.

[46] "San Mateo County Hazards: Earthquake Liquefaction & Shaking," County of San Mateo Planning and Building, accessed April 10, 2018, https://planning.smcgov.org/documents/san-mateo-county-hazards-earthquake-liquefaction-shaking.

that would be disrupted by an earthquake of magnitude 7.0 or higher. Road, bridge, runway, or track closures could also affect the operations of multiple agencies in the same vicinity. If co-located agencies can coordinate during emergencies, they may be able to provide a pool of staff, equipment, and financial resources to enhance recovery.

C. CHAPTER CONCLUSION

The three modes of transportation located in the study area (air, rail, and surface) have been targets of terrorism around the world, if not yet in the Bay Area. The area has, however, seen natural threats that disrupt transportation: the Loma Prieta earthquake, the airline disaster of 2013, and the power line outage of 2015 all affected and at times halted transportation service by one or more Bay Area agencies.[47] Transportation sector operations face challenges to continuity of operations in the wake of a major disaster—the challenges are heightened for a transportation "system of systems," in which many agencies are interdependent.[48] In the Bay Area, this system of systems provides routine convenience for citizens and serves as a basic economic engine that transports goods and services throughout the region.

Disruption to critical infrastructure affects the region's economic health; the region's ability to move people and goods is critical to its resiliency. In a 2016 interview, Dan O'Connor, director of field operations for the chief security officer at FEMA, defines resilience as "the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies, whether the disruption is the result of terrorism, cyber attacks, pandemics or a catastrophic natural disaster."[49] This means the government must coordinate preparedness planning efforts with all sectors of the community. O'Connor's comment directly applies to the study area, where multiple

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[47] "Board Meeting: Crash of Asiana Flight 214 Accident Report Summary," National Transportation Safety Board, June 24, 2014, https://www.ntsb.gov/news/events/Pages/2014_Asiana_BMG-Abstract.aspx; United States History, "Loma Prieta"; Quintana and Woodrow, "Hwy 101."

[48] Michael J. DiMario, *System of Systems Collaborative Formation* (Singapore: World Scientific, 2010), 87.

[49] Dan O'Connor, "Resilience in Homeland Security," YouTube video, posted by Center for Homeland Defense and Security, December 7, 2016, https://www.chds.us/ed/items/15605.

agencies working in close proximity to each other have reporting responsibility to multiple levels of government.

III. COMPARISON OF EMERGENCY PLANNING DOCUMENTS

Well-coordinated emergency plans and interagency collaboration will enhance response and recovery when an emergency affects multiple agencies. For example, according to Eggers in *Delivering on Digital*, communication inconsistencies can mean an employee is able to enter an agency office in one city, but is locked out in another. Hassles like these, which slow progress, can lead to dire situations in a security context.[50] For instance, when multiple fire agencies arrive at a scene and do not have common communication lines, confusion ensues. The agencies must devote time to establishing coordinated communication, which slows response to the emergency incident. Agencies must work together at the local level to coordinate, prepare, and establish resiliency operations. As FEMA says, "all disasters are local."[51] The most effective emergency response occurs spontaneously; advanced preparation is needed to ensure agencies are using common language and communication channels, and that they understand leadership channels.

This chapter examines existing emergency plans for the agencies in the study area to determine areas of—and gaps in—coordination. While some emergency plans come directly from the nine agencies located in the study area, emergency plans from Cal OES and the Metropolitan Transportation Commission (MTC) (stakeholders that are not physically located in the TC, but that have direct responsibility for the transportation of goods and services through the area) are also examined. In total, 10 main planning documents are reviewed in this chapter. The plans show that the agencies need additional coordination and collaboration. Some plans are nearly a decade old, while others address some of the necessary topics (such as planning or mitigation) but not others (such as recovery or continuity of operations). In some cases, it is possible more recent plans are available and were simply not located by the author.

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[50] William D. Eggers, *Delivering on Digital*, Kindle edition (New York: RosettaBooks, 2016), loc 2638.

[51] Tim Manning (lecture, Naval Postgraduate School, Monterey, CA, September 2016).

The author obtained the plans by searching online and contacting each agency. Table 3 shows which documents discuss the nine Bay Area TC agencies, and which discuss areas of analysis used for this work in relation to those agencies: planning, response, mitigation, recovery, and continuity of operations. The numbers used in Table 3 relate to the 10 documents reviewed in this work.

1. Cal OES: "San Francisco Bay Area Regional Emergency Coordination Plan: RECP Transportation Subsidiary Plan," March 2008[52]

2. Caltrain: "Caltrain Emergency Preparedness Plan," September 2015[53]

3. Caltrans: *Transit Emergency Planning Guidance*, July 2007[54]

4. Cal OES: "State of California Emergency Plan," October 2017[55]

5. Caltrans: "Emergency Function 1 Transportation Annex Executive Summary," October 2013[56]

6. San Mateo County Transit District, "San Mateo County Transit District Short-Range Transit Plan Fiscal Years 2014–2023," January 2015[57]

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[52] Cal OES et al., "San Francisco Bay Area Regional Emergency Coordination Plan: RECP Transportation Subsidiary Plan" (planning document, Department of Homeland Security, March 2008), http://bayareauasi.org/sites/default/files/resources/RECP%2520Transportation%2520Subsidiary%2520Plan.pdf.

[53] April Maguigad et al., "Caltrain Emergency Preparedness Plan" (planning document, Caltrain, September 2015).

[54] California Department of Transportation (Caltrans), *Transit Emergency Planning Guidance* (Sacramento, CA: California Department of Transportation, 2007), http://www.caloes.ca.gov/AccessFunctionalNeedsSite/Documents/Caltrans%20Transit%20Emergency%20Planning%20Guidance.pdf.

[55] Edmund G. Brown, Jr., and Mark S. Ghilarducci, "State of California Emergency Plan" (planning document, Cal OES, October 2017), http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/California_State_Emergency_Plan_2017.pdf.

[56] California State Transportation Agency, Caltrans, and California Highway Patrol, "Emergency Function 1 Transportation Annex: Executive Summary" (planning document, Caltrans, October 2013), http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/01%20Transportation%20Annex%20October%202013%20(2).pdf.

[57] San Mateo County Transit District (SamTrans), "San Mateo County Transit District Short-Range Transit Plan Fiscal Years 2014–2023" (planning document, SamTrans, January 2015), www.samtrans.com/Assets/_Planning/2014-2023+SamTrans+Short-Range+Transit+Plan.pdf.

7. San Mateo County Sheriff's Office, "City of Millbrae Emergency Operations Plan: Basic Plan," March 2017[58]

8. City of San Bruno, "City of San Bruno Emergency Operations Plan," April 2008[59]

9. California High-Speed Rail Authority, "Draft 2018 Business Plan," March 2018[60]

10. MTC, "San Francisco Bay Area Regional Transportation Emergency Management Plan," May 2008[61]

Table 3. Emergency Plans by Agency

Agency	Planning	Response	Mitigation	Recovery	Continuity of Operations
SFO	1, 10	1, 10	-	10	1
BART	1, 10	1	-	10	1
Caltrain	2, 3, 4	2, 3, 4	2,3, 4	-	-
Union Pacific	2, 3, 4	2,3, 4	2,3, 4	-	-
Caltrans	5, 10	5, 10	-	10	5
samTrans	6	6	6	-	-
High-Speed Rail	-	-	-	-	-
City of Millbrae	7	7	7	-	7
City of San Bruno	8	8	8	-	8

Document key is shown in the list preceding this table; document 9, the California High-Speed Rail Authority "Draft 2018 Business Plan," does not mention any of the topics.

[58] Millbrae Bureau Office of Emergency Services, "City of Millbrae Emergency Operations Plan: Basic Plan" (planning document, San Mateo County Sherriff's Office, March 2017).

[59] City of San Bruno, "City of San Bruno Emergency Operations Plan" (planning document, City of San Bruno, April 2008).

[60] California High-Speed Rail Authority, "Draft 2018 Business Plan" (planning document, California High-Speed Rail Authority, March 2018), 4, https://www.hsr.ca.gov/docs/about/business_plans/Draft_2018_Business_Plan.pdf.

[61] MTC, "San Francisco Bay Area Regional Transportation Emergency Management Plan: Baseline Operating Plan" (planning document, MTC, May 2008), https://mtc.ca.gov/sites/default/files/FINAL_RTEMP_May_2008.pdf.

