# Draft City of Kenai Hazard Mitigation Plan

**Photo Credit: Eagle Eye Gallery**

*Prepared for:*
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DMVA/DHS&EM
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LeMay Engineering & Consulting, Inc.

November 2019

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## Acronyms/Abbreviations

| | |
|---|---|
| °F | Degrees Fahrenheit |
| ACS | American Community Survey |
| AEC | Alaska Earthquake Center |
| AFS | Alaska Fire Service |
| AICC | Alaska Interagency Coordination Center |
| AVO | Alaska Volcano Observatory |
| BLM | Bureau of Land Management |
| CFR | Code of Federal Regulations |
| City | City of Kenai |
| DCCED | Department of Commerce, Community, and Economic Development |
| DCRA | Division of Community and Regional Affairs |
| DGGS | Division of Geological and Geophysical Survey |
| DHS&EM | Division of Homeland Security and Emergency Management |
| DMA 2000 | Disaster Mitigation Act of 2000 |
| DMVA | Department of Military and Veterans Affairs |
| DNR | Department of Natural Resources |
| DOF | Division of Forestry |
| E | Earthquake |
| F | Fire |
| F&E | Flooding and Erosion |
| FEMA | Federal Emergency Management Agency |
| FMA | Flood Mitigation Assistance |
| FP&S | Fire Prevention and Safety |
| FY | Fiscal Year |
| G | General |
| *g* | gravity as a measure of peak ground acceleration |
| GI | Geophysical Institute |
| HAZUS | Multi-Hazard Software |
| HMA | Hazard Mitigation Assistance |
| HMGP | Hazard Mitigation Grant Program |
| HMP | Hazard Mitigation Plan |
| HVAC | Heating, Ventilation, and Air Conditioning |
| KPB | Kenai Peninsula Borough |
| M | Magnitude |
| MAP | Mitigation Action Plan |

| | |
|---|---|
| mm | millimeters |
| MMI | Modified Mercalli Intensity |
| mph | miles per hour |
| NFIP | National Flood Insurance Program |
| NWS | National Weather Service |
| PDM | Pre-Disaster Mitigation |
| PGA | peak ground acceleration |
| Stafford Act | Robert T. Stafford Disaster Relief and Emergency Assistance Act |
| STAPLEE | Social, Technical, Administrative, Political, Legal, Economic, and Environmental |
| SW | Severe Weather |
| TF | Technical Feasibility |
| UHMA | United Hazard Mitigation Assistance |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USFS | U.S. Forest Service |
| U.S. | United States |
| USC | United States Code |
| USGS | United States Geological Survey |
| V | Volcanic Ash |
| WUI | Wildland Urban Interface |

This section provides a brief introduction to hazard mitigation planning, associated grants, and a description of this 2019 Hazard Mitigation Plan (HMP) for the City of Kenai (City).

## 1.1 HAZARD MITIGATION PLANNING

Hazard mitigation, as defined in Title 44 of the Code of Federal Regulations (CFR), Section §201.2, is "any sustained action taken to reduce or eliminate the long-term risk to people and property from natural hazards and their effects. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage reconstruction and repeated damage. As such, States and Local governments are encouraged to take advantage of funding provided by Hazard Mitigation Assistance (HMA) grant programs." (FEMA, 2015c). Hazard mitigation is any work done to minimize the impacts of any type of hazard event before it occurs and aims to reduce losses from future disasters. Hazard mitigation is a process in which hazards are identified and profiled, people and facilities at risk are analyzed, and mitigation actions are developed. Implementation of mitigation actions, which include long-term strategies such as planning, policy changes, programs, projects, and other activities, is the end result of this process.

## 1.2 PLANNING REQUIREMENTS

### 1.2.1 Local Mitigation Plans

On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the act's previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). Section 322 directs State and Local entities to closely coordinate mitigation planning and implementation efforts. Additionally, it establishes the HMP requirement for the Federal Emergency Management Agency's (FEMA) HMA.

On October 2, 2015, FEMA published the Mitigation Planning Final Rule in the Federal Register, [Docket ID: FEMA-2015-0012], 44 CFR Part 201, effective November 2, 2015. Planning requirements for Local entities are described in detail in Section §201.6. Locally-adopted and FEMA-approved HMPs qualify jurisdictions for several HMA grant programs. This 2019 HMP for the City complies with Title 44 CFR Section §201.6 and applicable FEMA guidance documents as well as the 2018 *State of Alaska HMP* by the Department of Military and Veterans Affairs (DMVA) Division of Homeland Security and Emergency Management (DHS&EM).

Section 322 of the Stafford Act (42 USC 5165) as amended by P.L. 106-390 provides for State and Local governments to undertake a risk-based approach to reducing risks to natural hazards through mitigation planning. The National Flood Insurance Act of 1968 (42 USC 4001 et seq.) as amended, further reinforces the need and requirement for HMPs, linking Flood Mitigation Assistance (FMA) programs to State and Local HMPs. This change also requires participating National Flood Insurance Program (NFIP) communities' risk assessments and mitigation strategies to identify and address repetitively flood-damaged properties.

## 1.3 GRANT PROGRAMS WITH MITIGATION PLAN REQUIREMENTS

FEMA HMA grant programs provide funding to Local entities that have a FEMA-approved HMP. Two of the grants are authorized under the Stafford Act and DMA 2000, while the remaining

three are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. As of June 19, 2008, the grant programs were segregated. The Hazard Mitigation Grant Program (HMGP) is a competitive, disaster-funded grant program whereas the other Unified Mitigation Assistance Programs (Pre-Disaster Mitigation [PDM] and FMA, although competitive) rely on specific pre-disaster grant funding sources, sharing several common elements.

> *"The DHS&EM FEMA HMA grant programs present a critical opportunity to protect individuals and property from natural hazards while simultaneously* ***reducing reliance on Federal disaster funds****. The HMA programs provide PDM grants annually. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards.*
>
> *The PDM program is authorized by the Stafford Act and focuses on mitigation project and planning activities that address multiple natural hazards, although these activities may also address hazards caused by manmade events. The FMA program is authorized by the National Flood Insurance Act and focuses on reducing claims against the NFIP"* (FEMA, 2019h).

### 1.3.1 Hazard Mitigation Assistance (HMA) Unified Programs

The HMGP provides grants to Local entities to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Projects must provide a long-term solution to a problem; for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. FEMA may provide a State or Local entity with up to 20% of the total aggregate disaster damage costs to fund HMGP project or planning grants. The cost-share for this grant is 75% Federal/25% non-Federal.

The PDM grant program provides funds to Local entities for hazard mitigation planning and mitigation project implementation prior to a disaster event. PDM grants are awarded on a nationally-competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. In Fiscal Years (FY) 2016 and 2017, PDM program funding totaled approximately $90 million each year. The cost-share for this grant is 75% Federal/25% non-Federal.

The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the NFIP. Particular emphasis for this program is placed on mitigating repetitive loss properties. The primary source of funding for this program is the

The City of Kenai does not participate in the NFIP.

National Flood Insurance Fund. Grant funding is available for three types of grants, including Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to States and Local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. In FY 2016, FMA funding totaled $199 million. In FY 2017, FMA funding totaled $160 million. The cost-share for this grant is 75% Federal/25% non-Federal.

## 1.4 HMP DESCRIPTION

The remainder of this HMP consists of the following sections and appendices:

**Prerequisites**

Section 2 addresses the prerequisites of plan adoption, which includes adoption by the City Council. The adoption resolution is included in Appendix F.

**Community Description**

Section 3 provides a general history and background of the City, including historical trends for population and the demographic and economic conditions that have shaped the area.

**Planning Process**

Section 4 describes the planning process and identifies the Project Team Members, the meetings held as part of the planning process, and the key stakeholders within the City. In addition, this section documents public outreach activities (Appendix A) and the review and incorporation of relevant plans, reports, and other appropriate information.

**Hazard Analysis**

Section 5 describes the process through which the Project Team identified, screened, and selected the hazards to be profiled in this 2019 HMP. The hazard analysis includes the characteristics, history, location, extent, impact, and recurrence probability statements of future events for each hazard. In addition, historical and hazard location figures are included.

**Vulnerability Analysis**

Section 6 identifies potentially vulnerable assets—people, residential and nonresidential buildings, critical facilities, and critical infrastructure—in the City. The resulting information identifies the full range of hazards that the City could face and potential social impacts, damages, and economic losses. Land use and development are also discussed.

**Mitigation Strategy**

Section 7 defines the mitigation strategy which provides a blueprint for reducing the potential losses identified in the vulnerability analysis. The Project Team developed a list of mitigation goals and potential actions to address the risks facing the City. Mitigation actions include preventive actions, property protection techniques, natural resource protection strategies, structural projects, emergency services, and public information and awareness activities.

**Plan Maintenance**

Section 8 describes the Project Team's formal plan maintenance process to ensure that the 2019 HMP remains an active and applicable document. The process includes monitoring, evaluating (Appendix E), and updating the HMP; implementation through existing planning mechanisms; and continued public involvement.

**References**

Section 9 lists the reference materials used to prepare this HMP.

**Appendix A**

Appendix A provides public outreach information, including newsletters, meeting sign-in sheets, trip reports, and presentations.

**Appendix B**

Appendix B contains a glossary of terms that are used throughout this HMP.

**Appendix C**

Appendix C provides the FEMA crosswalk, which documents compliance of this HMP with FEMA criteria.

**Appendix D**

Appendix D contains the Benefit-Cost Analysis Fact Sheet used to prioritize mitigation actions.

**Appendix E**

Appendix E provides plan maintenance documents, such as an annual review sheet, the progress report form, and a community survey.

**Appendix F**

Appendix F provides the adoption resolution by the City Council and FEMA's approval letter.

## 2.1 ADOPTION BY CITY COUNCIL AND SUPPORTING DOCUMENTATION

Requirements for the adoption of this 2019 HMP by the local governing body, as stipulated in the DMA 2000 and its implementing regulations, are described below.

**DMA 2000 REQUIREMENTS: PREREQUISITES**

**Local Plan Adoption**

**Requirement §201.6(c)(5):** The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council).

**Element**

- Has the local governing body adopted the local hazard mitigation plan?
- Is supporting documentation, such as a resolution, included?

*Source: FEMA, 2015.*

The City is the local jurisdiction represented in this 2019 HMP and meets the requirements of Section 322 of DMA 2000. The City will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 2 CFR Parts 200 and 3002 and will amend this HMP whenever necessary to reflect changes in Federal laws and statutes.

The local governing body of the City is the City Council, and they adopted the 2019 HMP by resolution on _____, 2020. A scanned copy of the resolution is included in Appendix F.

This section describes the location, history, demographics, and economy of the City.

## 3.1 LOCATION


Kenai is located on the western coast of the Kenai Peninsula in Southcentral Alaska, fronting Cook Inlet. It lies on the western boundary of the Kenai National Wildlife Refuge, on the Kenai Spur Highway. It is approximately 65 air miles and 160 highway miles southwest of Anchorage via the Sterling Highway at approximately 60.5537 North Latitude and -151.2546 West Longitude. Kenai is located in the Kenai Peninsula Borough (KPB) Recording District" (Department of Community, Commerce, and Economic Development [DCCED], Division of Community and Regional Affairs [DCRA], 2019).

The City covers approximately 29.9 square miles of land and 5.6 square miles of water. Kenai falls within the gulf coast transitional climate zone, characterized by a semi-arid atmosphere; long, cold winters; and mild summers. Summer temperatures typically range from 46 to 65 degrees Fahrenheit (°F), and winter temperatures from 4 to 22°F. Annual precipitation is 20 inches. Kenai's northern climate is tempered by Upper Cook Inlet to the west and the Kenai Mountain Range to the south and east. Average wind speeds are 7.8 miles per hour (mph) (WeatherSpark, 2019).

## 3.2 HISTORY

Prior to Russian settlement, Kenai was a Dena'ina Athabascan village. Russian fur traders first arrived in 1741. At that time, about 1,000 Dena'ina lived in the village of Shk'ituk't, near the river. The traders called the people "Kenaitze" or "Kenai people." In 1791, a fortified Russian trading post, Fort St. Nicholas, was constructed for fur and fish trading. It was the second permanent Russian settlement in Alaska. In 1849, the Holy Assumption Russian Orthodox Church was established by Egumen Nicholai. In 1869, the U.S. Military established a post for the Dena'ina in the area, called Fort Kenay, which was abandoned in 1870 after Alaska was purchased by the U.S. A post office was established in 1899. Through the 1920s, commercial fishing was the primary activity. In 1940, homesteading enabled the area to develop. The first

dirt road from Anchorage was constructed in 1951. In 1957, oil was discovered at Swanson River, 20 miles northeast of the City - the first major Alaska oil strike. The City was incorporated in 1960. In 1965, offshore oil discoveries in Cook Inlet fueled a period of rapid growth. After rapid increases during the economic booms of the 1960s through the 1980s, population growth in Kenai began to stabilize by 2000, with more long-term residents and a generally older population. Several other communities, such as Soldotna, Nikiski, Kasilof, and Sterling, are within 20 miles of the City, giving the northwest peninsula a population of roughly 34,000. Kenai has been a growing center for oil exploration, production, and services since that time.

## 3.3 DEMOGRAPHICS

The 2010 U.S. Census recorded 7,100 residents for the City. The 2016 American Community Survey (ACS) recorded 7,551 residents, of which the median age was 37, indicating a relatively young population and is expected to continue increasing as depicted in Figure 1. Over 74% of the population is 18 years of age or older (ACS, 2016).

The City is a blended community. About 77% of residents recognize themselves as White, 11% of residents recognize themselves as Alaska Native, and 8% recognize themselves as two or more races. The percentage of males is 51.6%, and the percentage of females is 48.4%. The 2010 U.S. Census indicated that there are 3,508 households with the average household having approximately three individuals.

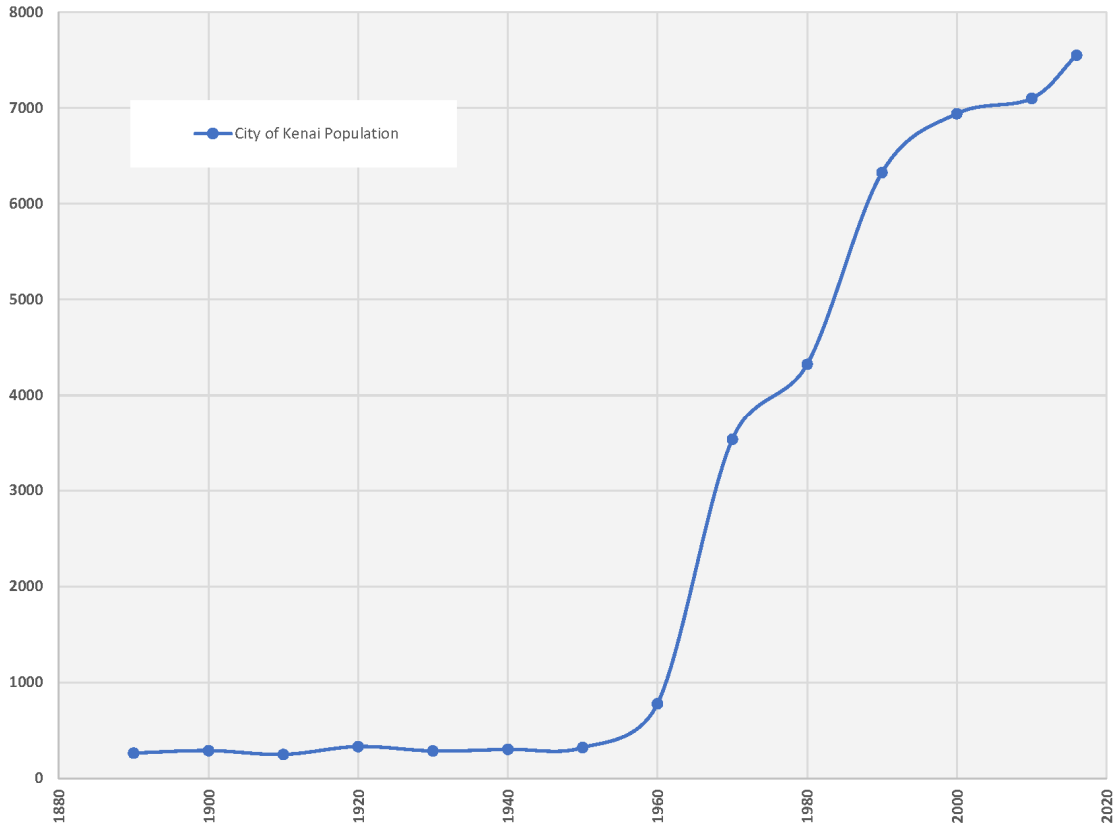



**Figure 1. Kenai's Historic Population**

## 3.4 ECONOMY

The City of Kenai's economic well-being is closely tied to general economic conditions in the Kenai/Soldotna area. This area continues to be the trade and service center for the western Kenai peninsula and a local government center. The area has an industrial base and a healthy visitor industry centered on the recreational fisheries of the Kenai River and Cook Inlet.

According to the 2010 U.S. Census, the median household income for the City was $58,732. Approximately 991 individuals (14%) were reported to be living below the poverty level. The potential work force (those aged 16 years or older) for the City was estimated to be 5,820, of which 3,716 were actively employed.

The Kenai River is a major sport fishing location for Anchorage residents and tourists. The river is world-renowned for trophy king and silver salmon. The Kenaitze (Tanaina Athabascans) live borough-wide and utilize the rich resources of Cook Inlet.

This section provides an overview of the planning process; identifies the Planning Team members and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used to develop this HMP. Additional information regarding the Planning Team and public outreach efforts is provided in Appendix A.

Requirements for the planning process, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Planning Process**

**Local Planning Process**

**Requirement §201.6(c)(1):** [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

**Element**

- Does the plan provide a narrative description of the process followed to prepare the plan?
- Does the plan indicate who was involved in the planning process?
- Does the plan indicate how the public was involved?
- Does the plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?
- Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?
- Does the plan document how the planning team reviewed and analyzed each section of the plan?

*Source: FEMA, 2015.*

## 4.1 OVERVIEW OF PLANNING PROCESS

The DMVA DHS&EM provided funding and project oversight to LeMay Engineering & Consulting, Inc. Ms. Jennifer LeMay, PE, PMP guided the Hazard Mitigation Project Team to assist the City with development of the HMP.

The following five-step process occurred from August through December 2019.

1. Organize resources: Members of the Hazard Mitigation Project Team identified resources, including staff, agencies, and local community members, who could provide technical expertise and historical information needed in developing the HMP.
2. Assess risks: The Hazard Mitigation Project Team identified hazards specific to the City and developed a risk assessment for the identified hazards, including the vulnerability analysis, prior to and during the development of the mitigation strategy.
3. Assess capabilities: The Hazard Mitigation Project Team reviewed current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately address relevant hazards.
4. Develop a mitigation strategy: After reviewing the risks posed by each hazard, the Hazard Mitigation Project Team developed a comprehensive range of potential mitigation goals and actions based on hazard events. Goals were then integrated into mitigation actions and were then prioritized based on community concerns with the top three hazards being fire, erosion of the Kenai Bluffs, and earthquakes.

5. Monitor, evaluate, and update the HMP: The Hazard Mitigation Project Team developed a process to monitor the HMP to ensure it will be used as intended while fulfilling community needs. The Hazard Mitigation Project Team then developed a process to evaluate the HMP on a yearly basis to compare how their decisions affect hazard impacts. They then outlined a method to share their successes with community members to encourage support for mitigation activities and to provide data for incorporating mitigation actions into existing planning mechanisms and providing data for the HMP's five-year update. Opportunities are described in the Continued Public Involvement Section of this HMP (Section 8).

## 4.2 HAZARD MITIGATION PLANNING TEAM

Table 1 lists the Hazard Mitigation Planning Team members and contact information.

**Table 1. Hazard Mitigation Planning Team**

| NAME | TITLE | ORGANIZATION | EMAIL |
|---|---|---|---|
| Elizabeth Appleby | City Planner | City of Kenai | eappleby@kenai.city |
| David Ross | Police Chief | City of Kenai | dross@kenai.city |
| Jeff Tucker | Fire Chief | City of Kenai | jtucker@kenai.city |
| Jeremiah Hamilton | Fire Marshal | City of Kenai | jhamilton@kenai.city |
| Bob Frates | Parks and Recreation Director | City of Kenai | bfrates@kenai.city |
| Mary Bondurant | Kenai Municipal Airport Director | City of Kenai | mbondurant@kenai.city |
| Scott Curtin | Public Works Director | City of Kenai | pcurtin@kenai.city |
| Jennifer LeMay, PE, PMP | Mitigation Planner | LeMay Engineering & Consulting, Inc. | jlemay@lemayengineering.com |
| Rick Dembroski | State of Alaska PDM Project Manager | DHS&EM | rick.dembroski@alaska.gov |
| Brent Nichols, CFM | State of Alaska Hazard Mitigation Officer | DHS&EM | brent.nichols@alaska.gov |

## 4.3 PUBLIC INVOLVEMENT & OPPORTUNITY FOR INTERESTED PARTIES TO PARTICIPATE

Table 2 lists the community's public involvement initiatives to encourage participation and insight for the HMP effort.

**Table 2. Public Involvement Mechanisms**

| Mechanism | Description |
|---|---|
| Newspaper Advertisement, dated October 25, 2019 | On October 25, 2019, the City advertised in the *Peninsula Clarion*, a newspaper of general circulation. The newspaper advertisement contained the agenda for the October 30, 2019 Planning and Zoning Commission meeting as Item A: SCHEDULED PUBLIC COMMENT: Jennifer |

| Mechanism | Description |
|---|---|
| | LeMay, LeMay Engineering & Consulting, Inc. to discuss the City of Kenai Local Hazard Mitigation Plan. This advertisement is contained in Appendix A. |
| Newsletter #1 Distribution (November 8, 2019) | On November 8, 2019, the City distributed a newsletter describing the Draft 2019 HMP's availability and identifying a 30-day public comment period. The newsletter encouraged the community to provide comments and was posted at the City Hall, the Post Office, and the Kenai Community Library. The newsletter also invited the community to a December 4, 2019 City Council meeting for a public hearing on the HMP. The newsletter was posted on the City's website, City Facebook page, and read on radio. |
| Public Notice, dated November 29, 2019 | On November 29, 2019, the City advertised in the *Peninsula Clarion*. The newspaper advertisement contained the agenda for the December 4, 2019 City Council meeting as Item A: SCHEDULED PUBLIC COMMENT: Jennifer LeMay, LeMay Engineering & Consulting, Inc. to discuss the City of Kenai Local Hazard Mitigation Plan. This advertisement is contained in Appendix A. |

The 2010 KPB HMP included an annex which identified the City of Kenai's hazards. In 2019, the City of Kenai chose to have its own standalone HMP. Rather than begin the process at the stakeholder level, it was necessary for a rough draft to be developed which could be used by the community to provide constructive feedback. LeMay Engineering & Consulting, Inc. developed a standalone HMP with consultation with the City Planner. The Hazard Mitigation Planning Team fine-tuned the HMP via email and met on October 30, 2019 from 2-4 pm to further discuss input into the HMP.

