



NORTH AMERICAN HUMANITARIAN RESPONSE SUMMIT (NAHRS) PROJECT

SYNTHESIS REPORT

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COMMISSIONED BY THE AMERICAN RED CROSS

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Acronyms

AAL	Average Annual Loss
CAUSE	Canada and United States Resiliency Experiment
CBO	Customs and Border Patrol
CEC	Commission for Environmental Cooperation
CMP	Canada-Mexico Partnership
EAPC	Euro-Atlantic Partnership Council
EMCG	Emergency Management Consultative Group
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAR	Global Assessment Report
GEG	Global Emergency Group
HSWG	Health Security Working Group
IFRC	International Federation of Red Cross and Red Crescent Societies
IPAWS	Integrated Public Alert and Warning System
ISDR	International Strategy for Disaster Reduction
JCP	Joint Contingency Plan
MASAS	Multi-Agency Situational Awareness System
MOU	Memorandum of Understanding
NAAEC	North American Agreement on Environmental Cooperation
NACSP	North American Climate Services Partnership
NADM	North American Drought Monitor
NAHRS	North American Humanitarian Response Summit
NALS	North American Leaders' Summit
NAPAPI	North American Plan for Animal and Pandemic Influenza
NASFAO	North American Seasonal Fire Assessment and Outlook
NATO	North Atlantic Treaty Organization
NVOAD	National Voluntary Organizations Active in Disaster
PML	Probably Maximum Loss

POE	Point of Entry
SCB	Senior Coordinating Body
SCEPC	Senior Civil Emergency Planning Committee
SEMARNET	Secretaria de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources)
SOI	Statement of Intent
ToR	Terms of Reference
TTX	Tabletop Exercise
UNISDR	United Nations Office of Disaster Risk Reduction
WHO	World Health Organization

Executive Summary

This Synthesis Report provides an overview of the context within which the North American Humanitarian Response Summit (NAHRS) process will take place, simulated catastrophic disaster response scenarios that can test the collaboration that would be needed amongst the participating entities (American Red Cross, Canadian Red Cross, Mexican Red Cross and their respective government counterparts) during a catastrophic response and an analysis of the existing fora already engaged, or previously recently engaged, in efforts of relevance to NAHRS. A Policy Scan was conducted as part of the NAHRS project (summarized in the main body of the Synthesis Report) to assist in identifying those policy issues most of relevance to this process. The Policy Scan is available as part of the NAHRS project. Recommendations to support the NAHRS project are provided based on all of the available data, related findings and analysis. All combined, the Synthesis Report and Policy Scan are intended to serve as the underpinning documentation and research needed to initiate the NAHRS.

Disaster context information and proposed disaster scenarios included in this Synthesis Report are focused on understanding the realistic disaster situations that each of the three countries have faced while also identifying hypothetical disaster scenarios that would require and test cross-border international collaboration in response to a catastrophic natural disaster. Global Emergency Group (GEG) researchers focused on identifying past disaster trends and researching related large-scale catastrophic disasters that would necessitate cross-border response.¹ This research includes past disaster data² from Canada, Mexico and the USA used to identify the most significant past historical events, as well as secondary research that identifies future humanitarian events that may have the greatest impact on North America. These were then cross-referenced against the criteria of identifying a hypothetical catastrophic disaster that would necessitate cross-border international assistance. Three recommended simulation scenarios emerged from this work:

- » **Canada:** Solar flare event resulting in a widespread national power outage in the middle of winter.
- » **Mexico:** A massive eruption of the Popocatepetl volcano near Mexico City.
- » **United States of America:** An east coast tsunami resulting in widespread damage to the Eastern Seaboard.

GEG researchers continued with a literature review of fora already established related to cross-border collaboration. This review indexed relevant existing agreements in North American Emergency Assistance Compendiums. The results from this review identified a wide array of existing fora through which efforts are already being made to strengthen cross-border communication and collaboration related to disaster response. However, these efforts appear to operate independently of each other and have yet to be tested via a simulated exercise for functionality in the case of a catastrophic disaster response. Thus, there was no other initiative identified that was deemed to be duplicative of the NAHRS process. Instead, this effort demonstrated the importance of integrating existing on-going initiatives into the NAHRS process to the greatest extent possible while also recognizing the fact that there are a multitude of other fora that must be considered throughout the NAHRS process.

The American Red Cross (ARC) hired a third-party researcher to conduct a systematic Policy Scan focused on North American cross-border humanitarian response. Findings from the Policy Scan are incorporated into this Synthesis Report analysis. The Policy Scan is available as part of the NAHRS project.

Based on the data and analysis conducted several key recommendations emerged that all persons involved in the NAHRS process are encouraged to consider:

- 1 For all aspects of the review, researchers excluded contexts that involved open conflict between neighboring countries.
- 2 Researchers used the EM-DAT database to pull disaster data. EM-DAT is created and maintained by the Centre for Research on the Epidemiology of Disasters – CRED Global Health Department at the University Catholique de Louvain.

Revise and Refocus the Problem Statement - The previous summary of the problem that NAHRS seeks to address requires further definition. Specifically, that the problem statement should be redefined as follows:

There exist many different efforts (laws, legal authorities, compacts, memoranda of understanding, projects) related to strengthening cross border support during crises in North America. However, there is limited comprehensive understanding of these various efforts beyond the entities directly involved in the development and maintenance of them. This silo approach within countries and across the three countries (Canada, Mexico and the United States) combined with bureaucratic barriers will impede response efforts particularly during a catastrophic response when the rapid flow of humanitarian assistance (professional personnel, equipment and supplies) is required to save lives and reduce suffering.

Therefore, the NAHRS process should be focused on testing the functionality of the existing efforts already in place amongst the nations of North America. This testing will identify gaps, barriers and concerns related to cross-border response support during a truly catastrophic disaster scenario. Based on that common understanding amongst the NAHRS participants, next steps, outcome targets and activities will be established that build upon existing efforts, increase cross-border collaboration, breakdown bureaucratic barriers and close gaps in understanding.

Five (5) Initial Topic Areas for Focus - The following topic areas should be used to focus future NAHRS discussions and serve as primers for all future NAHRS related deliberations:

- » Determination of national requirements and triggers for accepting and facilitating international support
- » Cross border movement of professional response personnel and their equipment
- » Cross border movement of humanitarian supplies and tools
- » Licensure requirements for professional response personnel
- » Migration issues related to the movement of people from one country to another due to a disaster (either due to the threat of a disaster or following the occurrence of a disaster)

Participants and Organizers to Focus on Collaboration & Communication - There can be the tendency to focus and be fascinated by the types of catastrophic disaster scenarios that would necessitate cross-border response support. However, the fundamental purpose of the NAHRS should be to address the problem statement recommended above which can only be achieved through more effective collaboration and communication. Thus, all work done as a part of the NAHRS must focus on how best to increase collaboration and communication with less concern given to the actual disaster scenarios utilized as a part of the NAHRS process.

Frame Red Cross Role within the Wider Governmental Role – As the convening entity responsible for initiating, funding and delivering the NAHRS, it is critical the American Red Cross continue, in collaboration with the Canadian Red Cross and Mexican Red Cross, to emphasize the importance of their government counterparts engaging and helping to lead the NAHRS process. This is a unique opportunity for the Red Cross National Societies involved to more clearly analyze and understand their relationships with government response organizations, strengthen their roles as auxiliaries to their governments, reaffirm their responsibilities during catastrophic disaster responses and strengthen catastrophic disaster preparedness through humanitarian diplomacy. However, the primary responsibility for disaster response in any nation is always the nation state itself and the designated authority departments or agencies. Continuing to frame the Red Cross role within the wider context of the whole of government responses that will be needed in these types of catastrophic response is essential to the success of the NAHRS.

1. Introduction to the NAHRS Project

1.1 Objective of the Synthesis Report

This Synthesis Report serves as the strategic foundation of the North American Humanitarian Response Summit (NAHRS) process. It is based on the Project Terms of Reference (ToR), discussions with the American Red Cross, and the research efforts of Global Emergency Group (GEG) to determine the context for NAHRS and provide information on fora (efforts and events having similar objectives to the NAHRS process and goals). The Synthesis Report also includes data from a multinational Policy Scan also conducted by the American Red Cross. Thus, the Synthesis Report:

- » Elaborates on and further clarifies the NAHRS Project ToR and the Inception Report;
- » Provides a disaster contextual overview for each of the three countries involved (Canada, Mexico and the United States);
- » Identifies relevant fora related to this project; and
- » Outlines in additional detail the NAHRS meeting approach.

Approval of the Synthesis Report marks the end of the NAHRS Project Phase 2: Contextual Analysis and Synthesis Report. It includes results from an analysis of hazards and risks, mapping of existing fora, and a summary of results of the multinational Policy Scan. The project will continue with Phase 3: Design Agenda and Simulation for Initial Convening Meetings and Phase 4: Preparatory Meetings and final Summit will follow concluding with Phase 5: Recommendations and Final Reporting.

1.2 Subject of the NAHRS Project

The American Red Cross is a Congressionally Chartered, humanitarian organization that provides emergency assistance, disaster relief and education in the United States. It is a participating National Society of the International Federation of Red Cross and Red Crescent Societies (IFRC). Recently, the organization reaffirmed its commitment to disaster management leadership with the:

- » Revision of its international operations strategic direction (2016);
- » Facilitated refinement of its domestic disaster model and management (2013-2015); and
- » Prioritization of relevant, high-quality, effective and coordinated inter-American disaster responses (2015).

The American Red Cross has identified the need to further develop its readiness to respond, leveraging technology and partnerships and pursuing synergies and shared solutions between international and domestic operations. Guided by this reaffirmed focus, the organization is implementing the NAHRS Project to engage the American Red Cross, Mexican Red Cross, Canadian Red Cross and their respective governments in efforts to increase efficiencies, better align operational procedures in cross-border disaster response, and improve relevant policy and diplomatic relations.

The total project duration is expected to take approximately 16 months, and consists of numerous components including:

- » Analysis of existing fora, disaster context and multinational policy related to the goals of the NAHRS Project;
- » A high-level leadership convening event;
- » Three (3) country-level preparatory meetings; and
- » The NAHRS Summit.

At the close of the project, a final report will be prepared detailing lessons learned, outcomes, agreements and next steps for the three Red Cross Societies and their governmental partners.

1.3 Rationale for the NAHRS Project

Mexico, the United States, and Canada share both common borders and a vulnerability to significant risks. Building on mutual aid agreements, recognition of shared risks, and a dedication to maintaining readiness, the Red Cross national societies representing these three countries meet to update and coordinate response strategies and changes to mandated roles and responsibilities. The National Societies exercise cross-border response collaboration by deploying employees and volunteers with specialized skillsets to fill staffing gaps, leverage and build experience in different response domains, and ensure vulnerable populations are connected to services. In parallel, the respective governments seek to exchange and harmonize response strategies across their various domestic agencies, especially in relationship to immigration policies, national security, disease control strategies, and trade agreements.

The NAHRS Project focuses on identifying the critical gaps and barriers to effective cross-border response as well as identifying opportunities for innovation to inform and improve policy and operational concerns. This initiative provides visibility of the range of cross-border response concerns and begins to establish a clear framework with agreed priorities for further investment and development.

2. Project Overview

2.1 NAHRS Project Scope

Phases 3 and 4 of this effort begin with the initial Convening Meeting of representatives from the North American National Societies and their respective governments hosted by the American Red Cross in September 2017. A series of targeted Preparatory Meetings in each country will take place between October 2017 and January 2018. Lastly, in March 2018, the Summit will be held to consolidate learning, findings and harmonize proposals from the initial preparatory meetings.

2.1.1. Purpose of the NAHRS Project:

Engage the American Red Cross, Mexican Red Cross, Canadian Red Cross and their respective governments in efforts to increase efficiencies and better align operational procedures in cross-border disaster response, as well as improve relevant policy and diplomatic relations.

2.1.2. Goal of the NAHRS Project:

Improve the effectiveness of cross-border response to a potential catastrophic disaster in North America.

2.1.3. Objectives of the NAHRS Project:

- » Identify barriers and relevant work completed to-date.
- » Measurably improve communication, coordination, collaboration, diplomatic relations and the exchange of ideas amongst all major parties involved.
- » Identify clear and quantifiable next steps to prepare for a major catastrophic response.

2.2 NAHRS Stakeholders

The individuals and organizations seen as stakeholders, and who should therefore be invited to attend the NAHRS events must be considered. NAHRS events will include the Convening Meeting, three national Preparatory Meetings and then the Summit. Stakeholders for each meeting may vary slightly.

For the Convening Meeting and the Summit, the following stakeholders should be considered:

- » Red Cross:
- » Society leadership
- » Domestic disaster leadership
- » Domestic disaster operations
- » International leadership
- » International operations
- » Government relations
- » Those who manage the deployment of equipment and personnel internationally
- » Federal Government:
- » Emergency management leadership
- » Emergency management operations
- » State Department and equivalency
- » Customs and Border Patrol and equivalency
- » USAID/OFDA and equivalency
- » Military leadership and personnel with roles in defense support to civilian authorities
- » Health and Human Services and equivalency
- » CDC and Equivalency
- » Select State/Provincial Government Representatives
- » Representation from the Regional Emergency Management Advisory Committees for

- the US and Canada
- » Emergency management
- » Health Department
- » Other
- » International Federation of Red Cross and Red Crescent Societies (IFRC) Representatives
- » International Committee of the Red Cross (ICRC)
- » Representatives from the Emergency Management Consultative Group (US-Canada) and the Working Group on Emergency Management Cooperation (US-Mexico)
- » Other NGO Representatives
- » Private Sector (Chamber of Commerce)
- » Higher Education subject matter experts in disaster/emergency management

For the National Preparatory Meetings, based on the emphasis on national needs and requirements, the following stakeholders should be considered:

- » Red Cross:
 - » Society leadership
 - » Domestic disaster leadership
 - » Domestic disaster operations
 - » International leadership
 - » International operations
 - » Government Relations
 - » Those who manage deployment of equipment and personnel internationally
- » Federal Government:
 - » Emergency management leadership
 - » Emergency management operations
 - » State Department and equivalency
 - » Customs and Border Patrol and equivalency
 - » USAID/OFDA and equivalency
 - » Military leadership and personnel with roles in defense support to civilian authorities
 - » Health and Human Services and equivalency
 - » CDC and Equivalency
 - » Select State/Provincial Government Representatives
 - » Representation from the Regional Emergency Management Advisory Committees (For US and Canada meetings)
- » Emergency Management
- » Health Department
- » Other
- » International Federation of Red Cross and Red Crescent Societies (IFRC) Representatives
- » International Committee of the Red Cross (ICRC)
- » Private Sector

3. NAHRS Context

3.1 Disaster Research

3.1.1 Methodology

The research team's primary source for historical disaster data was the EM-DAT database¹. The database contains data on the occurrence and effects of over 22,000 disasters in the world from 1900 to the present day and is compiled from a variety of sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies. For a disaster to be entered into the database, at least one of the following criteria must be fulfilled:²

- » Ten or more people killed
- » 100 or more people reported affected
- » Declaration of a state of emergency
- » Call for international assistance

Researchers around the globe use this database, and while not perfect, it enabled GEG researchers to access data that would have been unwieldy otherwise given the time constraints of the project. Researchers also considered other comparable datasets from both the US and Canadian governments. However, the Canadian data tool was not readily searchable and the data sets for the United States (FEMA declared disasters) began in 1953 and included multiple entries for each disaster, based on multiple disaster declarations for the same event. Researchers looked for other sources, but the data varied so widely it was determined that the EM-DAT database would be the best option. Researchers understand that any database is only as good as the data included. For instance, a glaring oversight in the EM-DAT database is the inclusion of the 1918 influenza epidemic in the Canadian data but not in the US or Mexican data. Data for Mexico does not begin until 1929.

