Saskatchewan Flood and Natural Hazard Risk Assessment

- Stakeholder Insights Report -

Prepared for Saskatchewan Research Council
as part of the Saskatchewan Flood and Natural Hazard Risk Assessment

By **Darrell R. Corkal, P.Eng.**
Walker Projects Consulting Engineers

SRC Publication No. 14113-1E18

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R.Halliday & Associates Water Resources Management

WALKER PROJECTS Consulting Engineers · Project Managers

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EXECUTIVE SUMMARY

"The people of this province have the right attitude and demeanor to endure these hardships [natural hazards in Saskatchewan] and improve upon them. They need good vision and science to help them make the best decisions"

"Climate change…will change the playing field for all of these natural hazards"

"During a natural disaster communication is probably the most challenging part"

"this study is on the right track, getting the people's view"

"[I] would like to see results incorporated into long-term government planning."

(Anonymous Stakeholders)

Six workshops were held across Saskatchewan, with around 200 invited stakeholders representing diverse interests, institutions and agencies (local, provincial, federal), including:

- Communities and Rural Municipalities, including their associations (Saskatchewan Urban Municipalities Association, Saskatchewan Association of Rural Municipalities)
- First Nations communities, and respective associations (e.g. Tribal Councils)
- Government agencies (local, provincial, federal)
- Academia, Subject Matter Experts and Specialists (in disaster risk reduction; emergency management professionals - preparedness planners and responders; mitigation and climate change adaptation professionals, etc.)
- Industry (forestry, mining, agriculture, energy, road and rail transportation, etc.)
- Non-government organizations (e.g. emergency management organizations, insurance providers, watershed groups, environmental groups, agriculture and engineering associations, industry groups such as irrigation associations, etc.)

The stakeholders identified unique impacts, mitigations and priorities for each regional area, and identified many points common to all regions. The stakeholders identified:

- natural hazard risks and local/regional vulnerabilities
- current mitigations practiced, and
- their considerations of the implications of future natural hazard risks and mitigations under a climate change scenario

The stakeholders appreciated the workshops and information sharing. They indicated a desire to keep the following types of activities on-going:

- share information, current science and knowledge
- improve natural disaster preparedness planning and response plans
- continue to engage local stakeholder discussions with future planning and actions

The following sections provide a high-level overview of the major natural hazard impacts and mitigation priorities, as identified by the stakeholders. Detailed lists of the natural hazards were identified at each regional workshop and are compiled in the body of the main report entitled "Saskatchewan Flood and Natural Hazard Risk Assessment Stakeholder Insights Report" (Corkal, 2018). Subsequently, the stakeholders evaluated the detailed lists by voting on those they recognized as being the most critical. The stakeholder-priorized impacts and mitigations were then grouped and organized around common themes, as listed below in Tables A to C.

Droughts and Water Scarcity

Stakeholders recognise droughts and water scarcity are common natural hazard risks in Saskatchewan, and are essentially part of Saskatchewan's natural climate variability. People recognize that the recent period (2010-2016) has been extremely wet across much of Saskatchewan. [The year 2015 did experience agricultural drought in select geographic areas, but generally speaking, sloughs and groundwater supplies remained well above average.] Even with such exposure to extremely wet conditions over a six-year period, all stakeholders understand drought is a natural characteristic of the prairies and expect that future droughts will recur. Prolonged droughts have serious impacts to agriculture, communities and many sectors. Rural communities are particularly hard hit due to their strong reliance on agriculture and related sectors. Severe droughts affect both provincial and federal economic activities. Stakeholders desire to be "better prepared" for drought and realize that strengthening local resilience is possible. Saskatchewan requires a comprehensive multi-sector drought contingency plan to address water scarcity, and risks from medium- to long-term drought exposure (e.g. multi-year droughts, increasing water scarcity and water supply shortages). The concept that climate change may exacerbate future drought risk is also recognized by stakeholders as an important factor in preparedness planning for drought and water scarcity.

All stated that more severe water scarcity or prolonged multi-year drought, requires a much more co-ordinated institutional response from provincial and federal governments to address severe economic, social and environmental impacts (e.g. loss of soil organic matter, negative ecosystem impacts, etc.). The key feature for drought or severe water scarcity as a natural hazard, relates to its slow on-set. Drought impacts may intensify over time and generally have wider-spread geographic exposure than natural disasters such as flooding, which tends to be more localized. Much can be learned from past droughts, yet people acknowledge that droughts tend to be forgotten when times are better. People relate to, and are concerned about, the potential for future droughts similar to those in the past (e.g. 2001-02, 1930s). A "**DroughtSmart**" program would be beneficial, along with long-term planning. Drought and water scarcity preparedness planning needs to be continually improved and at-the-ready, even during non-drought years. While not often seen as an "emergency" due to its slow onset, drought preparedness planning can adopt many if not all of the emergency preparedness planning concepts recognized to be standard operating procedures for flood risk and/or fire risk natural hazard reductions. Planning for drought needs to be a regular (annual) occurrence, even during wet periods or non-water scarce periods. As with FireSmart planning, drought preparedness planning continually needs to be updated, with stakeholders and institutions to be "at the ready" to implement actions that address water scarcity risks as they may occur.

Table A - Drought Impacts and Mitigations (priorized by stakeholders)

Drought Impacts	Drought Mitigations
i. Community and Municipal Water Impacts o Potable water availability and quality o Alternate water supplies o Community evacuation **ii. Social and Institutional Impacts** o Inter-jurisdictional challenges o Priority of water use (hierarchy of needs – who gets water during water shortages?) o Lack of public acceptance of impacts o Lack of local awareness or watershed groups o Increased water use/competition between people, industries, agriculture during rationing periods o Social impacts on people, impaired coping o Unequal coping capacity in different areas **iii. Ecosystem and Resource Impacts** o Water supply shortages o Water competition (local needs, communities, agricultural sector especially with irrigation, mining sector, energy sector, recreation/tourism impacts, etc.) o Increased wildfire risk (grasslands and forests, especially before spring "green-up" and in fall); less water available for fire suppression o Agricultural sector (farmland) is the most severely affected sector (crop failures, livestock affected, direct on farm impacts to production; spin-off rural community impacts, potential rural / provincial economic downturn) o Energy sector impacted (hydro, energy consumption) o Ecological impacts (poor water quality, plant and animal disease, increased algae, impaired grasslands, wetlands and ecosystems, including wildlife health) **iv. Infrastructure and Information** o Water resource data and information flow [to share data with various stakeholders, institutions and agencies] o Illegal drainage problems o Road maintenance is easier to complete during drought periods	**i. Water Management** o Water storage, reservoirs, stockpiling o Allocations; Rationing; Water Pricing o Watershed assessments o Effective drainage; correct drainage issues o Sharing of equipment / pumps, pipelines o Alternate water supplies o Resilient water infrastructure o Co-ordinated institutional plans (local, provincial, federal) o Strengthened engagement of stakeholders and watershed groups o Improved local, sector water management strategies (conservation, protection) **ii. Long-term planning** o Incorporate drought risk in long-term plans; scenario planning o Emergency preparedness plans in place and understood o Learn from past experiences (since settlement) o Use lessons from past to guide preparedness plans Plan for a "non-rainy" day o Incorporate preparedness planning ("WaterSmart" programs with "FireSmart programs") o Incorporate climate change into natural hazard risk assessment and preparedness **iii. Resource Protection and Conservation** o Improved water resource planning o Source water protection o Knowledge of water resources for drought mitigation and fire suppression o Open fire restrictions (drought and fire correlate) o Preservation of wetlands and ecosystems **iv. Knowledge, Public Education, Communications** o Education and awareness o Value of water conservation and restrictions stakeholder knowledge and understanding, including knowledge of past lessons

	o Communications plans on water management (esp. during water scarcity and drought) o Improved water knowledge base (shared between experts and the public)

Floods and Excessive Water

Most stakeholders have had some experience with floods or excessive moisture. Much of Saskatchewan has experienced extremely wet conditions during the period from 2010 to 2016. Stakeholders believe that floods and their variability have intensified in recent times. They recognize that floods affect all types of infrastructure, communities, and economic activities. And they recognize other effects on "soft infrastructure" (e.g. loss data, administrative and financial records, etc.). Mitigations generally involve water management, flood protection, safeguarding of infrastructure, back-up systems, and effective zoning, planning and development (to remove activities and infrastructure in flood-prone areas, and prevent building or commercial developments in high-risk flood-prone locations). A "**WaterSmart**" program would be beneficial. Flooding and excess water emergency preparedness planning must be adopted at a local scale, with consideration for regional implications (e.g. water management and runoff implications). Integrated agency responses are essential. There is a concern that flood intensities are changing over time (i.e. becoming more severe). Some of the drivers for flood protection will be administrative and regulatory, and will also include engineering design and insurance considerations. In Saskatchewan, most flood risk maps for urban areas date to the 1980s. Residual risk of flooding can be decreased considerably by zoning urban and rural areas with updated flood risk assessments to restrict development in flood plains.

Table B Flood Impacts and Mitigations (priorized by stakeholders)

Flood Impacts	Flood Mitigations
i. Infrastructure Impacts o Railways, Highways, Rural roads o Access to communities and critical infrastructure is cut-off or impaired o Urban storm water drainage o Utilities (Sask Power, energy outages and infrastructure access limitations) o Dams, incl. dam safety o Landfills, waste sites o Loss of water and wastewater facilities o Buildings, structures, property, agricultural land (commercial, private and recreational property damages) **ii. Human and Economic Impacts** o Not a full understanding of risk o Social impacts, individuals, communities o Stress and anxiety to affected citizens, people, emergency responders, institutions	**i. Planning and Monitoring** o Hydrology, forecasting, emergency planning, flood water control, flow and conveyance management (infrastructure) o Improved hydrology, understood at a local level o Improved topography (e.g. LiDAR surveys) o Property buy-out to remove development that exists in flood-prone locations o Flood-risk mapping - for urban and rural areas (most existing urban flood risk maps in Saskatchewan date back to the 1980s) o Water quality protection plans **ii. Infrastructure Design** o Water control, flow and management (infrastructure and ecosystems inc. wetlands)

- Displacement of people, industry, and community impacts
- Displacement of First Nations communities, rural remote communities, people in critical facilities such as hospitals, care homes, seniors' residences, etc.
- Livestock and agricultural land impacts may be unique
- Access in/out of flooded areas cut-off
- Economic activities stopped or reduced, tourism and production impaired
- Human toll and stress (from impaired property, economic stress and loss during flood and post-recovery, which can be a prolonged period)

iii. Environmental Impacts

- Contaminated water risking water safety; increased salinity; degradation of surface water supplies, and contaminated ground water supplies; impairment of lakes, rivers and recreational water sources (e.g. nutrients, other runoff contaminants)
- Erosion, slumping, infiltration
- Shoreline alteration
- River or stream changes
- Animal carcass disposal
- Runoff of animal and human waste (e.g. dispersion of flooded lagoons)

iv. Institutional Impacts

- Emergency Planning
- Hydrology (knowledge)
- Institutional responses
- Need for coordination of institutions

v. Policy Impacts

- Non-compliance of by-laws, zoning
- Non-enforcement by insurance agencies
- Agricultural drainage issues
- Infrastructure planning, reduced urban runoff, managed runoff with existing sub-divisions, and new residential and commercial development, etc.)
- More, better engineering to protect from flood risk
- Consider water storage with drainage design (i.e. design for excess water and for water scarcity)
- Identify critical infrastructure
- Improve infrastructure where beneficial (road grades and access road, flood protection, drainage, soil erosion protection

iii. Zoning, Policy, Infrastructure

- Zoning improvement; enforcement of legislation; by-laws and building codes, land use plans, community development and sub-divisions, private and commercial development, source water protection plans (the Saskatchewan regulatory flood is the 1:500 year event)
- Flood risk management: plan wisely, do not construct on flood-prone locations
- Develop/incorporate new standards (e.g. flood frequency returns)

iv. Proactive Planning and Preparedness

- Regional and local planning; partnership planning, agency integration, effective leadership, for communities, parks, etc. (strengthened and more coordinated institutional responses)

	o Local, provincial, federal mitigation planning o Emergency preparedness plans in place and understood o Proactive measures, financial incentive for flood protection and awareness o Incorporate climate change into natural hazard risk assessment and preparedness planning o Flood hazard response planning and communications; emergency preparedness planning and implementation /public education o Effective communications (emergency preparedness and response) o Emergency power, alternate water supplies o Evacuation planning, local input o Incorporate climate change into natural hazard risk assessment and preparedness planning **v. Knowledge and local capacity** o Hydrology and knowledge (inc. local) of water flow on land systems, ecosystems, collect better water data o Downstream impacts and effects knowledge (inc. local) o Develop a common understanding of risk o Learning from impacts and experiences o Educate local leaders, councils, and public o Support and train local groups and volunteer responders; incorporate local knowledge and strengthen local flood response capacity to respond to floods; cross-training with disaster response o Watershed education **vi. Ecosystem Benefits** o Wetland preservation to improve water management, buffer extreme wet conditions o Green infrastructure to assist with water management and runoff protection

Wildfires – Forest Fires and Grassland Fires

Stakeholders identified both forest wildfires and grassland wildfires as natural hazard risks in Saskatchewan. Wildfires impact people, communities, economic activities, and all types of infrastructure. The rapid growth of a large fire requires astute emergency management responses to protect human life. Evacuations may be required. The impacts of wildfires are more pronounced with dry or drought conditions. Mitigations require effective emergency response preparedness planning and incident response at a local and regional scale. Road, rail, air access is critical, as fires often affect remote or rural areas. Communications and local response actions are also critical. Saskatchewan's **FireSmart** programming is recognized as a very effective preparedness planning measure, and emergency management approach. Access to water for fire suppression, back-up energy supplies, backup communications systems, zoning, development, and integrated agency responses are all critical features in mitigating impacts from wildfires. Stakeholders and residents in remote communities desire firefighting training so they could participate in protecting their communities and be early responders so as not to be in a position of inactivity while waiting for emergency responders (e.g. EMS) to address fire risks.

Table C Wildfire Impacts and Mitigations (priorized by stakeholders)

Wildfire Impacts	Wildfire Mitigations
i. Social Impacts o Law and order, looting, crime, security o Isolation of rural people, or those in remote locations (e.g. the north) o Employment loss, employee care o Critical of decision-makers o Taxed government resources, emergency responders o Evacuations o Health impairment (smoke inhalation) – this can occur hundreds of kilometers or more away from fire source o Lack of experience of responders affect human risk o Coordination response problems - poor interagency communication o People are challenged to deal with the aftermath **ii. Industry and Economic Impacts** o Individual, industry economic impact o Mines, forestry, other business activities shut down, lost income for industry and employees (for event and post-recover) o Impairment of water system, utilities o Agricultural and livestock losses o Cascading infrastructure losses o Loss of communications towers **iii. Infrastructure and Resource Impacts** o Power supplies	**i. FireSmart, Knowledge and Communications** o Strengthened FireSmart programming, especially additional funding o Risk assessment o Education and Awareness (local and public); communications pre-event, during-hazard and post-hazard to keep all informed o Critical infrastructure identified o Partner with industry and local responders; training of responders o Maintain access, egress o Plan for water supplies, pumps, pipelines o Municipal fire bans, fire permits o Public education on fire risk, and emergency plans, including economics o Better exchange of information, with local input and decision-making contributions o Clearer leadership and communications during hazards o Strengthen local resilience, stand-by fire crews, succession-planning for responders ii. **Proactive Planning and Partnerships**

o Water and wastewater supplies o Homes, buildings, industry, commercial infrastructure, roads o Human resources reach limited capacity as focus on firefighting leads to less capacity to address other issues o Water resource impacts as there is less water available to fight fires (water shortages or limited supplies) o Challenges to evacuate parks and recreational communities	o Emergency preparedness plans in place and understood, emergency planners, local responders working with provincial/federal responders o Evacuation plans in place and understood o Air purification systems o Create incentive for risk reduction o Establish the ability to make and implement difficult or tough decisions o Mobilization of neighboring fire departments and responders o Incorporate climate change into natural hazard risk assessment and preparedness planning **iii. Coordination of institutions and emergency responders** o Critical Incident Command/Response o Communications between Incident Command and Emergency Social Services o Data-sharing between agencies o Mutual aid agreements in place o Coordination with provincial institutions o Cross-training, inter-disciplinary response **iv. Management, Policy, Infrastructure** o Landscape-scale forest management o Firebreaks in southern lands/agricultural lands to reduce grass fire risk o Industry fire breaks o Emergency management plans in place and enforcement (implementation) o Zoning, Development, Regulatory tools, e.g. property, industry set-backs o Control burns, policy incentives, insurance incentives **v. Identify water supplies for fire suppression** o Groundwater protection o Access to surface water/groundwater o Readily-accessible water maps identifying water sources for fire suppression (in all areas: e.g. fires during droughts may make it difficult to access water sources).

The stakeholders also identified Other Natural Hazards (i.e. beyond droughts, floods, wildfires). They believe the Province of Saskatchewan is susceptible to risks from other natural hazards identified in Table D as follows.

