Alaska Seismic Hazards Safety Commission

Annual Report to the Governor and State Legislature for 2012

March 2013

Example of a large landslide triggered by an earthquake. There were no people or man-made structures in the path of this landslide, so there were no impacts except to the mass balance of Sherman Glacier, about 20 miles east of Cordova, Alaska. This large rock-slide avalanche was triggered by the magnitude 9.2 great Alaska earthquake of March 27, 1964. The rock-slide deposit was about 5.6 km (3.5 mi) long, 4 km (2.5 mi) wide, 5 m (16 ft) thick, and contained about 25 million cubic meters (883 million cubic feet) of rock debris. USGS photograph taken August 25, 1965.

ASHSC Alaska Seismic Hazards Safety Commission

EXECUTIVE SUMMARY

This annual report to the Governor and Legislature from the Alaska Seismic Hazards Safety Commission (ASHSC) reiterates the priority issues and goals of the Commission and identifies its 2012 accomplishments. The report updates the history and status of the Commission, identifies the current membership, lists the accomplishments to date, describes various committee functions, and presents Commission Policy Recommendations to improve seismic safety in Alaska.

The Federal Emergency Management Agency (FEMA) has estimated that with the present infrastructure and policies, Alaska will have the second highest average annualized earthquake-loss ratio (ratio of annualized value of loss or damage, to the replacement cost of the building inventory) in the country. Reducing these losses requires public commitment to earthquake-conscious siting, design, and construction. The Alaska Seismic Hazards Safety Commission is committed to addressing these issues. Earthquake-risk mitigation measures developed by similar commissions in other states have prevented hundreds of millions of dollars in losses and precipitated significant reductions in casualties when compared to other seismically active areas of the world that do not implement effective mitigation measures.

The Commission operates under the powers and duties prescribed by its enacting legislation (Appendix A) and is guided by its Charter (Appendix B) and its Strategic Plan (Appendix C) which provide a clear understanding of the Commission's roles and expectations, empowers Commission members, and provides operating guidelines agreed to by all members. The Commission is administered by the Division of Geological & Geophysical Surveys (DGGS) in the Alaska Department of Natural Resources.

During the past year the Commission has invited numerous governmental and private organizations to give presentations describing their approaches to seismic risk mitigation. These briefings have provided the members of the Commission with opportunities to gain an understanding of current programs and various approaches to seismic risk mitigation, identify areas of concern, and to focus initial mitigation efforts in these areas. Most of these briefings are available for viewing on the Commission web site (http\\:www.seismic.alaska.gov).

The Commission addressed four "sunset review" recommendations by a 2011 State of Alaska Legislative Budget and Audit Committee report as follows:

Recommendation A: *The commission should develop a strategic plan to guide its efforts to mitigate seismic hazard risk in Alaska.*

The commission completed a comprehensive strategic plan (Appendix C) in early 2012, and it is posted on the public website. The commission chair has instructed all subcommittee chairs to implement the plan in their current and ongoing activities. The strategic plan is a dynamic document that will be reviewed annually and revised as necessary to respond to evolving understanding of seismic risks in Alaska.

Recommendation B: The commission should ensure it provides reasonable public notice of all of its meetings.

Since the commission's extension, effective July 1, 2012, the Division of Geological & Geophysical Surveys has posted advance public notice of all meetings. With one exception, all notices were posted at least seven days prior to the scheduled meeting. The division is committed to issuing reasonable public notice of all commission meetings and will ensure they are posted at least seven days in advance.

Recommendation C: *The commission should recommend replacement of its members in a timely manner.*

This item is now a regular topic of the commission's monthly meetings. Unexcused absences are reviewed and the commission's rules of procedure are followed to ensure chronically absent members are replaced in a timely manner.

Recommendation D: *The Office of the Governor and the commission should work to fill appointments to all commission seats in a timely manner.*

Since the commission's extension, the chair has maintained frequent telephone and email contact with the Office of Boards and Commissions to discuss actual and anticipated vacancies. One new vacancy occurred, effective January 1, 2013, for which the chair is working with Boards and Commissions to consider candidates for replacement.

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POLICY RECOMMENDATIONS

The Commission has drafted eight (8) policy recommendations. Supporting documentation or white papers for a majority of these recommendations are contained in Appendix D.

Policy Recommendation 2010-1:

Given that schools in Alaska serve not only as educational facilities but also as gathering places for the general public, and that many are designated as emergency shelters in case of a natural disaster, the Commission recommends that the State appropriate the resources necessary to identify those school facilities most at risk from earthquakes.

Policy Recommendation 2010-2:

The Commission recommends that all future school design, construction, and major renovations project funding include monies allotted for seismic risk mitigation tasks to include:

- *Seismic design by a structural engineer proficient in the design and detailing required for earthquake engineering tasks.*
- *An independent peer review of seismic design calculations and detailing by a qualified structural engineer.*
- *On-site observation of as-constructed earthquake engineering details during construction by a qualified inspector to ensure they are constructed in accordance with the contract documents.*

Policy Recommendation 2011-1:

Alaska is the most seismically active state in the union, yet its active fault locations and characterization are the least understood. Therefore the Commission recommends that the Legislature consider means to fund State governmental agencies in their ongoing efforts to characterize these faults.

Policy Recommendation 2011-2:

Considering that Alaska is the most seismically active state, the safety of Alaska's populace and economy rely on the assumption that the design and construction of infrastructure adequately considers the seismic hazard. Therefore, the Commission recommends that applicants for registration as a Professional Engineer practicing civil engineering in Alaska be required to have completed a university level or equivalent course addressing seismic hazards.

Policy Recommendation 2011-3:

Perform FEMA Rapid Visual Screening of Existing Buildings to identify and prioritize all seismically vulnerable State of Alaska owned buildings. Establish a mitigation plan to reduce risk imposed by those buildings, including structural and nonstructural elements, equipment, and contents. The most essential buildings should be addressed as the highest priority.

Policy Recommendation 2011-4:

Given that the Alaska State Seismic Hazard Safety Commission (ASHSC) and the Alaska Division of Homeland Security and Emergency Management is sponsoring training for qualified individuals to serve as volunteer post-earthquake safety evaluators of buildings and infrastructure, the Commission recommends that the State provide relief from liability for qualified and trained volunteers who are assigned by a jurisdiction to serve following a damaging earthquake.

Policy Recommendation 2011-5

There is consensus among Federal and western state agencies and general agreement within the scientific community that the next great devastating earthquake in North America may likely occur in the Pacific Northwest region, along the Cascadia subduction zone or on a shallow Puget Sound fault. While such an earthquake would not likely cause any physical damage to Alaska's infrastructure or directly pose a safety hazard to Alaska's population, it could, however, have a significant effect on Alaska's economy given the importance of the Pacific Northwest region to Alaska's commerce, shipping, oil exports, fishing and tourism industries, and communications. Therefore, the Commission recommends that the respective Alaska government agencies investigate potential impacts and develop contingency plans to prepare for and mitigate the possible detrimental effects on Alaska of a great Pacific Northwest earthquake.

Policy Recommendation 2012-1

Post-earthquake technical clearinghouse web sites have become the standard platform to disseminate information, coordinate reconnaissance investigation activities, and archive perishable geologic and geotechnical data in the aftermath of a damaging earthquake. The Commission encourages the State to develop an Alaska-specific post-earthquake technical clearinghouse.

These and other policy recommendations, as well as other activities and projects to meet the objectives in the Commission's Strategic Plan (Appendix C), continue to be addressed by the following Commission Standing Committees:

- *Insurance*
- *Schools*
- *Earthquake Scenarios*
- *Education, Outreach, and Partnership*
- *Hazards Identification*
- *Response and Recovery*

The 2012 activities of these committees are described in more detail in the committee activities section of this report.

Our basic public-policy goal areas remain unchanged from the previous Commission reports:

- *Education*
- *Guidance*
- *Assistance*
- *Implementation*

INTRODUCTION

The Alaska Seismic Hazards Safety Commission ("the Commission") is charged by statute (AS 44.37.067; Appendix A) to recommend goals and priorities for seismic hazard mitigation to the public and private sectors; recommend policies to the governor and the legislature, including needed research, mapping, and monitoring programs; review the practices for recovery and reconstruction after a major earthquake; recommend improvements to mitigate losses from similar future events; and to gather, analyze, and disseminate information of general interest on seismic hazard mitigation, among other duties to reduce the state's vulnerability to earthquakes. The Commission consists of eleven members appointed by the Governor from the public and private sectors for three-year terms. It is administered by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS).

Commission members include: A representative from the University of Alaska, three representatives from local government; a representative from the Department of Natural Resources; a representative of the Department of Homeland Security and Emergency Management; a representative from an appropriate federal agency; a representative of the insurance industry; and three members of the public who are experts in the fields of geology, seismology, hydrology, geotechnical engineering, structural engineering, emergency services, or planning. Six members constitute a quorum. The Commission membership elects its own chair and vice-chair. There is no executive director, although DGGS provides administrative, travel, and publication support.

HISTORY AND STATUS OF THE COMMISSION

In 2002, the 22nd Alaska Legislature passed, and the Governor signed into law, House Bill 53 establishing the Alaska Seismic Hazards Safety Commission with nine members. The legislation originally placed the Commission in the Office of the Governor, but in January 2003, Governor Frank Murkowski issued Executive Order Number 105 transferring the Commission to the Department of Natural Resources. Governor Murkowski appointed the first nine members to the Commission in 2005.

In 2005, the House of Representatives passed House Bill 83 (HB 83) to extend the Commission to June 30, 2008, add tsunami risks to its purview, and provide two additional Commission positions representing local government. In 2006, the Senate passed a substitute version of HB 83 including the two additional local government positions but omitting specific mention of tsunamis in the Commission's powers and duties. The Senate bill extended the Commission through June 30, 2012. The House concurred with the Senate version and Governor Murkowski signed the bill into law at a Commission meeting on June 16, 2006. Although the revised statute does not specifically include tsunami hazards in the Commission's powers and duties, the definitions in AS 44.37.069 include tsunami inundation as a seismic hazard. Consequently the Commission addresses tsunamis in its discussions and recommendations. As a result of passage of HB 83, the Commission currently has 11 members. In 2012, House Bill 279 extended the Commission to June 30, 2014.

The Commission first met on October 28, 2005, at which time it elected a Chair and Vice Chair, listened to briefings from the California Seismic Safety Commission and various state and local agencies in Alaska with responsibilities in earthquake-risk mitigation, and began developing goals and priorities for its activities. There were twelve meetings of the Commission through December 2006, six of which were via teleconference. Since 2006, the Commission has held eight to ten meetings annually. Typically, all but two of these meetings have been held via teleconference.

The Commission published its first annual report to the governor and legislature on April 18, 2006, and has since published reports annually during the state legislative sessions. A Commission web site posts basic information about its mission, earthquake risk in Alaska, meeting agendas, minutes, presentations, and appropriate links. The Web site address is: http://www.seismic.alaska.gov

COMMISSION MEMBERSHIP

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EARTHQUAKE RISK IN ALASKA

Alaska has more earthquakes than any other region of the United States and is one of the most seismically active areas of the world. The catastrophic April 2011 moment magnitude 9.0 Tohoku Earthquake in Japan is a grim reminder of why it is important for a society to be prepared for the furies of nature. The second largest earthquake ever recorded occurred on the Prince William Sound portion of the Alaska–Aleutian megathrust in southern Alaska on March 27, 1964, with a moment magnitude of 9.2. The largest on-land earthquake in North America in almost 150 years occurred on the Denali fault in central Alaska on November 3, 2002, with a magnitude of 7.9. From January 1 through December 31, 2012, the Alaska Earthquake Information Center (AEIC) recorded 28,003 earthquakes, for an average of more than 2,300 monthly, including 168 events with magnitude 4.0–4.9, 15 events of magnitude 5.0–5.9 and 4 events of magnitude 6.0 or greater. The largest event was a moment magnitude 6.4 in the Andreanof Islands area of Alaska. The largest mainland event was a moment magnitude 5.8 on December 4, 2012, in the northern Cook Inlet region. It is not possible to predict the time and location of the next big earthquake, but the active geology of Alaska guarantees that major, potentially damaging earthquakes will continue to occur. The risks to public safety and infrastructure from these future events can be greatly reduced through proper planning, design, and construction.

Alaska has changed significantly since the great 1964 earthquake. The population has more than doubled, but many new buildings are designed to prevent collapse during intense shaking. Some older buildings have been reinforced, and development has been discouraged in some particularly hazardous areas.

However, despite these improvements, and because practices to reduce vulnerability to earthquakes and tsunamis are not applied uniformly in regions of high risk, future earthquakes may still cause life-threatening damage to buildings, cause items inside buildings to be dangerously tossed about, and disrupt the basic utilities and critical facilities that we take for granted.

Anchorage 4th Avenue slide (USGS photo library)

In addition to the 1964 and 2002 ruptures, there are other sources of potentially damaging earthquakes in Alaska. These include the Castle Mountain fault in lower Matanuska–Susitna valley, the Wadati–Benioff zone beneath southcentral Alaska, the active belt of faulting and folding in northern Cook Inlet, three active seismic zones in the Fairbanks area, the Yakataga seismic gap near Yakutat, and the Queen Charlotte-Fairweather fault in southeastern Alaska, among others. The mechanics of faulting on these sources differ, so the earthquakes they generate may affect structures differently, in ways that may or may not be ameliorated by the current building codes.

Earthquakes of magnitudes that could cause major structural damage and injury to residents continue to occur in Alaska. The interested reader is directed to Appendix E for additional information concerning Alaska earthquake activity in 2012.

SOME ADDITIONAL EARTHQUAKE STATISTICS FOR ALASKA

- Eleven percent of the world's recorded earthquakes have occurred in Alaska.
- Alaska has more frequent earthquakes then the entire rest of the United States.
- Three of the eight largest earthquakes in the world were in Alaska.
- Seven of the ten largest earthquakes in the United States were in Alaska.

Since 1900, Alaska has had an average of:

- One "great" (magnitude 8 or larger) earthquake every 13 years.
- One magnitude 7 to 8 earthquake every two years.
- Six magnitude 6 to 7 earthquakes per year.
- Fifty magnitude 5 to 6 earthquakes per year.
- Three hundred magnitude 4 to 5 earthquakes per year.
- Approximately 2,000 earthquakes recorded in Alaska each month.

Scientists have estimated where large earthquakes are most likely to occur, and the probable levels of ground shaking to be expected in the state. With this information, as well as information on soil properties and landslide potential, it is possible to estimate earthquake risks in any given area. It is also possible to estimate the potential for earthquakes to generate tsunamis, and to model the extent to which tsunamis will inundate coastal areas. For a summary of earthquake activity during the past year, see Appendix E.

COMMISSION ACCOMPLISHMENTS IN 2012

The Commission's standing committees continued to be active in 2012. The Partnership Committee was combined with the Education and Outreach Committee to eliminate any redundancy in member efforts. Planning for the 10th National Conference on Earthquake Engineering to be held in Anchorage in 2014 is well under way and will be reported through the Education, Outreach, and Partnership Committee.

2012 general accomplishments include:

1. Held seven telephonic and two face-to-face (two-day) meetings of the Commission.
2. Participated in the following briefings on seismic risk mitigation from the following agencies and discussed the Commission's activities as they relate to work being accomplished elsewhere:
   a. Space Weather and Tsunami Prediction—Dr. Robert McCoy—UAFGI
   b. Earthquake Engineering Research at UAA—Dr. Joey Yang
   c. Alaska Sea Grant Support of the Alaska Coastal Commission—Kurt Beyer
   d. Anchorage Seismic Instrumentation Maintenance Program—Dr. John Power—AVO
   e. Earthquake Focal Mechanisms—Dr. Rich Koehler, DGGS/ASHSC
   f. Rapid Visual Screening for Schools—Laura Kelly (ASHSC/USCG)
   g. Achieving Risk Reduction at the University of Oregon—Professor Theodoropoulos
   h. Paleoseismic Studies in the Region of the 2011 Japanese Tohoku Earthquake—Dr. Rich Koehler (DGGS/ASHSC)
   i. DNR Legislative Liaison Update—Ester Tempel
3. Commission Chair Dr. John Aho gave a one-hour earthquake briefing presentation to the Alaska Partnership for Infrastructure Protection (APIP).
4. Commission members Dr. John Aho and Buzz Scher presented training for a two-day Commission-sponsored course on Post-Disaster Safety Assessment of Facilities December 11–12, 2012. Forty-five participants were trained in evaluating the safety of buildings after a damaging earthquake.
5. Developed and published the seventh annual report to the Governor and Legislature in January 2012.
6. Commission Chair Dr. John Aho gave an earthquake briefing to the Alaska BAR Association in Anchorage, Alaska.
7. Commission members continued to be active in the Western States Seismic Policy Council (WSSPC).
8. Responded to the State of Alaska Legislative Budget and Audit Committee recommendations.
9. Developed the ASHSC Strategic Plan as recommended in item 8 above.
10. Developed white papers in support of policy recommendations.
11. The Commission continued to work with the Kodiak Island Borough (KIB), the Department of Homeland Security & Emergency Management (ADHS&EM), and the Federal Emergency Management Agency (FEMA) to develop an Earthquake Response Scenario for the KIB.
12. Completed a brochure describing earthquake insurance.
13. Completed white paper titled *Potential Development of a Post-Earthquake Clearinghouse for Alaska.*
14. The Commission continued to have representation with the Alaska Partnership for Infrastructure Protection (APIP).

15. Commission member Laura Kelly continued to participate on the Project Review Panel for ATC-71-4, Update of Rapid Visual Screening Guidelines (FEMA 154) during 2012.
16. The Commission held a joint meeting with the Municipality of Anchorage Geotechnical Advisory Commission to develop an understanding of common efforts.
17. Completed the publication titled *Pacific Northwest Earthquakes and Potential Effects on Alaska.*
18. Supported the completion of the publication *Quaternary Faults and Folds in Alaska: A Digital Database.*
19. The Commission Chair, Dr. John L. Aho, was presented the 2012 Lifetime Achievement Award by the Western States Seismic Policy Council.
20. Sent ASHSC letter to the MOA Port of Anchorage urging the development of a seismic instrumentation program for the new port expansion.
21. Sent correspondence to the Knik Arm Bridge and Transportation Authority (KABATA) urging external peer review to be developed for the project.
22. Sent correspondence to the State of Alaska Attorney General asking for an opinion on liability protection for post-earthquake damage assessors.
23. Sent correspondence to the Alaska Board of Architects, Engineers, and Land Surveyors requesting that a basic knowledge of the earthquake threat in Alaska be made a part of licensure requirements.
24. ASHSC sponsored Lloyd Cluff lecture at UAA on the evolution of modern geotechnical engineering and research.
25. Participated in planning efforts for the 10th National Conference on Earthquake Engineering to be held in Anchorage in 2014.