The GEG research team identified longer-term historical disaster data in order to analyze major disasters that have affected Canada, Mexico and the United States. For the purposes of this study, major disasters are defined as those scoring in the top 10 since 1900 for each country in terms of population affected, total damages, or total deaths. The full datasets are included in Annex 1. This process allowed the team to not only identify disasters that ranked in the top ten for each country in each individual category (number affected, total damages and people killed), but also to identify the disasters that ranked in the top ten across multiple categories. These historical disaster trends helped provide a baseline context for determining the NAHRS catastrophic disaster scenarios, and helped the team conceptualize the disaster types having had the largest impacts on each country.

While historic loss can help explain the past, it does not necessarily provide solid guidance for the future. The United Nations Office of Disaster Risk Reduction (UNISDR) Global Assessment Report (GAR)³ was used to look at the probabilistic risk. Probabilistic risk assessment uses mathematical models to combine any possible future hazard scenarios, information about the exposed assets and the vulnerability, to provide results of an estimate of probable loss levels in a region of interest. Unlike historical estimates, probabilistic risk assessment takes into account all disasters that can occur in the future, including very intensive losses with long return periods, and helps overcome the limitations associated with estimates derived from historical disaster loss data. Probabilistic risk assessment gives an overview of estimated losses, which can provide guidance to predict and plan for future losses. This information can be used to plan and prioritize invest-

1 EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir, www.emdat.be, Brussels, Belgium.

2 Found on Preventionweb.net, EM-DAT (Feb. 2015) - The OFDA/CRED - International Disaster Database <http://www.emdat.be> - Université catholique de Louvain Brussels – Belgium,

3 The Global Assessment Report on Disaster Risk Reduction (GAR) is a biennial global assessment of disaster risk reduction and comprehensive review and analysis of the natural hazards that are affecting humanity

ments and strategies for managing disaster risk.⁴ The GEG Research Team also reviewed country data from the ThinkHazard! online risk assessment tool.⁵

GEG researchers analyzed historical disaster data combined with projections of potential future risks for each country to support the creation of catastrophic disaster scenarios for the NAHRS preparatory events. The team used this data in conjunction with the requirement for high-impact scenarios with catastrophic outcomes that would necessitate North American cross-border response initiatives. As a result of this analysis, the team is able to recommend disaster scenarios to frame each preparatory meeting in Canada, Mexico and the United States, in support of overarching NAHRS goals.

3.1.2 Findings, Analysis and Scenario Suggestions

3.1.2.1 *Canada Findings*

A) Overview

Canada borders three oceans, stretches across six time zones, and encompasses mountains, plains, forests and tundra. It hosts weather patterns that range from Arctic to moderate, from seemingly endless rains to drought, from numbing cold to heat waves.⁶ Canada's immense size, varied climate and extensive geography expose it to numerous natural hazards. The geologic characteristics of western Canada make it susceptible to rock falls, snow avalanches, and earthquakes. Approximately 1500 earthquakes are recorded in Canada each year with potential risk to several major Canadian cities on Canada's west coast, the Ottawa-Montréal corridor, and the St. Lawrence Valley. Approximately eighty percent of Canadian disasters are due to weather and weather-related hazards such as tornadoes, hurricanes, hailstorms, blizzards, storm surges, ice storms, and floods. Hailstorms and tornadoes are recorded annually in southern Ontario, southeastern Québec, and in the Prairie provinces of Manitoba, Saskatchewan, and Alberta. Canada's Atlantic coast is susceptible to hurricanes and storm surges and severe winter storms occur frequently across parts of the country. In the summer months, high temperatures and low humidity create conditions ideal for wild fires that typically threaten rural settlements on the Prairies, in British Columbia, Ontario, and Québec. Flooding, which is Canada's most frequently occurring disaster, affects all provinces and territories with the highest frequency in Ontario, New Brunswick, Québec, and Manitoba.⁷

B) Historical

The EM-DAT database includes 131 natural disasters for Canada since 1900; 32 percent of those events have been storms (rain, tropical cyclone, convective storms); 30 percent have been floods; and 22 percent have been wildfires. As depicted in Figures 1 and 2 below, major disasters with high impact since 1900 have primarily been wildfires and hydrological hazards such as flood and storms. The Influenza Pandemic of 1918, drought and severe technological disasters have also greatly impacted the Canadian population and/or cost the country billions.

4 UNISDR (GAR) - <http://www.preventionweb.net/english/hyogo/gar/2015/en/home/> accessed from <http://www.preventionweb.net/countries/can/data/>

5 ThinkHazard! is a new web-based tool enabling non-specialists to consider the impacts of disasters on new development projects

6 <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/ntrl-hzrds/index-en.aspx>

7 Hwacha, Valeria. Canada's Approach to Disaster Mitigation accessed from <http://www.unisdr.org/2005/mdgs-drr/national-reports/Canada-report.pdf>

Figure 1:
Top 10 Canadian
Disasters by Total Affected
Population

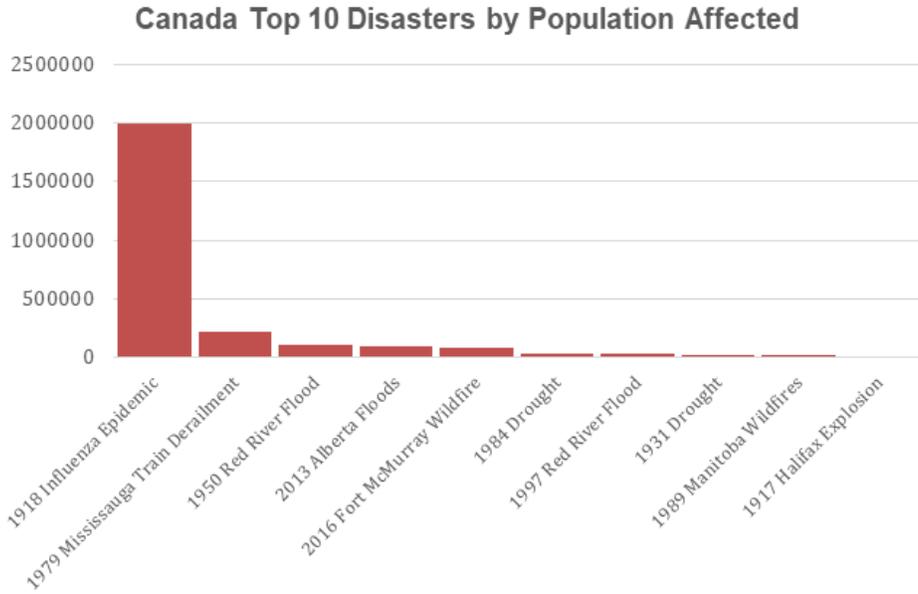
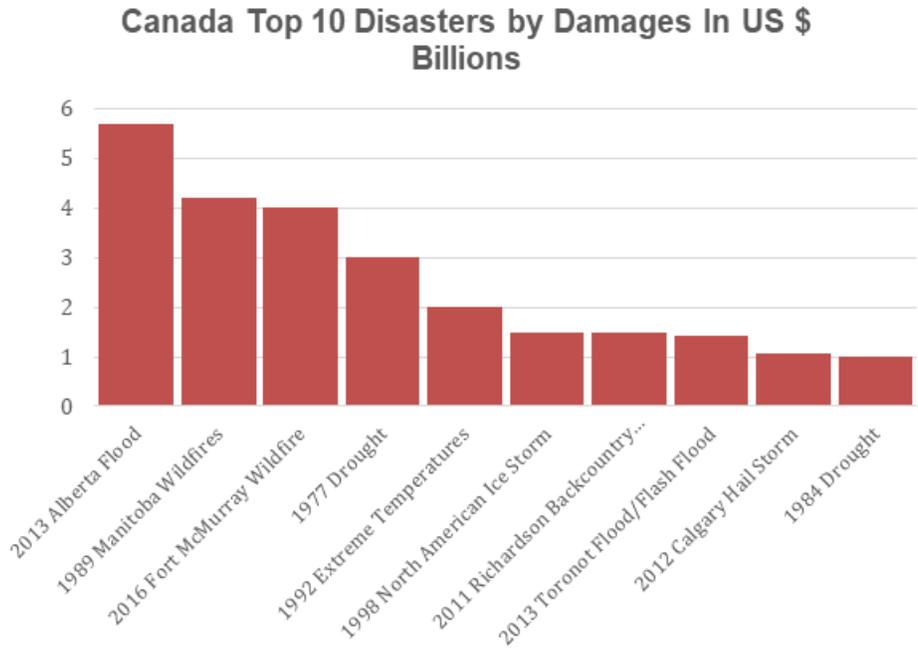


Figure 2:
Top 10 Canadian
Disasters by Total
Economic Damages

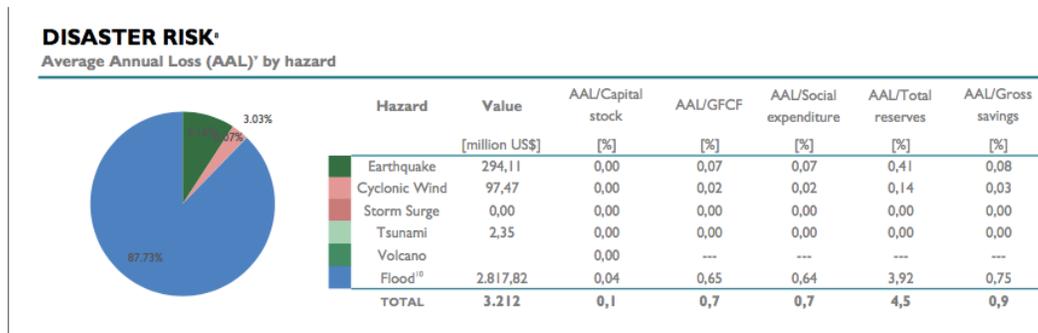


C) Future Risk

UNISDR GAR reports examine probabilistic risk order to determine the disaster types that are most likely to affect Canada in the future. The GAR report discusses Average Annual Loss (AAL), which is defined as “the expected loss per annum associated to the occurrence of future perils assuming a very long observation timeframe. It considers the damage caused on the exposed elements by small, moderate and extreme events and results a useful and robust metric for risk

ranking and comparisons.”⁸ As shown in Figure 3, floods by far pose the largest threat to Canada in terms of AAL. See Annex 2 for an overview of GAR terminology.

Figure 3:
Canadian AAL Per
Disaster Type



D) Suggested Scenario

While historical information and future predictions give a baseline understanding of the disasters that may impact Canada, there is a key issue with determining the best scenario for use in Canada. The land mass of Canada coupled with the low density of the population make it difficult for any of the hazards discussed above to present participants with an event resulting in a truly national catastrophe for which international assistance would be required. Therefore GEG determined that for the purposes of the NAHRS an even more impactful catastrophic emergency should be applied to the Canada preparatory meeting. Based on research, and conversations, GEG recommends a scenario of a solar flare event resulting in a widespread national power outage in the middle of winter for the Canada preparatory meeting. This scenario would use as its base the 1989 geomagnetic storm that caused a massive blackout in Quebec. The geomagnetic storm was itself the result of a coronal mass ejection.

i. Detailed Description

A major solar coronal mass ejection (CME), essentially a solar superstorm, erupts from the sun and travels directly towards Earth. Its estimated trajectory to Earth’s orbit is 24 hours. Upon impact, the CME generates huge electrical currents in Earth’s upper atmosphere, disabling satellites and communications equipment.

Due to the conductivity of the ground, large electrical currents get picked up by power stations and are fed into the national power grid when the CME hits the Earth’s surface. The power grid in North America is not designed to handle huge amounts of current coming from the ground.⁹ The ground currents induced by the large geomagnetic storm melt the copper wiring of a significant number of expensive extra-high voltage transformers that lie at the heart of power distribution systems. Within 12 hours, massive nation-wide power outages begin.

Because of the interconnectivity of the power grid, the effects of this outage spread rapidly. Heating and cooling systems no longer function. All lights go out, the Internet is down, electronic devices no longer work and GPS technology is cut off. In the cities and regions with electronically controlled municipal water supplies — like most modern cities — toilets and sewage treatment systems stop working, ATMs are useless and gas pumps go offline. The power plants, substations, and transmission lines for entire cities and regions are destroyed or incapacitated.

