City of Seward

All Hazard Mitigation Plan

Final Plan
April 12, 2010

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Chapter 1 - Introduction

I. Purpose of Plan

The purpose of this plan is to fulfill local Hazard Mitigation Plan requirements. The plan will identify hazards; establish community goals and objectives and select mitigation activities that are appropriate for the City of Seward.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d) 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, identify and prioritize mitigation actions, encourage the development of local mitigation and provide technical support for those efforts.

In addition, this plan has fulfilled the requirements of the National Flood Insurance Reform Act of 1994 (NFIRA). With this act, Congress authorized the establishment of a Federal grant program to provide financial assistance to States and communities for flood mitigation planning and activities. The Federal Emergency Management Agency (FEMA) has designated this Flood Mitigation Assistance (FMA).

Under the FMA, FEMA provides assistance to States and communities for activities that will reduce the risk of flood damages to structures insurable under the National Flood Insurance Program (NFIP). FMA is a state-administered, cost-share program through which states and communities can receive grants for flood mitigation planning, technical assistance and mitigation projects.

The purpose of this plan is to produce a program of activities that will best tackle Seward's hazard and flood problems and meet other community needs. Consistent with FEMA planning process guidelines, the purpose of this plan is to accomplish the following objectives:

- Ensure that all possible activities are reviewed and implemented so that disaster related hazards are addressed by the most appropriate and efficient solution;
- Link hazard management policies to specific activities;
- Educate residents about potential hazards that threaten the community, including but not limited to flood and wildfire hazards, extreme weather conditions, earthquakes and tsunami;
- Build public and political support for projects that prevent new problems from known hazards and reduce future losses;
- Fulfill planning requirements for future hazard mitigation project grants; and,
- Facilitate implementation of hazard mitigation management activities through an action plan.

II. Methodology

The methodology used for the development and updating of the Seward Hazard Mitigation Plan, consisted of the following tasks:

1. Public involvement
2. Coordination with other agencies or organizations
3. Hazard area inventory
4. Problem identification
5. Review and analysis of possible mitigation activities
6. Local adoption following a public hearing
7. Periodic review and update

This hazard 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.

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 Seward, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than the 12 months following the date the disaster occurs.

Routine maintenance of the plan will include adding projects, as new funding sources become available or taking projects off the list when they are accomplished.

The Plan is organized as follows:

Chapter 1
Chapter 1 presents sections on the purpose and goals of the plan, methodology used, and a background study of the City of Seward.

Chapter 2
Chapter 2 identifies known hazards in Seward, such as flooding, tsunami and earthquake potential, and beach erosion, including probability of each event.

Chapter 3
Chapter 3 addresses historical floods and other hazards that have occurred within the City of Seward.

Chapter 4
Chapter 4 includes annexes of hazards affecting the City of Seward with hazard assessment vulnerability and potential mitigation measures.

Chapter 5
Chapter 5 outlines the public participation process undertaken during the planning process and for the purpose of prioritizing projects and updating the plan.

Chapter 6
Chapter 6 addresses implementation procedures and a process for updating the plan.

References
References are included in this section.

IV. City of Seward – Background

General Location

Seward is situated on Resurrection Bay on the east coast of the Kenai Peninsula, 125 highway miles south of Anchorage. It lies at the foot of Mount Marathon, and is the gateway to the Kenai Fjords National Park. The communities of Bear Creek and Lowell Point are adjacent to Seward. The city lies at approximately 60.10417° North Latitude and 149.44222° West Longitude (Sec. 10, T001S. R001W, Seward Meridian). The City of Seward is located in the Seward Recording District. The incorporated area encompasses 14.4 sq. miles of land and 7.1 sq. miles of water.

Climate

Seward experiences a maritime climate. Winter temperatures average from 17 to 38 degrees F; summer temperatures average 49 to 63 degrees F. The average annual precipitation includes 66 inches of rain and 80 inches of snowfall. Due to the proximity of the Gulf of Alaska and the topography of the land, large low pressure systems often bring heavy rains and strong winds during the fall storm season.

History of Seward

Resurrection Bay was named in 1792 by Russian fur trader and explorer Alexander Baranof. While sailing from Kodiak to Yakutat, he found unexpected shelter in this bay from a storm. He named the bay Resurrection because it was the Russian Sunday of the Resurrection. Seward was named for U.S. Secretary of State William Seward, who negotiated the purchase of Alaska from Russia during the Lincoln administration. In the 1890's, Capt. Frank Lowell arrived with his family and established a settlement. In 1903 John and Frank Ballaine and a group of settlers arrived to begin construction of a railroad. Later, this settlement became a town. Seward became an incorporated city in 1912. The Alaska Railroad was constructed between 1915 and 1923, and Seward was developed as the ocean terminus and supply center for interior Alaska. By 1960, Seward was the largest community on the Peninsula. Tsunamis generated after the 1964 earthquake destroyed the railroad terminal and killed several residents. As an ice-free harbor, Seward has become an important supply center for Interior Alaska. 2003 was the 100th anniversary of the founding of Seward.

Culture

Seward is primarily a non-Native community, although the Qutekcak Tribe is very active within the community. Seward's annual Fourth of July celebration and its grueling Mount Marathon race attract participants and visitors worldwide. Other annual events include the Seward Silver Salmon Derby in August and the Polar Bear Jump-Off Festival in January.

Population and Economy

In 2009, the Department of Community and Economic Development certified Seward's population at 2,619 people. Seward is incorporated as a home rule city.

As the southern terminus for the Alaska Railroad and road link to Anchorage and the Interior, Seward has long been a transportation center. The economy has diversified with tourism, commercial fishing and processing, ship services and repairs, oil and gas development, a coal export facility for Usibelli Mine, Alaska Vocational Technical Center (AVTEC), the Spring Creek Correctional Center, and the University of Alaska's Institute of Marine Sciences. The Alaska SeaLife Center, the Kenai Fjords National Park and the Mt. Marathon Race during the Fourth of July festivities attract visitors. Over 320,000 cruise ship passengers visit Seward annually. Approximately seventy- five residents of Seward hold commercial fishing permits.

Facilities

Water is supplied by nine wells, is treated and distributed throughout Seward. Sewer is collected via pipes to a secondary treatment lagoon. Almost all homes are connected to the city systems. Refuse collection is provided by the city under contract; the Borough provides solid waste disposal. The Kenai Peninsula Borough refuse transfer facility is located on Dimond Boulevard.

Seward Public Utility purchases power from Chugach Electric Association for day to day operations, and owns six emergency standby diesel generators.

Harbor facilities include approximately 4000 linear feet of moorage and space for up to 650 vessels.

Seward Providence Medical Care Center is licensed to admit and care for up to six in-patients. The Long Term Care Facility, Seward Mountain Haven, is licensed to admit and care for up to forty patients.

Fire/rescue resources include Seward's primary facility, Seward Fire Department located at 316 4th Avenue in downtown Seward and one satellite station located at mile 6.5 Nash Road in the Seward Marine Industrial Center basin area.

Transportation

Seward is connected to the Alaska Highway system by the Seward Highway. Bus and commercial trucking services to and from Anchorage are available daily. Air services and charters are available at the State-owned airport. Two paved runways are utilized, at 4,240 and 2,300 feet. The port serves cruise ships, cargo barges and ocean freighters from Seattle and overseas. The small boat harbor has two launch ramps, slips for 650 vessels and approximately 4,000 linear feet of moorage for transient vessels. The Alaska Railroad provides over 1.4 billion pounds of cargo transit each year, importing cargo for the Alaskan Interior and exporting coal to the Pacific Rim. Seasonal passenger transportation is available by rail and highway.

Chapter 2 – Hazard Identification

The Alaska Division of Homeland Security and Emergency Management is in the process of preparing a Hazard Mitigation Plan for the state. The following hazard matrix was modified from that plan for the Seward area.

Hazard Matrix – Seward Census Area

	Flood	Wildfire	Earth-quake	Volcano	Ash Fall	Snow Avalanche	Tsunami	Weather	Land-Slides	Erosion	Drought	Tech	Eco-nomic
Probability	Y-H	Y-L	Y – H	U	Y	Y	Y	Y	Y	Y	N	Y	Y
Extent	L	L	T	Z	T	L	L	T	L	T	Z	T	T
Previous Occurrence	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y

Probability:
Y = Hazard is present in jurisdiction but probability unknown
Y – L = Hazard is present with a low probability of occurrence
Y – H = Hazard is present with a high probability of occurrence
N = Hazard is not present
U = Unknown if the hazard occurs in the jurisdiction

Extent:
Z = Zero
L = Limited
T = Total or extensive

Previous Occurrence
Y = Yes
N = No

The following sections are explanations of hazards that are present in the City of Seward.

Flood

Definition

Riverine:	Periodic over bank flow of rivers and streams.
Flash:	Quickly rising small streams after heavy rain or rapid snow melt.
Urban:	Overflow of storm sewer system usually due to poor drainage following heavy rain or rapid snowmelt.
Tidal/Storm:	Surge and wave run-up, higher than normal tidal range and higher inshore wave run-up due to storm effects in coastal areas.

The East Zone of the Kenai Peninsula Borough is at risk to flooding from heavy rains; spring ice jams and rapid snow melt; tidal storm surges and coastal wave run-up, glacial damming and glacial outburst flooding, and special geologic conditions. High flows can occur during any season, but are most common as a result of rapid snowmelt in the spring or intense precipitation during the summer and fall. In the East Zone, flooding hazards are compounded by steeply sloped, unstable mountain streams.

In Seward, development is occurring on alluvial fans and deltas which have been deposited by these steep drainages. The hazards associated within the area were demonstrated in major flood occurrences in October of 1986, August 1989, September 1995, October and November 2001, October 2006 and December 2009. Flooding in Seward and the surrounding area has resulted in repeated disruption of vital services such as water, sewer, power, and transportation routes; damage to roadways, bridges, flood control structures (dikes, weirs), buildings, port and harbor facilities, airport facilities, railroad facilities, utilities and communications systems and in addition natural/environmental emergencies such as landslides.

Seward Area Drainages:

Spruce Creek	surge-release/debris
Lowell Creek	surge-release/debris
Japanese Creek	surge-release/debris
Resurrection River	seasonal
Glacier/Salmon Creek	seasonal
Sawmill Creek	surge-release/debris
Godwin Creek	surge-release/debris
4th of July Creek	surge-release/debris
Lost Creek	surge-release/debris

Debris and surge-release flooding will continue to be a problem in the Seward area. According to the 1994 Resurrection River Reconnaissance Report, the US Army Corps of Engineers stated that the 1986 and 1995 storms left the steep drainages even less stable and more prone to landslides and avalanches in future storms. In addition, stream channels tend to migrate unpredictably across the alluvial fans as deposition occurs. Consequently, mapping flood hazard areas on these fans is difficult and unreliable.

In 2003, residents of Seward, Bear Creek and Lowell Point established a flood-service area board, the Seward/Bear Creek Flood Service Area (SBCFA). This board's duties are to provide flood protection, planning and mitigation services, as well as developing, implementing and updating a development plan for furnishing flood protection services. The board will develop criteria for determining service area involvement in future flood control projects, and coordinate with the City of Seward to ensure there is neither duplication nor contradiction in the flood control projects or services provided.

The SBCFSA Flood Hazard Mitigation Plan was originally published July 2005 and updated November 2007.

The October 2006 flood event resulted in federal disaster declaration as residents were evacuated, highways and roads flooded, levees damaged and critical infrastructure damaged. The December 2009 high water event and storm surge resulted in a state disaster declaration as critical waterfront infrastructure was damaged including the wave barrier along Lowell Point Road, the Seward Green belt area and the seawall at the Alaska SeaLife Center.

Earthquake

Definition: Sudden motion of the earth's surface, faulting, and ground failure.