On October 30, 2019 at 7 pm, Jennifer LeMay gave a hazard mitigation planning presentation as an agenda item for the regularly scheduled Planning and Zoning Commission meeting (see Appendix A for meeting attendees, agenda, Powerpoint© presentation slides, minutes, and trip report). Hazards were confirmed, the risk assessment was summarized, and mitigation actions were presented. The Planning and Zoning Commission recommended sending the HMP to the City Council.

A 30-day public comment period began on November 8, 2019 to allow the community the opportunity to read the HMP and provide comments. The Draft HMP was posted on the City's web page. A newsletter was also posted at City Hall, the Post Office, and the Kenai Community Library notifying the public of the availability of the Draft HMP and inviting the public to provide comments.

On December 4, 2019 at 6 pm, Jennifer LeMay presented an HMP summary as an agenda item for the regularly scheduled City Council meeting (see Appendix A for meeting attendees, agenda, Powerpoint© presentation slides, minutes, and trip report). A public hearing was held, and comments are summarized in the trip report in Appendix A.

The HMP was updated based on public comments provided at the December 4, 2019 City Council meeting and comments that were emailed or telephoned to the City Planner during the 30-day public comment period. This updated document known as the Draft HMP was then submitted to DHS&EM for review before being submitted to FEMA for evaluation.

## 4.4 INCORPORATION OF EXISTING PLANS AND OTHER RELEVANT INFORMATION

During the planning process, the Hazard Mitigation Project Team reviewed and incorporated information from existing plans, studies, and reports into the HMP. The following were

reviewed and used as references for the jurisdiction information and hazard profiles in the risk assessment (see Section 6) of the HMP:

- Draft *KPB Comprehensive Plan*, 2019: provides the goals, visions, and conditions of the KPB. Kenai is a city within the KPB.
- *U.S. Army Corps of Engineers (USACE), Alaska Kenai Bluffs Bank Stabilization Section 116 Feasibility Study, Kenai, Alaska, 2018*: addresses storm damage, coastal erosion, and ice and glacial damage occurring at the Kenai Bluffs site. The Kenai Bluffs, lining the north shore of the Kenai River estuary for roughly 5,000 feet, have been receding at an average rate of approximately three feet per year, due to a combination of coastal storm surge, tidal currents, and other erosive forces. Public and private property, structures and infrastructure, and cultural resources have been lost and continue to be threatened by the receding bluff.
- *FEMA Region X – KPB, Alaska Risk Report for the KPB and the Incorporated Cities of Homer, Kachemak, Kenai, Seldovia, Seward, and Soldotna, 2017*: contains the results of an in-depth risk assessment for flood, earthquake, erosion, tsunami, and dam failure hazards for KPB cities, including a summary of the Risk Assessment Database.
- *City of Kenai Comprehensive Plan, 2016*: documents the City's effort to guide development in the community until 2030 and provides important information about the population, environment, economy, transportation, and land use.
- *City of Kenai's Annex to the KPB Local All-Hazard Mitigation Plan, 2010*: provides a brief overview of natural hazards that have the potential to affect the City.
- *City of Kenai Emergency Operations Plan, 2007*: addresses authorities, roles, and responsibilities for disaster-specific functions.
- *Kenai Area: Community Wildfire Protection Plan, 2006*: provides a risk assessment and mitigation plan for the City regarding wildfire.
- *State of Alaska, DCCED Community Profile*: provides historical and demographic information.

This section identifies and profiles the hazards that could potentially affect the City.

## 5.1 OVERVIEW OF A HAZARD ANALYSIS

A hazard analysis includes the identification, screening, and profiling of each hazard. Hazard identification is the process of recognizing the natural events that threaten an area. Natural hazards result from unexpected or uncontrollable natural events of sufficient magnitude. Even though a particular hazard may not have occurred in recent history in the study area, all-natural hazards that may potentially affect the study area are considered; the hazards that are unlikely to occur or for which the risk of damage is accepted as being very low, are eliminated from consideration. Human and Technological, and Terrorism-related hazards are beyond the scope of this HMP.

Hazard profiling is accomplished by describing hazards in terms of their characteristics, history, location, extent, breadth, magnitude, frequency, and recurrence probability. Hazards are identified through the collection of historical and anecdotal information, review of existing plans and studies, and preparation of hazard maps of the study area. Hazard maps are used to determine the geographic extent of the hazards and define the approximate boundaries of the areas at risk.

## 5.2 HAZARD IDENTIFICATION AND SCREENING

Requirements for hazard identification, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Risk Assessment: Identifying Hazards**

**Identifying Hazards**

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

**Element**

- Does the plan include a description of the types of all-natural hazards with the potential to affect the jurisdiction?
- Does the risk assessment identify the location (i.e., geographic area affected) of each natural hazard addressed in the plan?
- Does the risk assessment identify the extent (i.e., breadth, magnitude, or severity) of each hazard addressed in the plan?
- Does the plan provide information on previous occurrences of each hazard?
- Does the plan include recurrence probability statements of future events (i.e., chance of occurrence) for each hazard addressed?

*Source: FEMA, 2015.*

For the first step of the hazard analysis, the Hazard Mitigation Project Team reviewed possible hazards that could affect the City according to the 2018 *State of Alaska HMP* (DHS&EM, 2018a). They then evaluated and screened the comprehensive list of potential hazards based on a range of factors, including prior knowledge or perception of their threat and the relative risk presented by each hazard, the ability to mitigate the hazard, and the known or expected availability of information on the hazard (see Table 3). The Hazard Mitigation Project Team determined that the hazards that have the potential to impact the City include: changes in the

cryosphere, earthquakes, flood/erosion, volcanic ashfall, severe weather, and wildland/ conflagration fires. The remaining hazards excluded through the screening process were considered to pose a lower threat to life and property in the City due to the low likelihood of occurrence or the low probability that life and property would be significantly affected.

**Table 3. Identification and Screening of Hazards**

| Hazard Type | Should It Be Profiled? | Explanation |
|---|---|---|
| Changes in the Cryosphere | Yes | Changes in the cryosphere is designated as a hazard in the 2018 *State of Alaska HMP*. The City suffers from "silent storms" where high-water storm surges erode and undercut the banks. This hazard is included under floods/erosion in Section 5.3. Both sea ice and river ice collect at the toe of the Kenai Bluffs during the winter months, although to what extent is dependent on temperatures, wind direction and intensity, tides, and ice concentration in Cook Inlet (USACE, 2018). |
| Earthquakes | Yes | Earthquakes are designated as a hazard in the 2018 *State of Alaska HMP* with a high probability of occurring in the KPB. The 1964 Great Alaska Earthquake and resulting tsunami caused significant damage in Seldovia. Land subsidence within the KPB occurred in Seward, Homer, Hope, and Seldovia, where some of the most drastic subsidence dropped land six feet. The City was relatively undamaged in the 1964 Great Alaska Earthquake. The 2018 earthquake caused damage to the City dock and wellhouse. |
| Floods/Erosion | Yes | Flooding is designated as a hazard in the 2018 *State of Alaska HMP* with a high probability of occurring in the KPB. The 2017 FEMA Risk Report did not identify flooding as a concern for the City; however, the Wastewater Treatment Plant was identified as having the potential to be affected by erosion. |
| Ground Failure | No | The terrain in the City is not likely to produce ground failure. |
| Volcanic Ashfall | Yes | The City has been affected by volcanic ashfall from volcanoes in the past. Volcanoes are designated as a hazard in the 2018 *State of Alaska HMP* with a high probability of occurring in the KPB. |
| Severe Weather | Yes | Annual weather patterns, such as fog and high winds, are predominant threats. Severe weather is designated as a hazard in the 2018 *State of Alaska HMP* with a high probability of occurring in the KPB. High winds cause trees to fall on power lines. |
| Wildland/Conflagration Fires | Yes | Dead and dying spruce trees pose the greatest risk of wild fire on the entire KPB, including the City. Wildland fire is designated as a hazard in the 2018 *State of Alaska HMP* with a high probability of occurring in the KPB. |
| Tsunamis | No | The City is not at risk for tsunamis based on its location near the relatively shallow depth of upper Cook Inlet. |

## 5.3 HAZARD PROFILE

Requirements for hazard profiles, as stipulated in DMA 2000 and its implementing regulations, are described below.

The specific hazards selected by the Planning Team for profiling have been examined in a methodical manner based on the following factors:

- Hazard Characteristics;
    - Typical event characteristics;
    - Potential climate change impacts are primarily discussed in the Changes in the Cryosphere hazard profile but are also identified where deemed appropriate within selected hazard profiles;
- History (geologic as well as previous occurrences);
- Location;
- Extent (breadth, magnitude, and severity);
- Impact (general impacts associated with each hazard are described in the following profiles, and detailed impacts to the City's residents and critical facilities are further described in Section 6 as part of the overall vulnerability summary for each hazard); and
- Recurrence probability statement of future events.

The hazards profiled for the City are presented in the rest of Section 5.3. They are placed in alphabetical order which does not signify the importance level or risk.

## 5.3.1 Changes in the Cryosphere

### *5.3.1.1 Hazard Characteristics*

The "cryosphere" is defined as those portions of Earth's surface and subsurface where water is in solid form, including sea, lake, and river ice, snow cover, glaciers, ice caps and ice sheets, and frozen ground (e.g., permafrost). The components of the cryosphere play an important role in climate. Snow and ice reflect heat from the sun, helping to regulate the Earth's temperature. They also hold Earth's important water resources, and therefore, regulate sea levels and water availability in the spring and summer. The cryosphere is one of the first places where scientists are able to identify global climate change.

Hazards of the cryosphere can be subdivided into four major groups:

- Glaciers;
- Permafrost and periglacial;
- Sea ice; and
- Snow avalanche.

Glaciers, permafrost, and snow avalanche are not applicable to the City of Kenai. Of these four major groups, sea ice applies to the City of Kenai.

Sea ice is frozen ocean water that forms, grows, and melts in the ocean. Sea ice grows in Cook Inlet during the winter and melts during the summer. The winds from a fall storm can push sea ice onto the beach. The ice will then gouge the beach and cause other damage. Both sea ice and river ice collect at the toe of the Kenai Bluffs during the winter months, although to what extent is dependent on temperatures, wind direction and intensity, tides, and ice concentration in Cook Inlet. The average Kenai River ice freeze-up is December 10, and the average ice break-

up is April 2. Ice can close the river to vessel traffic for short periods from December to early April (USACE, 2018).

#### *5.3.1.2 Climate Factors*

The cryosphere is strongly tied to climate, and thus, very responsive to climate warming. Changes in climate can modify natural processes and increase the magnitude and recurrence frequency of certain geologic hazards (e.g., floods caused by storm surge, erosion, and increased precipitation), which if not properly addressed, could have a damaging effect on Alaska's communities and infrastructure, as well as on the livelihoods and lifestyles of Alaskans. Wave climate, and extreme water level events all have the potential to change with climate and influence coastal erosion rates.

During the last several decades, Alaska has warmed twice as fast as the rest of the U.S. The major climatic factor leading to warming is an increase in air temperatures. Even in non-ice-rich soils, process-driven models show more material is available for erosion and transport when soil is thawed, which leads to increased exposure of underlying material to thermal and physical stressors.

#### *5.3.1.3 Cryosphere Hazard History*

The 2016 *City of Kenai Comprehensive Plan* noted a drying trend in wetlands and that trees are growing at higher altitudes. The 2019 Draft *KPB Comprehensive Plan* states the average May to August temperature has increased nearly 2°F over the last 50 years. The increase in temperature changed the U.S. Department of Agriculture (USDA) plant hardiness zones for the KPB. The 2015 USDA Climate Change Vulnerability Assessment for the Chugach National Forest predicted the following climate conditions: shorter winter months, more snowpack at higher elevations and less snowpack at lower elevations, less rain in spring and more rain in autumn, and a drying trend for the western KPB that may increase the risk of wildland fire.

#### *5.3.1.4 Location, Extent, Impact, and Recurrence Probability*

**Location**

Within the City, sea ice primarily occurs in Upper Cook Inlet, and river ice occurs at the mouth of the Kenai River. Snow occurs everywhere on land.

**Extent**

The entire state of Alaska is at risk of affects from climate change. Historical climate data shows that the average annual temperature in Alaska has warmed about 4°F since the 1950s and 7°F in winter. The state has grown wetter, with a 30% increase in average precipitation between 1968 and 1990. The growing season has lengthened by about 14 days. Models predict continued warming, including an increase in temperature by 1.5 to 5°F by 2030 and 5 to 18°F by 2100.

**Impact**

Impacts of a warming climate may include:

- Springs, seeps, or wet ground that is not typically wet;
- New cracks or bulges in the ground or pavement;
- Soil subsiding from a foundation;
- Secondary structures (decks, patios) tilting or moving away from main structures;
- Broken water line or other underground utility;
- Leaning structures that were previously straight;
- Offset fence lines;
- Sunken or dropped-down road beds;
- Rapid increase in stream levels, sometimes with increased turbidity;
- Rapid decrease in stream levels even though it is raining or has recently stopped; and
- Sticking doors and windows, visible spaces indicating frames out of plumb.

**Recurrence Probability**

Changes to the cryosphere are occurring and will continue to do so.

### 5.3.2 Earthquake

Alaska is one of the most seismically active regions in the world and is at risk of societal and economic losses due to damaging earthquakes. On average, Alaska has one "great" magnitude [(M) >8] earthquake every 13 years and one M 7-8 earthquake every year. Earthquakes have killed more than 130 people in Alaska during the past 60 years (DHS&EM, 2018a).

It is not possible to predict the time and location of the next big earthquake, but the active geology of Alaska guarantees that major damaging earthquakes will continue to occur and can affect almost anywhere in the state. Scientists have estimated where large earthquakes are most likely to occur, along with the probable levels of ground shaking to be expected. With this information, as well as information on soil properties and landslide potential, it is possible to estimate earthquake risks in any given area.

Alaska earthquake statistics include:

- Alaska is home to the second-largest earthquake ever recorded (1964 Great Alaska Earthquake, M 9.2);
- Alaska has 11% of the world's recorded earthquakes; and
- Three of the eight largest earthquakes in the world occurred in Alaska.

Since 1900, Alaska has had an average of:

- 45 M 5-6 earthquakes per year;

- 320 M 4-5 earthquakes per year; and
- 1,000 earthquakes located in Alaska each month.

Source: Alaska Earthquake Center (AEC)

#### *5.3.2.1 Hazard Characteristics*

An earthquake is a sudden motion or trembling caused by a release of stress accumulated within or along the edge of Earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning, and after only a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, or the vibration or shaking of the ground during an earthquake.

Ground motion generally increases with the amount of energy released and decreases with distance from the rupture area. An earthquake causes waves in the earth's interior (i.e., seismic waves) and along the earth's surface (i.e., surface waves). Two kinds of seismic waves occur: P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back and forth oscillation along the direction of travel (vertical motion), and S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). There are also two types of surface waves: Raleigh waves and Love waves. These waves travel more slowly and typically are more damaging than seismic waves because they cause larger motions and their frequency is close to harmonic frequencies for human structures and for sedimentary deposits.

In addition to ground motion, several secondary natural hazards can occur from earthquakes such as:

- **Strong Ground Motion** is ground shaking. Strong ground motion intensity is directly correlated with earthquake magnitude (i.e., the larger the earthquake magnitude, the more intense and widespread the ground shaking will be). The strong ground motion severity is also dependent on the distance from the energy source.
- **Surface Rupturing** occurs when the subsurface patch of fault that slips in an earthquake intersects the earth's surface. This causes discrete, differential ground movement during intense earthquake shaking. The relative crustal block motion is dictated by the rupture's fault type, which can be horizontal, vertical, or a combination of both. Earthquakes larger than a M of 6.5 have sufficient energy to create surface ruptures, but whether or not this occurs is dependent on the earthquake's depth. The shallower a depth at which a significant earthquake occurs, the more likely it is to create a surface rupture. Permanent displacement along faults can be substantial. Surface ruptures, as a product of intense strong ground motion, can cause severe damage to existing structures.
- **Landslides/Debris Flows** occur as a result of horizontal seismic inertia forces induced in the slopes by ground shaking. The most common earthquake-induced landslides include shallow, disrupted landslides such as rock falls, rockslides, and soil slides. Debris flows are created when surface soil on steep slopes becomes completely saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill

at very high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

The severity of an earthquake can be expressed in terms of intensity and M. Intensity is based on the damage and observed effects on people and the natural and built environment. It varies from place to place depending on the location with respect to the earthquake rupture (where the fault moved). While the area directly above the rupture usually experiences the most intense earthquake effects (e.g., shaking), the total area affected can cover hundreds of thousands of sq. miles, depending on the earthquake's M.

Larger earthquakes are less common than smaller earthquakes, such that the smallest earthquakes are extremely frequent, while the largest earthquakes are relatively infrequent.

Earthquakes are also classified by their felt effects (e.g., perceived shaking intensity). However, the effects of an earthquake are directly related to the distance from the earthquake rupture, among other parameters such as the type of crust where the earthquake occurs. In general, the closer one is to an earthquake's epicenter, the more severe the felt effects and damage will be. An earthquake's intensity is described by the Modified Mercalli Intensity (MMI) Scale. As shown in Table 4, the MMI Scale consists of 10 increasing levels of intensity that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is also used to measure earthquake intensity by quantifying how hard the earth shakes in a given location. PGA can be measured as acceleration due to gravity (g) (MMI, 2006).

**Table 4. Perceived Shaking, Potential Damage, and Peak Ground Acceleration**

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Mod./Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <0.05 | 0.3 | 2.8 | 6.2 | 12 | 22 | 40 | 75 | >139 |
| PEAK VEL.(cm/s) | *<0.02* | *0.1* | *1.4* | *4.7* | *9.6* | *20* | *41* | *86* | *>178* |
| MMI scale | I | II–III | IV | V | VI | VII | VIII | IX | X+ |

M is the measure of the earthquake's strength and is related to the amount of seismic energy released at the earthquake's hypocenter, the actual location of the energy released inside the earth. It is based on the amplitude of the earthquake waves recorded on instruments, known as the Richter magnitude test scales, which have a common calibration.

### *5.3.2.2 History*

The KPB is subject to numerous earthquake events of varying magnitudes. Several fault lines traverse the KPB, including the Lake Clark Fault, Bruin Bay Fault, Sterling Fault, Border Ranges Fault, and Eagle River Fault. The region's tectonic activity, documented back to 1933, includes 258 earthquakes centered within the KPB that registered over a M of 4.5 (FEMAj, 2017).

A 7.1 earthquake with an epicenter north of Anchorage on November 30, 2018 damaged some City facilities. Damage was not as extensive as that in the Municipality of Anchorage or the Matanuska-Susitna Borough since the epicenter was farther away from Kenai. The Kenai City Dock was damaged with structural cracks in the concrete. Well House #1 and the building surrounding the well house were damaged. A water main break in a residential neighborhood

resulting from the earthquake about a week after its occurrence was fixed by the City's Public Works Department.

One of the largest earthquake events in the region occurred 53 miles west of Anchor Point on January 24, 2016, with a M of 7.1. This earthquake, referred to as the 2016 Old Iliamna Earthquake, occurred 123.4 kilometers below ground, approximately 54 miles west of Anchor Point. It was reported that the shaking could be felt from Fairbanks to Juneau. The earthquake caused immediate regionwide power outages, gas leaks, and fires, which destroyed four homes. Additionally, businesses reported damaged merchandise, and the Kalifornsky Beach Road dropped down a foot, creating a 150-foot-long-crack. The Red Cross provided shelters for those whose homes were damaged, and for residents unable to return home due to closed roads. No fatalities were reported, and the structural damage was minimal.

As a result of the 2016 Old Iliamna Earthquake, the City felt the greatest impact when a gas line broke on Lilac Lane and released 406,000 cubic feet of natural gas (KBBI, 2016). The Pipeline and Hazardous Materials Safety Administration and the Regulatory Commission of Alaska didn't cite any corrosion or pre-existing problem with the line. There were two house explosions, and a fire claimed two more, resulting in a total of four homes on Lilac Lane being completely destroyed. Lindsay Hobson, a spokeswoman for Enstar Natural Gas, stated, "But for the earthquake, there wouldn't have been any damage to the line at all. The earthquake moved the line, and we had the resulting release of gas."

Since 1931, 27 earthquakes have been recorded with a M of 5.0 or greater within a 50-mile radius of the approximate center of the City (60.559454$^{o}$ N, 151.233000$^{o}$ W) (Table 5).

**Table 5. Historical Earthquakes within a 50-Mile Radius of the Approximate Center of the City**

| Date | Latitude | Longitude | Depth | M | Place |
|---|---|---|---|---|---|
| 2017-05-30 | 60.8341 | -151.8152 | 81.2 | 5.2 | 33km WNW of Nikiski, Alaska |
| 2017-05-07 | 60.1828 | -151.6783 | 67.2 | 5.3 | 29km SW of Cohoe, Alaska |
| 2014-05-10 | 60.0101 | -152.126 | 89.1 | 5.8 | 30km NNW of Anchor Point, Alaska |
| 2012-12-04 | 61.24 | -150.7682 | 63.7 | 5.8 | Southern Alaska |
| 2011-06-16 | 60.7649 | -151.076 | 58.9 | 5.1 | Kenai Peninsula, Alaska |
| 2009-08-19 | 61.2279 | -150.8579 | 66.4 | 5.1 | Southern Alaska |
| 2004-05-30 | 61.056 | -152.2015 | 124.9 | 5.3 | Southern Alaska |
| 2004-03-05 | 60.5023 | -151.64 | 61.7 | 5 | Kenai Peninsula, Alaska |
| 2001-01-25 | 60.114 | -152.363 | 86.9 | 5.5 | Southern Alaska |
| 1999-04-18 | 60.387 | -151.852 | 73.4 | 5.3 | Kenai Peninsula, Alaska |
| 1995-05-24 | 61.007 | -150.119 | 41.8 | 5.6 | Southern Alaska |
| 1994-04-25 | 60.899 | -151.142 | 67.9 | 5.4 | Kenai Peninsula, Alaska |
| 1991-12-07 | 60.954 | -150.344 | 50.9 | 5.2 | Kenai Peninsula, Alaska |
| 1990-08-13 | 60.115 | -152.006 | 87.6 | 5.5 | Southern Alaska |
| 1990-03-09 | 60.307 | -152.286 | 84.9 | 5.3 | Southern Alaska |
| 1984-04-18 | 60.833 | -152.067 | 95 | 5.1 | Southern Alaska |
| 1971-06-02 | 61.055 | -151.147 | 29 | 5 | Southern Alaska |
| 1960-06-30 | 60.3 | -150.9 | 55 | 5.9 | Kenai Peninsula, Alaska |
| 1958-11-19 | 60.46 | -150.91 | 46 | 5.9 | Kenai Peninsula, Alaska |
| 1958-01-24 | 60.16 | -151.76 | 52 | 6.4 | Kenai Peninsula, Alaska |
| 1954-10-03 | 60.651 | -150.392 | 61.5 | 6.4 | Kenai Peninsula, Alaska |
| 1941-07-30 | 60.927 | -151.033 | 35 | 6.4 | Kenai Peninsula, Alaska |
| 1940-10-11 | 60 | -150.5 | | 6 | Kenai Peninsula, Alaska |
| 1934-06-18 | 60.855 | -151.316 | 15 | 6 | Kenai Peninsula, Alaska |
| 1933-06-13 | 61 | -151 | | 6.25 | Southern Alaska |

| | | | | | |
|---|---|---|---|---|---|
| 1933-04-27 | 61.131 | -151.004 | 15 | 6.8 | Southern Alaska |
| 1931-12-24 | 60 | -152 | 100 | 6.25 | Kenai Peninsula, Alaska |

### *5.3.2.3 Location, Extent, Impact, and Recurrence Probability*

**Location**

The Uniform Building Code rates the entire state of Alaska in Earthquake Zone 4, the highest hazard level. Figure 2 shows the locations of active and potentially active faults in Alaska. Approximately 75% of Alaska's detected earthquakes occur in the Alaska Peninsula, Aleutian, Cook Inlet, and Anchorage areas. About 15% occur in Southeast Alaska, and the remaining 10% occur in the Interior. The greatest earthquake in North American history occurred in the Alaska-Aleutian Seismic zone. That earthquake was a M 9.2, lasting between four and five minutes and was felt over a 7,000,000 square mile area. The megathrust zone where the North Pacific Plate plunges beneath the North American Plate still has the potential to generate earthquakes up to a M of 9.