An event occurring in November, with the winter months quickly approaching, results in greater

⁸ UNISDR GAR on Disaster Risk Reduction 2015

⁹ Lloyd’s. ‘Solar Storm Risk to the North American Electric Grid’ (May 22, 2013). Atmospheric and Environmental Research (AER) pg.4

concerns for the health and safety of the populace. New transformers are needed and the estimated delivery time for replacements is likely to be a minimum of 5 months.¹⁰ Widespread panic is possible as a long-term blackout over the winter months becomes likely. Longer-term effects of the power outage include food shortages and medical shortages.

ii) Basic Characteristics

- » A solar storm is a term used for atmospheric effects felt on Earth from certain events that occur on the Sun.¹¹ It occurs when the Sun emits huge bursts of energy in the form of solar flares and coronal mass ejections. These phenomena send a stream of electrical charges and magnetic fields toward the Earth at a speed of about three million miles per hour¹².
- » Coronal Mass Ejections (CME) when the Sun flares up and shoots a giant cloud of magnetized plasma off into space. CMEs are the slowest form of solar weather, taking anywhere from 12 hours to several days to reach the Earth. They're also by far the most dangerous.
- » When CMEs hit the Earth, they can cause geomagnetic storms that disrupt satellites and electrical power grids¹³.

iii) Expected Response Needs

- » Emergency medical
- » Food
- » Shelter
- » Internally displaced person camps (in addition to shelters)
- » Water & Sanitation
- » Mental health services
- » Infrastructure repair

Figure 4:
Past Examples of
Solar Storms

Name/Location	Year	Effects
Carrington Flare or Carrington 'Event'	1859	On September 1–2, 1859, one of the largest recorded geomagnetic storms (as recorded by ground-based magnetometers) occurred. Auroras were seen around the world. Estimates of the storm strength range from -800 nT to -1750 nT. Telegraph systems all over Europe and North America failed, in some cases giving telegraph operators electric shocks. Telegraph pylons threw sparks. In June 2013, a joint venture from researchers at Lloyd's of London and Atmospheric and Environmental Research (AER) in the United States used data from the Carrington Event to estimate the current cost of a similar event to the U.S. alone at \$0.6–2.6 trillion.
Quebec	1989	The March 1989 geomagnetic storm knocked out power across large sections of Quebec.
SuperStorm, missing Earth	2012	On July 23, 2012 a "Carrington-class" solar superstorm (solar flare, coronal mass ejection, solar EMP) was observed; however, its trajectory missed Earth in orbit. Information about these observations was first shared publicly by NASA on April 28, 2014..

10 Ibid.

11 <http://wonderopolis.org/wonder/what-is-a-solar-storm>

12 <http://wonderopolis.org/wonder/what-is-a-solar-storm>

13 <http://wonderopolis.org/wonder/what-is-a-solar-storm>

3.1.2.2 Mexico Findings

A) Overview

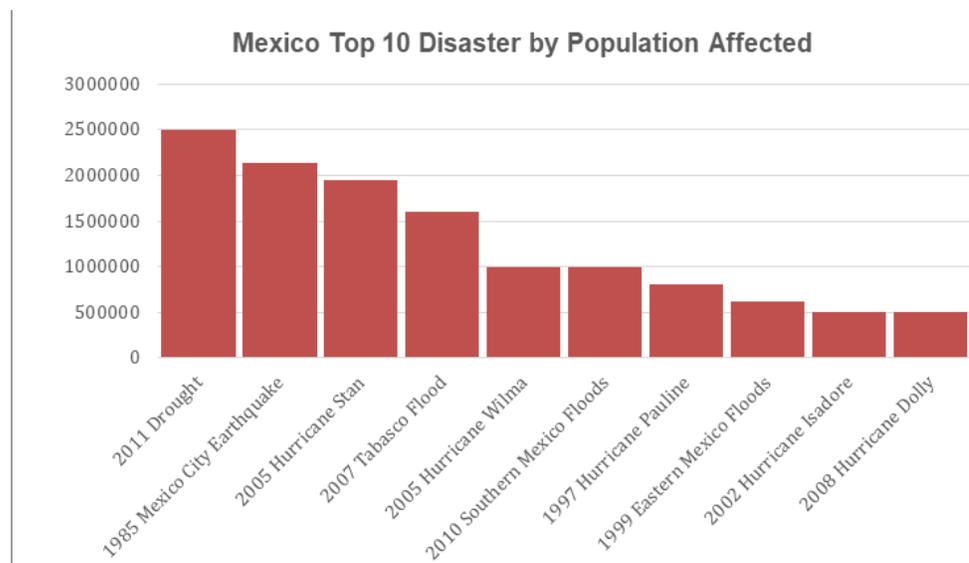
Mexico, with its diverse geography, is exposed to a variety of hazards. The country is ranked as one of the 30 most exposed countries to three or more types of natural hazards and is susceptible to earthquakes, volcanoes, tsunamis, hurricanes, wildfires, floods, landslides, and droughts. Between 1970 and 2009, approximately 60 million people were affected by natural disasters in Mexico.¹⁴

Mexico is located along the “fire belt” where 80 percent of the world’s seismic activity occurs. The country averages 90 earthquakes per year having a magnitude of 4.0 or greater on the Richter scale and is therefore ranked as one of the most seismically active countries in the world. They are also located within the Trans-Mexican Volcanic Belt, containing nine active volcanoes. Mexico City, the sixth largest urban agglomeration as of 2015, with a population of 21 million people¹⁵, sits within this belt. Tsunamis are a threat to Mexico’s Pacific Coast with most tsunamis resulting from seismic activity. Hurricanes, heavy rains and flooding occur with high frequency within Mexico affecting the Yucatan Peninsula, and the coastal regional along the Gulf of Mexico and the Pacific Ocean. Drought is prevalent in large portions of the country as are wildfires in the arid and semi-arid regions. Due to terrain and the reality of heavy rainfall, Mexico is also highly exposed to landslides, with the most prone areas being those along the southern coast of the country.¹⁶

B) Historical

The EM-DAT database includes 253 natural disasters for Mexico since 1900; 40 percent of those events have been storms (rain, tropical cyclone, convective storms); 26 percent have been floods; and 13 percent have been earthquakes. As depicted in Figures 4 and 5 below, major disasters with high impact since 1900 have primarily been hydrological hazards such as flood and storms. Although earthquakes do not happen often, the Mexico City Earthquake in 1985 is in the top 10 of historic events for population affected, damages and deaths.

Figure 5:
Top 10 Mexican Disasters
by Number of People
Directly Affected

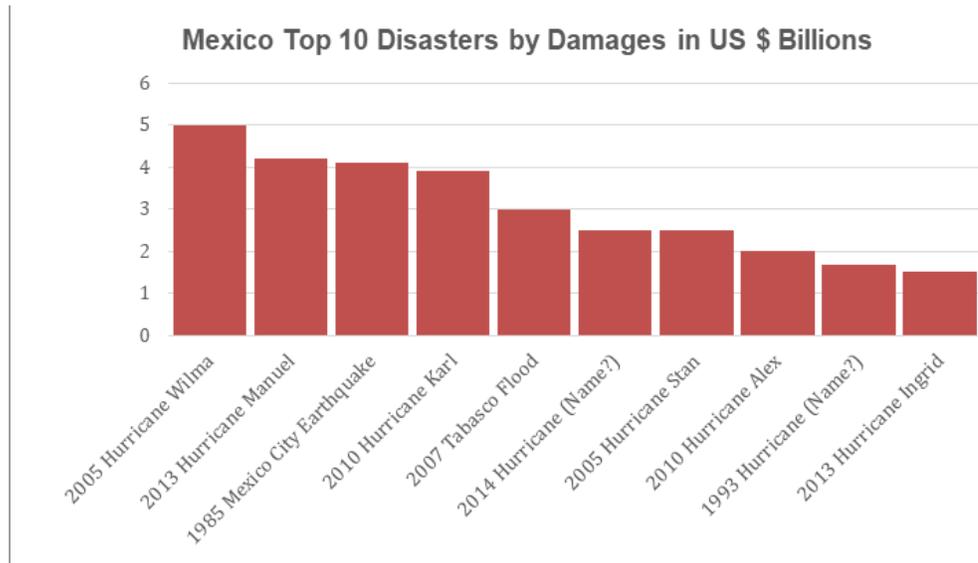


14 FONDEN: Mexico’s Natural Disaster Fund – A Review, May 2012, The World Bank Global Facility for Disaster Reduction and Recovery

15 United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, CD-ROM Edition

16 FONDEN: Mexico’s Natural Disaster Fund – A Review, May 2012, The World Bank Global Facility for Disaster Reduction and Recovery

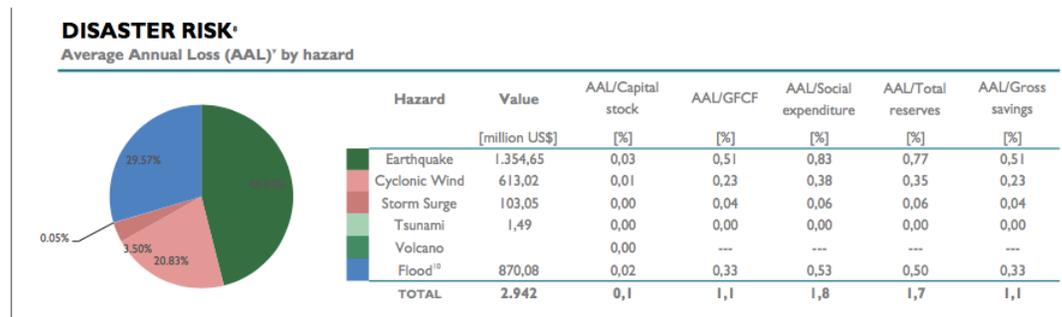
Figure 6:
Top 10 Mexican Disasters
by Total Economic
Damages



C) Future Risk

UNISDR GAR reports examine probabilistic risk order to determine the disaster types that are most likely to affect Mexico in the future. The GAR report discusses Average Annual Loss (AAL), which is defined as “the expected loss per annum associated to the occurrence of future perils assuming a very long observation timeframe. It considers the damage caused on the exposed elements by small, moderate and extreme events and results a useful and robust metric for risk ranking and comparisons.”¹⁷ As shown in Figure 6, earthquakes by far pose the largest threat to Mexico in terms of AAL. See Annex 2 for an overview of GAR terminology.

Figure 7:
Mexican AAL Per Disaster
Type



D) Suggested Scenario

While historical information and future predictions give a baseline understanding of the disasters that may impact Mexico, and show that hydrological events happen most often, with an earthquake potentially having the largest impact, the GEG is suggesting using a massive eruption of the Popocatepetl Volcano near Mexico City as the scenario for the Mexico Preparatory Meeting. The UNISDR Global Assessment Report Country Risk Profile for Mexico shows 15.4 million people (14 percent of the population) living within 30km of a volcano in Mexico. As stated in the overview, Mexico City is the sixth largest urban agglomeration in the world. Volcanic eruptions in the region have occurred and a full eruption near that urban center would border on catastrophic.

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i) Detailed Description

An eruption of a volcano would last hours sending hurricane blasts of hot ash plumes 25 miles high, scalding gas (pyroclastic flows), and lahars (flows of ash, mud and volcanic debris) scouring down the flanks of the volcano and into surrounding areas. 200 million tons of microscopic sulfur particles are pumped into the stratosphere to form a giant aerosol veil that encloses North America and acts to block incoming sunlight. 50 cubic miles of ash return to earth in the following days and weeks with winds pushing the ash clouds at a rate of more than 500 miles. Utter blackness prevails for five days.

In the immediate aftermath of the eruption 1.5 million people are dead (mostly from asphyxiation by carbon monoxide and the destruction of homes). 25 million people are directly affected with widespread injuries related to respiratory illnesses, massive injuries, and blindness. Two million livestock and animals are killed with 40 million livestock and animals affected. A thick 12-inch covering of ash and dust results in collapsed roofs for five million homes. 17 airplanes caught in the ash cloud crash¹⁸ and all air traffic is halted. The psychological effects are massive with millions of people leaving the affected area for fear of another eruption.

The predicted long-term affects for North America include significant cooling with temperatures decreasing 50 degrees Fahrenheit for up to three years. Incessant rains and unusually powerful storms accompany unseasonably cold temperatures. Snowfalls are expected in June and July. Massive crop failures are anticipated for one year resulting in a potential 200% increase in food prices in North America and globally. Massive economic losses result in the beginning of a recession. Floating pumice clogs shipping routes (some a mile in length). The eruption exacerbates and speeds the effects of climate change.

ii) Basic Characteristics

- » Massive volcanic eruption that ejects extraordinary amounts of volcanic ash, dust, gases and lava flows.
- » Immediate deaths of 1.5 million people within 300 miles of the volcano site
- » Major crop failures causing food production issues and shortages
- » Rivers and streams clogged by ash and debris resulting in water shortages

iii) Expected Response Needs

- » Emergency medical
- » Shelter
- » Internally displaced person camps (in addition to shelters)
- » Water and sanitation systems to support displaced
- » Additional food supply
- » Search and rescue
- » Mental health services
- » Debris management
- » Infrastructure repair

¹⁸ Jet engines process enormous amounts of air, and flying through finely dispersed ash can cause engine failure. Impacting the tiny ash particles at high speed is very similar to sandblasting. This can “frost” the jet’s windshield and damage external parts of the plane.

Figure 8:
Past Example(s) of Major
Volcanic Eruptions

Name/Location	Year	Effects
Toba	75,000 years ago	Erupted mass was 100 times greater than that of the largest volcanic eruption in recent history. 2,000-3,000 km ³ of eruptive volume (2800 km ³ of magma and 800 km ³ of ash). 6 inches of ash all over South Asia. 15 degrees centigrade of cooling.
Yellowstone Caldera (USA – Wyoming)	640,000 years ago	Super volcano at Yellowstone last erupted 640,000 years ago, the magma and ash ejected from the caldera covered most of the United States west of the Mississippi river and part of northeastern Mexico.
Mount Tambora (Indonesia – Sumatra)	1815	With an estimated ejecta volume of 160 km ³ (38 cu mi), Tambora's 1815 outburst is the largest volcanic eruption in recorded history. Death toll of at least 71,000 people. Resulted in a volcanic winter. Crops failed and livestock died in much of the northern hemisphere.
Novarupta (USA – Alaska)	1912	60 hour long eruption that expelled 13-15 cubic kilometers of ash (30 times as much as 1980 Mount St. Helens eruption. No deaths due to remoteness of location.
Mount St. Helens (USA – Washington)	1980	57 people killed, 250 homes, 47 bridges 15 miles of railways and 185 of highway were destroyed. The debris avalanche was up to 2.9 km ³ in volume.
Pinutubo (Philippines)	1991	11 cubic kilometres of pyroclastic ash flow.
Mount Nyiragongo (Democratic Republic Congo)	2002	400,000 people evacuated from Goma (N. Kivu provincial capital). 147 people died in the eruption from asphyxiation by carbon monoxide and buildings collapsing due to earthquakes and lava flow.
Evjafjallajokull (Iceland)	2010	800 people evacuated. Eruption threw volcanic ash several kilometres into atmosphere, which led to air travel disruption for 6 days.