Table D Other Natural Hazards as identified in all six workshops

OTHER NATURAL HAZARDS (all workshops; grouped under thematic titles)

SEVERE WEATHER AND STORMS

Heat and Convective Summer Storms

- excessive heat (intensity and duration) with extreme temperatures over prolonged periods of time (affecting people, plants, animals, energy consumption, etc.)
- rapid changes in weather with wind, rain, hail (greater storm intensity)
- extreme summer storms with intense rain and wind and hail
- excessive moisture causing land slumping
- plough winds (affecting infrastructure, forests, etc.)
- tornados
- lightning storms (affecting power distribution, communication systems, causing fires)
- hail (intensity and frequency)
- severe weather, severe summer storms

Winter Storms, Blizzards, Snow and Ice

- snow storms (intensity and frequency)
- severe snow storms (which may cause casualties, particularly with transportation)
- heavy wet snow
- winter ice storms (affecting people, infrastructure, power, transportation, etc.)
- ice storms combined with wind
- blizzards with greater frequency and intensity
- severe weather, severe winter storms

ENVIRONMENTAL CHANGES, including ECOSYSTEMS and DISEASE VECTORS

- changing ecosystems (biology, insects, plants, trees, animals) i.e. microbiology, flora and fauna
- beavers, rodents, other ecosystem biota changes
- pest infestations, ecosystem shifts
- landscape changes (e.g. caused by changes to ecosystems, forest health, etc.)
- invasive species changing natural ecosystems and affecting aquatic life, water quality, plants, animals and human health
- exotic plants, insects, animals, invasive species (not common to the local region)
- aquatic invasive species; invasive plant species (i.e. including microbial species, viruses, parasites, bacteria)
- quagga mussels, zebra mussels
- Mountain Pine Beetle
- Diseases (human, crop, livestock, wildlife, plants, forests)
- Livestock diseases such as foot and mouth disease, BSE /Mad Cow disease [BSE is Bovine Spongiform Encephalopathy, a variant of Creutzfeld-Jakob disease] and associated risks to human health

- unique specialized diseases
- West Nile virus
- Lyme disease
- Insects
- Plant and tree diseases (affecting natural ecosystems, plants, trees, forest health)
- New vector-borne diseases [. e.g. health of humans, crops, livestock, wildlife, plants may be affected by new microbiological and biological disease vectors]
- Deteriorating water quality (in the natural environment)
- Excessive moisture causing slumping or swelling of land (e.g. at slopes, shorelines, etc.) and causing damage to infrastructure such as buildings, roads, rail lines, etc.
- Cascading effects of environmental changes; natural hazard "shocks"
    - e.g. rapid changes from drought to flood, as experienced in the 2009-10 summer to winter drought with extremely dry soils, followed by rapid changes with excessive moisture and flooding causing severe shifting and heaving soil, impacting infrastructure such as homes, natural gas lines, dams, culverts, bridges, etc.
    - e.g. floods and flood runoff causing contaminant runoff from human wastewater, livestock runoff effluent, industrial pollution, and other contaminants

OTHER NATURAL HAZARD RISKS

- Land slumping and swelling (e.g. from excessive wet conditions)
- Earthquakes
- Volcanic eruptions (in other regions) and ash migration
- Solar flare (affecting communications systems)
- Atmospheric winds (transporting global contaminants from other regions in the world)
- Drought and dry conditions in northern regions impairing forest health, changing northern ecosystems and landscapes, and increasing forest fire risks
- Excessive, prolonged multi-year drought

Policy Implications

The workshops identified strong stakeholder awareness of the diverse types of natural hazard risks, current mitigations, and potential for strengthening resilience. Stakeholders have implicit and vested interests in better understanding local and regional risk. Knowledge exchange and stakeholder participation is desired, along with longer-term planning, emergency preparedness and emergency response. Stakeholders identify an interest in improved knowledge and communications, natural disaster risk awareness, emergency response planning, better inter-agency collaboration with local input, longer-term planning, and integration of the science of climate change as some of the key factors in natural disaster preparedness, emergency response and strengthening capacity and resilience. There was strong support for enhanced inter-agency communication and coordination, including clear and strong engagement with local stakeholders.

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INTRODUCTION

The Saskatchewan Flood and Natural Hazard Risk Assessment is assessing Saskatchewan's resiliency and vulnerabilities to natural disasters. Stakeholder knowledge is crucial in identifying current natural hazard risks and mitigations. Stakeholder knowledge is also critical in establishing priority risk reduction strategies and hazard mitigation measures for current and anticipated future risks. This chapter summarizes key findings from diverse stakeholder groups in six regional workshops held across Saskatchewan in May-June 2017.

Natural disasters have affected human populations in the Canadian prairies for millennia. First Nations populations were particularly affected by water scarcity and drought, and their responses were driven by their critical needs for food and water. They adapted their hunting activities and nomadic social communities to live sustainably within the prairie landscape and its ever-changing climate and water supply (Daschuk, 2009; Toth et al. 2009).

Today, natural disasters impact Saskatchewan's people, industry and economic activities, territorial security, wildlife, and the ecosystems that support life in this province. The most common natural disasters in Saskatchewan are *water scarcity and drought*, *excessive wet conditions and floods*, and *wildfires in forested lands and grasslands*. However, there are other significant natural disasters that also cause serious impacts, including storms, hail, wind, tornados, pest infestations, *etc.*

Globally, natural disasters are increasingly impacting people, communities and economic activities. Public Safety Canada states that "natural disasters are increasing globally in number, frequency and intensity" and that Canada is no exception to this trend (Public Safety Canada, 2017). Disaster recovery responses may cause serious social and economic hardships, and require significant investments. This trend towards greater economic impacts from natural disasters is due in part to global growth, but there is also increasing evidence that climate change is affecting the intensity and frequency of extreme weather events (Insurance Bureau of Canada, 2014; Swiss Re, 2013).

Historically, populations have typically responded and reacted to natural disasters after the event occurs. Modern approaches are shifting away from only considering "response, relief and recovery" activities. Societies around the world are now being encouraged to proactively undertake "cost effective, evidence-based disaster mitigation" activities to mitigate risks in advance of a disaster, and to adapt to present and future risks from climate change impacts (National Emergency Risk Assessment Guidelines, 2010; Swiss Re, 2013). The goals of proactive planning and emergency preparedness are to reduce risk exposure, to reduce social and economic damages and losses, and to enhance society's overall coping capacity. Mitigation and adaptation includes emergency preparedness and other actions that strengthen overall local, regional and national resiliency when natural disasters occur.

Natural disaster risk assessment and mitigation require stakeholder participation and scenario planning, to identify impacts, mitigation measures and adaptation approaches. It is critical to include perspectives from stakeholders representing broad interests: industry and user groups, citizens and special interest groups, local communities, institutions, academia, non-government

organizations, environmental interest groups, and all orders of governments. It is also important to understand and incorporate stakeholder values in determining mitigation and adaptation responses that integrate science with specific local knowledge (Corkal et al, 2009; Diaz et al, 2009; National Emergency Risk Assessment Guidelines, 2010; Nelson et al, 2008).

METHODOLOGY – SCENARIOS AND DIALOGUE

Six regional workshops were held in May and June 2017 to gather local and expert knowledge from diverse groups of stakeholders. The purpose of the workshops was to gain a better understanding of how diverse stakeholders identify the nature and level of impacts that any individual natural hazard imposes on various sectors, industry, individuals, communities and the natural environment. The goal was to gather local and regional knowledge of:

- natural hazard risks and local vulnerabilities (i.e. local natural hazard data)
- current mitigations practiced (i.e. identify natural hazard mitigation measures in place)
- to consider the implications of future natural hazard risks and mitigations under a climate change scenario (i.e. to consider how risks may change, and how mitigations may address future risks)

Different geographic locations were selected to capture local knowledge within various regions and places across Saskatchewan:

- Yorkton
- Saskatoon
- Prince Albert
- La Ronge
- Swift Current, and
- Regina.

The Saskatchewan government sent out direct invitations by email, and followed up with telephone conversations with about 300 individuals representing targeted stakeholder groups, including:

- Communities and Rural Municipalities, including their associations (Saskatchewan Urban Municipalities Association, Saskatchewan Association of Rural Municipalities)
- First Nations communities, and respective associations (e.g. Tribal Councils)
- Government agencies (local, provincial, federal)
- Academia, Subject Matter Experts and Specialists (in disaster risk reduction, mitigation and climate change adaptation)
- Industry (forestry, mining, agriculture, energy, road and rail transportation, etc.)
- Non-government organizations (e.g. emergency management organizations, insurance providers, watershed groups, environmental groups, agriculture and engineering associations, industry groups such as irrigation associations, etc.)

The invited stakeholders were selected based on their local knowledge and expertise; each represented targeted stakeholder interests in natural disaster risk reduction and mitigation.

The invitees were also invited to submit their own input on disaster risk reduction following a pre-workshop form (See: "*Pre-workshop Input from Invited Stakeholders*" in the Appendix). This allowed all invitees to contribute to the risk assessment, should they not be able to attend the

workshops. About 75 respondents provided data on their experiences with natural disasters: impacts, mitigations, current and future risk exposure, and mitigation measures needed to improve preparedness for future risks.

About 200 stakeholders attended the six workshops (58 attendees was the largest number and 21 the smallest at individual workshops). They had expertise and/or interests in local disaster response and recovery, human health and safety, community protection and public safety, infrastructure and transportation, natural resource management, environmental health and protection, and expertise on social, economic and industrial development.

Each workshop was conducted in one day, with a morning and afternoon session (See: *Stakeholder Workshop Agenda* in the Appendix). The project team set the stage with short presentations to establish the workshop context and define the scope of the Saskatchewan Flood and Natural Hazard Risk Assessment project. They presented an overview of natural disasters common to Saskatchewan, focussing on droughts and water scarcity, excessive moisture and floods, and wildfires in forests and grasslands. Modeled climate change for the Year 2050 was also correlated to help stakeholders consider potential climate change impacts affecting future natural disaster risks (intensity, frequency and variability).

Each workshop was facilitated. Most discussions were conducted in small groups, followed by some large group plenary discussions. The goal was to encourage all attendees to contribute their knowledge and elicit stakeholder experiences and knowledge of natural disaster risks, current mitigations, future risks as they may be affected by climate change, and future mitigations or adaptations that would help reduce disaster impacts.

Plausible scenarios were developed for drought, floods, and wildfires. The morning scenarios addressed current experiences. Visual graphics, posters, extracts from scientific publications and newspaper articles, and other references were available throughout the sessions, to stimulate thought and discussion of natural hazards, impacts and mitigations. Discussions occurred in small groups; each theme was discussed twice, with different stakeholders, to capture broader input. The stakeholders' discussions often related and referred to personal experiences or other actual local knowledge. The afternoon future scenarios presented natural disasters with greater intensity, often overlapped by multiple hazards occurring simultaneously and over a prolonged timespan. Because the severity of future hazards was more extreme, the stakeholders were challenged to consider how such events might impact their interests, and what, if any, mitigations might be possible.

The workshop scenarios and stakeholder discussions elicited broad input of the impacts of natural hazards and current mitigation measures. They considered effects to human health and safety, social systems and communities, public administration and institutions, infrastructure, and economic and environmental impacts. Stakeholders also provided input on future scenarios or changing scenarios of impacts and mitigations, considering climate change trends. Stakeholders also identified what other hazards they perceived could be problematic, along with some sensitive geographic locations that could be "at risk" or "vulnerable" to natural hazards. And finally, stakeholders identified some key priorities for impacts and mitigations.

The participants were also invited to complete a workshop evaluation form and offer any additional insights or comments on natural disaster risks (See: *Stakeholder Evaluation* form in the Appendix).

The scenarios used to stimulate stakeholder discussions are briefly summarized as follows:

Drought

Current scenario – 3-year drought, serious water scarcity, industry and urban water competition, deterioration of water quality (e.g. toxic algae), First Nations water shortages and quality problems, pressure on provincial/federal institutions, slightly worse than the 2001-02 drought which caused $1.6B agricultural GDP drop in Saskatchewan (across Canada this drought caused a $5.8B drop in Canadian GDP).

Future Scenario – severe 5-year drought, widespread water scarcity, heat stress, insect and disease vectors affect crops and human health, extremely low flows in streams and rivers impair aquatic ecosystems, water bans now affect diversified economic actors and communities, some agricultural producers are forfeiting on long-term contracts, significant economic impacts impair a broader and diversified economy, food security is being questioned. Old-timers or their relatives recall the multi-year droughts of the 1920s-30s.

Flood

Current Scenario – above average snowpack and seasonal rain events with very wet antecedent conditions in the prairies, reservoirs are overtopping, some water diversion structures are eroding, severe flooding has affected recreational lakes and cottages, 40% of southern agricultural land is flooded or waterlogged, water quality degraded with turbidity and contaminant runoff from industry and lagoon overtopping, 10 First Nations communities can no longer supply safe drinking water. Many towns and cities have had to declare states of emergency due to flooding. People recall the waterlogged, wet phase experienced from 2010-2016.

Future Scenario – extremely wet conditions have persisted for 3 years; wet snow and winter rains during a warm winter are causing flooding and ice damage during winter, health departments are reporting serious rise in injuries due to slipping on ice, hundreds of homes have suffered damage to roofs, two major industries were forced to stop production due to roof collapse, ice blockages washed out two major crossings affecting Highways 10 and 16, power lines have collapsed and communities have lost power, emergency management responses are taxed. People remember news stories of the 1998 Quebec Ice Storm.

Wildfire

Current Scenario – severe forest and grassland fires occur over several areas, over 1 million hectares of forest burned in June-July, 8,000 people were evacuated including 500 First Nations people in two communities and 1,500 campers in the Prince Albert area, oil and gas production in the northeast was shut down for 4 weeks in the St. Walburg area, 20,000 hectares of grassland fires occurred in parched prairies near Swift Current and Maple Creek, seniors have been hospitalized due to smoke and poor air quality. Emergency management responders are taxed and exhausted after an extended demand on their resources (June-September). People recall the devastating 2015 forest fires near La Ronge.

Future Scenario – extremely dry conditions over 4 years have significantly increased fire risk. Compounding matters, the Mountain Pine Beetle made a resurgence, infecting 2 million hectares of forest; another 2 million hectares of forest are actively burning, and smoke extends deep into the mid-U.S. states. Communities across Saskatchewan and Manitoba have sent hundreds of

seniors to seek health care with smoke allergies. Severe winds have damaged many homes. Two tornadoes caused 10 deaths and destroyed 100 homes. Regional forest fires and grassland fires are also occurring near rural population bases in the southern portions of the province. Local economic and firefighting damages exceed $2 million. Provincial firefighting costs are estimated to be as much as $150 million. People recall past extreme fires, but recognize the mountain pine beetle infestation and major wind and tornado damages have caused devastating compounding impacts, with the most serious impacts to northern people, First Nations, tourism and northern economic activities.

SYNTHESIS OF ALL STAKEHOLDER WORKSHOPS – THE STAKEHOLDERS INPUT

"[natural hazards] are imminent and preparedness is crucial"

"We cannot reduce the risk of natural hazards to zero. Benefit/cost assessment is important to consider."

"The people of this province have the right attitude and demeanor to endure these hardships [natural hazards in Saskatchewan] and improve upon them. They need good vision and science to help them make the best decisions"

"The proposed scenarios at the scheduled workshops are an excellent method to convey and subsequently discuss future hazards."

"Climate change…will change the playing field for all of these natural hazards"

"how would we respond should large numbers of people experience loss of electricity and/or heat during a blizzard that restricted …ability to travel and our ability…to respond?"

"Public education providing plausible scenarios of what changes are expected with respect to future natural hazards…. will aid and enable stakeholders to design their own mitigation measures"

"During a natural disaster communication is probably the most challenging part"

"this study is on the right track, getting the people's view"

"[I] would like to see results incorporated into long-term government planning."

(Anonymous Stakeholders)

The six workshops identified unique impacts, mitigations and priorities for each regional area, and identified many points and themes common to all regions. The following synthesis sections identify workshop insights for the drought, flood and wildfire natural hazards. Attendees represented most of the targeted and invited stakeholder groups. The diversity of stakeholder interests was noted and appreciated by the participants. Some suggested that representation from more industries and health services would have been beneficial (both groups were invited).

The stakeholders were committed participants at each workshop. They asked for the results from this project once it is complete, and they believe that disaster risk assessment along with proactive planning, mitigations and action plans are necessary. They indicated a desire to keep the following types of activities on-going:

- share information, current science and knowledge
- improve natural disaster preparedness planning and response plans
- continue to engage local stakeholder discussions with future planning and actions
- work together to develop proactive, long-term plans and actions to reduce risk and strengthen local and regional resiliency.

Stakeholders learned from each other, and the unique perspectives that each brought to the discussions. The ***FireSmart*** programming is viewed as a model, helping develop preparedness plans, protection plans, emergency response plans, improving infrastructure, coordinated fire response and recovery approaches, public education and awareness, training for emergencies, coordinated/integrated and cooperative disaster responses, effective communications, etc. Stakeholders valued such proactive long-term planning for local and senior levels of governments, the formalized mutual aid agreements and institutional arrangements, and the on-going and continuous review to ensure **FireSmart** programming is kept current and enhanced year after year. Some suggested similar programs and principles are needed for water scarcity and drought (i.e. a ***DroughtSmart*** program), and excessive moisture and flooding (i.e. a ***FloodSmart*** program). All stakeholders supported the concept of long-term planning and preparedness and coordinated responses. Public protection (individuals and communities) is seen as the top priority. Economic and environmental protection are also recognized as key elements to consider with natural disaster risks.