Coastal Alaska is within the pacific subduction zone. Subduction zones are areas where one tectonic plate plunges beneath another. Earthquakes cluster at the edge of the plunging plate, and its path into the mantle can be traced by the location of the earthquakes. The "ring of fire" around the Pacific is a giant earthquake zone, and coincides with a ring of subduction zones that produces the world's deepest trenches, such as the 36,000 foot deep Marianas Trench. It is striking evidence for the existence of these zones. An example of a subduction-zone plate boundary is found along the northwest coast of the United States, western Canada, and southern Alaska and the Aleutian Islands. Subduction zones are characterized by deep-ocean trenches, shallow to deep earthquakes, and mountain ranges containing active volcanoes. Seward is located on this subduction zone.

Seward's earthquake risk may be better explained by using the matrix prepared by the Alaska Division of Homeland Security and Emergency Management (ADHS&EM) designates Seward as a jurisdiction that has a high probability of an earthquake. Seward is designated as having a zone 4 risk. Earthquakes can trigger secondary hazards including fires, fuel spills, landslides, avalanches, tsunamis, uplift, subsidence, infrastructure failures and soil liquefaction.

Tsunami Hazard

Tsunamis are ocean waves that are generally triggered by vertical motion of the sea floor during major earthquakes. Near ocean or undersea landslides or volcanic eruptions can also generate tsunamis. They can be generated locally or a great distance from where they landfall. Tsunamis have historically caused significant damage to coastal communities

throughout the world. As the tsunami crosses the deep ocean, its length from crest to crest may be a hundred miles or more, and its height from crest to trough will only be a few feet or less. They can not be felt aboard ships nor can they be seen from the air in the open ocean. In the deepest oceans, the waves will reach speeds exceeding 600 miles per hour (970 km/hr). When the tsunami enters the shoaling water of coastlines in its path, the velocity of its waves diminishes and the wave height increases. It is in these shallow waters that a large tsunami can crest to heights exceeding 100 feet (30 m) and strike with devastating force.

As a tsunami leaves the deep water of the open sea and travels into the more shallow waters near the coast, it undergoes a transformation. Since the speed of the tsunami is related to the water depth, as the depth of the water decreases, the speed of the tsunami diminishes. The change of total energy of the tsunami remains constant. Therefore, the speed of the tsunami decreases as it enters shallower water, and the height of the wave grows. Because of this "shoaling" effect, a tsunami that was imperceptible in deep water may grow to be several feet or more in height. When a tsunami finally reaches the shore, it may appear as a rapidly rising or falling tide, a series of breaking waves, or even a bore. Reefs, bays, entrances to rivers, undersea features and the slope of the beach all help to modify the tsunami as it approaches the shore.

Earthquake or other seismic activities near Seward can cause a tsunami to occur in Resurrection Bay as was the case in 1964. Due to the frequency of earthquakes within Alaska and the ocean topography of Resurrection Bay, there is a significant threat that a tsunami will occur again.

Shoreline Erosion

Definition: Storm induced waves and flooding cause the destructive erosion of the coastal areas.

From the fall through the spring, large low pressure systems that develop in the Gulf of Alaska and systems that are brought to the region by winds in the upper atmosphere steer massive storms in the North Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and rain, occasionally causing 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 is the amount of rain associated with the system. Fierce storm conditions do not have to be present to cause damage.

Coastal shoreline erosion is a continuing problem within the City of Seward along the waterfront campground and near the Seward Marine Industrial Center. Weather conditions make shoreline erosion an ongoing threat to the city.

Erosion to the beaches caused by storms or high winds are an ongoing hazard in the City of Seward. The December 2009 storm surge with high water event caused extensive damage to the wave barrier along Lowell Point Road, the Seward Green belt area and the seawall at the Alaska SeaLife Center. Lowell Point Road is the only access for Kenai Peninsula Borough Citizens living in that community, access for State and Federal Parks and a key sewer and electric utility corridor for Seward. Other wave action and coastal flooding also causes damage to the shoreline. Use of Resurrection Bay by recreational boaters, is a source of wave action which will continue to be a problem even without significant storms. City of Seward has taken steps to minimize the impacts of erosion on the beaches with the addition of rock walls, culverts and channels, but additional measures are necessary.

Coastal erosion regularly threatens significant assets including the City owned bike path, Playgrounds, park, RV sights landmarks and the Alaska Sea Life Center.

Wildfire

Wildfires that were reviewed are:

Wildland fire
Urban Interface fire
Firestorms

Wildfires do not present a major threat to people or property because of the coastal weather conditions in the Seward area. Urban Interface Fire risk changes, as more development occurs, placing people and property at a higher risk due to accidental and man made fires.

The fire risk has also been increasing in recent years due to the spruce bark beetle infestation. The dead trees are very dry and therefore highly combustible. This will present an even bigger problem in the coming years as the trees start to fall, littering the forest floor with flammable material.

Volcanoes

Alaska is the home to more than 80 major volcanic centers. In general, there are one or two eruptions a year. Over half of the state's population lives within 100 miles of an active volcano.

The single greatest hazard from an explosive volcanic eruption is ash, fine fragments of rock blown into the atmosphere during volcanic eruption.

Lahars, lava and tsunami generating landslides are also potential hazards during a volcanic eruption.

Avalanches

An avalanche is a slope failure consisting of a mass of fluidized snow sliding down a hillside. The damage caused by an avalanche varies based on the avalanche type, the consistency and composition of the avalanche flow, the flow's force and velocity, as well as the avalanche path. Avalanches usually occur on slopes between 25 and 50 degrees, with most starting between 30 and 40 degrees. They can be triggered by both natural and human factors.

There is growing exposure to this hazard as development continues to occur in avalanche prone areas and participation in winter recreational activities increases.

Winter Weather

Winter weather includes heavy snows such as blizzards, ice storms and extreme cold. Heavy snows can bring the community to a standstill by inhibiting transportation, knocking down trees and utility lines, and by causing structural collapses in buildings not designed to withstand the weight of the snow. The cost of repairs and snow removal can be significant.

Ice buildup can bring down utility and communication lines as well as making transportation difficult.

Extreme cold causes fuel to congeal in storage tanks and supply lines stopping fuel flow to residential furnaces. Without heat water and sewer pipes can freeze and pipes can rupture. Alternate heating sources can cause their own set of problems, from accidental fires and illness from carbon monoxide in the home. Extreme cold can also increase the likelihood of ice jams and flooding.

Landslide

Landslide refers to "the downward and outward movement of slope forming materials reacting under the force of gravity." The materials are usually natural soil, rock, artificial fill or a combination of those items. The term covers a range of events including mudflows, mudslides, rock flows, rockslides, debris flows, debris avalanches, debris slides and earth flows.

Geology, precipitation, topography and cut and fill construction practices all influence landslide activity. They are often the result of heavy precipitation, coastal storms, flooding, volcanic eruption, construction work or seismic activity.

One of the costliest landslide events ever experienced in the United States was associated with the 1964 Good Friday earthquake. Approximately 60 percent of the total damage caused by the earthquake was due to landslides. This was part of the equation for the tsunami damage in Seward.

Drought

Droughts are fairly rare in Seward. A drought is commonly defined as a period of time of very low precipitation. Drought severity depends on duration, intensity and geographic extent as well as the demand on the water supply.
Seward experiences periods without rain, and the forests and grasslands become extremely dry, increasing the probability of Urban Interface fires.

Economic

A large section of the Alaskan economy is resource based. When the resources generate insufficient revenue, due to lack of the resource availability, poor prices or other conditions, an economic disaster may be the result. Economic disaster consequences usually affect a wide geographic area. Some of the resources that could lead to disasters if their availability becomes limited include fish, lumber and coal. Seward is a tourist destination for cruise ships, road and rail. The visitor decline would have a major impact on the economic wellbeing of Seward.

Interactive Nature of Hazards

A hazard cannot be treated in isolation, as there are inter-relation between the hazard agents. Frequently one hazard event triggers another. For example, a coastal storm will often trigger flood and landslides. Or a wildfire could increase erosions and flooding risks. As a result, all possible consequences of a hazard need to be considered when deciding the most appropriate mitigation actions. It is also important to consider all the hazards that could occur in an area when decided which mitigation activities to undertake. Some mitigation measures could worsen the effects from the hazards such as allowing economic development in areas susceptible to tsunamis or landslides.

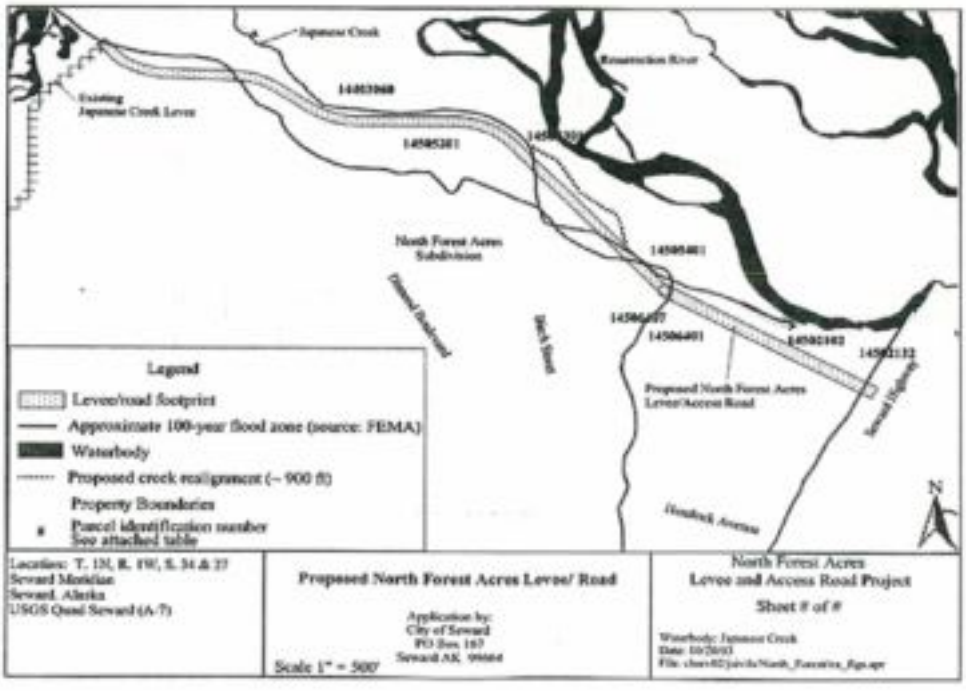
Chapter 3 – Historical Hazards in Seward

History of Flooding in Seward

In 1986, over 15 inches of rain fell in a 36 hour period; saturating the steep slopes and causing severe erosion. In some areas, landslides and avalanches dammed stream channels, eventually causing a "surge-release" of floodwaters and debris when the dam failed. This material, which included boulders as large as 8-feet in diameter, caused extensive damage to buildings and facilities located downstream on the alluvial fans.

In August 1989 and September 1995, only active channel work kept Japanese Creek from changing course and charging through the western edge of Forest Acres Subdivision. Workers kept it within the channel. Creek waters joined Resurrection River to flood southerly along the Seward Highway embankment into the undeveloped Forest Acres and Fort Raymond area. Water moved across the highway and moved toward the Port Avenue section of the small boat harbor. Part of the Seward Fisheries Meal Plant and the north boat launch facility in the harbor were destroyed by the rapid water movement. The City of Seward has worked with the Kenai Peninsula Borough to implement the Resurrection River/Japanese Creek flood mitigation work. The work in the Resurrection River delta was completed in 1999 and some maintenance work was done in July 2000. The construction for the initial phase of the Japanese Creek Levee was completed during the summer of 2001.