**Extent**

Although Southcentral Alaska is in a high seismic risk zone, the City was relatively undamaged in the 1964 Great Alaska Earthquake; however, the potential for seismic events remains high.

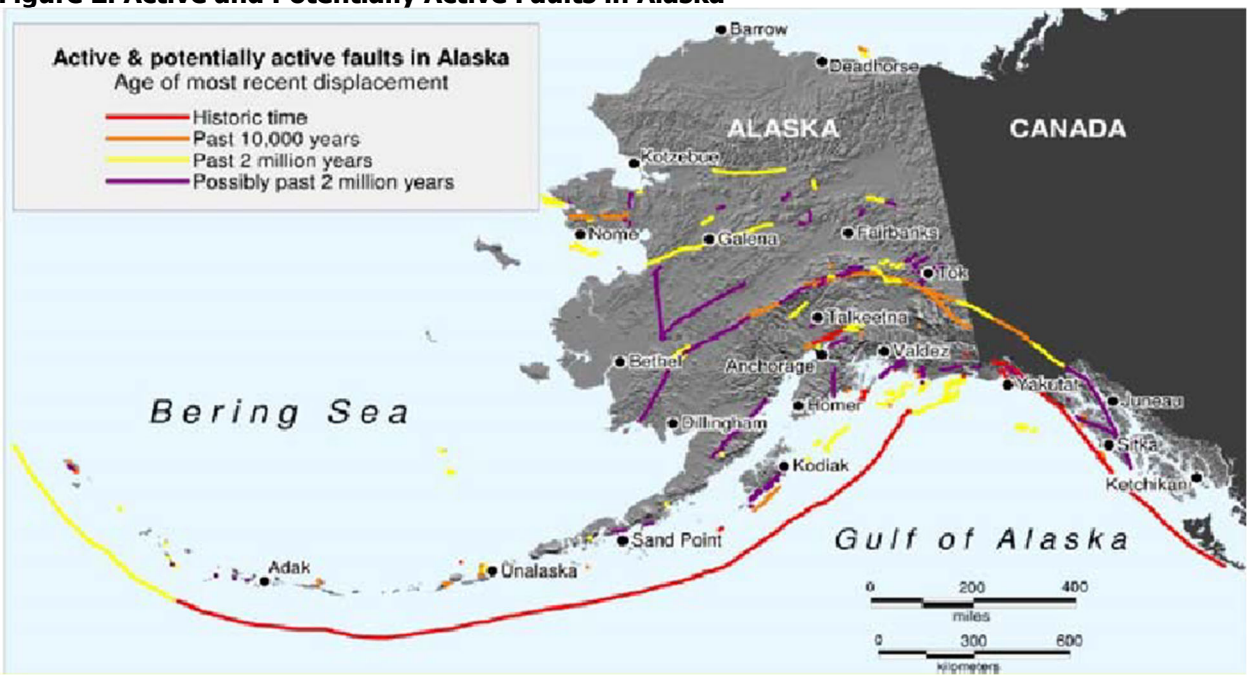
*"Alaska has changed significantly since the damaging 1964 earthquake, and the population has more than doubled. Many new buildings are designed to withstand intense shaking; some older buildings have been reinforced, and development has been discouraged in some particularly hazardous areas.*

*Despite these precautions, and because practices to reduce vulnerability to earthquakes are not applied consistently in regions of high risk, future earthquakes may still cause life-threatening damage to buildings, cause items within buildings to be dangerously tossed about, and disrupt basic utilities and critical facilities.*

*FEMA estimates that with the present infrastructure and policies, Alaska will have the second highest average annualized earthquake-loss ratio (ratio of average annual losses to infrastructure) in the country. Reducing those losses requires public commitment to earthquake-conscious siting, design, and construction. The Seismic Hazards Safety Commission is committed to addressing these issues. Earthquake-risk mitigation measures developed by similar boards in other states have prevented hundreds of millions of dollars in losses and significant reductions in casualties when compared to other seismically active areas of the world that do not implement effective mitigation measures. The San Francisco (1989), Northridge (1994), and Nisqually (2001) earthquakes caused comparatively low losses as a result of mitigation measures implemented in those areas. Many of these measures were recommended by the states' seismic safety commissions."*

Source: HAZUS 99 Estimated Annualized Earthquake Losses for the U.S., FEMA Report 66. September 2000. Via DHS&EM, 2018a.

**Figure 2. Active and Potentially Active Faults in Alaska**




## Impact

Two earthquake risk assessments were performed by FEMA using multi-hazard software (HAZUS) (FEMAj, 2017). The first assessment used a U.S. Geological Survey (USGS) ShakeMap created from the January 2016 M 7.1 Old Iliamna earthquake event and provides an estimate of expected earthquake losses. The second assessment simulated the 1964 Great Alaska with a M of 9.2 (using a USGS-developed shaking scenario) to predict losses if the event were to happen in 2017. The results for the City are summarized in Table 6. See Table 7 for a detailed breakout of impacted facilities for the City.

**Table 6. Hazus Earthquake Results for M7.1 and M9.2 Earthquakes in the City of Kenai**

| Total Estimated Value of Improved Parcels | Total Number of Improved Parcels | M 7.1 Event | | M 9.2 Event | |
|---|---|---|---|---|---|
| | | Total Dollar Loss | Loss Ratio (Dollar Losses/Total Value) | Total Dollar Loss | Loss Ratio (Dollar Losses/Total Value) |
| $1,525,005,650 | 3,652 | $2,482,040 | 0.16% | $52,539,885 | 3.45% |

## Recurrence Probability

While it is not possible to predict an earthquake, the USGS has developed Earthquake Probability Maps that use the most recent earthquake rate and probability models. These models are derived from earthquake rate, location, and M data as well as from mapping of active faults, from the USGS National Seismic Hazard Mapping Project.

The measure of peak ground acceleration is relative to the acceleration due to gravity (1 g). At 1 g vertical acceleration, objects will be lofted off the ground as it moves down, and then experience twice their own weight when the ground moves up. One g of horizontal

**Table 7. FEMA RiskMap Identified Areas of Mitigation Interest**

| Category | Name | Total Value (Building and Contents) | Estimated Loss from M9.2 Earthquake | M9.2 Earthquake Loss Ratio |
|---|---|---|---|---|
| Water Treatment Facility | Kenai Wastewater Treatment Facility | $14,625,200 | $453,829 | 3.1% |
| School | Kenai Central High School* | $115,594,200 | $4,971,042 | 4.3% |
| School | Kenai Middle School* | $46,243,200 | $1,988,654 | 4.3% |
| City Office | Kenai City Hall | $3,279,950 | $123,822 | 3.78% |
| Fire Station | Kenai Fire Department | $3,279,950 | $123,822 | 3.78% |
| City Office | Kenai Fire Department | $3,279,950 | $123,822 | 3.78% |
| Police Station | Kenai Police Station | $3,279,950 | $123,822 | 3.78% |
| Emergency Shelter | LDS Chapel | $3,459,400 | $129,867 | 3.75% |
| Emergency Shelter | Kaleidoscope Charter School | $20,886,600 | $783,338 | 3.75% |
| Federal Office | U.S. Army Corps of Engineers' Kenai Field Office | $879,600 | $32,401 | 3.68% |
| Park | Beaver Creek Park | $15,800 | $552 | 3.49% |
| School | Mountain View Elementary* | $27,087,400 | $942,826 | 3.48% |

Note: Hazards are considered identified if the following applies:

1. Earthquake: Subject has a M 9.2 Earthquake Loss Ratio greater than 3.48%.
2. Flood: Subject is identified in a 0.2 percent or 1 percent annual change flood hazard area.
3. Erosion: Subject is within a parcel along an identified Cook Inlet erosion zone.

* Facility is also a designated Emergency Shelter.

The results of each code type are summarized in Table 8.

**Table 8. Moderate- and High-Code Buildings in the City of Kenai**

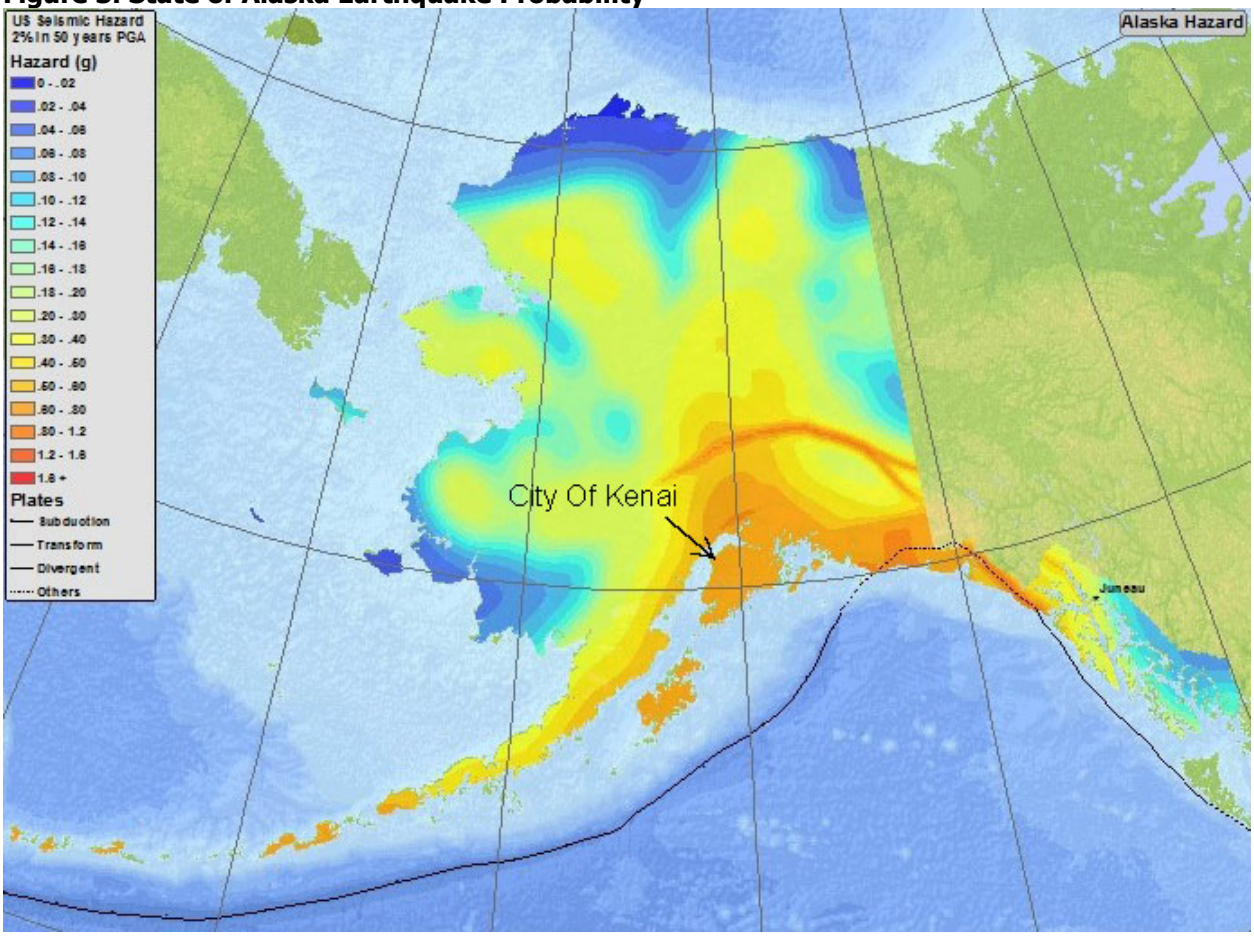
| Total Moderate-Code Buildings | Percent Moderate-Code Buildings | Total High-Code Buildings | Percent High-Code Buildings | Total Number of Buildings |
|---|---|---|---|---|
| 1,077 | 29.49% | 2,575 | 70.51% | 3,652 |

Notes: 1. Pre-code buildings were built before 1941, without a wooden frame.

2. Moderate-code means buildings were constructed after 1941, but with a wood frame and may include some earthquake building components.
3. High-code means buildings built after 1975.

acceleration will make flat ground feel as though it is sloped at 45 degrees – steep enough that most things would fall. Figure 3 indicates that the USGS earthquake probability model places the probability of an earthquake in the City of Kenai with a likelihood of experiencing severe shaking (0.60g to 0.80g peak ground acceleration) at a 2% probability in 50 years, based on the USGS Alaska hazard model. A 2% probability in 50 years is the rare, large earthquake, and statistically, it happens on average every 2,500 years.

**Figure 3. State of Alaska Earthquake Probability**




## 5.3.3 Flood and Erosion

### *5.3.3.1 Hazard Characteristics*

#### *Floods*

Approximately 6,600 miles of Alaska's coastline and many low-lying areas along Alaska's riverbanks are subject to severe flooding and erosion. The U.S. Government Accountability Office reported in 2003 that flooding and erosion affect 184 out of 213 (86%) of Alaska Native villages. Many of the problems are long-standing, although studies indicate that increased flooding and erosion are being caused in part by changes in the cryosphere (DHS&EM, 2018a).

**Flooding** is the overflow of excess water from a stream, river, lake, reservoir, glacier, or coastal body of water onto adjacent floodplains or normally dry land. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Flooding is Alaska's most common disaster, often costing in excess of one million dollars annually, causing major disruptions to society and occasionally loss of life (DHS&EM, 2018a).

Many floods are predictable based on rainfall patterns. In the City, most of the annual precipitation is received from August through October with September being the wettest. This rainfall leads to flooding in winter. Spring snowmelt increases runoff, which can cause flooding.

To develop flood predictions, the National Weather Service (NWS) and DHS&EM operate a flood-forecasting network in the most populated parts of Alaska (River Watch), including the KPB. Predictions are also difficult for many of the smaller rivers because of the short time span between when the precipitation occurs and the flooding starts.

***Erosion***

**Erosion** is the action of surface processes (such as water) that remove soil, rock, or dissolved material from one location and transport it to another location. Erosion can be gradual or occur quite quickly as the result of a flash flood, storm, or other event. Most of the geomorphic change to a river system is due to peak flow events that can dramatically increase the erosion rate. Erosion is a problem in developed areas where disappearing land threatens development and infrastructure (DHS&EM, 2018a). Erosion rarely causes death or injury. However, erosion causes the destruction of property, development, and infrastructure. There are three main types of erosion that affect human activity in the City:

- Coastal erosion;
- Riverine erosion; and
- Wind erosion.

**Coastal and Riverine Erosion**

Coastal erosion is the wearing away of coastal land. This term is commonly used to describe the horizontal retreat of the shoreline along the ocean, or the vertical down cutting along the shores. Erosion is considered a function of larger processes of shoreline change, which includes erosion and accretion. Erosion results when more sediment is lost along a particular shoreline than is redeposited by the water body. Accretion results when more sediment is deposited along a particular shoreline than is lost. When these two processes are balanced, the shoreline is stable. Some erosion is related to redistributing sediment on a beach; moving sediment from bluffs to sand flats, especially under the influence of sea-level rise. In assessing the erosion hazard, it is important to realize that there is a temporal, or time aspect associated with the average rate at which a shoreline is either eroding or accreting. Over a long-term period (years), a shoreline is considered to be eroding, accreting, or stable. A hazard evaluation should focus on the long-term erosion situation. However, in the short-term, it is important to understand that storms can erode a shoreline that is, over the long-term, classified as accreting, and vice versa.

Riverine erosion results from the force of flowing water into and adjacent to river channels. This erosion affects the bed and banks of the channel and can alter or preclude any channel navigation or riverbank development. In less stable braided channel breaches, erosion and deposition of materials are a constant issue. In more stable meandering channels, episodes of erosion may occur occasionally.

Erosion is measured as a rate, with respect to either a linear retreat (i.e., feet of shoreline recession per year) or volumetric loss (i.e., cubic yards of eroded sediment per linear foot of shoreline frontage per year). Erosion rates are not uniform, and vary both over time at any single location and at any given time along the coast. Annual variations are the result of seasonal changes in wave action and water levels.

Erosion is caused by coastal storms and flood events; changes in the geometry of tidal inlets, river outlets, and bay entrances; man-made structures and human activities such as shore protection structures and dredging; long-term erosion; and local scour around buildings and other structures. Major erosion occurs when there is a high tide and large storm waves that carry away the base material of the bluff making the slopes steeper. These steeper slopes are more susceptible to erosion by wind and surface or groundwater.

**Wind Erosion**

Wind erosion is when wind is responsible for the removal, movement, and redepositing of land. It occurs when soils are exposed to high-velocity wind. The wind will pick up the soil and carry it away. The wind moves soil particles 0.1-0.5 millimeters (mm) in size in a hopping or bouncing fashion (known as saltation) and those greater than 0.5 mm by rolling (known as soil creep). The finest particles (less than 0.1 mm) are carried in suspension. Wind erosion can increase during periods of drought.

Wind erosion can cause a loss of topsoil, which can hinder agricultural production. Loess, deposits of silt laid down by wind action, can reduce visibility causing automobile accidents, hinder machinery, and have a negative effect on air and water quality, creating animal and human health concerns. Wind erosion also causes damage to public utilities and infrastructure.

Most of the City is unaffected by erosion. The 2017 FEMA Risk Report identified the wastewater treatment plant at risk of erosion. Additionally, large sections of the City's coast, including the Historic District and residential areas are affected by coastal erosion. The City has lost land and structures due to the erosion. Roads have been abandoned and sewer mains relocated. In 2000, a sewer line was relocated due to the erosion on Mission Street. The relocation of the line and subsequent roadwork was in excess of $300,000 (Funded through State of Alaska Capital Improvements funding).

The Kenai River meanders through the City. An example of coastal, riverine, and wind erosion working together is represented in Figure 4 on the Kenai Bluffs. The Kenai Bluffs are 5,000 linear feet of bluff (high bank) located in the City along the north bank of the Kenai River at the mouth to Cook Inlet (see Figure 5). Figures 6 and 7 show photographs taken in 2018 with the erosive forces labeled.

The Kenai Bluffs height ranges between 55 to 70 feet, and the bluff face is receding at an average rate of three feet per year. A review of aerial photographs that extended over a 56-year period of record indicate that the erosion rate ranges from two to four feet per year. The erosion is episodic, and the amount of bluff loss at any particular location can vary from chronic to an acute large loss of bluff face over a short period. Public and private property, structures and infrastructure, and cultural resources have been lost and continue to be threatened by the receding bluff. The bluff consists of unconsolidated sediments that remain unstable because it is exposed to Cook Inlet coastal storms and extreme floodtides that have the fourth largest range in the world of 31.4 feet. Tidal currents and wave action during flood tides attack the toe of the bluff, removing sediments that originate from the bluff face and accumulate at its toe. Coastal storms also degrade the structural integrity of the exposed lower bluff face. In order for the bluff to stabilize, an effective structural project alternative will

