City of Homer
Local All-Hazard
Mitigation Plan

Draft Plan

Last updated July 28, 2004

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Chapter I – Introduction

A. Purpose of the Plan:

The purpose of the All-Hazard Mitigation Plan is to fulfill the FEMA requirement under The Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Act), Section 322, Mitigation Planning enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390). This initiative provides new and revitalized approaches to mitigation planning. Section 322 emphasizes the need for State, ***local***, and *tribal* entities to closely coordinate mitigation planning and implementation efforts. As part of the process of implementing the DMA, FEMA prepared an Interim Final Rule (the Rule) to clearly establish the mitigation planning criteria for States and local and tribal governments. This Rule was published in the Federal Register on February 26, 2002, at 44 CFR Part 201. This plan will identify hazards; establish community goals and objectives and develop mitigation strategies and activities that are appropriate for the City of Homer.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d), as implemented through 44 CFR Part 201.6 requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, encouraging development of local mitigation and providing technical support for those efforts.

The purpose of this plan is to produce a program of activities through actions and projects that will best deal with the City of Homer's hazard problems, while meeting other community needs. This plan will accomplish the following objectives consistent with FEMA planning process guidelines:

- Describe the planning process to include public involvement;
- Conduct an assessment of the risks;
- Determine what facilities, or portions of infrastructure, are vulnerable to a disaster;
- Develop a mitigation strategy to reduce potential losses and target resources;
- Describe how each entity will periodically evaluate, monitor maintain and update the plan; and,
- Describe the process for implementing the plan after adoption by the local governing body of the community and receiving FEMA approval.

B. Methodology

The approach used for the development and updating of the City of Homer All-Hazard Mitigation Plan consisted of the following tasks:

1. Coordinate with other agencies and organizations
2. Solicit public involvement
3. Conduct hazard area inventory
4. Review and analysis of possible mitigation activities
5. Describe the update and review process and schedule for plan maintenance
6. Coordinating the Plan with the State Hazard Mitigation Plan
7. Submitting to the State Hazard Mitigation Officer for Review
8. Submitting to FEMA Region 10 for Review and Approval
9. Adoption of the Plan following a public hearing

This All Hazard Local Mitigation Plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of hazards in the City of Homer: flooding, earthquake, wildfire and etc. and recommends mitigation strategies and activities.

The mitigation plan will be evaluated and updated every five years. In addition, the plan will be updated, as appropriate when a disaster occurs that significantly affects the City of Homer, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date the disaster occurs.

Routine maintenance of the plan will include updating historical hazard information, completing hazard analysis and adding projects, as new funding sources become available or taking projects off the list when they are accomplished.

C. Homer – Background

The following information was obtained from the DCED Alaska Community Database at this website: http//www.dced.state.ak.us/cbd/commdb/CF_COMDB.htm

General Location

Homer is located on the north shore of Kachemak Bay on the southwestern edge of the Kenai Peninsula. The Homer Spit, a 4.5-mile long gravel bar, extends from the Homer shoreline into Kachemak Bay. Homer is 227 road miles south of Anchorage, at the southern-most point of the Sterling Highway. It lies approximately 59.6425° North Latitude and -151.54833° West Longitude. (Section 19, Township 6 South, Range 13 West, Seward Meridian.) Homer is located in the Homer Recording District. The area encompasses 10.6 square miles of land and 11.9 square miles of water. Homer lies in the maritime climate zone.

Climate

During the winter, temperatures range from 14° F to 27° F; summer temperatures vary from 45° F to 65° F. Average annual precipitation is 24 inches, including 55 inches of snow.

History

The Homer area has been home to Kenaitze Indians for thousands of years. In 1895, the U.S. Geological Survey arrived to study coal and gold resources. Prospectors bound for Hope and Sunrise disembarked at the Homer Spit. The community was named for Homer Pennock, a gold mining company promoter, who arrived in 1896 and built living quarters for his crew of 50 on the Spit. Their plans were to mine the beach sands along Cook Inlet, from Homer to Ninilchik. The Homer post office opened shortly thereafter. In 1899, Cook Inlet Coal Fields Company built a town and dock on the Spit, a coal mine at Homer's Bluff Point, and a 7-mile long railroad, which carried the coal to the end of the Homer Spit. Various coal mining operations continued until World War I, and settlers continued to trickle into the area, some to homestead in the 1930s and 1940s, other to work in the canneries built to process Cook Inlet fish. Coal provided fuel for homes, and there is still an estimated 400 million tons of coal deposits near Homer. The City government was incorporated in March 1964. After the Good Friday earthquake in 1964, the Homer Spit subsided approximately 4 to 6 feet, and several buildings had to be relocated.

Culture

While commercial and sport fishing are the center of the economic activity, Homer has a large community of artists. The Homer Jackpot Halibut Derby runs from May 1 through Labor Day each year. Homer is the "Halibut Capital of the World".

Population and Economy

The Department of Community and Economic Development certified Homer's population at 4,721 people. Figure 2 depicts the historic population of Homer as determined by the U.S. Census Bureau.

Homer is incorporated as a first-class city. It is primarily a fishing, fish processing, trade and service center, and enjoys a considerable seasonal visitor industry. Approximately 10 cruise ships dock each summer. During summer months, the population swells with students and other seeking cannery or fishing employment. Sport fishing for halibut and salmon contribute significantly to the economy. 520 area residents hold commercial fishing permits. The fish dock is equipped with cold storage facilities, ice manufacturing and a vacuum fish-loading system. The Spit also has two deep water docking facilities: the Deep Water Dock and the newly constructed Pioneer Dock which is home to the U.S. Coast Guard Cutter Hickory and is the home berth of the Alaska Marine Highways Ferry Tustumena. Homer is home of the newly constructed $13 million U.S. Fish & Wildlife Visitors Center for the Alaska Maritime National Wildlife Refuge named the Islands and Ocean Visitor Center.

Employment by Occupation and Industry in Homer (2000)

OCCUPATION		**INDUSTRY**	
Management/ Professional	585	Agriculture/ Forestry/ Fishing/Mining	115
Sales & Office	327	Construction	116
Farming/ Fishing/ Forestry	55	Manufacturing	54
Construction/Extraction/ Maintenance	169	Wholesale Trade	28
Production/Transportation	234	Retail Trade	198
		Transportation/warehousing/utilities	171
		Information	35
		Finance/Insurance/Real Estate/Rental/Leasing	95
		Professional/Scientific/Management, Administration/Waste Management Services	82
		Education/Health/Social Services	411
		Arts/Recreation/Food & Lodging	256
		Other	110
		Public Administration	90
2000 Totals	**1,761**		**1,761**

The annual average unemployment rate from 1990 to 2002 for the Kenai Peninsula Borough has fluctuated between a low of 9.7% in 2001, to a high of 15.5% in 1992 (reported by the State Department of Labor Research and Analysis website).

Facilities

Over 90% of homes are fully plumbed. Water is supplied by a dam and 35-acre reservoir at Bridge Creek, is treated, and stored in a 500,000-gallon tank and a newly constructed 1,000,000-gallon tank, and piped to the majority of homes in the City. The system provides 2 million gallons per day. Other residents use individual wells or have water delivered to home tanks. City sewage is piped to a deep-shaft sewer treatment plant; capacity is 880,000 gallons per day. Refuse is collected by Peninsula Sanitation, a private firm, and hauled to the Borough operated Class 2 landfill and balefill in Homer, at mile 169.3 Sterling Highway. Homer Electric Association operates the Bradley Lake Hydroelectric Plant and is part owner of the Alaska Electric Generation & Transmission Cooperative, which operates a gas turbine plant in Soldotna. It also purchases electricity from Chugach Electric.

Transportation

Homer is accessible by the Sterling Highway to Anchorage, Fairbanks, Canada and the lower 48 states. It is often referred to as “The End of the Road”, because it lies at the terminus of the Sterling Highway. The State owns and operates the Homer Airport, with a 6,700’ asphalt runway, and a seaplane base at Beluga Lake. The City is served by several scheduled and chartered aircraft services. There are four additional private landing strips in the Homer vicinity. The Alaska Marine Highway and local ferry services provide water transportation. The Deep Water Dock was constructed in 1990 and can accommodate vessels up to 800’, displacing 65,000 tons. The Pioneer Dock, constructed in 2001/2002 can accept vessels up to 750’ and displacing 80,000 tons. The Small Boat Harbor has 920 reserved boat slips (up to 85’ boats); 6,000+ linear feet of transient moorage; 48.7 acre boat basin; 2 tidal grids; and a 5 lane load and launch ramp.

Chapter II – Adoption Process and Documentation

The City of Homer All-Hazards Mitigation Plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 the plan was adopted (pending approval by the State Hazard Mitigation Officer) by the local governing body as well as the borough.

SAMPLE

City of Homer All Hazard Mitigation Plan Adoption Resolution

Resolution # _______

Adopting the City of Homer **All Hazards Mitigation Plan**

Whereas, the City of Homer recognizes the threat that all hazards pose to people and property; and

Whereas, undertaking hazard mitigation actions before disasters occur will reduce the potential for harm to people and property and save taxpayer dollars; and

Whereas, an adopted all hazards mitigation plan is required as a condition of future grant funding for mitigation projects; and

Whereas, the City of Homer participated jointly in the planning process with the other local units of government with the Borough to prepare an All Hazards Mitigation Plan;

Now, therefore, be it resolved, that the Homer City Council**,** hereby adopts the City of Homer All Hazards Mitigation Plan as an official plan; and

Be it further resolved, that the City of Homer will submit on behalf of the participating municipalities the adopted All Hazards Mitigation Plan to the Alaska Division of Emergency Services and the Federal Emergency Management Agency officials for final review and approval.

Passed: _____________

____

Certifying Official

Chapter III – Planning Process

A. Planning Process

The City of Homer Fire Chief/Director of Emergency Services along with the City of Homer Planning, Public Works Departments and Administrative Staff developed the City of Homer All-Hazard Mitigation Plan. Various City departments coordinated with agencies to include; the Alaska Division of Homeland Security & Emergency Management and the Kenai Peninsula Borough Office of Emergency Management. These agencies provided information from existing plans including; Alaska State All Hazard Mitigation Plan and the Kenai Peninsula Borough All-Hazard Mitigation Plan (Draft). The Fire Chief/Director of Emergency Services compiled all pertinent data and completed a draft plan with subsequent review and input by all listed parties.

The All-Hazard Mitigation Plan was then reviewed by the Homer City Council and public comment was sought regarding the drafted plan. The City of Homer also relied on information provided by the Kenai Peninsula Borough, which conducted an on-line survey regarding this issue.

B. Contributors

The City of Homer Fire Chief/Director of Emergency Services, Planning Department, Public Works Department, Port of Homer, Alaska Department of Transportation, Kenai Peninsula Office of Emergency Management, Alaska Division of Homeland Security and Emergency Management, Homer City Council and Mayor, Public, and private sector businesses and non-profit organizations contributed to the development, review, and submission of this document.

C. Public Opportunity for Involvement

In order to enlist public comment on the development of the City of Homer All-Hazard Mitigation Plan the Mayor and City Council added the item to the City Council Agenda beginning with the first meeting in March. Having the item on the agenda permitted the public to comment on the process and development. In addition the Kenai Peninsula Borough placed an All-Hazard Mitigation Planning Survey on their web-site. This information became a shared resource with the various local governmental jurisdictions (including Homer) on the peninsula.

On April 26, 2004, during the regularly scheduled City Council meeting, public comment was sought on the Draft All-Hazard Plan. This meeting was advertised pursuant to Homer City Code and State of Alaska Open Meeting laws. There were no people that commented.

Chapter IV– Hazard Identification & Risk Assessment

A. Hazard Identification

***Hazard Matrix** – City of Homer

Flood	Wildland Fire	Earthquake	Volcano	Snow Avalanche	Tsunami & Seiche
Y-M	Y-H	Y-M	Y-M	Y	Y-M
Weather	**Landslides**	**Erosion**	**Drought**	**Technological**	**Economic**
Y-H	Y	Y-M	N	Y	Y

Hazard Identification:

Y: Hazard is present in jurisdiction but probability unknown
N: Hazard is not present
U: Unknown if the hazard occurs in the jurisdiction

Risk:
L : Hazard is present with a low probability of occurrence
M : Hazard is present with a moderate probability of occurrence
H: Hazard is present with a high probability of occurrence

B. Profile of Hazard Events

Flood

Flooding is a natural event and damages occur when humans interfere with the natural process by altering the waterway, developing watersheds, and/or building inappropriately within the floodplain. This flooding threatens life, safety and health; causes extensive property loss; and results in substantial damage.

Flooding in Homer can be broken into a number of categories including rainfall-runoff floods, snowmelt floods, ground-water flooding, and stream/creek flash floods. Homer also experiences coastal flooding from storm surge but this will be discussed in the Weather section. These are not exclusive categories as a flood event could have elements of more than one type.

In the fall of 2002 Homer and the lower Kenai Peninsula experienced three separate and distinct flooding events, two of which were declared disasters. The first event in October was the result of heavier than normal rainfall saturating the ground and swelling area creeks and streams. As a result of the already saturated ground, additional rain soon overwhelmed existing culverts and accumulated stream debris clogged normally docile streams washing out several crossings and closing roads north and east of Homer in effect isolating the community. Emergency services were unable to respond to areas cut off by the closed roads except by helicopter for several days. Alaska DOT, Kenai Peninsula and Homer Public Works crews worked around the clock to open closed roads, some of which remained closed until after the second heavy rainfall overwhelmed existing drainages and flooded area roads, once again closing East End Road and contributing to delays in re-opening the Sterling Highway north of Homer, and in Ninilchik.