Currently, the City of Seward has completed the permitting process for the second phase of the project, has completed the Japanese Creek relocation and, by the time of this plan's approval, will have completed all the property acquisitions. The second phase of the project will extend the levee/road to the Seward Highway. Construction of the levee and relocation of utilities is planned to begin in 2010. (Please see maps below and attached)



A major area of flood concern in the city involves the Lowell Creek Flood Control Project. This project, built in 1940, diverts Lowell Creek away from the city through a tunnel in Bear Mountain and into Resurrection Bay. During floods, Lowell Creek can reach high velocities and carry boulders and debris weighing several tons. Blockage of the tunnel would cause flood flow to go over the spillway and flow through the middle of the city. Due to the age of the tunnel and the potential for catastrophic failure from debris blockage, the tunnel has been determined to be inadequate and unsafe. Many repairs of the tunnel have taken place throughout the years beginning in 1945, with additional emergency repairs in 1984, 1988, and 1991. More recently an overhaul of the tunnel occurred in the winter of 2002-2003. The US Army Corps of Engineers and subcontractors were responsible for tunnel work including a lining of high strength concrete on the floor and replacement of some railroad ties at the entrance for protection. Voids were found beneath the tunnel and were filled during this project period.

During the 1995 and 2001 flood event, sediment and rock that flowed out of Lowell Creek washed away riprap and a portion of the bridge at the waterfall which eroded the water main and sewer line.

The flooding event in October 2006 was caused by the combination of high tides, warm temperatures and the remnants of a typhoon stalled over south central Alaska caused 9 to 15 inches of rain to fall on the Seward area. The heavy rains contributed to the closing of the Seward Highway at Mile 4, portions of the airport were flooded and residents from outlying areas were evacuated from their homes. The outflow from the Lowell Creek diversion tunnel dumped a 25 foot pile of debris and gravel on the bridge, severed the only road to residents living at Lowell Point and threatened water main and sewer lines. Several levees were damaged and approximately 200,000 cubic yards of bed load was deposited in Japanese Creek severely constraining the levee's ability to contain flood waters.

The Alaska District of the U.S. Army Corps of Engineers assumed long-term maintenance and repair responsibility of the tunnel, inlet and outlet structures, until completion of construction of an alternative method of flood diversion or until November 8, 2022. The City of Seward continues to work with our congressional delegation to insure this project is funded.

History of Earthquake and Tsunami Events in Seward

On Good Friday, March 27, 1964, North America's strongest recorded earthquake, with a moment magnitude of 9.2, rocked central Alaska. Large areas were lifted up or dropped by several feet, landslides were extensive, ground failure led to large fissures in the ground, landslides into bays caused huge seiche waves locally and a tsunami caused damage thousands of miles away. The result in Seward was disastrous to the town, waterfront, boats and railroad. An estimated $14 million in damage occurred. An entire section of the waterfront slid into Resurrection Bay.

During the 1964 earthquake, landslides into bays near Valdez and Seward sent 35 foot waves sloshing back and forth like water in a bathtub. In Seward, an oil tanker was wrenched loose from a pipeline, which erupted in flames, spreading to the nearby oil tanks. Burning oil on the water washed inland. Ships were battered against piers and washed ashore. Warning time can be limited when the tsunami is triggered close to the impacted coastline. In Seward, a 1070 meter section of the waterfront slid into the Resurrection Bay due to the earthquake shaking. This generated a local tsunami causing much damage. Oil from storage tanks was spread on to the water and ignited. About 20 minutes later, the first wave of the main tsunami hit. The 11-13 fatalities in Seward were due to the local and the main tsunamis.

History of Erosion in Seward

Coastal erosion is an ongoing problem for the City of Seward. Areas most seriously affected by shoreline erosion include Lowell Point Road, Alaska SeaLife Center Lease site, Waterfront Park south to the waterfall and the Seward Marine Industrial Center (SMIC). Emergency erosion control efforts by the City of Seward include the shoreline at the waterfront camping area and within the Seward Marine Industrial Center. In recent years, the city has replaced riprap along Lowell Point Road in a number of different locations to maintain the protection of the city sewer line.

The December 2009 storm surge event with high water caused extensive erosion and damage to the wave barrier along Lowell Point Road, the Seward Green belt or water front park area and the seawall at the Alaska SeaLife Center.

Chapter 4 – Hazards in Seward

The goal of mitigation is to reduce the future impacts of a hazard including property damage, disruption to local and regional economies, and the amount of public and private funds spent to assist with recovery. However, mitigation should be based on risk assessment.

A risk assessment predicts the potential loss from a hazard event by assessing the vulnerability of buildings, infrastructure and people. It identifies the characteristics and potential consequences of hazards, how much of the community could be affected by a hazard, and the impact on community assets.

A risk assessment consists of three components: hazard identification, vulnerability analysis and risk analysis. Hazard identification will attempt to identify known hazards within the community. Vulnerability analysis will show how each hazard may have an impact on the community. Risk analysis will show what frequency and what damage from identified hazard may impact the community.

The following annexes describe hazards that may occur in the City of Seward. The hazards are broken into annex sections, which when appropriate, identify the hazard, assess vulnerability, risk, mitigation goals and potential projects. Due to time constraints, hazards that are not identified as a significant risk to the City of Seward are included but given less comprehensive attention.

Annex A - Floods

A. Hazard Assessment

Step one is to identify the hazard. As outlined in Chapter 2 of this plan, flooding in the City of Seward occurs primarily as a result of heavy rains and the effects of being built on the alluvial fans of Resurrection River and Lowell Creek.

B. Vulnerability Assessment and Impacts

Step two is to identify the jurisdiction's vulnerability (the people and property that are likely to be affected). Inventorying the jurisdiction's assets to determine the number of buildings, their value, and population in hazard areas can also help determine vulnerability. Identifying hazard prone critical facilities is vital because they are necessary during the response and recovery activities.

Major rain events in the past have shown that the Seward area is prone to flooding by many factors, including swelling of water ways, surge-debris release and the damming effects caused by erosion of the steep banks of the surrounding mountains, rapid snow melt and to some degree, storm surge. The City of Seward remains vulnerable due to its being built on an alluvial fan. The Lowell Creek Tunnel Project is an example of mitigation

planning for the City of Seward. In 1992, a report on flood damage reduction was created by the US Army Corps of Engineers. In this report, the Corps determined that the tunnel has deteriorated due to debris abrasion. The rails used to armor the tunnels floor had been torn out and floor has eroded to the bedrock. The report states the tunnel has been determined to be vulnerable to blockage and possible collapse. They also determined that the tunnel is deteriorating faster than it could be repaired. Blockage of the tunnel by lining failure, debris and/or landslides would cause flood flow to go over the spillway. Water and debris would flow through the heart of the city. Homes, senior citizen apartments, medical and dental clinics, and the hospital are situated in the Lowell Creek Canyon just below the diversion dike. According to the 1992 US Army Corps of Engineers report, the flood control project is considered unsafe and inadequate. The most recent repair work was done during the winter of 2002-2003, in which the Corps replaced the floor, rails and part of the eroded bedrock voids. These repairs should control the erosion problem for a number of years but this will be an ongoing project. The 2008 Water Resources and Development Act (WRDA) returned the Lowell Creek diversion tunnel to the US Army Corps of Engineers management and authorized a project to correct current deficiencies.

Resurrection River is another area prone to flood damage. In 1994, the US Army Corps of Engineers did a reconnaissance report on prevention of flood damage for the Seward Area Rivers. In this report, all the watersheds entering the upper Resurrection River were examined and it was determined that rapid sedimentation in the Resurrection River channel places much of the development adjacent to the river in danger of flood damage. A significant concern of possible flood damage is the Seward Highway bridge crossings. During the 1995 flood event, water crossed the highway at or near these crossings. In 1999, 150,000 cubic yards of debris, woody material, gravel, sand and silt was removed from Resurrection River approximately 2000 feet downstream from the center Seward Highway Bridge. The desired effect of the work was to alleviate backwater conditions eliminating potential flooding. Along with this project, the city replaced the culverts of the lagoon outflow at 4th Avenue. Recent improvements to the Seward Highway and Alaska Railroad bridges include the installation of clear span bridges across the Resurrection River.

In 1996, the City of Seward developed a mitigation plan for flood hazards in the city. Flooding mitigation and recommendations have been done for Spruce Creek, Lowell Creek, Rudolph Creek, Japanese Creek, Resurrection River Basin, Sawmill Creek and Fourth of July Creek. That plan is available at the City of Seward Community Development office. The Kenai Peninsula Borough Flood Mitigation Plan also includes Seward and areas north of the city and is available through the borough office. In 2003 the Kenai Borough adopted Ordinance 2003-30 establishing the Seward/Bear Creek Flood Service Area (SBCFA). Section 16.50.090 of the Kenai Peninsula Code defines the SBCFSA Board of Directors powers and duties, which include responsibility for developing, implementing and updating a plan for furnishing flood protection, planning and mitigation services. The SBCFSA Flood Hazard Mitigation Plan was originally published July 2005 and updated November 2007.

Risk analysis is the final level of hazard assessment. It involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result (defined through

the vulnerability assessment); and (2) the likelihood or probability of the harm occurring (multiple flooding scenarios).

The magnitude of the flooding in Seward has been historically high. Debris and surge-release flooding will continue to be a problem due to the topography and traditional weather patterns of the area. Risk depends on the degree of flooding and can include disruption of services, transportation routes, and communication systems. According to the FEMA FIRM maps, if there was a 100 year flood event, the estimated borough assessed values of structures within the flood affected area is in excess of $21,000,000. These structures include residential buildings, commercial buildings and public facilities. In 1986, estimated recovery costs for the City of Seward were projected at $2.2 million. The 1995 flood had estimated repairs to just city property was $147,700.

In Seward, there are flood warning systems which give community residents' an organized notification of impending flood danger. The National Weather Service (NWS) provides flood forecast and warning data utilized by many communities that have local warning systems.

National Flood Insurance Programs (NFIP)

The function of NFIP is to provide flood insurance to homes and businesses located in floodplains at a reasonable cost, and to encourage the location of new development away from the floodplain. The program is based upon mapping areas of flood risk, and requiring local implementation to reduce that risk, primarily through guidance of new development in floodplains.

The City of Seward uses Flood Insurance Rate Maps (FIRM), effective May 19, 1981, and codified the Flood Plain Mitigation Plan in October 1999, to depict areas of flooding within the city limits. The FIRM depicts the flood plain as determined by FEMA.
Details of the NFIP can be found at http://www.fema.gov/doc/library/nfipdescrip.doc.

The 1981 Flood Insurance Rate Maps are outdated and are in need of updating to address the following items.

- 1981 maps need to be reevaluated with the 29 years of additional data.
- Corrections may need to be made for areas where fill or naturally high ground is now shown as flood prone but may not be in jeopardy of flooding.

In 2010, FEMA will update its FIRM maps for the City of Seward. The estimated date for release of the draft maps is March 30, 2010. Draft hard copy maps will be released for public review, and once public meetings are held by FEMA and public comment is obtained, final maps and digital shapefiles will be available in 2011.

The City of Seward Community Development Office is available for estimates of the number and assessed values of structures located within the areas identified on the FIRM.

To deal with problems of flooding at the Seward Airport, the State of Alaska Department of Transportation and Public Facilities published the Seward Airport Master Plan and environmental assessment in July 2008.

The City of Seward and the US Army Corps of Engineers have made substantial progress in prevention of flooding in Seward. The Lowell Creek Tunnel Project completed in 1940, diverts the waters of Lowell Creek away from the city through Bear Mountain and into Resurrection Bay. The Japanese Creek Levee Project completed in 2001, keeps flood waters from entering the Forest Acres Subdivision and crossing the highway. These projects, as well as the Resurrection River dredging project, currently reduce the risk of major flooding within the city.

C. Mitigation Measures

This section of Annex A addresses flood mitigation goals for the City of Seward with potential projects to achieve these goals.

