



SECTION 4. RISK ASSESSMENT

4.8 Hazardous Materials

2018 HMP UPDATE CHANGES

- ❖ The hazard profile has been significantly enhanced to include a detailed hazard description, location, extent, previous occurrences, and probability of future occurrence (including climate change).
- ❖ Hazardous materials incidents that occurred in the State of Hawai'i from January 1, 2012, through December 31, 2017, were researched for this 2018 HMP Update.
- ❖ The capability information regarding the State Emergency Response Commission and the Hawai'i Emergency Planning and Community Right to Know Act was removed, to focus more on the hazard itself.
- ❖ The profile and vulnerability assessment have been updated to include the most up-to-date information on the numbers of chemical facilities and Superfund sites, the addition of information on pipelines, and the consideration of both fixed-sites and in-transit hazardous materials.
- ❖ A qualitative vulnerability assessment of damage to state assets and critical facilities from hazardous materials incidents is provided at the State level.
- ❖ A qualitative vulnerability assessment is provided at the county level of risk to the population, general building stock, and environmental/cultural resources from hazardous materials incidents.
- ❖ Discussion of future changes that may impact State vulnerability has been added.

4.8.1 Hazard Profile

HAZARD DESCRIPTION

“Hazardous substances” include materials and wastes that are considered severely harmful to human health and the environment, as defined by the United States Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (commonly known as Superfund). Many hazardous materials are commonly used substances which are harmless in their normal uses, but are quite dangerous if released in concentration. The EPA designates more than 1,300 substances as hazardous and subject to the reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA), CERCLA, and/or Clean Air Act (CAA). This number does not include all hazardous chemicals for which material safety data sheets are required (EPA 2015). Because relevant legislation uses the term “hazardous substance,” but the emergency management and response community typically uses the term “hazardous materials,” for the purpose of this hazard profile, “hazardous materials” and “hazardous substances” are used interchangeably.

According to CERCLA, the definition of a hazardous substance includes the following:

- Any element, compound, mixture, solution, or substance designated as hazardous under Section 102 of CERCLA.



- Any hazardous substance designated under Section 311(b)(2)(a) of the Clean Water Act (CWA), or any toxic pollutant listed under Section 307(a) of the CWA. There are over 400 substances designated as either hazardous or toxic under the CWA.
- Any hazardous waste having the characteristics identified or listed under Section 3001 of the Resource Conservation and Recovery Act (RCRA).
- Any hazardous air pollutant listed under Section 112 of the Clean Air Act (CAA), as amended. There are over 200 substances listed as hazardous air pollutants under the CAA.
- Any imminently hazardous chemical substance or mixture which the EPA Administrator has "taken action under" Section 7 of the Toxic Substances Control Act (TSCA) (EPA 2013).

If released or misused, hazardous substances can cause death, serious injury, long-lasting health effects, and damage to structures and other properties, as well as the environment. Many products containing hazardous substances are used and stored in homes and these products are shipped daily on highways, waterways, and pipelines. There are two general types of hazardous material incidents:

- **Fixed-site hazardous substances (materials and waste) incident** is the uncontrolled release of materials from a fixed-site capable of posing a risk to health, safety, and property as determined by RCRA. It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site. Hazardous materials at fixed-sites are regulated by the EPA.

The EPA chooses to specifically list substances as hazardous and extremely hazardous, rather than providing objective definitions. Hazardous substances, as listed, are generally materials that, if released into the environment, tend to persist for long periods and pose long-term health hazards for living organisms. Extremely hazardous substances, while also generally toxic materials, represent acute health hazards that, when released, are immediately dangerous to the lives of humans and animals and cause serious damage to the environment. When facilities have these materials in quantities at or above the threshold planning quantity (TPQ), they must submit "Tier II" information to appropriate state and/or local agencies to facilitate emergency planning.