COMMITTEE ACTIVITIES

Schools Committee *(Laura Kelly, chair)*

The Commission remains focused on assessing and minimizing loss due to structural instability of critical facilities in the event of a major seismic incident. Schools are a primary concern, but so are other critical facilities. These include hospitals and clinics; fire, rescue, and police stations; as well as jails and detention facilities. Other important infrastructure at potential risk also includes military bases, airports, college complexes, harbors, and utility system lifelines (communications, electric, oil, transportation, water, and wastewater). Schools remain a major focus, however, due to the number of facilities in the state, their high occupancy, and common designation as emergency shelters (see foldout map).

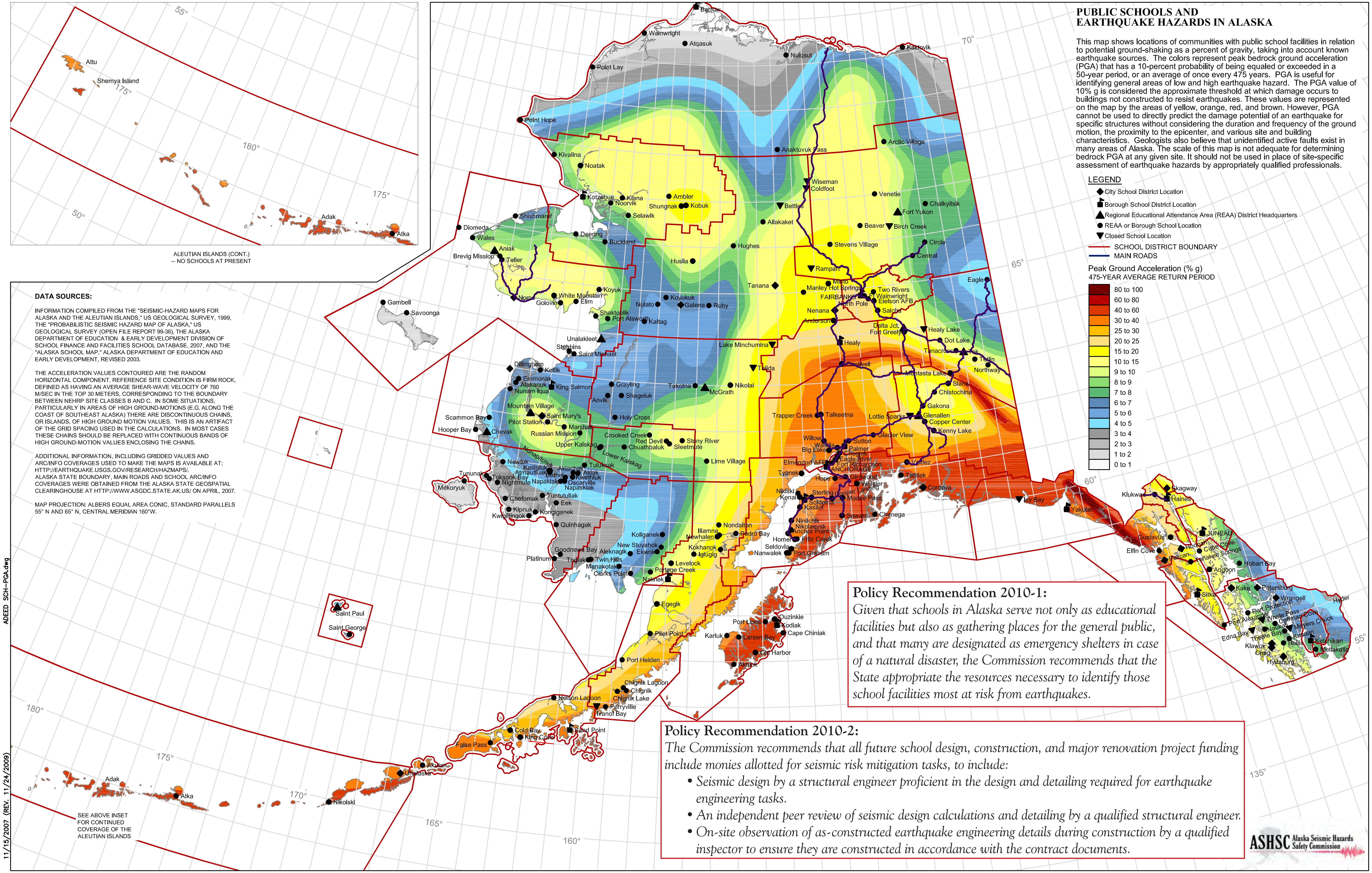
In an effort to begin mitigating earthquake risk to critical facilities, the committee continues applying the following approaches to address the issue:

- Advocate for the prioritization, identification, and mitigation of at-risk facilities; initially focusing on schools, due to high occupancies and common use as emergency shelters.
- Develop work plan(s) in collaboration with state and local agencies/governments.
- Advocate cost–benefit analyses for both existing and new construction.
- Identify current legislation/programs, including those adopted by other states/countries. Foster contacts with successful proponents.
- Identify pertinent code and construction requirements and potential limitations.
- Recommend improvements including policy changes, legislation, and public outreach.

The Commission upholds the belief that focusing on schools in high-risk seismic zones provides the greatest potential cost–benefit to the State. Schools, especially in smaller communities, tend to be some of the

PUBLIC SCHOOLS AND EARTHQUAKE HAZARDS IN ALASKA

This map shows locations of communities with public school facilities in relation to potential ground-shaking as a percent of gravity, taking into account known earthquake sources. The colors represent peak bedrock ground acceleration (PGA) that has a 10-percent probability of being equaled or exceeded in a 50-year period, or an average of once every 475 years. PGA is useful for identifying general areas of low and high earthquake hazard. The PGA value of 10% g is considered the approximate threshold at which damage occurs to buildings not constructed to resist earthquakes. These values are represented on the map by the areas of yellow, orange, red, and brown. However, PGA cannot be used to directly predict the damage potential of an earthquake for specific structures without considering the duration and frequency of the ground motion, the proximity to the epicenter, and various site and building characteristics. Geologists also believe that unidentified active faults exist in many areas of Alaska. The scale of this map is not adequate for determining bedrock PGA at any given site. It should not be used in place of site-specific assessment of earthquake hazards by appropriately qualified professionals.



DATA SOURCES:

INFORMATION COMPILED FROM THE "SEISMIC-HAZARD MAPS FOR ALASKA AND THE ALEUTIAN ISLANDS," US GEOLOGICAL SURVEY, 1999, THE "PROBABILISTIC SEISMIC HAZARD MAP OF ALASKA," US GEOLOGICAL SURVEY (OPEN FILE REPORT 99-36), THE ALASKA DEPARTMENT OF EDUCATION & EARLY DEVELOPMENT DIVISION OF SCHOOL FINANCE AND FACILITIES SCHOOL DATABASE, 2007, AND THE "ALASKA SCHOOL MAP," ALASKA DEPARTMENT OF EDUCATION AND EARLY DEVELOPMENT, REVISED 2003.

THE ACCELERATION VALUES CONTOURED ARE THE RANDOM HORIZONTAL COMPONENT. REFERENCE SITE CONDITION IS FIRM ROCK, DEFINED AS HAVING AN AVERAGE SHEAR-WAVE VELOCITY OF 760 M/SEC IN THE TOP 30 METERS, CORRESPONDING TO THE BOUNDARY BETWEEN NEHRP SITE CLASSES B AND C. IN SOME SITUATIONS, PARTICULARLY IN AREAS OF HIGH GROUND-MOTIONS (E.G. ALONG THE COAST OF SOUTHEAST ALASKA) THERE ARE DISCONTINUOUS CHAINS, OR ISLANDS, OF HIGH GROUND MOTION VALUES. THIS IS AN ARTIFACT OF THE GRID SPACING USED IN THE CALCULATIONS. IN MOST CASES THESE CHAINS SHOULD BE REPLACED WITH CONTINUOUS BANDS OF HIGH GROUND-MOTION VALUES ENCLOSING THE CHAINS.

ADDITIONAL INFORMATION, INCLUDING GRIDDED VALUES AND ARC/INFO COVERAGES USED TO MAKE THE MAPS IS AVAILABLE AT: HTTP://EARTHQUAKE.USGS.GOV/RESEARCH/HAZMAPS/.
ALASKA STATE BOUNDARY, MAIN ROADS AND SCHOOL ARC/INFO COVERAGES WERE OBTAINED FROM THE ALASKA STATE GEOSPATIAL CLEARINGHOUSE AT HTTP://WWW.ASGDC.STATE.AK.US/ ON APRIL, 2007.

MAP PROJECTION: ALBERS EQUAL AREA CONIC, STANDARD PARALLELS 55° N AND 65° N, CENTRAL MERIDIAN 160°W.

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- *An independent peer review of seismic design calculations and detailing by a qualified structural engineer.*
- *On-site observation of as-constructed earthquake engineering details during construction by a qualified inspector to ensure they are constructed in accordance with the contract documents.*

most heavily occupied and important structures. Collapse during an earthquake would not only be devastating to the occupants, but also to the recovery of a community if the structure could no longer be used for emergency shelter in Alaska's harsh climate. Globally, schools remain the primary focus for prioritizing structural mitigation, especially given widespread collapses during large earthquakes in China (2008) and Haiti (2010). The more recent 2011 Japan quake highlighted the effectiveness of proper seismic design, but also illustrated the vulnerability of coastal communities to tsunami inundation.

Schools Committee Activities in 2012:

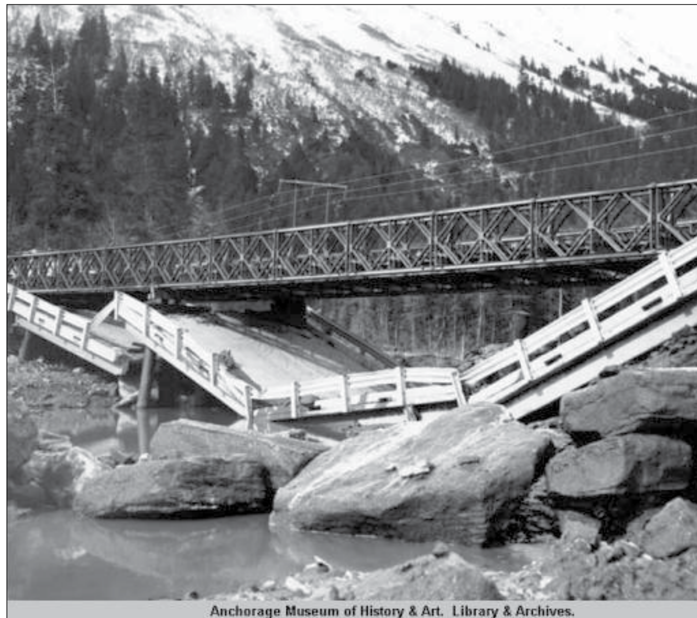
- Continued collaboration with the Alaska Board of Education and Early Development (ADEED) regarding its new capital improvement project application form that specifically addresses seismic issues. Schools can now apply for funds that specifically identify seismic hazards, and mitigate seismic risk via investigation, design and special construction inspections for any major project involving a school facility.
- Continued working with ADEED to prioritize identification of schools at greatest seismic risk.
- Coordinated meetings with other state seismic hazard safety professionals, including Professor Christine Theodoropoulos, Dean of Architecture, University of Oregon, and Professor Orson Smith, Interim Dean of Engineering, University of Alaska Anchorage (UAA). The meeting may result in using UAA undergraduate and graduate students to perform FEMA's Rapid Visual Screenings to identify at-risk schools in Alaska. This approach was successfully implemented in Oregon, ultimately resulting in millions of dollars being dedicated to mitigating earthquake hazards for hundreds of structures. See: http://www.oregongeology.com/sub/projects/rvs/default.htm
- Invited Alaska's Parent–Teacher Association (PTA) to the ASHSC's September Face-to-Face meeting, which resulted in an agreement via Janice Crutchfield, PTA Advocacy Chair, to begin working as partners to reduce school seismic risk, especially for those in high seismic regions.
- After participating on an Applied Technology Council (ATC) Project Review Panel, Laura Kelly, School Committee Chair, developed and delivered a PowerPoint presentation to provide basic training and overview of current and proposed changes for ATC-71-4, Update of Rapid Visual Screening Guidelines (FEMA 154). Presentation is available on ASHSC website.

Schools Committee Plan for 2013:

- Continue working with ADEED to identify existing at-risk school structures, and prioritize seismic mitigation.
- Maintain and foster relationships with other organizations and commissions involved with improving school seismic safety, with a focus on further developing partnerships with the state PTA and UAA.
- Further review state policies and procedures related to constructing and maintaining critical facilities and infrastructure, with a focus on identifying and improving resiliency in the event of a major earthquake. On-site construction inspection remains a key concern.
- Continue seeking funding to identify and retrofit critical structures at risk of damage or collapse during a major seismic event. Estimating the cost to perform Rapid Visual Screenings (or a similar approach) has been identified as an important first step.
- Advocate for policy changes, legislation, and public outreach that mitigates earthquake risk. This includes continuing to work with the Alaska university system to systematically perform Rapid Visual Screenings of schools and other critical facilities throughout the high seismic regions of the state.
- Examine Alaska Science Education Standards and identify potential opportunities for enhancing existing curricula. Support teacher training and development of materials that address earthquake science, school preparedness, and individual safety.

Insurance Committee *(Robin McSharry, chair)*

As part of the Alaska Seismic Hazard Safety Commission's Charter, the Insurance Committee has an ongoing mission to bring awareness of issues concerning availability of earthquake insurance and its importance to Alaskans through ongoing education. The committee also provides information and resources to other members of the commission as needed throughout the year. The committee had three goals in 2012. These were:



Bridge failure

1. Continue providing basic information on the ASHSC website that is easily accessible to the public concerning earthquake exposures, insurance availability, and personal safety measures.
2. Complete an informational brochure for the public about earthquake and tsunami risks, insurance, and choice. Find venues for distributing this information.
3. Continue to work with the Division of Insurance to provide information on hazards throughout the state, steps that can mitigate those hazards, and assist as needed to attract additional carriers to the Alaska market who will provide affordable earthquake insurance to citizens throughout the state.

Insurance Committee Activities in 2012:

- The Earthquake Insurance brochure was completed and approved by the necessary stakeholders. It is published on the ASHSC website and available for downloading by any interested party. Hard copies can be published in necessary quantities upon request to DGGS.
- Continued link with the Division of Insurance to their publication: *2011 Homeowners Insurance Guide*, which includes a section on earthquake insurance. It will be updated when the Guide is updated.
- Continued work with our liaison with the Division of Insurance to deepen our relationship. Further, a staff member of the Division is now a member of the committee and is able to attend some of our commission meetings.

Additional work with other Commission members on white papers was also completed as requested on other projects throughout the year.

Insurance Committee Plan for 2013:

In 2013, the Committee's goal will be to facilitate a panel discussion between commission members and insurance professionals during the annual I-Day conference in May. This conference provides insurance education and will be an excellent opportunity to bring the commission's work to other professional individuals with a stake in earthquake safety issues.

Earthquake Scenario Committee *(Gary Carver, chair)*

An earthquake scenario is a planning tool that helps people understand earthquakes and plan for the future. Earthquake scenarios have been used successfully in several areas of the U.S. to identify weaknesses in the built environment as well as vulnerable interdependencies among utility and transportation systems that could result in multiple or cascading failures even if only one system fails. Communities, state and federal agencies, private industry, and emergency response organizations use scenarios as tools to increase public awareness, develop risk-reduction strategies, and for response and mitigation planning. The Western States Seismic Policy Council, in its adopted Policy Recommendation 09-1, recommends "…that each member state, province, and territory establish an active program to produce Earthquake Planning Scenarios for areas with high risk of earthquake losses."

Earthquake scenarios begin by defining a hypothetical but geologically realistic earthquake suitable for the purpose of the scenario. Depending on the complexity and desired results, a scenario may describe the types and severity of shaking and ground breakage likely to result; the likely impacts to facilities, including types and extent of damage to buildings according to building type and age; and disruptions to utilities and transportation systems. A scenario may also describe secondary effects such as tsunamis, fire, and toxic materials release; estimate the numbers of deaths, injuries, and dollar value of losses by building type; and estimate the long-term business losses and socioeconomic consequences. The resulting information provides the basis for planning earthquake-response exercises, prioritizing and pre-locating response resources, and developing mitigating measures for reducing vulnerability to future earthquakes.

Developing an earthquake scenario requires assembling pertinent geologic and seismologic data for a realistic event, compiling and updating building and utility system inventory information for the affected region, assigning seismic fragilities to the building stock, and assembling current data on population demographics. Loss-estimation technology such as FEMA's HAZUS software is often used to model the event, incorporating all the compiled data. The results are then documented in one or more reports and presentations to all interested groups. If done effectively, a scenario helps decision makers visualize specific impacts that are based on currently accepted scientific and engineering knowledge, providing a powerful tool for private industry, government officials, and the general public to develop effective mitigation policies and programs.

Earthquake Scenario Committee Activities in 2012:

The Earthquake Scenario committee is working on ways to promote the development of scenarios that help identify and mitigate seismic risk in Alaska. During 2012, the committee performed the following tasks:

- The Committee was successful in obtaining the Kodiak Island Borough's (KIB) commitment to work with the Commission in developing an Earthquake Planning Scenario for the affected communities.
- The Committee was successful in enlisting FEMA's assistance, at no charge to the Borough, in running HAZUS Level 2 loss estimation for the KIB.
- The Committee is currently helping to coordinate and oversee development of a scenario as described above.
- The Committee initiated an assessment of the impacts on Alaska of a major earthquake in the Pacific Northwest. Two scenario earthquakes are considered, a magnitude 9 subduction earthquake on the Cascadia Subduction Zone and a large, shallow earthquake on one of several active faults traversing Puget Sound. Completed the publication titled *Pacific Northwest Earthquakes and Potential Effects on Alaska*. The Committee assisted the Alaska Department of Homeland Security & Emergency Management in defining an earthquake scenario at Anchorage for their planned post-earthquake response exercise.

Earthquake Scenario Committee Plan for 2013:

- Completion of the KIB Earthquake Planning Scenario.
- Identify other at-risk Alaska communities that are willing to partner in the development of earthquake scenarios for their communities.
- Consider submitting proposals to the National Earthquake Hazard Reduction Program and Earthquake Engineering Research Institute for support in developing other scenarios.
- Address earthquake scenario activities identified in the ASHSC Strategic Plan.

Hazards Identification Committee *(Rich Koehler, chair)*

Seismic hazards include a number of physical phenomena generated by earthquakes that have the potential to cause damage to the state's infrastructure and compromise the safety Alaska's residents and visitors. The most common and widespread seismic hazard is strong ground motion. Surface fault rupture, seismically triggered landslides and snow avalanches, ground failure including liquefaction, ground settlement, and subsidence, and seiches and tsunamis are also significant seismic hazards in many regions of the state. Identification and characterization of seismic hazards are fundamental to developing mitigation strategies and reducing losses from earthquakes.