Goal 1: Identify hazard areas and select mitigation measures for those areas
Goal 2: Increase public awareness of hazards
Goal 3: Enact mitigation measures

This first goal is to identify the flood hazard areas and mitigation measures that will better protect individual and commercial property owners within the City of Seward. On going mitigation measures include:

- Floodplain development permits to include elevation certificates and data
- Request base sea level and flood elevations from builders on proposed projects
- Provide maps of flood hazard areas, in digital and hard copy
- Update as required city code floodplain management ordinance
- Update the Seward Flood Hazard Mitigation Plan, 1996; this was subsequently replaced by the Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan, Originally published July 2005 and updated in November 2007.
- Integrating Flood Hazard Mitigation strategies into the Seward 2010 Comprehensive Plan, 1990
- Include flood issues in the Seward Strategic Plan, 1999
- Provide FEMA Public Outreach Floodplain information booklets
- Staff coordination with SBCFSA, KPB, State of Alaska, and Federal Floodplain managers on flood issues within the City of Seward.
- Building Permits; insuring the adopted building codes address flood issues
- Continue working with the Seward Bear Creek Flood Service Area Advisory Board to update the working mitigation plan.
- Advising the US Army Corps of Engineers of conditions concerning the Lowell Creek Tunnel Project including renovating the tunnel and developing a new outfall.
- Maintain and extend the Japanese Creek Levee.
- Remove excess bed load accumulation in Seward's rivers and creeks.

- Ditch, drainage, sea wall and culvert construction, coordinated to help ensure the safe, flood free drainage even during potential storm events.

Potential Projects:

- Acquire land within the city to develop a usable secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004)
- Complete the Two Lakes Park Replat and the joint use access agreements providing the secondary evacuation route.
- Update Flood Insurance Rate Maps: the 1981 maps need to be reevaluated with 29 years of additional data. Evaluate additional programs that address Seward's unique alluvial fan flood problem.
- The City of Seward should continue improving its NFIP Community Rating System, under the Federal Insurance Administration's Community Rating System (CRS) by exceeding the required standards to obtain further flood insurance premium reductions for policyholders within communities while simultaneously reducing flood losses.
- North Forest Acres Levee and Access Road Project: Phase 2 of this project has begun to protect the North Forest Acres Subdivision and other areas of the City of Seward from recurrent flood damage by constructing a levee along the lower portion of Japanese Creek. Flood-proofing existing structures: Improving existing structures to make them less susceptible to flood damage could be a viable project for many of the historic buildings or non-elevated structures.
- Dairy Hill Drainage Improvements: Upsize culverts and improve haphazard drainage in the Dairy Hill Area. During heavy rainfall events, the flows in the drainages can become severe and cause washouts of roadways, culverts and building improvements. An HMGP grant application was submitted in 2010 in the amount of $339,387.00.
- Replace the Dairy Hill Road/ Seward Lagoon culverts with larger culverts. During flood events, the existing culverts cannot divert enough water to prevent flooding of the road.
- Conduct a structural assessment of the 4th of July Creek dike. A failure of the existing dike would cause damage to infrastructure of the city water supply and Spring Creek Correctional Center.
- Coordinate with the US Army Corps of Engineers as they develop a project to upgrade, replace or find an alternative to the Lowell Creek diversion tunnel and it's resulting out-flow sediment build up
- Japp Creek investigation to evaluate the flow capacity of the existing flood control corridor, to determine sedimentation trends/rates, and to utilize this information to develop a long term maintenance strategy and funding plan to preserve the system.
- Fourth of July Creek investigation to evaluate the flow capacity of the existing flood control corridor, to determine sedimentation trends/rates, and to utilize this information to develop a long term maintenance strategy and funding plan to preserve the system.

- Spruce Creek evaluate the flow capacity of the flood control corridor and determine sedimentation rates. Use this information to develop a plan to preserve the flood control corridor and to create a long term maintenance strategy and funding plan.
- A geomorphic investigation should be conducted of Scheffler Creek to determine the size, frequency, and potential deposition characteristics of future debris flows.
- Consider land use code regulation changes to more effectively guide development and floodplain use. Evaluate certain areas for additional preventative measures. The city subdivision regulations which govern the division of land for sale or development should include floodplain regulations. The floodplain regulations should be incorporated into the Alaska Coastal Management Program (ACMP) and the Seward Comprehensive Plan.
- Support a U.S. Army Engineer District, Alaska needs Assessment this fall to consider needs throughout the greater Seward watershed area. Alternative, the City could proceed ahead to request our Congressional delegation to establish earmarks of $100K for our preliminary assessments.

Goal two is to increase public awareness. This could be accomplished by the following measures.

- Information Dissemination: The purpose of information dissemination is to provide the community residents with knowledge about the flood hazards in their neighborhoods and possible activities for mitigation. A variety of agencies can participate in information dissemination. Manuals are available through the City of Seward Clerks Office, Community Development Office and at the Seward Community Library.

Outreach Projects: The City continues to provide flood information and technical assistance to current and prospective residents and business owners. The City will schedule training/info sessions for local realtors, contactors and lending institutions. Real estate disclosure: Alaska State Statute 34-70 requires a seller to disclose flood hazard on residential properties.

- Risk Analysis: With advances made in Geographic Information System (GIS) technology, it is becoming increasingly easy to analyze the risk of various flood events. This analysis, of course, depends on the availability of data relating to building location and value and flood recurrence. Performing multiple risk analyses helps to increase public understanding of a coastal or river flood potential. Often, risk is understood only at the "100-year" level, because this forms the basis for Flood Insurance Rate Maps. The "100-year" flood means a flood level having a 1% chance of being equaled or exceed annually. If information is collected and reviewed, the possibility of predicting what areas may be impacted during a 5, 10, 15 year cycle.

Potential Projects:

- Continue distributing the brochure describing the City of Seward flood dangers and floodplain building regulations.
- Continue working with FEMA and other Federal and State Agencies as the Flood Insurance Rate Maps (FIRMs) are updated and researching other tools for accurately forecasting and mitigating Seward's complex alluvial fan flood problem.
- Continue working with FEMA to obtain the latest National Flood Insurance Program information and scheduling workshops.
- Provide floodplain regulations information, updates or revisions to the citizens of Seward.
- Continue coordination with FEMA to conduct flood proofing or elevating workshops for the City and public.
- Continue the City's efforts working with potential partners or agencies while capitalizing on multiple funding sources for mitigation projects, including erosion and sediment control projects.
- Continue refining the education and outreach programs to notify current homeowners and potential homebuyers about flood hazard risks in identified areas.
- Provide local realtors and lending institutions with GIS copies of FIRM as they are updated.
- Complete North Forest Acres Levee and Access Road Project.
- Complete Dairy Hill Road/ Seward Lagoon culvert replacement.
- Conduct a structural assessment of the 4th of July Creek dike.
- Obtain ongoing permits for the Lowell Creek outfall sediment and erosion control program.
- Continue public education concentrating on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on the Emergency Alert Network. (Planning and Zoning Commission May 6, 2004)
- Continue providing new homeowners, builders or renovators a brochure detailing the fuel tank stand codes helping to insure they're more *flood/earthquake prepared* (Planning and Zoning Commission May 6, 2004)

The third goal in the process is to enact mitigation solutions. The City working closely with the SBCFSA has identified flood mitigation problems and recommended solutions within their capabilities, which have been through the public process and approved by the City Council, with some funded and others competing for state or federal funding. Mitigation problems exceeding the City and SBCFSA capabilities and expertise have been forwarded to FEMA, US Army Corps of Engineers and other federal and state organizations for their assistance. The City and SBCFSA have agreed on those projects that can be funded by each and included in their budget. Grant requests and other financial sources are being sought on those that exceed either's capacity. Completion of any project will depend on the availability of funds and any changes of priority.

Annex B - Earthquake

A. Hazard Assessment

Earthquakes are common occurrences in Seward. The threat of a tsunami is dependent on the magnitude and location of the tectonic activity.

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 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.

On the Richter scale, magnitude is expressed in whole numbers and decimals. A 5.0 earthquake is a moderate event, 6.0 characterize a strong event, 7.0 is a major earthquake and a great earthquake exceeds 8.0. The scale is logarithmic and open-ended.

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.

On Sunday, November 3, 2002 magnitude 7.9 Denali Fault Earthquake, one of the largest ever recorded on U.S. soil according to the U.S. Geologic Survey, resulted in no damage in Seward. On a global level, three of the ten strongest earthquakes ever recorded occurred in Alaska.

B. Vulnerability Assessment and Impacts

Seward, Alaska is located in the Pacific Subduction Zone in which Oceanic-continental convergence is taking place. This area is also known as the Ring of Fire or the Pacific Rim of Fire. It is the place where two tectonic plates are in a very slow collision. The buildup of pressure between the tectonic plates determines the degree of earth movement. Such destruction (recycling) of crust takes place along convergent boundaries where plates are moving toward each other, and sometimes one plate sinks (is *subducted*) under another. The location where sinking of a plate occurs is called a *subduction zone* (USGS). Volcanic activity is also high along subduction zones.

The City of Seward is very vulnerable to such earth movements. A risk analysis for the City of Seward shows significant impact to priority infrastructures and the economy. If the right conditions occur during an earthquake, a tsunami is also a potential hazard.

This photo was taken after the 1964 earthquake. It shows the waterfront area where major devastation occurred from both the earthquake and the resulting tsunamis.

Photos from the *Earth Science Photographs from the U.S. Geological Survey Library*, by Joseph K. McGregor and Carl Abston, U.S. Geological Survey Digital Data Series DDS-21, 1995.

Impact to the city would be substantial if a major earthquake occurred. The history of Seward during the 1964 earthquake shows that many major problems were eminent. Depending on the magnitude of the quake, a number of different outcomes could take place. Transportation, infrastructure, emergency services, commerce and individual property as well as lives would be affected by a large quake. In the 2004 plan edition, mitigation measures Goal 1; had an objective to obtain land for a secondary evacuation route that bypasses the Seward Lagoon and boat harbor areas.

In January 2010, the Seward Planning & Zoning Commission approved a replat of land owned by the City to designate it as a park. A sixty foot wide Right –of- Way was included in the request to allow for access to a private landholder. The landholder agreed to allow for a secondary access route across their property for consideration of the right of way. Details on the exact location of the secondary route and its width will be determined in the spring of 2010. Construction of the route will not start until funds are available to complete it.

Goal 2 in the Plan mitigation measures had an objective to develop a brochure to educate homeowners on fuel tank stands. That objective was included in the information packet given to anyone applying for a Building Permit. During the plan review phase of a project items that are of concern for earthquake mitigation are pointed out to the developer and where possible required for the project.

C. Mitigation Measures

Goal 1: Identify hazard areas and select mitigation measures for those areas

- Update building codes to stay current with state requirements and industry concerning earthquake protection.
- Identify non-buildable sites through the city's land use plan and city zoning maps.
- Earthquake proof priority structures (schools, city buildings, public safety offices, etc.) This project requires the involvement of many government entities and assessments of various structures. Where possible employ Earthquake resistant building technology to mitigate damage.
- Acquire land within the city to develop a secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004) (Land has been designated in January of 2010. The survey of the route is scheduled to be accomplished in the spring of 2010.)

Goal 2: Increase public awareness of hazards

- Conduct community mock emergency exercises and evaluate response.
- Develop public education to concentrate on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on EAN (Emergency Alert Network). (Planning and Zoning Commission May 6, 2004) Possibly make public announcements using the utility billing memo and the scanner announcement page with GCI cable TV and radio.

Continue to update brochures and handouts to educate homeowners on fuel tank stand codes and earthquake mitigation measures so they will be more flood/earthquake prepared.

Goal 3: Enact mitigation measures

The third goal in the process is to enact mitigation solutions. Once the potential problems and solutions have been addressed along with input from the public process and approval of the City Council, the mitigation can go forward. The process of funding each project can be addressed during the normal budget process and/or with grant funding. Completion of any project will depend on the availability of funds and any changes of priority.

Annex C -Tsunami

A. Hazard Assessment

Tsunamis are ocean waves that are generally triggered by vertical motion of the sea floor during major earthquakes. Near ocean or undersea landslides or volcanic eruptions can also generate tsunamis. They can be generated locally or a great distance from where they landfall. Warning time can be limited when the tsunami is triggered close to the impacted coastline.