Note: This entire chapter is based on stakeholder contributions and perspectives, and does not attempt to evaluate confidence levels in stakeholder perceptions. Highly subjective perspectives or a lack of data backing up perspectives may affect confidence levels. Selected quotations are from anonymous stakeholders' statements, predominantly from the pre-workshop input with some from the workshop evaluations.

DROUGHT AND WATER SCARCITY - INSIGHTS FROM SIX WORKSHOPS

"We are probably due for a much worse drought in the coming decades."

"widespread drought is one of the most severe natural hazards to impact the prairies"

"the slow on-set of drought can make it difficult"

"Drought is insidious, and it is easy to become complacent during "normal" or wet periods"

"low flows [in transboundary rivers] are challenging for interprovincial water sharing"

"Develop more drought resistant [crops]…discourage the breaking of marginal lands. Develop best practice irrigation capacity…encourage novel forms of agriculture"

"While floods get the media attention, they can be largely mitigated through proper planning and flood proofing. The bigger long-term risk is drought, which has been experienced in the past, but climate models suggest these could be longer and more severe in future."

(Anonymous Stakeholders)

Stakeholders clearly identified drought's primary impacts to water availability (scarcity of both surface and ground water) and impaired water quality. Water scarcity affects critical human needs for communities, industries, and economic activities. There are also negative impacts to river and lake ecosystems, with deteriorated water quality, less water flow in streams and depleted water supplies in lakes and reservoirs. Recreational uses of rivers and lakes become impaired and economic losses occur with loss of tourism. Drought causes serious economic impacts to agriculture and other water dependent industries. Drought causes both direct and indirect economic impacts to rural economies, communities and prairie cities which are in large part dependent on healthy agricultural economic activities. Should hydropower generation suffer, alternate or back-up energy sources may be required during droughts. Drought is a slow-onset phenomenon, and should drought persist in time (e.g. multi-year water scarcity) the impacts of drought increase and may extend over a wider geographic region, as in the 1920s-30s or the 1850's. Accordingly, there are increasingly significant impacts on water managers, increased water competition, social challenges, and potential conflicts between water users, industry, competing sectors or problems between sectors and communities (e.g. hydropower versus irrigated agriculture versus community supplies); there may even be administrative, social and governance problems within institutions and between government agencies (local, provincial, federal). As drought severity increases, there is greater economic and human impact. During extended droughts, the province could become a net food importer rather than an exporter, challenging regional food security. Market confidence may be impaired by extended drought, and loss of markets is possible. And yet, warmer conditions (with global warming), may also lead to opportunities, if higher-value or drought- tolerant crops can be established with effective water management (soil water conservation and expanded irrigation). Such anticipatory changes in agricultural production or economic activities will take significant research, development and proactive long-term transitional planning. Changes to agriculture would also need to factor in risks (e.g. when

insufficient water supplies are available for irrigation, or when excessive heat stressors may impair agricultural activities with crop and livestock production).

Drought mitigation largely relates to water security during times of scarcity, and will include water management processes (including setting priority-of-use hierarchies), watershed management and source water protection (surface and ground water), enhancements in water storage and conveyance infrastructure, and improving water use efficiencies for all water users. Drought risks, as they intensify, rely on the expertise and support of provincial and federal government agencies – the problem is recognized to be much larger than what can be addressed solely by local communities or industries. Accordingly, drought mitigation and greater water security are strongly correlated to effective institutional arrangements that can provide technical and policy expertise, guidance and programming by provincial and federal governments (e.g. monitoring of climate, hydrology, agricultural water management research), and including the participation and application of academic knowledge of best management practices (current, innovative, and/or experimental).

Social and economic adaptation will be challenged by persistent droughts, and will require proactive planning (e.g. drought coping responses for people, communities and affected industries, including ecosystems impacts). New types of animal and human diseases may occur, stressing the health of people, livestock, wildlife and ecosystems. During extreme multi-year droughts (the future scenario), there was recognition that social, economic and environmental impacts could be more severe than the droughts of the 1920s-30s. Society and modern economic activities have changed, and impacts will be different, worse, and potentially more global in nature as there is more development and activity in the region. Human migration is a risk during severe prolonged droughts. Human health and mental health will be impacted, and may pose stress on medical systems should new types of diseases or disease vectors occur with a warmer climate. Mitigation may therefore need to include capacity to address health impacts, social issues, and ecosystems impacts.

Changes to ecosystems are expected with global climate change. Existing or new flora and fauna, exotic plants, insects, animals and non-native species may move or migrate into new geographic areas. New types of microbiological diseases, pests and invasive species could become problematic. Ecosystem alteration may impair economic and recreational activities. Resource protection and ecosystem conservation measures are therefore, unique mitigations that should also be considered in drought planning preparedness.

Drought was also recognized to be strongly linked to wildfires in any forested location (northern or southern Saskatchewan) as well as across prairie grasslands. For example, hot, dry conditions and strong prairie winds cause grass fires to spread rapidly. A significant risk involves insufficient access to water for fire suppression in the south during a prolonged dry period with depleted water supplies. A warming climate that increases hot, windy days and water scarcity, will also increase fire risk. Grassland fires are now seen as risking southern rural populations, communities, agricultural producers (crops, livestock) and other industries. There are also impacts to emergency management systems (Emergency Management and Fire Safety, Fire Commissioners, Forest Fire Commissioners). Stakeholders noted a mitigation idea to link or integrate forest and grassland fire suppression response programs, as they tend to be addressed with separate support systems

and initiatives, and may compete for resources (e.g. aerial fire suppression may assist with grass fires as well as forest fires).

Stakeholders stated that mitigation for droughts requires proactive long-term planning, learning from the past where possible, and being careful to be prepared for drought in advance. Emergency management plans for drought need to be developed similar to flood management planning (e.g. establishing priority of water use, considerations for alternate supplies). As drought severity increases, people and regions affected become increasingly reliant on provincial and federal support and programs, as individual and regional coping capacity become exhausted. Funding may be needed for relief and development investments to strengthen resilience. Drought is recognized as a natural characteristic of the prairies, and stakeholders recognize drought will recur (even though much of the region has been wet between 2010-2016). Stakeholders believe one of the key risks of drought is not being prepared for its slow onset (it is out of sight and out of mind in years with normal precipitation). Stakeholders recommend that proactive planning and revisiting drought preparedness planning is key, and should be done regularly, even during "normal" or "wet" years. Taking cues from Saskatchewan's successful *FireSmart* program, stakeholders stated it would be wise to establish a "*DroughtSmart*" planning program and to plan and budget for a "*non-rainy*" day. With the risks of climate change posing greater climate variability, mitigations for drought, will require complex research coupled with water and climate modeling to consider options for affordable, sustainable mitigations and adaptations. Not all mitigations are costly, though. Drought planning may start with thinking about and completing a preparedness plan for improved water security, and perhaps identifying alternate available water supplies for critical needs during times of water scarcity.

People noted that the time to start regional planning is now (and not during the actual drought event). They stated that leadership is needed from provincial and federal governments because these issues are at a grand scale. And there was recognition that there is a challenge to "personalize" risk, largely to motivate individual and institutional planning to mitigate drought risk.

Drought may also impact and change economic systems; for example, conventional agricultural activities such as rain-fed agriculture may be at high risk for repeated years, and may require agriculture to adapt to new production and water management systems. Mitigations such as irrigation expansion to reduce water scarcity risk, requires long-term planning and investment. Drought, while a natural characteristic of our region, tends to not be considered during non-stressed times. So, it is critical to strengthen individual and agency capacity (e.g. Water Security Agency, watershed groups). Stakeholders also emphasised we need to learn from past successful institutional arrangements/programs (e.g. the federal government's soil and water conservation programming delivered through the former Prairie Farm Rehabilitation Administration [*the former Prairie Farm Rehabilitation Administration was a branch of Agriculture and Agri-Food Canada; it was created in 1935 in response to devastating multi-year droughts; PFRA assisted prairie agricultural adaptation with sustainable farming practices and soil and water conservation programming and research; PFRA operated during 1935-2013*]). Knowledge and public education are critical needs for drought mitigation and preparedness measures. Stakeholders identified that better knowledge and public education will help with economic decisions and social awareness to avoid complacency during non-stressed times – they stated continual awareness and mitigation strategies are needed even during non-stressed times.

FLOOD AND EXCESS MOISTURE/WET CONDITIONS - INSIGHTS FROM SIX WORKSHOPS

"Flood damage could be substantially reduced through education and responsible planning and development…. No new developments should be allowed in flood risk zones, and all existing developments should be flood proofed."

"We are going to be dealing with significant climate change impacts…that will tax the current economic and social structure…"

"Without a solid basis for mitigation and collaboration, there will tend to be losers and winners."

"The best approach to adaptation is regional – a cooperative approach…do the hard work to identify the most promising options for a community and region [and watershed]"

(Anonymous Stakeholders)

Stakeholders identified common, current flooding impacts, including: flooded communities, flooded agricultural lands (which may have long-term impacts on production), damages and losses to personal and public infrastructure (buildings, equipment, other property), transportation systems (rural roads, highways, railway lines), community water and wastewater systems, landfills and industrial storage sites or waste sites, SaskPower and SaskTel lines (i.e. above-ground electricity and tele-communications utility lines), dams and reservoirs, damages to economic activities including agricultural losses (crops, livestock), oil and gas production losses, damages to power grids, impaired industry activities, conflict between neighbours and neighbouring regions (particularly where drainage projects or illegal drainage have been implemented historically or during a flood event), etc. Impacts to infrastructure also include "soft infrastructure" including data systems, computers and digital media, books and files, administrative and legal records, financial documents, photographs, historic archives, and other critical perhaps non-replaceable materials. Mitigation for these items is challenging, and relate to infrastructure design, storage management, and back-up copies or systems in another site, where that may be possible.

Due to the nature of flooding, most flood impacts are relatively obvious, often happen fast, and generally occur during a relatively short time-frame (in contrast to the slow on-set and long duration of persistent droughts). In some cases, flood impacts and losses are catastrophic. There is no disputing that response actions must be undertaken immediately to repair, rebuild and recover from flood losses and damages (e.g. road washouts, building flooding, loss of property, etc.). The challenges in recovery involve economic costs, time and duration of rebuilding, and the design concepts for rebuilding (e.g. to the existing past state as required by the Provincial Disaster Assistance Program, or to consider "building better" by rebuilding to an improved and more resilient state, with due considerations for broader and more regional upstream or downstream consequences that could be caused by changes). Changes clearly require regional thinking and planning within the affected community and watershed.

Stakeholders understand that floods impact the natural environment, parks and recreation areas. This may include land and water degradation by contamination from human wastewater, industrial sources of pollution, runoff of agricultural chemicals and livestock waste, etc. Other

environmental risks relate to various erosion problems, slumping of river banks, stream banks and lake shorelines, contamination of water wells and ground water supplies (aquifers). All of these effects will have spin-off impacts on people, homes, industry, and economic activities in the vicinity. In some cases, there may be re-routing of river flows should banks overflow to such an extreme as causing formation of a new channel. Sediment and silt transport may also impair aquatic ecosystems. Mitigations may involve deliberate attempts to preserve wetlands, incorporate green infrastructure, and to encourage land use practices that recognize environment benefits (alternative land use services for agriculture, and industry or community development projects that incorporate ecosystem benefits and ecosystem services).

Floods may impact human health, with disease transfer in drinking water or other sources of water pollution. Water and wastewater treatment systems may not be effective, or may not be functioning at all. Hygiene and disease transfer in evacuation sites may also be problematic. There will also be stress and mental health issues, particularly with those who have suffered large-scale losses, were evacuated from homes or communities, and even with responders who have suffered demanding emergency response activities. Mitigation includes existing medical and mental health support systems, and these may be taxed by the sheer number of affected people during the event and the recovery phase.

Institutional programs such as the Saskatchewan Provincial Disaster Assistance Program and the Emergency Management and Fire Safety Program (both within Saskatchewan's Ministry of Government Relations), and the Emergency Flood Damage Reduction Program (Saskatchewan's Water Security Agency) have been very beneficial in flood response and recovery, as have local and provincial emergency responders. Flood insurance is also critical for individuals, communities and industry.

Zoning, engineering and insurance mitigations were emphasised. It is recognized that some communities (e.g. Moose Jaw) have done well by buying-out properties in high-risk floodplain lands, as it is not wise to have homes, buildings, structures and economic activities in areas that repeatedly flood. New developments across the province need to consider drainage and run-off impacts. Structures (private, public, industry) also need to be designed for appropriate flood protection events; considering climate change and variability, engineering designs may require the consideration of constructing to cope with more extreme precipitation and flood events than what has been previously been used historically. [Note that Engineers Canada has, for some time now, been investigating these issues with their program *Public Infrastructure and Engineering Vulnerability Committee*, PIEVC: https://pievc.ca/]. During the last decade or more, insurance agencies have experienced an increasingly higher and more costly number of flood claims related to sewer backup; they are now establishing new approaches and new guidance to individuals and communities, and new insurance programs and risk management for flood protection and other natural disasters [e.g. See the Insurance Bureau of Canada: http://www.ibc.ca/on/disaster, and http://www.ibc.ca/on/disaster/water, and the IBC's *Municipal Risk Assessment Tool*: http://www.ibc.ca/nb/disaster/water/municipal-risk-assessment-tool]. Improved zoning, engineering and insurance were recognized as needing effective legislation and enforcement (e.g. to ensure illegal drainage is not allowed nor occurring).

Mitigations for flood protection will also require ensuring better, continued infrastructure maintenance (road and highway culverts, canals and water diversions, dams and reservoirs, water

and wastewater systems, landfills, etc.). Improved knowledge is also essential with development of improved flood-risk mapping. This may include conventional surveys to identify flood-risk zones, and unique or specialized *LiDAR* surveys to improve topographic knowledge [LiDAR is Light Detection and Ranging remote sensing surveys using light and radar imaging techniques]. Better topographic maps would be useful in determining flood inundation risks, drainage flows and patterns, and can help guide flood protection needs, as well as flood mitigation measures for new development projects and land use practices. As well, improved hydrological monitoring, forecasting of flows and precipitation events and related impacts would be useful for early warning systems as well as for appropriate mitigation and response/recovery practices.

Stakeholders emphasised a need for mitigation measures that included improved protective systems (dyking, better and effective legal drainage systems), adherence to existing building codes, consideration for enhanced building codes, improved water management approaches and improved infrastructure that is more resilient to flooding (buildings, highways, railway lines, utilities, etc.). They also indicated that knowledge exchange and communications between local stakeholders is critical to ensure a mutual understanding of flood risks and how water and flood management measures (including institutional decisions) will interact with their own local flood protection preparedness and response activities.

Stakeholders emphasised that mitigation measures include emergency preparedness and response plans, public education and awareness of these plans before and during flood events, and effective communications during flood events and recovery. Strong leadership and clear decision-making are critical especially during the event. Stakeholders indicated concern with some communications (e.g. social media); concern was expressed about incorrect or inaccurate information being propagated, and causing serious problems in the protection of people, property and recovery responses. Stakeholders also recognized that individuals (rural or urban) also have responsibility for protection and preparedness. Self-sufficiency is seen as being greater in rural areas, where by necessity people often must address problems on their own. The concept of a 72-hour emergency supply (food, water, heat, etc.) is seen as a good mitigation concept for all individual rural or urban properties, and even for communities that may be cut-off by a disaster.

Cross-training and emergency response coordination between orders of government, local responders and different agencies is critical, and essential for all emergency flood response and recovery. This is seen as particularly critical for northern communities, which also requires local expertise and knowledge of their local conditions, communities and people. Mutual aid agreements are often already in place, but can always be strengthened. Public education is important. The role of watershed agencies, and public knowledge and awareness of watershed issues and activities (e.g. water management, source water protection, wetland preservation, etc.) are important mitigation measures. The better and more informed the public is, the better and more coordinated the flood disaster response will be, as people and agencies work together more effectively.

Depending on scale and flood intensity, evacuations may be problematic, and people will experience significant stress levels. People and human resources will be taxed during floods and the recovery period, which can drag out for very long periods of time for proper clean-up and rebuilding. In some cases, chaos can occur during the event, and will need to be managed for public protection. Certain people and communities are more vulnerable to flood impacts: this

includes the elderly, people in seniors' homes or hospitals, and residents of remote or rural communities including First Nations communities and those in the north. Evacuations will be especially problematic when road, rail access is damaged or impaired by flood events. There may be only one good road into/out of the affected communities, so access/egress becomes very challenging. This will also be an issue during the flood recovery phase.

Stakeholders identified that established emergency preparedness plans, communications plans, and training of responders, are instrumental mitigations that must be established with local responders in advance of events, to be more effective in resiliency, response and recovery of flood events. Such mutual preparedness is a governance challenge, and requires significant institutional awareness, strategic planning, coordination and implementation involving all orders of government (including rural municipalities), and should include industries that may be capable and willing to assist in flood protection and response.