Hazards Identification Committee Activities in 2012:

- In 2012, members of the ASHSC Hazards Identification Committee participated in outreach efforts, collaborative research, and national conferences, and performed investigations aimed at better characterizing the locations and relative activity of tectonic faults that have potential to impact State infrastructure and public safety. Additionally, the committee published several products through the State of Alaska, Division of Geological & Geophyysical Surveys (DGGS) that contribute new information related to the identification of seismic risk in the state.
- A multi-year effort to compile a comprehensive inventory and database of active faults in the state was completed by committee chair Koehler and published by DGGS in January 2012. The database is a comprehensive inventory of active faults in the state and includes a GIS shapefile showing the locations of active faults and an attribute table outlining specific fault parameters such as age, type, and slip rate. The database is available for download at: http://www.dggs.alaska.gov/pubs/id/23944. Since its release, the database has been accessed by more than 80 members of the user community, including researchers, engineers, policy planners, and the general public.
- Committee members Koehler and Carver participated in collaborative seismic hazards projects with DGGS and the U.S. Geological Survey (USGS). DGGS was assisted in their efforts to characterize seismic hazards along the Alaska Highway corridor in east-central Alaska near Tok. A report synthesizing field investigations along previously identified faults and an assessment of their relative activity was published through DGGS (http://www.dggs.alaska.gov/pubs/id/23923). The USGS was assisted in a field study designed to evaluate the recurrence of subduction zone earthquakes and tsunami hazards in the eastern Aleutian Islands. Fieldwork was conducted on Sedanka Island near Dutch Harbor. A total of seven suspected tsunami deposits were identified in gouge cores and stream cut exposures. Analyses of samples is ongoing and expected to provide information on the timing of great earthquakes.
- The committee produced a report describing the potential economic effects on Alaska of an earthquake in the Pacific Northwest (Washington state) (http://www.dggs.alaska.gov/pubs/id/24224). In particular, potential impacts on supply lines that control Alaska's vital imports and exports including petroleum products and processed food were examined. The report concluded that it would be in the best interest of the state to initiate an economic study to evaluate the expected monetary losses associated with a future Pacific Northwest earthquake.

Alaska Native Hospital slide

- Committee chair Koehler attended the American Geophysical Union conference in San Francisco, California, and presented new information of the style of deformation associated with the Castle Mountain fault, a major structure capable of producing a large earthquake potentially damaging to Anchorage. These new results are applicable to seismic safety associated with the design and construction of a proposed natural gas pipeline from Prudhoe Bay to Anchorage, the Alaska Stand Alone Pipeline (ASAP).
- The committee met with members of the Geotechnical Advisory Commission (GAC) in Anchorage to discuss the need for data necessary to design buildings with appropriate seismic safety considerations. It was determined that strong communication between members of the GAC, the geotechnical consulting community, state agencies, and researchers is necessary to ensure that the most up-to-date earthquake knowledge is utilized in geotechnical design. Additionally, committee chair Koehler advised state agencies and consultants on current infrastructure projects including the Riley Creek bridge replacement, Point Thompson pipeline, Susitna–Watana hydroelectric dam, and Akutan geothermal projects.
- The committee participated in a tsunami operations workshop led by the Alaska Division of Homeland Security & Emergency Management (DHS&EM) in Cordova, southeastern Alaska. Committee chair Koehler gave a presentation outlining tsunami hazards from local and distant subduction zone earthquakes. Tsunami hazards from submarine and subaerial landslides and lateral spreads were also covered.
- Post-earthquake technical clearinghouse websites have become the standard platform to disseminate information, coordinate reconnaissance investigation activities, and archive perishable geologic and geotechnical data in the aftermath of a damaging earthquake. The committee produced Policy Recommendation 2012-1 and a supporting white paper to encourage the state to develop an Alaska-specific clearinghouse.

- A position statement was produced by the committee in support of ASHSC Policy Recommendation 2011-1 to encourage support of a dedicated earthquake research program. Despite recent advances in earthquake science, there remains a lack of information to accurately characterize seismic hazards in many areas of Alaska. It is the position of the Commission that an earthquake research program is necessary to better characterize active faults. This program could also help fund the writing of detailed descriptions of individual faults to accompany the Alaska fault and fold database. Committee chair Koehler participated in discussions with the State Geologist and DGGS on the possibility of submitting a multi-hazards Capitol Improvement Project (CIP) to support these goals.

Hazards Identification Committee Plan for 2013:

- In 2013, the committee plans to complete a report outlining the current state of knowledge on seismic sources in the state. This report will represent a compilation of a previous draft report completed in 2011 that described the seismic hazards within discrete regions of the state and new information assembled in 2012. Additional information that will be incorporated into the report includes summaries of seismicity solicited from the Alaska Earthquake Information Center at the University of Alaska Fairbanks for the respective regions and new fault locations based on the Alaska Quaternary fault and fold database.
- The committee will continue to encourage the administration and legislature to implement programs to fund earthquake research and establish a post-earthquake clearinghouse web site.
- To further address its goals, the Hazards Identification Committee will continue to collaborate with DGGS, USGS, university researchers, and the consulting community in efforts to identify, map, and characterize active earthquake sources.

Response and Recovery Committee *(Ann Gravier, chair)*

Response and Recovery Committee Activities in 2012:

- Provided an annual review of the seismic sections of the State Hazard Mitigation Plan goals that relate to the Seismic Safety Hazards Commission.
- Co-sponsored Post-Earthquake Safety Evaluation of Buildings training in 2012.
- Supported planning efforts for the 2014 anniversary of the 1964 Great Alaska Earthquake including training and outreach on earthquake and tsunami emergency response.
- Continued the Commission's availability for review of seismic sections of community emergency operations plans.
- Continued the Commission's availability for consultation on emergency response exercises to seismic events.
- Encouraged all Commission members to successfully complete the Incident Command System (ICS) 100 course. Achieved 90 percent by 2012.

Response and Recovery Committee Plan for 2013:

- Refine the Commission's role one month and six months following a significant seismic event in the state including draft legislation and policy recommendations that can be proposed.
- Draft a "Continuity of Operations" (COOP) plan to provide for continuing critical Commission functions in the event of an interruption of standard Commission operation.
- Develop a post-earthquake data clearinghouse process that sets in place a procedure, structure, and organization to capture—for Alaska State use—all data, photos, records, and notes produced from post-earthquake investigations conducted in Alaska following a significant seismic event.

Education, Outreach and Partnering Committee *(Buzz Scher, chair)*

The Committee continues its focus to identify opportunities and develop information pertaining to earthquake education for the Governor's office, legislators, administrative agencies, local governments, professional and industry groups, and the public.

Seward fires

Education, Outreach, and Partnering Committee Activities in 2012:

- Prepared a position paper, submitted in December to the Alaska State Board of Registration for Architects, Engineers, and Land Surveyors (AELS), recommending amendments to Alaska Administrative Code 12 AAC 36 to ensure that civil and structural engineers registered to prepare and seal designs in the state possess a basic knowledge of seismic hazards and seismic engineering. *[Commission Policy Recommendation 2011-2; Strategic Plan Objective 1, and Objective 2, Strategy d]*
- Requested the Alaska Attorney General provide an opinion regarding the extent of relief from civil liability provided under Alaska Statute Sec. 09.65.091 *(Civil liability for responding to disaster)* for trained volunteers participating in post-earthquake safety evaluations of buildings. *[Commission Policy Recommendation 2011-4; Strategic Plan Objective 3, Strategy a]*
- Drafted an informational paper for local building officials, facility owners, and engineers explaining the value and potential near-term and long-term benefits of strong motion instrumentation. *[Strategic Plan Objective 2, Strategy b]*
- Sent a letter to the Port of Anchorage recommending it establish and maintain a seismic instrumentation program as part of their routine operating systems, to help mitigate the seismic hazard at that critical facility. *[Strategic Plan Objective 2, Strategy b]*
- Sent a letter to the Knik Arm Bridge and Crossing Authority recommending it establish an independent technical advisory board to review the design process and construction documents. *[Strategic Plan Objective 1]*
- Established cooperative links with the Education Services group at the Alaska Sea Grant program, and National Earthquake Engineering Simulation (NEES). *[Strategic Plan Objective 5]*
- Merged the former Education & Outreach Committee and Partnering Committee to improve efficiency and reduce redundancy.

Education, Outreach and Partnering Committee Plan for 2013:

- Participate in the Post-Earthquake Safety Evaluation of Buildings Training Program. *[Strategic Plan Objective 3, Strategy a]*
- Resolve *Commission Policy Recommendation 2011-4*, subject to the opinion of the Alaska Attorney General regarding the extent of relief from civil liability provided under Alaska Statute Sec. 09.65.091

for trained volunteers participating in post-earthquake safety evaluations of buildings. *[Strategic Plan Objective 3, Strategy a]*

Man recovering personal goods

- Give earthquake hazard briefing presentations as requested. *[Strategic Plan Objective 4, Strategy f]*
- Develop an informative brochure that describes the Commission and its activities. *[Strategic Plan Objective 4, Strategy d]*
- Work with the University of Alaska Anchorage and the Earthquake Engineering Research Institute to arrange for the 2013 Joyner Lecturer to come to Anchorage for their presentation. *[Strategic Plan Objective 4, Strategy f]*
- Seek partnership opportunities with other agencies, organizations, and public entities. *[Strategic Plan Objective 5]*
- Work with the Alaska DMVA–DHS&EM and the Anchorage Museum to plan and prepare for an exhibition at the museum in 2014 to commemorate the 1964 Great Alaska Earthquake. *[Strategic Plan Objective 5, Strategy f]*
- Complete and distribute an informational paper for municipal building officials, facility owners, and engineers explaining the value and potential near- and long-term benefits of strong motion instrumentation. *[Strategic Plan Objective 2, Strategy b]*
- Work with the Alaska Earthquake Information Center to enhance public awareness, understanding, and use of ShakeMaps for earthquake scenario emergency response planning. *[Strategic Plan Objective 2, Strategy d, and Objectives 3 and 7]*
- Enhance the Commission's website to screen for and link to other organizations involved with earthquake mitigation. *[Strategic Plan Objective 1, Strategy c, and Objective 4, Strategy g]*

SEISMIC-RISK ISSUES BEING ADDRESSED BY THE ALASKA SEISMIC HAZARDS SAFETY COMMISSION

The following issues relating to seismic risk mitigation continue to serve as a guide to developing the path forward for the Commission and for the formation of standing committees.

1. **Assess the Structural Stability of Critical Facilities**
   Description of the Issue: Some existing critical buildings in the state may not be constructed in a manner that would withstand future earthquake and tsunami events. A specific concern is school buildings. Hospitals, clinics, and fire, rescue, and police stations across the state are also vulnerable to failure. Also at possible risk are large Federal, State and private complexes such as military bases, Coast Guard stations, airports, college campuses, harbors, power-generating stations, communication centers, water and wastewater treatment facilities, jails and detention facilities, pipelines, and highways and bridges.

Importance of the Issue: If attention is not focused on this issue before a damaging earthquake or tsunami, Alaska communities could see massive structural failure of important community facilities, resulting in human casualties, economic loss, and environmental damage. Further, Alaska's remote nature and extreme weather conditions can cause delays in response efforts and put displaced building occupants at severe risk from exposure. Adequate preparedness is imperative to timely, rapid response and recovery from a significant seismic event.

Benefits of Addressing the Issue: Some private and public entities have taken important steps to improve the seismic resistance of key facilities and infrastructure. For example, prior to constructing the Trans-Alaska Pipeline System, Alyeska hired geologists and engineers to specifically address seismic hazards. The resulting design and earthquake-resistant construction prevented the spillage of any oil during the M7.9 Denali fault earthquake of November 3, 2002. The Alaska Department of Transportation and Public Facilities is undertaking a seismic retrofit program for State-owned bridges, and is focusing on upgrading bridges that provide critical access to communities. Some boroughs and cities across the State have taken the initiative to identify and begin retrofitting seismically vulnerable school buildings and other essential facilities.

Despite the newness of most construction in Alaska and implementation of modern building codes, many buildings and key infrastructure remain vulnerable due to proximity to seismic hazards, some of which are known and others of which are poorly understood. Building codes continue to change and have been significantly upgraded in the period between 1976 and 1997. The Federal Emergency Management Agency (FEMA) and earthquake consortia such as the Cascadia Regional Earthquake Workgroup (CREW) in the Pacific Northwest have long recognized that addressing the problems prior to a catastrophic event can have benefits far into the future. However, building codes are often inadequately implemented and recommendations of advisory bodies are often ignored.

How the Commission Can/Will Address the Issue: The Commission will encourage mitigation efforts by presenting information about earthquake hazards and risk and suggesting approaches to addressing the strengthening of at-risk critical facilities. Public education must include the correct mix of information on potential damage and suggestions of effective actions to be taken.

2. **Address the Importance of Earthquake Insurance**

Description of the Issue: Catastrophic natural perils, particularly earthquakes, are unpredictable, relatively infrequent, and can be financially disastrous. Earthquake risk is especially difficult to insure against because insurers are unable to accumulate adequate reserves for such high severity, low frequency losses.

Importance of the Issue: Insurers are unwilling to provide insurance in a market where premium rates are inadequate to create the reserves necessary to pay for damages in the event of a major earthquake. This can create a severe deficiency in availability of insurance as existing insurers withdraw from the market and new insurers are unwilling to enter.

Benefits of Addressing the Issue: Improved pre-loss mitigation efforts, such as retrofitting existing structures, emergency planning to speed post-loss recovery, and actuarially sound earthquake insurance rates encourage additional insurers to enter the market. This in turn improves availability of insurance products and results in more competitive premiums.

How the Commission Can/Will Address the Issue: The Commission can encourage development of public–private partnerships that provide education and mitigate the potential impact of future events. We will examine the seismic-hazard information needs of the insurance industry and provide recommendations for improvement.

3. **Approaches to Seismic Risk Mitigation in Future Building Construction**
   Description of the Issue: Sustainable development entails maintaining environmental quality, improving a community's quality of life, and fostering social equity while maintaining a healthy economy. Therefore, sustainable development includes incorporating disaster resilience and mitigation into a community's decisions and actions. Building codes normally have a performance goal of life safety, which is considered a minimum safety level, but are typically the maximum level to which buildings are designed. Codes do not appropriately address the effects of ground failure or ground-shaking amplification, or provide guidance to designers and construction contractors.

   Importance of the Issue: Communities need to know the potential earthquake risk and impacts at a structure site and should implement appropriate standards to mitigate the identified risk so new buildings are not subjected to the effects of massive ground failure and strong ground shaking.

   Benefits of Addressing the Issue: The results of addressing the issue include more effective mitigation and assurance that countermeasures are not only adequate but the cost of implementation is not prohibitive.

Anchorage Airport control tower (USGS photo library)

How the Commission Can/Will Address the Issue: The Commission will encourage continued Federal, State, and private partnerships in updating ground failure susceptibility mapping of Anchorage, ground-shaking characterization in high-risk Alaska communities, and determination of structural response of buildings and bridges. We will work with the technical community and the construction industry to inform, educate, and work with communities to provide guidance to improve building and land-use codes.

4. **Response and Recovery Practices to Mitigate Future Seismic Risk**
   Description of the Issue: Communities don't have a good understanding of the costs and resources needed for response and recovery. First responders to a damaging earthquake in one of Alaska's major cities will be overwhelmed in the initial hours following the event. Damage to transportation systems will make movement of people and goods difficult. Demand for emergency shelter, food, and water will strain communities' resources. Disruptions to lifeline systems will complicate recovery.

   Importance of the Issue: An understanding of response and recovery issues is critical to assessing the impacts to state and local resources.

   Benefits of Addressing the Issue: Implementing effective response and recovery practices will reduce economic and social costs of recovery and will help mitigate risks from future events.

   How the Commission Can/Will Address the Issue: The Commission will promote and assist in the development and use of "earthquake planning scenarios" to define the impact of future damaging earthquakes and will communicate lessons learned from past events to provide guidance to communities on recovery planning and preparation.

5. **Hazard Identification and Public Education**
   Description of the Issue: A damaging earthquake has not affected a major population region in Alaska since 1964. The majority of the population is unaware of the consequences of a major seismic event. The 2002 Denali fault earthquake resulted in relatively minor damage to smaller rural communities but had little effect in larger communities such as Anchorage and Fairbanks. It was evident, during damage assessment evaluations after the Denali fault event, that the residents of the smaller at-risk communities had little understanding of the earthquake hazard, had not implemented measures to mitigate damage, and were unprepared to respond to the consequences of damage. It is important that the population of Alaska be aware of the earthquake hazard and be informed of the measures that can be taken to mitigate risk.

   Importance of the Issue: There is a high probability that Alaskans will experience the results of a damaging earthquake in the future. All Alaskans will be better prepared to take measures ahead of time to reduce losses and casualties and to respond to the event if they are informed of, and truly understand, the hazard and the resultant risk.

   Benefits of Addressing the Issue: An educated public has a greater potential of responding appropriately before, during, and after a damaging earthquake. Improved knowledge and public awareness of hazard and risk can change behavior and lead to more cost-effective mitigation.

How the Commission Can/Will Address the Issue: The Commission will examine the need for greater public investment in identification and assessment of earthquake hazards, and the most effective ways of communicating this information to the public. The Commission will examine and promote the concept of seismic resilience of communities, addressing reduced failure probabilities, reduced consequences of failure, and reduced time to recovery.

6. Recommended Public-Policy Goals of the Commission

a. Education
- Develop an effective public education and outreach program.
- Convey scientific and technical information from credible authorities.
- Communicate information in a manner that is understandable by the public.

b. Guidance
- Provide advice on seismic risk mitigation and recommend policies to improve preparedness.
- Recommend goals and priorities for risk mitigation to public and private sectors.
- Recommend needed research, mapping, and monitoring programs.
- Offer advice on coordinating disaster preparedness and seismic risk mitigation.

c. Assistance
- Review seismic and tsunami hazard notifications and recommend appropriate response.
- Review predictions and warnings and suggest appropriate responses.

d. Implementation
- Establish and maintain working relationships with other private and public agencies.
- Gather, analyze, and disseminate information.
- Conduct public hearings.
- Appoint committees from Commission membership and/or external advisory committees to address risk mitigation issues.
- Accept grants, contributions, and appropriations.

Seldovia post-earthquake flooding

APPENDIX A
ASHSC ENACTING LEGISLATION

Alaska Seismic Hazards Safety Commission statute

Sec. 44.37.065. Commission established; membership.

(a) The Alaska Seismic Hazards Safety Commission is established in the Department of Natural Resources. The Department of Natural Resources shall provide staff support to the commission.

(b) The commission is composed of 11 members appointed by the governor for terms of three years. A vacancy is filled for the unexpired term.