Seismically-generated local tsunamis
Seismically-generated local tsunamis were produced during the 1964 earthquake. Earthquakes generate tsunamis when the sea floor abruptly deforms and displaces the overlying water from its equilibrium position. Waves are formed as the displaced water mass, which acts under the influence of gravity, attempts to regain its equilibrium. The main factor which determines the initial size of a tsunami is the amount of vertical sea floor deformation. This is controlled by the earthquake's magnitude, depth, fault characteristics and coincident slumping of sediments or secondary faulting. Other features which influence the size of a tsunami along the coast are the shoreline and bathymetric configuration, the velocity of the sea floor deformation, the water depth near the earthquake source, and the efficiency which energy is transferred from the earth's crust to the water column.

Landslide-generated tsunamis
Submarine and sub-aerial landslides can generate large tsunamis. Sub-aerial 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. During the 1964 earthquake, landslides into bays near Valdez and Seward sent 35 foot waves sloshing back and forth like water in a bathtub. Warning time can be limited when the tsunami is triggered close to the impacted coastline. In Seward, a 1070 meter section of the waterfront slid into Resurrection Bay due to the earthquake shaking. This created a local tsunami causing much damage. Landslides usually occur in the heavily glaciated areas of Prince William Sound and parts of Southeast Alaska. 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. Loading on the delta from added weight such as trains or a warehouse or added fill can add to an area's instability.

Resurrection Bay borders the Gulf of Alaska and it is vulnerable to tsunamis generated by landslides, underwater landslides, crustal plate movement, and volcanic activity in the North Pacific Ocean. The Gulf of Alaska could receive a tsunami from several possible sources.

B. Vulnerability Assessment and Impacts

The map below is from the State of Alaska Hazard Mitigation Plan which designates Seward as having a high tsunami hazard.

This truck at Lowell Point, 2 miles from Seward, was bent around a tree by the surge waves generated by the underwater landslides along the Seward waterfront. The truck was about 32 feet above water level at the time of the earthquake.

Source US Geological Survey.

C. Mitigation Measures

Seward was one of the first cities in the U.S. to be considered Tsunami Ready. The city has put together evacuation maps, pamphlets and signs designated to help people in our community escape potential risk. Due to the history of tsunamis in Seward, the city has cooperated with the State of Alaska and the Kenai Peninsula Borough in the development of tsunami warning signals. The city has developed response plans to deal with the effects of tsunamis. In the 2004 version of this plan, in Goal 1 we identified two potential projects that benefit the community. With the assistance of The State of Alaska DHS/EM, USGS, UAF Geological Department and NOAA we have finalized a new inundation map for the community. This map shows the effects of different size waves and effects from waves generated inside and outside of Resurrection Bay. The final version of the map went to the publishers in January 2010. The second project was to acquire land to develop a secondary evacuation route. An agreement has been reached with the private landowner who will allow for this route over their property. Survey of the route has been completed and we are currently looking into any engineering studies that may be required.

Goal 1: Identify earthquake and tsunami hazards within the City of Seward and evaluate and prioritize potential mitigation measures.

Potential Projects:

- Revise tsunami inundation hazard prediction maps as needed after an event or disaster.
- Develop a secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004)
- Drill or dry run practice community evacuations of above and existing evacuation routes.
- Place one electrical supply circuit underground across the Lagoon in an old waterline.
- Complete an underground electrical supply circuit over Dairy Hill and through Two Lakes Park.
- Complete an underground circuit from the South Harbor expansion to Jefferson along Ballaine Blvd.
- Complete the SMIC electrical loop along Sorrel Rd.
- Complete the electrical loop along Alemeda St. To Leirer Rd.
- Complete the underground electrical loop on Lowell Pt. from Beach Drive to Lowell Pt. Rd., and the loop from Shady Ln. to Beach Dr.

Goal 2: Protect lives and properties in the event of a tsunami through public education and emergency response exercises.

- Install AWS (Alaska Weather System) radios in public buildings. These radios will also broadcast tsunami watches and warnings.
- Install EMWIN (Emergency Managers Weather Information Network), from the National Weather Service into the police dispatch area.

- Conduct community mock tsunami exercises and review responses to correct deficiencies.
- Develop public education to concentrate on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on EAN (Emergency Alert Network).

Annex D – Coastal Erosion

A. Hazard Assessment

Erosion to the beaches caused from storms or high winds are an ongoing hazard in the City of Seward. Other wave action and coastal flooding also causes damage to the shoreline. South facing shorelines within the city are more susceptible to wave erosion. These shorelines are mainly public property.

B. Vulnerability Assessment and Impacts

Erosion in the form of wave action in Resurrection Bay is caused by a number of different scenarios. The most damaging wave action is the result of storm surge. These storm-induced waves cause the destructive erosion of coastal areas. Use of Resurrection Bay by recreational boaters, is a source of wave action which will continue to be a problem even without significant storms.

The City of Seward has taken steps to minimize the impacts of erosion on beaches with the addition of rock walls, culverts and channels. In 2002, the City of Seward did some emergency erosion control work south of the ship lift located in Seward Marine Industrial Center. The project was designed to reduce the ongoing erosion in that area. Over $38,000 was spent on that repair effort. The U.S. Army Corps of Engineers is looking into more extensive erosion work at the SMIC.

After the 2006 flood event, the City of Seward evaluated options for additional erosion control within the Seward Small Boat Harbor basin. A new Travelift dock was built in 2008, connecting the existing sheet-piling dock forming the foundation for the Best Western Hotel. Additional rock was placed in the north-west corner to help alleviate the erosion problem in this quadrant of the harbor.

The north-east corner of the harbor requires additional mitigation efforts to prevent future damage from future flooding events. A stormwater drain is currently in place in this area; however shore bank erosion will continue to be a problem unless rock, sheetpile or other substrate is placed in the area to prevent further erosion. This area of the harbor has been subject to damage from wave action because the east breakwater was not originally designed or built long enough to protect this area from wave events originating from

Resurrection Bay. In 2010 the US ARMY Corps of Engineers awarded a contract to extend the east breakwater 215 feet to mitigate this problem.

An additional consequence of the flooding events in Seward is the accumulation of debris (soil, rocks, vegetative matter, trash) that is deposited in the harbor basin. This requires additional dredging to maintain proper depth in the harbor. The US Army Corps of Engineers maintains responsibility for a portion of the harbor dredging, but most flood prone areas are the City of Seward's responsibility. Dredging is scheduled to occur in 2011 based on funding availability.

Lowell Point Road on the south end of the City of Seward has suffered repetitive erosion and flood damage problems from both weather and coastal erosion. Lowell Point Road serves as the infrastructure access to the sewage treatment facility. This access must be maintained. Erosion to the access road south of the waterfall has been a major economic and safety concern. The city estimates it would cost approximately $5 million dollars to replace and erosion proof the existing access, electric and sewer lines.

In December of 2009 a storm surge caused severe damage to Lowell Point Road, Alaska SeaLife Center, the south camping area, camping area along Ballaine Blvd and the south beach of SMIC. The State of Alaska made a declaration of disaster for this event.

The likelihood of coastal erosion becoming more problematic and occurring more often in Resurrection Bay also increases with possible global climate change and associated rising of sea levels.

C. Mitigation Measures

GOAL: Reduce the amount of shoreline erosion within allowable practices and monetary constraints.

Potential Projects:

- Build a protective barrier south of the Seward Marine Industrial Center (SMIC) for erosion control.
- Complete wave barrier at the ship lift located in SMIC.
- Maintain the rock barrier located in the Waterfront Park area.
- Create a baseline assessment on Lowell Point Road, existing infrastructures and the feasibility of culvert/ditch line installation.
- Maintain or redesign rip-rap barriers along Lowell Point Road.
- Dredging operations to remove debris and fill at the head of Resurrection Bay near the airport.
- Cover the underground electric line to Lowell Pt. with concrete
- Current Mitigation measures required at Waterfront Park includes 1) repairing, maintaining and redesigning the rock barrier located in the Waterfront Park area and 2) implementing a regenerative program of our native Beach Rye Grass (Elymus arenarius) by aggressively replanting, relocating city campground fire pits, implementing educational signage to redirect foot and recreational vehicle traffic and

installing boulders and other barriers to prohibit vehicles from damaging the coastal vegetation.

- Install a protective "spit" near the waterfront in cooperation with the state, to protect from coastal erosion, storm surge tides and tsunami inundation. Similar to the south harbor upland, but smaller.
- Install sheet-piling or a rock barrier along the north-east edge of the harbor to prevent further erosion.
- Dredging operations to remove debris and sediment accumulation within the harbor from flooding events and to maintain necessary depth.

Annex E – Wildland Fire

A. Hazard Assessment

The City of Seward has a low probability of direct wildland fire hazard but there have been instances of wildland/urban interface fire situations in May of 2000 and 2001.
Seward is subject to the effects of a wildland fire in the East Zone of the Kenai Peninsula. Primarily, transportation to the city would be disrupted if a major wildland fire event would take place in the East Zone.

B. Vulnerability Assessment and Impacts

The City of Seward has a low risk of wildland fire and secondary effects of a fire from the East Zone are covered in the KPB Hazard Mitigation Plan.

The communities of the East Zone have the potential to experience both large structural and urban/wildland interface fires. Large wildland fires also have the potential to affect Seward from secondary effects such as air space and road closures due to smoke. Fires may arise as isolated incidents, or be caused by other emergencies such as earthquakes. In addition, they may be complicated by the presence of hazardous materials, and extreme weather conditions.

There is a history of large wildland fires in the East Zone such as the Moose Pass fire of 1985 or the Crown Point fire of 2001. The increasing amount of spruce-bark beetle killed forest coupled with the right mix of weather and fire behavior could result in a large wildfire that would impact people, property, air quality and the transportation corridor. Under certain conditions, the increased beetle kill forest may increase the potential for fire starts of urban/wildland fires in formerly low risk areas. The potential risk to property and people can be great given the correct mix of extreme fire weather and increased fuel loading.

Although the City of Seward has a low probability of wildland fire, the East Zone wildland fire potential has been problematic for Seward and continues to pose a threat to the city. In the case of the wildland fire that affected the Kenai Lake/Trail River campground in 2001, the City of Seward gave mutual aid to the US Forest Service. The Seward Fire Department crew was on the fire from June 26 through June 29, 2001.

Potential projects:

- Acquire permission to clear hazard, and potential hazard trees beyond the permit area for the transmission line from Dave's Creek to Grouse Lake from the State and the USFS.
- Clear the trees from the newly acquired permission areas and the brush within the permitted area.

Urban Fires

As with many communities, the City of Seward has a greater probability of urban fire situations than wildland fires. Urban fires continue to dominate the city's fire prevention/protection efforts within the City of Seward. Structural, vehicle, marine and small brush fires are common occurrences within the city.

C. Mitigation Measures

The Kenai Peninsula Borough offered a course on urban interface fire fighting in May of 2004 to better prepare firefighters for wildland/urban fire situations. The three day course was sponsored by the Borough Office of Emergency Management and Central Emergency Services in Soldotna. It was designed to address the issues of wildland/urban fires on the peninsula. The City of Seward has participated in the Alaska Firewise Program, which identifies hazards to homeowners and offers solutions to protect residents in or near forested areas. Relocating the Seward Building Department into the Fire Department has helped streamline this part of the process for builders by consolidating review of potential response to a structure, operational needs of the builder and City department's requirements in one location. During this plan review structures that are in an area that has risk/exposure to a wildland/urban fire, have been required to incorporate protective measures.

KPB is tracking the spread of the spruce bark beetle throughout the peninsula. The KPB Spruce Bark Beetle Office offers assistance and advice to businesses and homeowners.