Homer Storm Flood Damage

The third event which resulted in flooding in Homer occurred when several separate events compiled to exaggerate a seasonal high tide to flood portions of the Homer Spit that had not been flooded since following the 1964 earthquake. A combination of high tide, extreme water levels in Kachemak Bay (the result of already full creeks and streams emptying into the bay) and a strong wind, pushed what was in effect a storm surge onto low lying areas of the spit including an RV parking campground under construction.

Rainfall-Runoff Floods

A typical rainfall event occurs in mid to late summer. The rainfall intensity, duration, distribution and geomorphic characteristics of the watershed all play a role in determining the magnitude of the flood. Runoff flooding is the most common type of flood. They usually result from weather systems that have prolonged rainfall associated with them.

Snowmelt Floods

Snowmelt floods usually occur in the spring or early summer. The depth of the snowpack and spring weather patterns influence the magnitude of flooding. Snowmelt floods can also be caused by glacial melt.

Ground-water Floods

Ground-water flooding occurs when water accumulates and saturates the soil. The water-table rises and floods low-lying areas, including homes, septic tanks, and other facilities. Ground-water flooding can also occur in basements of structures along streams or in low-lying areas.

Flash Floods

These floods are characterized by a rapid rise in water. They are often caused by heavy rain on small stream basins, ice jam formation or by dam failure. They are usually swift moving and debris filled, causing them to be very powerful and destructive. Steep coastal areas in general are subject to flash floods. Debris slides are often associated with heavy rains.

Fluctuating Lake Level Floods

Generally, lakes buffer downstream flooding due to the storage capacity of the lake. But when lake inflow is excessive, flooding of the area around the lake can occur. Beluga

Lake and the Bridge Creek Reservoir area sees periodic flooding due to rainfall and snowmelt.

Wildland Fires

Wildland fires occur in every state in the country and Alaska is no exception. Each year, between 600 and 800 wildland fires, mostly between March and October, burn across Alaska causing extensive damage.

Fire is recognized as a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. In Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location. The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the fire management planning process and the full range of fire management activities is exercised in Alaska to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social consequences on firefighter and public safety and welfare, natural and cultural resources threatened, and the other values to be protected dictate the appropriate management response to the fire. Firefighter and public safety is always the first and overriding priority for all fire management activities.

Hazard Analysis/Characteristics

Fires can be divided into the following categories:

Structure fires – originate in and burn a building, shelter or other structure.

Prescribed fires - ignited under predetermined conditions to meet specific objectives, to mitigate risks to people and their communities, and/or to restore and maintain healthy, diverse ecological systems.

Wildland fire - any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Use - a wildland fire functioning in its natural ecological role and fulfilling land management objectives.

Wildland-Urban Interface Fires - fires that burn within the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The potential exists in areas of wildland-urban interface for extremely dangerous and complex fire burning conditions which pose a tremendous threat to public and firefighter safety.

Fuel, weather, and topography influence wildland fire behavior. Wildland fire behavior can be erratic and extreme causing fire-whirls and firestorms that can endanger the lives of the firefighters trying to suppress the blaze. Fuel 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. Temperature and humidity also affect fire behavior. High temperatures and low humidity encourage fire activity while low temperatures and high humidity help retard fire behavior. Wind affects the speed and direction of a fire. Topography directs the movement of air, which can also affect fire behavior. When the terrain funnels air, like what happens in a canyon, it can lead to faster spreading. Fire can also travel up slope quicker than it goes down.

Wildland fire risk is increasing in Alaska due to the spruce bark beetle infestation. The beetles lay eggs under the bark of a tree. When the larvae emerge, they eat the tree's phloem, which is what the tree uses to transport nutrients from its roots to its needles. If enough phloem is lost, the tree will die. The dead trees dry out and become highly flammable.

Homer like other areas of the Kenai Peninsula has been dramatically affected by the beetle-kill. While there have been numerous human caused fires in the Homer area most have been contained to less than 10 acres. The fire with the greatest potential of loss of property and lives occurred in June of 1999. Called the Mansfield-Hutler Road Fire, this 75 acre fire was the result of open burning. High winds and low relative humidity quickly spread the fire in uncharacteristic patterns, forcing the emergency evacuation of area residents, the closure of East End Road and the use of smoke jumpers, air tankers and fire retardant drops. Only through ongoing and pre-existing defensible space programs was the loss held to only one un-occupied mobile home type structure.

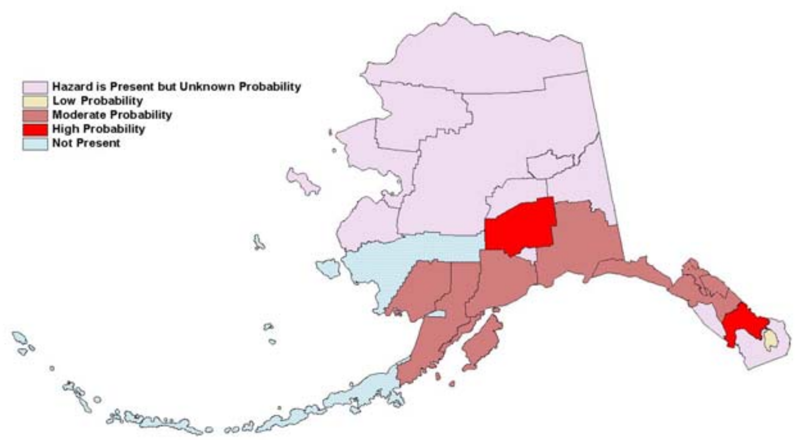
Wildland Fire Management in Alaska

In Homer, wildland fire management is the responsibility of two agencies: Division of Forestry and the City of Homer, Homer Volunteer Fire Department.

Each agency provides fire-fighting coverage for a portion of Homer regardless of land ownership.

These agencies have cooperated to develop an area-wide interagency wildland fire management plan.

These two agencies and others, work together to fight fire.



Areas with wildfire potential.

Weather

Weather is the result of four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet. Certain combinations can result in severe weather events that have the potential to become a disaster.

In Homer, there is potential for weather disasters. Wind-driven waves from intense storms produce coastal flooding and erosion. High winds, common on the Kenai Peninsula can topple trees, damage roofs, and result in power outages across vast areas of Homer and the surrounding communities. Heavy snow contributes to the availability of water for the Bradley Lake Hydroelectric Plant, and for keeping the Bridge Creek watershed supplied, but can also cause avalanches or collapse roofs of buildings throughout the area when accumulations are too heavy. A quick thaw can lead to erosion and flooding along creeks and area streams.

Winter Storms

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Cold air - Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and/or near the ground to make snow and/or ice.
- Moisture - The air must contain moisture in order to form clouds and precipitation.
- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:
- The flow of air up a mountainside.
- Fronts, where warm air collides with cold air and rises over the dome of cold air.
- Upper-level low pressure troughs.

A series of severe winter storms in December 1999 and January 2000 triggered avalanches and flooding in Southcentral Alaska and resulted in a Federal Disaster Declaration. The Municipality of Anchorage, the Kenai Peninsula Borough, the Matanuska-Susitna Borough, and the Valdez-Cordova census area received funding to supplement the recovery needs of the local governments to pay for debris removal, emergency services, and repair and replacement costs for damaged public facilities related to the storms.

Heavy Snow

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and major roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. In the mountains, heavy snow can lead to avalanches. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Record heavy snow occurred in Anchorage on March 17, 2002 when two to three feet of snow fell in less than 24 hours over portions of the city. Ted Stevens International Airport recorded a storm total of 28.7 inches, and an observer near Lake Hood measured over 33 inches. The city of Anchorage was essentially shut down during the storm, which fortunately occurred on a Sunday morning when a minimal number of businesses were open. Both military bases, universities, and many businesses remained closed the following day, and Anchorage schools remained closed for two days. It took four days for snow plows to reach all areas of the city. This snowfall also impacted Homer and the Kenai Peninsula and resulted in airport closures, travel delays, and delays of transportation of foodstuffs and other commodities.

Ice Storms

The term ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. They can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result from the accumulation of freezing rain, which is rain that becomes super-cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth’s surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become super-cooled. When these super-cooled drops strike the frozen ground, power lines, tree branches, etc., they instantly freeze.

The atmospheric conditions that can lead to ice storms occur most frequently in Southwestern Alaska along the Alaska Peninsula and around Cook Inlet. Brief instances of freezing rain occur frequently along the southern coast of Alaska, but these events generally produce very light precipitation with less than ¼ inch of ice accumulation.

High Winds

In Alaska, high winds (winds in excess of 60 mph) occur rather frequently over the coastal areas along the Bering Sea and the Gulf of Alaska because of coastal storms. High winds, especially across the Arctic coast, can also combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures.

They can reach hurricane force and have the potential to seriously damage port facilities, the fishing industry and community infrastructure (especially above ground utility lines).

Localized downdrafts, downbursts & microbursts, are also important in Alaska. Downbursts and microbursts can be generated by thunderstorms. Downburst winds are strong concentrated straight-line winds created by falling rain and sinking air that can reach speeds of 125 mph. The combination induces a strong wind downdraft due to aerodynamic drag forces or evaporation processes. Microburst winds are more concentrated than downbursts and can reach speeds up to 150 mph. They can cause significant damage as both can last 5 – 7 minutes. Because of wind shear and detection difficulties, they pose a big threat to aircraft landings and departures.

In the spring of 2003 strong winds across the Kenai Peninsula resulted in wide-spread power outages, downed trees, and structural damage and fanned the flames of a 150 acre wildfire in Anchor Point.

Coastal Storms

From the fall through the spring, low pressure cyclones either develop in the Bering Sea or Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that tend to steer storms in the north Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and occasionally cause coastal flooding and erosion.

The intensity, location and the land's topography influence the storm's impact. Another factor that influences the damage done to the shoreline by coastal storms, particularly in northwest Alaska, is whether or not the shore ice is solid enough to protect against erosion and physical damage to community infrastructure.

Fierce storm conditions do not have to be present to cause damage. Northwestern communities suffer from "Silent Storms" where high-water storm surges erode and undercut the banks melting the permafrost.

Homer has an extensive history of storm damage, especially in the coastal areas along the Homer Spit and adjacent properties. In August of 1989 the U.S. Army Corp of Engineers published a Storm Damage Reduction Draft Interim Feasibility Report with Engineering Design And Environmental Assessment for the Homer Spit. Over the years attempts have been made to reduce the impacts of coastal storms and subsequent erosion with varying degrees of success and some notable failures. In 1982 significant damage to the sheet pile reinforcement along the Spit prompted the installation of a concrete slab revetment. In a storm in 1984 those repairs were mostly washed away, again resulting in significant damage to the State Highway leading to the end of the Homer Spit. In the 1990's a major project along the western edge of the Spit Road involving the placement of significant large rock revetments along the Spit corridor lessening, but not completely eliminating damage to the roadway during severe storms.

Definitions:
Groin - A narrow, elongated coastal-engineering structure built on the beach perpendicular to the trend of the beach. Its purpose is to trap longshore drift to build up a section of beach.

Jetty - A narrow, elongated coastal-engineering structure built perpendicular to the shoreline at inlets to stabilize the position of a navigation channel, to shield vessels from wave forces, and to control the movement of sand along adjacent beaches to minimize the movement of sand into a channel.

Seawall - A vertical, wall-like coastal-engineering structure built parallel to the beach or duneline and usually located at the back of the beach or the seaward edge of the dune.
They are designed to halt shoreline erosion by absorbing the impact of waves.

Revetment - An apron-like, sloped, coastal-engineering structure built on a dune face or fronting a seawall. Designed to dissipate the force of storm waves and prevent undermining of a seawall, dune or placed fill.

Storm Surge

Storm surges, or coastal floods, occur when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive force of the flooding waters. The conditions that cause coastal floods also can cause significant shoreline erosion as the flood waters undercut roads and other structures. Storm surge is a leading cause of property damage in Alaska.

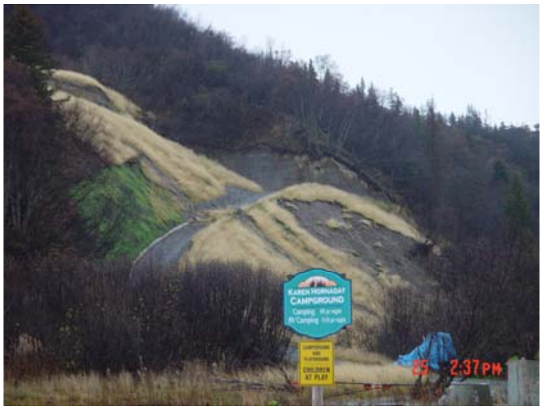
The meteorological parameters conducive to coastal flooding are low atmospheric pressure, strong winds (blowing directly onshore or along the shore with the shoreline to the right of the direction of the flow), and winds maintained from roughly the same direction over a long distance across the open ocean (fetch).

Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding.

The Homer Spit has a moderate exposure to coastal flooding due to the consistent effects of erosion and the extraordinary tidal range in the region. A storm surge and high water levels resulted in flooding on the Homer Spit in November of 2002.

Landslides

Ground failure can occur in many ways. Types of ground failure in Alaska include landslides, land subsidence, and failures related to seasonally frozen ground and permafrost.



Homer Landslide 11-02

Landslide is a generic term for a variety of downslope movements of earth material under the influence of gravity. Some landslides occur rapidly, in mere seconds, while others might take weeks or longer to develop.

Landslides usually occur in steep areas but not always. They can occur as ground failure of river bluffs, cut-and-fill failures associated with road and building excavations, collapse of mine-waste piles, and slope failures associated with open-pit mines and quarries. Underwater landslides usually involve areas of low relief and slope gradients in lakes and reservoirs or in offshore marine setting.