(c) The governor shall appoint to the commission

(1) a representative from the University of Alaska;

(2) three representatives, each from a local government in a separate seismically active region of the state;

(3) a representative from the Department of Natural Resources;

(4) a representative from the Department of Military and Veterans' Affairs;

(5) a representative from an appropriate federal agency;

(6) a representative of the insurance industry; and

(7) three members from members of the public who are expert in the fields of geology, seismology, hydrology, geotechnical engineering, structural engineering, emergency services, or planning.

(d) The commission shall elect annually from its members a chair and vice-chair. A majority of the commission may vote to replace an officer of the commission.

(e) Six members constitute a quorum.

(f) Members of the Alaska Seismic Hazards Safety Commission serve without compensation but are entitled to per diem and travel expenses authorized for boards and commissions under AS 39.20.180.

Sec. 44.37.067. Powers and duties.

(a) The commission shall

(1) recommend goals and priorities for seismic hazard mitigation to the public and private sectors;

(2) recommend policies to the governor and the legislature, including needed research, mapping, and monitoring programs;

(3) offer advice on coordinating disaster preparedness and seismic hazard mitigation activities of government at all levels, review the practices for recovery and reconstruction after a major earthquake, and recommend improvements to mitigate losses from similar future events;

(4) gather, analyze, and disseminate information of general interest on seismic hazard mitigation;

(5) establish and maintain necessary working relationships with other public and private agencies;

(6) review predictions and warnings issued by the federal government, research institutions, and other organizations and persons and suggest appropriate responses at the state and local levels; and

(7) review proposed seismic hazard notifications and supporting information from state agencies, evaluate possible socioeconomic consequences, recommend that the governor issue formal seismic hazard notifications when appropriate, and advise state and local agencies of appropriate responses.

(b) The commission may

(1) advise the governor and the legislature on disaster preparedness and seismic hazard mitigation and on budgets for those activities and may recommend legislation or policies to improve disaster preparedness or seismic hazard mitigation;

(2) conduct public hearings;

(3) appoint committees from its membership and appoint external advisory committees of ex-officio members; and

(4) accept grants, contributions, and appropriations from public agencies, private foundations, and individuals.

Sec. 44.37.069. Definitions.

In AS 44.37.065 - 44.37.069,

(1) "commission" means the Alaska Seismic Hazards Safety Commission;

(2) "disaster preparedness" means establishing plans and programs for responding to and distributing funds to alleviate losses from a disaster as defined in AS 26.23.900 ;

(3) "seismic hazard" means an earthquake-induced geologic condition that is a potential danger to life and property; in this paragraph, "geologic condition" includes strong ground shaking, landslide, avalanche, liquefaction, tsunami inundation, fault displacement, and subsidence;

(4) "seismic hazard mitigation" or "mitigation" mean activities that prevent or alleviate the harmful effects of seismic hazards to persons and property, including identification and evaluation of the seismic hazards, assessment of the risks, and implementation of measures to reduce potential losses before a damaging event occurs;

(5) "tsunami" means a large ocean wave produced by an earthquake, landslide, or volcanic eruption.

APPENDIX B

JANUARY 2010

ASHSC Alaska Seismic Hazards Safety Commission

Charter

Purpose

To provide a vehicle through which statewide seismic risk issues can be addressed and solutions can be proposed that will reduce life and property losses from a future damaging earthquake.

Vision

Eliminate losses from future earthquakes and tsunamis. Promote public and government awareness of Alaska's seismic hazards and seismic risk mitigation.

Mission

Make recommendations to the governor and legislature for reducing the State's vulnerability to seismic hazards. Advise the public and private sectors on approaches for mitigating earthquake and tsunami risk.

Act in an Advisory Capacity

Advise the Governor, the Legislature, and the public on Alaska's seismic hazards and risk mitigation.

Provide Information and Technical Guidance

Recommend studies, policies, and programs that will mitigate the risks associated with seismic hazards.

Recommend Educational Programs

Recommend and participate in programs that will disseminate information to government agencies and the public.

Encourage Seismic Hazards Risk Mitigation Efforts

Encourage efforts to address issues related to seismic hazards risk mitigation.

By achieving this mission, we create an opportunity to be an effective body in mitigating the potential damaging effects of major seismic events.

Core Values

- Honesty
- Integrity
- Trust
- Diligence
- Service to the State
- Responsibility for One's Own work
- Support to Other Commission Members
- Commitment to Complete Accepted Assignments
- Provide Value to Stakeholders
- Be Objective and Reasonable
- Advocate for Seismic Risk Mitigation Efforts
- Recognize Exemplary Seismic Risk Mitigation Efforts

Key Success Factors and Measures of Success

Success Factor	Measure
• Stakeholder Satisfaction	• Facilitate governor and legislature understanding of seismic risk mitigation issues; • Meet or exceed SOA expectations; • Advice is sought; • Advice is accepted; • SOA endorsement; and; • Positive feedback from staff.
• Advocate of Risk Mitigation	• Provide advocacy for seismic risk mitigation programs; • Create opportunities for seismic risk mitigation advocacy; • Become familiar with current existing programs; and • Develop stakeholder support.
• Advocate Public Outreach Programs	• Encourage social environment where seismic risk mitigation is accepted; • Examine existing programs within the State; and • Be available for public education presentations.
• Promote Development of Earthquake Scenarios	• Complete earthquake scenarios for realistic events in high-risk areas; • Use scenario results to reduce earthquake risk; and • Seek community involvement in scenario development and application of results.

Key Success Factors and Measures of Success (continued)

Success Factor	Measure
• Facilitate Partnerships for Seismic risk Reduction	• Identify potential partners to assist in addressing Commission goals; and • Involve Federal, State, Municipal, and Private sector in addressing goals.
• Critical Facilities Earthquake Risk Reduction	• Assist in prioritizing and identification and mitigation of facilities with life safety issues; • Develop work plans in collaboration with State and local agencies/governments; • Identify current legislation/programs adopted by other states/countries; • Foster contacts with proponents who have had seismic risk mitigation successes; • Identify pertinent code and construction requirements and potential limitations; and • Recommend improvements including policy changes, legislation, and public outreach.
• Earthquake Insurance in Alaska	• Review current trends and provide advice; • Review existing "white paper" and update as appropriate; and • Develop "pros and cons" brochure describing earthquake insurance issues.
• Promote Seismic Hazard Identification	• Identification and characterization of seismic risk hazards; • Definition and description of seismic risks; • Seismic risk and hazard research; and Dissemination of seismic risk and hazard information to State and local governments, the public, and industry and scientific and professional community.

APPENDIX C

STRATEGIC PLAN

Alaska Seismic Hazards Safety Commission

Last updated: February 2013

Prepared by

ASHSC Alaska Seismic Hazards Safety Commission

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Table of Contents

Executive Summary

Alaska has more earthquakes than any other region of the United States and is, in fact, one of the most seismically active areas of the world. Recent disastrous earthquakes in Haiti, Chili, Japan, New Zealand and other areas of the world remind us of the need to be prepared for the next damaging seismic event in our area. Scientists cannot predict when a damaging earthquake may affect a metropolitan area but they can say, with some certainty, that a future event will affect one of our population centers. The mission of the Alaska Seismic Hazards Safety Commission (ASHSC) is to make recommendations to the Governor and Legislature for reducing the State's vulnerability to seismic hazards and to advise the public and private sectors on approaches for mitigating earthquake and tsunami risk.

This Strategic Plan has been developed to guide the ASHSC in their efforts to address seismic risk mitigation issues. The plan is dynamic and is intended to be monitored over time and modified as experience is gained and additional information is obtained. Several strategies identified in the Plan can be addressed and solved quickly while other strategies will take time, perhaps years, to totally resolve. The ultimate goals of the ASHSC are directed to providing advice that will result in developing an earthquake-resilient society, one that can recover relatively quickly after a damaging seismic event.

The Strategic Plan begins with an introductory section that describes the history and status of the Commission and addresses the earthquake risk in Alaska. Supporting earthquake statistics are also given to further support the need to address the risk. Current Commission membership is also presented in this section.

The next section of the Plan describes the Charter that has governed ASHSC activities from its inception. The Charter states the purpose, vision, mission, and core values that were developed when the commission was initially formed.

The final section of the Plan addresses seven strategic objectives for earthquake safety and risk mitigation and provides strategies for accomplishing these objectives. Each strategy includes a priority designation, target date, and measure of success.

Readers should recognize that successful seismic-safety advocacy takes time to introduce to the public and decision-makers. Repeated efforts are necessary to make the case that earthquakes are truly a threat and that cost-effective actions can be taken to mitigate risk. The ASHSC is committed to assuring policy makers that effective steps can be taken before a damaging earthquake occurs, risks can be greatly reduced, and solutions are affordable.

1.0 Introduction

The Alaska Seismic Hazards Safety Commission (ASHSC) developed this Strategic Plan to address concerns raised in a "sunset review" by the Alaska State Legislative Budget and Audit Committee and their June 15, 2011, report on the Commission's activities. The Audit Committee's concluded that the "ASHSC termination date should be extended until June 30, 2016" and that the ASHSC was "operating in the public's interest". This Strategic Plan has been prepared in response to Recommendation No. 1 of the audit report.

The Alaska Seismic Hazards Safety Commission ("the Commission") is charged by statute (AS 44.37.067; Appendix A) to recommend goals and priorities for seismic hazard mitigation to the public and private sectors; recommend policies to the governor and the legislature, including needed research, mapping, and monitoring programs; review the practices for recovery and reconstruction after a major earthquake; recommend improvements to mitigate losses from similar future events; and to gather, analyze, and disseminate information of general interest on seismic hazard mitigation, among other duties to reduce the state's vulnerability to earthquakes. The Commission consists of eleven members appointed by the Governor from the public and private sectors for three-year terms. It is administered by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS).

Commission members include: A representative from the University of Alaska, three representatives from local government; a representative from the Department of Natural Resources; a representative of the Department of Homeland Security and Emergency Management; a representative from an appropriate federal agency; a representative of the insurance industry; and three members of the public who are experts in the fields of geology, seismology, hydrology, geotechnical engineering, structural engineering, emergency services, or planning. Six members constitute a quorum. The Commission membership elects its own chair and vice-chair. There is no executive director, although DGGS provides administrative, travel, and publication support.

1.1 History and Status of the Commission

In 2002, the 22nd Alaska Legislature passed, and the Governor signed into law, House Bill 53 establishing the Alaska Seismic Hazards Safety Commission with nine members. The legislation originally placed the Commission in the Office of the Governor, but in January 2003, Governor Frank Murkowski issued Executive Order Number 105 transferring the Commission to the Department of Natural Resources. Governor Murkowski appointed the first nine members to the Commission in 2005.

In 2005, the House of Representatives passed House Bill 83 (HB 83) to extend the Commission to June 30, 2008, add tsunami risks to its purview, and provide two additional Commission positions representing local government. In 2006, the Senate passed a substitute version of HB 83 including the two additional local government positions but omitting specific mention of tsunamis in the Commission's powers and duties. The Senate bill extended the Commission through June 30, 2012. The House concurred with the Senate version and Governor Murkowski signed the bill into law at a Commission meeting on June 16, 2006. Although the revised statute does not specifically include tsunami hazards in the Commission's powers and duties, the definitions in AS 44.37.069 include tsunami inundation as a seismic hazard. Consequently the Commission addresses tsunamis in its discussions and recommendations. As a result of passage of HB 83, the Commission currently has 11 members. In 2012 the legislature passed HB 279, extending the Commission to June 30, 2014.

The Commission first met on October 28, 2005, at which time it elected a Chair and Vice Chair, listened to briefings from the California Seismic Safety Commission and various state and local agencies in Alaska with responsibilities in earthquake-risk mitigation, and began developing goals and priorities for its activities. There were twelve meetings of the Commission through December 2006, six of which were via teleconference. Since 2006, the Commission has held eight to ten meetings annually, generally all but two of which have been via teleconference.

The Commission published its first annual report to the governor and legislature on April 18, 2006, and has since published reports annually during the state legislative sessions. A Commission Web site posts basic information about its mission, earthquake risk in Alaska, meeting agendas, minutes, presentations, and appropriate links. The Web site address is: www.seismic.alaska.gov.

1.2 Earthquake Risk in Alaska

Alaska has more earthquakes than any other region of the United States and is, in fact, one of the most seismically active areas of the world. The catastrophic April 2011 moment magnitude 9.0 Tohoku Earthquake in Japan is a grim reminder of why it is important for a society to be prepared for the furies of nature. The second largest earthquake ever recorded occurred on the Prince William Sound portion of the Alaska-Aleutian megathrust in southern Alaska on March 27th, 1964, with a moment magnitude of 9.2. The largest on-land earthquake in North America in almost 150 years occurred on the Denali fault in central Alaska on November 3rd, 2002, with a magnitude of 7.9. In January through mid-November 2011, the Alaska Earthquake Information Center (AEIC) recorded 22,096 earthquakes, for an average of 2,100 monthly, including 189 events with magnitude 4.0 or greater, 36 events of magnitude 5.0 or greater and 4 events of magnitude 6.0 or greater. The largest event was a moment magnitude 7.3 in the Fox Islands area of Alaska. It is not possible to predict the time and location of the next big earthquake, but the active geology of Alaska guarantees that major, potentially damaging earthquakes will continue to occur. The risks to public safety and infrastructure from these future events can be greatly reduced through proper planning, design, and construction.

Alaska has changed significantly since the great 1964 earthquake. The population has more than doubled, but many new buildings are designed to prevent collapse during intense shaking. Some older buildings have been reinforced, and development has been discouraged in some particularly hazardous areas. However, despite these improvements development has been allowed in susceptible areas such as the Turnagain neighborhood which catastrophically failed in a landslide caused by the 1964 Great Alaska Earthquake. , Thus practices to reduce vulnerability to earthquakes and tsunamis have not been applied uniformly in regions of high risk, and future earthquakes may still cause life-threatening damage to buildings, cause items within buildings to be dangerously tossed about, and disrupt the basic utilities and critical facilities that we take for granted.

In addition to the 1964 and 2002 ruptures, there are other sources of potentially damaging earthquakes in Alaska. These include the Castle Mountain fault in lower Matanuska-Susitna valley, the Wadati-Benioff zone beneath Anchorage, the active belt of faulting and folding in northern Cook Inlet, the Fairbanks seismic zone, and the Yakataga seismic gap near Yakutat, among others. While the seismic provisions of current Alaska building codes are largely geared toward preventing collapse from the types of shaking that occurred in 1964, earthquakes on these other sources may affect structures differently, in ways that may or may not be ameliorated by the current codes.

Earthquakes of magnitudes that could cause major structural damage and injury to residents continue to occur in Alaska.

1.3 Some Earthquake Statistics for Alaska

- Eleven percent of the world’s recorded earthquakes have occurred in Alaska.
- Alaska has more frequent earthquakes than the entire rest of the United States.
- Three of the eight largest earthquakes in the world were in Alaska.
- Seven of the ten largest earthquakes in the United States were in Alaska.

Since 1900, Alaska has had an average of:

- One “great” (magnitude 8 or larger) earthquake every 13 years.
- One magnitude 7 to 8 earthquake every two years.
- Six magnitude 6 to 7 earthquakes per year.
- Fifty magnitude 5 to 6 earthquakes per year.
- Three hundred magnitude 4 to 5 earthquakes per year.
- Approximately 2,000 earthquakes recorded in Alaska each month.

Scientists have estimated where large earthquakes are most likely to occur, and the probable levels of ground shaking to be expected in the state. With this information, as well as information on soil properties and landslide potential, it is possible to estimate earthquake risks in any given area. It is also possible to estimate the potential for earthquakes to generate tsunamis, and to model the extent to which tsunamis will inundate coastal areas.

1.4 Current Commission Membership

John L. Aho	Public Member	CH2M HILL
Gary A. Carver	Public Member	Carver Geologic, Inc.
Bud Cassidy	Local Government	Kodiak Island Borough
Mark Delozier	Local Government	Kenai Peninsula Borough
Ann Gravier	Alaska Department of Military & Veterans Affairs	Alaska Div. of Homeland Sec. & Emergency Mgmt.
Laura W. Kelly	Federal Agency	U.S. Coast Guard
Richard D. Koehler	Vice-Chair Alaska Department of Natural Resources	Division of Geological and Geophysical Surveys
Robin McSharry	Insurance Industry	State Farm Insurance Co.
David E. Miller	Local Government	City and Borough of Sitka
Robert L. (Buzz) Scher	Chair, Public Member	R&M Consultants, Inc.
Mike West	University of Alaska Representative	Geophysical Institute

2.0 Commission Charter

2.1 Purpose

To provide a vehicle through which statewide seismic risk issues can be addressed and solutions can be proposed that will reduce life and property losses from a future damaging earthquake.

2.2 Vision

Eliminate losses from future earthquakes and tsunamis. Promote public and government awareness of Alaska's seismic hazards and seismic risk mitigation.

2.3 Mission

Make recommendations to the governor and legislature for reducing the State's vulnerability to seismic hazards. Advise the public and private sectors on approaches for mitigating earthquake and tsunami risk.

Act in an Advisory Capacity
Advise the Governor, the Legislature, and the public on Alaska's seismic hazards and risk mitigation.

Provide Information and Technical Guidance
Recommend studies, policies, and programs that will mitigate the risks associated with seismic hazards.

Recommend Educational Programs
Recommend and participate in programs that will disseminate information to government agencies and the public.

Encourage Seismic Hazards Risk Mitigation Efforts
Encourage efforts to address issues related to seismic hazards risk mitigation.

By achieving this mission, we create an opportunity to be an effective body in mitigating the potential damaging effects of major seismic events.

2.4 Core Values

- Honesty
- Integrity
- Trust
- Diligence
- Service to the State
- Responsibility for One's Own work
- Support to Other Commission Members
- Commitment to Complete Accepted Assignments
- Provide Value to Stakeholders
- Be Objective and Reasonable
- Advocate for Seismic Risk Mitigation Efforts
- Recognize Exemplary Seismic Risk Mitigation Efforts

3.0 Strategic Objectives for Earthquake Safety and Risk Mitigation

The objectives stated below are the powers and duties assigned to the Seismic Hazards Safety Commission in the Alaska Statutes, AS 44.37.067.

3.1 Objective # 1: Recommend Goals and Priorities for Seismic Hazards Mitigation to Public and Private Sectors

3.1.1 Strategies

a. Develop a directory of speakers with expertise in seismic risk mitigation issues and make it available on our website for use by interested groups.

Priority: Important
Target Date: 2013
Measure of Success: A directory is made available on the ASHSC website.

b. Work with the Alaska State Board of Education and Early Development to develop requirements specific to safe seismic design and construction of public schools.

Priority: Very Important
Target Date: 2015
Measure of Success: Joint development with the Board of Education and Early Development of seismic design and construction requirements for public schools. The State Board implements seismic design and construction section in the funding documents.

c. Continue to populate the ASHSC website with items of interest relating to seismic risk mitigation.

Priority: Important
Target Date: Continuing
Measure of Success: ASHSC website is up to date and contains information of interest to the public and private sectors.

d. Educate Commission members about the State of Alaska's plans to identify and retrofit "at-risk' critical structures.