Annex F- Weather

A. Hazard Assessment

The City of Seward has a high probability of weather related hazards. Winter storms can include heavy snowfall, ice storms, blizzards and extreme cold. Heavy spring or fall precipitation can lead to flooding in the Seward area.

B. Vulnerability Assessments and Impacts

The probability of weather related hazards in Seward is high. Weather can disrupt communications; power, transportation, emergency services, and can pose a risk to individuals. Heavy snow has secondary effects as well, such as avalanches that close the highway and rail access into the city. A major winter storm in 2000 caused numerous avalanches that closed the Seward Highway in several places between Anchorage, Girdwood and Seward. This storm also caused power outages that affected the city and outlying areas. People rushed to the local grocery stores and most of the perishable foods were cleaned out as soon as the town was notified that the road would be closed. Medical supplies had to be flown in and the state ferry Tustumena was given deliveries from other communities to bring into Seward. Many people were stranded for up to seven days in one of the several communities that were affected.

Other major weather events include flooding, wind and extreme cold. Flooding of the past was a direct result of major downpours and already saturated ground. Extended dry periods and wind have affected the city by hampering efforts of controlling fire. In May 2000, a wildland fire in the Japanese Creek region quickly spread due to high winds and dry conditions. The City of Seward evacuated the Gateway Subdivision due to the speed at which the fire was traveling.

C. Mitigation Measures

Goal: Increase public awareness of hazards related to severe weather

- Coordinate responses of private contractors during a severe event as indicated in the City's Emergency Plan.
- Public education on the effects of severe weather.
- Inform public of availability of AWS radios, in preparation of potential weather advisories.
- Activate the City's EOC to coordinate planning and logistical efforts in dealing with the emergency.

Potential projects:

- Rebuild the old transmission line sections in Lawing, Boulder Ck, and Lakeview to current distribution standards (its current use) so that it will withstand known weather conditions.
- Rebuild the double Circuit line from Dimond Blvd. to Dairy Hill Rd to withstand known weather conditions.

Annex G – Snow Avalanches/Landslides

A. Hazard Assessment

Both snow avalanches and landslides are common occurrences within the City of Seward. Lowell Point Road is commonly closed during the winter from snow avalanches. Landslides occur along that same road during heavy rains. Lowell Canyon is also prone to landslides during heavy rain. If a landslide were to block the Lowell Creek Tunnel entrance, serious flooding could affect homes, businesses, the hospital, and the senior center. Monitoring of Lowell Creek during major weather events is a high priority for the City of Seward.

B. Vulnerability Assessment and Impacts

There is a moderate probability of snow avalanches/landslides within the City of Seward. Infrastructure disruption in Lowell Canyon can be a result of an avalanche or landslide event. Many of the secondary effects of avalanche are road closures on the Seward Highway which have greater impact to the community as a whole.

C. Mitigation Measures

Goal: Increase public awareness of hazards of avalanche/landslides in the community

- Identify avalanche areas within the city and generate GIS Hazard Maps. Coordinate with Community Development on locations of areas for any zoning issues.
- Create safe parking areas along Lowell Point Road for vehicles.
- Develop and install signs designating avalanche danger zone.
- Renovate Lowell Canyon Tunnel access.
- Establish a retaining structure in Lowell Canyon to prevent avalanches from disrupting city water storage system.

Potential Projects:

- Design and develop a new generation of diversion structures and flexible transmission poles to bend with the snow impact.
- Underground more of the distribution lines in avalanche areas, ex. Mile 22.

Annex H – Volcano

A. Hazard Assessment

The City of Seward, in the East Zone of the Kenai Peninsula Borough, would see secondary effects from a volcanic eruption. Actions needed are to be able to cope with potential long term effects and continual activity from the volcanoes. Infrastructure, facilities

and priority buildings will need to be secured from volcanic ash fallout. Citizens with respiratory conditions would need to be protected or evacuated.

B. Vulnerability Assessment and Impacts

The vulnerability assessment is covered in the Kenai Peninsula Borough Hazard Mitigation Plan for the East Zone. In the Borough's Emergency Plan is a checklist that covers volcanic activity. The City has adopted the checklist for activities to be performed for warning, response and recovery phases (Vol. 2 KPB Emergency Plan Hazard Specific Checklist).

C. Mitigation Measures

Goal: Increase public awareness of hazards

- Refer to KPB Hazard Mitigation Plan for guidance on mitigation plans
- Identify critical facility risk and need from ash fallout.

Annex I – Technical

A. Hazard Assessment

There are various technical hazards within the City of Seward. One of the most prevalent is the anhydrous ammonia that is used in chilling facilities at the local fish processing plants. Facilities are located at the SMIC, the boat harbor and the south end of town. Other potential technical hazards within the city include; fuel storage facilities, explosive storage and hazardous materials shipped into the city by marine vessel and truck or train cargo.

B. Vulnerability Assessment and Impacts

The probability of a technical hazard incident in the City of Seward is low, although there have been incidents in the past. Anhydrous ammonia is the most significant hazard that affects the community. Anhydrous ammonia is a corrosive and toxic gas that is an eye, nose and throat irritant. It is highly toxic if inhaled and may be an explosive hazard in a confined space. An example of this is the anhydrous ammonia leak and explosion at the Icicle Seafood's processing plant in Homer, Alaska, On July 1, 1998. The fire/explosion destroyed the Homer Plant. A broken ammonia line, under repair at the plant, was the source of the explosion. An estimated 34,000 lbs was in the system at the time of the explosion. It is not clear how much anhydrous ammonia escaped out of the system before the incidents. The plant was located on the Homer Spit, which is away from the heavily populated portion of the city but within close proximity of many businesses, campgrounds and the boat harbor. During the fire, the Spit had to be evacuated which took approximately one hour to complete.

Icicle Seafood's Seward Plant, located in the Seward boat harbor and within 1 mile of downtown Seward, holds 23,000 lbs. of anhydrous ammonia in their system with an additional 300 lb external cylinder. Resurrection Bay Seafoods, located at the southern end of town has 650 lbs. in the system. Polar Seafoods, located in the SMIC area has 4500 lbs. Due to the proximity of two of these processing plants to populated areas, the city has a high risk from the effects of an anhydrous ammonia release.

Icicle Seafoods currently has an Emergency Response Plan in place for potential release of anhydrous ammonia. In coordination with the Seward Fire Department, Icicle Seafoods conducts a simulated leak exercises. Icicle also does an in-house monthly exercise as part of their ERP. The plan is designed to meet the requirements of the Process Safety Management of Highly Hazardous Chemicals, the Hazardous Waste Operations and Emergency Response regulation, and Part 68 of Risk Management Plan regulations. The plan is available at the Icicle Seafoods Seward Fisheries Plant.

Another potential technical hazard incident is the fuel storage tanks located north of the small boat harbor. These include gasoline, heating oil, motor oil, and diesel and propane storage facilities. All of which have the ability cause extreme environmental disasters and/or fire/explosion incidents. In the event of a failure of any of these tank systems, the risk to the City of Seward is high. The probability however of such failures is low. The largest threat from a fuel spill would be environmental contamination. The petroleum tank facility is located within a few hundred yards of the shoreline. A major spill or rupture of any tank would have far reaching impacts.

All of these technical hazards can also occur as secondary affects of other identified hazards such as earthquakes, tsunamis and flooding. During the 1964 earthquake, ruptured fuel lines and ignition of the fuel caused additional problems for the City of Seward. Other technical hazards that could affect the City of Seward by secondary effects are listed in the KPB Hazard Mitigation Plan.

C. Mitigation Measures

Goal: Increase public awareness of hazards of potential spills/accidents

- Work with industry operators to educate the public on potential hazards and develop strategies for response, evacuation, and containment.
- Develop spill/clean up plans with industry.
- Encourage sites to meet standards/regulations for all reportable quantity hazard materials.
- During large renovation, repairs or after a disaster, encourage the use of utilidoors for future pipelines.

Annex J – Economic

A. Hazard Assessment

An economic hazard for the City of Seward would primarily result as a secondary effect of other potential hazards such as earthquakes, tsunamis and flooding. Because of the diversified economy of Seward, the probability of an economic hazard is low.

B. Vulnerability Assessment and Impacts

The economic impact of increased natural gas prices is currently being felt through the Fuel Adjustment Charge in our electric bills. This increase is expected to increase dramatically in the next few years.

The City of Seward has a low probability of other economic hazards. There are a number of scenarios that could cause a hazard to the economy if they were to occur. A few of these would be the closure of one or many of the government/private industry that has significant influence to the local economy. A few of the local industries that could affect the City of Seward would be the loss of the tourism industry or the closure of the Alaska Vocational Technical Center.

Tourism in Seward is an industry that has far reaching impact on Seward businesses and residents. There are many different industries that stem from the influx of the travel industry. There are approximately 28 hotels, motels, and bed and breakfasts, 27 restaurants, 4 seasonal water tour companies, 66 charter boats, 2 grocery stores, 22 art/gift shops, the Alaska SeaLife Center, hardware businesses and charter booking agencies, 2 fuel companies, campgrounds, and other related industries throughout the area could all be impacted by the reduction or elimination of tourism. A potential cause of reduction would be a terrorist threat or action based in the city or within the US. If one cruise ship was destroyed or taken by a terrorist organization in the US the reduction of tourist coming to Seward could be 100%.

Another major industry that has far reaching impacts on the City of Seward is the Alaska Vocational Technical Center (AVTEC). AVTEC is a state entity. AVTEC owns and operates 12 buildings, leases 1 building, has 69 full time employees with a payroll of $4.4 million, and spend approximately $530,000 in local businesses. AVTEC offers its employees good wages, benefits and a retirement system. The employees in return live in the community using the various businesses and services. A possible scenario that could affect the role of AVTEC in our community would be the reduction of the State budget.

An impact to the commercial fishing industry could also affect the City of Seward by the reduction of services, employment and the decrease in vessels and crews who support many businesses throughout the city. These include the 3 local fish processing facilities, fuel companies, grocery stores, restaurants and hardware/fishing supply stores.

Government agencies would also be impacted such as the City of Seward for port fees, business license fees, and other research/enforcement agencies.

The probability of any of these events to occur is very low but the impact to the economy of the community would be high.

C. Mitigation Measures

Goal 1: Increase public awareness of potential hazards

- Make concise information available to the public about local industry concerning any government control.
- Make sure that accurate information is given to agencies that are responsible for dissemination of information concerning the City of Seward or other government agencies.
- Public groups (Chamber of Commerce, Lions, and Rotary Clubs, etc.) with business interests have accurate and timely information available to dispel rumors.

Goal 2: Support and encourage planned economic development that will be beneficial to the City of Seward.

- Develop and find existing programs that insure that the City of Seward is a safe and clean place for visitors to come.

Goal 3: Support and encourage the permitting and construction of an in state gas line to the states vast gas reserves.

Chapter 5 – Public Participation on Plan

In 2010 Fire Chief David Squires led the revision of the Hazard Mitigation Plan for the City of Seward under the direction of the City Manager, Phillip Oates.

Working with the following people within City of Seward departments Executive Liaison to the City Manager, Suzi Towsley collected information.

Departments from the City of Seward that assisted in compiling information include:
Fire Department – David Squires, Fire Chief
Engineering / Building Department– Stefan Nilsson
Public Works – W.C. Casey and Kirsten Vesel
Community Development- Christy Terry and Donna Glenz
Electrical Department- John Foutz and Jeff Estes
Small Boat Harbor- Kari Anderson
Seward Parks and Recreation- Karin Sturdy

Upon completion of the first draft, copies were distributed to the Fire Station, the Public Library and the City Clerks office for public review.

The first public hearing for the draft proposal was held at the Planning and Zoning Commission meeting of April 6, 2010.

An additional public hearing on The All Hazard Mitigation Plan was conducted at City Council meeting on April 12, 2010.

Comments from the public from the meetings will be incorporated into the plan before submission to the KPB, State of Alaska, and Federal Governments.