3.2.3 United States Findings

A) Overview

The continental United States spans four time zones, is bordered by two oceans and shares borders with Canada and Mexico. The variety of geography within the US, from coastal areas to high plains and mountains, deserts to wetlands, and the variation in climate zones leaves the US vulnerable to a wide variety of natural hazards. Coastal and river areas are prone to flooding. Tropical storms and hurricanes impact the coast each year. Drought and wildfires are not uncommon, primarily in the western US. Approximately 1200 tornadoes impact the US each year.¹⁹ 42 of 50 US states have a reasonable chance of experiencing an earthquake.²⁰

¹⁹ <http://www.nssl.noaa.gov/education/svrwx101/tornadoes/>

²⁰ <http://news.nationalgeographic.com/news/2014/07/140717-usgs-earthquake-maps-disaster-risk-science/>

B) Historical

The EM-DAT database includes 970 natural disasters for the United States since 1900; 62 percent of those events have been storms (rain, tropical cyclones, convective storms, winter storms); and 18 percent have been floods. Wildfires account for 8 percent of disasters. As depicted in Figures 9 and 10 below, major disasters with high impact since 1900 have primarily been storms.

Figure 9:
Top 10 Historical US
Disasters by Number of
People Directly Affected

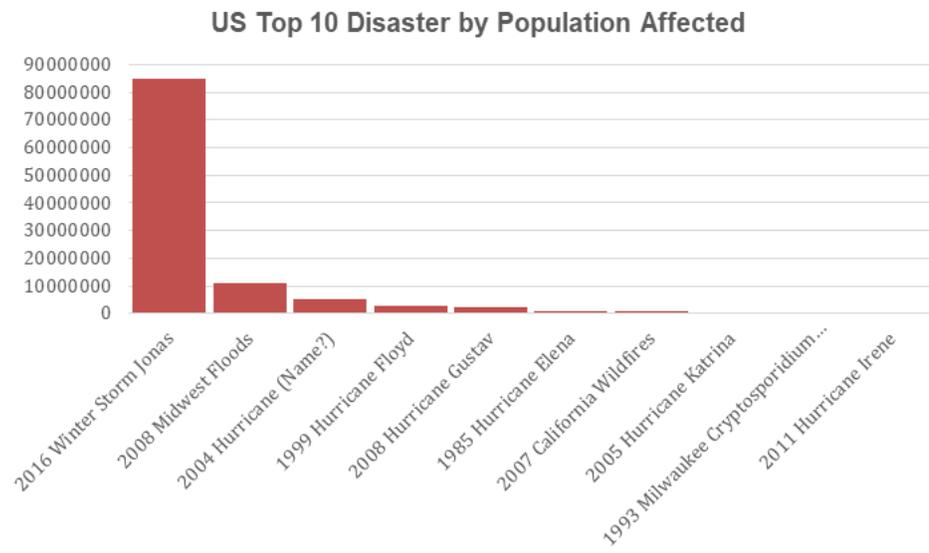
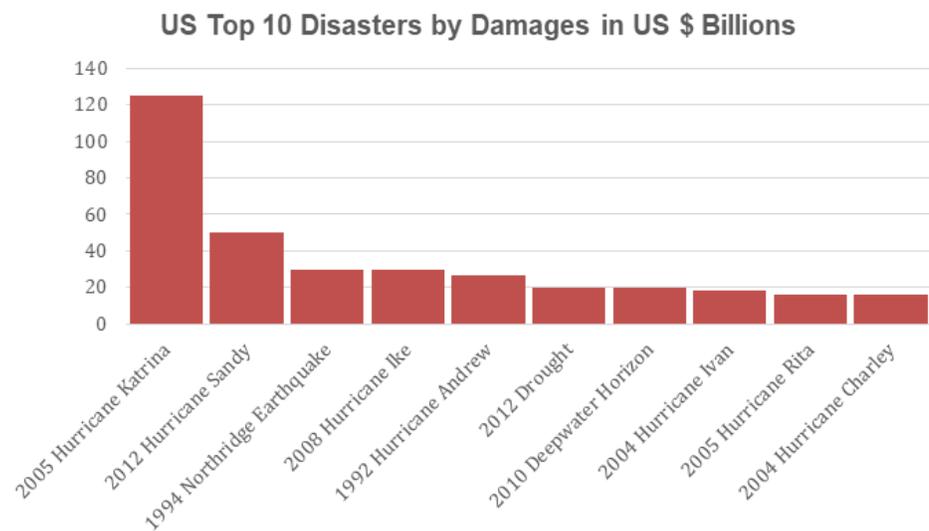


Figure 10
Top 10 Historical US
Disasters by Total
Economic Damages

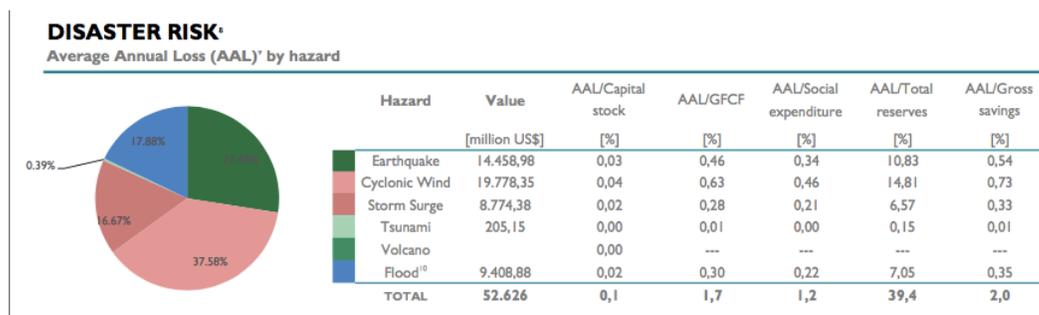


C) Future Risk

UNISDR GAR reports examine probabilistic risk order to determine the disaster types that are most likely to affect United States in the future. The GAR report discusses Average Annual Loss (AAL), which is defined as “the expected loss per annum associated to the occurrence of future perils assuming a very long observation timeframe. It considers the damage caused on the exposed elements by small, moderate and extreme events and results a useful and robust metric

for risk ranking and comparisons.”²¹ As shown in Figure 11, cyclonic winds and earthquakes by far pose the largest threat to the US in terms of AAL. See Annex 2 for an overview of GAR terminology.

Figure 11:
US AAL per Disaster Type



D) Suggested Scenario

While historical information and future predictions give a baseline understanding of the disasters that may impact the US, there is a key issue with determining the best scenario for use in the US. As with Canada, the landmass of the US makes it difficult for any of the hazards discussed above to present participants with an event resulting in a truly national catastrophe for which large amounts of external assistance would be required. Therefore, GEG determined that for the purposes of the NAHRS an even more impactful catastrophic emergency should be applied to the US preparatory meeting. Based on research the GEG recommends a scenario of an east coast tsunami resulting in a widespread damage to the Eastern Seaboard.

i) Detailed Description

A tsunami is a set of powerful ocean waves most commonly caused by a large earthquake or landslide that occurs near or under the ocean. Tsunami waves are unlike typical ocean waves generated by wind and storms. When tsunami waves approach shore, they behave like a very fast-moving tide that extends far inland. Most tsunamis do not “break” like the curling, wind-generated waves. Even “small” tsunamis (for example, 6 foot high) are associated with extremely strong currents, capable of knocking people off their feet. As with many natural phenomena, tsunamis can range in size from micro-tsunamis detectable only by sensitive instruments on the ocean floor to mega-tsunamis that can affect the coastlines of entire oceans, such as the Indian Ocean tsunami of 2004. Because of complex interactions with the coast, tsunami waves can persist for many hours. Mega tsunamis occur when a very large amount of material suddenly falls into water or anywhere near water or are caused by volcanic activity. They can have extremely high initial wave heights of hundreds and possibly thousands of meters, far beyond any ordinary tsunami, as the water is “splashed” upwards and outwards by the impact or displacement. As a result, two heights are sometimes quoted for mega tsunamis – the height of the wave itself (in water), and the height to which it surges when it reaches land, which depending upon the locale can be several times larger.

A La Palma tsunami scenario, as postulated by Steven Ward and Simon Day, while a remote possibility, could impact the whole of the US East Coast from Boston to Miami. A volcanic eruption of the Cumbre Vieja volcano on the island of La Palma in the Canary Islands, Spain results in the collapse of the western wall of the volcano into the Atlantic Ocean creating a mega tsunami as it collapses all at once. The resulting mega tsunami potentially results in initial waves that may attain a height in excess of 500 meters and travel rapidly across the Atlantic Ocean. The tsunami reaches the eastern seaboard of North America in 7 to 9 hours, by which time the initial wave have subsided into a succession of smaller ones, each about 20 to 25 meters high. As modeled by Ward and Day, the event inundates up to 25 km inland. This scale of inundation greatly dam-

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ages or destroys cities along the entire North American eastern seaboard, including Boston, New York City, and Miami, as well as many other cities located near the Atlantic coast. While the theory has been called into question because of the assumption of the whole of the west side of the volcano shearing off at one time and depositing the volume of material into the ocean required to create a mega tsunami, it is not entirely out of the realm of the possible.

ii) Basic Characteristics

- » Explosion of the Cumbre Viejo volcano resulting in a mega tsunami
- » No more than 8 hours of notification for the east coast of the US and Canada resulting in limited time for evacuation, especially on a summer, holiday weekend
- » Destruction up and down the coast with potential inland destruction up to 25 km
- » Issues in major coastal cities

iii) Expected Response Needs

- » Emergency medical
- » Shelter
- » Internally displaced person camps (in addition to shelters)
- » Replace water and sanitation systems to support displaced
- » Additional food supply
- » Search and rescue
- » Mental health services
- » Debris management
- » Infrastructure repair
- » Mortuary concerns
- » Policing

Figure 12:
Past Examples of Mega
Tsunamis

Name/Location	Date	Effects
Mount Unzen, Japan	1792	Mount Unzen in Japan erupted, causing part of the volcano to collapse into the sea. The landslide caused a mega tsunami that reached 100 meters (330 ft) high and killed 15,000 people in local fishing villages.
Krakatoa, Sumatra	1883	The eruption of Krakatoa created pyroclastic flows, which generated mega tsunamis when they hit the waters of the Sunda Strait on 27 August 1883. The waves reached heights of up to 24 meters (79 feet) along the south coast of Sumatra and up to 42 meters (138 feet) along the west coast of Java
Lituya Bay, Alaska, US	1958	On July 9, 1958, a giant landslide at the head of Lituya Bay in Alaska, caused by an earthquake, generated a wave with initial amplitude of up to 520 meters (1,710 ft). This is the highest wave ever recorded, and surged over the headland opposite, stripping trees and soil down to bedrock as it surged along the fjord.
Vajont Dam, Italy	1963	On October 9, 1963, a landslide above Vajont Dam in Italy produced a 250 meters (820 ft) surge that overtopped the dam and destroyed the villages of Longarone, Pirago, Rivalta, and Villanova, killing nearly 2,000 people.

Name/Location	Date	Effects
Banda Aceh, Sumatra	2001	On December 26, 2004 the Banda Aceh 9.1 magnitude earthquake created a tsunami in Sumatra killing more than 250,000 people. Wave heights of 20 to 30 m (65 to 100 ft) were recorded at the island's northwest end and evidence has been found suggesting that wave heights may have ranged from 15 to 30 m (50 to 100 ft) along a 100-km (60-mi) stretch of the northwest coast of the island.
Tohoku earthquake, Japan	2011	On March 11, 2011 a 9.1 magnitude earthquake created a tsunami with waves reaching run-up heights (how far the wave surges inland above sea level) of up to 39 meters (128 feet) at Miyako city and that traveled inland as far as 10 KM (6 miles) in Sendai killing over 15,000 people. The tsunami flooded an estimated area of approximately 561 Square KM (217 square miles) in Japan. It caused a cooling system failure at the Fukushima Daiichi Nuclear Power Plant, which resulted in a level-7 nuclear meltdown and release of radioactive materials.

3.2 Fora Overview

There are a number of trilateral and bilateral agreements, memoranda of understanding, and initiatives taking place in support of cross-border preparedness and response within North America. The below information provides an overview of these activities and some context to the on-going cross border efforts in support of disaster preparedness and response between the nations. Although this review looks primarily at national level agreements and initiatives, it should also be noted there are a myriad of on-going local and state level agreements and initiatives.

3.2.1 Findings

The amount of interaction between the governments of Canada, Mexico and the US has been growing in the past ten to twenty years. The recognized interdependencies among the nations and the understanding that disasters know no boundaries have helped to increase the frequency and intensity of interaction. There are a number of agreements, MOUs, commissions, and working groups supporting cross border interaction for disaster preparedness and response.

Trilateral agreements and initiatives mostly concern public health and the environment, with each having a component related to emergency preparedness and response. The gaps identified can serve as a basis for deliberation and conversation during the NARHS process.