WILDFIRES (FOREST FIRES AND GRASSLAND FIRES) - INSIGHTS FROM SIX WORKSHOPS

"Saskatchewan has many communities at risk from wildfire…. Forest fringe and northern communities face the greatest risk…but …we have seen an increase in the number and size of prairie [grassland] fires in the last few years"

"Severe droughts in 2001 and 2002 resulted in busy fire seasons with fires in 2002 that burned down into the peat bog areas making them very destructive and very difficult to suppress. El Nino winters have resulted in extreme fire seasons the following spring & summer...droughts mean more fires."

"many programs do not account for future hazards exacerbated by climate change"

"Research involves working with First Nations…. Indigenous people have different values at risk."

"Good communication plans need to be developed and clearly communicated to all residents"

(Anonymous Stakeholders)

Wildfires, forest and grass fires naturally occur in all areas of the world. Unfortunately, about 50% of forest and grass fires in Saskatchewan are human-induced (e.g. improper extinguishing of campfires, discarded burning materials, arson, etc.). Important elements of addressing fire risk involves: advanced planning and emergency response measures; inter-agency coordination; public education; data-sharing and exchange of information; and, effective inter-active communications between decision-makers and locally-affected people and communities. Early warning systems, access, egress and evacuation planning are critical factors in responding to wildfire disasters.

Mitigation for wildfires (forest fires and grass fires) and disaster preparedness include larger-scale management, policy, and infrastructure responses. Landscape-scale forest management is practiced. Development, property line set-backs, fire breaks, controlled burns, insurance incentives are all used in wildfire disaster preparedness. Programs established by emergency management systems (Emergency Management and Fire Safety, Fire Commissioners, Forest Fire Commissioners, Public Safety Canada, Wildfire Management Branch of Saskatchewan's Ministry of Environment, FireSmart programming) are recognized as being extremely useful for managing fire protection practices, developing emergency fire response plans, ensuring the plans are current and practiced, public education, training, and proactively designing fire response procedures and practices.

Forest Fires

"Wildfires are a natural part of the Boreal Forest ecosystem."

"Effective fire suppression combined with new development within the wildlands has resulted in large areas of over mature and unhealthy forests, parklands, and grasslands that lead up to and into many communities."

(Anonymous Stakeholders)

Stakeholders identified a broad scope of wildfire impacts with forest fires, including impacts to power supplies, grids and distribution networks, water and wastewater supplies, buildings, roads, bridges, railroads, etc. Another significant issue with forest fires relates to communications systems; northern fires risk damage to communications systems (which may be destroyed), and will impact the infrastructure and the important communications connections needed to suppress the disaster. Mitigations require back-up communications systems for local and regional communications.

First Nations people and traditional practices (hunting, fishing, agriculture), northern recreational activities (hunting, fishing, camping), and northern economic activities (tourism, mining, forestry, power generation, oil and gas production, agriculture and northern farming activities) may be seriously impacted by forest fires. Depending on the extent of exposure and damage, recovery responses may be challenged. Depending on the remoteness of the location, rebuilding and recovery costs may be very costly and take long periods of time to complete. Mitigation generally involves fire risk reduction practices, preparedness, and emergency response planning.

Impacts to human resources were also seen as significant, as responders are under significant physical and mental stress, often taxed with workloads and little time for rest, and face real challenges working with inexperienced responders or with responders who are not familiar with the geographic area and/or local cultural practices. Outside resources can be helpful, but need to be coordinated by those familiar with the region (and preferably by local leaders and decision-makers). There was a suggestion that the deployment of the federal Department of National Defence should be implemented more frequently, as scale and need requires; however, such deployments require training and guidance from experienced wildland firefighters, and those with specific local knowledge of the region. Furthermore, should any provincial or federal help be deployed, stakeholders were emphatic that local stakeholder knowledge, expertise, input and participation were essential factors in any fire disaster risk reduction preparedness planning and response activities. Larger-scale provincial and federal responses require effective coordination, and need to include effective integration with local leaders and authorities. Advanced preparedness for integrated responses is needed, with an emphasis of incorporating local knowledge, expertise, leadership and personnel.

Mitigation measures to address complex coordination challenges include mutual aid agreements, FireSmart programs which help to prepare fire protection and emergency responses to fires, education programs and learning from past events, risk assessments and fire risk reduction programs, identification of critical infrastructure and means to protect them, coordination of emergency measures for fire response, etc. A significant emphasis of FireSmart programming is

that it is designed to reduce the risk of human-induced fires by reducing fire hazard risks in and around communities (e.g. vegetation management, designing and using fireproof building materials in building infrastructure, etc.). Stakeholders recognized that industry may have large-scale impacts from fire. Industry also stated that they may have capacity in helping mitigate fire response (providing firefighting equipment, communications systems and additional human resources to help responders).

A significant issue in responding to forest fires relates to incident command and communications with those affected. Often there is confusion, chaos, and uncertainty, or even unacceptance of decisions taken in response to the fire, and fire suppression activities. Sometimes it is unclear who is in charge of making the decisions, and/or there is confusion about the course of actions taken by different agencies. Stakeholders expressed a need for clear levels of authority during fires, and the need to ensure that local authorities are engaged in the decisions, that there is effective and timely data-sharing of the fire risk, and that local people are informed of the decisions, particularly when outside help and support may be coming from far away distances (e.g. provincial, federal responders implementing aerial fire suppression activities). Local communications with affected citizens and the public is essential, and needs to occur in a safe and timely means to help advance best public safety protection and fire suppression actions. Local understanding and awareness is essential, and may require different communications strategies and frequent continual initiatives and attempts by officials – common, clear information must be disseminated to those affected to maintain credibility and public safety.

An impact to northern communities also involves the concept of "prepare and defend." This relates to the local fire responders who wish to be ready to suppress fires and remain in the affected location as long as is possible. However, if this approach is implemented, significant investment in training of local firefighters will be required, and additional best practices would need to be developed to achieve maximum protection of firefighters and others involved in any "prepare and defend" approaches. Mitigation measures require safe housing, air purification systems, effective communications systems, and integrated incident command systems to accept mutual local/external inter-agency decision-making in fire suppression and evacuation.

A major impact with forest fires is the evacuation of people in "at-risk" communities or those living near the fire zone. Evacuation is an important decision, but not always accepted by those affected. Fire movement can be unpredictable, and when evacuation is decided or ordered by authorities, the next challenge is to do so effectively. Road or air evacuation may be affected by the fire (road access may be cut-off; air evacuation will be affected by smoke and visibility). There are significant challenges evacuating vulnerable people in care homes, hospitals, retirement homes, etc. Psychological stress and loss also often occur for those affected by evacuations.

Health impacts from smoke inhalation may be significant with forest fires, and can extend hundreds or even thousands of kilometers away. Pressures on medical facilities are intensified particularly in directly-affected communities.

Social impacts include security, higher risks to looting, crime and maintenance of law and order. People suffer personal economic impacts when their jobs are terminated by forest fires (forestry, or other employment by industries such as mining or tourism that may be affected by forest fires). Northern communities and First Nations communities affected by forest fires may have a

widespread human impact, due to remote locations of affected communities. Economic problems could be widespread within a community, and there may be feelings of isolation. Recovery operations from fire-affected communities and industries can be very long-term, and in some cases, may not occur (e.g. permanent shut-down of an industry or business). The social impact is significant in these cases both to individuals and the affected communities. Emergency social services during the fire event, as well as longer-term targeted social services supports "post-recovery" are also important mitigation considerations.

Changes to ecosystems increase fire risk (e.g. Mountain Pine Beetle, diseased forests, drought occurrences, etc.) And major ecosystem changes can result from wildfires, as landscapes and hydrology may be changed on a widespread scale (invasive species, including aquatic organisms). Wildfires may also have significant effects on habitat for species at risk (e.g. woodland caribou). It is recognized, however, that forest fires are also a natural process that aid in ecosystem regeneration. Mitigations should include zoning and by-laws for development and economic activities in forested areas.

Large-scale forest fires have a significant economic and environmental impact, as well as serious impacts to local, provincial and federal governments, as they attempt to suppress the fire, and plan recovery post-event. Budget impacts to local, provincial and federal resources are significant, and will have additional impacts for future budgetary planning. Spending priorities may require adjustments. Large-scale forest fires may be significant enough to impact future taxation.

Grassland Fires

"Major grass fires [have been] fueled by dead grass in the spring and standing crops in the fall."

(Anonymous Stakeholder)

Stakeholders identified a broad scope of fire impacts. Stakeholders in the south tended to focus on southern geography (grassfires, bush, crops). Nevertheless, risks are similar to larger scale forest fires. In hot dry times, grassland fires can be extensive, rapidly burning, threaten human and animal populations, and destroy agricultural land, crops, community buildings, infrastructure and transportation systems. One unique problem with grass fires is the challenge to construct firebreaks (e.g. continuous cropping and/or natural grasslands leave few or limited interruptions/firebreaks). When grassfires are combined with excessive winds, grassfires may easily spread with a continual fuel source and little to no natural or man-made impedances that slow the fire down. Grassfires are also more significant during times of drought, so a strong correlation exists between both natural disasters. Another operational impact relates to competing resources and institutional arrangements, where grassland fires are treated with different responses to forest fires, yet may benefit with similar responses (stakeholders believed there was a need for greater aerial fire suppression, yet understood this was difficult to implement should forest fires be occurring during the same period of time).

Economic impacts from grassland fires can be severe, and have broad impacts to agriculture, industry, transportation and energy systems, water and wastewater systems, etc.

There are often impacts to local human resources, most of which tend to be volunteer fire fighters, and impact to regional and provincial emergency management responders, when their resources are taxed.

Mitigation includes emergency management planning and communications strategies. Many communities have established plans, and there are usually trained responders that work with the volunteers. Industry is also often available to help. Industry may also have firefighting emergency plans (e.g. railway operators take steps to minimize fires from ignition from wheel sparks).

One of the unique challenges in the more "water scarce" southern region, is fighting fires when water resources are either limited or depleted (often the case when fires occur during drought or extremely dry periods and fuel sources are higher risk with dry grasslands). Accordingly, water access may be an issue and water sourcing for fighting fires must be anticipated or sought with expertise from water agencies (WSA- Saskatchewan's Water Security Agency, databases of the former PFRA- Agriculture Canada's former Prairie Farm Rehabilitation Administration, etc.). There is a need for additional mapping of water supplies. Deliberate firebreak planning was suggested for grasslands in the south, to reduce risks from grassland fires (akin to a forest firebreak).

Coordination of local responders (the primary emergency responders for southern fires), provincial responders and the centralized provincial Emergency Coordination Office, aerial support when needed, and federal assistance from Public Safety Canada are all helpful mitigations, when needed. FireSmart is a successful program, and could be extended to education of individuals (e.g. private homes, farms, etc.). Mutual aid agreements are extremely beneficial where formal arrangements are established to get assistance from others trained in specific emergency response as well as disaster recovery (particularly from other areas or neighboring areas that are not affected by the fire disaster).

NORTHERN SASKATCHEWAN FIRST NATIONS AND NON-FIRST NATIONS: LOCAL KNOWLEDGE AND EXPERTISE

"Northern evacuations imposed on our [First Nations] communities represent unique impacts including culture shock and long-term displacement. Family reunification issues are also among those mentioned by evacuees."

"[mines and mining operations] have been under [wildfire threats] several times"

(Anonymous Stakeholders)

Stakeholders from the La Ronge workshop were emphatic about the unique nature of the north – its geographic location and natural resources, its unique mix of First Nations and non-First Nations peoples, and the strong and special cultural characteristics and approaches towards life, communities and survival in the north. The north is more remotely populated, and geographically distant from "centres of power" and senior levels of government. Most northern people, including many of those in northern communities, have much stronger skills in self-sufficiency and resilience than most southern people. In part, this is driven by necessity for northern life and survival. Life in the north is an intimate relationship with the water and land, the landscape and extreme climate, the harsh winters, summer rains, the wildlife and nature, and the types of economic activities in the north: hunting, fishing, gathering, tourism, forestry, and mining, all of which are intertwined with northern natural resources and northern ecosystems.

Northern stakeholders, therefore, are a special and unique group of stakeholders with highly vested interests in their "place" of residence. They strongly expressed an essential need for local engagement in natural disaster preparedness planning and response, and that without effective, continued integration, cautioned that natural disaster risk reduction and mitigation strategies would not be properly designed nor implemented. Therefore, they were passionate in stating a need for local leadership and involvement in disaster risk management and mitigation responses, including (and perhaps especially) when senior levels of provincial or federal government agencies were required, and even when activities were the responsibility of other agencies (e.g. aerial fire suppression activities). They emphasised the need for local and regional forest firefighter training so that they would be prepared to help defend their communities and property, and build local capacity. Education, training, communications of emergency preparedness plans, responses, and evacuations must always include information exchanges, data-sharing, and inter-active communications with northern peoples including First Nations, to ensure local knowledge, local interaction, local leadership and local guidance for implementation of mitigations, disaster responses, and recovery actions. This was, to some extent, a recommendation at all six workshops, insofar as local stakeholder knowledge and expertise is essential for place-based solutions. However, the northern geography and population are far more unique because of its people, its geography, and the fact it is much further away from the senior levels of government.

OTHER NATURAL HAZARDS – A SUMMARY OF RISKS IDENTIFIED BY SASKATCHEWAN STAKEHOLDERS

"people with resources can recover from a disaster, people without resources cannot"

[current mitigation measures] "are adequate for what we have faced in the past. They are not adequate for what we may face in the future"

"***the entire province is at risk from future climate extremes"***

"This is not a site-specific issue [to Saskatchewan], rather an issue of national significance"

"I laud the Government for forums such as this to compile the knowledge of stakeholders so that we can better understand how we should adapt and/or mitigate the worst effects of climate change going forward."

(Anonymous Stakeholders)

The workshop discussions focused on droughts, floods, and wildfires, but one session involved the stakeholders identifying what other types of natural hazards were likely risks in their region.

It is worth noting that the stakeholders made clear recognition of links between the natural hazard risks and human responses or interventions. Most saw these "other types of natural hazards" to be potentially changing with intensity, frequency or duration, when looking ahead into the future. Many commented that the recent wet phase (2010-2016) has been unprecedented in their memories, yet they recognize that drought is natural to the prairies, and will recur. The stakeholders expressed concern that people tend to be so focused on current exposures, to the extent that other natural disasters are "out of sight" and "out of mind." Yet they stated that disaster risk planning and preparedness is valuable, and needs to be proactively managed, even if the disaster is not "on-going." They also noted that there are challenges with human mitigations and jurisdictional issues [i.e. likely related to natural hazard responses such as coordination of federal/provincial responses]. Stakeholders indicated that the public needs to take natural hazard risks and warnings seriously. There was a sense that the present variability in frequency and intensity of storms and floods is different than what has occurred in their past experience, and that the future will require greater planning, preparedness and mitigation for even more types of natural disasters, and for even greater variability in frequency, intensity and duration.

Other natural hazards identified by the stakeholders are listed in (Table 1).

Table 1 Other Natural Hazards as identified in all six workshops

OTHER NATURAL HAZARDS (all workshops; grouped under thematic titles)

SEVERE WEATHER AND STORMS

Heat and Convective Summer Storms

- excessive heat (intensity and duration) with extreme temperatures over prolonged periods of time (impacting people, plants, animals, energy consumption, etc.)
- rapid changes in weather with wind, rain, hail (greater storm intensity)
- extreme summer storms with intense rain and wind and hail
- excessive moisture causing land slumping
- plough winds (affecting infrastructure, forests, etc.)
- tornados
- lightning storms (affecting power distribution, communication systems, causing fires)
- hail (intensity and frequency)
- severe weather, severe summer storms

Winter Storms, Blizzards, Snow and Ice

- snow storms (intensity and frequency)
- severe snow storms (which may cause casualties, particularly with transportation)
- heavy wet snow
- winter ice storms (affecting people, infrastructure, power, transportation, etc.)
- ice storms combined with wind
- blizzards with greater frequency and intensity
- severe weather, severe winter storms

ENVIRONMENTAL CHANGES, including ECOSYSTEMS and DISEASE VECTORS

- changing ecosystems (biology, insects, plants, trees, animals) i.e. microbiology, flora and fauna
- beavers, rodents, other ecosystem biota changes
- pest infestations, ecosystem shifts
- landscape changes (e.g. caused by changes to ecosystems, forest health, etc.)
- invasive species changing natural ecosystems and affecting aquatic life, water quality, plants, animals and human health
- exotic plants, insects, animals, invasive species (not common to the local region)
- aquatic invasive species; invasive plant species (i.e. including microbial species, viruses, parasites, bacteria)
- quagga mussels, zebra mussels
- Mountain Pine Beetle
- Diseases (human, crop, livestock, wildlife, plants, forests)
- Livestock diseases such as foot and mouth disease, BSE /Mad Cow disease [BSE is Bovine Spongiform Encephalopathy, a variant of Creutzfeld-Jakob disease] and associated risks to human health
- unique specialized diseases

- West Nile virus
- Lyme disease
- Insects
- Plant and tree diseases (affecting natural ecosystems, plants, trees, forest health)
- New vector-borne diseases [. e.g. health of humans, crops, livestock, wildlife, plants may be affected by new microbiological and biological disease vectors]
- Deteriorating water quality (in the natural environment)
- Excessive moisture causing slumping or swelling of land (e.g. at slopes, shorelines, etc.) and causing damage to infrastructure such as buildings, roads, rail lines, etc.
- Cascading effects of environmental changes; natural hazard "shocks"
    - e.g. rapid changes from drought to flood, as experienced in the 2009-10 summer to winter drought with extremely dry soils, followed by rapid changes with excessive moisture and flooding causing severe shifting and heaving soil, impacting infrastructure such as homes, natural gas lines, dams, culverts, bridges, etc.
    - e.g. floods and flood runoff causing contaminant runoff from human wastewater, livestock runoff effluent, industrial pollution, and other contaminants

OTHER NATURAL HAZARD RISKS

- Land slumping and swelling (e.g. from excessive wet conditions)
- Earthquakes
- Volcanic eruptions (in other regions) and ash migration
- Solar flare (affecting communications systems)
- Atmospheric winds (transporting global contaminants from other regions in the world)
- Drought and dry conditions in northern regions impairing forest health, changing northern ecosystems and landscapes, and increasing forest fire risks
- Excessive, prolonged multi-year drought

INSIGHTS FROM THE PRE-WORKSHOP INPUT

The pre-workshop exercise identified key points made from diverse stakeholder groups. The excerpts below are samples of some of the responses. The following statements are quoted from anonymous individual submissions representing the invited targeted groups, and are identified by an anonymous stakeholder number (e.g. S3).