Landslides can occur naturally or be triggered by human activities. They occur naturally when inherent weaknesses in the rock or soil combine with one or more triggering events such as heavy rain, snowmelt, changes in groundwater level, and seismic or volcanic activity. They can be caused by long-term climate change that results in increased precipitation, ground saturation and a rise in groundwater level, which reduces the shear strength and increases the weight of the soil. Erosion that removes material from the base of a slope can also cause naturally triggered landslides.

Human activities that trigger landslides are usually associated with construction such as grading that removes material from the base, loads material at the top, or otherwise alters a slope. Changing drainage patterns, groundwater level, slope and surface water, for example the addition of water to a slope from agricultural or landscape irrigation, roof downspouts, septic-tank effluent, or broken water or sewer lines can also cause landslides.

Three main factors that influence landslides: topography, geology and precipitation. Topology and geology are associated with each other, the steeper the slope, the greater the influence from gravity. Rock strength is important as certain bedrock formations or rock types appear to be more prone than others to landsliding. Precipitation may erode and undermine slope surfaces. If precipitation is absorbed into the ground, it increases the pore water pressure and lubricates weak zones of rock or soil.

Though the risk of landslide in Homer is low, the majority of town rest on a bench of land bordered on the north with steep slopes and gullies that have historical evidence of slides and sloughing. South Peninsula Hospital is situated immediately below such a steep slope and is subject to landslide damage should one occur. Homer is currently addressing steep slope development to mitigate future impacts from construction in these potentially unstable areas.

Types of Landslides

Landslides are usually classified by type of movement; falls, topples, lateral spreads, slides, and flows. A combination of two or more types is called a complex movement. Each type can be further broken down based on the type of material involved.

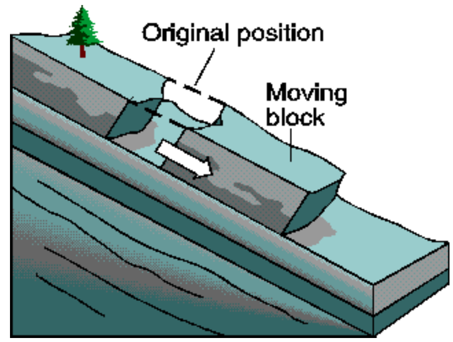
Falls

Falls occur when masses of rock or other material detach from a cliff or other steep slope and move downhill by free fall, rolling or bouncing. The movement is very quick. The typical slope angle involved is from 45 to 90 degrees. Rock falls occur when a rock on a steep slope becomes dislodged and falls down the slope. A rock fall may be a single rock or a mass of rocks and the falling rocks can dislodge other rocks as they collide with the cliff. At the base of most cliffs is an accumulation of fallen material termed talus**.** Rock falls are a constant problem along transportation routes through rocky terrain.

Debris falls are similar, except they involve a mixture of soil, regolith (unconsolidated weathered rock and soil material), vegetation, and rocks.

Slides

Slides are characterized by shear displacement along one or several surfaces. The two general types of slides are rotational and translational. In a rotational slide, the rupture surface is concave upward, and the mass rotates along the concave shear surface. Rotational slides, also called slumps, can occur in bedrock, debris, or earth. In a translational slide, the rupture surface is a smooth or gently rolling slope. In bedrock and earth, translational slides are sometimes called block slides if an intact mass slides down the slope. If rock fragments or debris slide down a slope on a distinct shear plane, the movements are called rockslides or debris slides. It is obvious that confusion can result by referring to all types of landslides as “slides”.



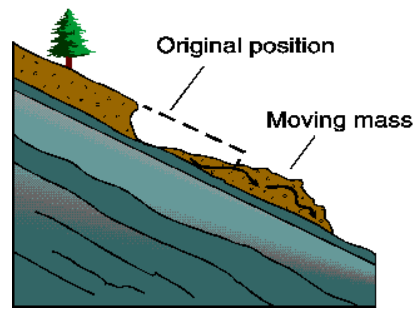
A Translational Slide. Image courtesy of Landslides in British Columbia.

Flows

In general, a flow is a moving mass that has differential internal movements that are distributed throughout the mass. They differ from slides by their higher water content and the distribution of velocities that resembles a viscous fluid. Flows in bedrock, also called sackung, gravitational sagging or rock flow, and not common nor is the process very well understood.

Flows in debris include soil creep, solifluction, block streams, debris flows, and debris avalanches. Soil creep is an imperceptibly slow, steady downward movement of slope-forming soil or rock due to gravity. Creep can occur due to alternate wetting and drying which expands and contracts the ground. Creep is more of a problem where the ground freezes and thaws or where clay minerals are present because many of them expand considerably when they contact water. Evidence of soil creep includes bent fences or retaining walls, curved tree trunks, and tilted poles.

Solifluction is a slow downward flow of water-saturated soil. It is often observed in areas with perennially or permanently frozen ground because the frozen ground traps snow and ice melt within the surface layer making it more fluid. Meltwater and rain saturate the soil in the springtime because they cannot percolate into the frozen layers below. The surface layers thaw to only a small depth during the short summer. This creates a very unstable situation at the interface between the frozen and unfrozen layers, and the heavy, waterlogged bed on top flows downslope as a dense sludge lubricated by the semi-liquid layer below. The whole surface layer tends to move together as a cohesive mass. Solifluction can occur on even moderate slopes, because of the ease with which a lobe slides on the frozen substratum. Solifluction does not occur abruptly, but solifluction lobes can move downhill several inches per day.



Flow. Image courtesy of Landslides in British Columbia.

A debris flow is a rapid movement of loose soil, rock and organic matter combined with water and air to form a downward moving slurry. The slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way.

Debris flows tend to occur on slopes in the 20-45 degree range. They are usually associated with unusually heavy precipitation or with rapid snowmelt. They can also occur following the bursting of a natural dam formed by landslide debris, glacial moraine, or glacier ice.

The phrase “debris avalanche” describes a very fast debris flow associated with volcanic hazards, usually strato-volcanoes because of their steep slopes and large amounts of easily remobilized materials.

Flows in earth include earth flows, loess flows, dry sand flows, wet sand flows, rapid earth flows, and mudflows. Earth flows are very slow to rapid flows with a characteristic hourglass shape. A bowl or depression forms at the source where the unstable material collects and flows out. The central area, the flow track, is narrow and usually becomes wider as it reaches the valley floor. Earth flows generally occur in fine-grained materials or clay-bearing rock on moderate slopes and with saturated conditions.

Rapid earth flows, also called quick clay flows, are very rapid flows that involve the liquefaction of subjacent material and the entire slide mass.

Mudflows are flows of fine-grained material such as silt or clay, with high water content. They differ from debris flows only in the size of their component materials (over 50% sand-, silt-, and clay-sized particles).

Secondary Effects

Landslides are often associated with other hazards. For example, a landslide may occur during floods because both involve precipitation, runoff, and ground saturation. Landslides are often associated with seismic and volcanic events. Some of the costliest landslides in American history were associated in the 1964 Good Friday earthquake. It has been estimated that ground failure, not shaking, caused about 60% of the damage.

The secondary effects of landslides can also be very destructive. Landslide dams cause damage upstream due to flooding and downstream due to a flood which may develop as a result of a sudden dam break. Landslides can also trigger tsunamis and seiches.

Land Subsidence

Land subsidence is any sinking or downward settling of the earth's surface. Underground mining for minerals, ground water or petroleum, and drainage of organic materials are typical causes of subsidence. However, these are rare in Alaska. More common causes of land subsidence in Alaska are sediment compaction and seismic or volcanic activity.

Erosion

Erosion is a process that involves the wearing away, transportation, and movement of land. Erosion rates can vary significantly as erosion can occur quite quickly as the result of a flash flood, coastal storm or other event. It can also occur slowly as the result of long-term environmental changes. Erosion is a natural process but its effects can be exacerbated by human activity.

Erosion rarely causes death or injury. However, erosion causes the destruction of property, development and infrastructure. In Alaska, coastal erosion is the most destructive, riverine erosion a close second, and wind erosion a distant third.

> Bluff erosion is when water runs off the land forming gullies. It is also caused by wave action at the toe of the bluff or when a bluff collapses under the weight of a heavy snow or rainfall.
>
> Beach erosion occurs when the wave action takes away the light sand.

Classifying erosion can be confusing, as there are multiple terms to refer to the same type of erosion. For example, riverine erosion may be called stream erosion, stream bank erosion, or riverbank erosion, among other terms. Coastal erosion is sometimes referred to as tidal erosion. Sometimes, bluff erosion is included in coastal erosion, other times they are two separate processes. The same goes for beach erosion. For this annex, coastal erosion encompasses bluff and beach erosion while riverine erosion will be considered synonymous for stream erosion, stream bank erosion and riverbank erosion.

Coastal Erosion

Coastal erosion is the wearing away of land resulting in loss of beach, shoreline, or dune material from natural activity or human influences. Coastal erosion occurs over the area roughly from the top of the bluff out into the near-shore region to about the 30 foot water depth. It is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. Bluff recession is the most visible aspect of coastal erosion because of the dramatic change it causes in the landscape. As a result, this aspect of coastal erosion usually receives the most attention.

Erosion warning sign in Homer.

On the coast, the forces of erosion are embodied in waves, currents, and wind. Surface and ground water flow, and freeze-thaw cycles may also play a role. Not all of these forces may be present at any particular location.

Coastal erosion can occur from rapid, short-term daily, seasonal, or annual natural events such as waves, storm surge, wind, coastal storms, and flooding or from human activities including boat wakes and dredging. The most dramatic erosion often occurs during storms, particularly because the highest energy waves are generated under storm conditions.

Coastal erosion also may be from multi-year impacts and long-term climatic change such as sea-level rise, lack of sediment supply, subsidence or long-term human factors such as the construction of shore protection structures and dams or aquifer depletion. Studies are underway to determine the effects generated from global warming.

Homer confronts coaster erosion seasonally, usually with winter storms, especially along the Spit and along Ocean Drive Loop, a residential housing area. A seawall has been constructed in an attempt to protect residential structures from continued erosion. Even before the seawall was completed it was damaged by a moderate storm and had to be repaired. Following storms have also damaged the seawall leading the engineering firm to bring lawsuit against the manufacturer of the seawall materials for its failure and reinforcement of the existing structure, but only time will determine the overall effectiveness of this strategy. Portions of the Sterling Highway along the Spit had to be reconstructed when undercut by several strong winter storms in 1998-1999.

Ironically, attempts to control erosion through shoreline protective measures such as groins, jetties, seawalls, or revetments, can actually lead to increased erosion activity. This is because shoreline structures eliminate the natural wave run-up and sand deposition processes and can increase reflected wave action and currents at the waterline. The increased wave action can cause localized scour both in front of and behind structures and prevent the settlement of suspended sediment.

Factors Influencing the Erosion Process

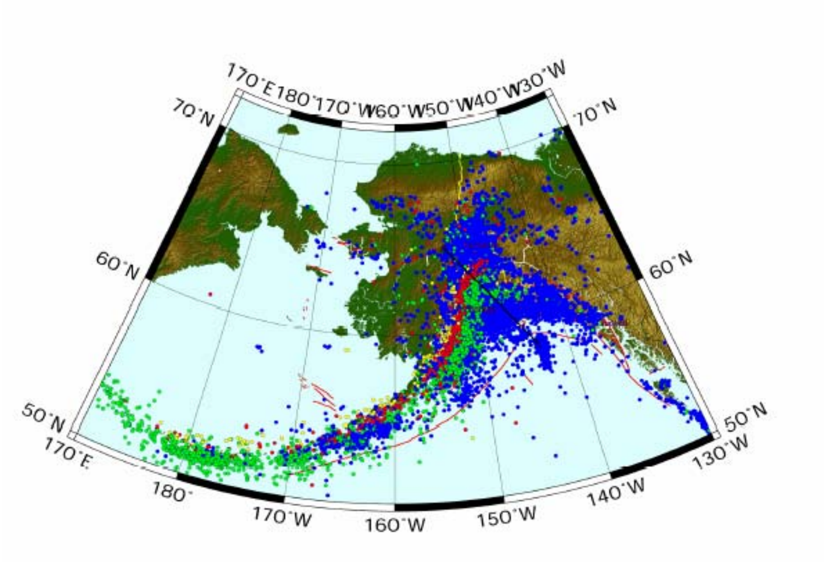
There are a variety of natural and human-induced factors that influence the erosion process. For example, shoreline orientation and exposure to prevailing winds, open ocean swells, and waves all influence erosion rates. Beach composition influences erosion rates as well. For example, a beach composed of sand and silt are easily eroded whereas beaches primarily consisting of boulders or large rocks are more resistant to erosion. Other factors may include:

- Shoreline type
- Geomorphology of the coast
- Structure types along the shoreline
- Density of development
- Amount of encroachment into the high hazard zone
- Proximity to erosion inducing coastal structures
- Nature of the coastal topography
- Elevation of coastal dunes and bluffs
- Shoreline exposure to wind and waves

Coastal Erosion in Alaska

Coastal erosion is a problem in all 30 coastal states, including Alaska. A 1971 USACE study showed that just less than 11% of Alaska's coastline was undergoing "significant" erosion. This may not sound like much but it means that approximately 5,100 miles of Alaska's coast is experiencing "significant" erosion. That's more than most states have coastline.

When undeveloped coastlines undergo erosion, it does not present a problem because there is nothing to be damaged. However, in developed areas, primarily along the western and northern coasts of Alaska and the Cook Inlet, erosion is a significant threat.



Earthquakes in Alaska 1988-1999.