Updating and standardizing these plans would provide coordination and collaboration that could enhance emergency situation operations. Several themes evolved from this work. In most cases, unless the plan addresses multiple agencies, the elements shown in Table 3 are not included across all agencies' plans. Inclusion of these categories would improve coordination of emergency efforts. In particular, areas to consider include incorporating an all-hazards approach, standardizing communication methods, involving the whole community, coordinating resources, establishing continuity of operations plans, and hardening facilities.

A. AIR, RAIL, AND SURFACE TRANSPORTATION EMERGENCY PLANS

At the 2001 American Public Transit Association conference, Federal Transit Administrator Jennifer Dorn highlighted the risks facing mass transit:

> The State Department reports that in 1991, 20 percent of all violent attacks worldwide were against transportation targets; by 1998, 40 percent involved transportation targets, with a growing number directed at bus and rail systems. The recent attacks on the World Trade Center … remind us all that we must respond to a new terrorist reality—terrorism that is well financed, well organized and ruthless. The credible threat of increasing terrorism directed toward our nation's transit systems requires that we take immediate prudent action to prevent, prepare for and respond to violence—the nature and magnitude of which was once unimaginable.[62]

The following sections provide an overview of emergency planning, as found in the planning documents, for the three types of transportation in the Bay Area TC: air, rail, and surface. To show how diverse the agencies are in both their operations and users, and to show how vast their customer base and reach are, the sections discuss information about the agencies' capacity, the services they offer, and their governance.

1. Air Transportation

The sole air transportation provider in the TC is SFO. Administrative, operational, and emergency functions are located onsite. Operational responsibility for SFO falls

[62] Ronald W. Tarr, Vicki McGurk, and Carol Jones, "Intermodal Transportation Safety and Security Issues: Training against Terrorism," *Journal of Public Transportation* 8, no. 4 (2005): 88.

under federal jurisdiction. If SFO needs additional resources, they would presumably come from San Francisco; however, San Francisco resources may be otherwise occupied during an emergency and may have a difficult time getting to SFO due to road closures, bridge failures, or similar issues. SFO is responsible for the surface transportation facilities that provide access to the airport, which includes approximately five miles of surface streets and at least four bridges on airport property. San Francisco's emergency plans address all city and county facilities, including the airport, even though SFO is located in San Mateo County.[63] During an emergency, the City of San Francisco provides and directs resources for the airport. Caltrain passengers may transfer to BART at the Millbrae Intermodal Station to travel to SFO; however, BART has eliminated direct service from Millbrae to SFO during certain times.

During an emergency, the airport would be working most directly with the City and County of San Francisco, including for resource allocation and assistance. Immediate neighboring agencies in San Mateo County would provide mutual aid response. More than six agencies are immediately adjacent to SFO, and more than two dozen agencies are within immediate response distance; however, only fire and police agencies have mutual response agreements with SFO. This close proximity to other agencies has proven valuable during numerous emergencies, including when an airliner fell short of the runway and crashed on airport property. During emergencies, mutual aid from adjacent agencies has helped minimize casualties.

Although the author could not locate stand-alone emergency plans for SFO, the airport is included in the MTC plans discussed later in this chapter. Cal OES's "RECP Transportation Subsidiary Plan" mentions that BART and SFO coordinate directly with the Department of Emergency Management for San Francisco.[64] However, the emergency plans for this area do not typically mention SFO, nor do they address standardizing communication among agencies or involving the community;

[63] Cal OES et al., "RECP Transportation Subsidiary Plan."

[64] Cal OES et al.

standardization and community involvement would enhance emergency preparedness for SFO and the TC.

2. Rail Transportation

The TC's rail services transport both passengers and cargo through BART passenger services, Caltrain passenger services, and Union Pacific freight services. High Speed Rail will join these agencies in the near future. In some cases, these agencies use the same corridor and the same facilities and transport passengers and cargo simultaneously. This combination adds complexity to emergency preparedness considerations.

a. BART

Since the early 1970s, BART has provided commuter rail service throughout the Bay Area. In the late 1990s, new stations serving SFO and surrounding areas—including the study area—were added to the system. These enhancements included connections to Caltrain and samTrans services. Last year, 4 million BART trips were made to SFO alone, which equals almost 11 percent of all air travelers at SFO.[65] BART is governed by a board of directors comprising elected officials from six counties. San Mateo is not one of the counties represented on the BART board. According to BART, the system has its own police department, which employs over 200 police officers, and maintains mutual aid agreements between all facilities and the communities they serve.[66]

Although the author could not find emergency preparedness plans specifically for BART, BART is addressed in the MTC plans. Additionally, the BART website houses emergency plans for incidents that may occur on trains or at a station, focusing on ridership needs.[67] The website, however, is silent regarding larger emergencies that affect the whole region (including the other transportation agencies) and that may require

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[65] "BART 2016 Factsheet," BART, February 2016, https://www.bart.gov/sites/default/files/docs/2016Factsheet_v11.pdf.

[66] Maguigad et al., "Caltrain Emergency Preparedness Plan."

[67] "Go Inside Our Emergency Operations Center," BART, June 9, 2017, https://www.bart.gov/news/articles/2017/news20170609-1.

interaction with its mutual aid partners. BART's administrative, operational, and emergency functions are located across the bay in Oakland, and may be unavailable during emergencies due to road closures, bridge failures, or the like.

b. Caltrain

Caltrain provides commuter rail services throughout the study area; trains run between San Francisco and San Jose with more than 62,000 riders per day.[68] Caltrain is governed by the Peninsula Corridor Joint Powers Board (JPB), which consists of agencies from the three counties served by Caltrain: San Francisco, San Mateo, and Santa Clara. Each member agency has three representatives on a nine-member board of directors.[69]

According to Caltrain's "Emergency Preparedness Plan," Caltrain's administrative, operations, and emergency functions are located in San Mateo County, approximately ten miles south of the study area.[70] This proximity makes it likely that emergency assistance from San Mateo County would be available to Caltrain during an incident. The documents reviewed for this thesis did not mention mitigation and recovery plans for Caltrain. Rather, the plans predominately address internal operations and regional interplay during an emergency.[71] Other agencies in the study area coordinate emergency planning with Caltrain, such as BART and samTrans.[72] Eventually, Caltrain facilities will be co-located with High Speed Rail lines in this vicinity.[73]

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[68] Ridership numbers from 2016. "Caltrain 2016 Annual Passenger Count: Key Findings," Caltrain, accessed April 16, 2018, http://www.caltrain.com/Assets/_Marketing/caltrain/pdf/2016/2016Annual+Passenger+Counts.pdf.

[69] Cal OES et al., "RECP Transportation Subsidiary Plan."

[70] Maguigad et al., "Caltrain Emergency Preparedness Plan."

[71] Maguigad et al.

[72] Cal OES et al., "RECP Transportation Subsidiary Plan."

[73] California High-Speed Rail Authority, "Draft 2018 Business Plan" (planning document, California High-Speed Rail Authority, March 2018), 4, https://www.hsr.ca.gov/docs/about/business_plans/Draft_2018_Business_Plan.pdf.

c. Union Pacific Railroad Cargo Service

Union Pacific Railroad operates freight services using the Caltrain right of way (its passenger services do not use this route). The agency maintains an operations facility in Oakland, 22 miles across the bay, and its dispatch center is located in Philadelphia. If access were blocked, it is unclear how equipment and personnel would respond to an emergency. The emergency plans reviewed for this thesis also do not clarify if Union Pacific contractually relies on Caltrain for initial emergency response. Although described as a separate agency operating in the TC, Union Pacific coordinates with Caltrain for facility maintenance and emergency efforts. The author could not find separate, agency-specific mitigation and recovery plans for Union Pacific, but emergency training, planning, response, and continuity of operations information for Union Pacific is included in the Caltrain document.[74]

d. California High Speed Rail

As mentioned, the California High Speed Rail project is underway, with a scheduled service start date in 2028.[75] The project was authorized by California voters in 2008, and includes facilities—including a railway stop—that will provide service through the study area.[76] Although emergency plans have not been officially issued, it is important to discuss this project so we can begin to understand how the TC environment will change and become more complex for the other agencies. Emergency planners for High Speed Rail should consider the existing plans of the other eight agencies, and should coordinate with these agencies. It is important to think about coordination now, as the existing agencies in this TC have not set a good precedent for coordination; although BART currently coordinates with SFO to a large extent, it coordinates to a lesser degree with the other TC rail providers. Caltrain and Union Pacific have developed a plan in unison, but details about standardizing communication across sectors, involving the

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[74] Caltrain, "Caltrain Emergency Preparedness Plan."