A snapshot of Stakeholders' Views on Drought

- "the slow on-set of drought can make it difficult to identify, which means that program supports may not come at the time they are needed" S3
- "We are probably due for a much worse drought in the coming decades" S8
- "Incentivize windrows, dugouts and tree planting in the wake of the loss of the PFRA [*the former Prairie Farm Rehabilitation Administration was a branch of Agriculture and Agri-Food Canada; it was created in 1935 in response to devastating multi-year droughts; PFRA assisted prairie agricultural adaptation with sustainable farming practices and soil and water conservation programming and research; PFRA operated during 1935-2013*] …. Reinstate wetlands in the southern farmland, in conjunction with organizations like Ducks Unlimited…Develop more drought resistant hay strains in conjunction with the UofS [*University of Saskatchewan*] …Discourage the breaking of marginal lands…. develop best practice irrigation capacity…and encourage novel forms of agriculture." S8
- "low flows are challenging for interprovincial water sharing…. Alberta or Saskatchewan may be unable to meet interprovincial or international apportionment objectives" [*apportionment objectives relate to water apportionment when a river or stream crosses international and/or provincial borders*] S20
- "We need to better understand our resilience to future drought, and develop mitigation, adaptation or contingency plans. Drought is insidious, and it is easy to become complacent during "normal" or wet periods such as we have experienced in recent years." S20
- "While floods get the media attention, they can be largely mitigated through proper planning and flood proofing. The bigger long-term risk is drought, which has been experienced in the past, but climate models suggest these could be longer and more severe in future." S20
- "widespread drought is one of the most severe natural hazards to impact the prairies. The drought of 2002 resulted in approximately one-billion-dollar payout under Saskatchewan Crop Insurance." S49
- "many programs do not account for future hazards exacerbated by climate change. Market-based programs like crop insurance may no longer be sustainable/affordable as costly disasters increase." S3
- "[animal disease in agriculture] …could devastate the entire livestock industry, as well as those communities that depend on it." S49
- "we are in a wet cycle currently, that could change into a drought cycle quite quickly and… I do not feel that the there are many people that would be prepared for that switch." S2

A snapshot of Stakeholders' Views on Flood

- "we have no knowledge whether the valley slope is unstable" [in areas throughout the Qu'Appelle Valley and Last Mountain Lake] S4
- "at the regional level, more needs to be done to assess resilience in public infrastructure." ...municipalities need to conduct risk assessments on their infrastructure to focus preparedness work and then complete that work to ensure their investment in current infrastructure is not lost." S7
- "Quill Lakes region and Qu'Appelle watershed are at great risk due to the flooding of that salt lake. Measures need to be taken to reduce the water and/or release it in a way that doesn't devastate downstream ecosystems." S8
- "Require flood-proofing to 0.5 m above the 1:500 flood elevation." S14
- "planning measures are a highly cost-effective means of addressing the future impacts of flooding. However, it doesn't do much for existing assets already vulnerable to flooding." S15
- "In our experience, communities and regions don't have a good grasp of relating extreme events to floodwater distribution, damage and damage cost. Nor do they have a good grasp of the influence that adaptation options might affect that. So they are shooting arrows in the dark in terms of identifying promising planning, infrastructure and other adaptation alternatives…. The best approach to adaptation is regional – a cooperative approach….do the hard work to identify the most promising options for a community and region. Well worth the effort" S15
- "vulnerability to any particular hazard may be highly location-specific. So, ranking these hazards in a general way might prove a bit misleading…Sound decision-making is hard work…hard work is needed to deliver great solutions for vulnerable communities and regions." S15
- "many dam owners are not aware of the flood risk associated with their projects" S20
- "flood risk for urban areas is generally well mapped and understood…[but] local government (cities and towns, RMs, resort communities, etc.) frequently ignore this information when planning and approving developments. Much of the flood damage in the news in recent times has resulted from flood events well below design standards (1:500 in Saskatchewan) and should not have produced the damages that did occur." S20
- "Flood damage could be substantially reduced through education and responsible planning and development by local government. No new developments should be allowed in flood risk zones, and all existing developments should be flood proofed." S20
- "no generally accepted methodology exists to evaluate the effect of climate change on flood frequencies" S20
- [some useful mitigation measures are] the Municipal Risk Assessment Tool (http://www.mrat.ca/) S21
- "we need to rethink infrastructure in light of changing conditions [due to climate change]" S33
- "one of the major needs is a willing government that will intervene and deal with problems both at the regional and watershed level….more collaborative planning….build positive long-term relationships." S35
- "We are going to be dealing with significant climate change impacts on the prairies…. droughts..storms…floods….will tax the current economic and social structure…Conflict

will inevitably result unless there are social planning skills and experience to coordinate a short or long-term response." S35

A snapshot of Stakeholders' Views on Wildfire

- "Severe droughts in 2001 and 2002 resulted in busy fire seasons with fires in 2002 that burned down into the peat bog areas making them very destructive and very difficult to suppress. El Nino winters have resulted in extreme fire seasons the following spring & summer…droughts mean more fires…" S1
- "Effective fire suppression combined with new development within the wildlands has resulted in large areas of overmature and unhealthy forests, parklands and grasslands that lead up to, and into, many communities….Forest fringe and northern communities face the greatest risk from wildfires, but with continuous cropping being the standard, we have seen an increase in the number and size of prairie fires in the last few years also."S1
- "The Fort McMurray TV fire coverage last year resulted in a significant decrease in the number of human caused wildfires that happened in Saskatchewan and within other jurisdictions last year."S1
- "Major grass fires [have been] fueled by dead grass in the spring and standing crops in the fall." S14
- "Wildfires are a natural part of the Boreal Forest ecosystem." S16
- "The ability to reduce the number of evacuations is paramount to human safety and this can only be done if we ensure that communities, industry and individuals incorporate the proper mitigation technique to reduce wildfire risk and develop response zones around values at risk where wildfires suppression work can take place." S16
- "Research involves working with First Nations in Saskatchewan who have been evacuated due to wildland fire. Many communities have been evacuated multiple times, including Lac La Ronge Indian Band….Indigenous people have different values at risk…[e.g. concerns with] Let-It-Burn policy, because it impacted traditional lands and cultural values…" S19
- [some useful mitigation measures are] Firemap http://firemap.rmwb.ca/ , Climate and Canadian Prairies (Agricultural Land Use) for regional climate variability S21
- "Good communication plans need to be developed and clearly communicated to all residents" S22
- "more of an effort for government ministries to work together" S32
- "Northern evacuations imposed on our [First Nations] communities represent unique impacts including culture shock and long-term displacement. Family reunification issues are also among those mentioned by evacuees." S39
- "[mines and mining operations] have been under [wildfire threats] several times….there…needs to be clear understanding of when and how [Wildfire Management Branch] will support mines with wildfire threats." S46
- "media and social media exaggerate real conditions, for example, in 2015…air quality was actually better in Waskesiu than in Saskatoon or Regina....Local economy lost approx. 30% of business, with some losing 50%." S52

A snapshot of some of the Stakeholders' broader Views on Natural Disasters

- [with my work], "I have found that underlying structural stressors (e.g. economic
- issues, social inequality, lack of access to resources and services) play a major role in shaping people's experience of disaster." S3
- "people with resources can recover from a disaster, people without resources cannot" S3
- "I would like to see more focus on the deeper structural issues that make hazards into disasters." S3
- [current mitigation measures] "are adequate for what we have faced in the past. They are not adequate for what we may face in the future" S8
- "The people of this province have the right attitude and demeanor to endure these hardships [natural hazards in Saskatchewan] and improve upon them. They need good vision and science to help them make the best decisions" S8
- "…. many of the proposals listed here [to respond to natural disasters] are not necessarily expensive, [they] just simply require resolve and energy or reallocating funds from existing forestry/agricultural programs." S8
- "During a natural disaster, communication is probably the most challenging part" S11
- "the best approach to adaptation is regional – a cooperative approach" S15
- "the entire province is at risk from future climate extremes" S20
- "I laud the Government for forums such as this to compile the knowledge of stakeholders so that we can better understand how we should adapt and/or mitigate the worst effects of climate change going forward." S20
- "Better planning at regional scales needs to be done to support the effectiveness of local mitigation measures. Scenario Planning exercises are required to understand the range of variance associated with severe weather events and their effects on natural hazards. Natural hazards need to be viewed in combination and not as isolated events in order to understand cumulative effects and dependencies.... This is not a site-specific issue, rather an issue of national significance…. Practices on the ground need to be linked to broader initiatives at a wider scale, such as provincial and federal policies and reporting." S21.
- [we need] "a comprehensive holistic plan that is properly funded…more working together rather than in small groups…regional emergency measures….and structures to deal with natural disasters…."S28
- [we need] "policies and institutional capacity to ensure that all communities (i.e. all people) have access to the information and tools they need to adequately plan and respond to climate extremes. Setting a strong comprehensive strategic direction is the essential first step." S29.
- "we may not understand that there are likely limits to economic and population growth that this land can support. Ignoring this will only make impacts of future climatic extremes more severe. Are we prepared as a society to both understand those limits and to implement policies that will respect them?" S29
- "Across Canada natural disasters and requests for Disaster Financial Assistance Arrangement funding have been increasing in frequency and cost. We often see statistics mentioned that for every $1 spent on mitigation measures it saves us $4 in recovery costs down the road." S30
- "There needs to be continued investment in infrastructure to control risks. There needs to be an attitude of individual responsibility to prepare for risks by implementing practices

that mitigate risks…There should be continued education about the risks…and what individuals can do to mitigate the risks." S31

- "We are tending to build an economy that does not have the inherent capacity to mitigate or deal with issues of climate change like an inadequate or excessive water regime. Without a solid basis for mitigation or collaboration, there will tend to be losers and winners. This is not the inherent nature of Saskatchewan or its residents. We need to get back to our cooperative and collaborative roots." S35
- "work needs to [be done] to recognize budget limitations, the cost or the risk to human life, infrastructure damage and the loss to the economy as a whole…Communication is the major component of the development and implementation of [planning]. All Levels of Government, NGO's Industry etc., etc. all have to be included [to determine where it makes sense to spend infrastructure dollars…drought-proofing…flood protection] …. identify problem areas province wide…perform…cost benefit analysis which also looks at environmental, social and other considerations…then the decisions to make changes proactively will follow" S36
- "[natural hazards] are imminent and preparedness is crucial" S44
- [to strengthen capacity to natural hazard risks:] "Public education providing plausible scenarios of what changes are expected with respect to future natural hazards…. will aid and enable stakeholders to design their own mitigation measures…The proposed scenarios at the scheduled workshops are an excellent method to convey and subsequently discuss future hazards." S48
- "how would we respond should large numbers of people experience loss of electricity and/or heat during a blizzard that restricted …ability to travel and our ability…to respond?" S53"
- "We cannot reduce the risk of natural hazards to zero. Benefit/cost assessment is important to consider." S56
- "This study is on the right track, getting the people's view." S60
- "Climate change…will change the playing field for all of these natural hazards…. [concerns I have about natural hazards include] lack of political will to acknowledge climate change risks, lack of capacity in municipal and provincial governments to develop adequate mitigations measures in a timely fashion." S68

REGIONAL STAKEHOLDER WORKSHOP SUMMARIES

The next sections summarize the major points identified by the stakeholders, for each regional workshop. The report is structured as follows:

- a brief overview of each regional workshop
- a grouped summary of the priorities identified for each drought, flood, and fire natural hazard scenario discussion
- a tabular detailed list of the natural hazard impacts and mitigations identified by the stakeholders for current and future scenarios.
- a table identifying the other hazards noted by the stakeholders.

As noted earlier, this entire chapter is based on stakeholder contributions and perspectives, and does not attempt to evaluate confidence levels in stakeholder perceptions. Highly subjective perspectives or a lack of data backing up perspectives may affect confidence levels**.**

Yorkton – 29 Stakeholders

Droughts, Floods and Wildfires

Yorkton's stakeholders provided a view of industry and ecological interactions to address natural disasters. Specifically, agriculture and rural communities are most "at risk" from natural disasters such as droughts and flooding. There were also clear connections made between drought and fire (e.g. water scarcity being problematic for both scenarios). The geographic area has been through a fairly continuous wet phase setting historic records during 2010-2016. Extremely wet conditions and flooding have been top-of-mind and challenging to address. The stakeholders identified issues related to infrastructure damage, illegal drainage, water movement and conveyance systems, and the need to learn from past experiences. The idea of mutual aid agreements is extremely beneficial for all natural disaster types, and is one way of helping cope when local and regional people are taxed beyond their capacity to address severe natural disasters. Yorkton stakeholders also identified heavy winds, plough winds and tornados as problematic natural disaster risks for this region.

The priority setting exercise targeted drought impacts on resources (agriculture, economic impacts, rural communities) with mitigations being long-term planning, effective resource management, planning (e.g. water management) and public education. For flooding, stakeholders identified major impacts to infrastructure, institutions, and policies; mitigations were identified as knowledge and awareness (e.g. including hydrology), local capacity and infrastructure design. For fires, impacts were identified as infrastructure and resource impacts (power lines, water and wastewater, water resources), with mitigations priorizing a need for effective coordination of institutions and emergency responders, and safeguarding of water resources. The stakeholders emphasised the importance of effective warning and alert systems, communications, and well-coordinated well-integrated responses.

The Yorkton stakeholders' identified priorities for drought, flood and wildfire hazards are listed in tables 2 to 4.

Table 2 Yorkton drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Resource impacts (9 votes) o Water supply shortages o Increased fire risk (esp. before spring "green-up" and in fall) o Agriculture (on farm impacts to production; off-farm community impacts, inc. economic downturn) o Ecological impacts (agricultural land, grasslands and ecosystems impaired)	i. Long-term planning (26 votes) o Incorporate drought risk in long-term plans o Learn from past experiences o Use lessons from past to guide preparedness plans ii. Resource Protection and Conservation (18 votes) o Knowledge of water resources for drought mitigation and fire suppression o Open fire restrictions (drought and fire correlate) iii. Public Education (15 votes) o Education and awareness o Water conservation and restrictions stakeholder knowledge and understanding, including knowledge of past lessons o FireSmart programs

Table 3 Yorkton flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Infrastructure Impacts (26 votes) o Railways o Highways o Dams, incl. dam safety o Landfill o Water and wastewater facilities o Buildings and structure ii. Institutional Impacts (22 votes) o Emergency Planning o Hydrology (knowledge) o Institutional responses o Need for coordination of institutions iii. Policy Impacts (8 votes) o Non-compliance of by-laws, zoning o Non-enforcement of insurance agencies o Agricultural drainage issues	i. Knowledge and local capacity (26 votes) o Hydrology and knowledge (inc. local) of water flow on land systems, ecosystems o Downstream impacts and effects knowledge (inc. local) o Learning from impacts and experiences ii. Infrastructure Design (10 votes) o Water control, flow and management (infrastructure and ecosystems inc. wetlands) o Infrastructure planning

Table 4 Yorkton wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Infrastructure and Resource Impacts (5 votes) o Power supplies o Water and wastewater supplies o Other buildings, roads o Human resources reach limited capacity as focus on firefighting leads to less capacity to address other issues o Water resource impacts as there is less water available to fight fires (water shortages or limited supplies)	i. Coordination of institutions and emergency responders (12 votes) o Mutual aid agreements in place o Coordination with provincial institutions ii. Protection of ground water supplies (4 votes) iii. Access to sufficient water sources to suppress fires

Other Natural Hazards

Other hazards identified by Yorkton stakeholders are noted table 5.

Table 5 Yorkton other natural hazards identified

OTHER NATURAL HAZARDS (Yorkton Workshop)
- Severe weather and storms (intense rain, wind, downed trees blocking roads) - Plough winds - Snow storms causing casualties - need to have authority to shut down highways - Environmental changes – landscape changes, crops, trees

Yorkton Stakeholders' Detailed List of Drought, Flood and Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

Yorkton Stakeholders identified drought impacts and mitigations as follows (Table 6) .