- A **hazardous materials transportation incident** is any event resulting in uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by the U.S. Department of Transportation (U.S. DOT) Materials Transport regulations. Transportation incidents are difficult to prepare for because there is little, if any, notice about what materials could be involved should an accident happen. Hazardous materials transportation incidents can occur anywhere within the State. Transportation of hazardous materials on highways involves tanker trucks or trailers, and are responsible for the greater number of hazardous substance release incidents. Transportation of hazardous materials, such as imported petroleum products, occurs on navigable waters via ships and barges. Hazardous materials in transit are regulated by the U.S. DOT, and transportation of hazardous waste is regulated by the Hawai'i Department of Health (DOH).

The U.S. DOT regulations define hazardous materials as a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property



when transported in commerce, and has designated as hazardous under Section 5103 of federal hazardous materials transportation law (49 U.S. Code [U.S.C.] 5103). The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (see 49 Code of Federal Regulations [CFR] 172.101), and materials that meet the defining criteria for hazard classes and divisions. When a substance meets the DOT definition of a hazardous material, it must be transported in accordance with safety regulations providing for appropriate packaging, communication of hazards, and proper shipping controls.

The Emergency Planning and Community Right-to-Know Act (EPCRA) was passed by Congress in 1986 (Title III of SARA). The EPCRA establishes requirements for federal, state and local governments, Indian tribes, and industry regarding emergency planning and “Community Right-to-Know” reporting on hazardous and toxic chemicals. The Community Right-to-Know provisions help increase public’s knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment. There are four key provisions to the EPCRA, which include:

- **Emergency planning** – Local governments are required to prepare chemical emergency response plans, and to review plans at least annually. State governments are required to oversee and coordinate local planning efforts. Facilities that maintain Extremely Hazardous Substances (EHS) on-site in quantities greater than corresponding threshold planning quantities (TPQs) must also cooperate in preparing emergency plans.
- **Emergency release notification** – Facilities must immediately report accidental releases of EHSs and other hazardous substances, as defined under CERCLA. Any release of these substances in quantities greater than their corresponding reportable quantities must be reported to state and local officials.
- **Hazardous chemical storage reporting requirements** – Facilities handling or storing any hazardous chemicals, as defined under Occupational Safety and Health Administration (OSHA), must submit Material Safety Data Sheets (MSDSs), or Safety Data Sheets (SDSs), to state and local officials and fire departments. Facilities must also submit an inventory form for these chemicals to state and local officials and local fire departments.
- **Toxic chemical release inventory (TRI)** – Facilities must complete and submit a toxic chemical release inventory form (Form R) each year. Form R must be submitted for each of the over 600 TRI chemicals that are manufactured or other used above the applicable threshold quantities.

As part of the requirements for hazardous chemical storage reporting, facilities must submit annually an Emergency and Hazardous Chemical Inventory Form to the local emergency planning committee (LEPC), the state emergency response commission (SERC), and the local fire department. Facilities provide either a Tier I or Tier II inventory form; however, most states require Tier II inventory forms. The forms need to be submitted on or before March 1 each year for information on chemicals present at the facility in the previous year.

In 1993, the State of Hawai'i enacted the Hawai'i Emergency Planning and Community Right-to-Know Act (HEPCRA) which is modeled after the federal EPCRA. Hawai'i Administrative Rules for implementing HEPCRA regulations became effective in November 2010. Similar to EPCRA, HEPCRA has four major provisions: (1) emergency response planning, (2) emergency release reporting, (3) hazardous chemical storage and Tier II



reporting, and (4) toxic release inventory reporting. The Hawai'i Department of Health (DOH)'s Hazard Evaluation and Emergency Response (HEER) Office carries out the requirements of EPCRA, as well as HEPCRA.

In addition to traditional hazardous materials stored or transported, on-site sewage disposal systems (OSDS) that provide wastewater treatment for multiple homeowners need to be maintained properly. The lack of maintenance or a physical impact to these systems can lead to an environmental release potentially contaminating nearby waterbodies and drinking water sources, and compromising public health. The DOH's Clean Water Branch administers the Nonpoint Source management program, which includes the oversight of OSDs, and develops the State's Nonpoint Source Management Plan with watershed-specific strategies to control pollution (DOH 2015).