Priority: Important
Target Date: 2014
Measure of Success: ASHSC has documented the State of Alaska's plans for retrofit.

3.2 Objective # 2: Recommend Policies to the Governor and Legislature Including Needed Research, Mapping, and Monitoring Progress

3.2.1 Strategies

a. Encourage, and provide advice on, continued efforts in the Identification and characterization of active faults in Alaska.

Priority: Important
Target Date: Annually
Measure of Success: ASHSC offers suggestions to the Alaska Division of Geological and Geophysical Surveys (ADGGS) and receives annual updates from them concerning this work.

b. Encourage, and provide advice on, new and existing seismic monitoring at the municipal, state, and private industry levels.

Priority: Important
Target Date: Annually
Measure of Success: ASHSC offers suggestions to the United States Geological Survey (USGS) and the universities in Anchorage and Fairbanks concerning the seismic instrumentation program(s) and receives annual updates from them concerning this work.

c. Establish a routine communication avenue to inform the Governor and the legislature of earthquake risk mitigation research activities of significance to the State.

Priority: Important
Target Date: 2014
Measure of Success: ASHSC establishes a communication avenue that provides earthquake risk mitigation research updates to the Governor and legislature.

d. Develop Policy Recommendations, with supporting documentation, to address seismic risk mitigation issues.

Priority: Important
Target Date: 2014
Measure of Success: The ASHSC develops summary white papers in support of existing Policy recommendations and develops at least one new recommendation.

3.3 Objective # 3: Offer Advice on Coordinating Disaster Preparedness and Seismic Hazards Mitigation of Government at all Levels, Review the Practices for Recovery and Reconstruction After a Major Earthquake, and Recommend Improvements to Mitigate losses From Future Similar Events

3.3.1 Strategies

a. Develop a white paper that defines the ASHSC role for the following intervals after a damaging earthquake: 1 week, 1 month, 6 months and greater.

Priority: Important
Target Date: 2014
Measure of Success: The ASHSC develops a white paper that addresses its function after a damaging seismic event.

b. Work with the Alaska Department of Homeland Security and Emergency Management (ADHS&EM) in developing, and presenting, the Postearthquake Safety Evaluation of Buildings short course.

Priority: Important
Target Date: Annually
Measure of Success: At least one 2-day course is made available annually to public and private participants.

c. ASHSC Commissioners complete the Incident Command System (ICS) 100 short course.

Priority: Important
Target Date: 2012
Measure of Success: At least 85% of the ASHSC Commissioners receive a certificate of completion for the ICS 100 course.

3.4 Objective # 4: Gather, Analyze, and Disseminate Information of General Interest on Seismic Hazards Mitigation

3.4.1 Strategies

a. Develop a periodic newsletter to be distributed to the Governor and Legislators describing ASHSC ongoing activities and current earthquake information of a public interest.

Priority: Important
Target Date: 2013

Measure of Success: A biannual newsletter is developed (2 pages front and back maximum) is developed twice a year to keep the Governor and Legislators informed of earthquake risk mitigation activities.

b. Develop a regular information update exchange with seismic commissions in other States.

Priority: Important
Target Date: 2012
Measure of Success: A regular discourse and information exchange is developed between the ASHSC and at least 3 other Commissions outside the State of Alaska.

c. Develop an insurance brochure that addresses the pros and cons of acquiring earthquake insurance.

Priority: Important
Target Date: 2012
Measure of Success: ASHSC develops an earthquake insurance brochure and provides access to it on the ASHSC website.

d. Develop a brochure that describes the ASHSC and its current and ongoing activities.

Priority: Important
Target Date: 2013
Measure of Success: ASHSC develops an ASHSC information brochure and provides access to it on the ASHSC website.

e. Investigate the potential for establishing an Alaska post-earthquake information clearing house website.

Priority: Important
Target Date: 2014
Measure of Success: Current clearing house websites are surveyed for application to Alaska and a list is developed for potential use in Alaska.

f. Deliver earthquake risk mitigation briefing presentations to the general public and to public and private agencies.

Priority: Important
Target Date: Annually
Measure of Success: At least 2 presentations are given per year.

g. Populate the ASHSC website with earthquake and tsunami information, ASHSC activities, and other information of an earthquake risk mitigation interest.

Priority: Important
Target Date: Continuing
Measure of Success: The ASHSC website is updated on a monthly basis as pertinent information is developed.

3.5 Objective # 5: Establish and Maintain Necessary Working Relationships with Other Public and Private Agencies

3.5.1 Strategies

a. Assist the Kodiak Island Borough (KIB) and the Federal Emergency Management Agency (FEMA) in developing an earthquake planning scenario for the KIB.

Priority: Very Important
Target Date: 2013
Measure of Success: An earthquake planning scenario is developed for the KIB.

b. Actively participate in meetings of the Alaska Partnership for Infrastructure Protection (APIP).

Priority: Important
Target Date: Annually
Measure of Success: 50% of the APIP meetings are attended annually by an ASHSC representative.

c. Regularly interact with the Municipality of Anchorage Geotechnical Advisory Commission (GAC) on seismic risk mitigation issues.

Priority: Important
Target Date: Annually
Measure of Success: A joint meeting is held annually? to discuss common issues and there is regular delivery of verbal reports on Commission activities.

d. Continue participation as a seismic-commission member of the Western States Seismic Policy Council (WSSPC).

Priority: Important
Target Date: Annually
Measure of Success: An annual report of ASHSC activities is published in a WSSPC publication. WSSPC meetings are attended if funding is available.

e. Identify email access to the leaders of Alaska's Local Emergency Planning Committees (LEPC) and the State Emergency Response Commission (SERC) and provide them regular updates of ASHSC activities.

Priority: Important
Target Date: Annually
Measure of Success: At least 25% of the LEPC's and the SERC are provided with ASHSC meeting minutes and the Annual Report.

f. Work with the Earthquake Engineering Research Institute (EERI) on planning for the 10th Conference on Earthquake Engineering to be held in Anchorage, Alaska in July, 2014.

Priority: Important
Target Date: 2013
Measure of Success: ASHSC provides support as requested from EERI.

g. Invite public and/or private agency speakers to present topics of Commission and public interest on seismic-safety issues at ASHSC face-to-face meetings.

Priority: Important
Target Date: Continuing
Measure of Success: At least 4 speakers give presentations at these meetings.

h. Identify a member of the legislature who is willing to be a champion for earthquake risk mitigation issues and who will offer advice to the ASHSC on presenting Policy Recommendations and draft legislation.

Priority: Important
Target Date: 2013 Legislative Session
Measure of Success: A legislative champion is identified.

3.6 Objective # 6: Review Predictions and Warnings Issued by the Federal Government, Research Institutions, Other Organizations and Persons, and Suggest Appropriate Responses at the State and Local Levels

3.6.1 Strategies

a. Develop a method to identify earthquake predictions and warnings for Alaska issued by the State, Federal government, research institutions, other organizations, or individuals and suggest appropriate responses as requested.

Priority: Somewhat Important
Target Date: 2014

Measure of Success: A method is developed to track predictions and warnings.

3.7 Review Seismic Hazard Notifications and Supporting Information From State Agencies; Evaluate Possible Socioeconomic Consequences; Recommend that the Governor Issue Formal Seismic Hazard Notifications When Appropriate; and Advise State and Local Agencies of Appropriate Responses

3.7.1 Strategies

a. Develop a white paper discussing the potential effects of a major Pacific Northwest earthquake on commerce and services in Alaska.

Priority: Important
Target Date: 2012
Measure of Success: A white paper is developed and made available on the ASHSC website.

b. Develop a white paper discussing the present state of knowledge concerning Alaska's seismic hazards.

Priority: Important
Target Date: 2014
Measure of Success: A white paper is developed and made available on the ASHSC website and/or published in a peer reviewed journal.

APPENDIX D

POLICY RECOMMENDATION SUPPORTING DOCUMENTATION

ASHSC Alaska Seismic Hazards Safety Commission

ASHSC Policy Recommendation 2010-1

IDENTIFICATION AND MITIGATION PRIORITIZATION OF SEISMICALLY VULNERABLE SCHOOL BUILDINGS

Given that schools in Alaska serve not only as educational facilities but also as gathering places for the general public, and that many are designated as emergency shelters in case of a natural disaster, the Commission recommends that the State appropriate the resources necessary to identify those school facilities most at risk from earthquakes.

Recommendation

Schools frequently are the most heavily occupied and critical structures in a community. In addition to supporting students on a daily basis throughout the school year, most Alaskan schools also serve the public in various capacities with after school hour activities. Furthermore, many school facilities are designated as emergency shelters in the case of a natural disaster. Therefore, the Alaska Seismic Hazards Safety Commission (ASHSC) recommends that the State Legislature work with Alaska Department of Education and Early Development (ADEED) to establish an active program that begins the process of identifying schools that may be vulnerable to seismic hazards and pose a potential life safety threat to their occupants. The ASHSC further suggests that structural and non-structural elements be evaluated, since both can result in injuries or death in the event of a damaging earthquake. Evaluation for potential tsunami inundation, earthquake-induced ground failure below foundations, and local landslide effects also should be considered during the process.

Because of the expense of such an undertaking, the ASHSC suggests first ranking schools based on location in areas of potentially strongest earthquake ground shaking as identified on probabilistic seismic hazards maps produced by the United States Geological Survey (USGS) for Alaska (Wesson et al., 2007). A preliminary structural vulnerability screening process could be used to further rank and prioritize those schools. The at-risk schools would then be addressed in ranked order with the most vulnerable facilities being examined first.

Prioritization

Screening and ranking schools based on age, structural and foundation types, and seismic/site hazards prior to conducting detailed structural analysis is common practice, and is discussed below. However, the cost to screen every school in the State could prove prohibitive if conducted as a single project. The ASHSC suggests prioritizing the screening of schools by regions of highest seismic hazard, first. This can be done using the most current version of the Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations maps for Alaska, as published by the International Building Code, the American Society of Civil Engineers, and the USGS.

To further assist decision-makers, the ASHSC has identified Alaska public school buildings located in the areas of highest expected ground motions, as depicted on the attached map. The ASHSC recommends that the map be used along with other building information to establish budget priorities and select schools for seismic-safety evaluation. By ranking schools by location in areas of highest expected ground accelerations, age, and construction type, a sound basis can be established for evaluation, along with a goal to further screen "X number" of buildings per year to determine whether seismic upgrades are necessary.

Implementation of Formal Screening Methodology

Once schools are prioritized, other more detailed and professionally accepted screening methodologies for preliminary identification of at-risk structures could be utilized, such as FEMA's ***Rapid Visual Screening of Buildings,*** ASCE/SEI's ***Seismic Evaluation of Existing Buildings- Tier I Screening,*** and FEMA's ***Reducing the Risks of Nonstructural Earthquake Damage.*** These methods can be used as the basis for identifying which facilities are most likely prone to major damage or collapse in the event of strong ground-shaking.

The screenings will require follow-up with detailed evaluations for schools found to be at risk, including the verification of existing site and structural conditions. Preliminary screening, however, helps prevent spending money to analyze structures that in all probability meet life-safety requirements. It also enables the ranking of the structures by the highest probability of significant structural and/or non-structural damage. Some districts may have already conducted seismic-safety screening of their facilities, in which case existing information could be used.

These methodologies have been successfully used in other states and countries with high-seismic risk. States with the greatest success thus far include Washington, Oregon, California and Utah. These states are unified through the Western States Seismic Policy Council, which firmly believes that children have the right to be safe in school buildings during earthquakes. Furthermore, communities will be heavily dependent on adequate shelter from Alaska's harsh climate following a severe seismic event. Schools are often designated as the best resource, and need to meet this requirement.

Submitted by Laura Kelly, P.E., Chair of the ASHSC Schools Committee.

ASHSC Policy Recommendation 2010-2

SEISMIC RISK MITIGATION OF FUTURE DESIGN, CONSTRUCTION, AND MAJOR RENOVATION OF SCHOOLS

The Commission recommends that all future school design, construction, and major renovations projects include monies allotted for seismic risk mitigation tasks to include:

- *Seismic design by a structural engineer proficient in the design and detailing required for engineering tasks.*
- *An independent peer review of seismic design calculations and detailing by a qualified structural engineer.*
- *On-site observation of as-constructed earthquake engineering details during construction by a qualified inspector to insure they are constructed in accordance with the contract documents.*

California's Field Act which sets the seismic safety standards for public and private schools has been a central element of the state's earthquake preparedness policy for decades. Following the 1933 Long Beach Earthquake in which 300 schools experienced minor damage, 120 major damage, and 70 were destroyed the state Legislature took action and approved the Field Act within a month of the earthquake. Since its inception Field Act-compliant schools have withstood subsequent earthquakes with negligible damage. For example, there were 636 Field Act-compliant schools sites within a 25-mile radius of the 1971 damaging M 6.8 San Fernando Earthquake epicenter, comprising 8,600 buildings with a value of over one billion dollars that suffered less than 2.7 million dollars (three-tenths of one percent) in damage. In the 1983 Coalinga and 1984 Morgan Hill, California earthquakes schools suffered very little damage. During the 1989 Loma Prieta Earthquake five schools suffered major damage but three of those were constructed prior to the Field Act and one was damaged by a freeway collapse. In the 1994 Northridge Earthquake only 24 buildings in a total of 127 schools suffered appreciable damage. The Field Act has been deemed a success by the majority of concerned citizens.

Provisions such as those proposed in PR 2010-2 provide additional safety to the students, additional costs are relatively low, and money is saved in the long run from not having major reconstruction costs after a damaging earthquake.

ASHSC Policy Recommendation 2011-1

POSITION STATEMENT IN SUPPORT OF DEVELOPMENT OF AN EARTHQUAKE RESEARCH PROGRAM

Alaska is the most seismically active State in the union, yet active fault locations and characterization are the least understood. Therefore the Commission recommends that the legislature consider means to fund appropriate State governmental agencies in their on-going efforts to characterize these faults.

Introduction
As part of the mission of the Alaska Seismic Hazards Safety Commission (ASHSC), the Hazards Identification sub-committee is responsible for assessing the locations of active faults and associated secondary hazards that can potentially cause damage to state infrastructure and compromise the safety of Alaska's residents and visitors. This position statement lends support to ASHSC's policy recommendation 2011-1 and presents justification for establishment of an earthquake research program aimed at better characterizing active faults.

Justification
Identification and characterization of seismic hazards is fundamental to developing mitigation strategies and reducing losses from earthquakes. Accurate seismic hazards assessments depend on documenting the mapped traces of active faults and conducting studies to determine slip rates and paleo-earthquake histories. Without this information, estimates on the size and frequency of future earthquakes can only be based on assumptions of earthquake mechanics and leads to inaccurate forecasting. The State of Alaska, Division of Geological & Geophysical Surveys recent release of the Quaternary fault and fold database for Alaska represents a first step in identifying the locations of active faults. However, the database contains only limited information on earthquake parameters for individual faults.

The relatively few faults on the Quaternary fault and fold map of Alaska is a troubling reality for those who study seismic hazards in the state, especially considering the state's geographical position at the edge of one of the most active plate boundaries in the world. The scarce distribution of faults illustrates the real possibility that many more faults exist but have yet to be recognized, due to the general lack of detailed studies and remote, relatively inaccessible terrain. For faults that are known, data critical to assessing seismic potential such as slip rate, slip-per-event, recurrence interval, and time since the most recent event are few to non-existent. Thus, although it is accepted that Alaska will experience large damaging earthquakes in the future, the states preparedness for earthquakes, and in particular the ability to answer the "where, when, and how big" questions commonly asked by engineers and planners are extremely compromised by the lack of appropriate information from which to determine earthquake potential and probabilities. These basic data gaps can be addressed by focused paleoseismic research, however the state currently does not have an earthquake research program or funding adequate for comprehensive evaluation of seismic hazards. The Alaska Seismic Hazards Safety Commission recommends that the state legislature appropriate funds to support fundamental paleoseismic research by implementing an earthquake research program similar to those established in other seismically active states (i.e. Utah, California, Washington, etc.).

In addition to paleoseismic studies, post-earthquake investigations following large events provide the opportunity to collect vast amounts of information related to the earthquake surface rupture process, secondary ground deformation effects, and the response of the engineered or built environment. In particular, combining observations on the distribution of slip along the fault, the amount of slip during prior events, and slip rate can provide insight into future rupture potential along a particular fault. It is critical to evaluate the effects of earthquakes before erosion and rebuilding efforts erase delicate and perishable surface features. While important in the immediate time frame, data collected in post-earthquake investigations (i.e. 1906 Great San Francisco earthquake, California) have also been shown to become increasingly more valuable as new theories and technologies are developed. Thus, timely, detailed archiving of information after an earthquake is a critical step towards reducing seismic related hazards in Alaska and elsewhere.

Recommendation
It is the recommendation of the ASHSC that post-earthquake investigations be funded as part of the state earthquake research program.

If established, information developed by an Alaska earthquake research program will have direct immediate influence on seismic hazard zone mapping, earthquake probability estimates, and earthquake planning scenarios such as those currently being conducted by the Federal Emergency Management Agency (FEMA) and the Department of Homeland Security and Emergency Management (DHS&EM). Additionally, better information on the location, frequency, and size of earthquakes will help better assess potential earthquake damage and loss estimates due to future large events.

Submitted by Dr. Rich Koehler, Chair of the ASHSC Hazards Identification Committee

ASHSC Policy Recommendation 2011-2

EARTHQUAKE ENGINEERING BASIC KNOWLEDGE REQUIREMENTS FOR PROFESSIONAL ENGINEERING LICENSURE

Being the most seismically active State, the safety of Alaska's populace and economy rely that the design and construction of infrastructure adequately considers the seismic hazard. Therefore, the Commission recommends that applicants for registration as a Professional Engineer practicing civil engineering in Alaska be required to have completed a university level or equivalent course addressing seismic hazards.

Abstract
The mission of the Alaska Seismic Hazards Safety Commission (ASHSC) and the Alaska State Board of Registration for Architects, Engineers, and Land Surveyors (AELS) share a common goal to protect the safety and welfare of the public. Alaska is the most seismically active, and one of the highest ranked of the United States in terms of seismic risk; yet the Alaska statutes and regulations do not assure that all civil engineers registered to prepare and seal designs in Alaska have demonstrated knowledge of either seismic hazards or seismic engineering; at least by virtue of prerequisite education and experience, examination, registration by comity, or continuing education. This position paper presents the ASHSC's recommendations for simple and straightforward amendments to Alaska Administrative Code 12 ACC 36[1] (hereafter, the regulations) pertaining to minimum requisites for knowledge of seismic hazards and seismic engineering by civil engineers registered to prepare and seal designs in the state.