**Figure 4. Erosion Mechanism Schematic**

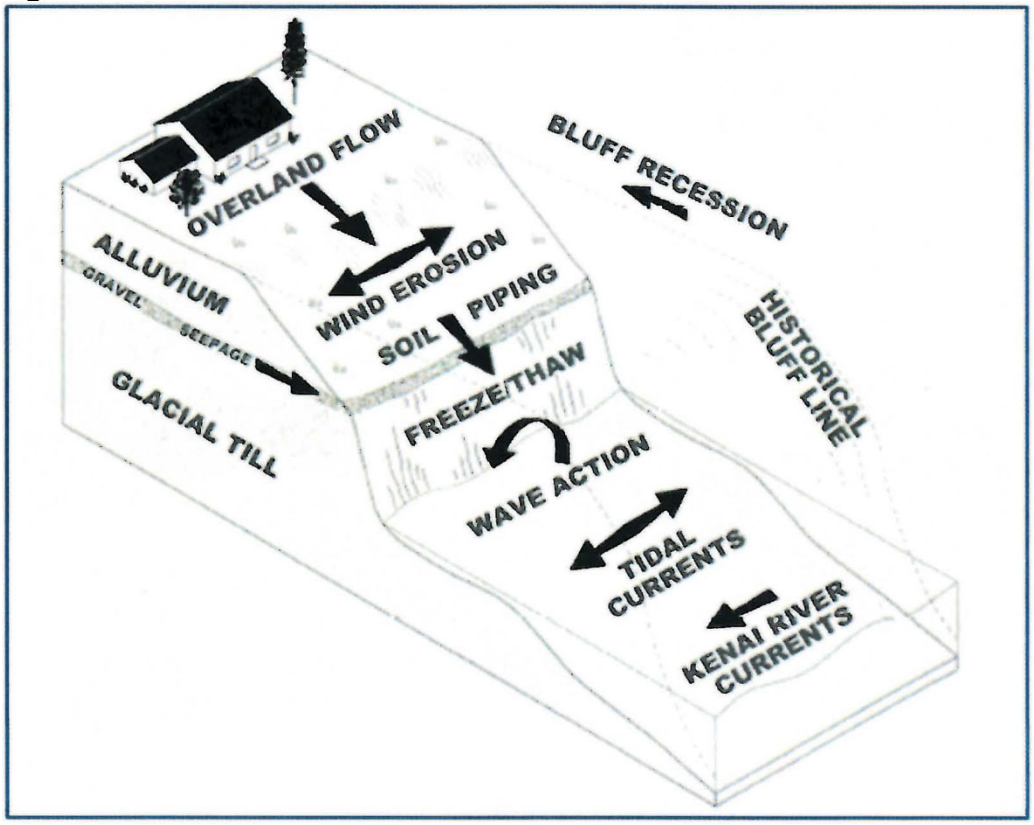



**Figure 5. Kenai Bluffs Location**

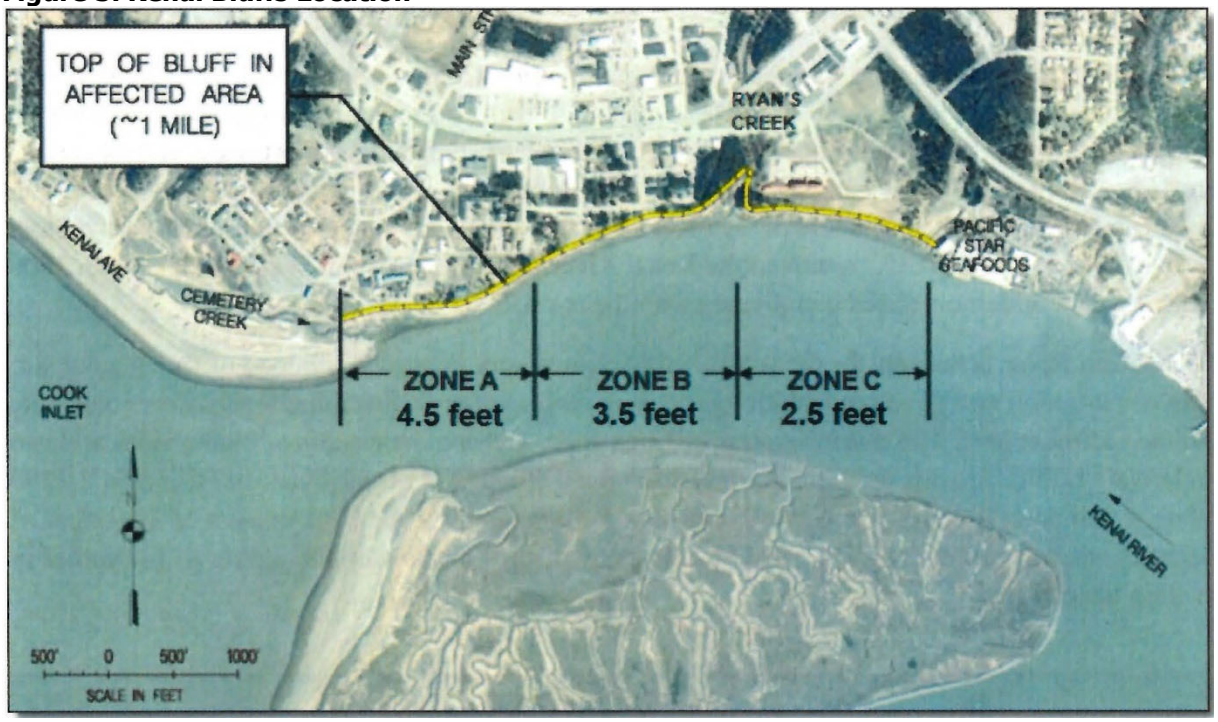


**Figure 6. Kenai Bluffs Eroded Surface**

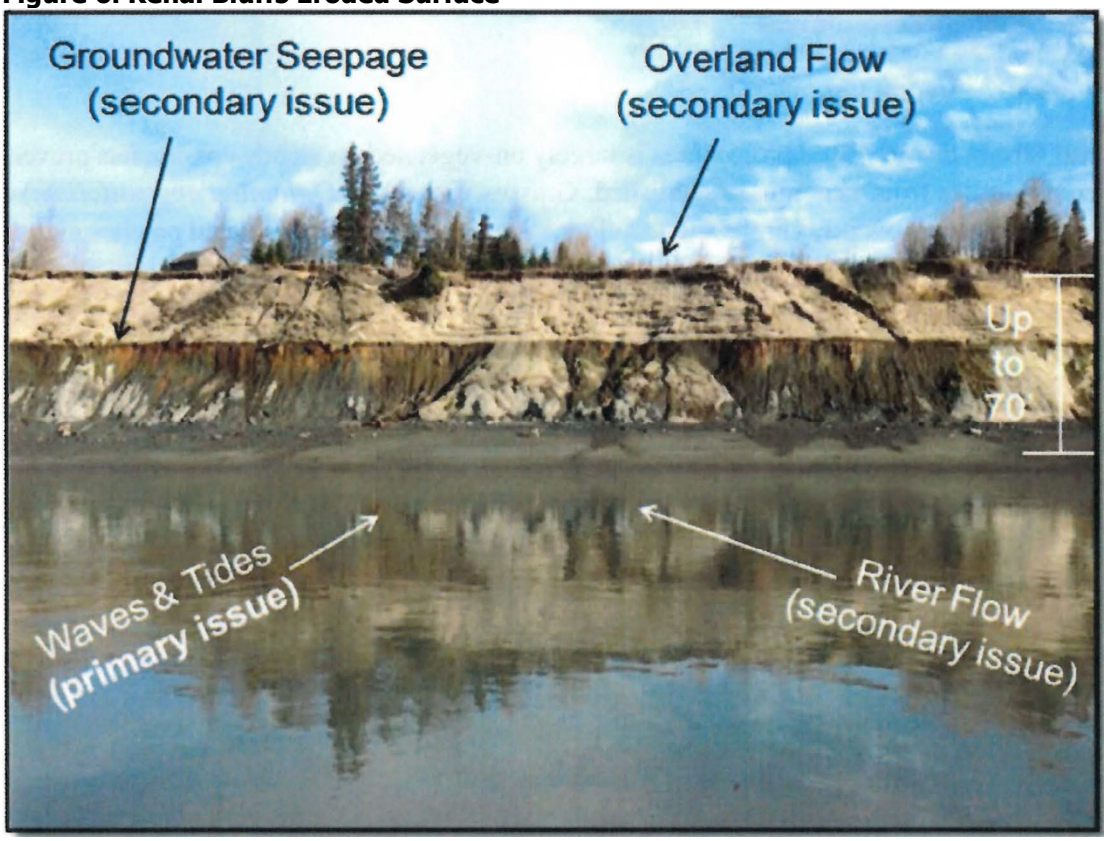



**Figure 7. Storm Event at Kenai Bluffs**

need to prevent the removal of accumulated sediment at the bluff and the structural damage of the lower bluff. The USACE completed a feasibility study in November 2018 that recommended a protective berm at the bluff toe. This Bluff Stabilization project includes constructing a berm at the bluff toe that is designed to prevent the removal of accumulated sediment between the bluff toe and the berm and prevent storm damages to the lower portion of the bluff. With the bluff toe protection in place, it will eventually stabilize, and the bluff surface will erode back naturally to a more stable slope, which is estimated to take up to 15 years (USACE, 2018). The City supports this option and is pursuing the design phase of this project.

In 2009, the City of Kenai added permanent fencing to the north beach dunes to help prevent bluff erosion. The fencing helped ensure that man-made destruction of vegetation did not compromise the integrity of the dunes. A similar fencing project was completed in the summer of 2010 on the south beach. The dunes were at risk of destruction from the annual personal use dipnet fishery if the fencing was not installed. The fencing fulfilled its purpose.

Erosion on the Kenai River, predominantly outside the City, is of great concern to resource management agencies because the increased sedimentation and loss of streamside cover associated with acceleration rates may threaten salmon returns to the river. The City's gross revenue from the 2019 personal use salmon fishery on the Kenai River was expected to be $416,000.

#### *5.3.3.2 Climate Factors*

Climate and weather are the two primary drivers of flooding and erosion in Alaska. Weather (i.e., the day-to-day state of the atmosphere) affects these hazards in the short-term with individual episodes of rainfall, wind, and temperature that initiate or intensify individual episodes of flooding or erosion. Climate is affecting the long-term incident rate and severity of these hazards, especially in Alaska, which is particularly vulnerable due to its high northern latitude and the unique importance of snow, ice, and permafrost.

#### *5.3.3.3 Flood and Erosion History*

The City has two flood and erosion events in the DHS&EM Disaster Cost Index (DHS&EM, 2018b). These events are listed below.

**96-180. Southcentral Fall Floods declared September 21, 1995 by Governor Knowles, then FEMA declared (DR-1072) on October 13, 1996:** Record rainfall in Southcentral Alaska caused widespread flooding in the KPB, Matanuska-Susitna Borough, and the Municipality of Anchorage. On September 29, 1995, the Governor amended the original declaration to include Chugach, and the Copper River Regional Education Attendance areas, including the communities of Whittier and Cordova, and the Richardson, Copper River, and Edgerton Highway areas which suffered severe damage to numerous personal residences, flooding, eroding of public roadways, destruction and significant damage to bridges, flood control dikes and levees, water and sewer facilities, power, and harbor facilities. On October 13, 1995, the President declared this event as a major disaster under the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Individual Assistance totaled $699K for 190 applicants. Public

assistance totaled $7.97 million for 21 applicants with 140 DSRs. Hazard mitigation totaled $1.2 million. The total for this disaster was $10.5 million.

The City of Kenai mobilized City boats, vehicles, and safety equipment to intercept and extract huge quantities of debris such as docks, sheds, large liquefied petroleum gas tanks, fuels storage tanks, and damaged boats from the Kenai River before this debris caused further property damage and before it could flow into Cook Inlet shipping lanes.

**13-F-243. 2013 October KPB Flood Disaster declared by Governor Parnell on November 18, 2013, then FEMA declared January 16, 2014 (DR-4161):** Beginning October 27, 2013, the KPB received substantial amounts of rain following several weather systems that had previously inundated low-lying areas. On October 26, the NWS issued a flood watch for areas around Western Prince William Sound due to a slow-moving system which brought widespread rainfall to the mainland. The forecast called for local amounts in excess of five inches of rain. Seward, Homer, and other areas of the KPB received heavy rain and flooding which caused landslides, bridge, and airport and road closures. Damages were reported in Seward, Homer, Kenai, Anchor Point, and the Tyonek area along Beluga Road. Flood damages affecting many individual homes were reported, and several businesses were also impacted.

#### *5.3.3.4 Location, Extent, Impact, and Recurrence Probability*

**Location**

Figure 8 is from the 2010 City Annex to the KPB HMP and shows estimated Kenai Bluff Erosion to 2057 (City, 2010). The 2017 FEMA RiskMap study did not identify any areas of concern for the City with regards to flooding (FEMAj, 2017).

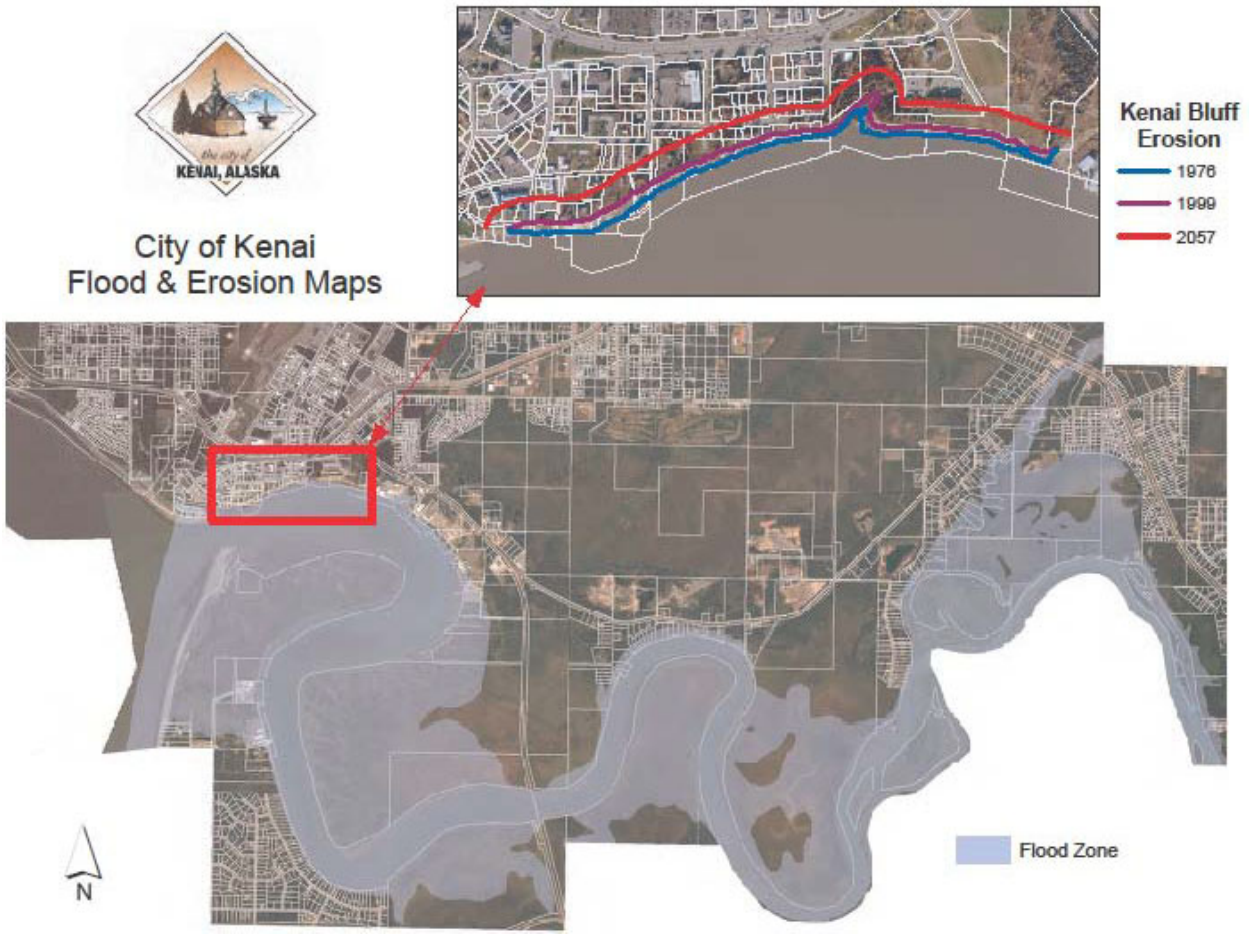
The City has experienced significant erosion. Figure 9 displays a coastal erosion rate along Cook Inlet near the City. Shorelines were compiled from three different time periods in the 1950s, 1960s, and 2000s used for the 2017 Risk Report analysis. The only critical facility that the 2017 Risk Report study designated as an area of mitigation interest is the Kenai Wastewater Treatment Facility.

**Extent**

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. The following factors contribute to flooding frequency and severity:

- Rainfall intensity and duration.
- Antecedent moisture conditions.
- Watershed conditions, including terrain steepness, soil types, amount, vegetation type, and development density.
- The attenuating feature existence in the watershed, including natural features such as lakes and human-built features such as dams.
- Flow velocity.

**Figure 8. Kenai Bluffs Erosion**



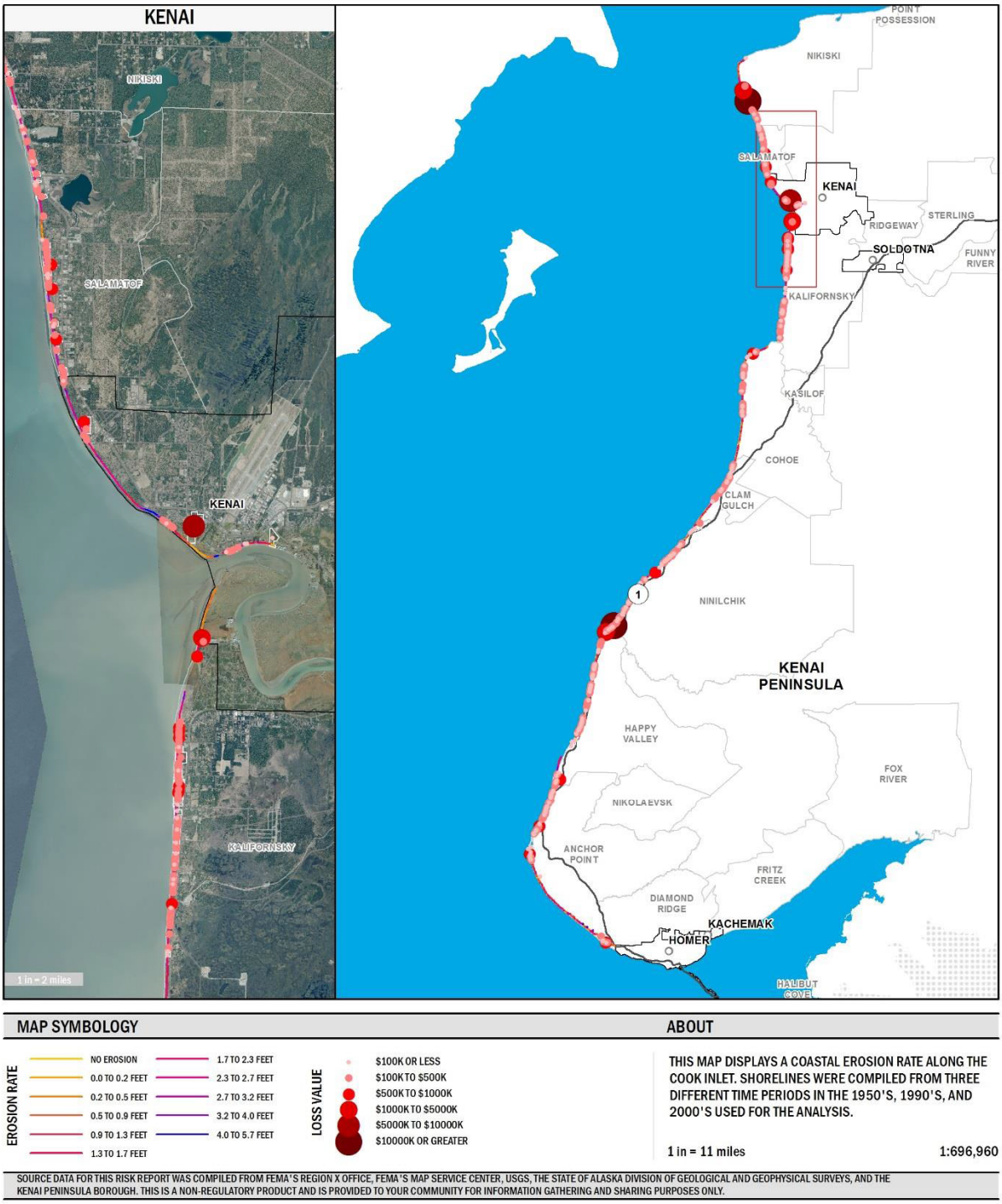

- Availability of sediment for transport, and the bed and embankment watercourse erodibility.
- Location of potentially-impacted structures related to the base flood elevation as indicated with their certified high-water mark.

A variety of natural and human-induced factors influence the erosion process. River orientation and proximity to up and downstream river bends can influence erosion rates. Embankment composition also influences erosion rates, as sand and silt erode easily, whereas boulders or large rocks are more erosion-resistant. Other factors that may influence erosion include:

- Geomorphology;
- Amount of encroachment in the high hazard zone;
- Proximity to erosion inducing structures;
- Nature of the topography;
- Density of development;
- Structure types along the embankment; and
- Embankment elevation.

The various erosion mechanisms acting on the Kenai Bluffs include:

**Figure 9. Kenai Coastal Erosion**




- Wind scour;
- Groundwater seepage and piping;
- Overland flow over the bluff; and

- Freeze thaw cycles; and
- Wave action and currents at the toe of the bluff.

**Impact**

The ongoing condition of the receding Kenai Bluffs has resulted in:

- Lost land to the sea: commercial, municipal, non-profit (e.g., Kenai Bible Church built in 1940):
  - 7 parcels have been completely lost;
  - 18 parcels have suffered land loss; and
  - Nearly all threatened parcels have lost value.
- Lost and damaged cultural resources (i.e., historical, potentially historical, and archeological sites):
  - 4 historic wooden structures;
  - Property of the historic Kenai Bible Church;
  - Human remains have eroded out of the bluff; and
  - Prehistoric house depressions have been lost or are exposed.
- Abandoned and/or condemned structures: residential, commercial, and municipal.
- Threatened structures and infrastructure: residential, commercial, non-profit, and municipal (e.g., Kenai Senior Center).
- Relocation of utilities and roads.

In addition, the ongoing receding Kenai Bluffs has had other negative impacts (i.e., other social effects) as listed below:

- Lack of development and investment in Old Town.
- Cultural vulnerability with local tribes and the local population.
- Under use of public-use areas by locals and tourists (e.g., scenic overlooks and nearby parks).
- Health and safety issues (The unstable bluff is preventing activities at the base and near the top edge of the bluff, although soft sediments on the beach area may continue to prevent activities at the base.).
- Negatively impacted social connectedness, identity, resiliency, leisure, and recreation.
- Contributes to uncertainty in community planning.

**Recurrence Probability**

Future populations of the City can expect to receive an increased number of flood and erosion events due to greater moisture content in warmer air.

## 5.3.4 Volcanoes and Ashfall

### *5.3.4.1 Hazard Characteristics*

Alaska is home to 41 historically active volcanoes stretching across the entire southern portion of the State from the Wrangell Mountains to the far Western Aleutians. An average of one to two eruptions per year occurs in Alaska. Figure 10 shows regional volcanoes located in the vicinity of the City.

***Volcanic Ash***

Volcanic ash, also called tephra, is fine fragments of solidified lava and rock crystals ejected into the air by a volcanic explosion. The fragments range in size, with the larger falling nearer the source. Ash is a problem near the source because of its high temperatures (may cause fires), burial (the weight can cause structural collapses; for example, it was 100 miles from Novarupta to Kodiak where structures collapsed), and impact of falling fragments. Further away, the primary hazard to humans is damage to machinery (including airplanes in flight), decreased visibility, and inhaling the fine ash (long-term inhalation can lead to lung cancer), but lightning in large ash clouds can also pose a hazard. In Alaska, this is a major problem as many of the major flight routes are near historically active volcanoes. Ash accumulation may also interfere with the distribution of electricity due to shorting of transformers and other electrical components (ash is an excellent conductor of electricity).

The largest volcanic eruption of the 20$^{th}$ century occurred at Novarupta Volcano in June 1912. The eruption started by generating an ash cloud that grew to thousands of miles wide during the three-day event. Within four hours of the eruption, ash started falling on Kodiak, darkening the City. It became hard to breathe because of the ash and sulfur dioxide gas. The water became undrinkable and unable to support aquatic life. Roofs collapsed under the weight of the ash. Some buildings were destroyed by ash avalanches while others burned after being struck by lightning from the ash cloud. Similar conditions could be found all over the area. Some villages ended up being abandoned, including Katmai and Savonoski Villages. The ash and acid rain also negatively affected animal and plant life. Large animals were blinded, and many starved because their food was eliminated.

### *5.3.4.2 History*

The Alaska Volcano Observatory (AVO), which is a cooperative program of the USGS, Alaska Department of Natural Resources (DNR) Division of Geological and Geophysical Survey (DGGS), and the UAF Geophysical Institute (GI), monitors the seismic activity at 23 of Alaska's 41 active volcanoes in real time. In addition, satellite images of all Alaskan and Russian volcanoes are analyzed daily for evidence of ash plumes and elevated surface temperatures. Russian volcanoes are also a concern to Alaska as prevailing winds could carry large ash plumes from Kamchatka into Alaskan air space. AVO also researches the individual history of Alaska's active volcanoes and produces hazard assessment maps. The Alaska Tsunami Warning Center, located in Palmer, also monitors volcanic and earthquake activity throughout the Pacific region.