Earthquake

Approximately 11% of the world's earthquakes occur in Alaska, making it one of the most seismically active regions in the world. Three of the ten largest quakes in the world since 1900 have occurred here. Earthquakes of magnitude 7 or greater occur in Alaska on average of about once a year; magnitude 8 earthquakes average about 14 years between events.

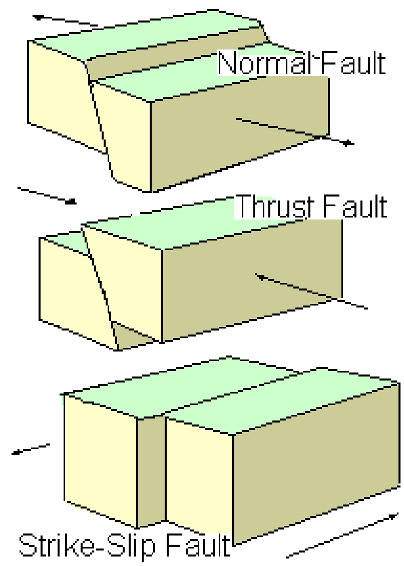
Hazard Analysis/Characterization

Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and constructing safe new structures.

Ground shaking is due to the three main classes of seismic waves generated by an earthquake. P (primary) waves are the first ones felt, often as a sharp jolt. S (shear or secondary) waves are slower and usually have a side to side movement. They can be very damaging because structures are more vulnerable to horizontal than vertical motion. Surface waves are the slowest, although they can carry the bulk of the energy in a large earthquake. The damage to buildings depends on how the specific characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock.



Three types of faults. Image courtesy of USGS.

Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting. Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and course silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength. In the 1964 earthquake, over 200 bridges were destroyed or damaged due to lateral spreads. Flow failures damaged the port facilities in Seward, Valdez and Whittier. Similar ground failures can result from loss of strength in saturated clay soils, as occurred in several major landslides that were responsible for most of the earthquake damage in Anchorage in 1964. Other types of earthquake-induced ground failures include slumps and debris slides on steep slopes.

The Homer Spit subsided approximately 4-6 feet due to the 1964 earthquake resulting in flooding of some structures which had to be raised or moved.

Tsunamis & Seiches

Tsunamis are traveling gravity waves in water, generated by a sudden vertical displacement of the water surface. They are typically generated by uplift or drop in the ocean floor, seismic activity, volcanic activity, meteor impact, or landslides (above or under sea in origin).

Most tsunamis are small and are only detected by instruments. Tsunami damage is a direct result of three factors: inundation (extent the water goes over the land), wave impact on structures and coastal erosion.

In 2003, Homer became the first community in Alaska to receive both a Tsunami and Storm Ready Community Designation from the National Weather Service and ADHSEM.

Types of Tsunamis

Tele-tsunami

Tele-tsunami is the term for a tsunami observed at places 1,000 kilometers from their source. In many cases, tele-tsunamis can allow for sufficient warning time and evacuation. No part of Alaska is expected to have significant damage due to a tele-tsunami. There is a slight risk in the western Aleutians and some parts of Southeast Alaska.

Magnitude	*Height (ft)*
-2 to –1	<1.0 to 2.5
-1 to 0	2.5 to 4.9
0 to 1	4.9 to 9.9
1 to 2	9.9 to 19.7
2 to 3	19.7 to 34.2
3 to 4	34.2 to 79.0
4 to 5	79 to >105.0

Tsunami Magnitude and Height relationships.

Most tele-tsunamis that have reached Alaska have not caused damage. In fact, most tele-tsunamis have had their largest recorded amplitude (in Alaska) at Massacre Bay, Attu Island. The amplitude is usually under 1 foot.

Only one tele-tsunami has caused damage in Alaska; the 1960 Chilean tsunami. Damage occurred to pilings at MacLeod Harbor, Montague Island and on Cape Pole, Kosciusko Island where a log boom broke free.

Volcanic tsunamis

There has been at least 1 confirmed volcanically triggered tsunami in Alaska. In 1883, a debris flow from the Saint Augustine volcano triggered a tsunami that inundated Port Graham (across Kachemak Bay from Homer) with waves 30 feet high. Other volcanic events may have caused tsunamis but there is not enough evidence to report that conclusively. Many volcanoes have the potential to generate tsunamis.

Seismically-generated local tsunamis

Most seismically-generated local tsunamis have occurred along the Aleutian Arc. Other locations include the back arc area in the Bering Sea and the eastern boundary of the Aleutian Arc plate. They generally reach land 20 to 45 minutes after starting.

Landslide-generated tsunamis

Submarine and subaerial landslides can generate large tsunamis. Subaerial landslides have more kinetic energy associated with them so they trigger larger tsunamis. An earthquake usually, but not always, triggers this type of landslide and they are usually confined to the bay or lake of origin. One earthquake can trigger multiple landslides and landslide-generated tsunamis. Low tide is a factor for submarine landslides because low tide leaves part of the water-saturated sediments exposed without the support of the water.

Landslide –generated tsunamis are responsible for most of the tsunami deaths in Alaska because they allow virtually no warning time.

There is some historical evidence of a landslide generated tsunami impacting the Homer area when a large landslide near the Grewingk Glacier across from Homer impacted the glacier lake sending large quantities of water across Kachemak Bay.

Tsunamis generated by landslides in lakes occur more in Alaska than any other part of the U.S. They are associated with the collapse of deltas in glacial lakes having great depths. They may also be associated with delta deposits from rapidly flowing streams and rivers carrying glacial debris.

Historical Tsunamis

1964 Earthquake Tsunami

The 1964 earthquake triggered several tsunamis, one major tectonic tsunami and about 20 local submarine and sub aerial landslide tsunamis. The major tsunami hit between 20 and 45 minutes after the earthquake. The locally generated tsunamis struck between two and five minutes after being created and caused most of the deaths and damage. Tsunamis caused more than 90% of the deaths – 106 Alaskans and 16 Californian and Oregonian residents were killed.


Tsunami damage in Kodiak.

While there was tsunami damage throughout the area, the effects were significant in Kodiak, Seward, Whittier and Valdez.

The Kodiak area experienced ten observed tsunamis. The main electrical power unit was knocked out and the water pipe system was destroyed. In addition, the dock pier, generators, roads, houses, runways, warehouses and other facilities were damaged or totally destroyed. In total, the damages amounted to $31.3 million, 80% of the city's industrial base was destroyed, and 600 people were made homeless out of a population of 2,658. Very few fatalities occurred; only six people were reported missing and presumed dead because most sought high ground after the earthquake,

In Seward, the shaking of the earthquake caused the Seward Waterfront to collapse, generating a 30-foot local tsunami. The local tsunami destroyed most of the facilities near the waterfront, including a fuel tank farm, which started the first of many fires. Smaller tsunamis then spread the burning oil floating on the water's surface and started another fire at the Texaco Petroleum tank farm further inland.

The combined slump and tsunami caused the dock to collapse and a number of boats to sink (30 fishing boats and 40 pleasure craft) within the small boat harbor. The railroad yards were heavily damaged, as were freight cars in the marshalling yards. A 120-ton locomotive was moved 100 feet and a 75-ton locomotive was carried 300 feet.

About 25 minutes after the earthquake, the tectonically generated tsunami arrived. This wave spread a wall of flaming oil into Seward, destroying and setting fire to a large section of the town. Overall, the tsunami caused about 95% of Seward's industrial base to be lost, 15% of the town's residential properties to be totally destroyed or very heavily damaged, 12 fatalities, 200 injuries and approximately $14 million in damage.

In Whittier, a series of at least eight tsunamis struck the town. Tsunamis destroyed two saw mills; the Union Oil Company tank farm, wharf and buildings; the Alaska Railroad depot; the railroad ramp handling towers at the army pier, and several houses, as well as causing damage to the small boat harbor. The tsunamis were responsible for 13 deaths and approximately $10 million in damages.

In Valdez, part of the waterfront slumped into the bay triggering, a locally generated tsunami. There was massive damage to the waterfront, storage, warehousing and railroad facilities. Half of the downtown business district was totally destroyed. The resulting fires burned at the waterfront for two weeks. Almost the entire town's fishing fleet, 68 out of 70 boats, were destroyed. Luckily, they were empty when the tsunami struck. The dock area was not as fortunate. Prior to the tsunami, 28 people had gathered to watch a freighter unload. All were swept away. Shifting cargo in the freighter's hold caused additional fatalities.

Tsunami caused fire in Valdez.

In nearby Shoup Bay, waves reached over 220 feet high. These were the highest recorded waves associated with the event.

1946 Unimak Island Tsunami

On April 1, 1946, a magnitude 7.3 earthquake occurred near Unimak Island. The resulting tsunami was approximately 100 feet high and was strong enough to knock the Scotch Cap lighthouse, a reinforced concrete structure, off its foundation. All five people in the lighthouse died. The tsunami caused about $250,000 in damages in Alaska but the effects were widespread. Relatively minor damage was reported in Washington and Oregon as well as French Polynesia and Chile, while California was more affected, with $10,000 in damages and one death. Hawaii was heavily impacted with $26 million in damages and 159 fatalities. This event renewed interest in tsunami research.

1994 Skagway Tsunami

The 1994 Skagway tsunami was a landslide-generated tsunami and was responsible for one fatality and over $25 million in damages. The triggering mechanism for the landslide is not known definitively. It is believed that the 23,350 tons of construction equipment and fill material on the railroad dock may have overloaded the sediments on which the dock was built, causing it to fail during the evening's low tide. It is also possible that the area failed as part of a larger underwater landslide.

Volcanoes

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 1-2 eruptions per year occurs in Alaska. In 1912, the largest eruption of the

20th century occurred at Novarupta and Mount Katmai, located in what is now Katmai National Park and Preserve on the Alaska Peninsula.

A volcano is a vent at the Earth's surface through which magma (molten rock) and associated gases erupt, and also the landform built by effusive and explosive eruptions.

Volcanoes display a wide variety of shapes, sizes, and behavior, however they are commonly classified among three main types: cinder cone, composite , and shield.

Types of Volcanoes

Cinder cones

A cinder cone is the simplest type of volcano. They are built from particles and blobs of congealed lava ejected from a single vent. As the lava is blown into the air, it breaks into small fragments that solidify and fall as cinders and bombs around the vent to form a circular or oval cone. Most cinder cones have a bowl-shaped crater or craters at the summit and are rarely more than a thousand feet above their surroundings. Cinder cones may form as flank vents on the sides of larger composite or shield volcanoes. They often occur in clusters and produce lava flows. Cinder cones are common in western North America as well as other volcanic terrain. Some Alaskan cinder cones are found in the following locations:

- St. Michael (in western Alaska along the southern Norton Sound shoreline)
- Ingakslugwat Hills (in western Alaska’s Yukon Delta region near the village of St. Mary’s)
- St. Paul Island (one of the Pribilof Islands in the Bering Sea)
- Table Top-Wide Bay (a satellite vent of Makushin Volcano near Unalaska in the Aleutian Islands)

Composite volcanoes

Composite volcanoes, sometimes called stratovolcanoes, are typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, blocks, and bombs and may rise as much as 8,000 feet above their bases. Some of the most conspicuous and beautiful mountains in the world are composite volcanoes, including Mount Shasta in California, Mount Hood in Oregon, Mount St. Helens and Mount Rainier in Washington, Mt Fuji in Japan, Mt. Vesuvius in Italy, and Shishaldin in Alaska.

Redoubt Volcano is one of the active volcanoes of the Cook Inlet region. Steam and volcanic gas rise above the summit crater of the volcano following the 1989 to 1990 eruptions. Iliamna Volcano is on the skyline at left. Photograph courtesy of C. Neal, USGS.

Composite volcanoes have a principal conduit system through which magma from a reservoir deep in the Earth's crust rises to the surface repeatedly to cause eruptions. The volcano is built up by the accumulation of material erupted through the conduit and increases in size as lava, ash, etc., are added to its slopes. Stratovolcanoes tend to erupt explosively because of the silica-based nature of magmas associated with these volcanoes. Some stratovolcanoes produce enormous explosive eruptions that destroy a large part of the volcano itself, leaving a wide, roughly circular depression called a caldera. Eruptions that produce calderas are among the most explosive and largest eruptions known.


A pyroclastic flow sweeping down the north flank of 1,282-m (4,206 ft)-high Augustine Volcano. Image courtesy M.E. Yount, USGS.

Most Alaskan volcanoes are stratovolcanoes, including Redoubt, Spurr and Iliamna.

Volcanic Hazards

Volcanic eruptions create the following hazards:

Lava Flows

Lava flows are streams of molten rock that flow from a volcano. The distance traveled by a flow is dependant on several variables including viscosity, volume, slope steepness and obstructions in the flow path. A typical flow is between 6 and 30 miles.

Lava flows cause damage by burning, crushing, or burying everything they contact. They can also melt ice and snow, causing flooding or move into a wooded area triggering wildland fires.

Pyroclastic Flows

Pyroclastic flows are high-density mixtures of hot gasses and dry rock that are usually released explosively from a volcano. They are hazardous because of their rapid movement and high temperatures. They travel at speeds of 30 to +90 miles per hour and can destroy or sweep away objects due to the impact of debris or associated high winds, or cause burns.

Pyroclastic Surges

Pyroclastic surges are turbulent low-density clouds of rock debris, air, and other gases that move over the ground at speeds similar to pyroclastic flows. There are two types: hot surges consisting of dry materials over 212ºF and cold surges consisting of cooler rock debris and water or steam.

Lava Domes

Volcanic or lava domes are formed when viscous lava erupts slowly from a vent. This causes it to solidify near the vent forming the dome instead of flowing away from the vent. A dome grows largely by expansion from within. As it grows its outer surface cools and hardens, then shatters, spilling loose fragments down its sides. Volcanic domes commonly occur within the craters or on the flanks of large composite volcanoes. Novarupta Dome was formed during the 1912 eruption of Katmai Volcano, Alaska, measures 800 feet across and 200 feet high.