Background & Need
Alaska experiences more earthquakes than any other region in North America. Seismographs monitored by the Alaska Earthquake Information Center[2] record 50-100 earthquakes daily, with over the past few decades on average at least one magnitude (M) 6-7 event annually, and one >M8 event about every 13 years. Further, the two major Alaska population centers, Municipality of Anchorage and Fairbanks-North Star Borough, are both situated in areas characterized by very high seismic activity. The codified[3] seismic ground motion parameters for designing buildings in Anchorage compare with those values used in Los Angeles and San Francisco. And while it is not possible to predict the time and location of the next large earthquake, the historic activity assures that major, potentially damaging earthquakes will occur in Alaska in the near future.

The Federal Emergency Management Agency (FEMA) completed a study[4] in 2008 to investigate the potential consequences, or risk, of earthquake hazard to the populace and built infrastructure (e.g. buildings, lifelines, etc.) in the United States. Based on that study: Alaska

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[1]State Board of Registration for Architects, Engineers, and Land Surveyors.
[2]http://www.aeic.alaska.edu
[3]American Society of Civil Engineers. 2010. Minimum Design Loads for Buildings and Other Structures. ASCE/SEI Standard 7-10.
[4]FEMA. 2008. HAZUS MH Estimated Annualized Earthquake Losses for the United States. FEMA 366.

was ranked second only to California in terms of the estimated annualized earthquake loss (AEL), or damage, versus the replacement value of the total infrastructure; Anchorage was the highest ranked non-California major metropolitan area in terms of AEL versus building replacement value; and, the risk along the rail belt (Anchorage to Fairbanks) compared with that in the greater Los Angeles and San Francisco metropolitan areas in terms of AEL per capita.

These attributes clearly point to the importance and need for engineers preparing and sealing civil and structural designs in Alaska to possess a basic understanding and appreciation of seismic hazards (e.g. earthquake sources and activity, earthquake-induced ground motions and ground failure, tsunamis, etc.), as well as seismic engineering (i.e. evaluation and design to mitigate seismic risk to the populace and infrastructure). However, the ASHSC believes that the current State statutes and regulations do not necessarily assure all civil engineers registered in Alaska have a basic knowledge of seismic hazards or seismic engineering; at least by virtue of prerequisite education and experience, examination, registration by comity, or continuing education. Accordingly, the Commission's 2011 report[5] to the Governor and Legislature included a policy recommendation (#2011-2) which read:

> *"Considering that Alaska is the most seismically active state, the safety of Alaska's populace and economy require that the design and construction of infrastructure adequately consider the seismic hazard. Therefore, the Commission recommends that applicants for registration as a Professional Engineer practicing civil engineering in Alaska be required to have completed a university level or equivalent course addressing seismic hazards."*

Discussion: *Alaska Statutes & Regulations*

The following summarizes the Commission's interpretation of the current Alaska Statute AS 08.48, and Alaska Administrative Code 12AAC36 (*regulations*), and why we believe these two documents do not presently assure that all professional engineers registered to prepare and seal civil and structural designs in Alaska have a demonstrated knowledge of seismic hazards or seismic engineering.

1. ***Specific "Statutes" for Seismic Knowledge of Registered Civil Engineers:*** The Alaska statutes for architects, engineers, and land surveyors (AS 08.48) do not include any direct mention of specific or inferred requirements relative to knowledge of seismic hazards or seismic engineering. Further, AS 08.48 does not even include the word 'seismic', or a synonym thereof.

2. ***Specific "Regulations" for Seismic Knowledge of Registered Civil Engineers:*** The Alaska regulations for architects, engineers, and land surveyors (12 ACC 36) include the word 'seismic', or a synonym thereof, in only three sections (specifically 060, 103, and 110). However, the 'seismic' requirements specified in each of these three sections only apply to architects, not engineers.

[5]Available at http://www.seismic.alaska.gov

Of particular example is Section 12 AAC 36.110, titled *Arctic and Seismic Requirements*, which requires that (i) all engineers and architects registering in Alaska must first complete a "board-approved" university level course in Arctic Engineering; and (ii) architects seeking registration by comity must also pass the NCARB examination on seismic forces (note that 12 AAC 36.110 does not define any specific "seismic" requirements for engineers). There is no question that understanding the effects of a cold climate on our built environment (arctic engineering) is very important to the longevity and efficiency of civil engineered designs in Alaska. However, lack of knowledge or detail for the cold region effects in civil and structural designs do not typically present an imminent risk to the health and safety of the populace. On the other hand, failure to recognize and adequately design for the seismic hazards and forces pose, without question, an immediate and often devastating risk to the populace.

3. ***"Regulations" that Possibly 'Infer' Seismic Knowledge of Registered Civil Engineers:*** The following Alaska categories of regulations may be considered to infer some degree of seismic knowledge in professional engineers; although the Commission does not believe that they necessarily apply to all civil engineers registered, or eligible for registration in the State.

   a. ***<u>Education for Registration</u>*** – The education requirements for registration of civil engineers are defined in 12 AAC 36.061; one of which is a degree from an accredited engineering school. While such schools likely offer courses pertaining to seismic hazards and seismic engineering, the regulations do not require such training, and therefore cannot be considered too infer that all registered civil engineers have any formal seismic engineering education.

   b. ***<u>Examination</u>*** – Section 12 AAC 36.100 specifies that applicants seeking registration as a professional engineer (PE) must pass the NCEES *Principals and Practices of Engineering Examination* for that branch of engineering for which the applicant is applying. The NCEES[6] examination for civil engineers was first administered in 1966, but did not include specific testing of seismic knowledge. In 2000, the NCEES exam was expanded to include five afternoon "depth" sessions, which individually address the five general sub-branches within civil engineering: structural, geotechnical, construction, transportation, and water resources and environmental. Note that only two of the five depth sessions of the NCEES exam, structural and geotechnical, address seismic hazards and seismic engineering; the other three depth sessions do not test for any seismic knowledge.

   While not referenced directly in the current Alaska regulations, NCEES also offers an examination for civil engineers intending to be registered specifically as a "structural engineer" (SE). The NCEES structural engineering exam[6] was first administered in 1985, and has always tested for knowledge of seismic-induced

[6]Personal communication, Mr. Jason Gamble, PE, NCEES, August 10, 2012.

lateral forces, but not specifically seismic hazards. However, the current State regulations do not stipulate that registered civil engineers eligible to prepare and seal structural designs in Alaska must have passed the NCEES's "structural" examination.

Therefore, inference of seismic knowledge by examination only applies to civil engineers who have both (i) passed the NCEES examination since the year 2000, and (ii) had opted to take either the geotechnical or structural depth portions of the exam.

c. ***Registration by Comity*** – Section 12 AAC 36.105 only infers that a registrant by comity has some knowledge of seismic hazards and seismic engineering if such knowledge was a requisite of their existing registration in another state. To the Commission's knowledge, California is the only state that has specific requirements for registered civil engineers that demonstrates their seismic knowledge (by virtue of their experience and passing a specific examination).

d. ***Continuing Education*** – Section 12 AAC 36.510 requires professional engineers accumulate at least 24 'professional development hours' of continuing education during the two-year period immediately preceding re-registration. Many of the continuing education opportunities directed specifically towards civil and structural engineers often include elements pertaining to seismic hazards and/or seismic engineering. However, the regulations do not stipulate that the continuing education must include training pertaining to any specific topic (other than being relevant to the engineer's field of practice). Therefore the continuing education requirement does not necessarily infer that registered civil engineers have knowledge of seismic hazards or seismic engineering.

In conclusion, the Commission believes that the current State statutes and regulations do not include any specific requirements for knowledge of seismic hazards or seismic engineering by civil engineers registered to prepare and seal designs in Alaska. Further, a presumption of such seismic knowledge could only be inferred if the engineer: (i) had voluntarily taken an academic course on the subject; (ii) had taken either the structural or geotechnical depth sessions of the NCEES civil engineering examination (which were not available to civil engineers tested prior to year 2000); (iii) was or is also a registered civil engineer in California; and/or (iv) has voluntarily taken continuing education training pertaining to the subject.

Recommendations

Based on the discussions above, the ASHSC recommends that the Alaska regulations for *professional engineers* practicing in the branches of civil and structural engineering be amended to include specific requirements to demonstrate a basic knowledge of seismic hazards and seismic engineers, by virtue of both prerequisite education or experience, and continuing education. The following summarize simple and straightforward amendments that the Commission believes would improve the regulations[7] in this regard. Note that the

[7] These recommendations would also apply, with some modification, to engineers registered in Alaska specifically as a Structural Engineer; as the Commission understands the AELS is currently considering.

commissions also believes that these amendments should not have any substantial bearing on the cost or time for civil engineers to either obtain or maintain registration in Alaska.

1. Add to the end of Section 12 AAC 36.063 (Engineering Education and Work Experience Requirements):

   (k) Engineers registering in the branches of civil engineering or structural engineering must have passed at least one course pertaining specifically to seismic hazards or seismic engineering from an ABET accredited education program; or provide satisfactory evidence to the board of seismic knowledge by virtue of work experience.

2. Add to Section 12 AAC 36.100 (Content of Examinations), Subsection (c):

   …Applicant engineers registering in the branch of civil engineering that will be involved with design of foundations, structures and bridges must take either the "structural" or "geotechnical" depth portions of the NCEES examination.

3. Add to Section 12 AAC 36.510 (Continuing Education Requirements), Subsection (g):

   (6) At least 4 of the professional development hours for registered professional engineers practicing in the branches of civil engineering or structural engineering must be related to the subjects of seismic hazards or seismic engineering.

   Note: This amendment (#3) would be the only proposed new regulation applicable to civil and structural engineers currently registered as a professional engineer in Alaska.

4. As an alternative to recommendation #1 (and possibly also #2), the scope and content of the board-approved Arctic Engineering course could be expanded to also include review of the seismic hazards in Alaska, and basic seismic engineering relative to the standard building codes adopted by the State[8]. While this alternative would certainly require the time and effort of a number of professionals to implement, the ASHSC believes it could be the most effective and efficient approach to address our concerns.

Robert L. Scher, P.E., Chair Education, Outreach & Partnering Committee

[8]Credit for this alternative belongs to Mr. Colin Maynard, PE, who originally suggested it AELS's meeting in Anchorage on August 2, 2012.

ASHSC Alaska Seismic Hazards Safety Commission

ASHSC Policy Recommendation 2011-3

IDENTIFICATION AND MITIGATION PRIORITIZATION OF SEISMICALLY VULNERABLE BUILDINGS

Perform FEMA Rapid Visual Screening of Existing Buildings to identify and prioritize all seismically vulnerable State of Alaska owned buildings. Establish a mitigation plan to reduce risk imposed by those buildings, including structural and nonstructural elements, equipment, and contents. The most essential buildings should be addressed as the highest priority.

Recommendation

Many years ago the State of Alaska developed a Request for Proposals to examine facilities for their seismic stability Therefore, the Alaska Seismic Hazards Safety Commission (ASHSC) recommends that the State Legislature work with Alaska Department of Transportation and Public Facilities (ADOT&PF) to establish an active program that begins the process of identifying State operated facilities that may be vulnerable to seismic hazards and pose a potential life safety threat to their occupants. The ASHSC further suggests that structural and non-structural elements be evaluated, since both can result in injuries or death in the event of a damaging earthquake. Evaluation for potential tsunami inundation, earthquake-induced ground failure below foundations, and local landslide effects also should be considered during the process.

Because of the expense of such an undertaking, the ASHSC suggests first ranking facilities based on location in areas of potentially strongest earthquake ground shaking as identified on probabilistic seismic hazards maps produced by the United States Geological Survey (USGS) for Alaska (Wesson et al., 2007). A preliminary structural vulnerability screening process could be used to further rank and prioritize those facilities. The at-risk facilities would then be addressed in ranked order with the most vulnerable facilities being examined first.

Prioritization

Screening and ranking facilities based on age, structural and foundation types, and seismic/site hazards prior to conducting detailed structural analysis is common practice, and is discussed below. However, the cost to screen every State operated/owned facility could prove prohibitive if conducted as a single project. The ASHSC suggests prioritizing the screening of facilities by regions of highest seismic hazard, first. This can be done using the most current version of the Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations maps for Alaska, as published by the International Building Code, the American Society of Civil Engineers, and the USGS.

Implementation of Formal Screening Methodology

Once at-risk facilities are prioritized, other more detailed and professionally accepted screening methodologies for preliminary identification of at-risk structures could be utilized, such as FEMA's ***Rapid Visual Screening of Buildings,*** ASCE/SEI's ***Seismic Evaluation of Existing Buildings- Tier I Screening,*** and FEMA's ***Reducing the Risks of Nonstructural Earthquake Damage.*** These methods can be used as the basis for identifying which facilities are most likely prone to major damage or collapse in the event of strong ground-shaking.

The screenings will require follow-up with detailed evaluations for facilities found to be at risk, including the verification of existing site and structural conditions. Preliminary screening, however, helps prevent spending money to analyze structures that in all probability meet life-safety requirements. It also enables the ranking of the structures by the highest probability of significant structural and/or non-structural damage.

ASHSC Alaska Seismic Hazards Safety Commission

ASHSC Policy Recommendation 2011-4

RELIEF FROM LIABILITY FOR QUALIFIED AND TRAINED VOLUNTEERS WHO ARE ASSIGNED TO DAMAGE ASSESSMENT TASKS

Given that the Alaska State Seismic Hazard Safety Commission (ASHSC) and the Alaska Division of Homeland Security and Emergency Management is sponsoring training for qualified individuals to serve as volunteer post earthquake safety evaluators of buildings and infrastructure, the Commission recommends that the State provide relief from liability for qualified and trained volunteers who are assigned by a jurisdiction to serve following a damaging earthquake.

Background

The Alaska Division of Homeland Security and Emergency Management (DHS&EM) and the Alaska Seismic Hazards Safety Commission[1] have jointly been presenting a course to train qualified individuals as volunteer responders to assist local, State and Federal authorities evaluate the safety of buildings and infrastructure immediately following a strong earthquake. The Commission is interested in learning the State Department of Law's opinion regarding the extent of relief from civil liability that these trained volunteers may be provided under Alaska Statute Sec. 09.65.091 (*Civil Liability for Responding to Disaster*).

In 2011 the Commission and DHS&EM partnered to present a training program to prepare qualified volunteers to conduct rapid inspections of buildings and infrastructure immediately following a damaging earthquake; following ATC-20, *Procedures for Postearthquake Safety Evaluation of Buildings*, developed for the Federal Emergency Management Agency. In the event of a damaging earthquake, these trained volunteers would be dispatched in teams by local, State or Federal authorities to help evaluate the safety of buildings and infrastructure, marking (by posting standardized color-coded placards) those structures that appear either (i) safe for immediate re-occupation, (ii) temporarily unusable, or (iii) unsafe for any re-entry; the latter two at least until more thorough evaluations can be completed.

In regards to relief from civil liability, the Commission is particularly interested if the text in part (a) of statute 09.65.091 "…or damage to any property…" is limited only to physical damage caused by the evaluator's actions, or if it also includes liability against a claim of monetary damage from loss of business or usage subject to how the building was tagged during the initial 'rapid' inspection?

The Commission requests that the State of Alaska Attorney General examine this issue an give an opinion on the liability of trained individuals assisting in earthquake damage assessment activities.

ASHSC letter to State of Alaska Attorney General.

[1] http://www.seismic.alaska.gov

ASHSC Alaska Seismic Hazards Safety Commission

ASHSC Policy Recommendation 2011-5

INVESTIGATE POTENTIAL IMPACTS AND DEVELOP CONTINGENCY PLANS TO PREPARE FOR AND MITIGATE THE POSSIBLE DETRIMENTAL EFFECTS OF A GREAT PACIFIC NORTHWEST EARTHQUAKE ON ALASKA

There is consensus amongst Federal and western state agencies and general agreement within the scientific community that the next great devastating earthquake in North American may likely occur in the Pacific Northwest region, along the Cascadia subduction zone or on a shallow Puget Sound fault. While such an earthquake would not likely cause any physical damage to Alaska's infrastructure or directly pose a safety hazard to Alaska's population, it could, however, would have a significant effect on Alaska's economy given the importance of the Pacific Northwest region to Alaska's commerce, shipping, oil exports, fishing and tourism industries, and communications. Therefore, the Commission recommends that the respective Alaska government agencies investigate potential impacts and develop contingency plans to prepare for and mitigate the possible detrimental effects of a great Pacific Northwest earthquake on Alaska.

See following paper (MP 148) for supporting information.

Alaska Division of Geological & Geophysical Surveys

MISCELLANEOUS PUBLICATION 148

PACIFIC NORTHWEST EARTHQUAKES AND POTENTIAL EFFECTS ON ALASKA

ALASKA SEISMIC HAZARDS SAFETY COMMISSION, 2012

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August 2012

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PACIFIC NORTHWEST EARTHQUAKES AND POTENTIAL EFFECTS ON ALASKA

by

ALASKA SEISMIC HAZARDS SAFETY COMMISSION, 2012

Executive Summary

Although Alaska has significant economic ties with the Pacific Northwest (PNW), the relative impacts of a destructive PNW earthquake on Alaska's economy has not yet been evaluated. The importance of this issue lies in the quantity of imports and exports that are vital to Alaska's economy and pass through the seaports and transportation infrastructure in the PNW. Potential damaging earthquakes are likely to occur along the Cascadia subduction zone and/or upper crustal faults in Puget Sound. These earthquakes will be of the size and type that caused widespread damage and economic hardship along the coast of Japan in 2011 (great subduction earthquake) and in the city of Kobe, Japan, in 2005 (large upper crustal fault earthquake). The geologic effects of PNW earthquakes on infrastructure in the PNW region have been well described in numerous scenario reports; however, these reports do not detail the far-field secondary effects, such as potential impacts on Alaska's supply lines to and from the Lower 48 and the impact on Alaska's economy. This paper provides background on PNW earthquake potential, expected damage to that region, and its potential effects on Alaska; it serves as a basis for the Alaska Seismic Hazards Safety Commission's recommendation to the Alaska Legislature and Governor's Office in 2011 for state agencies to investigate potential impacts and develop contingency plans for such an event.

Introduction

Alaska is the most seismically active state in the United States, accounting for more earthquakes than the other 49 states combined. As a result, many regions in the state are exposed to significant seismic hazards from local earthquakes. However, not all of Alaska's seismic vulnerability is the result of earthquakes originating in the state. Because of Alaska's close economic and geographic ties with the Pacific Northwest, a great earthquake on the Cascadia subduction zone and/or large, shallow earthquakes on crustal faults in Washington state's Puget Sound region (fig. 1) are expected to have significant economic and societal impacts in Alaska.