The Kenai Peninsula Borough has put together a public notice bulletin with contacts for the City of Seward as well as Borough contacts for individuals interested in the process of hazard mitigation. This is available on the internet at http://www.borough.kenai.ak.us/emergency/hazmit/plan.htm

Public input into The All Hazard Mitigation Plan planning process was solicited in a Public Notice published in the Seward Phoenix Log on April 1 and 8, and 15, 2010.

Interagency coordination was received from the following agencies:

Kenai Peninsula Borough

State of Alaska

US Army Corps of Engineers

The State of Alaska gave direction on how to formulate the plan, identify the hazards and mitigation measures. The State of Alaska reviews the plan for compliance and completeness and recommends changes that need to be made.

The Corp of Engineers provided information on past mitigation efforts and estimations on proposed mitigation measures and including the permitting process.

In the revision of this plan under the direction of City Manager, Phillip Oates, each of the City departments were contacted for input for completed mitigation measures, new proposed mitigation measures and other hazards that may effect the City of Seward. Any agency contacted to review the original plan was given the opportunity to review the revised document.

Chapter 6 – Implementation

The City of Seward will implement this plan by the methods outlined in this chapter. In addition to a positive cost/benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns and public support. The City Manager is responsible for implementing the plan as resources allow. Projects selected for funding will follow a public process with the Planning Commission making recommendations to the Seward City Council for further public input and approval of projects. Completion of any project will depend on the availability of funds, changes in priority and will need to be individually approved and adopted by the City Council prior to the start of that project.

The Planning and Zoning Commission will review the potential projects list for recommendations to the Council on which projects should receive the highest priority. The Council is responsible for making the final decision on which projects are submitted for funding.

Because flooding from severe storms presents the greatest probability of occurrence to Seward it is anticipated that projects mitigating damage from floods will receive the highest priority. In subsequent updates of the plan, continued evaluation of danger from other hazards will be undertaken.

Determining which projects should be submitted for funding will be based on a FEMA approved cost/benefit method. A publication by FEMA explains how to determine cost-effectiveness of mitigation projects and how to calculate the benefit-cost ratio. In addition to a positive cost/benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns and public support.

The Plan will be monitored and it will be updated when a disaster occurs that significantly affects Seward, whether or not it receives a Presidential Declaration, assuming funding is available to update The Plan. The update will be completed as soon as possible, but by no later than the 12 months following the date the disaster occurs. The normal review cycle will be five years.

The City Manager will direct staff to start the updating of this Plan two years before the end of the five-year cycle. Securing grant monies and developing a project plan will occur the two years before the end of the five year requirement. Writing of the update will happen one year before the end of the five year cycle, to allow for adequate time for public participation. The public will be advised of the revision process through announcements the paper for public review and comment at regular Planning and Zoning Commission meetings and City Council Meetings. Plans will be available at various public sites (example: Library, City Hall). Advertisements will run in the Seward Phoenix Log, our weekly local newspaper, requesting public comment.

The All Hazard Mitigation Plan will be updated as necessary as required by State of Alaska law, Title 29.40.030. At a minimum however The Plan will be evaluated and updated every five years.

6A – Potential Projects

The following list is based upon city staff analysis of vulnerabilities and mitigation measures for known hazards in the Seward area. Prioritizing the list will depend on future disasters and the needs of the community. Inclusion of short and long term projects is consistent with the state hazard plan.

- Short-term projects are those, which could be accomplished within a two year time period.

- Long-term projects will take longer than two years and/or depend on other projects being accomplished first or substantial funding resources.

Project Listing: *(not prioritized)*

1. Identify additional hazards not covered previously and do a risk analysis within a two year time period. (Short Term)

2. The current Flood Insurance Rate Maps are very outdated and are in need of updating to address the following items. (Long Term)

   - 1981 maps need to be reevaluated with 23 years of additional data.
   - Corrections may need to be made for areas where fill or naturally high ground is now shown as flood prone but may not be in jeopardy of flooding.
   - U.S. Corps of Engineers needs to analyze new flood boundaries as part of the harbor/port improvement project.
   - Investigate better flood programs, especially ones specific to alluvial fan flooding.

3. City of Seward should evaluate the benefits of applying to FEMA to join the Community Rating System. (Short Term)

4. City staff should work with adjustors on the Community Rating System to reduce interest rates. (Long Term)

5. Information on how to obtain insurance from the NFIP should be provided to private property owners. (Short Term)

6. Publish a brochure containing information on the City of Seward flood dangers to be distributed to the community. (Short Term)

7. Require that realtors disclose hazard risk in real estate transactions. (Short Term)

8. Bring a flood-proofing workshop to Seward to assist the City and private property owners. (Short Term)

9. Reevaluate land use codes and subdivision regulations that are specific to development within the flood prone areas. (Short Term)

10. Mitigate damage to roads, drainage and utilities by requiring that reconstruction be to a higher standard after a storm. (Long Term)

11. Revise the flood plain ordinance to include a provision for cumulative substantial improvement or damage. (Short Term)

12. Properties should be identified that would be appropriate for protection because of flood risks, and after public input, acquisition, conservation, or flood hazard protection regulations by the government should be pursued. (Long Term)

13. Require buildings to be built with the lowest floor one foot above base flood elevation. (Short Term)

14. Improve enforcement of floodplain regulations, including requiring certificates for all structures within the flood plain. (Short Term)

15. Continued maintenance of the Resurrection River drainage. In conjunction with KPB, conduct an engineering study to determine the most effective use of the dredge materials from the maintenance dredging. (Long Term)

16. Continue Lowell Creek Tunnel outflow maintenance. (Short Term)

17. Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability. (Short Term)

18. Identify buildings or locations vital to the emergency response effort and buildings or locations that, if damaged, would create secondary disasters. (Short Term)

19. Encourage real-time availability and use of satellite data to evaluate fire, spruce bark beetle killed forest, and flood or tsunami potential. i.e. EMWINS, KPB Spruce Bark Beetle. (Long Term)

20. Encourage KPB school mitigation efforts. This measure will increase help to protect children and retain a school's functionality as an emergency shelter. (Long Term)

21. Encourage non-structural mitigation and preparedness activities. Encourage activities at the household level. (Short Term)

22. Conduct city-wide earthquake/tsunami drills. Citywide earthquake/tsunami drills will educate people on what to do when an earthquake/tsunami occurs and reinforce interagency and individual expectations. (Long Term)

23. Encourage the development of earthquake structural performance standards and incorporate earthquake overlay zones in the community land use ordinances. Encourage the development of citing requirements based on soil type, slope, and other considerations. Before this can happen, information about where the various risks are located must be developed. (Long Term)

24. Promote incorporation of new methods to improve building performance. New materials and construction techniques might be more effective or feasible than what is currently available. (Long Term)

25. Evaluate the need for development of large-scale earthquake-hazard maps of the Seward areas. Seismic hazard area maps need to be created for the area. The maps should depict site amplification, liquefaction susceptibility, and ground failure at a minimum scale of 1 inch = 1 mile. (Long Term)

26. Publish Tsunami Inundation Maps. Revise maps after a significant event or natural disaster. (Long Term)

27. Improve the Lowell Creek diversion project by reassessing the best route for creek diversion, renovation of the tunnel and development of a new outfall. (Long Term)

28. Identify and advise of avalanche/landslide areas within the City of Seward for potential community development. (Short Term)

29. Encourage the Kenai Peninsula Borough to include service areas outside of City of Seward city limits in this plan.

References and Addendum

1 *City of Seward: Flood Hazards Mitigation Plan.* City of Seward Community Development Department and Hensley Consulting Services, 1996.

2 *Draft State Hazard Mitigation Plan*. Alaska Division of Emergency Services (ADES), March 2002.

3 *Flood Damage Reduction Revised Reconnaissance Report Seward, Alaska, Lowell Creek*. United States Army Corps of Engineers (USCOE), August 1992.

4 *Flood Mitigation Assistance Guidance.* Federal Emergency Management Agency (FEMA) FEMA 299, August 1997.

5 *Kenai Peninsula Borough All- Hazard Mitigation Plan First Draft 2003.* Bechtol Planning and Development, November 2003.

6 *Kenai Peninsula Borough Flood Mitigation Plan.* KPB, March 1996.

7 *Seward Area Rivers; Flood Damage Prevention Interim Reconnaissance Report.* United States Army Corps of Engineers, February 1994.

8 *Subduction Zones*. Alan Feuerbacher
http://www.geocities.com/Athens/Academy/6040/flood09.htm

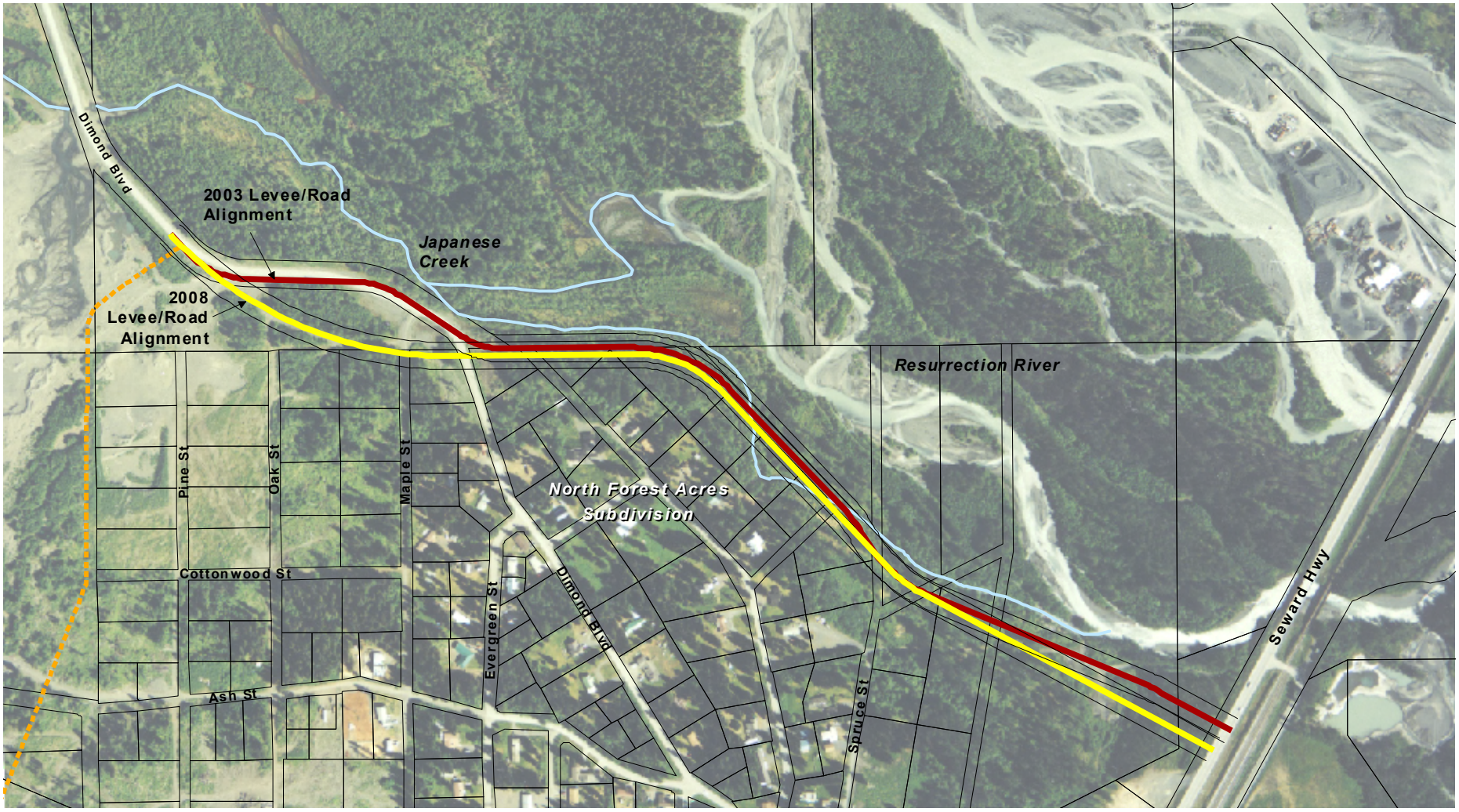
9 U.S. Geological Survey web sites; http://neic.usgs.gov;
http://pubs.usgs.gov/publications/text/understanding.html

10 FEMA publications: How to Determine Cost-Effectiveness of Mitigation Projects and Calculating the Benefit-Cost Ratio. http://www.fema.gov/fima/pdm.shtm

11 *The Water Resources Development Act of 2007*, Section 5032 Lowell Creek Tunnel, United States Army Corps of Engineers, 2007

12 Proposed North Forest Acres Levee/Road map, HDR, Wm. J. Nelson & Associates, AeroMetric, April 2008]

Addendum of Revisions/Updates



Proposed North Forest Acres Levee/Road

250 125 0 250 500 Feet

N W E S

Legend

- 2008 Alignment
- 2003 Alignment
- Existing Levee
- Parcel Boundary

Sources: HDR, Wm. J. Nelson & Associates, AeroMetric

Date: 04/15/08

SEC. 5032. LOWELL CREEK TUNNEL, SEWARD, ALASKA.