LOCATION

Hazardous materials are widely stored and transported throughout the State of Hawai'i. An event involving hazardous materials release can occur anywhere; for this reason, the location of a hazardous materials release is classified as either being at a fixed site or in-transit. A fixed site hazardous materials release occurs at facilities that store and/or use hazardous materials and include refineries, warehouses, portside facilities and harbors and Superfund sites. An in-transit hazardous materials release occurs while a hazardous material is being transported from one location to another along major highways, navigable waters, or via pipelines.

Fixed-Site Hazardous Materials

Serious hazardous materials incidents—those causing hospitalizations, deaths, and large-scale economic loss and environmental damage—are generally the result of a series of improbable events involving large quantities of material and are, thus, relatively rare and difficult to predict. Tier II reporting reveals the location and identity of large quantities of hazardous materials in storage and use. As of the date of this 2018 HMP Update, there are 1,026 Tier II reporting facilities in the State of Hawai'i (see Table 4.8-1).

Table 4.8-1. Hazardous SARA Tier II Reporting Facilities

County	Tier II Reporting Facilities
County of Kaua'i	124
City and County of Honolulu	472
County of Maui	184
County of Hawai'i	246
Total	1,026

Source: Hawai'i DOH HEER 2018

Superfund Sites

In response to concerns regarding health and environmental risks, Congress established the Superfund program in 1980 to clean up sites in which hazardous materials were released and ultimately abandoned. The Superfund program is locally administered by the EPA in cooperation with the Hawai'i DOH HEER Office.

Federal regulations, including CERCLA and the Superfund Amendments and Reauthorization Act (SARA), required that a National Priorities List (NPL) of sites throughout the United States be maintained and revised at least annually (SARA amended CERCLA on October 17, 1986). The NPL is a list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the



United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation. As of the date of this 2018 HMP Update, there are three NPL (Superfund) sites in Hawai'i, all located in the City and County of Honolulu (EPA 2018). In addition to the federal NPL sites, the Hawai'i DOH Response Program List of Priority Sites presents all sites in the State identified for potential or known non-emergency response actions managed by the HEER Office Site Discovery, Assessment, and Remediation Section Remedial Project Managers (RPMs). Sites are categorized as a potential hazard when sampling data indicate that contaminant concentrations exceed Hawai'i Environmental Action Levels. The list for the fiscal year 2017 includes 572 sites statewide that are managed within the HEER Office. Of those sites, 75 are listed as high priority, 207 as medium priority, 265 as low priority, and 14 as no further action unrestricted. For the full list of sites, refer to <https://health.hawaii.gov/opppd/files/2017/12/128D-128E.pdf> (State of Hawai'i Department of Health 2017b).

Both Superfund sites and identified high-priority sites increase the State's risk to impacts from other hazards such as flooding, storm surge, and erosion that can cause the migration or spread of hazardous materials throughout the environment. Adversely impacting both public and environmental health, and adding significant complications to recovery efforts following a disaster that impacts a superfund site or high-priority site if identified hazardous materials are not properly contained.