Bilateral cooperation between Canada and the United States spans a broad range of topics including:

- » Emergency management assistance
- » The movement of people and equipment across the border
- » Wildfire preparedness and response
- » Military to military frameworks for assistance during civil support operations
- » Critical infrastructure
- » Communications
- » Cyber security
- » Nuclear and radiological response
- » Search and rescue

Bilateral cooperation between Mexico and the United States is largely related to environmental issues and concerns within the border region, including mitigation of flooding in the watershed areas, and response to hazardous materials releases. Other areas for cooperation include:

- » Emergency Management Assistance
- » Communications and frequency use
- » Wildfire preparedness and response
- » Public health events

Figure 13:
Overview of Initiatives

Title	Type & Countries	Brief Overview	Year
Canada/United States Reciprocal Forest Fire Fighting Arrangement (Public Law 101-11, the Wildfire Suppression Assistance Act) and accompanying operating plan	Bilateral/Canada-US	Facilitates mutual assistance in wildland fire fighting	1982 updated 2012
The 1983 Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (La Paz Agreement)	Bilateral/Mexico-US	Empowers the federal environmental authorities to undertake cooperative initiatives on issues of environmental significance in the border area (defined as 100 kilometers to the north and south of the international border)	1983
Agreement between the Government of the United States of America and the Government of the United Mexican States on Maritime Search and Rescue	Bilateral/Mexico-US	Sets forth guidelines for cooperation between the maritime search and rescue authorities of both countries in responding to or coordinating the response to distress cases in which life or property is threatened at sea	1990
Commission for Environmental Cooperation	Trilateral/ Canada-Mexico-US	Support cooperation in a variety of environmental concerns and capacity building	1994
Memorandum of Understanding (MOU) between the United States of America and Mexico Concerning the Use of Radio Frequencies, Coordination and Cooperation for Emergency Purposes	Bilateral/Mexico-US	Procedures for coordinating and cooperating on firefighting and certain other emergency and disaster relief operations, establishing protection for radio frequencies to support such operations	1998
Wildfire Protection Agreement Between the Department of Agriculture and the Department of the Interior of the United States of America and the Secretariat of Environment Natural Resources and Fisheries of the United Mexican States for the Common Border, (Wildfire Protection Agreement)	Bilateral/Mexico-US	Enables wildfire protection resources originating in the territory of one country to cross the United States-Mexico border in order to suppress wildfires on the other side of the border within the zone of mutual assistance (defined as 16km or 10mi)	1999 amended 2003

Title	Type & Countries	Brief Overview	Year
<p>Memorandum of Understanding (MOU) for Co-Operation Among the Department of National Defence Canada, the Department of Fisheries and Oceans of Canada, the United States Coast Guard, the United States Air Force, the United Kingdom Maritime and Coast Guard Agency, the United Kingdom Civil Aviation Division of the Department of Environment, Transport and the Regions, and the United Kingdom Ministry of Defence Concerning Search and Rescue</p>	<p>Bilateral/Canada-US</p>	<p>Provides a framework for cooperation among the Participants for the provision of search and rescue (SAR) services in response to a maritime or aeronautical incident within the Participant's search and rescue region</p>	<p>1999</p>
<p>The Canada-Mexico Partnership</p>	<p>Bilateral/Canada-Mexico</p>	<p>Key mechanism for bilateral cooperation and catalyst for action between the governments, private sector, and non-governmental partners to pursue common goals and mutually beneficial priorities</p>	<p>2004</p>
<p>North American Leaders' Summit</p>	<p>Trilateral/Canada-Mexico-US</p>	<p>Annual Heads of State meeting to discuss areas of mutual support and cooperation</p>	<p>2005</p>
<p>U.S. Border Crossing Process for Voluntary Agency Groups/Individuals</p>	<p>United States</p>	<p>Facilitates the secondary "parole" entry of groups and individuals from Canada and other countries affiliated with the National Voluntary Organizations Active in Disaster (NVOAD) into the United States to provide voluntary services to non-governmental organizations in support of U.S. declared disaster recovery operations</p>	<p>2007</p>
<p>Mexico-United States Joint Contingency Plan: Preparedness for and Response to Emergencies and Contingencies Associated with Chemical Hazardous Substances in the Inland Border (Inland Border Plan)</p>	<p>Bilateral/Mexico-US</p>	<p>Provides a mechanism for cooperation and coordination between Mexico and the United States to ensure appropriate and effective preparedness and response to a chemical/hazardous substance emergency</p>	<p>2008</p>
<p>Memorandum of Cooperation between Public Safety Canada and the United States Department of Homeland Security (to promote joint efforts by the respective public affairs organizations) and Canada-US Incident Management Framework for Public Communications</p>	<p>Bilateral/Canada-US</p>	<p>Documents the partnership between the DHS Office of Public Affairs and Public Safety Canada for sharing of public information materials</p>	<p>2008</p>

Title	Type & Countries	Brief Overview	Year
Agreement between the Government of Canada and the Government of the United States of America on Emergency Management Cooperation	Bilateral/Canada-US	Established a Consultative Group on Emergency Cooperation between Canada and the United States and provided broad authority to the Group to work on emergency management topics affecting both countries including those involving mutual aid	2009
Emergency Management Consultative Group	Bilateral/Canada-US	Oversees several projects to increase cross border cooperation on a full range of emergency management and national security issues	2009
Canada-United States Framework for the Movement of Goods and People Across the Border During and Following an Emergency and Maritime Annex To The Canada-United States Framework For The Movement Of Goods And People Across The Border During And Following An Emergency	Bilateral/Canada-US	Commits the United States and Canada to work together to manage the movement of goods and people across the border during and following an incident that contributes to significant border disruption and requires national level engagement	2009
Plan for the Movement of People and Goods During and Following an Emergency	Canada	Lays out a triage methodology to assist the Government of Canada to establish which people and what goods are most urgently needed in Canada after an incident	2009 updated 2014
Memorandum of Understanding on the Facilitation of Vital Civil Cross Border Transport under the North Atlantic Treaty Organization's (NATO) Euro-Atlantic Partnership Council (EAPC) and approved by the Senior Civil Emergency Planning Committee (SCEPC)	Bilateral/Canada-US+	Creates the general framework for the transport and transit of relief personnel and material by water, land, or air to cope with the consequences of a disaster	2009
Canada-United States Action Plan for Critical Infrastructure	Bilateral/Canada-US	A comprehensive cross-border approach to critical infrastructure resilience	2010
Canada and United States Resiliency Experiment	Bilateral/Canada-US	Ongoing program of joint experiments to test and evaluate technologies and processes that enable cross-border information sharing	2011
Agreement between the Government of the United States of America and the Government of the United States of Mexico on Emergency Management Cooperation in Cases of Natural Disasters and Accidents	Bilateral/Mexico-US	Established a Working Group on Emergency Management Cooperation in Cases of Natural Disasters and Accidents	2011

Title	Type & Countries	Brief Overview	Year
North American Plan for Animal and Pandemic Influenza	Trilateral/ Canada-Mexico- US	Cooperation on pandemic influenza preparedness, including enhancing public health capabilities and facilitating routine and efficient information sharing	2012
North American Climate Services Partnership	Trilateral/ Canada-Mexico- US	Facilitate the exchange of information, technology and management practices related to the development of climate and water information and the development and delivery of integrated climate services for North America	2012
Technical Guidelines for United States-Mexico Coordination on Public Health Events of Mutual Interest	Bilateral/Mexico- US	Established a shared set of technical guidelines that both countries will follow to response to public health events affecting both countries	2012
Canada-U.S. Civil Assistance Plan	Bilateral/Canada- US	Provides a framework for the military of one nation to provide support to the military of the other nation while in the performance of civil support operations to the primary agency	2012
Cybersecurity Action Plan Between Public Safety Canada and the Department of Homeland Security	Bilateral/Canada- US	Enhance the cybersecurity of the nations through increased integration of national cybersecurity activities and improved collaboration with the private sector	2012
Border 2020: US-Mexico Environmental Program	Bilateral/Mexico- US	Eight-year (2013-2020) binational effort designed to protect the environment and public health in the U.S.-Mexico Border region	2013
Declaration of Intent to Coordinate Health Emergency Public Information Communications between the Department of Health and Human Services of the United States of America, the Public Health Agency of Canada, and the Secretariat of Health of the United Mexican States	Trilateral/ Canada-Mexico- US	Guidance for facilitating efficient sharing of public information and communications products related to health emergencies	2014
Statement of Intent Between the Department of Health of Canada and the Department of Energy of the United States of America Regarding Nuclear and Radiological Emergency Management and Incident Response Capabilities	Bilateral/Canada- US	Provides a framework for cooperation between the Department of Health of Canada and the Department of Energy of the United States to enhance radiological and nuclear security	2014

Title	Type & Countries	Brief Overview	Year
Memorandum of Understanding between the Department of National Defence of Canada, and the Federal Emergency Management Agency, U.S. Department of Homeland Security, Integrated Public Alert and Warning System (IPAWS) Program Management Office regarding the use of: The Multi-Agency Situational Awareness System (MASAS)/IPAWS Bridge and the IPAWS OPEN Platform for Emergency Networks (IPAWS-OPEN)	Bilateral/Canada-US	Supports establishment and utilization of a standardized, web-based application interface between the Information Technology systems	2016
TRIMET Exercises ²²	Bilateral/Mexico-US	MRC collaborated with the United States Northern Command to conduct simulation exercises to offer humanitarian aid between the two countries, mainly with the involvement of armed forces. However, the MRC reached the conclusion that such cooperation is not viable, due to the prevailing legal situation of each country.	2016

3.2.2 Trilateral

3.2.2.1 The North American Leaders' Summit

The North American Leaders' Summit (NALS) began in 2005 with an inaugural meeting in Washington D.C. Since then, the Heads of Government for Canada, Mexico and the United States have met annually to discuss mutual support and cooperation on a myriad of topics, including emergency coordination during times of crisis. NALS gives a forum for the leaders to address and solve issues. Accomplishments related to disaster preparedness and response have included setting up a system for coordinating responses to pandemics like Avian flu, Ebola, and Zika and recognizing the qualifications of emergency personnel who offer help in response to disasters.²³

3.2.2.2 The North American Plan for Animal and Pandemic Influenza

The North American Plan for Animal and Pandemic Influenza (NAPAPI), was one such initiative coming from the NALS. Launched in April 2012, it fulfilled the commitment made by the Presidents of Mexico and the United States and the Prime Minister of Canada at the at the 2009 NALS for a continued and deepened cooperation on pandemic influenza preparedness, including enhancing public health capabilities and facilitating routine and efficient information sharing. The plan provides a comprehensive, regional and cross-sectoral, health security framework outlining how Canada, Mexico, and the United States intend to strengthen emergency response capacities, as well as trilateral collaborations and capabilities to assist each other and ensure a quick and coordinated response to outbreaks of animal influenza or an influenza pandemic. The American Senior Coordinating Body (SCB) provides a high-level forum for collaboration on animal and pandemic influenza preparedness and includes assistant secretary-level senior officials

²² TRIMET exercises indicated via email with MRC staff

²³ North American Leaders' Summit: An Overview, Indian Council of World Affairs Issue Brief, Dr. Stuti Banerjee, accessed 23 June 2017 at <http://icwa.in/pdfs/IB/2014/TheNorthAmericanLeadersSummitIB26072016.pdf>

from the health, agriculture, public safety/homeland security, and foreign affairs sectors of the three countries. The SCB oversees the activities of the Health Security Working Group (HSWG), which include technical and policy subject matter experts from the three countries.

Guided by the principles established in the NAPAPI, the HSWG developed the NAPAPI Implementation Actions in 2012. The Implementation Actions outline a path forward for improving pandemic influenza preparedness in North America. Key areas identified for action include:

- » Mutual assistance during a response, particularly with regard to sharing medical countermeasures and personnel;
- » Interconnected systems for surveillance and early warning;
- » Protocols for emergency communications, laboratory sample transportation, and joint epidemiological investigations;
- » Integration on human and animal health; and
- » Development of border policies and protection of critical infrastructure.²⁴

3.2.2.3 Declaration of Intent to Coordinate Health Emergency Public Information Communications between the Department of Health and Human Services of the United States of America, the Public Health Agency of Canada, and the Secretariat of Health of the United Mexican States

Entered into force in 2014, this declaration provides guidance for facilitating efficient sharing of public information and communications products related to health emergencies in a timely and transparent manner to improve coordination of preparedness and response. It declares the intention of all three countries to exchange contact information of communication officials and share public communications plans and products prior to public release.²⁵

3.2.2.4 Commission for Environmental Cooperation

The Commission for Environmental Cooperation (CEC) is an international organization established in 1994 under the North American Agreement on Environmental Cooperation (NAAEC). Since its creation the CEC has advanced an understanding of trade-environment linkages; successfully promoted citizen engagement and increased government accountability regarding enforcement; achieved substantial results on key North American issues such as chemicals management and the conservation of North American biodiversity; and built substantial environmental capacities.²⁶ Each year, the North American Ministers to the CEC meet for the CEC Council Session to set the CEC's overall direction, including budget, and the activities to be pursued through the cooperative work plan. As needed, the Ministers assign responsibilities to the committees, workgroups, and expert trilateral groups to fulfill the mandate. At the close of each meeting, the Ministers deliver a Ministerial Statement outlining their strategy and vision for the coming year. The last meeting of the CEC was September 8-9 2016.²⁷

3.2.2.5 The North American Climate Services Partnership

The North American Climate Services Partnership (NACSP) is a trilateral partnership between the U.S., Mexico and Canada designed facilitate the exchange of information, technology and management practices related to the development of climate and water information and the development and delivery of integrated climate services for North America. It was established

24 Information from <https://www.phe.gov/Preparedness/international/Pages/napapi.aspx> accessed 24 June 2017

25 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

26 <https://www.epa.gov/international-cooperation/epas-role-north-american-commission-environmental-cooperation-cec>

27 <https://www.epa.gov/international-cooperation/cec-council-sessions>

to respond to an increasing demand for accessible and timely scientific data and information in order to make informed decisions and build resilience. Begun in 2012, the NSCSP is currently working to achieve the goals set out in the NACSP Strategic Work Plan 2013-2017.²⁸

Two components of the NACSP support broader collaboration between the three countries related to drought and wildfires. The North American Drought Monitor (NADM) was established 2001 as a trilateral partnership to improve drought monitoring on the North American continent and provide decision makers with information essential to planning, mitigation and response activities. The North American Seasonal Fire Assessment and Outlook (NASFAO) provides wildland fire managers a concise look at the expected conditions that will drive wildland fire activity and allows them to make strategic decisions about firefighting resource needs and distribution of capability. Each month, experts from the U.S., Canada and Mexico coordinate to prepare a three-month outlook of wildland fire potential across North America. The Outlook provides an assessment of the antecedent conditions that contribute to wildland fire and an outlook based on medium- and long-range weather and climate models coupled with historical fire occurrence.²⁹

3.2.3 United States-Mexico Bilateral

3.2.3.1 Agreement between the Government of the United States of America and the Government of the United States of Mexico on Emergency Management Cooperation in Cases of Natural Disasters and Accidents

This agreement was entered into force in 2011 and establishes a Working Group on Emergency Management Cooperation in Cases of Natural Disasters and Accidents between Mexico and the U.S. The Working Group meets annually. The mandate of the working group includes exchange of information, experts and technicians, risk analysis, assessment of emergency communications planning, promotion of symposia, conferences, workshops and training programs, and determination of opportunities for cooperation with other international entities involved in emergency management. The Working Group is co-chaired by representatives of the Departments of State and Homeland Security of the United States of America and representatives of the Secretariats of Foreign Affairs and Governance of the United Mexican States. Membership on the Working Group includes the following:

- » For the United States of America, representatives of the:
 - » Department of State;
 - » Department of Defense;
 - » Department of Health and Human Services;
 - » Department of Homeland Security;
 - » U.S. Agency for International Development;
 - » Federal Emergency Management Agency of the Department of Homeland Security;
 - » National Protection and Programs Directorate of the Department of Homeland Security
 - » Environmental Protection Agency.
- » For the United Mexican States, representatives of the:
 - » Secretariat of Governance
 - » Secretariat of Foreign Affairs
 - » Secretariat of National Defense
 - » Secretariat of the Navy
 - » Secretariat of Public Safety
 - » Secretariat of Finance and Public Credit
 - » Secretariat of Social Development