[75] California High-Speed Rail Authority, "Draft 2018 Business Plan," 4.

[76] California High-Speed Rail Authority.

community, and hardening facilities have not been addressed in concert with all agencies in the TC.

3. Surface Transportation

Caltrans, SFO, two cities, and samTrans all operate surface transportation facilities located in or adjacent to the study area. The operations and emergency preparedness plans for these agencies are outlined in this section.

a. Caltrans

There are both state and interstate roads within the study area that fall under the purview of the California Department of Transportation, commonly known as Caltrans. According to the Caltrans website, administrative, operations, and emergency efforts for Caltrans are located in Oakland, with substations throughout the region.[77] Caltrans is governed by the State of California, whose operations are based in Sacramento, about two hours from the study area. Caltrans' responsibility in the study area includes: Interstate 101 (immediately adjacent to and west of SFO), Millbrae Avenue (which lies along the south border of the study area), San Bruno Avenue (which runs along the north border of the study area), and State Highway 82 (along the western boundary of the study area). This means that Caltrans has responsibility for more than six miles of local roads and four bridges or overpasses in the study area. Caltrans' emergency planning efforts in regards to the state highway system are addressed in the July 2007 *Transit Emergency Planning Guidance*.[78] According to this document, the agency's emergency management efforts include "basic awareness training for transit managers [and] interagency training and tabletop exercises for transit staff, first responders, and emergency managers."[79]

b. City of Millbrae—Local Roads and Bridges

The City of Millbrae maintains the local roads within the study area that are not part of SFO or Caltrans. This means that Millbrae maintains approximately five miles of

[77] Google maps, accessed March 10, 2018, https://www.google.com/maps.

[78] Caltrans, *Transit Emergency Planning Guidance*.

[79] Caltrans, iii.

roads in the study area. In addition, the city has a corporation yard, which houses public works functions, the wastewater treatment plant, and water plant facilities. While the corporation yard provides personnel and equipment that may be needed for incident response, it is also a liability; any incident that affects the corporation yard's operations will also affect utilities it houses, as well as these utilities' availability for response efforts.

The City of Millbrae is governed by an elected five-member city council, and its administrative, operation, and emergency resources are located in the study area. An appointed city manager oversees city operations, serving as the chief executive officer.

The "City of Millbrae Emergency Operations Plan" was updated in March 2017 to address operational issues in an emergency situation.[80] The plan, prepared in conjunction with the San Mateo County Office of Emergency Services, establishes policies and procedures for effective emergency operations within the city. It is a basic plan that identifies a concept of operations for emergency situations, which calls for the city to prepare standard operating procedures and checklists that detail resources. The plan also calls for the city to conduct training and exercises to prepare for emergency operations. Mitigation information in this document coordinates with the city's hazard mitigation plan.[81] Furthermore, the plan identifies transportation as Essential Function – 1 (EF-1), consistent with DHS. The plan does not specifically address how it works with adjacent agencies, except for one reference to working with county emergency services as needed, and a mention of mutual aid agreements that address public safety issues with adjacent agencies.

A separate plan, the 2015 San Mateo County "Hazard Vulnerability Assessment"—written in collaboration with the County of San Mateo and agencies adjacent to the city—outlines plans to mitigate damage that might occur to city facilities

[80] San Mateo County Sheriff's Office, "City of Millbrae Emergency Operations Plan."

[81] San Mateo County Sheriff's Office of Emergency Services, "County of San Mateo Hazard Vulnerability Assessment: Appendix to the Emergency Operations Plan (Hazard + Risk = Vulnerability)" (planning document, San Mate County Sherriff's Office, January 2015), http://hsd.smcsheriff.com/sites/default/files/downloadables/2%20-%20Hazard%20Vulnerability%20Assessment.pdf.

and operations during both manmade and natural disasters.[82] This plan, which is formatted according to ABAG guidelines approved by FEMA, outlines projects estimated to cost three times Millbrae's annual budget.

c. City of San Bruno—Local Roads and Bridges

The City of San Bruno, like the City of Millbrae, maintains surface transportation facilities in the form of local roads and bridges. The city has administrative, operational, and emergency resources located just outside the boundaries of the study area. Also like Millbrae, San Bruno is governed by a five-member elected city council, with a city manager in charge of operations and serving as chief executive officer.

The 2008 "City of San Bruno Emergency Operations Plan" addresses public and private property that might be affected by manmade and natural disasters.[83] This plan is one of the most detailed and encompassing plans reviewed for this work. Although the city is currently in the process of updating the plan, the current plan still applies to emergency incidents. The document addresses emergency support functions consistent with the format used by DHS; transportation is given the designation Essential Sector Function 1 (ESF 1). The city's response to the 2010 gas pipeline explosion in San Bruno shows the ability of its public safety mutual aid agreements to function well in an emergency.

While the city is well organized to face emergency incidents, it has done no testing or exercises (beyond public safety) to prepare for events that affect multiple agencies, extend over prolonged periods of time, or require resources from adjacent agencies. The city has had difficulty overcoming the effects of prolonged recovery.[84]

d. samTrans—Bus Services

SamTrans provides bus services throughout San Mateo County. The current bus routes crisscross the study area, predominantly running north and south along Highway

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[82] San Mateo County Sheriff's Office of Emergency Services.

[83] City of San Bruno, "Emergency Operations Plan."

[84] City of San Bruno.

82 and Interstate 101. The San Mateo County Transit District operates samTrans, and its administrative, operational, and emergency resources are located within San Mateo County, approximately ten miles south of the study area. A general manager serves as the chief executive officer. SamTrans is responsible for local road and bridge construction, operation and maintenance, airport roads and bridges, state highway construction, and local bus services.

A specific document addressing emergency planning for samTrans does not appear online, nor is one available directly from the agency upon request. Emergency planning responsibility for samTrans is linked to MTC, which is the regional planning agency for transportation agencies. As part of the MTC planning efforts (outlined in the next section), samTrans has planned for emergencies and identified response protocols; however, MTC documents do not provide obvious details about emergency mitigation and recovery. The documents identified in Table 3 provide limited information regarding emergency operations—specifically concerning planning, response, and mitigation—for samTrans.

4. Air, Rail, and Surface Plans Conclusion

Because some of the agencies' administrative, operational, and emergency resources are not located in close proximity to the study area—and because of varying governing boards, mutual aid agreements, and administrative functions—the agencies face possible limitations when trying to access the study area during an emergency. Even when resources are generally available in the vicinity, a number of employees may be out of the area during an emergency situation and unable to access the area.

B. CAL OES AND MTC

Although their operating facilities fall outside the study area, Cal OES and MTC provide service region-wide. Cal OES's responsibility for emergency preparedness covers the entire state of California; any emergency that occurs in the study area will be directly affected by Cal OES operations, which means this agency's emergency preparedness documents have useful information that relates to the study area. In addition, MTC is charged with coordinating and planning for agencies located in the Bay

Area, which means its purview includes the study area. Neither Cal OES nor MTC has facilities located in the study area, but their planning documents address emergency preparedness for several TC agencies. These plans provide a basis for understanding the relationships between and preparedness levels of multiple agencies in the study area.

1. Cal OES

The California Emergency Services Act of 1970 established the California Governor's Office of Emergency Services (Cal OES), which is responsible for coordinating statewide emergency preparation, recovery, mitigation, and plan integration.[85] According to the Emergency Services Act, Cal OES must prepare an emergency plan to address manmade and natural disasters that may affect state resources. The "State of California Emergency Plan," released October 1, 2017 and cited in the previous section, provides new updates and details on emergency planning statewide.[86] The plan devotes five pages of a nearly 190-page document to transportation, which it recognizes as part of the state's critical infrastructure. The plan also recognizes that transportation components are interrelated with all other departments, and is designed to facilitate collaboration at all levels of government. The 2013 version of the plan contains sector-specific annexes that identify transportation as Essential Function (EF-1) within the primary sectors for emergency management activities. The Transportation Annex is a joint document of the California State Transportation Agency, the California Department of Transportation, and the California Highway Patrol.[87]

The administration resources for the State of California are based in Sacramento, with local offices in San Mateo County. Operational and emergency response resources would presumably come from the regional office in Sacramento; at a minimum, they might also come from regional substation or local officers such as Foster City or Devils Slide/Highway 1 in San Mateo County.