(a) LONG-TERM MAINTENANCE AND REPAIR.—
(1) MAINTENANCE AND REPAIR.—The Secretary shall assume responsibility for the long-term maintenance and repair of the Lowell Creek tunnel, Seward, Alaska.
(2) DURATION OF RESPONSIBILITIES.—The responsibility of the Secretary for long-term maintenance and repair of the tunnel shall continue until an alternative method of flood diversion is constructed and operational under this section, or 15 years after the date of enactment of this Act, whichever is earlier.
(b) STUDY.—The Secretary shall conduct a study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible.
(c) CONSTRUCTION.—
(1) ALTERNATIVE METHODS.—If the Secretary determines under the study conducted under subsection (b) that an alternative method of flood diversion in Lowell Canyon is feasible, the Secretary shall carry out the alternative method.
(2) FEDERAL SHARE.—The Federal share of the cost of carrying out an alternative method under paragraph (1) shall be the same as the Federal share of the cost of the construction of the Lowell Creek tunnel.

Encl

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON, D.C. 20314-1000

CEMP-POD

JUN 2 9 2009

MEMORANDUM FOR COMMANDER, Pacific Ocean Division (CEPOD-PDC)

SUBJECT: Implementation Guidance for Section 5032 of the Water Resources Development Act of 2007 (WRDA 2007) – Lowell Creek Tunnel, Seward, Alaska

1. Section 5032 directs the Secretary to assume responsibility for the long-term maintenance and repair of the Lowell Creek tunnel, Seward, Alaska until an alternative method of flood diversion is constructed and operational, or 15 years after the date of enactment of WRDA 2007 (8 November 2007), whichever is earlier. In addition, the Secretary is authorized to conduct a study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible. Further, if the Secretary determines an alternative method of flood diversion in Lowell Canyon is feasible, the alternative method shall be constructed and the Federal share of the cost of carrying out such alternative method will be the same as the Federal share of the cost of the construction of the Lowell Creek tunnel. A copy of Section 5032 is enclosed for information.

2. Construction was completed in 1940 of the existing Lowell Creek project to protect the city of Seward from the floodwaters of Lowell Creek. The project consists of a diversion dam and a concrete lined tunnel 10 feet in diameter and 2,070 feet long through Bear Mountain. The construction was performed at Federal expense and the City of Seward provided, at no cost to the Government, all lands, easements, and rights-of-way necessary for construction. The City of Seward assumed responsibility for operation and maintenance of the existing project upon completion of construction.

3. The Alaska District will assume long-term maintenance and repair responsibility of the concrete lined tunnel (and tunnel inlet and outlet structures) until completion of construction of an alternative method of flood diversion or until 8 November 2022 (15 years after the date of enactment of WRDA 2007), whichever is earlier. Funding to accomplish the long-term maintenance and repair will be budgeted in the O&M account in accordance with existing budgetary policies and procedures. In advance of the budget request, a letter report that details the extent and cost of the operations and maintenance must be submitted for review and approval by the ASA(CW). Long-term maintenance and repair activities of the concrete lined tunnel (and tunnel inlet and outlet structures) will be limited to those that meet the definitions for "replacement" and "rehabilitation" in Section 12 of ER 1110-2-401, "Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors" such as replacement of worn out portions of the concrete lined tunnel (and

tunnel inlet and outlet structures) or returning a deteriorated feature of the concrete lined tunnel (and tunnel inlet and outlet structures) back to its original condition. The need to rehabilitate the concrete lined tunnel (and tunnel inlet and outlet structures) also could result from unusual damage incurred during a flood event. Long-term maintenance and repair activities typically require multiple seasons to plan, design, and execute. If no alternative method of flood diversion is constructed before 8 November 2022, the responsibility for long-term maintenance and repair of the concrete lined tunnel (and tunnel inlet and outlet structures) shall revert back to the City of Seward.

4. Annual maintenance and repair of the concrete lined tunnel (and tunnel inlet and outlet structures) will remain the responsibility of the City of Seward. Annual maintenance and repair is defined in Section 12 of ER 1110-2-401 as "those activities of a routine nature that maintain the project in a well kept condition." Examples of such activities include annual removal of sediments and debris from the stilling basin at the outfall of the tunnel and repairs necessary to fences and ladders. Inspections are also part of the annual operations and maintenance responsibilities of the City of Seward and should continue in accordance with state regulatory authority. The District may accompany the city or state on the inspections and should obtain a copy of the final inspection reports.

5. Operation, maintenance, repair, replacement, and rehabilitation of the diversion dam will remain the responsibility of the City of Seward.

6. At such time as funds are appropriated for such work, the District should conduct a reconnaissance study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible in accordance with procedural guidance contained in ER 1105-2-100. If the reconnaissance study determines that there is at least one feasible solution, once funds are appropriated for such work, the District should conduct a feasibility study in accordance with current budgetary policy and procedural guidance contained in ER 1105-2-100 for projects authorized without a report. The costs of the feasibility study will be shared 50 percent Federal and 50 percent non-Federal pursuant to a Feasibility Cost Sharing Agreement. The feasibility report will be submitted to the POD RIT for policy compliance review by HQUSACE and approval by the Secretary.

7. Upon approval of a report that documents a feasible alternative to flood diversion in Lowell Canyon and receipt of Federal funding for construction of such alternative, a project partnership agreement (PPA) addressing design and construction of the approved plan may be executed in accordance with the current guidance on preparation of, approval, and execution of PPAs. The design and construction of the approved plan shall be accomplished at Federal expense and the non-Federal sponsor shall provide, at no cost to the Government, all lands, easements, and rights-

of-way necessary for the construction. Further, upon completion of construction the non-Federal sponsor shall operate, maintain, repair, replace, and rehabilitate the new project. Contact the POD RIT for direction on drafting the PPA.

FOR THE COMMANDER:

Encl

LLOYD D. PIKE
Chief, Pacific Ocean Division
Regional Integration Team
Directorate of Military Programs

Sponsored by: Administration

CITY OF SEWARD, ALASKA
PORT AND COMMERCE ADVISORY BOARD
RESOLUTION 2010-02

A RESOLUTION OF THE PORT AND COMMERCE ADVISORY BOARD OF THE CITY OF SEWARD, ALASKA, RECOMMENDING CITY COUNCIL ADOPTION OF THE ALL-HAZARD MITIGATION PLAN FOR THE CITY OF SEWARD

WHEREAS, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

WHEREAS, the Kenai Peninsula Borough incorporates into their plan the City of Seward's All-Hazard Mitigation Plan as an annex; and

WHEREAS, FEMA disaster recovery funding requires regular updates to the Plan; and

WHEREAS, the Kenai Peninsula Borough (KPB) is working with Peninsula cities to update the All-Hazard Mitigation Plan; and

WHEREAS, the City of Seward's All-Hazard Mitigation Plan is scheduled for adoption by the Council on April 12, 2010; and

WHEREAS, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

WHEREAS, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

NOW, THEREFORE, BE IT RESOLVED BY THE PORT AND COMMERCE ADVISORY BOARD OF THE CITY OF SEWARD, ALASKA that:

Section 1. The Board recommends Council approval of the Seward All-Hazard Mitigation Plan and consider changes based upon PACAB's comments attached.

Section 2. This resolution shall take affect immediately upon its adoption.

PASSED AND APPROVED by the Port and Commerce Advisory Board of the City of Seward, Alaska, this 7th day of April, 2010.

THE CITY OF SEWARD, ALASKA

Ron Long, Chair

AYES:
NOES:
ABSENT:
ABSTAIN:
VACANT:

ATTEST:

Jean Lewis
City Clerk

(City Seal)

CITY OF SEWARD INCORPORATED SEAL JUNE 1, 1912 STATE OF ALASKA

Sponsored by: Administration

CITY OF SEWARD, ALASKA
PLANNING AND ZONING COMMISSION
RESOLUTION 2010-04

A RESOLUTION OF THE PLANNING AND ZONING COMMISSION OF THE CITY OF SEWARD, ALASKA, RECOMMENDING CITY COUNCIL ADOPTION OF THE ALL-HAZARD MITIGATION PLAN FOR THE CITY OF SEWARD

WHEREAS, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

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WHEREAS, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

WHEREAS, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

NOW, THEREFORE, BE IT RESOLVED BY THE PLANNING AND ZONING COMMISSION OF THE CITY OF SEWARD, ALASKA that:

Section 1. The Commission recommends Council approval of the Seward All-Hazard Mitigation Plan as attached.

Section 2. This resolution shall take affect immediately upon its adoption.

PASSED AND APPROVED by the Planning and Zoning Commission of the City of Seward, Alaska, this 6th day of April, 2010.

THE CITY OF SEWARD, ALASKA

Sandie Roach', Chair

AYES:	Heinrich, Ecklund, Morgan, DeMarco, Roach'
NOES:	None
ABSENT:	None
ABSTAIN:	None
VACANT:	Two

ATTEST:

Jean Lewis
City Clerk

(City Seal)

CITY OF SEWARD INCORPORATED SEAL JUNE 1, 19[illegible] STATE OF ALASKA

Sponsored by: Oates

CITY OF SEWARD, ALASKA
RESOLUTION 2010-030

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SEWARD, ALASKA, TO APPROVE REVISIONS TO THE ALL HAZARD MITIGATION PLAN FOR THE CITY OF SEWARD FOR SUBMISSION TO THE KENAI PENINSULA BOROUGH

WHEREAS, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

WHEREAS, the Kenai Peninsula Borough incorporates into their plan the City of Seward's All-Hazard Mitigation Plan as an annex; and

WHEREAS, FEMA disaster recovery funding requires regular updates to the Plan; and

WHEREAS, the Kenai Peninsula Borough (KPB) is working with Peninsula cities to update the All-Hazard Mitigation Plan; and

WHEREAS, the City of Seward's All-Hazard Mitigation Plan is scheduled for adoption by the Council on April 12, 2010; and

WHEREAS, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

WHEREAS, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SEWARD, ALASKA that:

Section 1. The City Council approves the Seward All-Hazard Mitigation Plan as attached.

Section 2. This resolution shall take affect immediately upon its adoption.

PASSED AND APPROVED by the City Council of the City of Seward, Alaska, this 12th day of April, 2010.

CITY OF SEWARD, ALASKA
RESOLUTION 2010-030

THE CITY OF SEWARD, ALASKA

Jean Bardarson
Jean Bardarson, Vice-Mayor

AYES: Valdatta, Smith, Keil, Shafer, Amberg, Bardarson
NOES: None
ABSENT: Dunham
ABSTAIN: None

ATTEST:

Jean Lewis
City Clerk

(City Seal)