The Pacific Northwest (PNW) region, particularly Puget Sound, is the gateway to Alaska and provides transportation, commercial facilities, and services vital for Alaska's imports, exports, and tourism industries. The majority of the processed food, refined fuel, and manufactured goods consumed and used in Alaska are imported through transportation terminals in the Puget Sound area. A significant part of Alaska's natural resource exports (including oil), the underpinnings of the state's economy, pass through Pacific Northwest ports, transportation centers, and refineries. Many boats in the commercial fishing fleet that deliver ocean-caught seafood to Alaska seafood processors are based out of Washington and Oregon. Many tourists who visit the state depart from and return to airports and cruise ship terminals located in the Pacific Northwest. Long-term restoration of Alaska's supply lines from and export pathways to the Lower 48 may take many months, even years, while damaged or destroyed infrastructure in the PNW is repaired or replaced.

The geologic aspects, engineering effects, and societal impact of subduction zone and Puget Sound crustal fault earthquakes on Pacific Northwest communities have been detailed in several recent scenario studies[1,2,3,4]. However, the impacts to Alaska's economy remain unstudied. Thus, given the substantial and crucial ties between Alaska and the Pacific Northwest, this paper considers the effects of potential PNW earthquakes, and evaluates potential impacts of and vulnerabilities to such seismic events on Alaska and its citizens. It is in the best interest of the State of Alaska to develop plans and mitigation strategies to minimize such impacts on Alaska before a damaging PNW earthquake compromises the state's principal economic lifelines.

Background

The PNW coast between northern California and southern British Columbia lies along the Cascadia subduction zone, a system of major faults between the Gorda–Juan de Fuca and North American plates (fig. 1A). Research conducted over the last several decades has produced compelling evidence that the subduction zone is highly active and periodically generates great subduction earthquakes[5,6] and accompanying tsunamis similar to the 2011 Tōhoku earthquake in Japan or the 1964 Good Friday earthquake in Alaska. The Cascadia subduction zone has a long history of generating magnitude ~9 earthquakes[7] including a well-dated event on January 27, 1700[8,9]. The 312 years that have elapsed since the 1700 event is longer than some of the intervals between previous Cascadia earthquakes. Thus, based on the past performance of the subduction zone, the next great Pacific Northwest earthquake could occur at any time.

In addition to the Cascadia subduction zone, recent research has identified clear evidence of multiple past earthquakes in the recent geologic past along a number of shallow crustal faults in the Puget Sound region[10,11] (fig. 1B). These faults are active and capable of generating future powerful earthquakes that would be highly destructive to the Puget Sound area. In some cases, the time since the last major earthquake is close to the average recurrence rate, suggesting that the next earthquake could occur at any time. Several of these faults are located close to Seattle and Tacoma and others underlie the central and northern Puget Sound area in close proximity to refineries that process much of Alaska's oil.

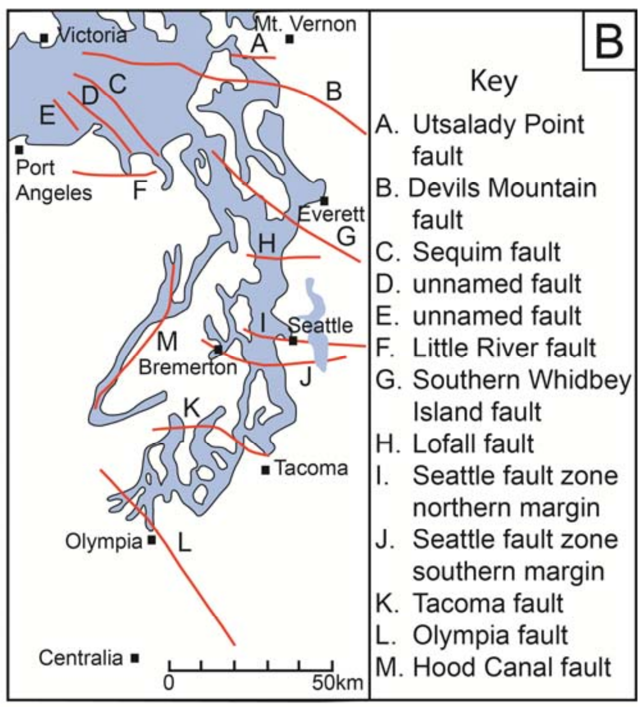

Figure 1. (A) The Cascadia Subduction Zone, stretching ~900 miles (~1,450 km) along the subduction boundary between the Juan de Fuca and North American plates offshore of the Pacific Northwest, is capable of generating great (M 9+) earthquakes. Illustration modified from CREW, 2005. (B) Active crustal faults in the Puget Sound region are capable of generating magnitude 6–7+ earthquakes. Importantly, the Seattle, Tacoma, Devils Mountain, and Utsalady faults pose significant hazards to population centers, seaports, industrial and commercial facilities critical to Alaska, and to refineries that process much of Alaska's North Slope oil.

A great Cascadia earthquake or a shallow Puget Sound earthquake has the potential to disrupt transportation and commerce between Alaska and the Lower 48 for an extended period of time. This disruption would be especially acute in the days and weeks following the earthquake when the emphasis will focus on rescue and relief efforts in areas directly affected. Especially significant in the immediate aftermath of a destructive Cascadia or Puget Sound earthquake is the potential impact on receipt in Alaska of necessary products and supplies such as food and fuel. Temporary replacement of transportation, communication, and other vital links with the Lower 48 in the near term following the earthquake will incur significant costs and cause greatly reduced efficiency, particularly if no prior planning is in place.

Effects of a major Pacific Northwest earthquake

A major earthquake of concern to Alaska is likely to occur along either or both known earthquake source zones in the PNW including:

1. **A great earthquake (Magnitude 8–9) on the Cascadia subduction zone.** This event would produce substantial damage in a broad region along the entire coastal region from northern Vancouver Island to northern California.
2. **A large earthquake (Magnitude 7–7.5) on an upper crustal fault within Puget Sound.** The direct effects of this event would be localized to the Puget Sound region.

A magnitude 9 subduction zone earthquake along the Cascadia coast, similar to the 2011 earthquake in Japan, would cause unprecedented damage over a wide region from northern California to southern Canada and generate a large tsunami that would cause catastrophic damage to low-lying coastal facilities along the entire PNW coast[1,2,3,4]. Geologic evidence clearly supports the occurrence of multiple large earthquakes in the geologic record[6] with recurrence intervals ranging between several hundred years to about a millenium[7]. Expected geologic effects from such an event will include strong, long-duration ground shaking lasting for several minutes, numerous landslides, widespread liquefaction, lateral spreads, ground failure, and tsunamis. Effects on the built environment will include fires, hazardous materials spills, power outages, disruption of transportation corridors, and damage or collapse of houses, large buildings, warehouses, and bridges. The destruction of roads, airport and port facilities, and rail lines will not only impact rescue and relief efforts but also disrupt commerce for weeks to many months. Some commercial activities will be permanently eliminated and many PNW businesses will never fully recover.

Along the coast, communities will be isolated from inland regions and each other due to damage to transportation routes by landslides, flooding in subsided low-lying areas, and collapse of bridges. Highway 101, the principal coastal highway, will be blocked in many places and not restored to full service for many weeks or months. Extensive damage is expected in low-lying coastal harbors and communities such as Long Beach and Ocean Shores in Washington, Seaside, Cannon Beach, Oceanside, Newport, Lincoln City, Florence, and North Bend–Coos Bay in Oregon, and Crescent City in California. Shoreline port facilities in Seattle, Tacoma, and the lower reaches of the Columbia River upstream as far as Portland also are highly vulnerable to a Cascadia tsunami. A magnitude 9 subduction earthquake would cause permanent land-level subsidence and result in tidal inundation of low-lying areas that were formerly above high tide along much of the coastline.

Inland U.S. Interstate 5, the main north–south highway linking the major PNW cities, will undergo bridge failures, landslides, and other earthquake-induced damage requiring weeks to months to repair. The major commercial cities of Seattle, Tacoma, Portland, and Vancouver (British Columbia) will undergo long-term power outages and disruptions of water, sewer, and natural gas service. Tall buildings, particularly vulnerable to long-period seismic shaking, and many poorly or unreinforced masonry buildings, will be extensively damaged. Soil conditions in many Puget Sound communities are susceptible to liquefaction and lateral spreads, the processes of saturated, loose, sandy soil liquefying during strong seismic shaking.

Artificially filled ground in the Duwamish River Valley at the southern end of Elliott Bay in Seattle, location of many of the city's port facilities, is particularly susceptible to liquefaction, as are many of the margins of rivers, lakes, and Puget Sound shorelines. Ground failure processes will affect many port facilities, roads, petroleum terminals, airports, manufacturing plants, and warehouses essential to the processing and export of goods and services to Alaska (fig. 2).

An earthquake along one of the many upper crustal faults in Puget Sound would have similar effects as a Cascadia event, although less severe and less widespread[3]. Damage will be focused near the epicenter of the earthquake and along the particular fault that ruptured. Local tsunami waves may inundate low-lying areas and strong ground shaking, surface fault rupture, and other secondary effects are likely to cause local destruction severe enough to disrupt transportation and commerce infrastructure. Recent moderately sized earthquakes have caused economic devastation to modern cities (such as Kobe, Japan, 1995) and underscore the importance of planning for their occurrence, specifically the interruption of the supply of goods and services to Alaska.

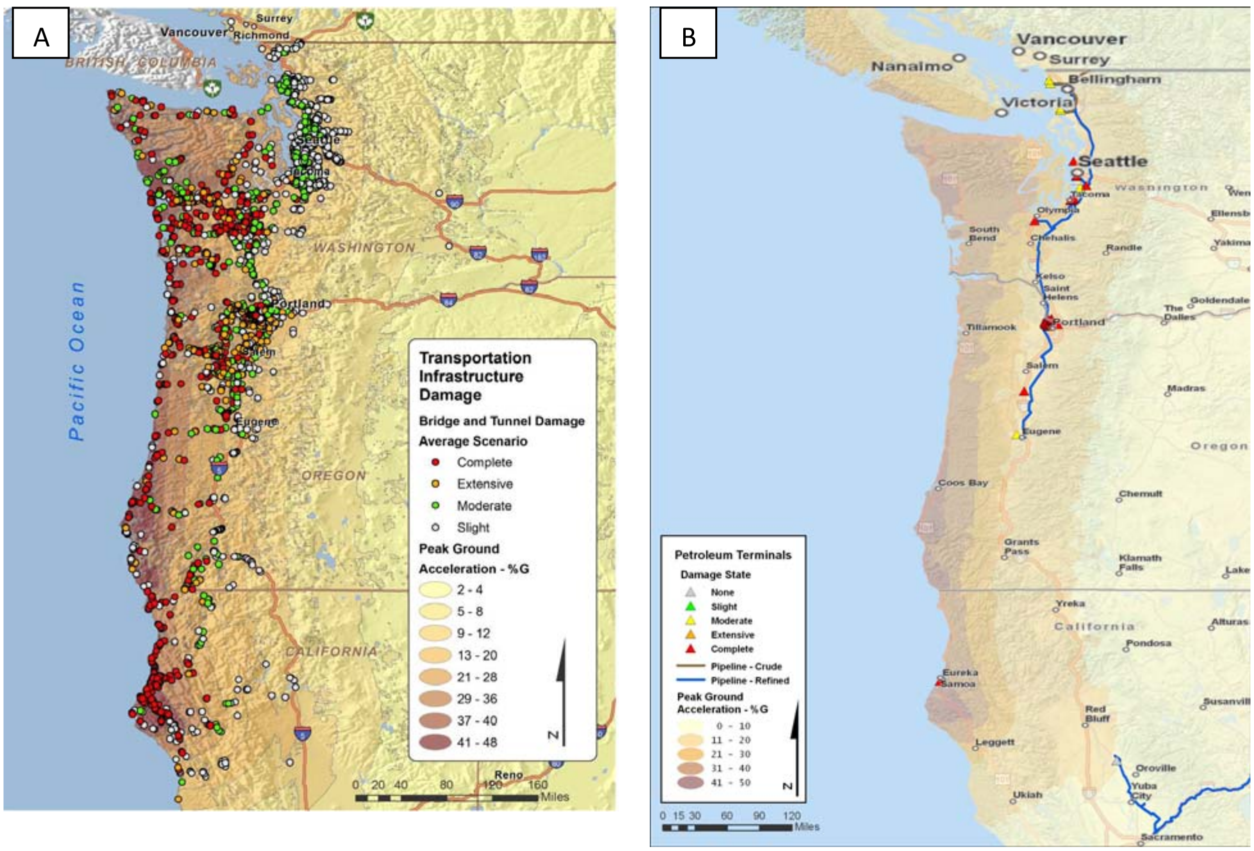

Figure 2. Potential damage estimated by HAZUS for a scenario Cascadia subduction zone earthquake. (A) Transportation infrastructure and (B) Petroleum terminals. Graphics provided by the U.S. Department of Homeland Security[4].

Potential impacts to Alaska's economy related to a Pacific Northwest earthquake

Major economic sectors that control Alaska's economic health are freight and transportation, petroleum, mining, tourism, and seafood. According to the 2009 state economic report, the overall economy GDP (gross domestic product) in Alaska was $41.7 billion[12]. Of that amount, $6.1 billion is attributed to tax and royalty payments from oil and gas, $2.9 billion from the mining industry, $3.4 billion in visitor spending associated with tourism, and $5 billion from the ex-vessel and wholesale seafood markets. The same report describes $87.9 million in timber exports, $31.9 million in agriculture industry receipts, and $14.2 billion in federal government spending (including military). The 2009 state economic report does not account for other economic and revenue-generating activities in the state, such as the 2011 construction spending forecast (without oil and gas) at $4.2 billion[13], or other private industry including transportation, medical, and general commerce.

A considerable part of Alaska's economy relies on transportation through facilities in the PNW. Much of this trade is transported to shipping ports by trucking on Interstate 5 and by rail from sources to the south and east. Damage and long-term disruption of these ports and trade routes would impair Alaska's ability to conduct business throughout the PNW. The potential impacts to several sectors of Alaska's economy due to a large earthquake in the PNW are described below.

Freight and transportation

Washington is the primary freight link for Alaska to the Lower 48 (the contiguous United States), and PNW ports and harbors provide a critical and interdependent service to the residents of Alaska. Together, the Port of Seattle and the Port of Tacoma facilities represent the third largest container load center in the United States, and Washingtons ports handle 8 percent of all U.S. exports[14]. The Port of Tacoma handles more than 70 percent of waterborne commerce between Alaska and the Continental United States[15]. Loss or compromise of services at these port facilities is highly probable in the event of a great Cascadia subduction earthquake or a large local earthquake and would have severe and immediate economic consequences not only for the Cascadia Region, but also for Alaskans who are dependent on container and air freight originating in Washington.

In addition to the port facilities, transportation facilities including ferry terminals and the associated shore-side network of roads and bridges, airports, railways and warehouses will also be impacted by a large earthquake. Transportation and utility losses create reactions up and down supply chains and can impact factory production, retailers, fishing, tourism, banking and health care sectors. Based on lessons learned in Japan (Kobe and Sendai), full economic recovery would take several years and have a multibillion-dollar effect on the economy. Many large and small businesses that serve the needs of Alaskans would be inoperable and alternative sources would have to be found. Undoubtedly, these services would eventually be obtained elsewhere, but not without long interruptions and at higher cost. Past experience with earthquakes of the size and type expected in the PNW shows lost revenue during the recovery period often exceeds the cost of repairs and replacement of damaged infrastructure.

With Pacific Northwest ports out of commission, considerable strain would be put on other transportation modes for consumer goods and commodities required to keep the state functional. Vital commodities from the Lower 48 such as gasoline, diesel, aviation fuel, food, and construction materials would diminish in variety and quantity and increase in cost. Without Pacific Northwest ports available to load barges and container ships with these commodities, the state and its consumers would rely on trucking to bring these supplies north in smaller amounts and at higher cost.

Oil

Nearly 90 percent (currently 89 percent) of the State of Alaska's operating budget is derived from oil revenues[16], hence the economic impacts on oil exports from Alaska resulting from a PNW earthquake are potentially significant. Oil exports and the supply chain to and from the West Coast are vital to the health of the state of Alaska and its citizens. Loss in oil production will likely cause financial distress for Alaska and its stakeholders.

Much of the tanker traffic carrying domestic product derived from North Slope crude is bound for destinations along the West Coast that may be damaged during a PNW earthquake, including facilities at March Point, Ferndale, Cherry Point, and Port Angeles in Puget Sound. For example, in December 2010, the average daily throughput at the Valdez, Alaska, terminal was 646,890 barrels of crude, and tanker traffic departing for ports in the Puget Sound region accounted for over half (11,832,599 barrels) of the 20,053,585 barrels offloaded[17]. Either type of PNW earthquake considered in this paper could prevent much of the product from offloading at its destination. Table 1 shows the refining capacity of Puget Sound refineries. Damage to one or all of these facilities and the resulting reduction in refining capabilities could rapidly result in storage and offloading bottlenecks in the supply chain. The total storage for North Slope crude at the Valdez terminal is about 9 million barrels[18]. Thus, at the December 2010 production rate, the storage facilities would be at maximum capacity after about 14 days. If refining facilities are not available in the aftermath of a PNW earthquake, a storage problem could result in a potential shutdown of the pipeline.

Clearly, a loss in storage or refining capability in the Puget Sound region will directly impact production of North Slope crude. Remaining processing infrastructure in operating condition could potentially be called upon to offset the lack of processing capability at damaged facilities. However, it is unlikely the surviving refining capacity will be able to process all of Alaska's crude oil exports. It will be imperative for the owners of North Slope crude to identify alternative storage and refining capabilities along the West Coast outside of the Puget Sound area to meet the demands of domestic use. The impacts to Alaska's economy of longer shipping distances and potential delivery reductions are unknown.

Table 1. Refining capacity of Puget Sound Refineries receiving Alaska crude[19].

Destination	Owner	Location	Throughput (Barrels Per Day)
March Point	Tesoro, Shell	Anacortes, WA	255,000 barrels
Cherry Point	BP	Blaine, WA	202,000 barrels
Ferndale	Conoco Phillips	Ferndale, WA	100,000 barrels

Tourism

Tourism is another major contributor to Alaska's economy. In 2010, cruise ship visitors numbered 1,026,600 persons, including passengers exiting the state by air after ending their cruise[20]. The majority of those passengers began or ended their cruises at the Ports of Vancouver and Seattle. Approximately one in ten jobs statewide depends on the travel industry[21]. Although alternate ports and airports outside of the affected regions in the Pacific Northwest are available to compensate for some of the lost transportation facilities in the affected region, these will involve longer travel distances, and increased demands on the alternate seaports and airports. How much of the increased traffic these alternate facilities can handle is not known and may not be sufficient to compensate fully for the lost capacity in the affected area. While air traffic may be more easily rerouted through alternate airports, cruise ship traffic is more specific to the PNW. Clearly the tourism industry in Alaska would be significantly impacted.

Fishing

Seafood processing is handled mainly at sea and at ports such as Dutch Harbor, Kodiak, and Southeast Alaska coastal communities[22]. To ensure freshness and quality of this resource as it is transported to market, prompt handling at PNW seaports is essential. In the event of an earthquake, damaged PNW seaports may result in reduced seafood handling capacity, and require rapid transfer to alternative handling facilities in California and elsewhere in the Pacific Rim at greater cost.