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[85] California Emergency Services Act, Title 2, Chapter 7, Stats. 1970, Ch. 1454) (2007), https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=GOV&sectionNum=8550.

[86] Cal OES, "State of California Emergency Plan."

[87] Cal OES.

2. MTC

In the early 1970s, the California legislature created the Metropolitan Transportation Commission (MTC) to coordinate the Bay Area regional transportation network.[88] This partnership gathered the cities, counties, and agencies in nine San Francisco Bay areas together in pursuit of federal dollars to support the transportation network and to coordinate facilities and operations, as well as emergency planning. MTC requires each agency to prepare a Short-Range Transit Plan (SRTP). San Mateo County Transit District's 2014–2023 SRTP acknowledges the agency's role in developing regional transportation plans, including emergency plans.[89] MTC's 2008 "San Francisco Bay Area Regional Transportation Emergency Management Plan" provides emergency guidance for all agencies that are part of MTC.[90] Although the document deals with planning and response issues, it has no clear plans for recovery, continuity of operations, and mitigation.

C. PLANNING DOCUMENT THEMES AND GAPS

When reviewed together, the documents point to inconsistent planning efforts, or specific—and important—planning efforts that are noticeably absent. For example, SFO emergency plans are coordinated with BART due to MTC efforts, but these plans do not appear to outline mitigation and recovery efforts. Continuity of effort planning is addressed—Caltrain, Union Pacific, and samTrans plans are well coordinated, as they are prepared together as a single effort, and State of California emergency plans address these agencies in detail. However, these plans also do not appear to address mitigation and recovery. City plans are coordinated with overall county plans, yet do not address recovery efforts. These gaps in overall coordination and collaboration can be remedied by joint planning efforts that extend beyond public safety sectors, and by exercising organizational efforts jointly such, as an EOC effort.

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[88] "MTC History," MTC, accessed April 13, 2018, https://mtc.ca.gov/about-mtc/what-mtc/mtc-history.

[89] San Mateo County Transit District, "Short Range Transit Plan."

[90] MTC, "Bay Area Regional Plan."

IV. NATIONAL AND INTERNATIONAL CASE STUDIES

One way to enhance emergency preparedness planning in the Bay Area TC is to examine relevant work in similar settings. This chapter reviews work in several U.S. and international cities that offer new techniques to address modern threats. The examples focus on implementing an all-hazards approach to emergency planning, improving communication, including the whole community in preparedness efforts, coordinating resource allocation, establishing continuity of operations, and hardening facilities.

Because transportation is designated as a critical infrastructure sector, transportation agencies have worked within DHS and the Department of Transportation to enhance security measures. These two federal agencies provide a template for improved emergency preparedness that focuses on coordination and collaboration at the local level, in areas surrounding transportation facilities. To gather more ideas for improving emergency preparedness, this comparative analysis looks at recent U.S. efforts to enhance infrastructure resiliency in Boston, New York City, Seattle, and Oakland. These efforts show how U.S. transportation agencies can expand emergency planning activities by including the local community (not just public safety agencies) and building public–private partnerships that improve community coordination and resilience.

In addition, coordination and collaboration efforts have occurred internationally in Australia, Canada, and the United Kingdom. When compared to the United States, these countries speak predominantly the same language, have similar Western cultures and similar democratic structures of government, face similar security threats, and use similar security approaches. In each country, frameworks for coordination and collaboration between public safety sectors and the local community are in place. This analysis is not limited to public safety disciplines; it embraces a whole-community perspective. Major industry and professional sports in these countries also offer lessons about collaboration—they show examples in which the entire team prepares, trains, and performs together to ensure success. As threats evolve, it is critical to continue to evaluate what is working in other parts of the world. According to Dr. Nadav Morag's book *Comparative Homeland Security: Global Lessons*, this comparative method helps

identify options that may be transferrable to the United States.[91] When a terror incident occurs in the United States, the U.S. government and public safety agencies seem to react by immediately increasing security. Alternatively, we could respond by widening our preparedness spectrum to include stakeholders from the whole community in preparedness and recovery efforts, rather than public safety alone. To protect the transportation network, however, the populations that use transportation services—as well as the adjacent communities—must understand the scale of their transportation facilities.

A. U.S. MODELS

In the United States, innovative emergency preparedness work is taking place in Oakland, New York City, Boston, and Seattle. This section reviews scenarios that have occurred in these cities, and their innovative solutions.

1. Oakland and FBI Multi-Agency Drill

In the summer of 2017, the FBI organized "Operation Seasick"—a staged mock chemical assault on the Port of Oakland in California, in close proximity to this thesis's study area. The goal of the operation was to test emergency response for an actual emergency of this scale and practice how local, state, and federal agencies will work together during a prolonged, complex attack. According to FBI Special Agent in Charge John Bennett, these agencies rarely work together on a day-to-day basis. Over 15 agencies took part in this exercise, including the Oakland Police Department, U.S. Coast Guard, DHS, FEMA, and the FBI. While the exercise did not focus on transportation incidents, the outcome is translatable to transportation agencies. For example, the agencies in Operation Seasick discovered some of their practices unintentionally worked against the other agencies' practices, and they found ways to minimize related conflict.[92]

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[91] Nadav Morag, *Comparative Homeland Security: Global Lessons* (San Francisco: John Wiley & Sons, 2011).

[92] Filipa Ioannou, "Simulated Terror Attack on Bay Tests Local Emergency Response," SFGATE, June 7, 2017, https://www.sfgate.com/bayarea/article/Simulated-terror-attack-on-bay-tests-local-11203758.php.

2. New York City's Single-Purpose Plan

In October 2016, New York Governor Andrew Cuomo proposed a major infrastructure upgrade that will create a transit hub complex, combining rail, bridges, tunnels, and road systems into a single transportation system in order to improve operations and financing, and heighten security.[93] The governor formed an infrastructure task force to quickly implement technological improvements that could enhance resiliency—a priority for New York's centuries-old infrastructure.[94] To address infrastructure needs for both natural and terror-related threats, the task force is developing a strategic approach to institute new protocols, coordinate agencies, eliminate duplicate agencies, and increase staffing. This strategic approach to infrastructure management has significant potential to enhance overall emergency preparedness for New York's transportation facilities.

3. Boston Plans Pre-marathon

Because Boston's first responder and healthcare agencies embraced a flexible, coordinated all-hazards approach, as exemplified in DHS's Quadrennial Homeland Security Review, they were able to respond swiftly to the Boston Marathon bombings in April 2013.[95] In her master's thesis, Anna Brooks explains that Boston agencies take part in annual preparations for the marathon, including drills based on after-action report details from previous marathon events. This preparatory work allows medical and security services to coordinate and adjust efforts at the national, federal, state, and local levels. The prior coordination, standard operating procedures, and frequent drills that

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[93] "Governor Cuomo Announces Transformational Plan to Reimagine New York's Bridges and Tunnels for 21st Century," New York State Governor, October 5, 2016, https://www.governor.ny.gov/news/governor-cuomo-announces-transformational-plan-reimagine-new-york-s-bridges-and-tunnels-21st.

[94] Jonathan Dienst, David Paredes, and Joe Valiquette, "FBI Appoints C. Bryan Paarmann as New Counterterror Chief in New York—and He's a Man on a Mission," NBC New York, October 25, 2017, https://www.nbcnewyork.com/news/local/C-Bryan-Paarmann-New-FBI-Chief-Counterterror-Joint-Terrorism-Task-Force-New-York-453082913.html.

[95] DHS, *The 2014 Quadrennial Review* (Washington, DC: DHS, 2014).

made the Boston Marathon response successful should be lessons for other communities.[96]

4. Seattle Information Integration Efforts

According to the City of Seattle, poor coordination significantly hampers resource availability during and after emergencies; improving coordination between local and regional sectors that operate key segments of transportation infrastructure can aid information and resource sharing.[97] Seattle has experienced a series of small-scale attacks, such as the 2011 attack on an armed forces recruiting center.[98] According to Seattle's report, authorities expect that any future attacks in the area will only be small scale as well.[99] Despite the low probability of future attacks, this progressive city has sought to reduce its vulnerabilities. In "SHIVA—The Seattle Hazard Identification & Vulnerabilities Analysis," the city discusses the need to develop procedures that integrate resources and information, and to work with regional partners to establish a system for prioritizing resources during disasters, which includes using common language among agencies.[100]

5. Lessons Learned from U.S. Models

The examples of current preparedness thinking in Oakland, New York, Boston, and Seattle point to methods for enhancing preparedness in the Bay Area TC. Transportation agencies should conduct joint training exercises, work across agency lines, plan together in advance of incidents, and share information. The next section reviews international models for further takeaways.