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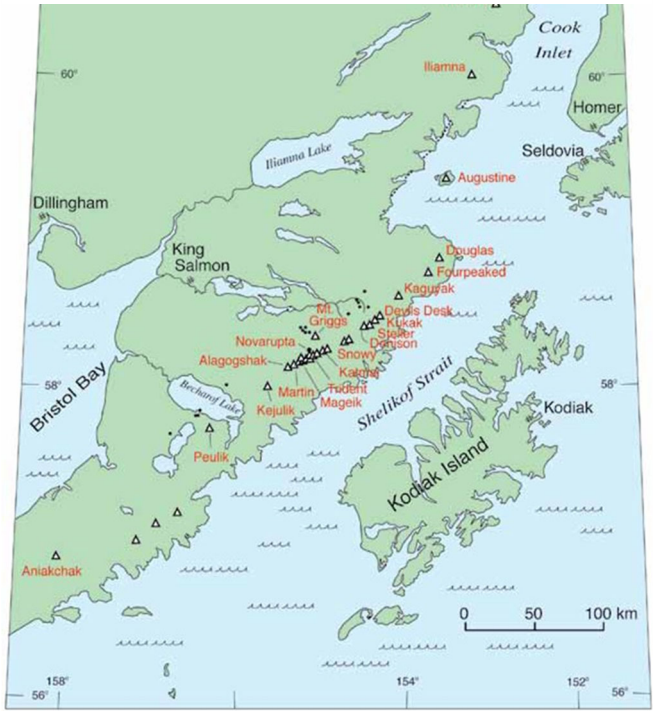
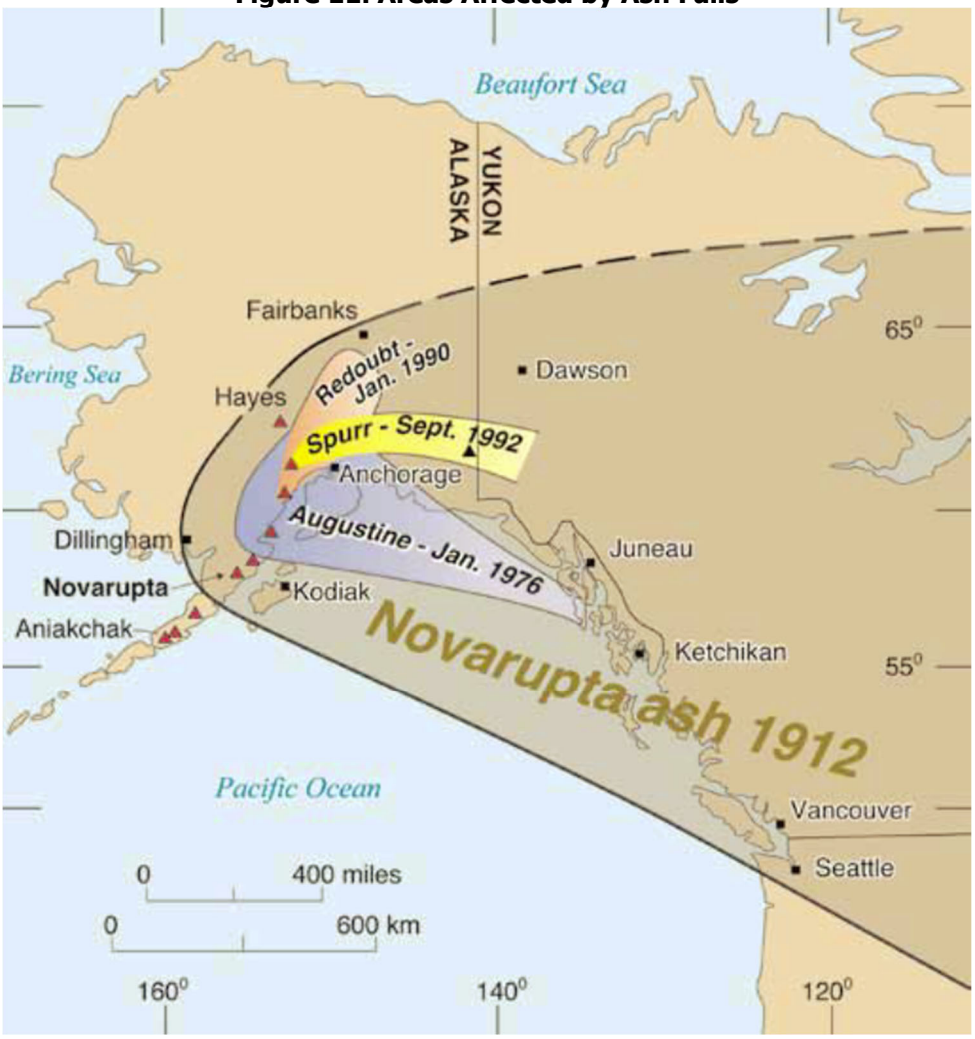
**Figure 10. Regional Volcanos**




The City has experienced volcanic ash in 1989, 1990, and 1992 from Mt. Redoubt and Mt. Spurr. These eruptions disrupted transportation and industry, particularly jet aircraft (Figure 11). Following the 1989-1990 eruptions, debris flows caused temporary closing of the Drift River Oil Terminal. A similar eruption event occurred again in 2009 affecting the offloading of 3.7 million gallons of crude oil from the oil terminal. The KPB received ashfall in 2009, but the wind direction spared the City. The Kenai Municipal Airport has an AVO tracking device, and no ash was present in 2009. Media reports, the KPB website, and the Kenai communications center, operated by the Kenai Police Department, adequately informed citizens of volcano precautions. The City government took steps to minimize damage to vehicles, buildings, and computer equipment. The City administration feels the above actions were more than adequate to mitigate potential damage from volcanic ash fallout to residential and commercial assets.

During the 1990 event, a KLM 747 jet aircraft, with 245 passengers and crew aboard, temporarily lost power in all four engines when it entered the volcanic plume. It would have crashed into the mountains had they not been able to restart their engines about 4,000 feet above ground.

**Figure 11. Areas Affected by Ash Falls**




### *5.3.4.3 Location, Extent, Impact, and Recurrence Probability*

#### *Location*

Figure 11 illustrates the spread of ash fall which is dependent on wind direction.

**Extent**

The single greatest volcanic hazard in the City is airborne ash, fine fragments of rock blown high into the atmosphere during explosive volcanic eruptions. For any given eruption, the depth of ash deposited at any given location depends on the total volume of ash ejected, the wind direction, and the distance between the volcano and a given location.

Extreme ashfall events, similar to the 1912 event, would have similar extreme consequences including building damage up to and including collapses, disruption of travel (air, sea, land), disruption of water, electric power and communications, and health and environmental impacts. Smaller ashfall events would result in little or no building damage, but would still have significant impacts, including:

- Respiratory problems for at-risk populations such as young children, people with respiratory problems and the elderly;
- Disruption of air, marine, and land traffic;
- Clean-up and ash removal from roofs, gutters, sidewalks, roads, vehicles, mechanical systems and ductwork, engines, and mechanical equipment;
- Clogging of filters and possible severe damage to vehicle engines, furnaces, heat pumps, air conditioners, commercial and public buildings' combined heating, ventilation, and air conditioning (HVAC) systems and other engines and mechanical equipment;
- Disruption of public water supplies drawn from surface waters, including degradation of water quality (high turbidity) and increased maintenance requirements at water treatment plants;
- Disruption/clogging of storm water drainage systems;
- Disruption of electric power from ash-induced short circuits in distribution lines, transmission lines, and substations; and
- Disruption of communications.

A major factor in determining ashfall is wind direction. Additionally, if there is a large ashfall, wind could blow and redistribute ashfall several times which would be a prolonged hazard.

**Impact**

The volcanic eruptions of 1989, 1990, 1992, and 2009 caused widespread distribution of ash over the central and southern peninsula and resulted in power outages and disruption of traffic. Volcanic ash nearly caused the greatest loss of life of any disaster event in Alaska.

Another impact of major ashfall is a breakdown of soil cover, accelerating erosion. This impact was seen on the flanks of Okmok in the eastern Aleutian Islands following the 2008 eruption. Former grasslands were cut with networks of deep, rapidly eroding gullies.

Ash fall from volcanic eruptions is a threat to health and to equipment that may draw in fine, abrasive particles. During times of high winds these fine particles pose a significant health threat.

The City has experienced a few tenths of an inch of ashfall on residents' vehicles. Planes do not fly. People do not operate motorized equipment. Air quality is poor. The City's policy is for people to shelter in place in their homes.

**Recurrence Probability**

The recurrence probability for the future residents of the City would remain the same as for current residents.

### 5.3.5 Severe Weather

#### *5.3.5.1 Hazard Characteristics*

In contemporary usage, climate change commonly refers to the change in global or regional climate patterns that spans from the mid- to late 20$^{th}$ century to the present. Evidence collected by scientists and engineers from around the world tells an unambiguous story: the

planet is warming. Climate change at high northern latitudes, such as Alaska, is causing rapid and severe environmental change.

Severe weather occurs throughout Alaska with extremes experienced by the City that include increasing high winds, winter storms, heavy and drifting snow, heavy rain/freezing rain/ice storms, and cold.

**High Winds**

High winds occur in Alaska when there are winter low-pressure systems in the North Pacific Ocean and the Gulf of Alaska. Alaska's high winds can equal cyclonic force. In Alaska, high winds (winds in excess of 60 mph) occur frequently over coastal areas along the Gulf of Alaska. They can also combine with loose snow to produce blizzards.

Localized downdrafts and downbursts are also common wind hazards. Downbursts are often generated by thunderstorms. Downbursts are areas of rapidly falling rain-cooled air. Upon reaching the ground, downbursts spread out in all directions in excess of 125 mph. Both types of wind, commonly lasting five to seven minutes, are hazardous to aviation. These winds reach hurricane force and have the potential to seriously damage community infrastructure (especially above ground utility lines) while disrupting vital marine transportation.

**Winter Storms**

Winter storms include a variety of phenomena described above and may include several components such as wind, snow, and ice storms. Ice storms include freezing rain, sleet, and hail and can be the most devastating of winter weather phenomena; often causing automobile accidents, power outages, and personal injury. Freezing rain coats every surface it falls on with an icy glaze. Freezing rain most commonly starts in a narrow band on the cold side of a warm front, where surface temperatures are at or just below freezing temperatures. Ice crystals high in the atmosphere grow by collecting water vapor molecules, sometimes supplied by evaporating cloud droplets. As the crystals fall, they encounter a layer of warm air where the particles melt and collapse into raindrops. As the raindrops approach the ground, they encounter a layer of cold air and cool to temperatures below freezing.

**Heavy and Drifting Snow**

Heavy snow generally means an accumulation of more than 12 to 24 inches of snow inside of 24 hours and often brings transportation to a stop. Airports and major roadways will close, disrupting supply flow and emergency response service access. Excessive accumulation will collapse roofs, knock down trees and power lines, damage parked light aircraft, and capsize small boats. Heavy snow increases flooding risks. Heavy snow is associated with vehicle accidents, overexertion, and hypothermia. Drifting is the uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

**Heavy Rain/Freezing Rain/Ice Storm**

Freezing rain and ice storms describe occasions when excessive ice accumulations are expected during a heavy rain event. They are a particularly hazardous winter weather phenomena and often cause numerous automobile accidents, power outages, and personal injury. Ice storms

form from freezing rain and pass through a thin layer of cold air just above the ground and cool to below freezing. The drops remain in a liquid state until they impact a surface and freeze on contact. Ice accumulations can damage trees, utility poles, and communication towers which disrupts transportation, power, and communications.

**Cold**

The definition of extreme cold varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme". In Alaska, extreme cold usually involves temperatures - 40 °F with additional wind chills. Excessive cold may accompany winter storms or can occur without storm activity during clear skies with high barometric pressure. Extreme cold accompanied by wind exacerbates exposure injuries such as frostbite and hypothermia.

Extreme cold interferes with infrastructure across Alaska for days or sometimes weeks at a time. Liquid fuels may congeal or freeze, denying motorized transportation, heat, and electricity generation. In desperation, some people choose to burn propane stoves indoors, increasing their risk to carbon monoxide poisoning. Aircraft may be grounded, delaying the resupply of food and emergency supplies.

#### *5.3.5.2 Climate Change Influences*

Increases in carbon dioxide, methane, and other gases in the atmosphere are generally warming and changing the climate worldwide by trapping heat that would have escaped back into space. Trees and other plants cannot absorb as much carbon dioxide through photosynthesis as is produced by burning fossil fuels. Therefore, carbon dioxide builds up and changes precipitation patterns, increases storms, wildfires, and flooding frequency and intensity; and substantially changes flora, fauna, fish, and wildlife habitats.

Alaska's temperature rise rate has been twice the average of the rest of the U.S. in recent decades. During the period from 1949 to 2014, the Statewide average annual air temperature increased by 3°F, and the average winter temperature increased by 6°F (ACRC, 2018). This included considerable annual and regional variability, and was accompanied by a greater number of extremely warm days and fewer extremely cold days (CCSP, 2008). The Statewide average annual precipitation during this same period has increased by about 10%, with recent decades showing amounts largely above normal, but with substantial annual and regional variability (Shulski and Wendler, 2007, ACRC, 2018).

Global climate is projected to continue changing over this century, and changes to Alaska's climate are expected to be unprecedented (Chapin et al, 2014). Average annual temperatures in Alaska are projected to rise by an additional 2°F to 4°F by 2050, and by 6°F to 12°F by the end of the century depending on emission levels (Stewart et al, 2013). Projections of annual precipitation show an increase across Alaska as part of the broad pattern of increases projected for high northern latitudes.

Snow cover extent and depth have been decreasing in most places in Alaska for nearly three decades. Warmer winter temperatures change the precipitation frequency of snow and rain, and are producing more frequent rain-on-snow events.

### *5.3.5.3 History*

The City of Kenai has a history of two windstorm events in the DHS&EM Disaster Cost Index (DHS&EM, 2018b). These events are listed below.

**12-237. 2011 Kenai Peninsula Windstorm declared by Governor Parnell on December 12, 2011, then FEMA declared February 2, 2012 (DR-4054):** On November 1, 12, 15, and 16, 2011, a series of major windstorms caused widespread power outages threatening life and property. Power was disrupted to 17,300 homes and businesses. Local utilities, Homer Electric Association and Chugach Electric employed several work crews to restore power to the area. Public Infrastructure, commercial property, and personal property damages were reported in the metropolitan areas and throughout the borough. DHS&EM received local declarations from the KPB requesting state disaster assistance to cover immediate response, public, and individual costs. In the City of Kenai, pipes were frozen and burst at City Hall and Vintage Pointe facilities. The primary response by City personnel was to remove downed trees and debris from high winds, supply temporary power to critical facilities during the storm, and respond to burst pipes in buildings without power.

**AK-17-262, 2017 December KPB Storm declared by Governor Walker on January 19, 2018, then FEMA declared on June 18, 2018 (DR-4369):** On December 4, 2017, a fast-moving storm system moving northward out of the Gulf of Alaska brought widespread high winds to coastal areas on both the east and west sides of the KPB. In the Lower Cook Inlet area, this storm system created high winds gusting 30-40 mph, reaching a maximum wind speed of 58 mph, producing seven to ten- foot waves that impacted the Cook Inlet coastline from Homer to Kenai.

### *5.3.5.4 Location, Extent, Impact, and Recurrence Probability*

**Location**

In the City, there is potential for weather disasters. High winds can topple trees, damage roofs and windows, and result in power outages. Heavy snow can cause power outages or collapse roofs of buildings. Storms can make travel difficult. Extreme weather is most prevalent during the winter with any combination of cold temperatures, strong winds, storm surge, and heavy snow.

**Extent**

Severe weather is a normal part of living in Alaska. However, sometimes the confluence of elements produces extreme conditions. Being prepared is the key to survival. Alternate forms of home heat and lighting, stored food, appropriate clothing, and advance planning are critical.

The most common forms of damage to structures as a result of severe wind includes loss of roofing materials, damage to doors and hinges, broken water lines due to freezing, fallen trees, structural failure of out-buildings, fallen or damaged exterior lights, flag poles, and antennae. Overhanging signs on businesses and satellite dishes become airborne projectiles under certain conditions.

Heavy snow brings another set of damages. Structural deflection or collapse of structures is common. Deflection causes cracks or breakage of interior walls and finishes. Falling ice from roof eaves can knock out electric meters, damage vehicles, break windows, and threaten injury to passersby. Sliding snow can cause damages described above plus cause damage to roof mounted vents and other equipment. Wind packed snow and ice can block windows and emergency exits.

**Impact**

Heavy snowfall can also damage infrastructure and critical facilities. Heavy snowfalls make transportation difficult, especially by road, and result in more money spent on snow plow services. High numbers of injuries and fatalities are not expected with a heavy snow event. Heavy snow can have a greater impact on people who need access to medical services, emergency services, pedestrians, and people who rely on public transportation. The cost of fuel to heat homes during times of heavy snow can be a financial burden on populations with low or fixed incomes.

The most vulnerable City residents to any of the hazards of severe weather are the homeless who lack adequate shelter and those on fixed incomes who may not be able to adequately heat their homes.

Extreme weather also interferes with community infrastructure and its proper functions. It can cause fuel to congeal in storage tanks and supply lines, stopping electric power generation, which in turn causes heaters and furnaces to stop. Without electricity, heaters and furnaces do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase, disturbing buried pipes. The greatest danger from extreme cold is its effect on people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices not intended for indoor use during extreme weather events.

While the scope, severity, and pace of future climate change impacts are difficult to predict, it is clear that potential changes could impact U.S. agencies' ability to fulfill their respective missions. The challenges posed by climate change, such as more intense storms, frequency of heavy precipitation, heat waves, drought, and extreme flooding could significantly alter the types and magnitudes of hazards faced by communities and the emergency management professionals serving them.

**Recurrence Probability**

Alaska will continue to experience diverse and seasonal weather events. Severe weather will occur annually in the City. Severe wind and rain are becoming more likely with climate change, while extreme snow and cold are becoming less likely.

### 5.3.6 Wildfire and Conflagration Fire

During the five-year period spanning 2013 through 2018, over 82 fire-related fatalities were recorded in Alaska. Since 2013, the State has declared over 3,077 fire-related emergencies or disasters (DHS&EM, 2018a).

For the purposes of profiling the hazard in Alaska, fires in this HMP are characterized by their primary fuel sources into two categories:

- Wildland fire, which consumes natural vegetation.
- Community fire conflagration, which propagates among structures and infrastructure.

While fire is critical for maintaining the viability of Alaska's ecosystems, it must be tempered with the need to protect human life and property. This is particularly true of fires burning in "wildland urban interface" areas, where structures and other human development meet or intermingle with undeveloped wildland. Wildland urban interface (WUI) has gained importance throughout Alaska with increased development adjacent to wildlands.

Urban conflagration is a large destructive fire that is widespread throughout an urban area or community involving one or more developed areas in the community. In contrast to the commonly destructive individual property fire, conflagrations frequently overwhelm resources and damage infrastructure.

Firefighter and public safety are the primary concern of each local fire response agency. In Alaska, thousands of acres burn every year in 300 to 800 fires, primarily between the months of March and October. According to the Alaska Interagency Coordination Center (AICC), Alaska lost 7,815,368 acres from 2013 to 2017. This figure consisted of the 2,408 wildland fires that started throughout that same time period. This is an average of 3,246 acres per wildland fire (DHS&EM, 2018a).

The KPB, including the City of Kenai, has experienced a regional spruce bark-beetle outbreak. Fire risk has also increased in recent years due to spruce bark beetle infestations which have affected both white and black spruce forest stands. Alaska's 10.25 million-acre KPB has experienced a regional spruce bark-beetle outbreak that peaked in 1996 and continues to spread to uninfected areas. Up to 2004, an estimated four million acres of spruce in southcentral Alaska have been affected. While spruce bark beetle outbreaks are natural events, the magnitude of spruce mortality during historic episodes was typically much less (20% to 30%) than the current infestation in which mortality rates exceeded 90% (KPB, 2006).

Dead and dying spruce trees present a wildfire hazard when standing because they can support intense, rapidly moving fires. These insect-killed trees also present a hazard after they have fallen because they can support very intense surface fires. Wildfire in either fuel type is very difficult for firefighters to control by direct attack.

#### *5.3.6.1 Management in Alaska*

In Alaska, fire management is the responsibility of three agencies: Alaska Department of Forestry (DOF), Bureau of Land Management (BLM) (through the Alaska Fire Service (AFS), and U.S. Forest Service (USFS). See Figure 12. Each agency provides firefighting coverage for a

portion of the State regardless of land ownership. These agencies have cooperated to develop a state-wide interagency wildland fire management plan. In the KPB, the DOF has the responsibility to manage fire response. In 2006, the City adopted a Community Wildfire Protection Plan for its entire acreage. The Alaska Interagency Fire Management Plan has mapped the City as Full.

#### *5.3.6.2 Hazard Characteristics*

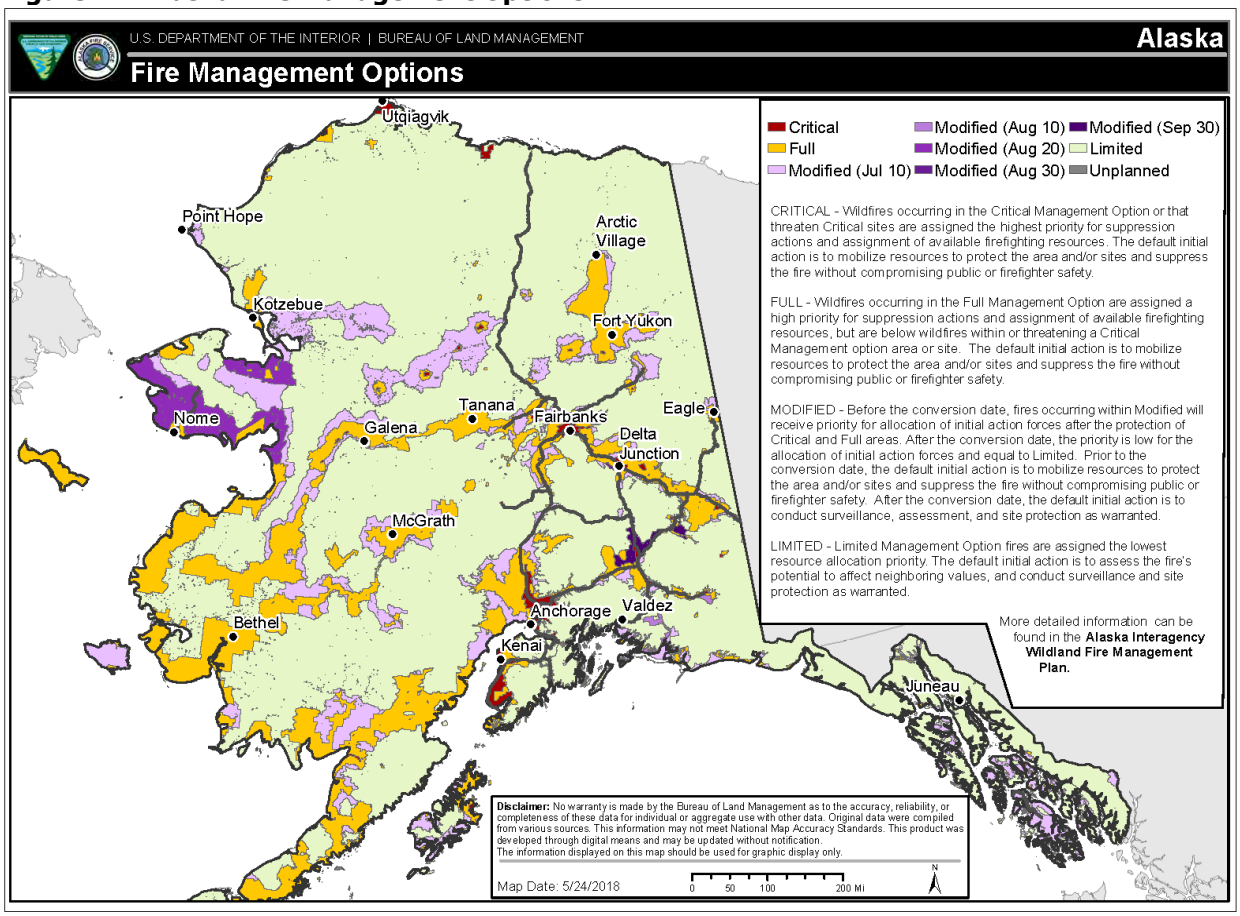
A wildland fire is a type of wildfire that spreads through consumption of vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible for miles around. Wildland fires can be caused by human activities (such as arson or unattended campfires) or by natural events such as lightning. Wildland fires often occur in forests or other areas with ample vegetation. In addition to wildland fires, wildfires can be classified as tundra fires, urban fires, interface or intermix fires, and prescribed burns.