Table 6 Identified current drought impacts and mitigation strategies by Yorkton stakeholders

Drought Impacts (Current Scenario)	Drought Mitigations (Current Scenario)
-Fire risk increased, especially in spring, after snow-melt/prior to green-up, and fall with dry vegetation a large source of fuel -Water shortages also mean less water is available for fighting any fires that occur -Surface water quality degrades -Surface and Ground water supplies depleted; less community water supplies available -Agricultural crop failures; also, loss of water for livestock -Ag economic impacts, which then lead to broader regional and provincial economic impacts -Loss of water or impacted lakes, rivers, pools parks affect recreation and impair economy -Food quality, quantity and cost impaired	-Need to know secure water sources for fire suppression -Water conservation is critical -Watering restrictions -Safeguarding of wetlands is beneficial -Open fire and burning restrictions during droughts -Public Education and awareness of conservation and protection of water supplies -Knowledge of alternate back-up supplies -Mitigate Ag losses with farm stewardship and other types of crops (diversification, drought tolerant) -Long-term drought planning that incorporates drought risk

-Health and well-being of population -Multiplying economic impacts leads to severe economic decline	-Document lessons learned (from past) and incorporate into future planning -Have documented planning (for drought) for municipal knowledge retention over time (and use in future) -Organizations (knowledge, expertise, awareness, communications)

Yorkton stakeholders identified future drought impacts and mitigations in Table 7.

Table 7 Identified future drought impacts and mitigation strategies by Yorkton stakeholders

Drought Impacts (Future Scenario)	Drought Mitigations (Future Scenario)
-Severe to extreme droughts have severe to extreme impacts -Severe shortages of municipal water supplies	-Severity requires larger players to engage and respond (industry, provincial and federal governments) -Local conservation plans for municipal water but include industrial, commercial, residential -Water use restrictions and enforcement -Education / “WaterSmart” -Strengthen water security (secure water supply/quality) -Identify resources available in a written drought plan/water scarcity plan at local scale -Cooperation and collaboration needed at all levels

Flood

Yorkton stakeholders identified flood impacts and mitigations as follows (Table 8).

Table 8 Identified current flood impacts and mitigation strategies by Yorkton stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-Transportation systems (roads, rail) impaired -Municipalities are challenged to deal with institutions responsible for road/rail – slow to deal with during times of emergency -Municipalities have transportation access problems -Dam safety issues are not well understood (likely especially at the local level where risk may be imminent) -Municipal water and wastewater systems are impacted - Agricultural land is lost (crops, livestock impacted) -Emergency plans may not be current or a challenge for local resources to implement -Regional landfills at risk (leading to contamination and transport of pollution) -Lack of hydrological knowledge is an impediment -Non-compliance of bylaws; Non-enforcement by insurance companies (at risk properties, commercial developments) -Sustained responses are weakened or challenged over time (local resources are taxed or stressed beyond capabilities) -Actions are uncertain and disjointed when there is no emergency response plan in place or if it is not well understood	-Emergency plans improved for urban areas -Storm water infrastructure improved -Impediments are costly – tax hikes -Retention of water on landscape to slow water runoff -Provincial Disaster Assistance Program is beneficial; seek improved response planning -Water infrastructure – but it does not always consider downstream effects, and this is critical -Debriefing after disasters (continual learning) -Control and manage water strategically together (RMs, urban communities, highways ministries, etc.) Remove development from flood-prone land -Emergency Management and Fire Safety is beneficial, could be improved deployment -Emergency Action Plans (up-to-date) -Local knowledge needs to be integrated into regional/provincial planning - improvement in hydrology and topographic knowledge is critical -More and better communications is needed between rural municipalities and urban communities (inc. residents)

-Complex responses and coordination (City of Yorkton, Highways, Rural Municipalities, Lower Qu'Appelle Watershed Stewards, etc.) -Response impaired without central coordination, and/or improper, insufficient communications.	

Yorkton Stakeholders identified future flood impacts and mitigations as follows (Table 9).

Table 9 Identified future flood impacts and mitigation strategies by Yorkton stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
[Note: Specific impacts were not identified or recorded, but are recognized by stakeholders in some of the current impacts. In fact, in some regards, the 2010-2016 wet phase in this region may be an analogue to some of the future impacts to infrastructure, ecological systems and communities – the region has been challenged to address severe and more extreme and sustained wet conditions and flooding. Repeated back-to-back wet years have left antecedent conditions wet, exacerbating new events. The events have dwarfed past events in severity and frequency, when one looks at the last 80 years of instrumented records.]	-Planning and preparedness is key; contingency thresholds/levels need to be explored with scenarios -Education and awareness are critical -Emergency plan execution – logistics and contingency planning, including how to manage evacuations and evacuees -Emergency services leadership and command are essential, establish an Emergency Operations Center with clear authorities, roles and responsibilities – chain of command -Communications is essential and must be planned properly to get out good information (but cannot supplant flood response actions) -Response resource deployment needs to be understood and managed -72-hour self-preservation is essential for all public (education of public) -Sustained action plans and responses require leadership and collaboration of all stakeholders -Must plan for more extreme future events -SaskAlert system needs to be fully implemented -Scenario/workshop planning is important and useful (preparedness planning for future) -Consider complex governance; need clarity of leadership and collaboration roles, responsibilities, authorities (to implement responses – citizens, rural municipalities, First Nations, provincial and federal governments, industry, utilities, volunteer organizations

Wildfire

Yorkton stakeholders identified wildfire impacts and mitigations as follows (Table 10).

Table 10 Identified current wildfire impacts and mitigation strategies by Yorkton stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Lack of firefighting resource (fire spreads) -Vulnerable people at risk of respiratory issues -Primary services impacted or stopped, may need to redirect (or do without) -Water treatment at risk (Yorkton) -Hospital unable to accommodate 20-30 injured -Fire services taxed locally (need outside help) -Lack of water to fight fires in a dry year -Mass power outage; sub-stations at risk -Rail lines out of service are sources of risk with no vegetation control	-Mutual aid enacted, improved -Updating of Emergency Measures Operations plans -Funding -More Regional planning (i.e. not just local municipalities) -Protection needed of groundwater supplies (water security, firefighting security) -Call-out lists for water supply and farm implements (i.e. ways to mitigate and respond with emergency water sources, and equipment) -Call province for assistance; expanded Emergency Management and Fire Safety helps reduce risk; a centralized communication system helps reduce risk -SaskPower looking a mutual aid to protect sub-stations; remote switching, calling RMs often about access

Yorkton Stakeholders identified future wildfire impacts and mitigations as follows (Table 11).

Table 11 Identified future wildfire impacts and mitigation strategies by Yorkton stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
-Sanitary systems are overwhelmed with evacuees (e.g. Wynyard an only house 200 evacuees) -Volunteers are taken away from their jobs -Long-term economic loss in the North -Possible out-migration from affected Northern communities -Greater impact on communities with transient populations (e.g. Oil/Gas, CN workers, others who are not familiar with local region) -Depression/ impacts on vulnerable populations becomes cumulative, alcoholism, suicide -Major infrastructure damage (gas, power, etc.) -Panic/hoarding by population -Breakdown of transportation networks, leading to inability to transport essential goods, services, food to destinations -All infrastructure is taxed or overtaxed -Major economic losses occur, and impacts generations differently; youth have less coping capacity	-Provincial assistance is available -SaskPower has ability to re-route power -Improved insurance would help -Communication and Education is critical -Better planning by all levels of government with grassroots involvement is needed (proactive) -Need enough legal power (authority) to address situation (during response) -Need more emergency management (risk) education and planning (in advance/proactive) -Need basic communications (non-technology based) warning and communications systems and public education of how communications will be handled in the emergency -Awareness and understanding of insurance -Communication – Cooperation - Coordination

Saskatoon – 39 Stakeholders

Droughts, Floods and Wildfires

The Saskatoon stakeholders identified a broad suite of risk impacts and mitigations. There was a strong emphasis on flooding and fire risk reduction, and the need for proactive planning in advance of natural hazard occurrence. Stakeholders suggested that broader, perhaps unique partnerships with industry and across agencies, be developed both for natural disaster preparedness and for disaster recovery.

The stakeholders identified a number of priority areas of concern. Drought impacts included impairment of community and municipal water supplies and related impacts to people, social and institutional impacts, and ecosystem impacts (including deteriorating water supply and water quality and increased fire risk). Agriculture and agricultural industry is the most affected sector during drought, with related impacts to communities. For flooding, major damage to infrastructure, buildings and transportation systems, utility lines, and land slumping are concerns, with related social impacts. Mitigations are seen to be improved planning and preparedness, better zoning, policy and infrastructure design, public education and knowledge, and incorporation of ecosystem management (e.g. wetland preservation, green infrastructure). Wildfire impacts were identified largely as social, industrial and economic. There was concern about law and order, security, isolations, economic slow-down, and stressed systems for decision-making. Wildfire mitigations were identified as FireSmart programming and knowledge, partnerships with planners, industry, institutions, and integrated response teams. Management, policy and infrastructure were identified as crucial for disaster preparedness, response and recovery.

The Saskatoon stakeholders' identified priorities for drought, flood and wildfire hazards are summarized in the following categories (Tables 12-14):

Table 12 Saskatoon drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Community and municipal water impacts (14 votes) o Potable water availability and quality o Alternate water supplies o Evacuation of communities severely impacted o Social impacts on people o Coping capacity impaired o Varying exposures (some areas seriously affected, others not, or drought in one location, flood in another) ii. Social and institutional impacts (10 votes) o Reactive strategies	i. Improved Planning, Knowledge, Education (12 votes) o Scenario planning o Water resource planning o Education of public o Knowledge developed for industry (e.g. drought tolerant crops, land management, forecasts short-term, seasonal) o Long-term plans (considering climate change impacts) o Preparedness planning and communications ii. Greater water security (12 votes)

- Uncertainty as storms occur in different times than historical experience
- Short-term memories (we forget about past disasters)
- Need to conduct hazard risk assessment
- Need to get correct information to the right people

iii. Ecosystem impacts (8 votes)

- Fire risk increase
- Fire bans
- Less water for fire suppression
- Poor water quality
- Wetlands impaired, wildlife affected
- Sloughs dry up, less water available in rural areas
- Ecosystems changes

iv. Agricultural and industry impacts (7 votes)

- Ag is the most affected industry (crop loss, livestock impact, soil erosion, etc.)
- Alternate sources of water
- Alternate sources of energy production (less hydro power)
- Access to more water sources
- More water storage systems
- Pipelines (for communities, for rural residents, e.g. Humboldt)
- Water rights and licences
- Multi-use pipelines
- Back-up reservoirs
- Canal systems
- Irrigation developments, technology improvements
- Manufactured engineered wetlands for storage

iii. Protection of ecosystems (10 votes)

- Wetland conservation and preservation
- Ecosystem services recognized
- Habitat preservation

Table 13 Saskatoon flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Infrastructure (13 votes) o Transportation systems (road, rail) o Sask Power Corp. power systems down (poles, outages, etc.) o Energy access limitations o Infrastructure, buildings not build to incorporate drainage o Property damage (individual, industry, commercial, etc.) ii. Human/Economic (5 votes) o Not a full understanding of risk iii. Environment (2 votes) o Erosion o Slumping o Infiltration into sanitary systems	i. Proactive Planning and Preparedness (47 votes) o Undertake regional planning approaches (i.e. local planning also needs regional planning to address larger geographic risk) o Undertake proactive measures (i.e. not just planning but proactive implementation) o Financial incentives for flood preparedness o Incorporate climate change into all types of natural hazards risk assessments and preparedness plans (i.e. not just flooding) o Partnerships in place (e.g. with Ducks Unlimited) ii. Zoning, Policy, Infrastructure change (16 votes) o Adopt zoning improvement and by-laws o Develop and implement new policies for flood risk reduction o Develop or incorporate new standards (flood frequency return in designs) o Incorporate water storage with drainage systems iii. Education and Knowledge (14 notes) o Municipal education (e.g. councillors and local leaders) o Public education (property owners and citizens) o Collect better data (e.g. drainage culverts surveyed, located, etc.) o Develop a common understanding of risk o Support and train groups inc. volunteer responders

	iv. Ecosystem Benefits (12 votes) o Wetland preservation (as a means of improving water management and runoff) o Incorporate green infrastructure in water management and runoff

Table 14 Saskatoon wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Social (12 votes) o Law and order o Looting, crime o Security o Economic impact for individuals – people want to work o Employee care and isolation esp. in remote affected industry (e.g. mine closure) o Decision-making credibility of officials making hard decisions to evacuate o Taxed government resources o Taxed and overwhelmed emergency responders ii. Industry and Economic (7 votes) o Mines shut down (other industries affected as well) o Impact to water systems and utilities o Challenge to achieve effective fire suppression	i. FireSmart and Knowledge (18 votes) o FireSmart (8 votes) encompass a gamut of items (including those noted below) o Improvements are possible to strengthen FireSmart o Education o Risk Assessment o Critical infrastructure identified and include in risk assessment ii. Proactive Planning, and Partnership (14 votes) o Proactive approaches o Create incentives for risk reduction o Municipal fire bans o Fire permits o Sask. Emergency Planners Assoc. o Strong decision-making to make tough decisions o Partner with industry inc. during evacuations o Partner with government and industry for education and awareness iii. Management, Policy, infrastructure (14 votes) o Landscape scale forest management o Emergency management plans and enforcement of plans o Regulatory tools o Property Line set-backs o Fire breaks, including targeted breaks to protect industry o Controlled burns o Policy incentives o Insurance incentives

Other Natural Hazards

Other hazards identified by Saskatoon stakeholders are noted in table 15.

Table 15 Saskatoon's other natural hazards identified

OTHER NATURAL HAZARDS (Saskatoon Workshop)

- Invasive species (quagga mussels, mountain pine beetle, etc.)
- Cascading effects of natural hazards
  o e.g. floods, excessive wet conditions causing infrastructure failures of dams, bridges, foundations, etc.) [these could also be propagated by shifts in hazards such as the 2009-10 winter drought with dry soils followed by intense rain/flooding in summer 2010 where ground shifting cause gas line breaks in Regina, other locations]
  o e.g. floods and runoff causing contamination from runoff (human wastewater, livestock runoff and effluent, industrial pollution or contaminants, etc.
- Wind events and storms, causing forest blowdown, need to manage forests for an ecologically healthy forest age distribution
- Note: there is a strong need for education and public awareness of natural hazards consequences: the public needs to take warnings of natural hazards seriously

Saskatoon Stakeholders' Detailed List of Drought, Flood and Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

Saskatoon stakeholders identified the following drought impacts and mitigations (Table .16)

Table 16 Identified current drought impacts and mitigation strategies by Saskatoon stakeholders

Drought Impacts (Current Scenario)	Drought Mitigations (Current Scenario)
-Water scarcity intensifies, affecting municipal supplies, rural supplies -Water becomes more costly -Responses become reactive (unplanned, slow on-set, uncertainty of responses)	-Access to secure, diverse, alternate water supplies (back-up in drought years); more water storage systems -Education and awareness of drought; – leading to better management decisions -Conduct more Scenario Planning (in advance of droughts) to be more proactive rather than

-Water security is threatened with lower river/lake levels; aquifers are depleted (even for Saskatoon if river flow is low) -Water quality worsens (rivers, lakes, streams, groundwater). Sloughs increase in salinity and sulphates [may pose extreme risk to livestock if used as water source, inc. risk of animal deaths] -Water hauling is challenged (limited capacity); shipping water, transport of water, temporary pipelines possibly -Fire bans imposed due to extremely dry conditions -High fire risk -Highly variable regional impacts occur (some areas extremely dry, while others less dry or maybe even in excess water conditions) [and this may lead to unclear responses] -Storms begin occurring at different times (changes in weather patterns as heat and drought lasts longer) -Wetlands and wildlife ecosystems impaired -Communities impacted, may need evacuation if severe prolonged drought (migrate away for serious impacts – similar to Fort McMurray evacuation, will be social impacts) -Energy impacted (less hydro power) -Social and institutional reactions/ responses are not clear (people forget severe past droughts) -Potable water systems threatened by scarcity, deteriorating quality; alternate sources may be limited if drought is severe, expansive -Agriculture production and sector are severely impacted (crop failure, livestock have limited feed, water and may need to be	reactive; consider what you would do in a severe drought, how you would react -Use of grey water (e.g. as a means of water conservation with laundry, grey or other suitable applications) -Enforce water bans -Water transport (shipping, trucking) if possible as a back-up supply (likely for rural homes) [could also need alternate delivery systems in temporary pipelines for livestock] -Build up livestock feed reserves and water supplies to ensure timely access -Consider new water storage infrastructure approaches such as manufactured wetlands, municipal retention ponds, as part of a proactive planning initiative for alternate water supplies during drought periods -Communications are important -Increase water security in rural communities and farmsteads (rural water pipelines, etc.), maximize water security with major sources where possible from North Sask and South Saskatchewan Rivers. -Expand irrigation (from secure sources; consider expansion of effluent irrigation) -Conserve wetlands and preserve habitat (e.g. Water Security Agency and wetlands preservation) -Consider value and payment for ecosystem services (alternate land use services) -Crop, livestock and agricultural production research/science for new varieties of resilient crops and animals (heat stress, water, feed research), improved land use practices (e.g. like zero till, improved vegetative cover to protection land during drought periods, etc.), agricultural irrigation research and technology

moved/sold off); extended drought may be devastating to production -Soil erosion with dry conditions, wind, so there will be loss of organic matter -Ecosystems start to change with extended drought	considering irrigation expansion as water security, shelterbelt research and expansion for agricultural soil protection -Establish social safety nets (as part of an emergency response plan for short-term and long-term drought risk) -First Nations impacts may have higher social capital or cultural capital to draw on [however impacts will be different due rural, remote locations] -Plan for longer-term and consider local areas and responses/actions; planning, preparations and communications so all understand the drought plan -Backup reservoirs for fire suppression (esp. in small rural communities during times of water scarcity) -Weather forecasts, fire ratings (immediate, seasonal forecasts to inform/guide users)

Saskatoon Stakeholders identified the following future drought impacts and mitigations (Table 17).