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96 Anna C. Brooks, "Police Self-deployment at Critical Incidents: A Wicked Problem or a Part of the https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=GOV&sectionNum=8550Solution?" (master's thesis, Naval Postgraduate School, 2017).

97 City of Seattle Office of Emergency Management, "SHIVA—The Seattle Hazard Identification & Vulnerabilities Analysis" (report, City of Seattle, April 2014), https://www.seattle.gov/Documents/Departments/Emergency/PlansOEM/SHIVA/SHIVAv6.3Final.pdf.

98 "Two Men Charged in Plot to Attack Seattle Military Processing Center," Department of Justice, June 23, 2011, https://www.justice.gov/opa/pr/two-men-charged-plot-attack-seattle-military-processing-center.

99 City of Seattle Office of Emergency Management, "SHIVA."

100 City of Seattle Office of Emergency Management.

B. INTERNATIONAL MODELS

Although terrorist plots in other countries have been relatively similar to those in the United States, plots—and actual attacks—have occurred far more frequently in other countries. Accordingly, those countries have more experience dealing with threats; emergency preparedness work in Australia, Canada, and the United Kingdom provides solid examples for the United States to follow. The ideas introduced in this section—along with those from the previous section—form the recommendations presented in the next chapter. If Bay Area TC agencies implement these recommendations, they can significantly improve emergency preparedness operations in northern California, and can serve as a model for other areas throughout the nation.

1. Australia's Strategy for Protecting Crowded Places

Published in 2017, *Australia's Strategy for Protecting Crowded Places from Terrorism* refocused the country's emergency preparedness discussion from natural disasters to both natural disasters and terror incidents.[101] The Australian system uses an index scale that measures disaster resilience in communities, and helps determine policy and strategy work needed to improve resilience.[102] The Australian system involves all sectors of government, the private sector, and the community in preparedness activities.

Crowded places do not have to be buildings; large numbers of people also predictably gather in stadiums, transportation facilities, shopping centers, and tourist attractions. According to the strategy document, strengthened partnerships between business owners and all levels of government will provide a mechanism for coordinating and sharing information, which will enhance emergency preparedness.[103] The strategy recognizes that its success rests on sustainable partnerships between private and public

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[101] Australia-New Zealand Counter-Terrorism Committee (ANZCTC), *Australia's Strategy for Protecting Crowded Places from Terrorism 2017* (Australia: Commonwealth of Australia, 2017), https://www.nationalsecurity.gov.au/Media-and-publications/Publications/Documents/Australias-Strategy-Protecting-Crowded-Places-Terrorism.pdf.

[102] "Australian Natural Disaster Resilience Index: A System for Assessing the Resilience of Australian Communities to Natural Hazards," Brushfire & Natural Hazards CRC, accessed April 17, 2018, https://www.bnhcrc.com.au/research/hazard-resilience/251.

[103] ANZCTC, *Protecting Crowded Places*.

sectors and recognizes that while it is not possible to prevent disruptions, it is critical to reduce the likelihood and consequences of an attack.[104]

Because Australia is geographically isolated, it is still a strong priority for the country to prepare for natural disasters, such as brushfires and other disasters not common in other areas. The Australian government believes these natural threats require regional emergency coordination; bushfires can devastate large areas populated with small communities that are unable to withstand the scale of disruption.[105]

2. Canada: "Prevent, Detect, Deny, and Respond" Approach

Luckily, Canada has been spared significant transportation-related terrorist attacks. However, since August 2016, the country's threat level has been considered "medium," meaning a violent act of terrorism could occur at any time.[106] Canada's approach to terrorism uses a single strategy to guide all national emergency preparedness efforts: the "Prevent, Detect, Deny, and Respond" approach focuses on building resilience. This national system also extends to the community level. For example, the Prevent approach involves more than just law enforcement and security; it employs cross-cultural roundtables to strengthen the dialogue about terrorism.[107] Police build partnerships with communities that respond to extremism.[108] The Canadian approach to emergency preparedness uses early role definition and includes local segments in all emergency preparedness efforts.

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[104] Australian Government Department of the Prime Minister and Cabinet, *Review of Australia's Counter-Terrorism Machinery* (Australia: Commonwealth of Australia, 2015), https://www.pmc.gov.au/sites/default/files/publications/190215_CT_Review_1.pdf.

[105] Brushfire & Natural Hazards CRC, "Australian Natural Disaster Index."

[106] Public Safety Canada, *2016 Public Report on the Terrorist Threat to Canada* (Government of Canada, 2016), https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/2016-pblc-rpr-trrrst-thrt/2016-pblc-rpr-trrrst-thrt-en.pdf.

[107] Government of Canada, *Building Resilience against Terrorism: Canada's Counter-Terrorism Strategy*, second edition (Government of Canada, 2013), https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/rslnc-gnst-trrrsm/rslnc-gnst-trrrsm-eng.pdf.

[108] A. Anne McClellan, "Public Safety and Emergency Preparedness Canada: Report on Plans and Priorities, 2005–2006" (report, Government of Canada, 2005), http://publications.gc.ca/collections/collection_2015/sp-ps/PS1-11-2005-eng.pdf.

Public Safety Canada is a Cabinet-level office that focuses on emergency preparedness.[109] This office integrates business leadership, health officials, utility company officials, and others into emergency preparedness efforts. Each segment of the community is involved in planning and has assigned roles and responsibilities to support emergency efforts. The Canadian system uses Cabinet Office Briefing Rooms (COBRs) to enhance communication, clarify roles and responsibilities, and develop and maintain up-to-date plans. COBRs coordinate tiers of response and emphasize two-way communication between Category 1 (public safety) and Category 2 (local community). To accomplish this coordination, Canadians set up a national cross-sector forum that promotes information sharing across sectors. This forum establishes communication between communities and creates seamless emergency management, integrated public safety, and community safety through Joint Emergency Planning Partnerships. The program funds innovative projects that emphasize cross-discipline approaches, such as those between planning, engineering, and environmental sciences components. Community education and participation is critical to combatting terrorism[110] This multi-layered approach acknowledges a complex, jurisdictional breakdown of responsibilities that could be applied to the Bay Area TC.[111]

3. The United Kingdom: Local Community Forums

The United Kingdom has been dealing with a greater level of terrorism for a longer period of time than either Canada or the United States. As such, their lessons learned offer useful ways to improve emergency preparedness. Compared to the United States, the United Kingdom has fewer agencies involved in emergency response, which creates smoother, less complex lines of communications.[112] The United Kingdom's emergency preparedness and recovery model focuses on partnerships between industry, utilities, and all levels of government. To heighten communication, the country hosts

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[109] Public Safety Canada, *Terrorist Threat to Canada*.

[110] McClellan, "Public Safety and Emergency Preparedness Canada."

[111] McClellan.

[112] Philip Johnson, "Ten Years on from 7/7: How London Responded to the Terror Attack," *Telegraph*, July 7, 2015.

annual security showcases to introduce stakeholders to the latest methods and equipment; these showcases make new tools readily available to all segments of the community, rather than limiting them to law enforcement.[113] The UK government also has a cabinet office responsible for assuring that regional training and resources are available for coordinated planning efforts.

Emergency efforts are well coordinated between local UK law enforcement agencies and other segments of the communities they serve. According to Morag, unlike the U.S. model, the United Kingdom treats operators of critical infrastructure as Category 2 first responders, who can assign roles in crisis situations; in the United Kingdom, Category 2 responders—in accordance with the Civil Contingencies Act—must form local community forums to assist with community response efforts.[114] Each community also maintains a website that addresses methods of local preparedness in support of law enforcement efforts.[115]

Emergency preparedness in the United Kingdom is consistent nationwide with a system based on four P's: Prepare, Protect, Prevent, and Pursue. The mayor and local staff regularly discuss contingency plans and, unlike in the United States, emergency preparedness efforts involve all segments of the local community, including local businesses such as refuse collectors and hotels. Examples of collaborative efforts in the United Kingdom and include:

- The Exercise Unified Response (EUR), which was conducted between February 29 and March 3, 2016, is the largest and most complex emergency services exercise ever held in the United Kingdom—and

[113] See https://www.internationalsecurityexpo.com/.