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

- **Topography:** As slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier, and thereby, intensifying wildland fire behavior. However, ridgetops may mark the end of wildland fire spread since fire spreads more slowly or may even be unable to spread downhill.
- **Fuel:** The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. Climate change is deemed to increase wildfire risk significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel load continuity, both horizontally and vertically, is also an important factor.
- **Weather:** The most variable factor affecting wildland fire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signal reduced wildland fire occurrence and easier containment. Climate change increases the susceptibility of vegetation to fire due to longer dry seasons.

The frequency and severity of wildland fires is also dependent on other hazards, such as lightning, drought, and infestations (such as the damage caused by spruce-bark beetle infestations or spruce needle aphids). The risk of wildfire has increased significantly over the past two decades, due in large part to the spruce-bark beetle infestation. If not promptly controlled, wildland fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties; they can also impact transportation corridors and/or infrastructure. In addition to affecting people, wildland fires may severely affect livestock and pets. Such events may require emergency water/food, evacuation, and shelter.

**Figure 12. Alaska Fire Management Options**




The indirect effects of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance rivers and stream siltation, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards.

Conflagration fires are very difficult to control. Complicating factors are wind, temperature, slope, proximity of structures, and community firefighting capability, as well as building construction and contents. Additional factors facing response efforts are hazardous substance releases, structure collapse, water service interruptions, unorganized evacuations, and loss of emergency shelters. Historical national conflagration examples include the Chicago City Fire of 1871 and the San Francisco City Fire following the 1906 earthquake. There have been no conflagration fires within the City of Kenai.

Many wildland firefighters are neither equipped nor trained for conflagration fires. When wildland firefighters encounter structure, vehicle, dump or other non-vegetative fires during the performance of their wildland fire suppression duties, firefighting efforts are often limited to wildland areas.

Structural fire suppression within defined service areas is the responsibility of the Kenai Fire Department.

### 5.3.6.3 Climate Factors

According to the Global Climate Change Impacts in the U.S., published in 2009 by the U.S. Global Change Research Program, "Under changing climate conditions, the average area burned per year in Alaska is projected to double by the middle of this century. By the end of this century, area burned by fire is projected to triple under a moderate greenhouse gas emissions scenario and to quadruple under a higher emissions scenario" (DHS&EM, 2018a).

Since 1990, Alaska has experienced nearly twice the number of wildfires per decade compared to a period from 1950 to 1980. Additionally, the sparsely-populated arctic region experienced only three wildfires over 1,000 acres from 1950 to 1970. Since 2000, there have been over 33 large wildfires in this same region.

The average duration of the wildfire season in the arctic region runs from May through July. Other regions south of the arctic may run from late April through mid-September. Average annual precipitation in Alaska has increased since 1950, but not quite as much as the average annual temperature.

Wind blows down dead trees that have been affected by spruce-bark beetles. As air temperatures warm, spruce-bark beetles spread; typically, this occurs when temperatures are over 60 °F.

### 5.3.6.4 History

The City does not have a history of fire events in the DHS&EM Disaster Cost Index (DHS&EM, 2018b). AICC maintains a website to consolidate Alaska's tundra fire information. Information in Table 9 and Figure 13 for the City and surrounding area were obtained from this site. Figure 14 shows the State's fire risk (DHS&EM, 2018a).

**Table 9. Historical Wildland Fires**

| Fire Name | Fire Year | Estimated Acres | Latitude | Longitude | Specific Cause |
|---|---|---|---|---|---|
| Berry | 1945 | 200 | 60.5499992 | -151.2166595 | Unknown |
| Norene Fire | 1953 | 2.5 | 60.583889 | -151.3333282 | Debris Burning |
| Peterkin | 1958 | 3 | 60.5499992 | -151.0833282 | Debris Burning |
| Spur | 1968 | 5 | 60.5666667 | -151.2833333 | Debris Burning |
| Crowder | 1969 | 2 | 60.5833333 | -151.2333333 | Equipment |
| Cement Plant | 1969 | 250 | 60.55 | -151.1833333 | Smoking |
| Wildwood | 1970 | 46 | 60.5833333 | -151.3 | Playing / Matches |
| Candlelight | 1984 | 80 | 60.5499992 | -151.1833344 | Other |
| Bigeddy | 1999 | 5.5 | 60.51667 | -151.0833 | Other |
| Cannery Rd. #1 | 2009 | 1.5 | 60.521389 | -151.2763824 | Other |
| California Ave. | 2009 | 1.5 | 60.5825005 | -151.2938843 | Unknown |
| Marathon Rd. | 2009 | 10.9 | 60.5811119 | -151.2302704 | Equipment |
| Redoubt | 2019 | 1.4 | 60.57805 | -151.275 | |

(AICC, 2019)

### *5.3.6.5 Location, Extent, Impact, and Recurrence Probability*

**Location**

Nearly every community in the KPB's wildfire risk is very high or extreme due to dead and dying spruce trees. Within the City, trees infested by the spruce bark beetle became a mitigation priority in the late 1990s, with firefighteres conducting door-to-door educational camptaigns in high-risk neighborhoods delivering information packets to homeowners on how to develop a defensible space around their properties.

Historically significant fires within the City included the 1969 Swanson River Fire and the Swires Road fire in the mid-1980s. The City experiences small wildland fires throughout the summer months, with the most recent being a 10-acre fire during the summer of 2009 which the City of Kenai Fire Department and DOF responded to cooperatively.

The KPB typically experiences wildfires, and in 2019, the Swan Lake fire was caused by lightning in June and burned 142,542 acres before it was 20% contained in August, northwest of Cooper Landing and to the east and northeast of Sterling. Smoke was a concern for the City of Kenai depending on which direction the wind blew. Fire burned adjacent to the road in some areas, and the only road to Anchorage was closed at times.

**Extent**

Generally, fire vulnerability dramatically increases in the late summer and early fall as vegetation dries out, decreasing plant moisture content, and increasing the ratio of dead fuel to living fuel. However, various other factors, including humidity, wind speed and direction, fuel load and type, and topography can contribute to the intensity and spread of wildland fires. The common causes of wildland fires in Alaska include lightning strikes and human negligence.

Fuel, weather, and topography influence wildland fire behavior. Fuel (e.g., slash, dry undergrowth, flammable vegetation) determines how much energy the fire releases, how quickly the fire spreads, and how much effort is needed to contain the fire. Weather is the most variable factor. High temperatures and low humidity encourage fire activity while low temperatures and high humidity retard fire spread. Wind affects the speed and direction of fire spread. Topography directs the movement of air, which also affects fire behavior. When the terrain funnels air, as happens in a canyon, it can lead to faster spreading. Fire also spreads up slope faster than down slope.

**Impact**

Impacts of a wildland fire that interfaces with the population center could grow into an emergency or disaster if not properly controlled. A small fire can threaten lives and resources and destroy property. In addition to impacting people, wildland fires may severely impact livestock and pets. Such events may require emergency watering and feeding, evacuation, and alternative shelter.

Indirect impacts of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and

support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life, and degrading water quality.

**Recurrence Probability**

Increased community development, fire fuel accumulation, and weather pattern uncertainties indicate that seasonal wildfires will continue into the future.

**Figure 13. Kenai Wildland Fire History**

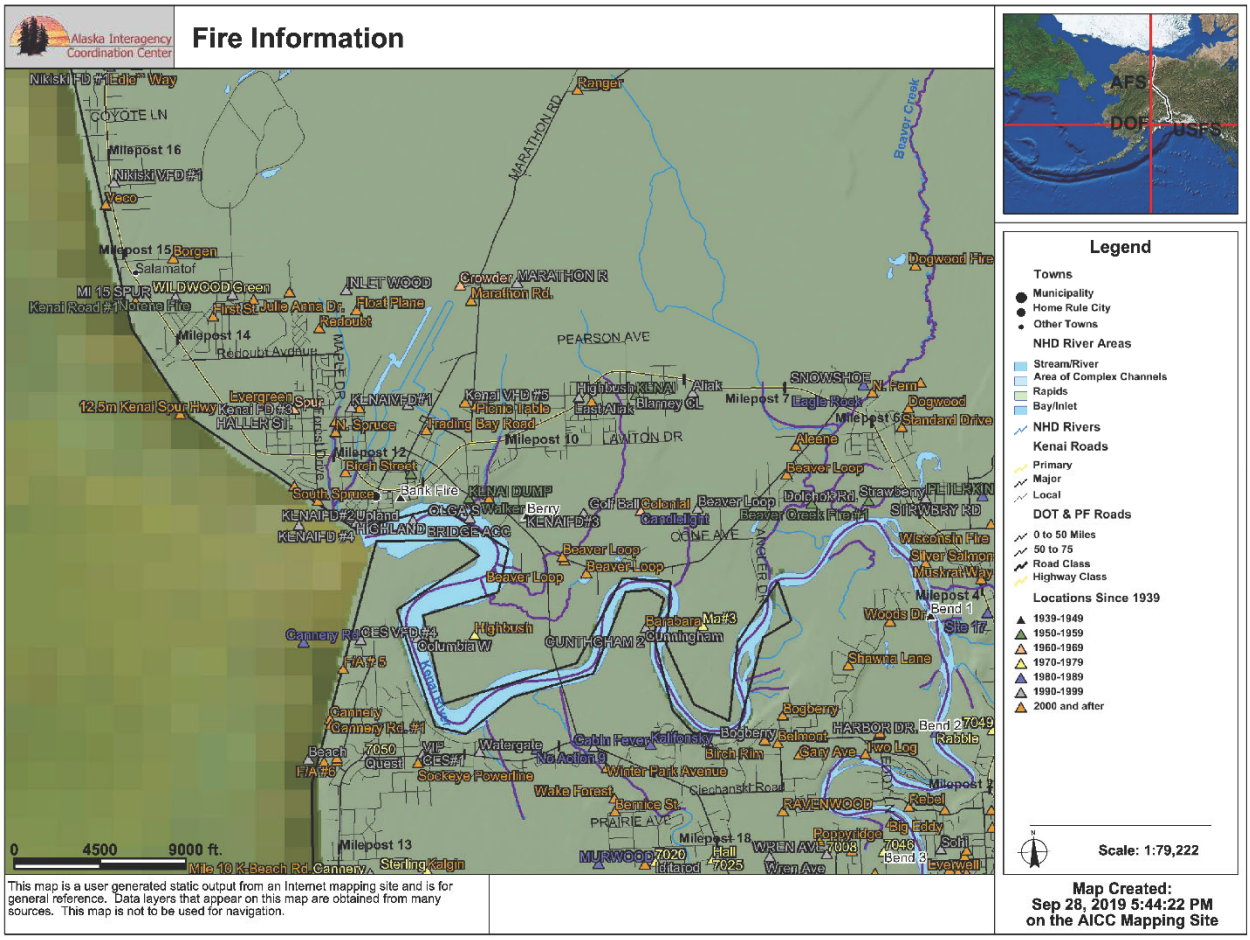
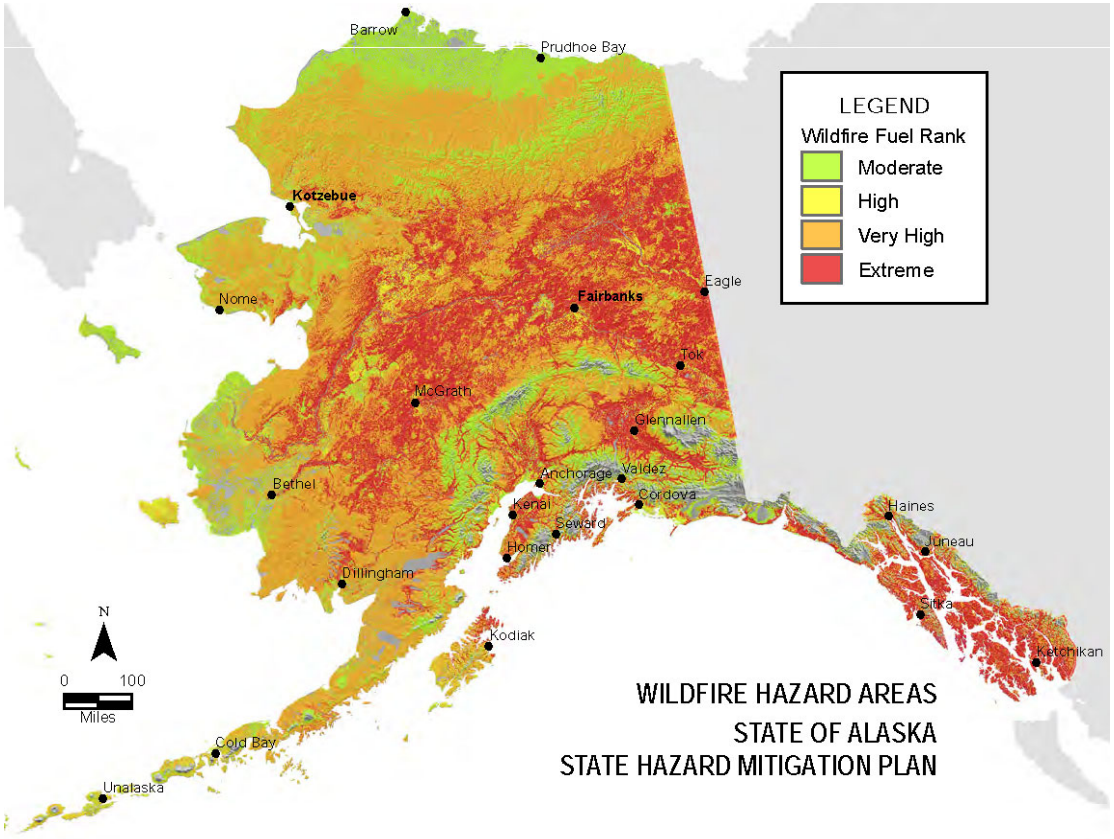


**Figure 14. City's Wildland Fire Risk**



This section provides an overview of the vulnerability analysis.

## 6.1 OVERVIEW OF A VULNERABILITY ANALYSIS

A vulnerability analysis predicts the exposure extent that may result from a given hazard event and its impact intensity within the planning area. This qualitative analysis provides data to identify and prioritize potential mitigation measures by allowing the community to focus attention on areas with the greatest risk. A vulnerability or risk analysis is divided into the following five focus areas:

1. Asset Inventory;
2. Infrastructure Risk, Vulnerability, and Losses from Identified Hazards;
3. Development Changes and Trends;
4. Data Limitations; and
5. Vulnerability Assessments.

DMA 2000 requirements and implementing state governance regulations for developing risk and vulnerability assessment initiatives are described below.

**DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Overview**

**Assessing Vulnerability: Overview**

**§201.6(c)(2)(ii):** The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described. This description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of:

**§201.6(c)(2)(ii)(A):** The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;

**§201.6(c)(2)(ii)(B):** An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

**§201.6(c)(2)(ii)(C):** Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Element**

- Does the plan include a description of the jurisdiction's vulnerability to each hazard?
- Does the plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the plan estimate potential dollar losses to vulnerable structures?
- Does the plan describe the methodology used to prepare the estimate?

Source: FEMA, 2015.

## 6.2 CURRENT ASSET EXPOSURE ANALYSIS

### 6.2.1 Asset Inventory

Assets that may be affected by hazard events include population (for community-wide hazards), residential buildings, and critical facilities and infrastructure. Assets are grouped into two

structure types: critical infrastructure and residential properties. The assets and associated values throughout the City are identified and discussed in detail in the following subsections.

### 6.2.1.1 Population and Building Stock

The City's total population for 2010 was 7,100, and the 2016 ACS data reported a population of 7,551 (Table 10).

**Table 10. Estimated Population and Building Inventory**

| Population | | Residential Buildings | |
|---|---|---|---|
| **2010 Census** | **2016 ACS Data** | **Total Building Count** | **Total Value of Buildings[1]** |
| 7,100 | 7,551 | 3,221 | Planning Team: 644,200,000 |

Sources: 2010 U.S. Census and 2016 ACS Certified population data.

[1] Planning Team determined the average replacement value of all single-family residential buildings to be $200,000 per structure. This value will be updated in the Final Plan once the value is received from the KPB.

### 6.2.1.2 Critical Infrastructure

Critical infrastructure is defined as a facility that provides essential products and services to the general public, such as preserving quality of life while fulfilling important public safety, emergency response, and disaster recovery functions. Critical facilities and infrastructure for the City are profiled in this HMP and include the following (see also Table 11):

- Government: City administrative offices, departments, or agencies;
- Emergency Response: including police and fire personnel services; and fire-fighting equipment; and
- Health Care: medical clinics, congregate living, health, residential and continuing care, and retirement facilities.

**Table 11. Alaska's Critical Infrastructure**

| | | | | |
|---|---|---|---|---|
| • Hospitals, Clinics, & Assisted Living Facilities | • Satellite Facilities | • Power Generation Facilities | • Oil & Gas Pipeline Structures & Facilities | • Schools |
| • Fire Stations | • Radio Transmission Facilities | • Potable Water Treatment Facilities | • Service Maintenance Facilities | • Community Washeterias |
| • Police Stations | • Highways and Roads | • Reservoirs & Water Supply Lines | • Community Halls & Civic Centers | • National Guard Facilities |
| • Emergency Operations Centers | • Critical Bridges | • Waste Water Treatment Facilities | • Community Stores | • Landfills & Incinerators |
| • Any Designated Emergency Shelter | • Airports | • Fuel Storage Facilities | • Community Freezer Facilities | • Community Cemeteries |
| • Telecommunications Structures & Facilities | | • Harbors / Docks / Ports | | |

### 6.2.1.3 Infrastructure Risk, Vulnerability, and Losses from Identified Hazards

Table 12 provides critical facilities and infrastructure identified for the City. See Figure 15 for a critical facilities map. Vulnerabilities are described further In Section 6.2.1.6.

### *6.2.1.4 Land Use and Development Trends*

Requirements for land use and development trends, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Analyzing Development Trends**

**Assessing Vulnerability: Analyzing Development Trends**

**Requirement §201.6(c)(2)(ii)(C)**: [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Element**

- Does the plan describe land uses and development trends?

*Source: FEMA, 2015.*

The City has been a deferred code enforcement entity since the late 1970s enforcing local building, fire, and life safety codes in plan reviews for new construction. This provides local access and oversight in new construction without requiring plans being sent through the State Fire Marshal's office in Anchorage.

Zoning changes are needed to comply with the 2016 *City of Kenai Comprehensive Plan* and to prevent infrastructure loss near the eroding Kenai bluffs. Public Works has been addressing this for several years, and the City has restricted new construction near hazardous areas, and infrastructure has been relocated to prevent added loss or damage (water and sewer lines, utilities, etc.).

The 2016 *City of Kenai Comprehensive Plan* projects modest economic growth and population increase. The region's main economic sectors of energy, fishing/fish processing, and tourism also experienced modest growth. Kenai is expected to continue as a trade and services center for the region. Consistent with regional and national trends, the proportion of people aged 65 and older is expected to increase within the City. The City of Kenai's median age is lower than the national median age and slightly higher than the State of Alaska's median age.

Approximately 1,680 homes and businesses (4,000-5,000 users) are connected to the City's water and sewer system. This is approximately 70% of the City's population. The City has four operational well houses and a wastewater treatment plant. A new 1,000,000-gallon water reservoir was constructed in 2016. Of the 99 miles of roads in Kenai, the City of Kenai maintains approximately 60 miles, including approximately 15 miles of gravel-surfaced roads. Improvements to the road system to create more vehicle and pedestrian traffic in the City Center and provide safety and efficiency in travel could include paving more streets, constructing sidewalks, creating trail linkages, and expanding road shoulders. The Kenai Municipal Airport is currently undergoing a major remodeling. The Kenai Municipal Airport is the largest airport with the KPB and is an important distribution center in the area.

The City has an ample supply of vacant land for future development. Development near existing City services will make the best use of public development expenditures. Commercial and retail development along the highway corridors has created a linear City form. Residential development is dispersed, and multiple commercial centers are emerging in the City.

#### 6.2.1.5 Data Limitations

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in a risk approximation. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment as well as the use of approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this HMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts may be addressed with future updates of this HMP.

#### 6.2.1.6 Vulnerability Assessments

Hazards are assessed with regards to their vulnerabilities in this section.

##### Fire Vulnerabilities

The 2018 *State of Alaska HMP* categorizes the KPB at risk of experiencing high fire impacts. Impacts associated with a fire event include the potential for loss of life and property. Buildings closer to the outer edge of town, those with a lot of vegetation surrounding the structure, and those constructed with wood are some of the buildings that are more vulnerable to the impacts of fire.

The City maintains a defensible space around all City facilities as a preventative measure for wildland fires.

Dry forest conditions increase fire fuels and insect infestations. These conditions create optimum conditions for fire propagation, especially around housing and other areas where fire fuels are not controlled near public or private structures. Future populations, residential structures, critical facilities, and infrastructure located in dryer regions of Alaska are anticipated to experience increased fire events compared to historical impacts.

##### Flood and Erosion Vulnerabilities

The 2018 State of Alaska HMP categorizes the KPB at risk of experiencing high flooding and erosion impacts. City Dock facilities are somewhat vulnerable to flood conditions, but were constructed with those events in mind, and generally remain usable in a flood event.

The City does not participate in the NFIP.