Volcanic Ash and Bombs

Volcanic ash, also called tephra, is fine fragments of solidified lava ejected into the air by an explosion or rising hot air. 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), and impact of falling fragments. Further away, the primary hazard to humans is decreased visibility and inhaling the fine ash. Ash will also interfere with the operation of mechanical equipment including aircraft. In Alaska, this is a major problem as many of the major flight routes are near historically active volcanoes.

Homer experienced significant ash fall from the 1986 eruption of Mt. St. Augustine.

Volcanic Gases

Volcanic gases consist mostly of steam, carbon dioxide, and sulfur and chlorine compounds, but may include other substances. The gases can damage eyes, respiratory systems and cause suffocation. They can also be very corrosive.

Lateral Blasts


Debris avalanche deposits form hummocky topography. Image courtesy of USGS.

Lateral blasts are inflated mixtures of gases, ash, and hot rock debris. They may be hundreds of feet thick and travel at speeds up to 370 miles per hour. They cause damage through abrasion, impact, burial, and heat. They may also trigger pyroclastic flows or surges.

Debris Avalanches

Debris avalanches are is a sudden downward movement of unconsolidated material (mostly rock and soil). They occur without warning and travel quickly. Debris avalanches can extend for miles and cover up to 300 square miles, causing damage from impact or burial.

Debris Flows

Debris flows, also known as lahars, are rapidly flowing mixtures of rock debris and water that originate on the slopes of a volcano. They form in a variety of ways, primarily by the rapid melting of snow and ice by pyroclastic flows, intense rainfall on loose volcanic rock deposits, breakout of a lake dammed by volcanic deposits, and as a consequence of debris avalanches. They generally have the consistency of wet cement and have the ability to destroy or bury anything in their path.

Historic Volcanic Activity

The largest volcanic eruption of the 20th century occurred at Novarupta Volcano in June 1912. It 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.

Novarupta ash fall compared to that from recent Alaskan eruptions. Image courtesy of USGS.

The ash fall from this eruption was significantly greater than the recent eruptions of Redoubt, Spurr and Augustine Volcanoes. Fourteen earthquakes of magnitude 6 to 7 were associated with this event. At least 10 Alaskan volcanoes are capable of this type of event.

A more recent eruption occurred on Augustine Volcano in 1986. An ash plume disrupted air traffic and deposited ash in Anchorage and across the Kenai Peninsula. A dome formed in the crater, and caused some to fear it would subsequently collapse and trigger a tsunami along the east shore of Cook Inlet, as happened in 1883.

Redoubt Volcano erupted in 1989-1990 and debris flows caused temporary closing of the Drift River Oil Terminal. KLM's 747 jet aircraft, flight 867, temporarily lost power in all four engines when it entered the volcanic ash plume. It would have crashed into the mountains had they not be able to restart their engines about 4,000 feet (1,219 meters) above ground.

LEVEL OF CONCERN COLOR CODE

To more concisely describe our level of concern about possible or ongoing eruptive activity at an Alaskan volcano, the Alaska Volcano Observatory uses the following color-coded classification system. Definitions of the colors reflect AVO's interpretations of the behavior of the volcano. Definitions are listed below followed by general descriptions of typical activity associated with each color

GREEN	**No eruption anticipated.** Volcano is in quiet, "dormant" state.
YELLOW	**An eruption is possible in the next few weeks and may occur with little or no additional warning.** Small earthquakes detected locally and (or) increased levels of volcanic gas emissions.
ORANGE	**Explosive eruption is possible within a few days and may occur with little or no warning. Ash plume(s) not expected to reach 25,000 feet above sea level.** Increased numbers of local earthquakes. Extrusion of a lava dome or lava flows (non-explosive eruption) may be occurring.
RED	**Major explosive eruption expected within 24 hours. Large ash plume(s) expected to reach at least 25,000 feet above sea level.** Strong earthquake activity detected even at distant monitoring stations. Explosive eruption may be in progress.

Hazard Identification and Assessment

The responsibility for hazard identification and assessment for the active volcanic centers of Alaska falls to the Alaska Volcano Observatory and its constituent organizations (USGS, DNR/DGGS, and UAF/GI). AVO is in the process of publishing individual hazard assessments for each active volcano in the State. As of 2002, published or in-press hazard assessments cover the following volcanoes: Hayes, Spurr, Redoubt, Iliamna, Augustine, the Katmai Group, Aniakchak, Shishaldin, Akutan, and Makushin. Additional reports for Shishaldin, Kanaga, Great Sitkin, Westdahl, Dutton, Okmok are expected within the next year or two. Each report contains a description of the eruptive history of the volcano, the hazards they pose and the likely effects of future eruptions on populations, facilities, and ecosystems.

AVO has the primary responsibility to monitor all of Alaska's potentially active volcanoes and to issue timely warnings of activity to authorities and the public. During episodes of volcanic unrest or eruption, AVO is also the agency responsible for characterizing the immediate hazards and describing likely scenarios for an evolving volcanic crisis. AVO uses a 4-color Level of Concern Color Code to succinctly portray its interpretations of the state of activity and likely course of unrest at a given volcano.

Basic information about vulnerable assets and populations are identified in these assessments. However, DCED and other State agencies could work with AVO map data to integrate quantitative, current information regarding communities and other at-risk elements to improve our analysis of vulnerability.

One of the most vulnerable sectors is the aviation industry that is at risk from the effects of airborne volcanic ash. The significant trans-Pacific and intrastate air traffic in Alaska, directly over or near 41 potentially active volcanoes, has necessitated development of a strong communication and warning link between AVO, other government agencies with responsibility in aviation management, and the airline and air cargo industry.

Technological (Future Addition)

Hazard Analysis/Characterization

Economic

Hazard Analysis/Characterization

Economic disasters can result from uncontrollable natural events that have large negative effects on a region's economic base. Unfortunately, economic disasters also result from poor business practices and public policies that inhibit competition. An economic disaster declaration does not trigger the availability of disaster assistance in the manner of a natural or technological disaster, but it can provide the basis for seeking and receiving financial assistance. For example, the declaration of an economic disaster for fisheries led to the availability of assistance through provisions of the Magnusen-Stevens Fisheries Conservation and Management Act and the Interjurisdictional Fisheries Act in 1998, 1999 and 2000. In other instances, a disaster declaration has been unnecessary to secure assistance. For example, when Southeast pulp mills closed, extensive worker assistance was provided through the Job Training Partnership Act and the Trade Adjustment Act;

funds were made available for projects through the Economic Development Administration, the US Forest Service and USDA-Rural Development.

Economic disaster mitigation is not usually done by emergency management agencies, as these agencies are oriented to natural and technological disasters. Instead, it is essentially performed by economic development agencies. These agencies, or any segment of government, cannot create private economies even though they have an historic and legitimate role in fostering opportunities for economic development. Government's role cannot be to create or replace the marketplace, but to recognize and understand it, and help its citizens capitalize on the opportunities. Economic development agencies have programs designed to build, broaden and diversify the economic base by fostering economic development, and/or creating an environment in which economic development can flourish.

Public infrastructure, sensible regulations, public-private partnerships, efficient and coordinated service delivery, industry advocacy, marketing, economic analysis, and the dissemination of timely information all represent legitimate venues for government to promote economic development.

Approaches to Economic Development

Economic development can be promoted in a variety of ways, using a variety of approaches. These approaches can overlap with one another and are not meant to represent distinctly separate strategies, but to be illustrative. These approaches are also dynamic, state strategies evolve accordingly. Economic development approaches include:

- Industrial recruitment - competing for the sitting of large industrial or manufacturing companies by promoting advantages such as tax abatement, transportation access or developed industrial locations.
- Targeted incentives - using regional economic and workforce analysis to match the most suitable type of industry for particular areas.
- Quality of life - promoting recreation and leisure opportunities, quality schools, cultural amenities, low crime rates, a skilled workforce and clean air and water, to attract new business.
- Tax abatement - offering property tax abatement and other forms of tax relief as a development incentive.
- Workforce development - training the resident workforce for existing and anticipated jobs created through policy-based development initiatives, evolving technology, etc. For example, showcasing well-educated workforces, where higher than average percentages of workers have high school degrees or college diplomas.
- Resource endowments - promoting the existence of natural resource endowments to attract extractive industries. Alaska, particularly, is known as the nation’s resource treasure chest with its huge oil and mineral reserves

- The new economy - promoting an adaptable, consumer-friendly, technology-savvy, innovative, performance-driven and accountable environment to attract technology-based and knowledge-based industries.
- Web-based economic information systems - developing web sites, often using boroughs or sub-state regions as portals, to display and link to comprehensive economic information providing users with easy access.
- Regional partnerships – promoting regional organizations to implement community and regional economic development priorities. These organizations are like a 'two-way door', with local and regional issues, problems and priorities passing upward to the agencies, and agency programs, funding and technical assistance passing downward to the benefiting populations.

Assessing Risk

The first step to long-term mitigation is understanding which economies are at risk and which economies have the best chance to reduce risks through public and private investments. Ways to quantify economic risks include:

- Identifying comparative advantages in order to produce goods or services better than a competitor,
- Monitoring long-term supply and demand trends,
- Measuring the diversity of end-product markets,
- Measuring the size and diversity of base industries,
- Measuring the growth rates in employment, income and gross sales,
- Monitoring the relative dependence on imports,
- Assessing the skill levels in the workforce,
- Assessing the infrastructure needs to reduce transportation and energy costs.

Risk can then be used to evaluate and rank economies on their potential resilience during an economic downturn. Perhaps more importantly, when risks are regularly monitored, economic information is more freely shared, creating fewer uncertainties.

C. Vulnerability Assessments

Identification of Assets -

The Hazard Matrix below includes a list of facilities and/or structures that have been determined to be critical in nature, structures or facilities that would seriously impact not only the quality of life in Homer but also the sustainability and survivability of Homer residents.

Critical Facilities include:

- Essential facilities, which are necessary for the health and welfare of an area and are essential during the response and recovery phase of a disaster such as: public safety facilities, hospital, schools.
- Transportation systems such as: airport, port and harbor, highway and roads.
- Lifeline utility systems such as: potable and waste water treatment plants, electrical generation facilities and power grid and communications systems.

Hazard Matrix for: City of Homer   Population: 4,721

	Flood	Wildfire	Earthquake	Volcano	Tsunami & Seiche	Weather	Landslides	Erosion
00. Airport			X	X		X		
01. Fire			X	X		X		
02. Police			X	X		X		
03. South Pen. Hospital		X	X	X		X	X	X
04. Schools	X	X	X	X		X		
05 Tank (fuel) Farm	X		X	X	X	X		
06. HEA	X	X	X	X		X		
07. Telephone	X	X	X	X		X		
08. Sewer Treatment	X		X	X	X	X		
09. Port & Harbor	X		X	X	X	X		X
10. Landfill		X	X	X		X		
13. Highways/Roads	X	X	X	X	X	X	X	X
14. City Hall			X	X		X		
16. Banks/S&L			X	X		X		
17. Stores	X	X	X	X	X	X		X
18. Public Works	X		X	X	X	X		X
19. Post Office			X	X			X	
20. Radio Repeater	X	X	X	X	X	X		X
21. Reservoir / Supply (water)	X	X	X	X		X		
22. Senior Center			X	X		X		
23. Churches			X	X		X		
25. Water Treatment Plant	X	X	X	X		X		X

Homer's Vulnerability to Identified Hazard:

In summary, most identified hazards are area wide. The principal hazards of flood, earthquake and wildfire could potentially impact any part of Homer. Flooding events, even for those properties unaffected directly, will suffer due to road closures, impacts to public safety (access and response capabilities), limited availability of perishable commodities, and isolation. Earthquake damage would be area-wide with potential damage to critical infrastructure up to and including the complete abandonment of key facilities. Some critical infrastructure has been seismically upgraded (Fire Station) to protect occupants long enough to exit the building, but not facilities have been hardened sufficiently to remain functional following a high magnitude event. Limited building damage assessors are available in Homer to determine a structures integrity following earthquake damage. Priority would have to be given critical infrastructure to include: public safety facilities, health care facilities, shelters and potential shelters, and finally public utilities. The entire South Zone of the Kenai Peninsula is subject to wildfire conflagration. Perhaps with the exception of portions of the Homer Spit, the entire Homer community could be considered an "interface" zone. History has demonstrated that fire brands can be carried by local winds up to ½ mile, jumping man-made fire lines and spreading fire across large areas. Most areas of homer are immediately adjacent to wildland areas and could be threatened by uncontrolled fire.

Based on newly developed tsunami inundation mapping provided by the Alaska Division of Homeland Security and Emergency Management very limited areas of the Homer coast line would be potentially damaged by tsunami, with no critical infrastructure immediately threatened.

Other assessed hazards not affecting the entire area would be landslides and erosion. With limited exceptions due to flooding, landslide danger would impact only those portions of Homer located near the base or top of the inland bluffs which create the "Homer bench" and those properties near the coast (due to storm erosion).

D. Development Trends

The City of Homer encompasses 10 zoning districts; Central Business, Residential Office, Urban Residential, General Commercial 1, General Commercial 2, Marine Commercial, Marine Industrial, Open Space Recreation, and Conservation. In addition to the 10 zoning districts the City received extra territorial jurisdiction from the Kenai Peninsula Borough to regulate development within the Bridge Creek Watershed outside of City Limits. The City recently adopted FEMA Floodplain regulations, a complex set of standards for retail/wholesale development larger than 15,000 square feet in area, and the Community Design Manual, which is a set of design guidelines for commercial construction in the Central Business District. A recent addition to the City is a Code Compliance/Planning Technician who focuses on permitting and zoning enforcement.