[114] Morag, *Comparative Homeland Security*.

[115] London First, accessed April 17, 2017, www.londonfirst.co.uk.

potentially in the European Union. The exercise involved 70 international and local teams.[116]

- The London Resilience Partnership, funded by the European Union, coordinates response to large-scale emergencies by working effectively with national and international partners. The partnership ensures appropriate arrangements are in place to support civil protection mechanisms and to increase skills of both responders and facilitators through the provision of a unique training opportunity.[117]

- Operation Strong Tower was conducted in London and Surrey between June 30 and July 1, 2015. The operation was commissioned by the Home Office National Program Board and developed by the Metropolitan Police Service in conjunction with the Office of Security and Counter Terrorism, plus 25 partner agencies; it involved multiple sites and multiple incidents.[118]

C. CHAPTER CONCLUSION

The national and international activities presented in this chapter provide a roadmap to improved preparedness for the Bay Area TC. Based on these case studies, this roadmap includes using an all-hazards approach, allowing transportation-sector personnel to coordinate with each other and monitor each other's systems, creating multi-discipline teams to prepare and effectively handle emergencies, hardening infrastructure, conducting joint-agency operations, planning multi-day incident exercises, and including

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[116] Catherine Neilan, "Unified Response: London Police, Ambulance and Fire Crews Test UK's Biggest Ever Multi-agency Disaster Training Exercise as Tower "Collapses" into Waterloo Tube Station," City A.M., February 29, 2016, http://www.cityam.com/235601/unified-reponse-londons-emergency-services-including-police-ambulance-and-fire-crews-are-holding-the-biggest-ever-multi-agency-training-exercise-this-week.

[117] "London Prepared," Mayor of London, accessed April 17, 2018, https://www.london.gov.uk/about-us/organisations-we-work/london-prepared/.

[118] Matt Chorley, "Britain Prepares for its Nightmare Scenario: Police Stage Mock Tunisia-Style 'Marauding Gun Attack' on Streets of London in Biggest Ever Counter-Terrorism Exercise in the UK," *Daily Mail*, June 30, 2015, http://www.dailymail.co.uk/news/article-3143410/Police-stage-mock-Tunisia-style-marauding-gun-attack-streets-London-biggest-counter-terror-exercise-prepare-atrocity-British-soil.html.

all segments of the community in planning—from industry and utilities to all levels of government.

In the next chapter, this thesis develops policy recommendations to address gaps identified in the case studies and other research. The thesis uses a matrix of emergency plans to analyze current conditions and propose solutions for the Bay Area TC. This format can be applied to other regional transportation centers as well to determine their level of preparedness for complex disasters that affect more than one agency.

V. FINDINGS AND RECOMMENDATIONS

This chapter provides research findings and recommendations and outlines preparatory steps agencies should take to limit service disruptions and enhance coordination and collaboration during emergencies. These recommendations are intended to improve upon gaps identified in the research. Recommendations include changes to public policy and may have public safety implications; they are designed to improve comprehensive and effective operations across agency lines.

A general best practice is to include all sectors in communication and planning activities. The Bay Area TC agencies need innovative crisis management skills to address new threats, as well as to address inconsistencies that hamper communication. Jurisdictions and agencies are no longer simply focusing on a single point of failure or an incident that spans a single day. To improve coordination, the TC agencies will need to work on coordinating plans and co-locating emergency operations facilities. The more a professional sports team practices, prepares, coordinates, and collaborates, the more likely the team is to have a successful season; similarly, firefighters take part in frequent drills that allow them to work together, and that enhance the success of fire emergency response. The same factors that create successful response in sports and in public safety hold true in all sectors of emergency response.

Several concepts will allow transportation agencies to enhance coordination and collaboration for emergency preparedness. The concepts can be generally grouped into six categories:

- adopt an all-hazards approach to emergency planning,
- improve communication,
- approach emergency preparedness as a whole community,
- establish methods for continuity of operations over extended periods of time,

- establish methods to coordinate resource allocation, and
- harden infrastructure.

These categories are described in the following sections.

A. ALL HAZARDS

An all-hazards approach means treating natural disaster planning the same as planning for terrorist threats. Emergency planning should be considered an issue that addresses all types of extraordinary operations. Agencies should implement advanced planning and preparation efforts for special events. Canada has implemented this all-hazards approach for disasters and terror incidents; Canada's success can serve as an example of multiple agency coordination and collaboration for the Bay Area TC.

B. COMMUNICATION

Currently, transportation agencies in the study area do not recognize identification badges of personnel from adjacent agencies (other than for public safety agencies). During an emergency, this prevents valuable, trained personnel from crossing into emergency site access points. To address security concerns, the agencies should establish a common form of identification using existing TSA systems. Additionally, public safety communication channels used on emergency sites (such as radios) do not allow all-encompassing use of a single channel for onsite emergency communications; instead, cross-agency communication must be established onsite when emergency response begins, which is time consuming.

According to the Texas Division of Emergency Management, one method for enhancing emergency operations is to consolidate "radio communication between multiple departments … in advance of an incident."[119] These lines of communication should be established in advance to facilitate swift transfer to common channels. This should include all adjacent cities, fire, police, and special district operations. The Texas

[119] "After Action Report & Improvement Plan," Texas Division of Emergency Management, accessed April 17, 2018, 6, https://www.dps.texas.gov/dem/documents/afterActionRptInstr.pdf.

Division of Emergency Management also discusses the need for coordination between agencies' information technology (IT) departments to provide server access for critical agencies in EOCs. To address this issue, agencies can prepare a needs assessment for the communication systems they believe will be needed during emergencies.

Because their operational channels transmit on different frequency ranges, communication between transportation agencies and first responders at an incident can be challenging. A simple way around this—at least during minor incidents—is to establish an incident command structure onsite that employs a transportation representative who acts as liaison between incident command and dispatch. In December 2010, Caltrain held a simulation of a derailment and onboard fire inside a tunnel near the border between San Francisco and San Mateo County; during the exercise, first responders were not able to communicate with other responding agencies. While this issue has since been corrected, it identifies a concern that needs to be addressed holistically within the transportation agencies' emergency planning efforts. The study area has agencies that are not all anchored to San Mateo County, such as SFO, BART, Caltrans, and Union Pacific. Securing the channels of communication across all agencies, regardless of organizational governance, will provide the ease of communication necessary for successful emergency operations.

Planning reliable communication methods is a critical emergency management practice. Mobile communication sources or Communication on Wheels stations (COWs) have become successful tools for special-incident communication. COWs have effectively expanded high-demand network coverage through use of temporary or portable cell towers mounted on trailers, vans, or trucks. Whenever large groups of people gather, there is a big demand for this type of connectivity. Agencies that are co-located should consider providing expanded cellular network coverage and planning in advance for communications needs. COWs have been used effectively during the following events:

- September 11, 2001, terrorist attacks in New York City
- Hurricane Katrina, U.S. Gulf Coast, August 23–31, 2005

- A slide fire in Arizona, May 20–June 5, 2014
- Mardi Gras in New Orleans, March 2015
- Hurricane Matthew, South Carolina, September 28–October 10, 2016
- Presidential inauguration on the National Mall in Washington, DC, January 2017
- Super Bowl LI in Houston, Texas, February 5, 2017
- NCAA Final Four at the University of Phoenix, April 1–3, 2017[120]

The photo in Figure 4 is an example of a COW facility that can be stored near the area study area, such as in the San Bruno Corporation yard, to provide easy access when needed.

Figure 4. Communication on Wheels Facility[121]

120 "Telescopic Mast Cell on Wheels: AT&T Enhances Coverage ahead of NCAA Men's Final Four," Alltech, May 17, 2017, http://goalltech.com/mobile-telescopic-mast-at-ncaa-final-four/.

Another way to improve emergency incident communication is to establish a trunk system like the one found in Santa Clara County's "BAY MAC," established by Umunhum Development Corporation in the 1950s to provide communication to rural areas.[122] The system is privately owned but serves as a key piece of the countywide communication system. Region-wide emergency planning for Super Bowl 50 in 2016 took advantage of this system. The study area transportation agencies, too, could coordinate with private communication groups in advance and include them in drills and training exercises.