In-Transit Hazardous Materials

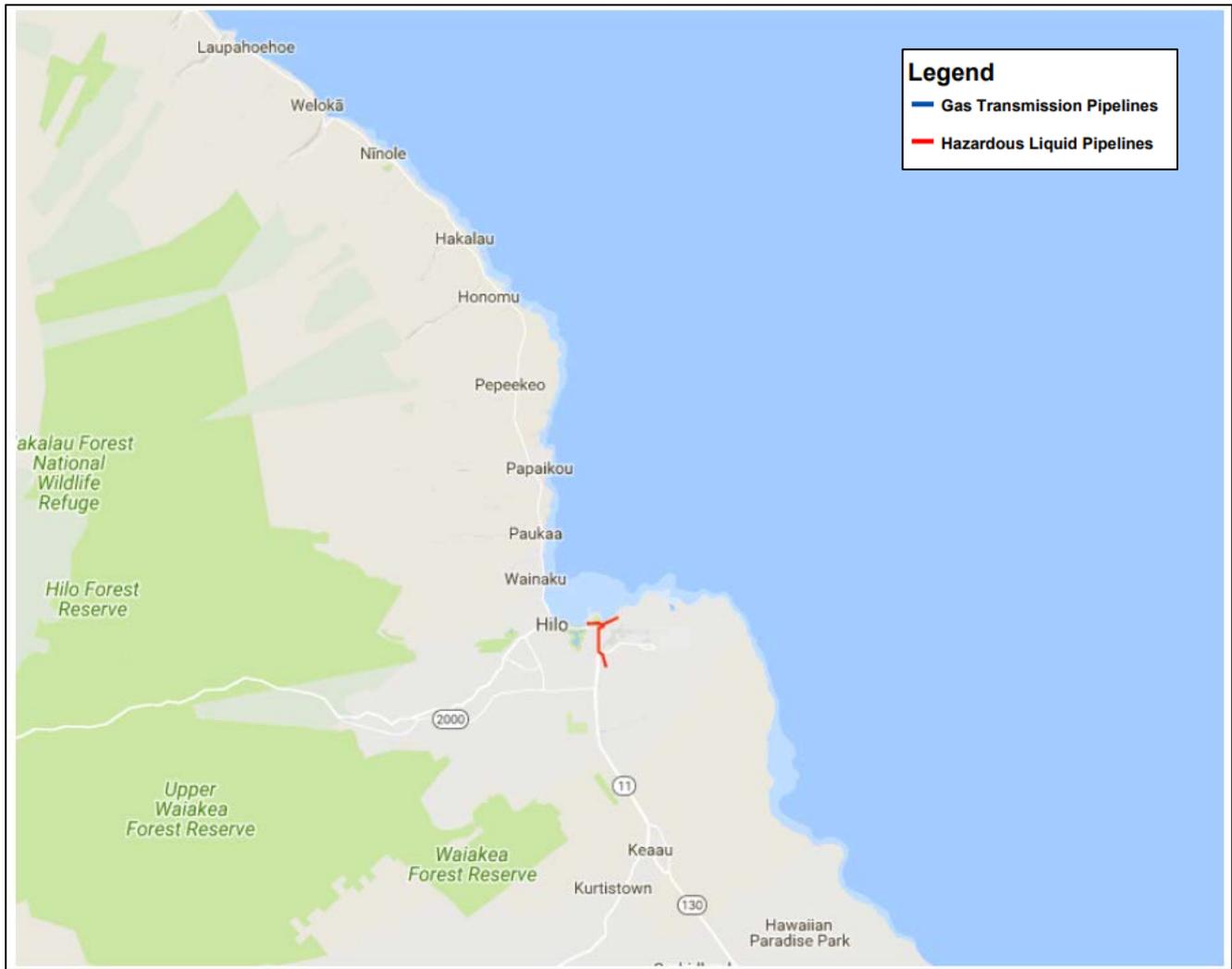
Incidents involving hazardous substances in transit can occur anywhere in the State. The primary mode of transportation on island is via the highway network. The State of Hawai'i has a widespread highway network in which hazardous materials may be transported.

Hazardous substances can also be transported via ships, barges and pipeline in Hawai'i. Refinery feedstock and refined petroleum products are imported to the State via navigable waters. There are two crude oil refineries on the leeward coast of O'ahu, in the vicinity of Campbell Industrial Park, that can produce a broad range of refined petroleum products. Because there are no inter-island pipelines to transport these products, refined petroleum products are loaded at Honolulu harbor terminals onto fuel barges for distribution to the other islands (U.S. Energy Information Administration 2017).

On the Island of O'ahu, petroleum is transported via pipeline from two crude oil refineries to other locations on the island (U.S. Energy Information Administration 2017). As of 2016, there were 95 miles of refined petroleum product pipeline on the Island of O'ahu (Pipeline and Hazardous Materials Safety Administration [PHMSA] 2017a). Figure 4.8-1 and Figure 4.8-2 show the gas transmission and hazardous liquids (refined petroleum products) pipelines. In addition, Hawai'i Gas operates over 1,000 miles of gas distribution pipeline, delivering synthetic natural gas to nearly 28,000 customers, and provides propane gas to 40,000 more customers on the Island of O'ahu and other islands (Hawai'i Gas 2017).