28 http://cpo.noaa.gov/sites/cpo/Partnerships/International/NACSP/docs/EN-%20NACSP_Strategy_Final_2013-2017.pdf

29 2016 North American Drought, Wildfire, and Climate Services Forum, Fort Worth, TX, USA June 21-23, 2016 Meeting Report accessed from <http://cpo.noaa.gov/sites/cpo/Documents/pdf/2016%20June%20-%20%20NADM%20Fire%20Climate%20Services%20Forum%20-%20Meeting%20Report.pdf>

- » Secretariat of the Environment and Natural Resources
- » Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food
- » Secretariat of Communications and Transport
- » Secretariat of Health
- » Center for Investigation and National Security
- » National Institute of Immigration
- » National Water Commission³⁰

3.2.3.2 Technical Guidelines for United States-Mexico Coordination on Public Health Events of Mutual Interest

In 2012, the health secretaries signed a declaration formally adopting a shared set of technical guidelines that both countries will follow to respond to public health events affecting both countries. The guidelines complement the International Health Regulations, which call for neighboring countries to develop accords and work together on shared epidemiologic events and public health issues.³¹

These guidelines facilitate binational cooperation by fostering more systematic and comprehensive sharing of information on epidemiologic events of mutual interest and promoting collaborative responses where appropriate. They emphasize the importance of clear, timely, and quality information sharing at all levels of government and better defines how the countries should collaborate on public health events. They present specific guidelines for preparation, identification and investigation of events, notification, information sharing, resource sharing, laboratory issues, and public health risk assessment and communications. They apply in cases of binational public health events, foodborne disease outbreaks, and potential terrorist events of public health importance.³²

3.2.3.3 Wildfire Protection Agreement Between the Department of Agriculture and the Department of the Interior of the United States of America and the Secretariat of Environment Natural Resources and Fisheries of the United Mexican States for the Common Border, (Wildfire Protection Agreement)

Originally established in 1999 and amended in 2003, the agreement enables wildfire protection resources originating in the territory of one country to cross the United States-Mexico border in order to suppress wildfires on the other side of the border within the zone of mutual assistance (defined as 16km or 10mi) in appropriate circumstances. The agreement also gives authority for both countries to cooperate on other fire management activities outside the zone of mutual assistance. This agreement calls for Annual Operating Plans to be concluded and executed between both countries that set forth specific criteria for: Approving resource requests; Developing plans for mobilization of resources; Establishing communication procedures; Providing for complete and timely reporting and recordkeeping; Identifying procedure and legal documentation needed for expeditious cross-border movement of resources; and Specifying the conditions and procedures for reimbursement of resources, including a cross-waiver for compensation for loss, damage, personal injury, or death occurring in consequence of the performance under the agreement.³³

30 Agreement between the Government of the United States of America and the Government of the United States of Mexico on Emergency Management Cooperation in Cases of Natural Disasters and Accidents, <https://www.state.gov/documents/organization/183502.pdf>

31 <https://www.cdc.gov/ncezid/dgmaq/feature-stories/mexico-us-connects.html>

32 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

33 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

3.2.3.4 The 1983 Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (La Paz Agreement)

This agreement empowers the federal environmental authorities in the United States and Mexico to undertake cooperative initiatives on issues of environmental significance in the border area (defined as 100 kilometers to the north and south of the international border). It is implemented through multi-year binational programs, the latest of which is the Border 2020 program. Annex II of the agreement provides the coordination framework for emergency response and planning in response to pollution through discharge of a hazardous substance. Appendix I outlines the Joint Contingency Plan (JCP), which requires each country to report to the other any polluting incidents in the border area that may require a joint response. The plan calls for development and maintenance of cross-border communication systems and requires procedures to facilitate notification and reporting of these emergencies.³⁴

Regarding joint preparedness for response, the 1985 Annex II of the La Paz Agreement established cooperative measures for preparing and responding to oil and hazardous substance incidents along the Mexico-United States inland border. The agreement also required a JCP, developed in 1988 and signed in 1999. An updated version was finalized and signed in 2008. The Mexico-U.S. JCP provides the foundation for the 15 Sister Cities Bi-national Emergency Response Plans that have been developed over the last several years. The Emergency Preparedness and Response Policy Fora is co-chaired by U.S. EPA's Office of Emergency Management (OEM), Mexico's Procuraduría Federal de Protección al Ambiente (PROFEPA), and Secretaría de Gobernación, Coordinación General de Protección Civil (Mexico's Office of Civil Protection).³⁵

3.2.3.5 Border 2020: US-Mexico Environmental Program

Border 2020 is an eight-year (2013-2020) binational effort designed to protect the environment and public health in the U.S.-Mexico Border region. It is the latest cooperative effort implemented under the 1983 La Paz Agreement and builds upon previous binational efforts, particularly Border 2012. The U.S. Environmental Protection Agency (EPA) and Mexico's Secretaría de Medio Ambiente y Recursos Naturales SEMARNAT provide the guidance and oversight to the coordinating bodies: Policy Fora and Regional Workgroups. Policy Fora provide border-wide technical and policy support on issues that are primarily of a federal nature and border-wide scope. Regional Workgroups prioritize and implement projects and efforts in the four geographic regions of the border: California-Baja California, Arizona-Sonora, New Mexico-Texas-Chihuahua and Texas-Coahuila- Nuevo León-Tamaulipas. The Workgroups create and oversee local task forces.

The effort emphasizes a regional bottom-up approach as the basis for decision-making, priority setting, and project implementation to address the environmental and public health problems in the border region. The program has five strategic goals: Reduce Air Pollution; Improve Access to Clean and Safe Water; Promote Materials Management and Waste Management, and Clean Sites; Enhance Compliance Assurance and Environmental Stewardship; and Enhance Joint Preparedness for Environmental Response.³⁶

3.2.3.6 Mexico-United States Joint Contingency Plan: Preparedness for and Response to Emergencies and Contingencies Associated with Chemical Hazardous Substances in the Inland Border (Inland Border Plan)

Entered into force in 2008, this plan provides a mechanism for cooperation and coordination between Mexico and the United States to ensure appropriate and effective preparedness and

³⁴ Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

³⁵ https://www.epa.gov/sites/production/files/documents/border2020summary_0.pdf

³⁶ https://www.epa.gov/sites/production/files/documents/border2020summary_0.pdf

response to a chemical hazardous substances contingency or emergency that may present a significant threat for both countries or that affects one of them in such a way that justifies the notification of the other country or a request for assistance.³⁷

3.2.3.7 Agreement between the Government of the United States of America and the Government of the United Mexican States on Maritime Search and Rescue

Entered into in 1990, this agreement sets forth guidelines for cooperation between the maritime search and rescue authorities of both countries in responding to or coordinating the response to distress cases in which life or property is threatened at sea. It calls for facilitating cooperation in search and rescue through the free exchange of information, common procedures for operations and requesting and rendering assistance, provision for prompt permission for entry of search and rescue units into the territorial sea of the other country, and establishment of means of communication for joint operations and between rescue coordination centers.³⁸

3.2.3.8 Memorandum of Understanding (MOU) between the United States of America and Mexico Concerning the Use of Radio Frequencies, Coordination and Cooperation for Emergency Purposes

Established in 1998, this MOU establishes procedures for coordinating and cooperating on fire-fighting and certain other emergency and disaster relief operations. It establishes and provides protection for radio frequencies to support such operations. It also identifies departments and/or agencies that shall cooperate in the sharing of radio equipment.³⁹

3.2.4 United States-Canada Bilateral

3.2.4.1 Agreement between the Government of Canada and the Government of the United States of America on Emergency Management Cooperation

The Agreement was entered into force July 7, 2009 and superseded the 1986 Agreement between the Government of Canada and the Government of the United States of America on Cooperation in Comprehensive Civil Emergency Planning and Management. This agreement established a Consultative Group on Emergency Cooperation between Canada and the United States. This Group is provided broad authority to work on emergency management topics affecting both the United States and Canada including those involving mutual aid. Subject to domestic laws, the agreement also identifies general principles of cooperation, as a guide for civil emergency authorities. These principles include using best efforts to facilitate the movement of evacuees and emergency personnel and equipment, avoiding levying Federal taxes on services, equipment and supplies engaged in emergency activities in the territory of the other, etc.⁴⁰

3.2.4.2 Emergency Management Consultative Group (EMCG)

The EMCG was established in 2009 pursuant to the Agreement between the Government of Canada and the Government of the United States of America on Emergency Management Cooperation. Meeting at least annually, it oversees several projects to increase cross border cooperation on a full range of emergency management and national security issues.⁴¹

37 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

38 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

39 Compendium of Mexico-U.S. Emergency Assistance Mechanisms, January 2015

40 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

41 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

The EMCG promotes dialogue between stakeholders in Canada and the United States and provides a platform to advance collaborative emergency management initiatives.⁴²

National representation on the EMCG includes the following:

- » A representative from each of the Department of State and the Department of Homeland Security, for the United States, and a representative from each of the Department of Foreign Affairs and International Trade and the Department of Public Safety and Emergency Preparedness, for Canada, who act as co-chairs of the Consultative Group.
- » One representative from the Federal Emergency Management Agency of the Department of Homeland Security, one representative from the Agency for International Development, one representative from the Department of Defense, and one additional representative each from the Department of Homeland Security and the Department of State, for the United States.
- » One additional representative from the Department of Foreign Affairs and International Trade and the Department of Public Safety and Emergency Preparedness, and one representative from the Department of National Defence, for Canada
- » Representatives of other Canadian or United States government departments or agencies may participate as deemed appropriate by the Consultative Group.⁴³

The working groups currently established under the EMCG include Critical Infrastructure⁴⁴, Disaster Risk Reduction, and Response and Recovery.⁴⁵

3.2.4.3 Canada-United States Framework for the Movement of Goods and People Across the Border During and Following an Emergency and Maritime Annex To The Canada-United States Framework For The Movement Of Goods And People Across The Border During And Following An Emergency

Established in 2009, the framework commits the United States and Canada to work together to manage the movement of goods and people across the border during and following an incident that contributes to significant border disruption and requires national level engagement

- » An attack or threat of attack to the United States or Canada by terrorists
- » A natural or man-made incident, including a pandemic or other health incident that impacts large numbers of citizens and/or affects Critical Infrastructure and Key Resources of national interest to one or both Countries.
- » Federal, State, Local, Provincial, Territorial or U.S. Tribal Governments request national-level assistance through existing procedures.

The Maritime Annex supports efforts to work together in the context of incidents to manage the reasonable movement of vessels carrying goods and people between Canada and the United States during and following emergencies in the event of an incident affecting our shared maritime transportation systems. It facilitates coordinated, cooperative, and timely decision-making to mitigate impacts on citizens and economies.⁴⁶

42 Canada-United States Action Plan for Critical Infrastructure, 2010, https://www.dhs.gov/xlibrary/assets/ip_canada_us_action_plan.pdf

43 Agreement between the Government of Canada and the Government of the United States of America on Emergency Management Cooperation, <http://www.treaty-accord.gc.ca/print-imprimer.aspx>

44 Canada-United States Action Plan for Critical Infrastructure, 2010, https://www.dhs.gov/xlibrary/assets/ip_canada_us_action_plan.pdf

45 FEMA International Affairs Office of Policy and Program Analysis Annual Report 2015, accessed from https://www.fema.gov/media-library-data/1466080176357-31dc0423a30d9e97e4047e1645ca648c/FY15_IAD_ANNUAL_REPORT.pdf

46 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

3.2.4.4 Plan for the Movement of People and Goods During and Following an Emergency

Established in 2009 and last updated in 2014, the plan lays out a triage methodology to assist the Government of Canada to establish which people and what goods are most urgently needed in Canada after an incident, supporting determination on which people and goods should move through the border on a priority basis. It also establishes the process of communicating with stakeholders, not only to receive key information to be considered in the triage function, but to communicate the decisions of government. This plan also includes a supporting traffic framework function essential to the plan's success during activation as guidance to governments, public and private sector stakeholders for the physical movement of prioritized people and goods to and away from the border.⁴⁷

3.2.4.5 Canada/United States Reciprocal Forest Fire Fighting Arrangement (Public Law 101-11, the Wildfire Suppression Assistance Act) and accompanying operating plan

Originally established in 1982 and updated in 2015, the arrangement and supporting operating plan facilitates mutual assistance in wildland fire fighting between Canada and the United States. The operating plan addresses requests for assistance, designating officials, information to supply to Customs & Immigration Points of Entry (POE), and information to include in situation reporting. The operating plan also includes a "Directory of Designated Officials," updated annually.⁴⁸

3.2.4.6 Canada-U.S. Civil Assistance Plan (CAP)

Established in 2008 and renewed in 2012, the CAP provides a framework for the military of one nation to provide support to the military of the other nation while in the performance of civil support operations to the primary agency (e.g., floods, forest fires, hurricanes, earthquakes, and effects of a terrorist attack). The focus of the plan is on the unique, bilateral military planning considerations required to align respective national military plans to respond quickly to national requests for military support of civil authorities.⁴⁹

3.2.4.7 Canada-United States Action Plan for Critical Infrastructure

Established in 2010 in recognition of the interconnectedness of U.S. and Canadian critical infrastructure, the Action Plan is a comprehensive cross-border approach to critical infrastructure resilience. The Action Plan is based on three objectives, building partnerships, improved information sharing, and risk management. It identifies specific deliverables, provides a framework for managing risks, and supports regional cross-border relations. Specific communication and coordination actions include working together to improve sector-specific cross-border collaboration, establishing a virtual Canada-U.S. Infrastructure Risk Analysis Cell, developing compatible mechanisms and protocols to protect and share sensitive critical infrastructure information, collaborating to ensure effective information sharing during and following an incident, among others.⁵⁰

3.2.4.8 Cybersecurity Action Plan Between Public Safety Canada and the Department of Homeland Security

Established in 2012, the Action Plan seeks to enhance the cybersecurity of the nations through increased integration of Public Safety Canada's and the Department of Homeland Security's respective national cybersecurity activities and improved collaboration with the private sector. This Action Plan outlines three goals for improved engagement, collaboration, and information shar-

47 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

48 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

49 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

50 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

ing at the operational and strategic levels, with the private sector, and in public awareness activities. It establishes lines of communication and areas for collaborative work critical to enhancing the cybersecurity preparedness of both nations.⁵¹