In 2003 the Planning Department, in conjunction with the Public Works Department issued 86 zoning permits, an increase over the 72 issued in 2002. Total construction value of the zoning permits was $15,326,815. Residential construction was the clear push behind this figure; permitting included 47 new homes valued at $8,120,455 and 19 remodels valued at $806,600. New commercial construction was valued at $5,764,520, and commercial remodels were valued at $635,240. Total fees collected for zoning permits was $8,825.

Several large new projects are on the horizon for Homer. In addition to the expansion of the Kachemak Bay Campus of the University of Alaska Anchorage (currently underway) the City will soon begin construction of a new animal shelter facility and plans are underway for construction of a new 5.7 million dollar public library. In 2003 the voters approved funding of an expansion of the South Peninsula Hospital and design is well underway on that project with startup planned for the near future.

Chapter V– Mitigation Goals, Objectives, & Strategies

A. Tsunami –

<u>Goals</u>

1. ***Public Education*** **(Priority-High)**

   Objective 1.1: Encourage all coastal local residents with a tsunami threat to participate in the Tsunami Awareness Program**.**

Participants will be educated to the potential threat of Tsunamis along Homer's coastline, as well as identifying Tsunami Evacuation Routes and Assembly Areas. The community will also be encouraged to develop a Disaster Preparedness Kit for their Home and vehicles.

Action 1.1.1: *Advertise Disaster Preparedness Workshop/Homer Community Schools*

Responsible Parties:

Homer Volunteer Fire Department; ADHSEM, KPB-OEM, Homer Community Schools, West Coast/Alaska Tsunami Warning Center.

2. TsunamiReady Community Designation **(Priority-High) *Status Completed 2002**

Objective 2.1: Participate in the NWS/WC&ATWC TsunamiReady Program**.**

The TsunamiReady Program requires communities to complete extensive requirements for a TsunamiReady Community Certification (see program description above).

Responsible Parties:

Homer Volunteer Fire Department; ADHSEM, West Coast/Alaska Tsunami Warning Center.

3. Tsunami Evacuation Route Signage **(Priority-High) *Status Completed 2002**

Objective 3.1: Install evacuation route signs**.**

The Tsunami Ready Program requires that evacuation route(s) be identified and appropriately marks with standardized signage. The primary evacuation route for the Homer Spit is Kachemak Drive, East to the junction with East End Road. This route directs people away from the Beluga Slough crossing which is located in the projected tsunami inundation zone.

Responsible Parties:

Homer Volunteer Fire Department, Department of Transportation, Homer Public Works, ADHSEM.

4. Mapping **(Priority-Medium) *Status Completed-2004**

Objective 4.1: Obtain tsunami inundation maps for the City of Homer and adjacent communities.

Without inundation maps, communities must rely on historical or estimated information for land use and evacuation route planning. Inundation maps will provide more accurate information. This will assist the community with developing more accurate emergency management decisions.

Action 4.1.1: *Develop tsunami inundation map for the Homer/Seldovia area.*

Responsible Parties:

ADHSEM

5. ***Encourage City of Homer, Planning & Zoning Department to incorporate tsunami risk areas in land use planning and zoning.*** **(Priority-Medium) *Status Pending**

Land use planning and zoning can help limit tsunami damage by minimizing, reducing or preventing development in tsunami risk areas. This can be done in many ways including: encouraging the elevation of buildings, positioning structures on the high part of their lots, using the lower floors of high rise structures as non occupied spaces, encourage the development of site planning regulations requiring streets and structures to be perpendicular to potential waves creating a path of least resistance for the water and reducing debris impact. These measures are targeted to reduce non-coastal dependent development. Water based facilities like ferry terminals and shipping docks should be built to withstand tsunami wave forces.

Objective 5.1: Provide Tsunami Inundation Mapping and mitigation information to the City of Homer Planning Director for possible incorporation into the Cities Zoning/Permitting process.

Action 5.1.1: *Compile Tsunami Hazard Information*

Responsible Parties:

City of Homer Planning Department, City of Homer and Kenai Peninsula Borough Planning Commission, Homer Public Works Department.

6. ***Encourage federal flood insurance programs to cover tsunami damage.*** **(Priority-Low) *Status Ongoing**

Objective 6.1: Educate residents and property owners about the Federal Flood Insurance Program. Currently, the City of Homer is enrolled in the Flood Insurance Program

Action 6.1.1: *Obtain Federal Flood Insurance Program information from FEMA office for distribution*

Action 6.1.2: *Distribute Flood Insurance Program information during the Disaster Preparedness Workshops*

Responsible Parties:

FEMA, NFIP, City of Homer.

B. Wildfire –

There are two phases to addressing the wildfire issue in Homer. The first and foremost would revolve around public education. The second phase would be to focus on specific mitigation strategies found within the International Urban-Wildland Interface Code™. This code utilizes three mitigation strategies: creation and management of defensible spaces around threatened structures; wildfire fuel management; and encouraging or mandating use of fire-resistive construction techniques.

<u>Goals</u>

1. ***Public Education of Wildfire Potential and Mitigation Strategies.*** **(Priority-High)**

Objective 1.1: Educate Homer area residents of the high potential for catastrophic wildfire in the Homer area. While the threat of wildfire can not be fully eliminated, educating the public regarding their personal risk and vulnerability to wildfire entrapment.

__Action 1.1.1__ Conduct annual public information campaigns in cooperation with the Division of Forestry.

Objective 1.2: Cooperate with the Division of Forestry in the "Fire Wise" campaign. One of the most useful methods developed for wildfire mitigation has been the design of fire resistive buildings and the concept of "defensible space" thus limiting fuels immediately adjacent to at-risk structures. This strategy was proven during the Mansfield/Hutler Road Fires in which only one structure was lost. The Mansfield Road neighborhood had worked with the fire department in the development of defensible space in the year preceding the fire event. Additional lessons were learned as fire crews and home owners were able to immediately return to the fire area once the fire front had passed and were able to extinguish any remaining fires around their buildings.

__Action 1.2.1__ Encourage home owners and property owners to remove dead or diseased trees to promote regeneration of healthy forests and to replace vegetation know to easily ignite in wildfire conditions with fire resistive plants, shrubs and trees.
__Action 1.2.2__ Educate home owners in wildfire resistive construction techniques and strategies to limit their exposure to wildfire.
__Action 1.2.3__ Provide interested residents with Fire Wise informational packets and brochures.

Responsible Parties:

Homer Volunteer Fire Department, Alaska Division of Forestry, Kenai Peninsula Borough, Kachemak City, Kachemak Emergency Service Area, Homer Community Schools.

2. Control and direct open burning within the City limits of Homer. **(Priority-High)**

Objective 2.1 Limit the number, size and location of burn piles within City Limits. Homer City Code requires that residents obtain an Open Burning Permit anytime during the year for all fires other than "warming fires" (those less than 2 feet in diameter used for cooking or warming). State regulations require residents outside of Homer to have a Burn Permit during the "fire season" of May 1 through the end of September each year.

__Action 2.1.1:__ Issue burn permits year-round to Homer residents and seasonally to residents outside of Homer that wish to dispose of organic materials.

Responsible Parties:

Homer Volunteer Fire Department, City of Homer, Alaska Division of Forestry.

3. Establish alternative methods of disposal for slash, brush, and organic debris so that residents do not have to use open burning. **(Priority-High)**

Objective 3.1: Encourage use of alternative methods of debris disposal other then open burning.

__Action 3.1.1__ Encourage use of composting, chipping, or grinding as an alternative to burning of woody debris.

Responsible Parties:

City of Homer, Kenai Peninsula Borough.

***4. Prohibit open burning during high-risk periods.* (Priority-High)**

Objective 4.1: In cooperation with the Division of Forestry, suspend burn permits and open burning during high fire danger conditions or when other factors will contribute to high fire danger.

__Action 4.1.1__ Maintain open lines of communication between the Division of Forestry, National Weather Service, and the Homer Volunteer Fire Department to determine when fire conditions warrant suspension of burn permits or open burning in general.
__Action 4.1.2__ When conditions warrant suspension of burn permits or open burning in Homer, disseminate that information in the form of press-releases to the local radio and print media.
__Action 4.1.3__ When open burning is prohibited, or burn permits are suspended ensure that the Homer Police Department Dispatch center is notified so that they can advise persons that call in to activate their individual permit that a temporary suspension has been placed on open burning.
__Action 4.1.4__ Complete a daily assessment of fire danger during closures or suspensions by 10:00 AM each day to determine the need to continue the closure or resend the closure.

Responsible Parties:

Homer Volunteer Fire Department, Alaska Division of Forestry, National Weather Service, KPB-OEM.

5. Limit the types of roofing authorized materials approved for use in "interface" zones to prohibit use of highly flammable/combustible materials such as wood shingles. (Priority-Medium)

Objective 5.1: Establish zoning and planning ordinances to prohibit the use of highly combustible wood shingles in at-risk "interface zones".

__Action 5.1.1__ Establish the definition of Interface Zone in City Zoning Code.
__Action 5.1.2__ Determine which areas of Homer should be considered as being in an Interface Zone
__Action 5.1.3__ Adopt codes to prohibit the use of wood shingles on roofs of structures/buildings located within an Interface Zone.

Responsible Parties:

City of Homer, Planning Department, Homer Volunteer Fire Department, Division of Forestry.

6. Develop wildfire fuel load reduction projects, especially around critical infrastructure and identified "safe zone" and potential emergency shelters. (Priority-High, Funding Dependent)

Objective 6.1: Review current fuel loads surrounding infrastructure and safety zone/shelter locations within the City of Homer.

Action 6.1.1 *Develop list of know shelters (from Emergency Plan), safe zones, and critical infrastructure.*
Action 6.1.2 *Review wildfire fuel load and develop mapping of area in need of fuels management activities.*
Action 6.1.3 *Develop and implement fuel reduction plan*

Responsible Parties:

Homer Volunteer Fire Department, Alaska Division of Forestry, Kachemak City, Kenai Peninsula Borough.

C. EARTHQUAKE -

Goals

1. Protect existing critical infrastructure from earthquake damage. (Priority-Medium, Funding Dependent)

Objective 1.1: Perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Homer.

Action 1.1.1 *Identify buildings and facilities that must be able to remain operable during and following an earthquake event.*
Action 1.1.2 *Contract a structural engineering firm to assess the identified buildings and facilities to determine their structural integrity and strategy to improve their earthquake resistance.*

Objective 1.2 Perform those steps identified above to protect critical infrastructure from earthquake damage and to preserve functionality.

Action 1.2.1 *Identify priorities and budget to retrofit existing infrastructure to existing earthquake resistive construction standards.*
Action 1.2.2 *Develop a Request for Proposals to submit for design and construction of the retrofitting requirements.*

Responsible Parties:

City of Homer, Kenai Peninsula Borough, FEMA Mitigation Programs, Public Works, Homer Volunteer Fire Department.

2. Building Code Adoption-Seismic Requirement-New Construction (Priority-Low)

While the State of Alaska has adopted the International Building, Fire and Mechanical Codes that include seismic requirements, there is no State-wide building code for single family, duplex and triplex residential construction. There are no adopted seismic codes for these most vulnerable occupancies.

Objective 2.1: Adopt into the Homer City Code regulations pertaining to the construction of new buildings, including all residential occupancies including seismic engineering and construction.

Action 2.1.1 *Adopt the International Residential Code (2003 Edition) for the construction of all new residential occupancies within the City of Homer.*

Responsible Parties:

City of Homer, Planning Department, Public Works Department, Homer Volunteer Fire Department.

3. Existing Buildings – Non-Structural Mitigation Program (Priority-Medium, Funding Dependent)

Experience has demonstrated (Nisqually Earthquake, February 28, 2001) that non-structural mitigation programs are an effective and economical way to reduce property damage and loss of life during earthquake events.

Objective 3.1: Provide technical advice, information, and non-structural building inspection services to those individuals, businesses and institutions requesting non-structural mitigation program guidance.

Action 3.1.1 *Compile list of available non-structural mitigation materials available to the public.*
Action 3.1.2 *Compile list of individuals trained in non-structural mitigation strategies for dissemination to the public*

Responsible Parties:

City of Homer, Public Works Department, Planning Department, Kenai Peninsula Borough.

D. Flood -

Following the two flooding events in the fall of 2002, the City of Homer completely updated the Flood Damage Prevention section of the Homer City Code, codified under Chapter 12.12.

<u>Goals</u>

1. Participation in National Flood Insurance Program (Priority-High)

Homer participates in the National Flood Insurance Program following the floods of 2002.

Objective 1.1: Maintain the City of Homer's participation in the flood insurance program so that low cost flood insurance is available to residents.

> ***Action 1.1.1*** *Annually review the requirements of the National Flood Insurance Program to conform to enrollment objectives and criteria.*

Responsible Parties:
City of Homer, Planning Department, NFIP, FEMA, Kenai Peninsula Borough.

2. Update Flood Plain Maps (Priority-Medium, Funding Dependent)
The existing flood plain maps are obsolete and need to be reviewed and updated to reflect current developments and needs.

Objective 2.1: Obtain funding to update existing flood plain maps to include all current city limits and the Bridge Creek Watershed.

> ***Action 2.1.1*** *Coordinate with Alaska Department of Community and Economic Development and the Federal Emergency Management Agency to acquire funds to update area mapping.*
> ***Action 2.1.2*** *Work with the Federal Insurance and Mitigation Administration's Hazard Mapping Division to obtain updated maps*

Objective 2.1: Coordinate updated mapping with GIS capabilities to aid in the determination of flood susceptible infrastructure and facilities.