Figure 4.8-2. Petroleum and Gas Transmission Pipelines in the County of Hawai'i



Source: PHMSA 2017b



EXTENT

The extent of a hazardous substance release will depend on whether it is from a fixed or in-transit (mobile) source, the volume of substance released, duration of the release, the toxicity and properties of the substance, and the environmental conditions (for example, wind and precipitation, terrain, etc.).

Hazardous substance releases can contaminate air, water, and soils, possibly resulting in death and/or injuries. Dispersion can take place rapidly when the hazardous substance is transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

With a hazardous substance release, whether accidental or intentional, several potentially exacerbating or mitigating circumstances will affect its severity of impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact a release has on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place measures protects people and property from the harmful effects of a hazardous substance release. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous substance release, include:

- Weather conditions, which affect how the hazard occurs and develops (such as wind speed and direction)
- Micro-meteorological effects of buildings and terrain, which alters the dispersion of hazardous substances in compliance with applicable codes (such as building or fire codes)
- Mechanical failures (such as fire protection and containment features), which can substantially increase the damage to the facility itself and to surrounding buildings
- Land use, population and building density will be factors contributing to the extent of exposure and impacts incurred.

The severity of a hazardous material incident is dependent not only on the circumstances described above, but also with the type of substance released, distance from the release, and the related response time for emergency response teams to stabilize and contain the release. Generally, areas closest to a release are at the greatest risk, due to their exposure to higher concentrations of the substance and the limited warning time before being impacted. However, depending on the substance/material, a release can rapidly travel great distances or remain present in the environment for long periods of time (e.g. centuries to millennia) allowing for greater dispersal, increasing the spatial extent of impact.

Warning Time

Warning time for a hazardous materials incident can be sudden without any warning (such as an explosion), or may develop slowly (such as a leaking container). Facilities that store extremely hazardous substances are required to notify local officials when an incident occurs. Local emergency responders and emergency management officials determine the need to evacuate the public or whether to advise people to shelter in place. Similar to on-site hazardous substances incidents, the amount of warning time for incidents associated with hazardous substances in-transit varies based on the nature and scope of the incident. If an explosion or hazardous materials release does not occur immediately following an accident, there may be time for warning adjacent neighborhoods and enough time to facilitate appropriate protective actions.



PREVIOUS OCCURRENCES AND LOSSES

The 2013 HMP discussed hazardous material incidents that occurred in the State of Hawai'i through 2012. For this 2018 HMP Update, hazardous material incidents (in-transit and fixed-site) were summarized between January 1, 2012, through December 31, 2017. For events prior to 2012, please refer to Appendix X. This section is divided into the different forms of hazardous substance releases (fixed-site and in-transit).

Fixed-Site Hazardous Materials

The release of hazardous materials has occurred frequently throughout the State. Releases are reported to the Hawai'i DOH HEER Office. Table 4.8-2 shows the number of releases reported to the HEER Office in 2012 through 2017. In the five-year period between 2012 and 2017, there have been 2,065 instances of fixed-site hazardous material releases, equating to over one incident per day across the state over a five-year period.

Table 4.8-2. Hazardous Materials Releases Reported to the HEER Office by County, 2012 to 2017

Year	County of Kaua'i	City and County of Honolulu	County of Maui	County of Hawai'i	Total
2012	8	291	45	34	378
2013	10	301	56	29	396
2014	14	275	45	45	379
2015	3	158	18	18	341
2016	9	205	63	33	310
2017	16	214	57	35	261
Total	60	1,444	284	194	2,065

Source: State of Hawai'i Department of Health 2017a

In-Transit Hazardous Materials

The Pipeline and Hazardous Materials Safety Administration (PHMSA) tracks in-transit hazardous material releases through its nationwide database. Regulations in 49 CFR 171.15 and 171.16 govern situations where hazardous materials are released and the resulting required notifications and reporting. Unless they are properly reported, it is difficult to identify and track past hazardous materials releases that occur in-transit. Between 2012 and 2017, there were 14 highway incidents and three pipeline incidents reported, according to PHMSA's database (PHMSA 2017a). Further information on these incidents is listed in Table 4.8-3.