3.2.4.9 Canada and United States Resiliency Experiment (CAUSE)

The Canada-U.S. Enhanced Resiliency Experiment (CAUSE) is an ongoing program of joint experiments to test and evaluate technologies and processes that enable cross-border information sharing. CAUSE is co-sponsored by The U.S. Department of Homeland Security Science and Technology Directorate's First Responders Group and Defence Research and Development Canada's Centre for Security Science. Specific focus areas that CAUSE has explored include: coordination of local, state, provincial and national incident management and alerting systems across border; public safety broadband and deployable LTE; cross border request and acquisition of mutual aid; and using social media to enhance decision making in emergency management.⁵²

To date there have been four CAUSE experiments:

- » In June 2011, the CAUSE I experiment project engaged the operational emergency management communities in British Columbia and bordering U.S. states. The key outcomes were enhanced interoperability with earthquake alerts emanating from the National Resources Canada alerting system, and the demonstrated benefits of enabling live links between Canada's Multi Agency Situational Awareness System (MASAS) and the U.S.'s Integrated Public Alert and Warning System (IPAWS).
- » In March 2013, CAUSE II demonstrated the ability to exchange information between 12 local, state, provincial and national agencies using various systems and software, including Virtual Maine, MASAS, IPAWS, Virtual USA, Mutual Aid Support System and Mission Ready Package Tools.⁵³
- » In November of 2014 CAUSE III addressed improving interoperable communications (LMR, PSBN, Data, GIS), resource management/sharing protocols, and a cross-border Concept of Operations.
- » In April of 2016 CAUSE IV tested the current capabilities and limitations of emergency response technology and protocols across the U.S.-Canada border.⁵⁴

Outcomes of the CAUSE experiments have included:

- » Enhanced resilience through cross-border partnerships with interoperable communications and shared situational awareness;
- » Integration of non-traditional resources, including crowd-sourced information, open technologies, and digital volunteers to augment traditional emergency response; and
- » The ability to send and receive cross-border alerts via multiple channels and among multiple response partners.⁵⁵

51 Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

52 <http://www.nisconsortium.org/partner-highlights/736-2/>

53 <https://www.dhs.gov/sites/default/files/publications/Canada-US-Enhanced-Resiliency-Experiment-Fact-Sheet-508.pdf>

54 <https://www.dhs.gov/science-and-technology/news/2016/04/26/dhs-canadian-partners-run-cross-border-emergency-response>

55 <https://www.dhs.gov/science-and-technology/cause-iii>

3.2.4.10 Memorandum of Understanding between the Department of National Defence of Canada, and the Federal Emergency Management Agency, U.S. Department of Homeland Security, Integrated Public Alert and Warning System (IPAWS) Program Management Office regarding the use of: The Multi-Agency Situational Awareness System (MASAS)/IPAWS Bridge and the IPAWS OPEN Platform for Emergency Networks (IPAWS-OPEN)

Established in 2016, the MOU supports establishment and utilization of a standardized, web-based application interface between the Information Technology systems to facilitate the exchange of emergency messages.⁵⁶

3.2.4.11 Statement of Intent Between the Department of Health of Canada and the Department of Energy of the United States of America Regarding Nuclear and Radiological Emergency Management and Incident Response Capabilities

Established in 2014, the Statement of Intent (SOI) provides a framework for cooperation between the Department of Health of Canada and the Department of Energy of the United States to enhance radiological and nuclear security for major public events and minimize the actual or potential radiological consequences to health, environment and property of an incident involving nuclear or radiological material worldwide.⁵⁷

3.2.4.12 Memorandum of Understanding (MOU) for Co-Operation Among the Department of National Defence Canada, the Department of Fisheries and Oceans of Canada, the United States Coast Guard, the United States Air Force, the United Kingdom Maritime and Coast Guard Agency, the United Kingdom Civil Aviation Division of the Department of Environment, Transport and the Regions, and the United Kingdom Ministry of Defence Concerning Search and Rescue

Established in 1999 the MOU provides a framework for cooperation among the Participants for the provision of search and rescue (SAR) services in response to a maritime or aeronautical incident within the Participant's search and rescue region. A Participant may enter onto or over the territory of another Participant country for the purpose of rendering emergency rescue assistance to persons, vessels, or aircraft. Notification of such entry must be made as soon as practicable.⁵⁸

3.2.4.13 Memorandum of Understanding on the Facilitation of Vital Civil Cross Border Transport under the North Atlantic Treaty Organization's (NATO) Euro-Atlantic Partnership Council (EAPC) and approved by the Senior Civil Emergency Planning Committee (SCEPC)

The MOU came into effect for both nations in 2009. Participants agree to facilitate vital civil cross border transport and transit in accordance with the MOU. The MOU is a multilateral tool that creates the general framework for the transport and transit of relief personnel and material from a sending Participant to a requesting Participant by water, land, or air to cope with the consequences of a disaster.⁵⁹

⁵⁶ Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

⁵⁷ Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

⁵⁸ Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

⁵⁹ Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

3.2.4.14 Memorandum of Cooperation between Public Safety Canada and the United States Department of Homeland Security (to promote joint efforts by the respective public affairs organizations) and Canada-US Incident Management Framework for Public Communications

Established in 2008, this MOU documents the partnership between the DHS Office of Public Affairs and Public Safety Canada. The two have developed a Canada-US Incident Management Framework for Public Communications with best practices for sharing public affairs communications materials and contact lists for use during exercises, national security incidents involving the United States and Canada, large-scale incidents, and international incidents involving international allies. This framework is tested annually through exercises and reviewed routinely.⁶⁰

3.2.4.15 Regional Level Cooperation Between Canada and the United States

The Pacific Northwest Emergency Management Arrangement, the Emergency Management Assistance Memorandum of Understanding and the International Emergency Management Assistance Memorandum of Understanding are ongoing regional efforts between provincial and state governments and emergency managers to support mutual aid when preparing for, responding to, and recovering from disasters.

3.2.5 Canada-Mexico Bilateral

3.2.5.1 The Canada-Mexico Partnership

While not specifically related to disaster preparedness and response, a key mechanism for bilateral cooperation is the Canada-Mexico Partnership. Launched in 2004, it serves as a catalyst for action between the governments, private sectors, and non-governmental partners to pursue common goals and mutually beneficial priorities. The CMP meets annually and is coordinated by senior public servants from Global Affairs Canada and from Mexico's Ministry of Foreign Affairs. Membership is not fixed. It is based on participation in one of the CMP's seven working groups, which change periodically to accommodate shifts in national priorities.⁶¹ The current working groups (active 2015-2016) are:

- Agri-business
- Energy
- Environment
- Forestry
- Human Capital
- Labour Mobility
- Trade, Investment and Innovation

3.2.6 Events or Conferences

3.2.6.1 Upcoming

While a review of Prevention Web's Meeting and Conferences page⁶² and an Internet search show a variety of disaster related conferences and events for 2017 and 2018 in the Americas, researchers could find none specific to cross border interaction and support amongst the three North American countries. Most events, such as the Global Disaster Relief & Development Summit (September 6-7, 2017) tend to be broad development and disaster based forums.

3.2.6.2 Past

In March of 2017, the United Nations Office for Disaster Risk Reduction – Regional Office for the Americas held the Fifth Regional Platform for Disaster Risk Reduction in the Americas

⁶⁰ Compendium of U.S.-Canada Emergency Management Assistance Mechanisms, October 2016

⁶¹ <http://www.canadainternational.gc.ca/mexico-mexique/cmp-pcm.aspx?lang=eng>

⁶² <http://www.preventionweb.net/events/meeting/>

in Montreal, Canada. The Platform meeting brought together key players from North, South, Central America and the Caribbean, involved in disaster risk reduction and resilience building. The platform meeting was a multi-sectoral participatory forum reflecting the commitment and concern of the (national, subnational and local) governments, intergovernmental organizations (IGOs), international organizations (IOs), non-governmental organizations (NGOs), community organizations, scientific and academic institutions, private sector, donors and the media to disaster risk reduction efforts.⁶³

In June 2016 the North American Climate Services Partnership NACSP joined with the biennial North American Drought Monitor (NADM) Forum and annual North American Fire Forecasting Workshop to convene a joint meeting on drought, wildfire, and climate services across North America. Nearly 50 participants from the United States, Canada, and Mexico came to together to discuss existing monitoring, assessment, and outlook tools and products and to explore opportunities for enhanced collaboration and partnerships across regions and borders. Discussions resulted in specific recommendations on how to improve the development and delivery of North American and national products.⁶⁴

In March of 2012 the Trilateral Security Cooperation in North America program brought together leaders from the government, military, and academia in tri-national discussion of North American security cooperation. Three panels explored trilateral efforts in the spheres of national security and military cooperation, public security and police cooperation, and public safety and health cooperation.⁶⁵

In November of 2010 representatives of the Canadian, Mexican, and United States National Platforms for the United Nations International Strategy for Disaster Reduction (ISDR) met, joined by civil society stakeholders from each country. The meeting focused on progress, success strategies, and barriers with respect to implementation of the disaster risk reduction principles and goals of the Hyogo Framework for Action. The workshop participants discussed opportunities for cross-border collaboration, efforts beyond North America, and strategies to reduce urban disaster risk.⁶⁶

In November 2006 the Workshop on Preparing for and Responding to Disasters in North America was co-sponsored by the Homeland Defense and Security Education Consortium, the University of Texas San Antonio, and East Carolina University. The conference provided three panels focused on cross-border cooperation related to natural disasters, pandemic flu, and catastrophic terrorism.⁶⁷

3.2.7 Other

The United States has a process supporting the flow of people and equipment into the country. The U.S. Border Crossing Process for Voluntary Agency Groups/Individuals was established in 2007, as a process between the Federal Emergency Management Agency (FEMA) and Customs and Border Patrol (CBP). It facilitates the secondary “parole” entry of groups and individuals from Canada and other countries affiliated with the National Voluntary Organizations Active in Disaster (NVOAD) into the United States to provide voluntary services to non-governmental organizations in support of U.S. declared disaster recovery operations. The voluntary organization activates the process by providing a list of volunteers and other information to FEMA

63 <https://www.unisdr.org/we/inform/events/46627>

64 <http://journals.ametsoc.org/doi/full/10.1175/BAMS-D-16-0296.1>

65 <https://www.wilsoncenter.org/event/trilateral-security-cooperation-north-america>

66 Summary of the North American Workshop on the Mid-Terms Review: Washington, D.C., United States, Date: 3 November 2010, accessed from http://www.unisdr.org/files/18197_407northamericaworkshopsummaryandpa.pdf on 24 June 2017

67 Robinson, Lance. “Proceedings of the Workshop on Preparing for and Responding to Disasters in North America.” *Homeland Security Affairs, Proceedings of the Workshop on Preparing for and Responding to Disasters in North America* (December 2007). <https://www.hsaj.org/articles/136>

no later than one week prior to U.S. entry. FEMA verifies the information provided and sends a request letter to CBP. CBP reviews the information and forwards to the Point of Entry (POE) for consideration. Groups and individuals must be “credentialed” by the voluntary organization they represent. Tools and equipment being transported must be registered with CBP to ensure return to its country of origin.⁶⁸

3.3 Policy Scan Summary

Dr. Kirsten Bookmiller of the Center for Disaster Research and Education at Millersville University of Pennsylvania conducted the Multinational Legal and Policy Preparedness Scan (Policy Scan) to support and inform efforts for the NAHRS. The Policy Scan is available as part of the NAHRS project. The purpose of the Policy Scan was to review existing legal authorities, policies, and agreements held by the national governments or the Red Cross Societies of Canada, Mexico and the United States as they relate to national facilitation of efficient and effective mutual assistance after a catastrophic disaster.

Researchers looked at the political, legal and diplomatic operating environment that informs the development of North American cross-border disaster response law and policy. They conducted a legal and policy preparedness mapping and analysis, highlighting the current state of readiness in key areas identified by the stakeholders themselves as well as those identified through external evaluation. Opportunities for further growth in the legal and policy preparedness amongst the National Red Cross Societies and governments of North America were also examined and analyzed.

The Policy Scan does not serve as a comprehensive survey of all laws (national and subnational), policies and regulations in effect within and across the national governments and Red Cross Societies. Instead it draws attention to current areas of strength and vulnerability related to cross-border operational support. Researchers used a number of qualitative research methods to develop the Policy Scan starting with a primary document review of available legislation, policies, regulations and international agreements. Semi-structured interviews were conducted with a variety of stakeholders and experts. Finally, a secondary literature review was conducted in support of the Policy Scan’s conclusions and recommendations.

Policy Scan Key Findings

Legal, policy and regulatory interface covering cross-border disaster relief among the six stakeholders are extensive, multi-faceted and complex due to:

- » The multi-sector and multi-dimensional nature of incoming assistance, correspondingly triggering extensive regulatory mechanisms horizontally across numerous governmental agencies in each country;
- » The three countries’ federal governmental systems (as well as indigenous community modes of sovereignty) vertically stratifying domestic regulation of incoming disaster relief between national and subnational levels;
- » The three countries’ contrasting perceptions of the role of the international disaster response system as aid provider, possibly resulting in problematic response coordination among them;
- » The three national governments’ overarching diplomatic considerations and sensitivities, leading to an ever shifting legal, political and policy backdrop against which cross-border disaster response occurs;
- » The three National Societies’ distinctive relationships with their own respective governments, potentially generating differing policy expectations of their contributions during a cross-border disaster response;
- » The three National Societies’ decentralized organizational structure between national

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headquarters and local chapters, producing a multi-level network of relationships and operating values;

- » For the local communities residing along the respective borders, a keen sense of shared interests related to disaster relief irrespective of international boundaries and national policies, shaping their critical but often overlooked role as the first wave of cross-border disaster response.

Given such complexity, finding an appropriate entry point for a dialogue on North American cross-border assistance may appear overwhelmingly daunting from the outset. Yet a landscape analysis of this intricate web hints at ways forward in advancing legal and policy preparedness for both participating governments and the National Societies. More vitally, trinational stakeholder interviews strongly indicate not only receptiveness but also a high level of commitment to elevating the level of legal and policy preparedness in this domain.