Responsible Parties:
City of Homer, Alaska Department of Community and Economic Development, FEMA, Federal Insurance and Mitigation Administration, Planning Department, Kenai Peninsula Borough.

3. Review flood scenario of 2002 to determine potential mitigation strategies (Priority-Low)

Objective 3.1: Coordinate fact finding between Zoning and Planning and Public Works, Kenai Peninsula Borough and the State of Alaska DOT to map areas that experienced flooding in 2002.

Objective 3.2: Evaluate existing infrastructure to determine if changes need to be made to mitigate future flood under similar conditions.

> ***Action 3.2.1*** *Develop overlay map of existing infrastructure (drainages, culvert size, storm drains.*

Objective 3.3: Coordinate with responsible parties (Private, State, Borough, City) to determine design minimums to prevent future flooding under the heavy rainfall scenario similar to 2002.

Responsible Parties:

Homer Volunteer Fire Department, Homer Public Works Department, Alaska Department of Transportation, KPB-OEM, Planning Department.

4. Manage development in flood prone areas (Priority-Medium)

Ensure, through adequate zoning and planning oversight that all new development meets the intent of Chapter 12.12, Flood Damage Prevention, of the Homer City Code.

Objective 4.1: Provide for the regular review of Chapter 12.12 to ensure up-to-date requirements are being addressed.

Objective 4.2: Require developers/land owners to provide documentation of compliance with existing Flood Damage Prevention requirements if the project is located within a flood hazard area as defined by City Code.

Responsible Parties:

City of Homer, Planning Department, Kenai Peninsula Borough.

Chapter VI – Implementation & Maintenance Procedures

A. Implementation

The City of Homer will implement this plan by using mitigation actions within our Comprehensive Plan, the Capital Improvement Plan, and other plans to pursue our mitigation goals. Our various community plans will consider best mitigation practices to maximize the benefit to the community. We will consider projects that show they are cost effective by ensuring that for every dollar spent we will reduce loss of life or property damage.

We will use the following criteria to prioritize all community projects:

The Planning Commission will analyze and prioritize projects based on:

1. Life saving or personal safety issues
2. Projects will be coordinated with all community plans. For example: the Homer Comprehensive Plan, the Homer Capital Improvement Plan, the City of Homer All-Hazard Mitigation Plan, etc.

B. Maintenance

The City of Homer All-Hazard Mitigation Plan will be reviewed annually and will be updated at a minimum of every five years or 90 days after a Presidential declared disaster. The Director of Planning will be responsible for ensuring that reviews are completed, the planning commission and the general public will be notified of opportunities to review the plan by written invitation, use of newspaper, radio, television, brochures or flyers to advertise this opportunity and solicit involvement. Public involvement is essential to ensure that the mitigation goals, objectives and action items are addressing the community's needs.

Appendix A
Glossary of Terms

A-Zones	A-Zones are found on all Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs). An A-Zone is an area that would be flooded by the Base Flood, and is the same as a Special Flood Hazard Area (SFHA) or a 100-year floodplain. These areas may be unnumbered as AE, AH, or AO Zones. Numbered A-Zones indicates an area's risk to flooding.
Acquisition	Local governments can acquire lands in high hazard areas through conservation easements, purchase of development rights, or outright purchase of property.
Alluvial Fan	Area of deposition where steep mountain drainages empty into valley floors. Flooding in these areas often have characteristics that differ from those in riverine or coastal areas. (See Alluvial Fan Flooding)
Alluvial Fan Flooding	Flooding that occurs on the surface of an alluvial fan (or similar landform) that originates at the apex of the fan and is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and unpredictable flow paths.
Anabatic Wind	Any wind blowing *up* an incline; the opposite to katabatic wind.
Asset	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Avalanche	Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks, trees, and rubble of every description.
Base Flood	A term used in the National Flood Insurance Program to indicate the minimum size of a flood. This information is used by a community as a basis for its floodplain management regulations. It is the level of a flood which has a one-percent chance of occuring in any given year. Also known as a 100-year flood elevation or one-percent chance flood.
Base Flood Elevation (BFE)	The elevation for which there is a one-percent chance in any given year that flood water levels will equal or exceed it. The BFE is determined by statistical analysis for each local area and designated on the Flood Insurance Rate Maps. It is also known as 100-year flood elevation.
Base Floodplain	The area that has a one percent chance of flooding (being inundated by flood waters) in any given year..
Borough	The basic unit of local government in Alaska.
Building	A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight
Building Code	The regulations adopted by a local governing body setting forth standards for the construction, addition, modification, and repair of buildings and other structures for the purpose of protecting the health, safety, and general welfare of the public
Caldera	A caldera is a large, usually circular depression at the summit of a volcano formed when magma is withdrawn or erupted from a shallow underground

magma reservoir.

Chinook	A warm down-slope wind.
Community	Any state, area or political subdivision thereof, or any Indian tribe or tribal entity that has the authority to adopt and enforce statutes for areas within its jurisdiction.
Community Rating System (CRS)	The Community Rating System is a voluntary program that each municipality or county government can choose to participate in. The activities that are undertaken through CRS are awarded points. A community's points can earn people in their community a discount on their flood insurance premiums.
Critical Facility	Facilities that are critical to the health and welfare of the population and that are especially important during and after a hazard event. Critical facilities include, but are not limited to, shelters, hospitals, and fire stations.
Dam	A structure built across a waterway to impound water.
Designated Floodway	The channel of a stream and that portion of the adjoining floodplain designated by a regulatory agency to be kept free of further development to provide for unobstructed passage of flood flows.
Development	Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or of equipment or materials.
Digitize	To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer

	applications.
Disaster Mitigation Act	DMA 2000 (public Law 106-390) is the latest legislation of 2000 (DMA 2000) to improve the planning process. It was signed into law on October 10, 2000. This new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.
Earthquake	A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.
Earthquake Swarm	A collection of earthquakes that is frequent in time. There is no identifiable main shock.
Elevation	The raising of a structure to place it above flood waters on an extended support structure.
Emergency Operations Plan	A document that: describes how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources available for use in the disaster; and outlines how all actions will be coordinated.
Erosion	The wearing away of the land surface by running water, wind, ice, or other geological agents.
Federal Disaster Declaration	The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended. Same meaning as a Presidential Disaster Declaration
Federal Emergency Management Agency (FEMA)	A federal agency created in 1979 to provide a single point of accountability for all federal activities related to hazard mitigation, preparedness, response, and

recovery.

Flash Flood	A flood event occurring with little or no warning where water levels rise at an extremely fast rate. It is often the result of heavy rainfall in a localized area.
Flood	A general and temporary condition of partial or complete inundation of water over normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.
Flood Control	Keeping flood waters away from specific developed or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineered structures.
Flood Disaster Assistance	Flood disaster assistance includes development of comprehensive preparedness and recovery plans, program capabilities, and organization of Federal agencies and of State and local governments to mitigate the adverse effects of disastrous floods. It may include maximum hazard reduction, avoidance, and mitigation measures, as well policies, procedures, and eligibility criteria for Federal grant or loan assistance to State and local governments, private organizations, or individuals as the result of the major disaster.
Flood Elevation	Elevation of the water surface above an establish datum (reference mark), e.g. National Geodetic Vertical Datum of 1929, North American Datum of 1988, or Mean Sea Level
Flood Frequencies	Frequencies are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. The frequency is the chance of a flood occurring during a given timeframe. It is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1% chance and the 10-year flood

has a 10% chance of occurring in any given year.

Flood Fringe

That portion of the floodplain that lies beyond the floodway and serves as a temporary storage area for floodwaters during a flood. This section receives waters that are shallower and of lower velocities than those of the floodway.

Flood Hazard

Flood Hazard is the potential for inundation and involves the risk of life, health, property, and natural value. Two reference base are commonly used: (1) For most situations, the Base Flood is that flood which has a one-percent chance of being exceeded in any given year (also known as the 100-year flood); (2) for critical actions, an activity for which a one-percent chance of flooding would be too great, at a minimum the base flood is that flood which has a 0.2 percent chance of being exceeded in any given year (also known as the 500-year flood).

Flood Hazard Boundary Map

Flood Hazard Boundary Map (FHBM) means an Official (FHBM) map of a community, issued by the Administrator, where the boundaries of the flood, mudslides (i.e., mudflow) related erosion areas having special hazards have been designated as Zones A, M, and/or E.

Flood Insurance Rate Map

Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study

Flood Insurance Study or Flood Elevation Study means an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluations and determination of mudslide (i.e., mudflow) and/or flood-related' erosion hazards.

Floodplain

A "floodplain" is the lowland adjacent to a river, lake or ocean. Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood. The 100-year floodplain by the 100-year flood

Floodplain Management	The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.
Floodplain Management Regulations	Floodplain Management Regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as floodplain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.
Flood Proofing	Any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved property, water and sanitary facilities, structures and their contents
Floodway	Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.
Flood Zones	Zones on the Flood Insurance Rate Map (FIRM) in which a Flood Insurance Study has established the risk premium insurance rates.
Flood Zone Symbol	A Area of special flood hazard without water surface elevations determined. A1-30, AE Area of special flood hazard with water surface elevations determined.

	AO Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet.
	A-99 Area of special flood hazard where enough progress has been made on a protective system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes.
	AH Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet and with water surface elevations determined.
	B, X Area of moderate flood hazard.
	C, X Area of minimal hazard.
	D Area of undetermined but possible flood hazard.
Freeboard	Freeboard means a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. Freeboard tends to compensate for many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.
Fumarole	Fumaroles are vents from which volcanic gas escapes into the atmosphere. Fumaroles may occur along tiny cracks or long fissures, in chaotic clusters or fields, and on the surfaces of lava flows and thick deposits of pyroclastic flows. They may persist for decADHSEM or centuries if they are above a persistent heat source or disappear within weeks to months if they occur atop a fresh volcanic deposit that quickly cools.
Geographic Information System	A computer software application that relates physical features of the earth to a database that can be used for mapping and analysis.

Governing Body	The legislative body of a municipality that is the assembly of a borough or the council of a city.
Hazard	A source of potential danger or adverse condition. Hazards in the context of this plan will include naturally occurring events such as floods, earthquakes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
Hazard Event	A specific occurrence of a particular type of hazard.
Hazard Identification	The process of identifying hazards that threaten an area.
Hazard Mitigation	Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. (44 CFR Subpart M 206.401)
Hazard Mitigation Grant Program	The program authorized under section 404 of the Stafford Act, which may provide funding for mitigation measures identified through the evaluation of natural hazards conducted under §322 of the Disaster Mitigation Act 2000.
Hazard Profile	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
Hazard and Vulnerability Analysis	The identification and evaluation of all the hazards that potentially threaten a jurisdiction and analyzing them in the context of the jurisdiction to determine the degree of threat that is posed by each.
Hydrology	The science of the behavior of water in the atmosphere, on the earth's surface, and underground.

Infrastructure	The public services of a community that have a direct impact to the quality of life. Infrastructure refers to communication technology such as phone lines or Internet access, vital services such as public water supply and sewer treatment facilities, and includes an area's transportation system, regional dams or bridges, etc.
Intensity	A measure of the effects of a hazard event at a particular place.
Interferometer	A method employing the interference of electromagnetic radiation to make highly precise measurements of the angle between the two rays of light.
Inundation	The maximum horizontal distance covered by flood water, a seich or a tsunami.
Jökulhlaup	A sudden flood-like release of water from a glacier. (Glacier outburst flooding)
Katabatic wind	Any wind blowing down an incline; the opposite to anabatic wind.
Knot	A unit of measurement equaling 1 nautical mile per hour. This is roughly 1.15 statute miles per hour or 1.852 kilometers per hour.
Lahar	Lahar is an Indonesian word for a rapidly flowing mixture of rock debris and water that originates on the slopes of a volcano. Lahars are also referred to as volcanic mudflows or debris flows. They form in a variety of ways, chiefly by the rapid melting of snow and ice by pyroclastic flows, intense rainfall on loose volcanic rock deposits, breakout of a lake dammed by volcanic deposits, and as a consequence of debris avalanches.

Landslide — Downward movement of a slope, soil, and other materials or debris under the force of gravity.

Lava dome — Lava domes are rounded, steep-sided mounds built by very viscous magma. Such magmas are typically too viscous (resistant to flow) to move far from the vent before cooling and crystallizing. Domes may consist of one or more individual lava flows.

Liquefaction — The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like a thick or viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Littoral — Of or pertaining to the shore, especially of the sea.

Local Emergency Planning Committee (LEPC) — LEPCs consist of community representatives and are appointed by the State Emergency Response Commissions (SERCs), as required by Superfund Amendments and Reauthorization Act (SARA), Title III. They develop an emergency plan to prepare for and respond to a chemical emergency. They are also responsible for coordinating with local facilities to find out what they are doing to reduce hazards, prepare for accidents, and reduce hazardous inventories and releases. The LEPC serves as a focal point in the community for information and discussion about hazardous substances, emergency planning, and health and environmental risks.

Local Government — Any county, borough, municipality, city, township, public authority, school district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency, or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity, for which an application for assistance is made by a State or political subdivision of a State.

Magma	Molten rock originating from the Earth's interior.
Magnitude	A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.
Mitigate	To cause something to became less harsh or hostile, to make less severe or painful
Mitigation Plan	A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the State and includes a description of actions to minimize future vulnerability to hazards.
Municipality	A political subdivision incorporated under the laws of the State that is a home rule or general law city, a home rule or general law borough, or a unified municipality.
National Flood Insurance	The Federal program, created by an act of Congress in Program (NFIP) 1968 that makes flood insurance available in communities that enact satisfactory floodplain management regulations.
National Weather Service	Prepares and issues flood, severe weather, and coastal (NWS) storm warnings and can provide technical assistance to federal and State entities in preparing weather and flood warning plans.
Natural Disaster	Any natural catastrophe, including any hurricane, tornado, storm, high water, wind, driven water… tsunami, earthquake, volcanic eruption, landslide, snowstorm, fire, or drought. (44 CFR Subpart M 206.401)
New Construction	New construction means structures for which the "start of construction" on or after the effective date of

a floodplain management regulation adopted by a community and includes any subsequent improvement to such structures.