Table 4.8-3. In-Transit Hazardous Material Incidents from 2012 to 2017

Date of Incident	Event Type	Counties Affected	Impacts
June 25, 2012	Vehicular Incident (highway)	Hawai'i	4,000 gallons of jet fuel released; \$209,254 in damages
January 10, 2013	Excavation Damage (pipeline)	Honolulu	20 gallons of naphtha released; \$52,040 in damages
October 23, 2013	Excavation Damage (pipeline)	Honolulu	\$172,747 in damages
November 15, 2013	Vehicular Incident (highway)	Hawai'i	1,900 gallons of fuel released; \$60,776 in damages



Date of Incident	Event Type	Counties Affected	Impacts
December 16, 2013	Burst Gasoline Line	Hawai'i	Burst gasoline line in downtown Hilo led to the partial activation of the Hawai'i County Emergency Operations Center.
February 16, 2015	Corrosion (pipeline)	Honolulu	1,300 barrels of refined petroleum product spilled; \$2,816,000 in damages
June 15, 2015	Excavation Damage (pipeline)	Honolulu	1 injury; \$613,900 in damages
September 2, 2017	Vehicular Incident (highway)	Honolulu	1 fatality and 1 injury; \$66,700 in damages; 1,500 gallons of liquefied petroleum gas released

Source: PHMSA 2017c; State of Hawai'i 2018

FEMA Disaster Declarations

Between 1954 and 2017, FEMA has not included the State of Hawai'i in any hazardous material-related disasters (DR) or emergencies (EM) declarations.

PROBABILITY OF FUTURE HAZARD EVENTS

Since there have been no federal declarations for hazardous material incidents in the State of Hawai'i, all events reported earlier in this section that occurred between 2012 and 2017 were used to calculate the probability of future occurrences. Based on the extrapolation of data available on the occurrence of previous events, the State of Hawai'i experiences over 300 hazardous material incidents each year. Therefore, there is a 100 percent chance of a hazardous material incident occurring in any given year in the State. However, as was the case for historical events in the State, the magnitude of the incidents expected to occur will vary widely from very minor releases to the potential for major events in which thousands of gallons of hazardous materials may be released.

Impacts of Climate Change on Future Probability

As discussed in Section 4.1 (Climate Change) and Section 4.6 (Event-Based Flood), it is highly likely that changing future conditions will exacerbate current conditions and increase future event-based flood risk. Sites that store hazardous materials that are at risk from current flooding will become more vulnerable with climate change and sea level rise. Flooding during a storm event could cause releases of hazardous materials if they are not properly stored or contained. The release of these hazardous materials may expose the nearby population, harm water quality and the overall environmental and economic health of the area.

In terms of sea level rise, septic tanks, cesspools, and other on-site sewage disposal systems (OSDS) as well as other hazard materials/waste storage and disposal sites are located along the coast. The projected rise in sea level will eventually result in the failure of the OSDS, unable to operate properly they will contribute to the degradation of nearshore water quality. Additionally, a release from OSDS could change disease risk for coral reefs and negatively impact nearby coral and coastal resources. Refer to Section 4.1 (Climate Change) regarding the sea level rise projections for the State of Hawai'i (Hawai'i Climate Change Mitigation and Adaptation Commission 2017).



4.8.2 Vulnerability Assessment

Overall, it is difficult to quantify potential losses due to hazardous material incidents because of the many variables that must be considered, including but not limited to the specific hazardous substance, quantity, location, time of day, meteorological conditions, surrounding environment and emergency response and cleanup capabilities. Potential impacts may be local, regional, or statewide depending on the magnitude of the event and level of service disruptions. A qualitative assessment is discussed below.

ASSESSMENT OF STATE VULNERABILITY AND POTENTIAL LOSSES

This section discusses statewide vulnerability of exposed state assets (state buildings and state roads) and critical facilities to hazardous material incidents.