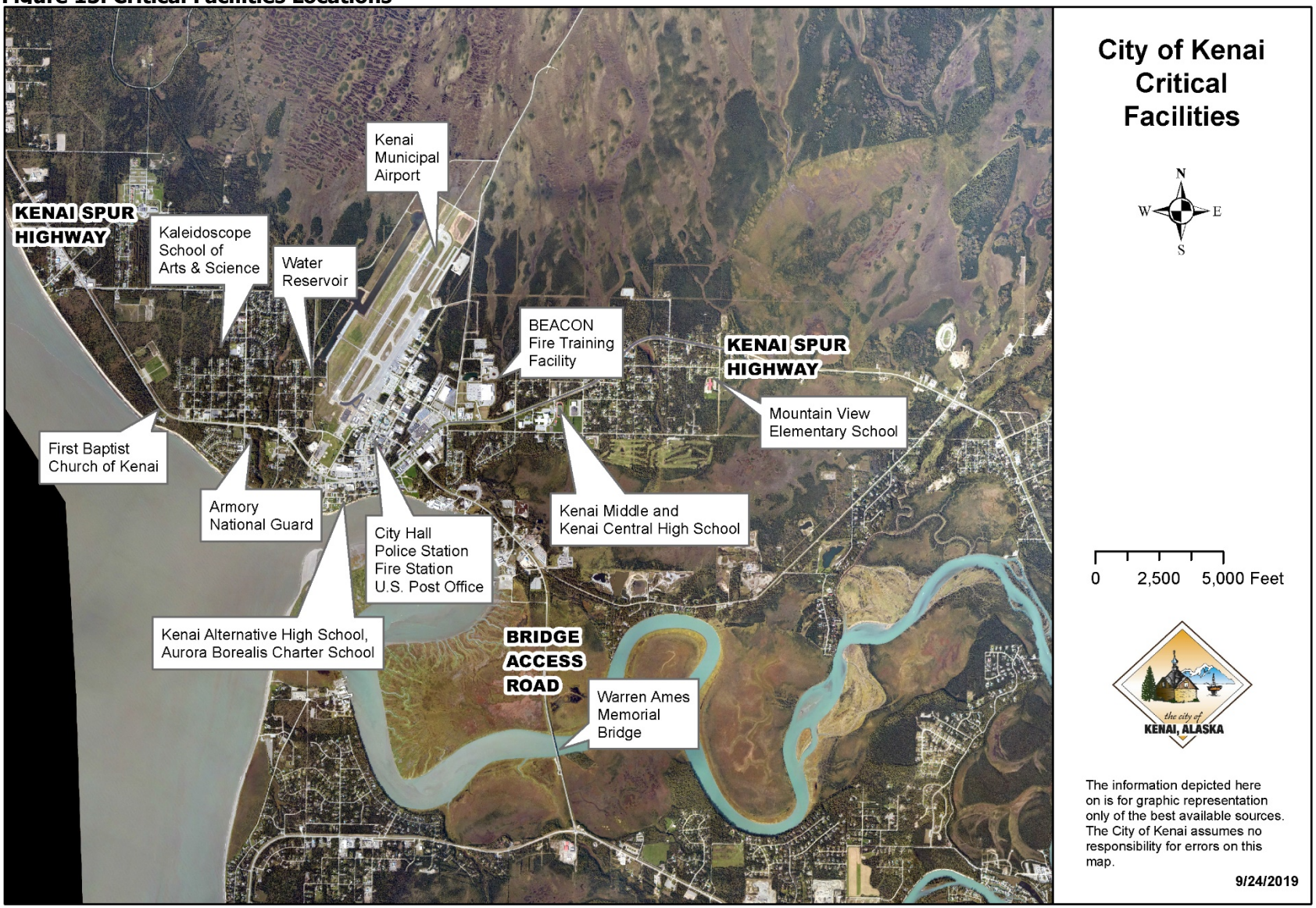
The Senior Center, Congregate Housing (Vintage Pointe Manor) and Wastewater Treatment Plant are more vulnerable to erosion damage than the remainder of City facilities. The Kenai Bluffs erosion is an important concern of the City's. The City has taken steps to preserve the integrity of protective dunes by installing permanent fencing.

**Table 12. Kenai's Critical Facilities**

| Type of Facility | Facilities | Address | Latitude | Longitude | Estimated Value (2019 KPB Estimate) | Number of Occupants | Building Type | Volcanic Ashfall | Earthquake | Flood/Erosion | Cryosphere | Weather (Severe) | Fire |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Government | City Hall | 210 Fidalgo Avenue | 60.559085 | -151.248688 | $831,600 | 20 | Class 6, Type 1 Steel | x | x | | x | x | x |
| | National Guard | 105 South Forest Drive | 60.559036 | -151.276414 | $1,086,800 | 20 | Class 51C Galvanized Steel | x | x | | x | x | x |
| | U.S. Post Office | 140 Bidarka Street | 60.557799 | -151.248010 | $2,709,600 | 15 | Stucco | x | x | | x | x | x |
| Transportation | Kenai Municipal Airport – Passenger Terminal | 305 North Willow Street | 60.565269 | -151.246915 | $14,000,000 | 200 | Airport | x | x | x | x | x | x |
| Emergency Response | Kenai Public Safety (Police Station and Fire Station) | 107 South Willow Street | 60.559112 | -151.250225 | $2,387,900 | 30 | Concrete Block (Jail), Class 1 Wood Frame | x | x | | x | x | x |
| Education | Mountain View Elementary School* | 315 Swires Road | 60.565476 | -151.176598 | $13,543,700 | 480 | Class 1 Wood Frame | x | x | | x | x | x |
| | Kenai Alternative High School, Aurora Borealis Charter School | 705 Frontage Road | 60.554048 | -151.253699 | $11,817,000 | 80 | Class 1 Wood Frame | x | x | | x | x | x |
| | Kaleidoscope School of Arts & Science* | 549 North Forest Drive | 60.568725 | -151.279090 | $10,443,300 | 290 | Class 1 Wood Frame | x | x | | x | x | x |
| | Kenai Middle School* | 201 North Tinker Lane | 60.562831 | -151.206125 | $23,121,600 | 360 | Class 1 Wood Frame | x | x | | x | x | x |
| | Kenai Central High School* | 9583 Kenai Spur Highway | 60.561267 | -151.212238 | $55,754,300 | 500 | Class 1 Wood Frame | x | x | | x | x | x |
| Medical | Kenai has Medical Clinics, but the nearest hospital is in neighboring Soldotna | N/A | N/A | N/A | N/A | N/A | N/A | | | | | | |
| Community | BEACON Alaska Regional Aircraft Fire Training Center | 450 Daubenspeck Circle | 60.566308 | -151.225563 | $6,626,500 | 50 | Class 1 Steel | x | x | | x | x | x |
| | First Baptist Church* | 12815 Kenai Spur Highway | 60.560715 | -151.295380 | $798,100 | 100 | Class 1 Wood Frame | x | x | x | x | x | x |
| Road | Kenai Spur Highway (approx. 10.5 miles) | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | x |
| | Bridge Access Road (3.5 miles) | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | x |
| Bridge | Warren Ames Memorial Bridge | Bridge Access Road | 60.526740 | -151.209042 | N/A | N/A | N/A | x | x | x | x | x | x |
| Utility | Electric – Homer Electric | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | x |
| | Telephone – GCI | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | x |
| | Gas – ENSTAR | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | x |
| | Wastewater Treatment Plant | N/A | 60.442466 | -151.276836 | $7,301,200 | 5 | Sewage Treatment Plant | x | x | x | x | x | x |
| | Four Wellheads | N/A | N/A | N/A | N/A | N/A | N/A | x | x | x | x | x | |
| | Water Reservoir | N/A | 60.564703 | -151.260959 | $2,750,000 | N/A | N/A | x | x | | x | x | |
| | | | | **Totals** | **$153,173,600** | | | | | | | | |

*Shelters

**Figure 15. Critical Facilities Locations**



Kenai's flood- and erosion-threatened population and infrastructure potentially include: the existing, transient, and future population, residential structures, critical facilities, and infrastructure that are exposed to changing flooding and erosion impacts.

### *Earthquake Vulnerabilities*

Alaska should expect the full spectrum of potential earthquake ground motion scenarios. Severe shaking may result in infrastructure damage that is equally as extreme. Although all structures are at some risk due to earthquakes, short wooden buildings are less vulnerable than multi-story and complex masonry/steel structures. The majority of Alaska's schools, State, and Federal buildings are built and sited based on stringent seismic construction standards and are expected to survive major earthquake events.

The 2018 *State of Alaska HMP* categorizes the KPB at risk of experiencing high earthquake impacts. Protective measures are in place to minimize damage such as housing emergency generators inside and meeting construction standards for the seismic zone.

Due to Alaska's highly active geologic setting at a tectonic plate boundary, future populations, residential structures, critical facilities, and infrastructure will be exposed to continued earthquakes of various magnitudes—from those that are barely felt to those that detrimentally affect large regions of the State.

### *Severe Weather Vulnerabilities*

The 2018 *State of Alaska HMP* categorizes the KPB at risk of experiencing high severe weather impacts. Impacts associated with severe weather events include roof collapse, trees and power lines falling, damage to light aircraft and sinking small boats, and injury and death resulting from snow machine or vehicle accidents and overexertion while shoveling (all due to heavy snow). A quick thaw after a heavy snow can also cause substantial flooding. Impacts from extreme cold include hypothermia, halting transportation from fog and ice, congealed fuel, frozen pipes, disruption in utilities, frozen pipes, and carbon monoxide poisoning. Buildings that are older and/or not constructed with materials designed to withstand heavy snow and wind (e.g., hurricane ties on crossbeams) are more vulnerable to the impacts of severe weather. The entire State is threatened by severe weather events.

Severe weather will occur annually in Kenai. Climate change impacts vary across Alaska. These conditions will negatively impact future populations, residential structures, critical facilities, and infrastructure.

### *Volcanic Ashfall Vulnerabilities*

The 2018 *State of Alaska HMP* categorizes the KPB at risk of experiencing high volcanic impacts. Impacts associated with an ashfall event include the potential for ashfall to damage motors and ashfall impairing air quality.

### *Changes in the Cryosphere Vulnerabilities*

Alaska can expect to experience ever-changing effects from melting polar ice sheets, mountain glaciers, and other cryosphere impacts. According to mapping completed by the USGS, Kenai does not have permafrost at ground level. Sea ice and river ice affect Kenai.

Similar to weather vulnerabilities, changing cryospheric conditions also vary across Alaska. Therefore, the entire population and infrastructure could be vulnerable to recurrent cryosphere hazard impacts.

A mitigation strategy provides the blueprint for implementing desired activities that will enable the City to continue to save lives and preserve infrastructure by systematically reducing hazard impacts, damages, and community disruptions. This section outlines the process for preparing a mitigation strategy including:

1. Develop Mitigation Goals to mitigate the hazards and risks identified (see Sections 5 and 6).
2. Identify Mitigation Actions to meet the Mitigation Goals.
3. Evaluate Mitigation Actions.
    a. Describe and analyze Local mitigation policies, programs, and funding sources.
    b. Evaluate Federal and State hazard management policies, programs, capabilities, and funding sources.
4. Implement the Mitigation Action Plan (MAP).

Within this section, the Hazard Mitigation Project Team developed mitigation goals and potential mitigation actions.

## 7.1 DEVELOPING MITIGATION GOALS

Requirements for hazard mitigation goals, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Mitigation Strategy –Hazard Mitigation Goals**

**Local Hazard Mitigation Goals**

**Requirement §201.6(c)(3)(i):** [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

**Element**

- Does the plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?

*Source: FEMA, 2015.*

The exposure analysis results were used as a basis for developing the mitigation goals and actions. Mitigation goals are defined as general guidelines that describe what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions. As such, goals were developed to reduce or avoid long-term vulnerabilities to identified hazards (Table 13). Goals are numbered according to the order of hazard priority; hazard designations are abbreviated as:

- F (Fire);
- F & E (Flooding and Erosion);
- E (Earthquakes);
- V (Volcanic Ash);
- SW (Severe Weather); and
- G (General).

**Table 13. Mitigation Goals**

| No. | Goal Description |
|---|---|
| F1 | Reduce or eliminate loss of homes and property due to fires. |
| F & E 2a | Reduce or eliminate the erosion of the bluff at the mouth of the Kenai River. Note that this goal incorporates the changes to the cryosphere hazard with the erosion hazard. |
| F & E 2b | Reduce or eliminate property damage and influx of debris into waterways due to floods by raising public awareness and through zoning changes. |
| E 3 | Prepare citizens and the built environment to better survive the hazards associated with earthquakes. |
| V 4 | Educate citizens to adequately protect themselves and property from hazards of volcanic ash. |
| SW 5 | Educate citizens and the built environment to better survive the hazards associated with severe weather. |
| G 6 | Identify ways for the City to better prepare for an emergency. |

## 7.2 IDENTIFYING MITIGATION ACTIONS

Requirements for identification and analysis of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions**

**Identification and Analysis of Mitigation Actions**

**Requirement §201.6(c)(3)(ii):** [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

**Element**

- Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?
- Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?
- Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?

*Source: FEMA, 2015.*

After mitigation goals and actions were developed, the Planning Team assessed the potential mitigation actions to carry forward into the mitigation strategy. Mitigation actions are activities, measures, or projects that help achieve the goals of an HMP. Mitigation actions are usually grouped into three broad categories: property protection, public education and awareness, and structural projects. The Planning Team placed particular emphasis on projects and programs that reduce the effects of hazards on both new and existing buildings and infrastructure. These potential projects are listed in Table 16.

## 7.3 EVALUATING AND PRIORITIZING MITIGATION ACTIONS

Requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions**

**Implementation of Mitigation Actions**

**Requirement: §201.7(c)(3)(iii):** [The mitigation strategy section shall include] an action plan describing how the actions identified in Section (c)(3)(ii) will be prioritized, implemented, and administered by the Local Government. Prioritization shall

**DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions**

include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

**Element**

- Does the mitigation strategy include how the actions are prioritized?
- Does the mitigation strategy address how the actions will be implemented and administered?
- Does the prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?

*Source: FEMA, 2015.*

The Planning Team identified mitigation actions on October 30, 2019, to determine which actions would be retained in the MAP. The MAP contained in Table 14 represents potential mitigation projects and programs. The Hazard Mitigation Planning Team ranked the top three hazards with the potential to impact Kenai as fire, erosion, and earthquakes.

### Table 14. Mitigation Goals and Potential Actions

| Goals | | Actions | |
|---|---|---|---|
| **No.** | **Description** | **ID** | **Description** |
| F1 | Reduce or eliminate loss of homes and property due to fires. | A | Promote the development of FireWise neighborhoods to include the removal of fuels and increased awareness of fire hazards in the community. |
| | | **B** | Develop a wildland hazard map based on vegetation data that ranks land based upon its likely susceptibility to the spruce bark beetle. |
| | | **C** | Map hydrant locations. Extend water lines as needed to increase coverage. |
| F & E 2a | Reduce or eliminate the erosion of the bluff at the mouth of the Kenai River. | **A** | Implement the recommendation from the 2018 USACE Report. |
| F & E 2b | Reduce or eliminate property damage and influx of debris into waterways due to floods by raising public awareness and through zoning changes. | **A** | Continue cooperative efforts of the KPB, City of Kenai Planning and Zoning Commission, City Council, and land owners/developers to enact and enforce a 50-foot setback of items on properties adjacent to waterways. |
| | | **B** | Evaluate the feasibility of participating in the NFIP. |
| E 3 | Prepare citizens and the built environment to better survive the hazards associated with earthquakes. | **A** | Raise public awareness of potential threats and necessary preparations to increase survivability of citizens and structures. |
| V 4 | Prepare citizens to adequately protect themselves and property from hazards of volcanic ash. | **A** | Educate the public to prepare for the harmful effects of volcanic ash fallout to life and property. |
| SW 5 | Educate citizens and the built environment to better survive the hazards associated with severe weather. | **A** | Enforce building codes for structures to withstand high winds. |

| | | | |
|---|---|---|---|
| G 6 | Identify ways for the City to better prepare for an emergency. | **A** | Update the City's Emergency Operating Plan from 2007 to ensure the appropriate response to natural hazards. |
| | | **B** | Update the Alaska Fire Training Facility as an Emergency Operations Command Center. |

The requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations are described below.

**DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions**

**Implementation of Mitigation Actions**

**Requirement: §201.6(c)(3)(iii):** [The mitigation strategy section shall include] an action plan describing how the actions identified in Section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

**Element**

- Does the mitigation strategy include how the actions are prioritized?
- Does the mitigation strategy address how the actions will be implemented and administered?
- Does the prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?

*Source: FEMA, 2015.*

The Hazard Mitigation Project Team reviewed the simplified social, technical, administrative, political, legal, economic, and environmental (STAPLEE) evaluation criteria (Table 15) and the Benefit-Cost Analysis Fact Sheet (Appendix D) to consider the opportunities and constraints of implementing each particular mitigation action. For each action considered for implementation, a qualitative statement is provided regarding the benefits and costs and, where available, the technical feasibility. A detailed cost-benefit analysis is anticipated as part of the application process for those projects the City chooses to implement.

**Table 15. Evaluation Criteria for Mitigation Actions**
Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE)

| Evaluation Category | Discussion "It is important to consider…" | Considerations |
|---|---|---|
| **Social** | The public support for the overall mitigation strategy and specific mitigation actions. | Community acceptance<br>Adversely affects population |
| **Technical** | If the mitigation action is technically feasible and if it is the whole or partial solution. | Technical feasibility<br>Long-term solutions<br>Secondary impacts |
| **Administrative** | If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary. | Staffing<br>Funding allocation<br>Maintenance/operations |
| **Political** | What the community and its members feel about issues related to the environment, economic development, safety, and emergency management. | Political support<br>Local champion<br>Public support |
| **Legal** | Whether the community has the legal authority to implement the action, or whether the community must pass new regulations. | Local, Tribal, State, and Federal authority<br>Potential legal challenge |

| Evaluation Category | Discussion "It is important to consider…" | Considerations |
|---|---|---|
| **Economic** | If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit-Cost Analysis. | Benefit/cost of action<br>Contributes to other economic goals<br>Outside funding required<br>FEMA Benefit-Cost Analysis |
| **Environmental** | The impact on the environment because of public desire for a sustainable and environmentally healthy community. | Effect on local flora and fauna<br>Consistent with community environmental goals<br>Consistent with Local, Tribal, State, and Federal laws |

On October 29, 2019, the Hazard Mitigation Project Team considered each hazard's history, extent, and probability to determine each mitigation action's priority. A rating system based on high, medium, or low was used. High priorities are associated with actions for hazards that impact the community on an annual or near annual basis and generate impacts to critical facilities and/or people. Prioritizing the mitigation actions in the MAP Matrix was completed on October 29, 2019, to provide the City with an approach to implementing the MAP. Table 16 defines the mitigation action priorities.

## 7.4 IMPLEMENTING A MITIGATION ACTION PLAN

Requirements for Local Government policies in mitigation strategies, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Mitigation Strategy**

**Implementation of Mitigation Actions**

**Requirement: §201.6(c)(3)(iii)**: [The mitigation strategy section shall include]: an action plan describing how the actions will be prioritized implemented, and administered by the Local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

**Element**

- Does the plan contain a mitigation action plan?

Table 16 defines the MAP.

**Table 16. City Mitigation Action Plan**
*(See acronym and abbreviations list for complete titles)*

| Action ID | Description | Priority | Responsible Department | Potential Funding | Timeframe | Benefit-Costs / Technical Feasibility |
|---|---|---|---|---|---|---|
| F 1a | Promote FireWise programs including public education programs in school and neighborhoods. | High | Fire Chief | Minimal cost anticipated; City | 2020 | B/C: This is an easily-implemented mitigation action.<br>TF: This action could be accomplished by the Fire Department at minimal cost. |
| F 1b | Promote the development of defensible space and landscaping techniques to community and home construction contractor participation. | High | Fire Chief | Minimal cost anticipated; City | Spring 2020 | B/C: This is an easily-implemented mitigation action.<br>TF: This action could be accomplished by the Fire Department at minimal cost. |
| F 1c | Encourage the reduction of fuels in hazardous areas and egress routes in coordination with the Kenai Peninsula Spruce Bark Beetle Mitigation Office, State Forestry, and land owners. | High | Fire Chief | City, DHS Preparedness Technical Assistance Program, HMGP, PDM Grants | 2020 | B/C: National statistics state that there is a $10 benefit for every $1 spent on wildfire mitigation. Flyers and radio ads are inexpensive.<br>TF: This action could be accomplished by the Fire Department at minimal cost. Homeowners and property owners would be responsible for their own lots. Funding would be needed for City property. |
| F 1d | Develop a wildland hazard map based on vegetation data that ranks land based upon its likely susceptibility to the spruce bark beetle. | High | KPB/City Planner | Funding has already been obtained | Spring 2020 | B/C: KPB has mapping expertise.<br>TF: This action is already in progress. |
| F 1 e | Map hydrant locations. Extend water lines as needed to increase coverage. | High | Public Works Director | Funding has already been obtained | Spring 2020 | B/C: Public Works has expertise.<br>TF: This action is already in progress. |

| Action ID | Description | Priority | Responsible Department | Potential Funding | Timeframe | Benefit-Costs / Technical Feasibility |
|---|---|---|---|---|---|---|
| F & E 2a | Implement Kenai Bluffs protection measure recommended in the 2018 USACE Kenai Bluffs study. | High | City Planner | City, USACE, Legislature Capital Budget | 2020-2025 | B/C: The USACE has already completed the study and identified the best solution. TF: The City is seeking funding opportunities. |
| F & E 2b | Establish zoning and building restrictions for the Kenai Bluffs area, and develop a plan to move infrastructure back from the bluff. | High | City Planner | City | 2020 | B/C: This project would prevent infrastructure from being eroded into the bluff below. TF: This project is feasible using existing community resources and construction standards. Equipment and materials require grant funding. |
| F & E 2c | Continue cooperative efforts of the KPB, City of Kenai Planning & Zoning Commission, City Council, and land owners/developers to enact and enforce a 50-foot setback of items on properties adjacent to waterways. | High | City Planner | City | Ongoing | B/C: The Kenai River Overlay mandates a 50-foot building setback from the mean high water line of the Kenai River. KPB regulations for development in this area meet the objective to minimize damage in the event of a flood. TF: The City has the necessary resources to enforce regulations already in place. |
| F & E 2d | Evaluate the feasibility of participating in the NFIP. | Medium | City Planner | City | 2020 | B/C: The KPB participates in the NFIP. TF: The KPB would act as the Floodplain Manager. |
| E 3a | In an effort to reduce property damage, the City will continue to adopt and enforce current building codes and construction standards that address the seismic concerns for the KPB. | High | City Planner | City | Ongoing | B/C: The City has already adopted the codes and enforces them. TF: Codes are already implemented. |
| E 3b | Prepare citizens and the built environment to better survive the | High | City Planner | City | Ongoing | B/C: A comprehensive earthquake safety program, |

| Action ID | Description | Priority | Responsible Department | Potential Funding | Timeframe | Benefit-Costs / Technical Feasibility |
|---|---|---|---|---|---|---|
| | hazards associated with earthquakes through the promotion of public education and the practice of sheltering in place. Encourage the preparation of citizens for self - sufficiency on a post-earthquake scenario. | | | | | delivered as appropriate to all ages and audiences will save lives. Seismic standard construction will increase survivability of occupants. TF: Codes are already implemented. |
| V 4 | Continue cooperative effort with KPB, Office of Emergency Management, local media, and City of Kenai websites to provide the public with preparedness information prior to and during periods of increased volcano seismic activity. | High | City Planner | City, KPB, AVO | Ongoing | B/C: During 2009 volcanic activity, the public was adequately informed for preparedness via the KPB and AVO websites as well as collaboration of City Government and local media. Continue preparedness exercises. TF: Regularly practice EOP. |
| SW 5 | In an effort to reduce property damage, the City will continue to adopt and enforce current building codes and construction standards that address high winds. Prepare citizens and the built environment to better survive the hazards associated with keeping power on such as backup generators. Residents should do self-assessments on their own properties and create open space around their houses accordingly so that trees do not fall on houses and powerlines. | High | Individual Homeowner | Individual Homeowner | 2020 | B/C: Homeowners are responsible for the defensiveness of their property in a natural disaster. Prevention now may save property in the future. TF: Residents would be responsible for following City codes and construction standards. |
| G 6a | Update the City's Emergency Operating Plan to ensure the appropriate response to natural hazards. | Medium | Fire Chief | City, Denali Commission | 2020 | B/C: Sustained mitigation outreach programs have minimal cost and will help build and support area-wide capacity. This type of activity enables the public to prepare for, respond to, and recover from disasters. Coordinated planning |

| Action ID | Description | Priority | Responsible Department | Potential Funding | Timeframe | Benefit-Costs / Technical Feasibility |
|---|---|---|---|---|---|---|
| | | | | | | ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and residents.<br><br>TF: This low-cost activity can be combined with recurring community meetings where hazard- specific information can be presented in small increments. This activity is ongoing, demonstrating its feasibility. |
| G 6b | Update the Alaska Fire Training Facility as an Emergency Operations Command Center. | Medium | City Manager | City, HMGP, PDM | 2020-2025 | B/C: The City needs to evaluate their EOC needs and determine if this building should be updated to replace the existing EOC. This building has many desirable features for an EOC.<br>TF: This building is sitting empty in the community and appears to meet criteria. |

This section describes a formal plan maintenance process to ensure that this HMP remains an active and applicable document. It includes an explanation of how the City's Hazard Mitigation Project Team intends to organize their efforts to ensure that improvements and revisions to the HMP occur in a well-managed, efficient, and coordinated manner.