Nonstructural Floodplain Management Measures Those measures, such as flood proofing, employed to modify the exposure of buildings to floods and use planning, warning, schemes, and insurance as opposed to structural measures (such as dams, levees, and channel modifications).

One Hundred (100)-Year The flood elevation that has a one-percent chance of occurring in any given year. It is also known as the Base Flood.

Orthophoto An aerial photo that has been corrected to eliminate the effects of camera tilt and relief displacement. The ground geometry is recreated as it would appear from directly above each and every point.

Overlay Zone Overlay zones (overlay districts) create a framework for conservation or development of special geographical areas. In a special resource overlay district, overlay provisions typically impose greater restrictions on the development of land, but only regarding those parcels whose development, as permitted under the zoning, may threaten the viability of the natural resource. In a development area overlay district, the provisions may impose restrictions as well, but also may provide zoning incentives and waivers to encourage certain types and styles of development. Overlay zone provisions are often complemented by the adoption of other innovative zoning techniques, such as floating zones, special permits, incentive zoning, cluster development and special site plan or subdivision regulations, to name a few.

Period The length of time between two successive peaks or troughs of a wave. The Period may vary due to complex interferences of waves. Tsunami wave periods generally range from 5 to 60 minutes apart.

Permeability	The property of soil or rock that allows water to pass through it.
Planning	The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.
Preparedness	The steps taken to decide what to do if essential services break down, developing a plan for contingencies, and practicing the plan. Preparedness ensures that people are ready for a disaster and will respond to it effectively. Actions that strengthen the capabilities of government, citizens, and communities to respond to disasters.
Presidential Disaster Declaration	The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended.
Probability	A statistical measure of the likelihood that a hazard event will occur.
Pyroclastic	Pertaining to fragmented rock material formed by a volcanic explosion or ejection from a volcanic vent.
Pyroclastic Flow	Lateral flow of a turbulent mixture of hot gases and unsorted pyroclastic material (volcanic fragments, ash, etc.) that can move at high speeds.
Recovery	The actions taken by an individual or community after a catastrophic event to restore order and lifelines in a community.
Regulatory Floodplain	That portion of the floodplain subject to floodplain regulations (usually the floodplain inundated by one-percent chance flood).

Regulatory Floodway	Regulatory Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.
Regulatory Power	Local jurisdictions have the authority to regulate certain activities in their jurisdiction. With respect to mitigation planning, the focus is on such things as regulating land use, development, and construction through zoning, subdivision regulations, design standards, and floodplain regulations.
Relocation	The moving of a structure from a flood area to a new location, normally to one where there is no threat of flooding.
Repetitive Loss Property	A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.
Response	Those activities and programs designed to address the immediate and short-term effects of the onset of an emergency or disaster.
Retrofit	The strengthening of structures to reduce or eliminiate (mitigate) future disaster risks.
Richer Scale	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
Rift Zone	A rift zone is an elongated system of crustal fractures associated with an area that has undergone extension (the ground has spread apart).
Risk	The estimated impact that a hazard would have on people, services, facilities, and structures in a

community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Riverine Relating to, formed by, or resembling rivers (including tributaries), streams, creeks, brooks, etc.

Riverine Flooding Flooding related to or caused by a river, stream, or tributary overflowing its banks due to excessive rainfall, snowmelt or ice.

Runoff That portion of precipitation that is not intercepted by vegetation, absorbed by land surface, or evaporated, and thus flows overland into a depression, stream, lake, or ocean (runoff, called immediate subsurface runoff, also takes place in the upper layers of soil).

Run-up The maximum vertical height of a tsunami in relation to sea level.

Scale A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.

Seiche An oscillating wave (also referred to as a seismic sea wave) in a partially or fully enclosed body of water. May be initiated by landslides, undersea landslides, long period seismic waves, wind and water waves, or a tsunami.

Seismicity Describes the likelihood of an area being subject to earthquakes.

Special Flood Hazard An area within a floodplain having a 1 percent or greater Area (SFHA) chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designation that include the latter A or V.

Special Hazard Area — Special Hazard Area means an area having special flood, mudslide (i.e., mudflow) and/or flood-related erosion hazards, as shown on a FHBM or FIRM as Zone A, AOA, A1-30, AE, A99, AH, VO, V1-30, VE, V, M, or E.

Stafford Act — 1) The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended. 2) The Stafford Act provides an orderly and continuing means of assistance by the Federal Government to State, local and tribal governments in carrying out their responsibilities to alleviate the suffering and damage which result from disaster.

Stakeholder — Individual or group that will be affected in any way by an action or policy. They include businesses, private organizations, and citizens

Standard Project Flood — A term used by the U.S. Army Corps of Engineers to designate a flood that may be expected form the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristics of the geographical area in which the drainage basin is located, excluding extremely rare combinations. The peak flow for a standard project flood is generally 40 to 60 percent of the probable maximum flood for the same location.

State Coordinating Agency — State Coordinating Agency means the agency of the State government, or other office designated by the Governor of the State or by State Statute at the request of the Administrator to assist in the implementation of the National Flood Insurance Program in that State.

State Disaster Declaration — A disaster emergency shall be declared by executive order or proclamation of the Governor upon finding that a disaster has occurred or that the occurrence or

	the threat of a disaster is imminent. The state of disaster emergency shall continue until the governor finds that the threat or danger has passed or that the disaster has been dealt with to the extent that emergency conditions no longer exist and terminates the state of disaster emergency by executive order or proclamation. Along with other provisions, this declaration allows the governor to utilize all available resources of the State as reasonably necessary, direct and compel the evacuation of all or part of the population from any stricken or threatened area if necessary, prescribe routes, modes of transportation and destinations in connection with evacuation and control ingress and egress to and from disaster areas. It is required before a Presidential Disaster Declaration can be requested.
State Hazard Mitigation Officer (SHMO)	The SHMO is the representative of State government who is the primary point of contact with FEMA, other State and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.
Stile	A set of stairs to allow access over an obstruction, such as a floodwall
Storm Surge	Rise in the water surface above normal water level on open coast due to the action of wind stress and atmospheric pressure on the water surface.
Stream	A body of water flowing in a natural surface channel. Flow may be continuous or only during wet periods. Streams that flow only during wet periods are termed "intermittent streams."
Structure	Something constructed. (see also Building)
Structural Floodplain	Those physical or engineering measures employed to modify the way floods behave; examples included

dams, dikes, levees, channel enlargements, and diversions.

Structural Mat Slab	The concrete slab of a building that includes structural reinforcement to help support the building's structure.
Structure	A walled and roofed building, including a gas or liquid storage tank, that is principally above ground and mounted to a permanent site, as well as a manufactured home.
Subdivision Regulations	Ordinances or regulations governing the subdivision of land with respect to things such as adequacy and suitability of building sites and utilities and public facilities.
Subsidence	Sinking of the land surface, usually due to withdrawals of underground water, oil, or minerals.
Subsidized Rates	Subsidized rates mean the rules established by the Administrator involving in the aggregate subsidization by the Federal Government.
Substantial Damage	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50 recent of the market value of the structure before the damage.
Substantial Improvement	Substantial improvement means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures, which have incurred "substantial damage," regardless of the actual repair work performed. The term does not, however, include either: (1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official

and which are the minimum necessary to assure safe living conditions or (2) Any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

Tectonic Plate — Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.

Tephra — Tephra is a general term for fragments of volcanic rock and lava regardless of size that are blasted into the air by explosions or carried upward by hot gases in eruption columns or lava fountains. Tephra includes large dense blocks and bombs, and small light rock debris.

Topography — The contour of the land surface. The technique of graphically representing the exact physical features of a place or region on a map.

Tribal Government — A Federally recognized governing body of an Indian or Alaska Native Tribe, band, nation, pueblo, village or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations, the ownership of which is vested in private individuals.

Tsunami — A sea wave produced by submarine earth movement or volcanic eruption with a sudden rise or fall of a section of the earth's crust under or near the ocean. A seismic disturbance or land slide can displace the water column, creating a rise or fall in the level of the ocean above. This rise or fall in sea level is the initial formation of a tsunami wave.

Variance — Variance means a grant of relief by a community from the terms of a floodplain management regulation.

Vent	Vents are openings in the Earth's crust from which molten rock and volcanic gases escape onto the ground or into the atmosphere. Vents may consist of a single circular-shaped structure, a large elongated fissure and fracture, or a tiny ground crack.
Venting	A system designed to allow floodwaters to enter an enclosure, usually the interior of foundation walls, so that the rising water does not create a dangerous differential in hydrostatic pressure. This is usually achieved through small openings in the wall, such as a missing or rotated brick or concrete block or small pipe.
Vulnerability	Describes how exposed or susceptible to damage an asset it. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. The vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electrical substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Other, indirect effects can be much more widespread and damaging than direct ones.
Vulnerability Assessment	The extent of injury and damage that may result from hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.
Watercourse	A natural or artificial channel in which a flow of water occurs either continually or intermittently.
Watershed	An area that drains to a single point. In a natural basin, this is the area contributing flow to a given place or stream.

Water Surface Elevation	Water surface elevation means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, (or other datum, where specified) of floods of various magnitudes and frequencies in the floodplains of coastal riverine areas.
Water Table	The uppermost zone of water saturation in the ground.
Wetlands	Areas that are inundated or saturated frequently and for long enough to support vegetative or aquatic life requiring saturated or seasonally saturated soil conditions for growth and reproduction.
Wildfire	An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.
Zoning Ordinance	An ordinance under the State or local government's police powers that divides an area into districts and, within each district, regulates the use of land and buildings, height, and bulk of buildings or other structures, and the density of population.

Appendix B

ACMP	Alaska Coastal Management Program
ADHSEM	Alaska Division Homeland Security and Emergency Management
ADF&G	Department of Fish and Game (State of Alaska)
ADOI	Alaska Division of Insurance
AEIC	Alaska Earthquake Information Center
AEMS	Alaska Emergency Management System
AFS	Alaska Fire Service
AGDC	Alaska Geospatial Data Committee
AHS	Alaska Hydrologic Survey
AKRR	Alaska Railroad
ALCOM	Alaskan Command
ANILCA	Alaska National Interest Lands Conservation Act
AOR	Area of Responsibility
AMSC	Alaska Mountain Safety Center
ANSS	Advanced National Seismic System
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ARNG	Army National Guard
ARRL	American Radio Relay League
AS	Alaska Statute
AST	Alaska State Troopers
ATV	All Terrain Vehicle
AVO	Alaska Volcano Observatory
AWCG	Alaska Wildfire Coordinating Group
BLM	Bureau of Land Management
CAP	Community Assistance Program
CAP	Civil Air Patrol
CDBG	Community Development Block Grant
CIAP	Coastal Impact Assistance Program
CRS	Community Rating System
CTOC	Communications Technology, Operations & Coordination
DART	Deep-ocean Assessment and Reporting of Tsunamis
DAS	Department of Administration
DC	Department of Corrections
DCA	Department of Community Advocacy
DCBD	Division of Community & Business Development (State of Alaska)
DCED	Department of Community & Economic Development (State of Alaska)
DEC	Department of Environmental Conservation (State of Alaska)
DEED	Department of Education & Early Development (State of Alaska)
DF&G	Department of Fish & Game

DGC	Division of Governmental Coordination (State of Alaska)
DGGS	Division of Geologic & Geophysical Surveys (State of Alaska)
DHSS	Department of Health & Social Services
DLAW	Department of Law (State of Alaska)
DMVA	Department of Military & Veterans Affairs (State of Alaska)
DNR	Department of Natural Resources (State of Alaska)
DOA	Department of Agriculture (U.S.)
DOD	Department of Defense (U.S.)
DOF	Division of Forestry (State of Alaska)
DOI	Department of the Interior (U.S.)
DOJ	Department of Justice (U.S.)
DOT&PF	Department of Transportation & Public Facilities (State of Alaska)
DPC	Governor's Disaster Policy Cabinet (State of Alaska)
DPS	Department of Public Safety (State of Alaska)
EAS	Emergency Alert System
EMPG	Emergency Management Program Grant
EOC	Emergency Operation Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geospatial Data Clearinghouse
FMA	Flood Mitigation Assistance Program
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellite
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
HVA	Hazard and Vulnerability Analysis
IHCA	Interagency Hydrology Committee for Alaska
KPB	Kenai Peninsula Borough
LEPC	Local Emergency Planning Committee
MSB	Matanuska-Susitna Borough
NAWAS	National Warning System
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NOS	National Ocean Service

NPS	National Park Service
NWS	National Weather Service
PMEL	Pacific Marine Environmental Laboratory
SBA	Small Business Administration
SEAAC	South-east Alaska Avalanche Center
SECC	State Emergency Coordination Center
SERC	State Emergency Response Commission
SHMO	State Hazard Mitigation Officer
SRC	Senate Concurrent Resolution
TIME	Tsunami Inundation Mapping Effort
UAF	University of Alaska Fairbanks
UAF/GI	University of Alaska Fairbanks Geological Institute
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USFA	United States Fire Administration
USFS	United States Forest Service
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
WC&ATWC	West Coast/Alaska Tsunami Warning Center
WMD	Weapons of Mass Destruction
WP	Warning Point