Many of the boats that commercially fish Alaska's waters are based in the PNW. The occurrence of an earthquake that generates a tsunami when these boats are berthed at home ports may result in the loss of many boats. Any reduction in the PNW-based Alaska fishing fleet would seriously impact seafood processors in many coastal communities by reducing harvest and deliveries.

Communications

A major earthquake in the PNW may disrupt communications between the Lower 48 and Alaska, especially during the immediate aftermath of the event. Communication in the affected area of the PNW will be the most seriously affected and may be out of service or disrupted for extended periods. Rerouted service may be slower and capacity reduced. Thus, communication alternatives will need to be employed to communicate with the Lower 48, including ham radio, satellite phone, cellular systems, microwave, and sea-floor fiberoptic cables. The fiberoptic system between the Lower 48 and Alaska includes cables on the ocean floor that are susceptible to breakage from submarine slope failures along the continental shelf. Repairs of the cables will depend on the number and location of cable breaks and the availability of repair ships. Although the economic impact of impaired communication after a PNW earthquake is unknown, it is thought that it will result in time delays in rerouting the supply chain for all sectors of Alaska's economy, resulting in increased costs.

Conclusions and Recommendations

A full analysis of the economic impacts across the entire spectrum of Alaska's economy is beyond the scope of this paper. The aftereffects of a PNW earthquake on the transportation, freight, oil, tourism, fishing and communication sectors of the economy described above are thought to have the largest and most direct impacts on Alaska and its citizens. Other sectors of the economy will likely suffer unknown setbacks. For example, shortages in building materials may affect the construction sector and increased fuel costs could hinder civilian and military endeavors. It is clear that a more detailed evaluation of the potential impacts on Alaska from future PNW earthquakes is necessary.

Based on the relative seismic quiescence in the PNW over the last 100 years and the mounting evidence for multiple Holocene earthquakes, it would be in the best interest of the State of Alaska to initiate an economic study to evaluate the expected monetary losses associated with disrupted PNW supply chains. A better understanding of potential losses related to PNW earthquakes will help provide the state of Alaska a basis on which to develop alternative distribution plans and mitigation strategies to minimize their impacts on Alaska.

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ASHSC Alaska Seismic Hazards Safety Commission

ASHSC Policy Recommendation 2012-1

DEVELOPMENT OF A POST-EARTHQUAKE CLEARINGHOUSE FOR ALASKA

Post-earthquake technical clearinghouse web sites have become the standard platform to disseminate information, coordinate reconnaissance investigation activities, and archive perishable geologic and geotechnical data in the aftermath of a damaging earthquake. The Commission encourages the State to develop an Alaska specific post-earthquake technical clearinghouse.

Potential development of a post-earthquake clearinghouse for Alaska

In the aftermath of major damaging earthquakes worldwide, earthquake clearinghouse web sites have served as an effective mechanism to disseminate information, document and archive earthquake effects, and coordinate various response groups. The documentation of perishable geologic, geotechnical, and engineering data is a critical component of understanding the environmental and social effects of earthquakes. These data are important for guiding rebuilding efforts, assessing the need for follow-up research, and mitigating the effects of future earthquakes. Earthquake clearinghouse web sites provide a venue for post-earthquake reconnaissance teams to post their observations, as well as serve as a semi-permanent location to disseminate information, archive measurements, photographs, and maps, and host links to other resources. At present, the State of Alaska does not have a protocol for establishing an earthquake clearinghouse or a plan to coordinate a post-earthquake reconnaissance in the event of a major damaging earthquake.

Since the initiation of the National Science Foundation's Learning from Earthquakes Program in 1973, multidisciplinary teams of researchers have been deployed to the location of damaging earthquakes to investigate earthquake effects. In 2002, the National Earthquake Hazard Reduction Program (NEHRP) and the Western States Seismic Policy Council (WSSPC) recommended that states with earthquake hazards establish a plan for post-earthquake technical clearinghouses to be activated within 24 hours of a major event. Since that time, earthquake clearinghouse web sites have been set up by the Earthquake Engineering Research Institute (EERI) for the majority of damaging earthquakes over the last several years including the 2010 Haiti, 2010 Canterbury, New Zealand, 2011 Tohoku, Japan earthquakes among others. Other similar web sites have been created by the Geo-engineering Extreme Events Reconnaissance (GEER), Universities, and government agencies. Additionally, the Group on Earth Observations has launched Geohazard Supersites to monitor and study major disasters including earthquakes, providing a rapid means to access a wide variety of data.

In preparation for a major earthquake in California, a multi-agency consortium created the California Earthquake Clearinghouse in 2010 to provide a venue where engineers, geologists, seismologists, sociologists, economists, and other professionals who arrive in the affected area can join a larger, temporary organization (the Clearinghouse). The purpose of the organization is to facilitate the gathering of information, maximize its availability, and better use the talents of those present to improve the information available to officials managing response and recovery operations. The Western States Seismic Policy Council (WSSPC) Basin and Range committee designed a clearinghouse based on the California model to create a model plan applicable to all Basin and Range Province states. The state of Utah has implemented parts of this plan and has launched a geologic hazards technical clearinghouse specific to Utah.

The State of Alaska is the most seismically active state in the U.S. The state will suffer the effects of future large magnitude earthquakes. Thus, based on the overwhelming acceptance in the earthquake community of earthquake clearinghouse web sites as the state-of-the-art in earthquake investigations, the Alaska Seismic Hazards Safety Commission recommends that the State should develop an Alaska specific post-earthquake technical clearinghouse.

Submitted by Rich Koehler, Hazards Identification Committee

APPENDIX E

EARTHQUAKE RELATED ACTIVITY IN 2012

Alaska Earthquake Information Center (AEIC) personnel continue to monitor and process data from the combined Alaska regional seismic network. See last section of this report for detailed seismicity overview. Over the past year AEIC has implemented a number of changes to the processing system at AEIC to improve performance in many ways.

This year AEIC upgraded our Antelope system to version 5.2. AEIC continued to phase out SUN workstations and replacing with MacPro computers for data analysts and field technicians, as well as for the core data processing systems. No major changes were implemented to the real time or post-processing systems. AEIC continued to work on refining their automatic earthquake detection algorithms.

AEIC continued to maintain the Anchorage Strong Motion stations through partnerships and agreements with the school district, municipality, various churches and fire departments, and now the Alaska Volcano Observatory. During this reporting period AEIC coordinated with AVO Anchorage on the upgrade of 13 K2 stations with ARRA-funded, NSMP-provided Basalts with external Episensors. Altogether, 18 out of 19 of the ARRA upgrades have been completed. AEIC continues to monitor data from all Anchorage strong motion stations and send regular reports to AVO Anchorage on state of health and maintenance needs.

AEIC continue to upgrade and expand the broadband component of their seismic network. During this reporting period AEIC personnel visited 84 seismic sites for routine maintenance, troubleshooting, or upgrades. Majority of the fieldwork was completed between May and October. In particular, three inactive short-period stations were upgraded with 3-component broadband sensors and Q330 dataloggers. Four stations with 3-component broadband and 3-component strong motion sensors were upgraded to digital telemetry with Q330 dataloggers. Four new stations were installed, three with 3-component broadband sensors and one with three-component broadband and 3-component strong motion sensors, as part of the monitoring project of the proposed hydro-electric dam site in southcentral Alaska. Additionally,AEIC reconfigured instruments and power systems at seven ARRA upgrade sites to compensate for the high power needs of the new instrumentation. They also assisted EarthScope personnel in installation of test sites in anticipation of TA projects' migration to Alaska in 2014.

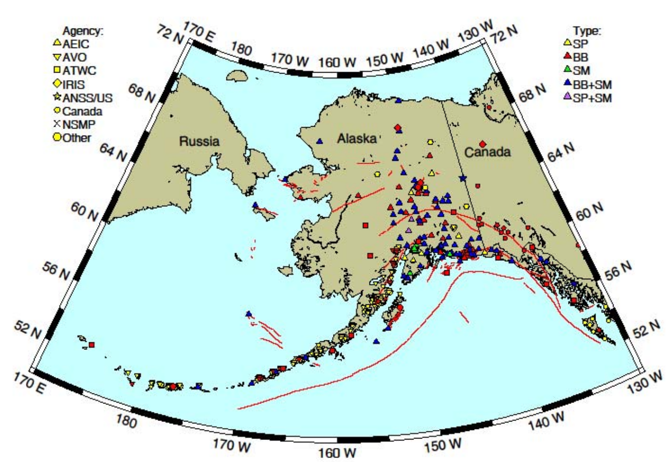


Figure 1. Map of seismic stations - Alaska Regional Seismic Network.

2. Seismicity report

From January 1, 2012 to December 31, 2012, AEIC located a total of 28,003 events within the combined regional seismic network (Figure 2). The events range in depth from 0 to 295 km, with the deepest earthquakes located in the central Aleutian arc. The magnitude range of reported events is between -0.5 and 6.2. The magnitude of completeness of the AEIC earthquake catalog for the reported time period is estimated to be 1.4 for the authoritative region and 2.5 for the Aleutians. There were 168 events with magnitude 4.0-4.9 (14 events per month on average), 15 events with magnitude 5.0-5.9 (~1 event per month on average) and 4 events with magnitude 6.0 or above. The largest earthquake (M_W 6.4) occurred on September 26, 2012 in the Andreanof Islands region of Aleutian Islands. The largest mainland earthquake of magnitude 5.8 occurred on December 4, 2012 in northern Cook Inlet region. See details in the following sections.

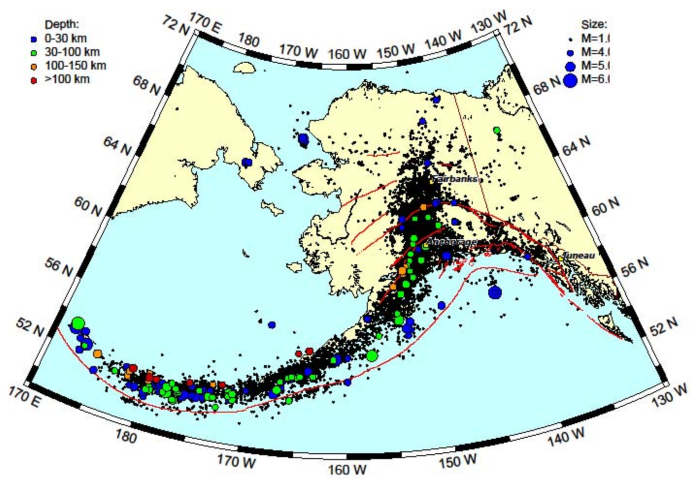
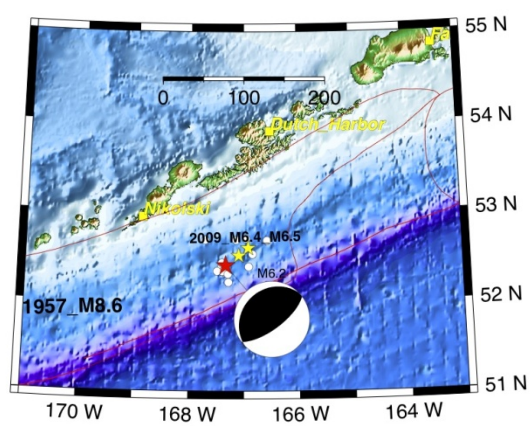


Figure 2. Earthquakes reported by AEIC: January 1 and December 31, 2012.

3. Notable Earthquakes

<u>3.1. M6.2 August 10, 2012 Fox Islands earthquake</u>

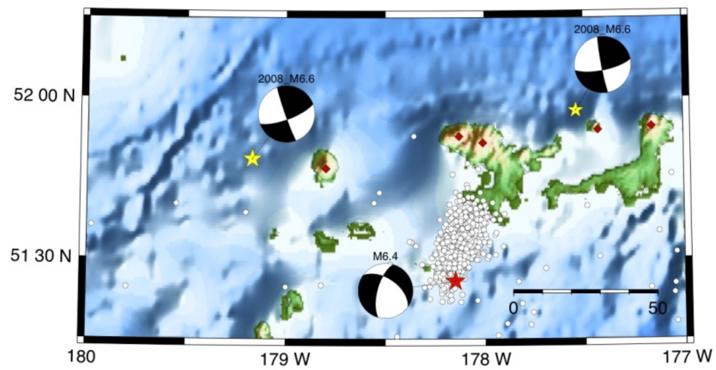
A magnitude 6.2 earthquake occurred on Friday, August 10, 2012 at 10:37 am AKDT (18:37 UTC) in the Fox Islands region of Alaska (red star on the map). It was located 114 km (71 miles) ESE of Nikolski and 169 km (106 miles) SSW of Dutch Harbor. No reports of this event being felt have been received. It was an "aftershock-poor" event, only 20 aftershocks (open circles) were located through the end of August, the largest had magnitude of 3.6.



This is the largest event to occur in the region since the magnitude 6.4 and 6.5 earthquakes on October 13, 2009 (yellow stars). The August 10 M6.2 earthquake occurred on convergent boundary between the subducting Pacific and overriding North American crustal plates. This region, where Pacific plate is being forced under the North American plate, is one of the world's most active seismic zones. In 1957, magnitude 8.6 Andreanof Islands earthquake ruptured a ~600 km-long portion of the plate boundary in the central Aleutian Islands (rupture area outlined on the map). The 2009 and 2012 earthquakes are located near eastern end of the 1957 rupture zone.

Waveform modeling indicates thrust type of faulting, consistent with the slip on the plate interface.

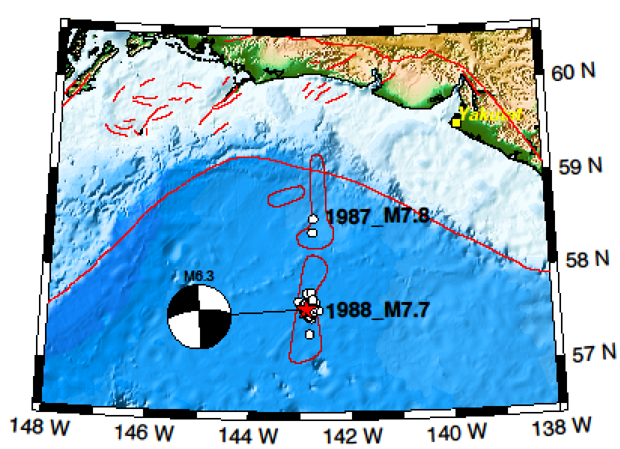
3.2. M6.4 September 26, 2012 Andreanof Islands earthquake



A magnitude 6.4 earthquake occurred on Wednesday, September 26, 2012 at 3:39 pm AKDT (18:37 UTC) in the Andreanof Islands region of Alaska (red star on the map). It was located 114 km (71 miles) WSW of Adak and 197 km (127 miles) E of Amchitka. It was felt on Adak and Atka. AEIC located nearly 900 aftershocks within the following month, with magnitudes as low as 1.0 (white circles). Seven aftershocks had magnitude 4 or greater, the largest aftershock of magnitude 4.4 occurred about 3 hours after the mainshock.

This is the largest event to occur in the area since the magnitude 6.6 earthquakes on April 15 and May 2, 2008 (yellow stars). The faulting parameters of these earthquakes estimated from the waveform inversion indicate strike-slip type of motion. Their locations, shallow and above the down-dip end of the locked interface, are consistent with the events occurring within the crust of the overriding North American plate. Similar earthquakes have occurred in the past in western and central Aleutian arc. In this region, the crust is partitioned into rotating blocks. In addition, direction of convergence between the two tectonic plates is oblique to the plate interface. The 2008 and 2012 strike-slip events manifest deformation along the Aleutian arc that accommodates relative motions of the crustal blocks and/or slip partitioning between the plate subduction and strike-slip motion.

3.3. M6.3 November 12, 2012 Gulf of Alaska earthquake



A magnitude 6.3 earthquake occurred on Monday, November 12, 2012 at 11:41 am AKDT (20:42 UTC) in the Gulf of Alaska region of Alaska (red star on the map). It was located 288 km (180 miles) SW of Yakutat and 371 km (232 miles)

SSE of Cordova. AEIC located about 110 aftershocks (open circles) within the following month, with the magnitudes ranging between 2.2 and 4.2. Due to the offshore location of this earthquake smaller aftershocks could not be detected.

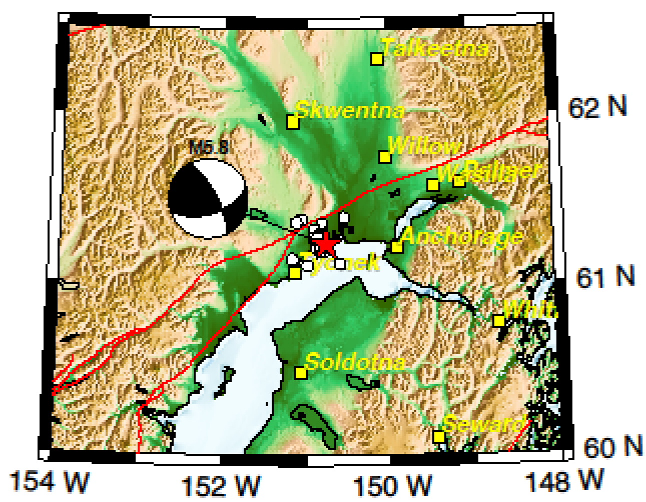
This earthquake was felt widely along the southern Alaska coast from Valdez and Cordova in the west to Sitka and Juneau in the east. Due to distant offshore location only weak intensity of felt shaking was reported.

This is the largest event to occur in the region since the magnitude 7.7 and 7.8 earthquakes in 1988 and 1987, respectively (outlines of old ruptures are shown next to the year and magnitude). The 6.3 earthquake re-ruptured portion of the 1988 fault.

Waveform modeling indicates strike-slip faulting, similar to the 1987-88 events.

3.4. M5.8 December 4, 2012 Northern Cook Inlet earthquake

A magnitude 5.8 earthquake occurred on Monday, December 3, 2012 at 4:42 pm AKST (December 4, 1:42 UTC) in the Cook Inlet region of Alaska (red star on the map). It was located 29 km (18 miles) NE of Tyonek and 44 km (27 miles) W of Anchorage. AEIC located about 110 aftershocks (open circles) within the following week, with the magnitudes ranging between 1.0 and 3.2.



This earthquake was felt strongly in southcentral Alaska, felt reports ranged from Kodiak in the south to Fairbanks in the north and Valdez in the east. Largest intensity of shaking, V - moderate, was reported in Anchorage, Willow and Cooper Landing.

This is the largest event to occur in the region since the July 28, 2011 magnitude 5.3 earthquake located about 100 km to the northwest. According to its depth (60 km) this event occurred inside the subducting Pacific plate.

Waveform modeling shows reverse faulting, indicating down-dip extension of the Pacific slab as it is being pulled into the mantle.