State Assets

Potential losses to state buildings caused by a hazardous materials release is difficult to monetize. The degree of damages to the asset depends on the scale of the incident. Generally speaking, all 6,095 state buildings are potentially vulnerable to a hazardous materials release. State assets proximate to Tier II facilities or NPL sites, or transportation corridors that permit the transport of hazardous materials have an increased risk of exposure. Depending upon the incident, state employees may need to evacuate the building if exposure may impact human health. This may result in loss of productivity that can be measured by days and dollar equivalency. In terms of building-related and property damage, damage may include but not limited to damage to heating, ventilation and air conditioning (HVAC) systems due to the corrosive effects of some chemicals; and/or contaminated soil, groundwater and nearby waterbodies.

All state roads that permit the transport of hazardous materials are potentially at risk of an incident. Transportation carriers must have response plans in place to address accidents, otherwise the local emergency response team will step in to secure and restore the area. Quick response minimizes the volume and concentration of hazardous materials that disperse through air, water and soil. Hazardous material releases may lead to road closures until response and clean-up efforts are completed. This may impact access to communities, commuting to work, and impact the ability to deliver goods and services efficiently.

Critical Facilities

Similar to state assets, potential losses to critical facilities caused by a hazardous materials release is difficult to monetize. The degree of damages to the asset depends on the scale of the incident. Critical facilities need to remain in operation before, during and after disaster events. Loss of use will impact the services they provide to the state which may have public safety and economic implications. Ports and harbors are critical points of entry that need to remain open and operational to maintain the vital just in time shipping logistics required to sustain each island. In the event of a large-scale hazardous materials release resulting in port closures, there will be cascading impacts statewide.

ASSESSMENT OF LOCAL VULNERABILITY AND POTENTIAL LOSSES

This section provides a summary of vulnerability and potential losses to population, general building stock, and environmental resources and cultural assets. Each county's vulnerability and potential loss will vary greatly



depending not only on the type and intensity of the release. The local HMPs were reviewed and their discussion of hazardous material incidents are summarized below:

- **County of Kaua'i**—In the 2015 Kaua'i County HMP, hazardous materials are briefly discussed in the individual hazards section (County of Kaua'i 2015). The County of Kaua'i has 124 Tier II facilities.
- **City and County of Honolulu**—The City and County of Honolulu has the greatest number of Tier II facilities compared to the other counties (472 facilities). The three NPL sites in the State of Hawai'i are located in the City and County of Honolulu. In addition, the oil refineries and pipelines are on the island.
- **County of Maui**—In the 2015 Maui County HMP, technological hazards and human-caused hazards (including hazardous materials) were not addressed as stand-alone hazards in the plan. According to the plan, Maui County has seven EPA-designated TRI facilities that are considered critical infrastructure operations. Damage to these facilities (as well as damage to the 184 Tier II facilities in the county) could have a detrimental effect on environmental and cultural resources. One of the TRI facilities is in the 6-foot sea level rise scenario and coastal zone and three are in the evacuation area for Wailuku Water 6 dam. One facility is within the 1-percent annual chance (100-year) flood zone. A hazardous materials spill from these facilities could spill into streams, rivers or storm sewers (Maui County 2015).
- **County of Hawai'i**—The 2015 Hawai'i County Multi-Hazard Mitigation Plan lists 10 sites in the County of Hawai'i that may be eligible for possible listing under the NPL (Hawai'i County 2015). These facilities are managed by the DOH HEER Office. In addition, there are 246 Tier II facilities on the County of Hawai'i.

Population

All counties in the State of Hawai'i have Tier II facilities. For the purposes of this assessment, the entire population is exposed and could potentially be impacted by a hazardous materials release—a fixed-site hazardous material release, in-transit hazardous material release, or both. When hazardous substances are released in the air, water or on land they may contaminate the environment and pose greater danger to human health. The general population may be exposed to a hazardous substances release through inhalation, ingestion or dermal exposure. Exposure may be either acute or chronic, depending upon the nature of the substance and extent of release and concentration. The populations considered most vulnerable include the elderly (persons over the age of 65), the young, pregnant women and people who are ill or immunocompromised.