Table 17 Identified future drought impacts and mitigation strategies by Saskatoon stakeholders

Drought Impacts (Future Scenario)	Drought Mitigations (Future Scenario)
-Increased pests, perhaps new varieties (mosquitos, grasshoppers, plant, animal inc. human impacts) -Water competition intensifies; municipalities stressed and competition between rural areas for limited water supplies -Human physical impacts – heat exhaustion with extreme heat	-Potential needs for alternate energy (generate power more efficiently) i.e. to compensate for less hydro production in times of less flow -Building and landscaping code changes for resilient landscaping, use of gray water in irrigation -More, better water conservation -Changes in crops and irrigation practices

-Agricultural land depreciates in value the longer the drought -Depressed economy -Depressed tourism -Depletion of surface water and ground water supplies -Significant crop losses and economic agricultural losses -Rural populations/areas are hit hardest, largely as a direct spin-off of the severe agricultural impacts -Deforestation may be an issue if people need to relocate to the north -Vulnerable populations are most affected (by heat, water scarcity, possible related health issues) -Increased fire hazards across the province; northern forests at extreme risk the drier, longer the drought lasts -Increased energy demand (e.g. air conditioning) yet less water is available for energy (hydro-electricity production) -Water sharing arrangements become tested and stressed as there is greater demand for the scarce resource -Social stress from cascading economic impacts and losses, some of which will be personal; mental health problems from stress; potential to lead to greater crime -Weather systems are impacted (less convective storms) -Depopulation begins with severely impacted drought locations	-Changes in geographic locations (e.g. population movement to locations of greater water security, water storage) -Improvements for water use efficiency in water-consuming industry [e.g. some industries require large volumes of water, such as oil and gas, potash, etc.] -Identify secure water supplies in community planning [i.e. don't take water for granted, and consider climate change impacts into the future, along with development and other water use factors] -Pipelines and water conveyance infrastructure -Upgrade mitigation infrastructure, learning from past drought experiences -Increase use of shelterbelts -Increase use of gray water -New, expanded social programs, education and awareness of severity of extended drought, and proactive drought response planning (i.e. political will to have anticipatory planning in place before the hazard) [this could be conducted with scenario planning] -Prioritize water sharing -Adopt new, innovative water saving technologies and techniques -Better water infrastructure and planning -Incorporate incentive programs for water conservation, consider using price models -Learn from other jurisdictions [e.g. water-scarce areas and responses, best practices and/or innovations, what works and does not]

-Significant price increases (as food, water will cost more) -Potential to lead to new innovations to cope with the problem	

Flood

Saskatoon stakeholders identified the following flood impacts and mitigations (Table 18).

Table 18 Identified current flood impacts and mitigation strategies by Yorkton stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-Contamination of drinking water and sanitary systems -Erosion, slumping -Not a full understanding of risks [chaos, confusion] -Transportation systems impacted (road, rail) -SaskPower down (poles, outages) -Emergency access limitations -Sanitary sewer, storm sewers overwhelmed - "Soft" infrastructure/services impacts (books, software, computers destroyed – could impact knowledge, research, universities, schools, businesses and industry) -Infrastructure (buildings) are not designed to drain flood water – so clean-up is challenging -Evacuation of large populations – costly, logistics issues, human issues, animal/livestock issues -Floods have varying impacts based on short vs. long durations (length of time flooded has greater impact on infrastructure) -Property damage could be extensive	-Insurance (large claims) -Provincial Disaster Assistance Program -Green infrastructure [water storage, wetlands, parks and buffer zones] -Financial incentives for flood preparedness -Consider designing water storage with water drainage (new systems, innovations for use during water scarcity or excess water) -Integration of "all hazards" considering impacts of climate change (i.e. climate change will affect all types of natural hazards) -Improved zoning (to keep infrastructure, property, businesses out of flood prone locations or areas where flood risk is higher) -Public education (e.g. homes, flood risks, preventive measures and safeguards, strengthen personal private property resiliency, as well as commercial resiliency) -Proactive measures (in advance) -Partnerships with others to reduce risk (e.g. Ducks Unlimited wetlands, buffers, water management systems)

	-Communications of risks (common understanding and approaches) -Support groups to train volunteers and responders during events -Raise roads in flood prone areas; improve drainage where feasible (e.g. to rivers) -Proactive flood protection measures and infrastructure (e.g. berms, dykes around vulnerable lands) -Improve municipal education and communicate risks to public (e.g. elected representatives need knowledge of risks) -Better current data of existing water infrastructure (e.g. location of culverts, asset maintenance and/or replacement needs) -Regional approaches (i.e. planning and knowledge needs to be both local and regional to effectively manage water in a watershed) -Wetland preservation (as buffering systems for managing water quantity and quality) -Policy and design (e.g. new developments must retain runoff rather than speed up runoff to another location magnifying the problem of excess water) -Standards – review, reconsider the appropriate design return period (e.g. 1:25? 1:50? 1:100? 1:500? Flood events) Consider the effects and risks of a changing climate for future impacts (perhaps related to the design life?)

Saskatoon stakeholders identified the following future flood impacts and mitigations (Table 19).

Table 19 Identified future flood impacts and mitigation strategies by Saskatoon stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
-Pavement damage (winter flood leads to issues with freeze-thaw problems, ice) -Insurance overwhelmed (large claims and widespread damages) -Limited access to impacted area -Communications systems down – leading to problems to recover and respond, particularly challenging in rural, remote locations -Livestock problems -Hospital overwhelmed with human injury from falls (ice issues post winter flood) -SaskPower may be overwhelmed to repair, replace lines if damage is extensive – may need external help (e.g. contractors) -Psychological stress of populations affected and responders overwhelmed by stress -Displaced people having challenges for safe housing, especially without power and heat -Options for response – what if Plan A does not work? Are there other options to cope with impacts? -Financial burden; high cost to bring in food -Accessibility issues, particularly in winter months -Environmental challenges, impacts on animals, food (e.g. livestock, pets) -Infrastructure repairs difficult to undertake in winter months and much more costly	-Personal survival kits (72 hours) -Public Education -Education of personal response plans and options (what do you do with power loss, flood in winter, etc.) - Ensure support centers have enough capacity and have supplies, trained staff -Raise awareness [see the numerous points also listed in "current" mitigations, as they are extensive and consistent for future risks, just magnified as there is a need for consideration more extreme flood risks)

-Culverts and drainage systems freezing -Safety and security of populations, individuals are challenging -Health impacts – where will aid be available?	

Wildfire

Saskatoon stakeholders identified the following wildfire impacts and mitigations (Table 20).

Table 20 Identified current wildfire impacts and mitigation strategies by Saskatoon stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Capacity to evacuate stressed -Need to seek options – transportation, lodging, communications -Government decisions are impacted -Security at risk, law and order, crime, looting -Transportation breakdowns -Technology breakdowns -Mining shut-down, must care for employees in affected area; isolation and feeling of being on your own -Credibility tested when making evacuation decisions – health and safety of front line workers are being affected -Stress, people displaced, trauma, anger -Water systems impacted -Government capacity taxed (municipal, provincial) -Smoke, Air quality, human health -Displacement of people	-Mitigate through insurance premiums -Partner with Industry for evacuation help -Partnerships with province and industry and need for more education -Communications systems -Need proactive approaches, create incentive for preparedness; municipal fire bans, and/or fire permits, Saskatchewan Emergency Planners Association) - FireSmart programming is effective, but needs to be strengthened -Fire rating posted (increased awareness and caution) -Need for municipalities to adopt building code -Landscape scale forest management -Fire breaks -Some controlled burns, need for more “carrots and sticks” to encourage fire risk reduction, insurance premiums

-Effective fuel suppression is challenged	-Identified values (infrastructure, resources) to indicate "at risk" -Industry fire breaks and fire capacity to protect industry (i.e. some self-resilience capacity) -Education and Risk Assessment (people, industry, agencies, communities need to be informed) -Regulatory tools for evacuation exist, but need to be strengthened -Provincial air filtration equipment purchased -Existing municipal emergency plans need to be enforced and encouraged (strengthened, and always current and ready for implementation)

Saskatoon stakeholders identified the following future wildfire impacts and mitigations (Table 21).

Table 21 Identified future wildfire impacts and mitigation strategies by Saskatoon stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
Loss of power -Access restricted -Rebuilding impaired with limited power/access -Insufficient coping capacity; this is beyond local (perhaps even provincial) capacity to cope; fire scenario is more than what a small town/community can deal with – provincial assistance needed -Financial institutions closed - "mad max" scenario; chaos, even larger communities or with prepared planning in advance chaos will occur	-SaskPower has Incident Command System to address lost power and re-establish -Emergency Management Services have strong working relationships with other agencies/communities -Mutual aid agreements in place -Insurance -Learn from past events -Large scale provincial/federal organization and response -Sharing of resources to deal with large disaster is critical (with trained personnel); this requires education

-Social impacts on community, including larger and smaller communities (people will be affected and there will be human impacts) -Large human toll -Lack of trained personnel (insufficient resources to address widespread disaster) -Cannot cope with scale of impacts -Lack of interprovincial transportation (effects across provinces) -Aging infrastructure -Politics of spending money (will be challenged) -Timeliness is critical for decision-making -Current mitigations cannot address this scope of disaster -Mature forest growth is a large fuel risk -Limited resources for personnel, infrastructure, fire suppression equipment -May need to determine which communities to sacrifice - triage (if cannot protect all) -Evacuation centers not available (or overwhelmed) -Evacuations become more difficult and more expensive -People are pulled away from their paying jobs (and the impact is both personal and economic to the region) -Loss of life; what about the aftermath? -Disease (secondary impact in aftermath) -Insufficient provisions	-Greater use of Dept. of National Defence is likely -May need to grant greater authority to local communities, particularly for initial pro-active mitigation/recovery responses -Education is key -Preparedness in advance is key -Enhance capacity for timely decision-making -Contracts with local RMs to assist or address regional park fires -Need to be self-sustaining for 72 hours -Equipment sharing across RMs -Livestock movement to secure locations -Agricultural community will help each other (tightly-knit industry) -Last resort decisions; e.g. industry shut downs (e.g. close mines until capacity can recover) -Greater reliance on government, which is already tapped out (i.e. government agencies are also under stress and capacity limitations) -Learn how to deal their longer-term larger scale event – how can we re-group?

- Agricultural losses -loss of animals (cattle, poultry, other) -Large scale of disaster impacts the viability of mitigation strategies -Equipment loss (risk of non-insurable losses) -Regional economic impacts and effects on international businesses (with local presence) -Loss of equipment for economic activities (e.g. need to use equipment to suppress fires and/or recover from losses) -air quality impaired (impact human and animal health) -No transition teams -Human limitations - can only do so much -Job issues – people want to help but may not be able to financially afford to help -Stress on individuals and on the population	

Prince Albert – 31 Stakeholders

Droughts, Floods and Wildfires

The Prince Albert stakeholders prioritized fires and floods as natural hazards of concern, but they were also clear in seeing a relationship between droughts and fires. They strongly recommended proactive long-term planning in advance of natural hazards, and proactive emergency response planning with effective implementation of emergency measures during the occurrence of natural hazards. The city of Prince Albert is a critical and important community link with northern Saskatchewan, and is recognized as an evacuation center or transportation hub for northern citizens affected by wildfires.

Drought impacts were priorized largely as an information and infrastructure concern, with communications, drainage, transportation systems identified (e.g. roads can be better maintained during lower water levels, which has been a concern during wet phases). Drought mitigations were seen as opportunities for fire management (e.g. fire break construction), water management, and proactive long-term planning. Flood impacts are a significant concern, with damages to infrastructure (highways, communities, commercial and private property/buildings). Floods also impact the social structures (directly affecting people, institutions, responders). Environmental impacts were also recognized (e.g. issues with animal carcass disposal). Flood mitigations include

inter-agency planning, watershed educations, effective leadership and decision-making and critical infrastructure (including buildings, roads, soil erosion protection). Zoning and by-laws are also recognized as critical mitigation efforts. Wildfire impacts clearly affect the forested lands and economic activities (forestry and recreation), but the Prince Albert stakeholders priorized wildfire impacts largely as social: evacuations of people, stress on evacuees and responders, challenges and stress on wildfire disaster responders. Mitigations are recognized as effective programs (e.g. FireSmart, with an emphasis on the response and recovery activities, communications and data sharing between people in the affected areas and authorities involved in the decision-making. Emergency response plans, warning systems, training and preparedness are critical mitigations for wildfires.

The Prince Albert stakeholders' identified priorities for drought, flood and wildfire hazards are summarized in the following categories (Tables 22-24):

Table 22 Prince Albert drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Information and Infrastructure (4 votes) o Information flow important (Timing of when) to who (who is the audience?) o Illegal drainage problems o Beaver dams affect water flows by redistributing o Cannot afford to be 100% efficient o Road maintenance becomes possible	i. Fire Management (16 votes) o Fire breaks o More resilient infrastructure o Firefighter training ii. Water Management (16 votes) o Water storage o Water stockpiling o Water allocations o Watershed assessments o Correct drainage issues o Sharing of equipment o Resilient infrastructure iii. Proactive planning (9 votes) o Long range plans o Long range asset plans o Communications

Table 23 Prince Albert flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Infrastructure damage (9 votes) o Highways, roads o Access to communities o Access to land o Property damage o Buildings and infrastructure o	i. Proactive planning (37 votes) o Long-term plans o Agency integration o Watershed education o Communications strategies o Funding o Public education

ii. Social and environmental (3 votes) o Human resource stress o Emergency Management and Fire Safety o Environmental problems o Animal carcass disposal	o Effective leadership o Critical infrastructure identified in advance o Soil erosion protection ii. Improved infrastructure (22 votes) o Mass drainage projects o Road grade infrastructure o Emergency Flood Damage Reduction Program (Water Security Agency) o Dykes o Soil erosion protection iii. Zoning and by-laws (21 votes) o By-laws o Building codes o Zoning o Land use plans o Source water protection plans

Table 24 Prince Albert wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Social (15 votes) o Evacuations, Emergency Management and Fire Safety o Maintenance workload o Health and smoke inhalation o Lack of experience (unskilled responders) o Greater workload o Magnitude of issues (stress) o Coordination problems o Evacuation (strain on those affected and on responders)	i. Recovery Response (24 votes) o Evacuation plans o Skill and wide array of responders o Incident command o Communications to communities (and to those affected) o Data sharing (between agencies and responders) o Public education, including information on economics ii. Preparedness plans (17 votes) o Resource sharing arrangements o SaskAlert warning systems o Contacts are identified before events occur o Fire breaks constructed o Training of responders in advance

Other Natural Hazards

Other hazards identified by Prince Albert stakeholders are noted in Table. 25

Table 25 Prince Albert's other natural hazards identified

OTHER NATURAL HAZARDS (Prince Albert Workshop)
- Diseases (human, crop, livestock, wildlife) - Insects (human, crop, livestock, wildlife; new disease vectors: biological, microbial) - Solar flare; impact on communications systems - Volcanic ash from other regions - Atmospheric wind transport of other hazardous contaminants - Extensive, prolonged, multi-year droughts - Tornados - Plough winds - Snow and blizzards; heavy wet snow - Ice storms - Hail - Intense heat - Lightning storms affecting power distribution, communications systems - Exotic plants, insects, animals, and invasive species (not common to region) - Beavers, rodents (and other ecosystem biota changes) - Unique specialized diseases (BSE, Mad Cow) affecting animals and livestock

Stakeholder Lists of Drought, Flood and Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

Prince Albert stakeholders identified the following drought impacts and mitigations (Table 26).