C. WHOLE COMMUNITY

The "whole community" concept, as discussed in the National Preparedness Goal, refers to "the participation of a wide range of players from the private and nonprofit sectors, including nongovernmental organizations and the general public, in conjunction with the participation of Federal, State, local, tribal, and territorial governmental partners in order to foster better emergency coordination."[123] The national and international best practices identified in the previous chapter show the benefits of including the whole community in preparedness efforts. "As a concept, Whole Community is a means by which residents, emergency management practitioners, organizational and community leaders, and government officials can collectively understand and assess the needs of their respective communities and determine the best ways to organize and strengthen their assets."[124]

The whole-community approach has not been implemented in the study area TC. Before emergencies occur, transportation agencies should cooperate with local agencies to create agreements and coordinate plans beyond the first responder level. How the local

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[121] Source: "Expanding High-Demand Network Coverage with Cell on Wheels," Cellsite Solutions, accessed October 1, 2017, https://cellsitesolutions.com/cell-on-wheels-expand-network-coverage/.

[122] Communications & Control Inc., accessed April 23, 2018, http://www.com-ctl.com/content.html.

[123] DHS, *National Preparedness Goal*, second edition (Washington, DC: DHS, 2015), www.fema.gov/media-library/assets/documents/25959.

[124] FEMA, *A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action*, FDOC 104-008-1 (Washington, DC: DHS, 2011), https://www.fema.gov/media-library-data/20130726-1813-25045-0649/whole_community_dec2011__2_.pdf.

community defines recovery will require additional preparations in the emergency planning stage. In the existing emergency management plans reviewed for this thesis, any connection the transit agencies have with adjacent communities for emergency response was vague beyond the first responder level.

Currently, residents must wait for the government to arrive with aid during emergencies; a whole-community approach, instead, creates a culture of enhanced personal preparedness. In recent hurricanes in Florida and Puerto Rico, for example, FEMA resources were overwhelmed. A whole-community approach will allow transportation agencies to take the lead in local preparedness. Working with labor groups, community nonprofits, and citizen groups in advance to encourage personal preparedness for employees and community volunteers will increase the pool of individuals available for emergency response assistance. According to FEMA's 2015 National Preparedness Goal, transportation agencies at all levels should collaborate and form relationships with local organizations that have access to transportation resources, including equipment, personnel, fuel, and maintenance facilities that can be made available for emergency response.[125] Emergency responders may need access to specialized equipment when responding to emergencies, and during recover efforts. Planning availability of specialized vehicles may be especially important for successful response activities. Advance planning activities should include non-safety equipment available in the surrounding community that may be accessed during emergencies. A whole-community approach to emergency management gives responders access to additional resources, including those gained through public–private partnerships. FEMA's experience in recent disasters has shown that bringing in a huge number of surge-force employees from other parts of the country has some limitations. Typically, FEMA responders are sent to an area and have direct responsibility. It seems the local conditions and practices take a while to connect with this surge force. Perhaps a good approach is to establish local or regional FEMA surge skeletal teams that can interface between the locals, who have knowledge of customs and resources, and the FEMA experts who are sent to assist communities.

[125] DHS.

D. CONTINUITY OF OPERATIONS

Transportation agencies should consider establishing plans to continue operations in the event that key staff are unavailable during emergencies. Continuity of operations plans typically outline how an organization will respond to disruptions by defining backup procedures to maintain and support critical functions. Cross-sector and cross-agency training and exercises will ensure the plans are effective during actual emergencies. Routine training exercises also ensure employees are familiar with the plans. Agencies should also use after-action reports to improve emergency operations over time.

While transportation agencies in the study area should be concerned with continuity of operations, so should the adjacent communities—after all, the transportation agencies allow people and goods to travel to and from the area, and these services will be affected during an emergency. One method of improving community confidence is to include all segments of the community in emergency planning. These efforts might include identifying resources, ensuring that allocation of resources is coordinated and not duplicative, and ensuring resources are allocated to those who need them most. The simplest solution is to include the entire community in planning efforts; this will ensure that everyone involved knows who will be in charge and what the priorities will be before an emergency occurs.

E. COORDINATED RESOURCE ALLOCATION

Over-allocation of resources is a common difficulty in emergency work. There are several solutions, including noncompetitive procurement and pre-determination of resource availability and allocation. Emergency preparations should ensure that the agencies' regulations permit the use of a noncompetitive procurement in declared emergency situations, as defined by FEMA. When routine practices will cause delays during an emergency, the FEMA system allows agencies to operate outside the normal requirements for purchasing. However, FEMA also states that coordinating in advance with local vendors and developing mutual aid agreements across all sectors will enhance

emergency response.[126] To prevent over-allocation of resources, agencies should identify resources in advance, ensuring that allocation is coordinated, efforts are not duplicated, and resources are properly prioritized. According to planning documents, each agency in the study area independently allocates resources. In some cases, a single resource has been allocated by multiple agencies.

Emergency preparedness plans should address management of equipment and vehicles, including issues such as advance fueling, how to access the equipment and vehicles, and how to ensure resources are still in place and accessible in the event that an emergency wipes out one location's resources (i.e., "splitting"). Plans should address the agencies' resources, but should also account for excess equipment and vehicles generated as a result of managing the emergency. Developing protocols to address the readiness of standing vehicles, movement of vehicles into and out of emergency areas, and locating equipment in areas not affected by the emergency or in the way of recovery functions will help recovery efforts. These issues were not addressed in the agency plans reviewed for this work.

Additionally, no-fare policies should be implemented before emergencies to allow easier vehicle boarding and to eliminate the need for money handling during emergencies.[127] Continuity of operations plans should provide for stockpile vehicles stored and maintained in preparation for emergency use. These plans should be developed across all sectors to include non-transportation agencies such as schools and health facilities.

F. HARDENED INFRASTRUCTURE

"The cost for physically protecting facilities, also known as hardening, is an eligible expense in Federal Transportation Agency grant applications."[128] California

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[126] General Procurement Standards, 2 CFR Part 220.317-326 (2014).

[127] Transportation Research Board, *Communication with Vulnerable Populations: A Transportation and Emergency Management Toolkit*, TCRP Report 150 (Washington, DC: National Academy of Sciences 2011), http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_150.pdf.

[128] "Grant Programs," Federal Transit Administration, accessed April 17, 2018, https://www.transit.dot.gov/grants.

cities are required to prepare hazard mitigation plans.[129] These plans are tied to a city's budget, as well as to capital improvement plans that typically span five years and use a cost-benefit analysis to focus funding on highest-priority improvements needed for emergency preparation. Caltrans also says that agencies should "ensure that new facilities are designed to withstand natural disasters and other emergencies, and provide shelter for agency personnel."[130] Agencies can prudently adopt the FEMA hazard mitigation approach of establishing a priority list of projects to protect existing assets. This list can be used to pursue funding that reduces exposure of the agency assets to service disruptions. For example, the Federal Transportation Agency developed a Hazard Mitigation Cost Effectiveness Tool that helps organizations determine which improvements will result in the greatest value.[131]

G. CHAPTER CONCLUSION

This chapter has identified recommendations for enhancing emergency preparedness coordination and collaboration. The next chapter reviews governance in place and discusses methods that can be used to improve accountability. The ultimate solution is to create an emergency services joint powers agency (JPA), which introduces the concept of a regional transportation emergency operations center (RTEOC) as a possible component.

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[129] "Hazard Mitigation Plan Requirement," FEMA, last updated October 31, 2017, https://webcache.googleusercontent.com/search?q=cache:AF1xn9K_-XQJ:https://www.fema.gov/hazard-mitigation-plan-requirement+&cd=1&hl=en&ct=clnk&gl=us.

[130] Caltrans, *Transit Emergency Planning Guidance*.

[131] "Hazard Mitigation Cost Effectiveness Tool," Federal Transit Administration, accessed April 17, 2018, https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/hazard-mitigation-cost-effectiveness-tool.

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VI. THE PATH FORWARD

Several lessons learned from this analysis can define a path forward for the transportation agencies in the study area. The agencies should expand their emergency planning practices to provide common ground and overlap in preparedness activities. This type of planning will be helpful for incidents that affect multiple agencies, but will also be helpful for the individual agencies themselves.

A. COLLABORATIVE EXERCISES

Taking a cue from other U.S. cities, the agencies should consider holding regular and collaborative emergency operations exercises (like those in Boston), giving responsibility for coordination efforts to a single entity (like New York City does), and holding drills that extend over several days and that involve agencies from both inside and outside the area (as in Oakland). In light of the international case studies, the agencies should consider forming public–private partnerships and including local sectors in preparedness efforts to enhance resiliency.