Population living and/or working near facilities that produce, store, or transport hazardous substances are at higher risk to exposure. In particular, populations downstream, downwind, and downhill of a released substance are particularly vulnerable. Depending on the type of release and environmental conditions, people may be evacuated as a precaution or instructed to shelter-in-place. Section 4.9 discusses the unique terrain in the State and how this impacts wind effects and speeds in each county which can play a role in the dispersion of airborne chemical releases.

Populations living and/or working near major transportation routes (such as Interstates H1, H2, H3, and H201) are more vulnerable to a hazardous materials release because of the potential for chemicals to be transported on these major thoroughfares. Hazardous substances can also be transported via pipeline. There are petroleum and gas transmission lines on the City and County of Honolulu, and the County of Hawai'i (Figure 4.7-1 and Figure 4.7-2). The closure of waterways, ports, harbors, airports, highways or refineries as a result of a hazardous



materials release has the potential to impact the ability to deliver goods and services efficiently, and could have cascading economic impacts to other islands.

General Building Stock

Hazardous material releases can damage and destroy public, commercial, and private property. Losses include both direct and indirect costs. Direct costs can be defined as the cost of materials, property damage, response cost, and remediation/cleanup cost for a specific release. All other costs and losses from hazardous material releases are indirect. These include (1) loss of productivity as a result of damage to land, facilities, or interruption of services, (2) loss of access to recreation lands and facilities, (3) cost of lost human productivity due to injury and death, (4) damages to ecosystems, and (5) the cost of litigation as a consequence of the release.

Damages to transportation infrastructure and their closure is not uncommon following a hazardous materials release. Similar to the fixed-site hazardous materials release, the greatest risk to population and the built environment would be from an explosion from hazardous materials in transport. Proximity, intensity and the structural integrity of the building itself are all factors in the subsequent vulnerability and expected damage.

Environmental Resources

A hazardous substance release, whether fixed-site or in-transit can negatively impact the natural environment. Depending on the nature and amount of the substance, the release may contaminate the air, water, or soil potentially causing concern for direct human and animal exposure, recreational usage, crop irrigation, and fish and wildlife consumption.

Water contamination, whether surface water, groundwater or marine, is an immediate concern from a hazardous materials release potentially impacting potable water supplies, wildfire and recreational activities. Hazardous material releases could also significantly impact soils including agricultural lands. Depending on the characteristic of the hazardous material and/or the volume of product involved, the affected area can be as small as several square feet or as large as many square miles that require soil remediation. Such environmental damage can linger for decades and result in extensive remediation costs.

Coral reef ecosystems are fragile and are extremely vulnerable to environmental stresses including runoff and oil spills. Runoff from land-based pollution sources that include hazardous materials such as runoff that carries sediment, high levels of nutrients from agricultural areas, sewage outflows, pollutants such as petroleum products and pesticides as a result of hazardous materials releases. The degree of damage will depend upon the coral species, life stage and exposure. Impacts can result in bleaching, which can damage or kill coral depending upon the severity and duration of the environmental stress (NOAA 2007a; NOAA 2007b).

Cultural Assets

Loss of and harm to native species and ecosystems as a result of a hazardous materials release will adversely impact the Hawaiian cultural traditions and practices, which are closely tied to the natural environment. Hawaiian fishponds may be impacted by a hazardous materials release. Depending on the material, the release may kill the fish species or the bioaccumulation of pollutants can affect animals high on the food chain long after a release. Additionally, site remediation efforts following a hazardous material release can result in adverse impacts to



archeological resources and sensitive cultural areas in the attempt to remove and/or excavate contaminated sediments from an affected area.

FUTURE CHANGES THAT MAY IMPACT STATE VULNERABILITY

Understanding future changes that impact vulnerability in the State can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change.

As development continues and populations increase, the risk for a hazardous material release and the potential impacts to the population, infrastructure, and environmental and cultural resources will increase as well. The number and types of hazardous chemicals stored in and transported through the State will likely continue to increase. As the population grows, the number of people vulnerable to the impacts of hazardous materials spills and transportation incidents will increase. Population and business growth along major transportation corridors increases the vulnerability to transportation-related hazardous material spills. Growth increasing commercial and residential density near fixed-site hazardous materials facilities will also increase vulnerability.