From the perspective of this scan and analysis, potential starting points for the NAHRS dialogue pertinent to building legal and policy capacity might include:

- » Empowering local Red Cross chapters along the US-Canadian and US-Mexican borders or otherwise geographically proximate chapters with Memorandums of Understanding (MOUs) or similar instruments to enhance operational preparedness; for those MOUs that are currently in existence, review and update them where appropriate.
- » Facilitating an information sharing process across the three national governments-- ideally in a compendium format in English, French and Spanish—that identifies and synthesizes national and subnational regulations within each country applicable to cross-border disaster aid in all forms (goods, personnel, equipment). A long-range goal should optimally involve an additional dialogue focusing on ways to reduce regulatory barriers to mutual aid provision. Still an initial understanding of the regulatory landscape is an important first step in moving away from what is currently an anecdotal based understanding of such challenges;
- » Updating the trilateral MOU between the American Red Cross, Mexican Red Cross and Canadian Red Cross so that it more fully recognizes the operational conditions generated by the regulations noted in #2 above;
- » Determining the best modes for “document preparedness” within and between the three National Red Cross Societies as well as with their respective governments. Disaster readiness in this form allows for immediate ease of access (both physically and lingually) and a shared understanding by all relevant parties as to mutual assistance protocols in force in force following a catastrophic event;
- » Considering potential value-added contributions and resources of other actors to cross-border responses by the three National Societies, including the International Federation of Red Cross and Red Crescent Societies (IFRC).

There are other key policy areas also essential to efficient cross-border disaster response operations that will require sustained policy attention at the highest, decision-making levels of the national governments of the United States (US), Mexico and Canada. The National Societies may want to consider initiating a dialogue with the appropriate governing authorities related to the following four areas:

- » Facilitated border entry of external disaster response personnel;
- » Facilitated entry of personnel providing emergency medical provision specifically as it relates to issues of licensing/credential recognition and liability;
- » Cross-border population movement in the wake of a catastrophic event;
- » Advance planning concerning operational arrangements between the three governments to ensure coordinated entry of relief-related goods and equipment, with specific attention dedicated to pro-active coordination of regulatory authorities of the

affected state(s).⁶⁹

These baseline findings will be used to inform and enhance the dialogue and activities at all NAHRS meetings and events.

⁶⁹ North American Humanitarian Response Summit Project Multinational Legal and Policy Preparedness Scan, Draft Submission, July 3, 2017, Prepared by Dr. Kirsten Nakjavani Bookmiller.

4. Recommendations

This section of the Synthesis Report is designed to provide recommendations that can be used to guide the NAHRS process.

- » Revise and Refocus the Problem Statement - The current summary of the problem that NAHRS seeks to address, lacks focus and requires further definition. Based on the work completed to-date and included in this Synthesis Report, there is the need to revise and refocus the NAHRS problem statement. Specifically, that:

There exist many different efforts (laws, legal authorities, compacts, memoranda of understanding, projects) related to strengthening cross border support during crises in North America. However, there is limited comprehensive understanding of these various efforts beyond the entities directly involved in the development and maintenance of them. This silo approach within countries and across the three countries (Canada, Mexico and the United States) combined with bureaucratic barriers will impede response efforts particularly during a catastrophic response when the rapid flow of humanitarian assistance (professional personnel, equipment and supplies) is required to save lives and reduce suffering.

Thus, the NAHRS process will test the functionality of the existing efforts already in place amongst the nations of North America. This testing will identify gaps, barriers and concerns related to cross-border response support during a truly catastrophic disaster scenario. Based on that common understanding amongst the NAHRS participants, next steps, outcome targets and activities will be established that build upon existing efforts, increase cross-border collaboration, breakdown bureaucratic barriers and close gaps in understanding.

- » Five (5) Initial Topic Areas for Focus - The following topic areas should be used to focus future NAHRS discussions and serve as primers for all future NAHRS related deliberations:
 1. Determination of national requirements and triggers for accepting and facilitating international support
 2. Cross border movement of professional response personnel and their equipment
 3. Cross border movement of humanitarian supplies and tools
 4. Licensure requirements for professional response personnel
 5. Migration issues related to movement of people from one country to another due to a disaster (either due to the threat of a disaster or following the occurrence of a disaster)

A matrix of the current practices for each of the three countries (Canada, Mexico and the United States) in all of the five topic areas above should be established in advance of the convening meeting. This matrix can then be used to identify gaps, barriers and potential future solutions during the NAHRS process.

- » Participants and Organizers to Focus on Collaboration & Communication - There can be the tendency to focus and be fascinated by the types of catastrophic disaster scenarios that would necessitate cross-border response support. However, the fundamental purpose of the NAHRS should be to address the problem statement above which can only be achieved through more effective collaboration and communication. Thus, all work done as a part of the NAHRS must focus on how best to increase collaboration and communication with less concern given to the actual disaster scenarios.
- » Frame Red Cross Role within the Wider Governmental Role – As the convening entity responsible for initiating, funding and delivering the NAHRS, it is critical the American Red Cross continue, in collaboration with the Canadian Red Cross and Mexican Red Cross, to emphasize the importance of their government counterparts engaging and

helping to lead the NAHRS process. This is a unique opportunity for the Red Cross National Societies involved to strengthen their roles as auxiliaries to their governments, reaffirm their responsibilities during catastrophic disaster responses and strengthen catastrophic disaster preparedness through humanitarian diplomacy. However, the primary responsibility for disaster response in any nation is always the nation state itself and the designated authority departments or agencies. Continuing to frame the Red Cross role within the wider context of the whole of government responses that will be needed in these types of catastrophic response is essential to the success of the NAHRS.

Annexes

Annex 1: Disaster Data Sets

Canada Disaster Data – Top 10 Since 1900^{1,2}

Table 1
Top 10 Disasters in Total
People Affected

Disaster No	Type	Date	Total Affected
1918-0015	Influenza Epidemic	01-00-1918	2000000
1979-0186	Mississauga Train Derailment	00-00-1979	220000
1950-0017	Red River Flood	05-05-1950	107000
2013-0190	Alberta Floods	06-20-2013	100000
2016-0172	Fort McMurray Wildfire	05-01-2016	88000
1984-9211	Drought	01-00-1984	30000
1997-0082	Red River Flood	04-24-1997	29000
1931-9014	Drought	01-00-1931	25000
1989-0280	Manitoba Wildfires	04-19-1989	25000
1917-0007	Halifax Explosion	12-06-1917	15000

Table 2
Top 10 Disasters in Total
Damages (Shown In US
Dollars)

Disaster No	Type	Date	Total Damage (US\$)
2013-0190	Alberta Flood	06-20-2013	5700000000
1989-0280	Manitoba Wildfires	04-19-1989	4200000000
2016-0172	Fort McMurray Wildfire	05-01-2016	4000000000
1977-9294	Drought	01-00-1977	3000000000
1992-0504	Extreme temperature	12-00-1992	2000000000
1998-0003	North American Ice Storm	01-04-1998	1500000000
2011-0630	Richardson Backcountry Wildfire	05-14-2011	1500000000
2013-0580	Toronto Flood/Flash Flood	07-08-2013	1410000000
2012-0626	Calgary Hail Storm	08-12-1012	1050000000
1984-9211	Drought	01-00-1984	1000000000

1 Created on May 31, 2017 Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) – CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

2 Names of disasters were determined through an internet search using the type and date from EM-DAT data

Table 3
Top 10 Disasters in Total
Deaths

Disaster No	Type	Date	Totals Deaths
1918-0015	Influenza Epidemic	01-00-1918	50000
1917-0007	Halifax Explosion	12-06-1917	1600
1914-0003	RMS Empress of Ireland Sinking	05-29-1914	1014
1936-0006	Extreme temperature	07-06-1936	500
1953-0030	Polio Epidemic	01-00-1953	481
1918-0013	Transport accident	10-23-1918	343
1985-0139	Gander Air Crash	12-12-1985	256
1913-0024	Great Lakes Storm	11-07-1913	235
1998-0287	Swissair Flight 111 Crash	09-02-1998	229
1916-0002	Matheson Fire	07-30-1916	228

Mexico Disaster Data – Top 10 Since 1900^{3,4}

Table 1
Top 10 Disasters in Total
People Affected

Disaster No	Type	Date	Total affected
2011-9363	Drought	09-00-2011	2500000
1985-0109	Mexico City Earthquake	09-19-1985	2130204
2005-0567	Hurricane Stan	10-01-2005	1954571
2007-0521	Tabasco Flood	10-28-2007	1600000
2005-0585	Hurricane Wilma	10-19-2005	1000000
2010-0467	Southern Mexico Flood	09-20-2010	1000000
1997-0243	Hurricane Pauline	10-07-1997	800200
1999-0391	Eastern Mexico Flood	09-12-1999	616060
2002-0609	Hurricane Isadore	09-20-2002	500030
2008-0304	Hurricane Dolly	07-20-2008	500000

3 Created on May 31, 2017 Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) – CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

4 Names of disasters were determined through an Internet search using the type and date from EM-DAT data. Note: Storm names are included where researchers have a degree of confidence. The volume of storms making landfall in Mexico made discreetly identifying some storms difficult.

Table 2
Top 10 Disasters in Total
Damages (Shown In US
Dollars)

Disaster No	Type	Date	Total Damage (US\$)
2005-0585	Hurricane Wilma	10-19-2005	5000000000
2013-0358	Hurricane Manuel	09-13-2013	4200000000
1985-0109	Mexico City Earthquake	09-19-1985	4104000000
2010-0494	Hurricane Karl	09-15-2010	3900000000
2007-0521	Tabasco Flood	10-28-2007	3000000000
2014-0333	Hurricane (Name?)	09-10-2014	2500000000
2005-0567	Hurricane Stan	10-01-2005	2500000000
2010-0260	Hurricane Alex	06-30-2010	2000000000
1993-0174	Hurricane (Name?)	06-22-1993	1670000000
2013-0406	Hurricane Ingrid	09-12-2013	1500000000

Table 3
Top 10 Disasters in Total
Deaths

Disaster No	Type	Date	Totals deaths
1985-0109	Mexico City Earthquake	09-19-1985	9500
1959-0001	1959 Mexico Hurricane	00-00-1959	2000
1949-0003	Volcanic activity	00-001949	1000
1959-0014	Storm	10-27-1959	960
1999-0391	Flood	09-12-1999	636
1976-0066	Storm	10-01-1976	600
1955-0016	Storm	09-28-1955	500
1973-0035	Earthquake	08-28-1973	500
1961-0014	Storm	11-12-1961	436
1990-0356	Extreme temperature	04-30-1990	380

United States Disaster Data – Top 10 Since 1900^{5, 6, 7}

Table 1
Top 10 Disasters in Total
People Affected

Disaster No	Type	Date	Total affected
2016-0010	Winter Storm Jonas	01-23-2016	85000012
2008-0627	Midwest Floods	06-09-2008	11000148
2004-0455	Hurricane (Name?)	09-05-2004	5000000
1999-0327	Hurricane Floyd	09-13-1999	3000010
2008-0352	Hurricane Gustav	09-01-2008	2100000
1985-0104	Hurricane Elena	08-30-1985	1000000
2007-0519	California Wildfires	10-21-2007	640064
2005-0467	Hurricane Katrina	08-29-2005	500000
1993-0562	Milwaukee Cryptosporidium Outbreak	04-05-1993	403000
2011-0328	Hurricane Irene	08-27-2011	370000

Table 2
Top 10 Disasters in Total
Damages (Shown In US
Dollars)

Disaster No	Type	Date	Total Damage (US\$)
2005-0467	Hurricane Katrina	08-29-2005	125000000000
2012-0410	Hurricane Sandy	10-28-2012	50000000000
1994-0002	Northridge Earthquake	01-17-1994	30000000000
2008-0384	Hurricane Ike	09-12-2008	30000000000
1992-0066	Hurricane Andrew	08-24-1992	26500000000
2012-9489	Drought	06-00-2012	20000000000
2010-0167	Deepwater Horizon	04-20-2010	20000000000
2004-0462	Hurricane Ivan	09-15-2004	18000000000
2005-0547	Hurricane Rita	09-23-2005	16000000000
2004-0415	Hurricane Charley	08-13-2004	16000000000

5 Created on May 31, 2017, Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) – CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

6 Does not include terrorist attacks

7 Names of disasters were determined through an internet search using the type and date from EM-DAT data

Table 3
Top 10 Disasters in
Total Deaths

Disaster No	Type	Date	Totals deaths
1900-0003	Galveston Hurricane	09-08-1900	6000
1906-0013	San Francisco Earthquake	04-18-1906	2000
1928-0014	Okeechobee Hurricane	09-13-1928	1836
2005-0467	Hurricane Katrina	08-29-2005	1833
1980-0063	Extreme temperature	06-00-1980	1260
1936-0005	Extreme temperature	07-00-1936	1193
1906-0003	Miscellaneous accident	00-00-1906	1188
1918-0007	Cloquet Wildfire	10-15-1918	1000
1904-0001	Transport accident	06-15-1904	1000
1915-0007	Transport accident	07-24-1915	812

Annex 2: Understanding UNISDR GAR

Capital Stock

Capital stock as referred to in GAR15 in the context of risk assessments is the total value of commercial and residential buildings, schools and hospitals in each country. This excludes infrastructure such as roads, telecommunications and water supply (UNISDR). Capital stock as defined in GAR 15, gives an idea of the value of the exposed assets and can be used to assess a country's average annual loss or probable maximum loss.⁸

GFCF (Gross Fixed Capital Formation)

GFCF (Gross Fixed Capital Formation) - formerly gross domestic fixed investment - includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in current U.S. dollars. In the context of GAR, GFCF is the total investment of a country in new infrastructure and improvement of existing infrastructure for a given year. This indicator is compared with Average Annual Loss (AAL) giving an idea of how much investment would be needed to cover future losses. GFCF is flow concept of a given year while capital stock is accumulated stock concept.⁹

Social Expenditure

Social Expenditure relates to government spending on education, health and social protection. In the context of GAR, social expenditure is compared with Average Annual Loss (AAL) to provide an idea of the implications of the potential negative impact on the social expenditure and accompanying loss of social welfare of a country.¹⁰

8 GAR 2014 - <http://www.preventionweb.net>

9 World bank Development indicators - <http://data.worldbank.org/> accessed from <http://www.preventionweb.net/countries/can/data/>

10 International Labour Organisation, ILO: Total Social Protection expenditure, 2012; Public Health Care expenditure, 2012; World Bank Development indicators, Public Education expenditure, 2011 accessed from <http://www.preventionweb.net/countries/can/data/>

Total Reserves

Total reserves minus gold comprise special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are excluded. Data are in current U.S. dollars. Total reserves suggests an element of a countries' capacity and ability to finance disaster recovery and reconstruction.¹¹

11 World Bank Development indicators - <http://data.worldbank.org/> accessed from <http://www.preventionweb.net/countries/can/data/>