B. LOCAL-LEVEL EFFORTS

The U.S. government has designated DHS as the single agency responsible for emergency preparedness. DHS efforts have focused on public safety at the national or state level. Now, efforts should prioritize coordination at the local level. Because local-level efforts can involve local government, businesses, and regional agencies in emergency planning, they have great potential to improve transportation sector emergency preparedness. As part of this effort, local government could develop an agreement that would engage the various agencies and compel them to work together. Additionally, formation of an emergency joint powers agency (JPA) would more clearly define the role of SFO and BART among their adjacent agencies. For example, an emergency involving air travel that occurs outside the boundaries of SFO would require assistance from SFO and adjacent partners, depending on the exact location and magnitude of the incident.

C. JOINT POWERS AUTHORITY

Currently, although the agencies are accustomed to working collaboratively, they each have their own governance structures, which makes coordination difficult. To help, they can establish a single JPA to govern all their emergency operations and to ensure the agencies have equal authority and responsibility during emergencies. A JPA could bring the agencies together with local government, businesses, and other regional agencies to prepare for and coordinate emergency operations. The JPA's powers should extend to recovery efforts as well, including those that take place over an extended period of time or that are still occurring (such as the 2010 San Bruno PGE gas explosion). Special legislation may be needed to create a framework for emergency response that allows all the agencies to share power, and that grants special privileges to law enforcement agencies that operate in close proximity to the study area. Furthermore, a JPA can also determine where the RTEOC will be located, and how it will be staffed and financed.

D. REGIONAL TRANSPORTATION EMERGENCY OPERATIONS CENTER

Furthermore, formation of a regional transportation emergency operations center (RTEOC) would allow agencies to define operational responsibility during critical incidents. It would also eliminate ambiguities by providing more structured processes, and would decrease the likelihood that the agencies will need to compete for resources during a large-scale or prolonged emergency. An RTEOC would better equip the region to make security decisions that consider all opinions and interests.

Given the number of agencies co-located in the study area, it is likely that an attack or prolonged natural disaster will affect all the agencies. The region's existing emergency preparedness efforts focus only on general emergencies, and EOC facilities are 15–20 miles away. During heavy commuter times, it can take over an hour to travel from an EOC to the study area. Additionally, access to the area may be blocked during an emergency, and the existing EOCs are small-scale, which means they may be occupied by local needs during an emergency. The study area needs a specialized transit EOC. Although there is a regional emergency operations center in the area, it is located across

the bay in Alameda County and its focus is general purpose law enforcement, not transportation. Once established, an RTEOC can serve both transportation and other emergency incident needs, taking on a multipurpose role in the region.

This thesis has identified a need for enhanced coordination and collaboration in emergency preparedness practices. Because the plans for California High Speed Rail are still being developed, it is an opportune time to raise—and address—this issue. Currently, the MTC emergency plan addresses four of the nine agencies: SFO, BART, Caltrain, and samTrans; however, it does not address all phases of emergency preparedness.[132] Other planning documents for the TC agencies vary in age, and some, including the MTC plan, are 10 or more years old. MTC is predominantly a planning and funding agency; it does not directly operate any transportation services. Additionally, MTC does not operate an EOC. When an incident occurs, the regional emergency operations center determines which EOC will take responsibility. In several instances, the agencies located in the study area have undertaken emergency preparedness efforts jointly. And, in some cases, their emergency plans are well coordinated and effective, if dated. Establishing an RTEOC within the study area can accomplish the goal of enhanced coordination. However, this will require the agencies to address governance structure, financing mechanisms, and location concerns.

One option for an RTEOC would be to expand one of the existing agencies, such as the San Mateo County EOC, San Francisco EOC, or MTC. Alternatively, creating a new agency could help bring partners together. However, since there are already nine existing agencies, it may be more efficient to work with an existing facility. Although the individual agencies are not big enough to successfully accomplish the task on their own, they may be able to by working together. Funding for an RTEOC facility, staff, and equipment could come from the special legislation mentioned previously, the agencies in the study area, and DHS—some local hazard mitigation needs may qualify for DHS funding. Establishing an RTEOC in central San Mateo County, which encompasses the study area, will enable regular joint exercises that include agencies external to the study

[132] MTC, "San Francisco Bay Area Regional Transportation Plan."

area as well, such as San Mateo County and San Francisco City and County, MTC, the FBI, FEMA, and DHS.

E. STANDARDIZING PLANS

Additionally, the regional EOC should update all plans with an eye for standardization. This will help simplify coordination between the agencies during emergencies. The regional EOC could also establish a credentialing program for local administrative personnel, which would provide training for first responders, transportation operators, and public administrators.

F. SFO

SFO is a major player in the study area. As mentioned, the airport is located in San Mateo County but is governed and regulated by San Francisco City and County, and also by the Federal Aviation Administration (FAA). Due to the complex regulatory and reporting implications, SFO does not generally participate in San Mateo County EOC exercises that do not directly involve the airport property. However, SFO, a Category X airport and an international hub, attracts visitors from around the world and is vulnerable to an isolated attack; if an attack were to limit the airport's operations, the effects would be seen across the Bay Area and beyond. Accordingly, SFO should be invited to join an emergency JPA, and should be included as an associate member of the San Mateo County Emergency Services Council. Including SFO will enhance transportation-related communication and information sharing regarding key regional data, intelligence, policy, and decision making. Further, including SFO in exercises will allow all regional facilities (as well as first responders) to become more familiar with the facility.

G. BART

Although BART did not originally have facilities in San Mateo County, its facilities eventually expanded into San Mateo; the county's representation on the BART board did not expand to follow suit. This gives San Mateo County a more limited role in the area's emergency operations. Although adding a seat on the BART board of directors

for San Mateo County is a complex issue, it would enhance coordination and collaboration.

H. SECURITY ENHANCEMENTS

Following the terrorist attacks of 2015, the French government enacted regulations that give law enforcement greater flexibility in areas such as house arrest, and search and seizure.[133] According to the *New York Times*, the regulations also give law enforcement greater ability to set up check points for extended periods of time near airports, ports, and train stations that offer international service in order to restrict access to areas that are vulnerable to terrorism.[134] However, this type of security enhancement comes at the expensive of civil liberties; while it may be a productive solution to address terrorism in certain regions, it would be met with controversy in northern California.

I. IMPLEMENTATION: PROOF-OF-CONCEPT APPROACH

This thesis suggests that the way forward for enhancing transportation emergency preparedness is to conduct exercises that include non–public safety personnel, and address communication and resource allocation. A first step could be a proof-of-concept approach that includes establishing a test RTEOC for a year and conducting regular exercises in an existing facility. This would provide a low-cost opportunity for the nine agencies to realize the benefits of a JPA and RTEOC, and would allow them to consider siting, funding, and staffing a permanent facility.

J. CONCLUSION

These concepts could also be employed in other jurisdictions that have multiple co-located agencies, and that require detailed coordination and collaboration to successfully address emergency preparedness and response. Establishing an RTEOC in the study area will provide a model for similar national transportation centers—a model that has been called for in previous research. For instance, in his 2016 master's thesis,

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[133] Alissa J. Rubin and Elian Peltier, "French Parliament Advances a Sweeping Counterterrorism Bill," *New York Times*, October 3, 2017, https://www.nytimes.com/2017/10/03/world/europe/france-terrorism-law.html.

[134] Rubin and Peltier.

Brian Seals calls for agencies to work in advance of an emergency to infuse adaptability into standard operating procedures.[135] Similarly, the TSA calls for "using collocation and pre-incident preparation to get various agencies on the same page."[136] According to the TSA, "passenger rail agencies and transportation agencies in general may not be adequately prepared to handle all emergencies or mitigate their consequences."[137] DHS (of which the TSA is one component) and the Department of Transportation work jointly to fund and sponsor connecting communities' workshops to coordinate transit systems' resources with local, county, and state emergency managers.[138] These funds could appropriately be used as a resource to establish an RTEOC.

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[135] Brian Seals, "Thesis Proposed Infusing Adaptability into Standard Operating Procedures," Center for Homeland Defense and Security, October 25, 2016, https;//www.chds.us/c/item/4359?utm_source= snapshots&utm_campaign=s_2016-12-20.

[136] DHS Office of the Inspector General, *TSA's Preparedness*.

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