The following three process steps are addressed in detail here:

1. Monitoring, evaluating, and updating the HMP;
2. Implementation through existing planning mechanisms; and
3. Continued public involvement.

## 8.1 MONITORING, EVALUATING, AND UPDATING THE HMP

Requirements for monitoring, evaluating, and updating the HMP, as stipulated in the DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Plan Maintenance Process - Monitoring, Evaluating, and Updating the Plan**

**Monitoring, Evaluating and Updating the Plan**

**Requirement §201.6(c)(4)(i, ii, and iii):** [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle; b] a process by which local government incorporates the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate; and c] discussion on how the community will continue public participation in the plan maintenance process.

**Element**

- Does the plan describe the method and schedule of monitoring the plan, including the responsible department?
- Does the plan describe a system for monitoring implementation of mitigation measures and project closeouts?
- Does the plan describe the method and schedule for updating the plan within the five-year cycle?

*Source: FEMA, 2015.*

This HMP was prepared as a collaborative effort among the Hazard Mitigation Project Team and LeMay Engineering & Consulting, Inc. To maintain momentum, the City Planner will use the Hazard Mitigation Project Team to monitor, evaluate, and update the HMP. Each authority identified in Table 16 will be responsible for implementing the MAP. The City Planner will serve as the primary point of contact and will coordinate local efforts to monitor, evaluate, and revise the HMP.

Each member of the Hazard Mitigation Project Team will conduct an annual review during the anniversary week of the HMP's official FEMA approval date to monitor the progress in implementing the HMP, particularly the MAP. As shown in Appendix E, the Annual Review Worksheet will provide the basis for possible changes in the HMP MAP by refocusing on new or more threatening hazards, adjusting to changes to or increases in resource allocations, and engaging additional support for the HMP implementation. The City Planner will initiate the annual review two months prior to the scheduled planning meeting date to ensure that all data is assembled for discussion with the Hazard Mitigation Project Team. The findings from these reviews will be presented at the annual Hazard Mitigation Project Team Meeting. Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Participation of authorities and others in the HMP implementation;

- Notable changes in the risk of natural or human-caused hazards;
- Impacts of land development activities and related programs on hazard mitigation;
- Progress made with the MAP (identify problems and suggest improvements as necessary and provide progress reports on implemented mitigation actions); and
- The adequacy of local resources for implementation of the HMP.

A system of reviewing the progress on achieving the mitigation goals and implementing the MAP activities and projects will also be accomplished during the annual review process. During each annual review, each authority administering a mitigation project will submit a Progress Report to the Hazard Mitigation Project Team. As shown in Appendix E, the report will include the current status of the mitigation project, including any changes made to the project, the identification of implementation problems and appropriate strategies to overcome them, and whether or not the project has helped achieve the appropriate goals identified in the HMP.

In addition to the annual review, the Hazard Mitigation Project Team will update the HMP every five years. To ensure that this update occurs, in the fourth year following adoption of the HMP, the Hazard Mitigation Project Team will undertake the following activities:

- Request grant assistance from DHS&EM and FEMA to update the HMP (this can take up to one year to obtain and one year to update the HMP);
- Thoroughly analyze and update the risk of natural hazards;
- Provide a new annual review (as noted above), plus a review of the three previous annual reviews;
- Provide a detailed review and revision of the mitigation strategy;
- Prepare an updated MAP for the City;
- Prepare an updated Draft HMP;
- Submit an updated Draft HMP to DHS&EM and FEMA for approval;
- Submit the DSH&EM- and FEMA-approved plan for adoption by the City Council; and
- Return adoption resolution to FEMA to receive formal approval.

## 8.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

Requirements for implementation through existing planning mechanisms, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Plan Maintenance Process - Incorporation into Existing Planning Mechanisms**

**Incorporation into Existing Planning Mechanisms**

**Requirements §201.6(c)(4)(ii)**: [The plan shall include a] process by which the Local Government integrates the HMP into other ongoing City planning efforts as well as other planning mechanisms such as comprehensive or capital improvement plans when appropriate.

**Element**

- Does the plan identify other planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?
- Does the plan include a process by which the City government will incorporate the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?

*Source: FEMA, 2015.*

After the adoption of the HMP, the City Planner will ensure that the HMP, in particular each Mitigation Action Project, is incorporated into existing planning mechanisms. The City Planner will achieve this incorporation by undertaking the following activities.

- Conduct a review of the community-specific regulatory tools to assess the integration of the mitigation strategy. These regulatory tools are identified in the capability assessment section (Tables 17-19).
- Work with pertinent community departments to increase awareness of the HMP and provide assistance in integrating the mitigation strategy (including the MAP) into relevant planning mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.
- The City Planner will be responsible for providing a copy of this HMP to contractors focused on developing new or updating existing Local Plans and ensuring that this HMP is incorporated into plans as applicable.

The City will involve the public to continually reshape and update this HMP. A paper copy of this HMP will be available at City Hall. This HMP will also be stored on the State DCCED/DCRA's plans website for public reference. Planners are encouraged to integrate components of this HMP into their own plans.

The following tables outline the resources available to the City for mitigation related funding and training. The tables delineate the City's regulatory tools, technical specialists, and financial resources available for project management.

**Table 17. Regulatory Tools**

| Regulatory Tools (ordinances, codes, plans) | Existing? | Comments (Year of most recent update; problems administering it, etc.) |
|---|---|---|
| Economic Development Plan | 2019 | KPB Comprehensive Economic Development Strategy |
| Comprehensive Plan | 2016 | City of Kenai Comprehensive Plan |
| Emergency Operations Plan | 2007 | City of Kenai Emergency Operations Plan |
| Land Use Plan | Yes | In the 2016 City of Kenai Comprehensive Plan |
| Transportation Plan | 2003 | Kenai Peninsula Borough Transportation Pan |
| Building code | Yes | The City can exercise this authority. |
| Zoning ordinances | Yes | The City can exercise this authority. |
| Subdivision ordinances or regulations | Yes | The City can exercise this authority. |
| Special purpose ordinances | Yes | The City can exercise this authority. |
| Land Use Regulation | Yes | The City can exercise this authority. |

### Local Resources

The City has a number of planning and land management tools that will allow it to implement hazard mitigation activities. The resources available in these areas are summarized below.

**Table 18. Administrative and Technical Resources**

| Staff/Personnel Resources | Y/N | Department/Agency and Position |
|---|---|---|
| Planner or engineer with knowledge of land development and land management practices | Yes | City Planner |
| Engineer or professional trained in construction practices related to buildings and/or infrastructure | Yes | Department of Public Works |
| Planner or engineer with an understanding of natural and/or human-caused hazards | Yes | City Planner |
| Floodplain Manager | Yes | Jimmy C. Smith, State Floodplain Manager<br>KPB Floodplain Manager |
| Surveyors | No | The City may hire surveying consulting services. |
| Staff with education or expertise to assess the jurisdiction's vulnerability to hazards | Yes | City Planner |
| Personnel skilled in GIS and/or HAZUS-MH | Yes | City Planner |
| Scientists familiar with the hazards of the jurisdiction | No | U.S. Fish & Wildlife Service; Alaska Dept. of Fish & Game |
| Emergency Manager | Yes | City Manager, Kenai Peninsula Borough |
| Finance (Grant writers) | Yes | Finance Director |

| | | |
|---|---|---|
| Public Information Officer | Yes | City Manager |

The following table includes additional information on existing City authority, policies, and programs.

**Table 19. Financial Resources for Hazard Mitigation**

| Financial Resource | Accessible or Eligible to Use for Mitigation Activities |
|---|---|
| General funds | Limited funding, can exercise this authority with voter approval. |
| Community Development Block Grants | Limited funding, can exercise this authority with voter approval. |
| Capital Improvement Projects Funding | Limited funding, can exercise this authority with voter approval. |
| Authority to levy taxes for specific purposes | Limited funding, can exercise this authority with voter approval. |
| Incur debt through general obligation bonds | Can exercise this authority with voter approval. |
| Incur debt through special tax and revenue bonds | Can exercise this authority with voter approval. |
| Incur debt through private activity bonds | Can exercise this authority with voter approval. |
| Hazard Mitigation Grant Program (HMGP) | FEMA funding which is available to local communities after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects. |
| Pre-Disaster Mitigation (PDM) grant program | FEMA funding which is available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects only. |
| Flood Mitigation Assistance (FMA) grant program | FEMA funding which is available on an annual basis. This grant can be used to mitigate repetitively-flooded structures and infrastructure to protect repetitive flood structures. |
| United State Fire Administration (USFA) Grants | The purpose of these grants is to assist state, regional, national, or local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors, and firefighters. |
| Fire Mitigation Fees | Finance future fire protection facilities and fire capital expenditures required. |

## 8.3 CONTINUED PUBLIC INVOLVEMENT

Requirements for continued public involvement, as stipulated in DMA 2000 and its implementing regulations, are described below.

**DMA 2000 Requirements: Plan Maintenance Process - Continued Public Involvement**

**Continued Public Involvement**

**Requirement §201.6(c)(4)(iii)**: [The plan maintenance process shall include a] discussion on how the Government will continue public participation in the plan maintenance process.

**Element**

- Does the plan explain how continued public participation will be obtained?

*Source: FEMA, 2015.*

The City is dedicated to involving the public directly in the continual reshaping and updating of the HMP. A paper copy of the HMP and any proposed changes will be available at the City Planning Office. An address and phone number of the City Planner to whom people can direct their comments or concerns will also be available at the City Office.

The City Planner will also identify opportunities to raise community awareness about the HMP and the hazards that affect the area with. The City will host a booth at the Community Health Fair that occurs each spring. The purpose of the booth will be to remind the public about the importance of mitigation and hand out community surveys (see Appendix E) to gauge what areas of mitigation the community feels is relevant. Any public comments received regarding the HMP will be collected by the City Planner, included in the annual report, and considered during future HMP updates.

## 8.4 POTENTIAL FUNDING RESOURCES

**Federal Resources**

The Federal government requires Local Governments to have an HMP in place to be eligible for mitigation funding opportunities through FEMA such as the UHMA Programs and the HMGP. The Mitigation Technical Assistance Programs available to Local governments are also a valuable resource. FEMA may also provide temporary housing assistance through rental assistance, mobile homes, furniture rental, mortgage assistance, and emergency home repairs. The Disaster Preparedness Improvement Grant also promotes educational opportunities with respect to hazard awareness and mitigation.

- FEMA, through its Emergency Management Institute, offers training in many aspects of emergency management, including hazard mitigation. FEMA has also developed a large number of documents that address implementing hazard mitigation at the local level. Key resource documents are available from the FEMA Publication Warehouse (1-800-480-2520) and are briefly described here:
    - How-to Guides. FEMA has developed a series of how-to guides to assist States, communities, and Tribes in enhancing their hazard mitigation planning capabilities. The first four guides describe the four major phases of hazard mitigation planning. The last five how-to guides address special topics that arise in hazard mitigation planning such as conducting cost-benefit analysis and preparing multi-jurisdictional

plans. The use of worksheets, checklists, and tables make these guides a practical source of guidance to address all stages of the hazard mitigation planning process. They also include special tips on meeting DMA 2000 requirements.

  - Post-Disaster Hazard Mitigation Planning Guidance for State and Local Governments. FEMA DAP-12, September 1990. This handbook explains the basic concepts of hazard mitigation and shows State, Tribal, and Local governments how they can develop and achieve mitigation goals within the context of FEMA's post-disaster hazard mitigation planning requirements. The handbook focuses on approaches to mitigation, with an emphasis on multi-objective planning.
  - Mitigation Resources for Success compact disc (CD). FEMA 372, September 2001. This CD contains a wealth of information about mitigation and is useful for State, Tribal, and Local government planners and other stakeholders in the mitigation process. It provides mitigation case studies, success stories, information about Federal mitigation programs, suggestions for mitigation measures to homes and businesses, appropriate relevant mitigation publications, and contact information.
  - A Guide to Federal Aid in Disasters. FEMA 262, April 1995. When disasters exceed the capabilities of State, Tribal, and Local governments, the President's disaster assistance programs (administered by FEMA) is the primary source of Federal assistance. This handbook discusses the procedures and process for obtaining this assistance, and provides a brief overview of each program.
  - The Emergency Management Guide for Business and Industry. FEMA 141, October 1993. This guide provides a step-by-step approach to emergency management planning, response, and recovery. It also details a planning process that businesses can follow to better prepare for a wide range of hazards and emergency events. This effort can enhance a business's ability to recover from financial losses, loss of market share, damages to equipment, and product or business interruptions. This guide could be of great assistance to a community's industries and businesses located in hazard prone areas.
  - The FEMA Hazard Mitigation Assistance Guidance and Addendum, February 5, 2015. The guidance introduces the five HMA grant programs, funding opportunities, award information, eligibility, application and submission information, application review process, administering the grant, contracts, additional program guidance, additional project guidance, and contains information and resource appendices (FEMA, 2015).

- Department of Agriculture (USDA). Assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service, and Rural Business and Cooperative Service.
- Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program. This program minimizes the adverse effects of high energy costs on low-income, elderly, and handicapped citizens through client education activities and weatherization services such as an all-around safety check of major energy systems, including heating system modifications and insulation checks.

- Department of Health and Human Services, Administration of Children & Families, Administration for Native Americans (ANA). The ANA awards funds through grants to American Indians, Native Americans, Native Alaskans, Native Hawaiians, and Pacific Islanders. These grants are awarded to individual organizations that successfully apply for discretionary funds. ANA publishes in the Federal Register an announcement of funds available, the primary areas of focus, review criteria, and the method of application.
- Department of Housing and Urban Development (HUD), Office of Homes and Communities, Section 108 Loan Guarantee Programs. This program provides loan guarantees as security for Federal loans for acquisition, rehabilitation, relocation, clearance, site preparation, special economic development activities, and construction of certain public facilities and housing.
- Department of Housing and Urban Development, Community Development Block Grants (HUD/CDBG). Provides grant assistance and technical assistance to aid communities in planning activities that address issues detrimental to the health and safety of local residents, such as housing rehabilitation, public services, community facilities, and infrastructure improvements that would primarily benefit low-and moderate-income persons.
- Department of Labor (DOL), Employment and Training Administration, Disaster Unemployment Assistance. Provides weekly unemployment subsistence grants for those who become unemployed because of a major disaster or emergency. Applicants must have exhausted all benefits for which they would normally be eligible.
- Federal Financial Institutions. Member banks of Federal Deposit Insurance Corporation, Financial Reporting Standards or Federal Home Loan Bank Board may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.
- Internal Revenue Service (IRS), Tax Relief. Provides extensions to current year's tax return, allows deductions for disaster losses, and allows amendment of previous tax returns to reflect loss back to three years.
- U.S. Small Business Administration (SBA). May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. Requests for SBA loan assistance should be submitted to DHS&EM.
- USACE Alaska District's Civil Works Branch studies potential water resource projects in Alaska. These studies analyze and solve water resource issues of concern to the local communities. These issues may involve navigational improvements, flood control or ecosystem restoration. The agency also tracks flood hazard data for over 300 Alaskan communities on floodplains or the sea coast. These data help local communities assess the risk of floods to their communities and prepare for potential future floods. The USACE is a member and co-chair of the Alaska Climate Change Sub-Cabinet.

**State Resources**

- DHS&EM is responsible for improving hazard mitigation technical assistance for Tribal and Local governments for the State of Alaska. Providing hazard mitigation training,

current hazard information, and communication facilitation with other agencies will enhance local hazard mitigation efforts. DHS&EM administers FEMA mitigation grants to mitigate future disaster damages such as those that may affect infrastructure including the elevation, relocation, or acquisition of hazard-prone properties. DHS&EM also provides mitigation funding resources for mitigation planning.

- Division of Senior Services (DSS): Provides special outreach services for seniors, including food, shelter, and clothing.
- Division of Insurance (DOI): Provides assistance in obtaining copies of policies and provides information regarding filing claims.
- Department of Military and Veterans Affairs (DMVA): Provides damage appraisals and settlements for VA-insured homes, and assists with filing of survivor benefits.
- The Community Health and Emergency Medical Services (CHEMS) is a section within the Division of Public Health within the Department of Health and Social Services (DHSS). DHSS is charged with promoting and protecting the public health and one of CHEMS' responsibilities is developing, implementing, and maintaining a statewide comprehensive emergency medical services system. The department's statutory mandate (Alaska Statute 18.08.010) requires it to:
    - Coordinate public and private agencies engaged in the planning and delivery of emergency medical services, including trauma care, to plan an emergency medical services system;
    - Assist public and private agencies to deliver emergency medical services, including trauma care, through the award of grants in aid;
    - Conduct, encourage, and approve programs of education and training designed to upgrade the knowledge and skills of health personnel involved in emergency medical services, including trauma care; and
    - Establish and maintain a process under which hospitals and clinics can represent themselves to be trauma centers because they voluntarily meet criteria adopted by the department which are based on an applicable national evaluation system.
- DCRA within the DCCED. DCRA administers the HUD/CDBG, FMA Program, and the Climate Change Sub-Cabinet’s Interagency Working Group’s program funds and administers various flood and erosion mitigation projects, including the elevation, relocation, or acquisition of flood-prone homes and businesses throughout the State. This department also administers programs for State "distressed" and "targeted" communities.
- Division of Environmental Conservation (DEC). The DEC’s primary roles and responsibilities concerning hazards mitigation are ensuring safe food and safe water, and pollution prevention and pollution response. DEC ensures water treatment plants, landfills, and bulk fuel storage tank farms are safely constructed and operated in communities. Agency and facility response plans include hazards identification and pollution prevention and response strategies.

- Department of Transportation and Public Facilities (DOT/PF) personnel provide technical assistance to the various emergency management programs, to include mitigation. This assistance is addressed in the DHS&EM-DOT/PF Memorandum of Agreement and includes, but, is not limited to: environmental reviews, archaeological surveys, and historic preservation reviews.

  In addition, DOT/PF and DHS&EM coordinate buy-out projects to ensure that there are no potential right-of-way conflicts with future use of land for bridge and highway projects, and collaborate on earthquake mitigation.

  Additionally, DOT/PF provides safe, efficient, economical, and effective operation of the State's highways, harbors, and airports. DOT/PF uses it's Planning, Design and Engineering, Maintenance and Operations, and Intelligent Transportation Systems resources to identify the hazard, plan and initiate mitigation activities to meet the transportation needs of Alaskans and make Alaska a better place to live and work. DOT/PF budgets for the temporary replacement bridges and materials necessary to make the multi-modal transportation system operational following a natural disaster.
- The Department of Natural Resources (DNR) administers various projects designed to reduce stream bank erosion, reduce localized flooding, improve drainage, and improve discharge water quality through the stormwater grant program funds. Within DNR, the Division of Geological and Geophysical Survey (DGGS) is responsible for the use and development of Alaska's mineral, land, and water resources, and collaboration on earthquake mitigation.
  - DNR’s DGGS collects and distributes information about the State's geologic resources and hazards. Their geologists and support staff are leaders in researching Alaska's geology and implementing technological tools to most efficiently collect, interpret, publish, archive, and disseminate that information to the public
  - The DNR’s Division of Forestry (DOF) participates in a statewide wildfire control program in cooperation with the forest industry, rural fire departments, and other agencies. Prescribed burning may increase the risks of fire hazards; however, prescribed burning reduces the availability of fire fuels, and therefore, the potential for future, more serious fires.
  - DOF also manages various wildland fire programs, activities, and grant programs such as the FireWise Program, the Community Forestry Program (CFP) and the Volunteer Fire Assistance and Rural Fire Assistance Grant (VFA-RFAG) programs.

**Other Funding Sources and Resources**

The following provide focused access to valuable planning resources for communities interested in sustainable development activities.

- FEMA, http://www.fema.gov - includes links to information, resources, and grants that communities can use in planning and implementation of sustainable measures.
- American Planning Association (APA), http://www.planning.org - a non-profit professional association that serves as a resource for planners, elected officials, and citizens concerned with planning and growth initiatives.

- Institute for Business and Home Safety (IBHS), http://ibhs.org - an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters.
- American Red Cross (ARC). Provides for the critical needs of individuals such as food, clothing, shelter, and supplemental medical needs. Provides recovery needs such as furniture, home repair, home purchasing, essential tools, and some bill payment may be provided.
- Crisis Counseling Program. Provides grants to State and Borough Mental Health Departments, which in turn provide training for screening, diagnosing, and counseling techniques. Also provides funds for counseling, outreach, and consultation for those affected by disaster.

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