Table 26 Identified current drought impacts and mitigation strategies by Prince Albert stakeholders

Drought Impacts (Current Scenario)	Drought Mitigations (Current Scenario)
-Economic impacts (even in cities, e.g. shutting down of car washes, other water using industries will all be impacted and/or incur additional costs) -Water use restrictions, lower quality of life with reduced water availability	-Construct wells as alternate supplies (individual, rural, community supplies) -Storage/stockpiling of water; retention of non-potable water becomes important -Provide training to other communities

-Opportunity for road construction and maintenance in drier conditions, particularly in locations where roads are affected by high water levels or wetlands -May need to import food (less self-sufficiency with crop failures) -Lack of knowledge of suitable water quality/quantity (unknown how to find alternate sources) -Large farmers at risk of water scarcity -Farms have financial risks (and spin-off financial risk goes through the economy; investments and savings are depleted – can't carry money from one year to the next) -Illegal drainage compounds water scarcity -Lack of communication compounds issues (drought is slow on-set, and extent of classification is not clearly established) -New farmers at greater risk and may leave farming -Forest ecosystems renewal -Budget priorities are shifted (individual, local, provincial, particularly as intensity/duration increases) -Out-migration of people (severe drought) -Prioritize water resources and uses (e.g. for fire suppression) -Timber industry is affected -Cost saving measures for drought vs. flood (perhaps this comment relates to an idea of an annual "natural disaster budget line" and expenditures vary based on risk occurrences)	-Water allocation and assessment of watersheds (becomes critical to protect resource) - Government grants, even for small initiatives like dugouts, become more beneficial for improved local water storage -Proactive planning for future is critical -Drainage systems corrected -Communications to all affected beneficial -Budget for "non-rainy" day -Public education -Wildfire suppression resources need to be discovered and/or identifies (fire risks increase with drought, and local fire suppression with secure water sources is critical) - Fire breaks on land (note: even field crops, not just forest, may require fire breaks to reduce risk of grass fires) -Pesticide spraying increases to mitigate pests -More training for fire fighters -Sharing equipment with others -More resilient infrastructure -Have Plan B for future -Forward thinking -Longer-range asset planning -Water use restriction/by-laws -Zero-scaping landscape changes to encourage less water use on yards, etc.

-Beavers are redistributing water flow (ecosystem dam-builders still manage water) -Ecosystem impacts and changes – less fish spawning, winterkill of wildlife as ecosystems suffer, grasshoppers and insect or other pest infestations as populations increase - Dust storms (health, soil organic matter degradation and negative spin-off effects for agriculture and environment, as occurred in the 1920s-30s severe droughts) -Infrastructure water use efficiency is never 100% -Water hoarding may become problematic with water restrictions	

Prince Albert identified the following future drought impacts and mitigations (Table 27).

Table 27 Identified future drought impacts and mitigation strategies by Prince Albert stakeholders

Drought Impacts (Future Scenario)	Drought Mitigations (Future Scenario)
-Higher stress on medical system (human disease risks increase) -Pest problems increase with livestock (e.g. ticks, other pests) -People leave farms, businesses, industry (most affected people and economic activities) -Stress increase on urban communities and populations (cascading negative social impacts) -Water reservoirs depleted, water supplies including ground water sources depleted -Water quality problems (lakes, rivers, streams, ground water)	-Collaborative approaches, water conservation (problems become too significant for individuals to solve) -Water is Plan B, what can be done to mitigate for future droughts; proactive plans also need to be continually revisited to keep current, and up-to-date (relates to scenario planning and action planning scale of mitigation and response) -Tap into water sources of greater water security -Know critical needs (plan for key needs) -Research and development are needed (e.g. water use, crop, efficiencies, adaptations)

-Higher cost to water treatment (due to poorer quality water) -Less flooding issues -Opportunities to conduct road maintenance are improved (e.g. wetter areas dry up) -Significant agricultural impacts (the greater the intensity, and duration, the more catastrophic) -Health problems, potential lack of sanitation -Financial impacts inc. transportation, industry -Social, Health services, greater impacts to vulnerable people, the elderly, the sick -Water control issues -Lack of food -Crime increases -Lack of source water for all uses (domestic, fire suppression, industry) -Fire hazards increase with dry conditions, and as water sources are depleted -Greater fire damages when fires do occur, deeper into forest soil structure -Algae problems in surface water (toxicity and water quality problems) -Less mosquitos -Stress and human health impacts -Tourism depressed, lakes, fish impacted -Economic health suffers -Power usage increases (extra demand for air conditioning)	-Water rationing, wastewater use/reuse, water conservation -List priorities (water hierarchy of needs) -Use oil pipelines for water (this comment likely refers to the idea for water security from and by innovative means; although this is not likely realistic nor safe for most water needs, it demonstrates the concept that severe droughts may require severe measures to access water). -Use (safeguard, protect) public water utilities -Prioritize which fires to suppress (if insufficient water is available) -Water use efficiency improvements (demonstrations, water/ wastewater reuse, new technology) - Improved water security (deeper wells, enhanced water storage facilities) -Trucking, piping, alternate water supplies -Fire bans -Sharing resources nationally and internationally -Water rationing -Water rights, distribution, allocation, consumption -Ability to build infrastructure during drought, targeted to water supply and management improvements -Seek alternate sources of water to improve water security

-Livestock feed impacted, less pasture -Increased animal feed -Livestock sell-off -Forestry industry -Wildlife impacted -Vegetation changes impacting agriculture and economic activities -Northern business activities impacted: trapping depressed, natural medicinal harvesting impacted -Bankruptcies -Risk of long-term civil unrest (the longer the depressed economies and natural disaster lasts)	

Flood

Prince Albert stakeholders identified the following flood impacts and mitigations (Table 28).

Table 28 Identified current flood impacts and mitigation strategies by Prince Albert stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-Stress/fatigue with human response -Wildfire management becomes problematic with human exhaustion from flood management -Economic impacts -Agricultural impacts -Social impacts (on those suffering from flood losses, economic losses, and on the responders helping with recovery) -Greater social impacts on vulnerable populations	-Monitoring water wells -Engagement with Water Security Agency -Dykes for flood protection (individuals, communities, industry) -Storm sewer installation (and design) -Emergency Management and Fire Safety provide assistance in flood impacts and recovery -Interagency integration and recovery responses are critical

-Watershed impacts -Contamination and water quality degradation -Environmental damage -Soil erosion -Loss of infrastructure; infrastructure damage: utilities, roadways, rail, buildings, commercial -Property damage -Equipment relocation due to infrastructure damages -Loss of life -Degraded confidence in leadership -Public trust degraded -Access to communities impaired or cut-off -Northern business/survival activities impaired, inc. hunting, fishing, food gathering -Major impacts on all utilities (power, water, wastewater, oil and gas distribution) -Evacuation challenges -Severe agricultural stress on farmers, farm businesses, losses of crops, farm production (and related economic impacts throughout the integrated rural communities) -Restricted access to farm lands -Significant labour and difficulty to locate and evacuate livestock -Potential disease increases -Environmental problems with animal carcass disposal -Public services impacted/impaired	-Water Security Agency has improved communications with Environment Canada (water, weather, hydrology, etc.) -Improved legislation for drainage projects now required form Water Security Agency -Emergency Flood Damage Reduction Program (Water Security Agency) -Better watershed and regional knowledge of upstream and downstream impacts, better planning -Culverts and infrastructure (need local and regional water runoff management strategies, including drainage management during excessive moisture or flooding conditions – must be coordinated, managed and enforced) -Community and regional planning -Education, planning and preparedness -Improved knowledge of flood risk reduction and perception -Zoning and land use planning and by-laws -Building codes -Watershed groups provide education and support for communities and rural citizens -Funding programs for flood risk reduction -Infrastructure improvements for risk reduction (roads, structures, grades, etc.) -Effective leadership -Communications are critical during the event (radio updates, etc.) -Source water protection planning -Over-engineering on flood plains, zoning and robust designs

-Land movement, slumping, erosion leading to longer-term impacts -Provincial capacities taxed (Emergency Management and Fire Safety, Water Security Agency, etc.)	-Need more proactive planning -LiDAR, Prince Albert has completed this but needs to incorporate the knowledge gained (i.e. surveys to understand topography and flood risk needs to be interpreted and incorporated effectively into planning and risk reduction) - Monitoring of beaver dams (which may affect water impoundment, runoff and drainage) -Critical infrastructure needs to be identified -Mitigation of soil and land erosion needs to be incorporated (into planning and operational actions)

Prince Albert Stakeholders identified the following future flood impacts and mitigations (Table 29).

Table 29 Identified future flood impacts and mitigation strategies by Prince Albert stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
-Lifestyle changes (wetter, warmer winters mean less snowmobiling, and recreational changes will result) -Infrastructure damages (culverts, roads, ice and water damage) -Contaminated water supplies -Increased demands on insurance coverages, and need additional insurance protection -Access to critical infrastructure impaired -Northern housing has greater reliance on power supplies for heat, and will be at greater risk with power losses in winter	-Leadership needed -Planning for priority infrastructure -Adapt building practices -Planning for extreme events (and risk reduction) -Alternate back-up power sources needed (self-generation perhaps possible) -Communication and Public Education -Personal responsibility; people need have some self-sufficiency) -Proactive planning and measures needed -Proactive mitigation

-Larger centers with winter power losses will be at greater risk, as smaller communities and First Nations are more resilient -Lack of preparation for hazards that are new or different or rare (e.g. tornados, plough winds, ice storms) -Greater impact to critical infrastructure -Tougher time surviving, maintaining power systems -Complications to livestock and production systems -Delayed access to crop seeding -Compounding infrastructure problems -Environmental impacts (e.g. excessive use of road salts)	-Communication between multiple levels of government; better lines of communication between province and communities -Need updated emergency response plans -Flood management plans needed -Emphasise long-term planning -Different and specialized equipment needed -Decentralize power systems/ move them -Agriculture has mandatory Saskatchewan Premises Identification system which identifies how many producers are affected (needs better user uptake) -Power line maintenance is important -Emergency planning needs to consider extreme events

Wildfire

Prince Albert stakeholders identified the following wildfire impacts and mitigations (Table 30).

Table 30 Identified current wildfire impacts and mitigation strategies by Prince Albert stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Evacuations and related issues, difficult to evacuate seniors and/or aging populations. How does one evacuate a prison such as Prince Albert prison? (what about seniors' housing? What about hospitals? etc.) -Magnitude of potential evacuations is difficult -Spin-off problems with evacuations: resistance, stubbornness in desire to remain, ignorance of risk and danger (social stress and conflict issues in response management)	-Evacuation plans in place (important for all types of hazards) -Communication to residents -Diverse expertise, wide array is important -Inventory needed for fire mitigation equipment -Resource sharing critical

-Resource issues on Emergency Management and Fire Safety; strain on resources, stress, etc. -No enforcement, no consequences for non-compliance -Pasture loss (agriculture and livestock impact) -Maintenance plans need consistent updating -Housing issues, particularly during recovery phase -Health problems, smoke inhalation, respiratory problems -Mental health problems, anxiety -Transportation cut-off (only one road in/out) -Power outages, during recovery will impact food storage, and cause food loss -Traditional practices of First Nations impacted (fishing, trapping, hunting, etc.) -Looting and crime may increase, (causing additional social stress, anxiety and fear for security) -Debris from fire and waste (contamination risk and hazardous waste exposure risks increase) -Experience in responding, coping, recovery is important (for responders, firefighters, volunteers, etc.) -Training is important -Safety issues occur (e.g. determining head count of communities is difficult) -Huge workload and resource impacts with fire response and recovery (some say 1 day of response activities is equivalent to 40 days of recovery activities)	-SaskAlert warning systems are critical, but there are issues with coverage, and signing up people -Contact lists in place are critical and must be current -Fire breaks -Incident command to First Nations communities -Data sharing -Education about economic impacts -Learn from recent events (recent fires, 2013 major forest fire event in La Ronge and north) -Communications to communities of imminent events -Do not shift fire suppression resources to mitigation (both are necessary, and it is critical to increase funding of fire suppression as forest fires and suppression activities will always be necessary) -Training, and a centralized training system (however, recognize that local responders require training; comment likely suggests more strategic training designs are needed) -Inter-agency consolidation (and coordination) are essential to avoid working in silos (and creating other problems and chaos in response and recovery)

-Lack of resources -Organizational disruption -Infrastructure issues -Impacts intensify when fires are nearer communities -Better communications and coordination of internal and external agencies (must avoid contradictory actions such as blocking roads to prevent access for public safety while others are trying to gain access to address the hazard) -watershed impacts, contamination (air, water) -Impacts are long-lasting and recovery takes years -Tourism impacted -Local businesses impacted -Communications issues; media is not always accurate (and problems can occur with misinformation; others noted social media problems can be an issue as well) -Psychological issues for affected populations	

Prince Albert Stakeholders identified the following future wildfire impacts and mitigations (Table 31).

Table 31 Identified future wildfire impacts and mitigation strategies by Prince Albert stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
-Personnel lacking (insufficient capacity or resources to respond, due to severity of event) -Challenges to the effectiveness of responses (need to plan for, and ensure efficacy of response)	-Equipment sharing arrangements, including with province and with United States (if aerial attacks, pumps, hoses, etc. are required in excess of local capacities) -Access to resources is global (includes human resources; with the extreme scenario, resource

-Landscape changes (ecosystem changes) -Lightning increases will cause fires -Forest health declines with climate change and with drought affecting the north, fire hazards increase -Proximity of power lines to trees and to highways, roads is an issue -Animal carcass disposal is an issue -Livestock feed and livestock relocation will be necessary -Food and appliance disposal is important post event -Leftover infrastructure can turn into hazardous waste post event -Agency capacity has limitations, how will society cope when at a "breaking point" -Disorganization results among agencies -Residences are impacted (primary, secondary) -Mental health issues associated with evacuations -Evacuation accommodation discomfort and safety (hygiene, air purification, etc.)	requests could extend into the USA and Mexico, or other international requests) -Critical area response (important priority-setting decisions are required in fire response) -Individuals should have a 72-hour preparedness plan -Fire Adaptive resilient communities -FireSmart Infrastructure, legislation of new developments, building codes -Better use of resources -Fire bans, issuing of dispatch charges if not complied with; issue "suppression charges" -Agency and individual responsibilities are important (accountabilities) -Tough decisions required, Life decisions, critical infrastructure decisions, and there are consequences of the decisions -Communicate response plan to public -Regional partnerships, collective, mutual aid -Determine level of service for communities -Incentives for communities to adopt FireSmart

La Ronge – 21 Stakeholders

Droughts, Floods and Wildfires

La Ronge stakeholders highly emphasised the critical need for local participation and involvement in all phases of natural disaster preparedness and response. In particular, the northern region is highly vulnerable for limited access and egress by road and transportation distances. The northern communities and populations are more vulnerable due to remoteness. First Nations communities are at risk. When natural disasters occur, response plans, evacuations and communications are challenged and even more critical due to the northern realities of life and geography.

Northerners are, by necessity, typically more self-resilient then those in the south, and in many ways better prepared for natural disasters. They are accustomed to solving problems, and their local knowledge is essential in advanced preparedness planning and disaster responses. When the disaster is at a scale that requires outside help, the local knowledge is also essential in developing and implementing better communications plans and integrated responses. Local leadership is critical to convey the best, and most accurate information to local people and industries responding to disasters. Back-up planning and infrastructure (for power, for access/egress, for human and equipment resources) is also extremely unique for northern people, their communities and northern industry. Capacities to deal with evacuations need to be considered (the how and the where, as northern capacities are also limited and stressed during disasters). Impacts to industry and recovery are costly, as supplies and transportation delivery have greater impacts with remote locations.

Some of the priority areas for flood impacts include planning and monitoring (hydrological information, real-time data of events, forecasting of risk and emergency response), access/egress into the north, with critical roads/bridges at risk of cutting off the region and/or affecting transportation systems for supplies and evacuations. Significant impacts from flooding occur on the economy, the communities and people, and infrastructure (buildings, roads, economic activities). Mitigations for flooding rely on effective communications as a disaster response, knowledge and best practices, and improvements to infrastructure and local capacity (including roads, bridges, drainage, development projects, alternate power supplies, etc. Wildfire impacts are clearly a main concern for stakeholders living in, and reliant on the forested landscape. Key impacts involve infrastructure damage (loss of power, water, heat, buildings, industrial activities), economic and social impacts affecting industry, forestry, recreation, tourism and local businesses. There may be widespread social impacts from wildfires affecting large regions and multiple communities. Wildfire mitigations are reliant on better evacuation plans, integration of local people and decision-makers, strengthened FireSmart programming, improved firefighting activities and communications. The integration of local capacity is seen as essential and critical in wildfire disaster preparedness planning, firefighting during a disaster, and response recovery. While drought was not specifically discussed, stakeholders recognized that northern drought relates to ecosystem changes, and increased risk of wildfires. Stakeholders also noted that the northern geography and ecosystems are susceptible to potentially significant impacts with natural disasters such as flooding, fires, and future climate change impacts, all of which affect the region's geography, communities, people and economic activities.

La Ronge stakeholders' priorities identified priorities for flood and wildfire hazards are summarized in the following categories (Tables 32-24).

Table 32 La Ronge drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Scenario not discussed, but stakeholders recognize northern droughts are linked to increased risk to wildfires and ecosystems impacts	i. See Fire Discussion

Table 33 La Ronge flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Planning and Monitoring (11 votes) o Unknown hydrology leads to confusion about flood risks o 60% of north is not monitored o Forecasting of flood risk impacts ability to prepare for flood hazards o Emergency planning not clear impacting people's ability /uncertainty of where to go to if flooded o Displacement challenges result (this is more complex in the north, with remote communities and residents; greater vulnerability for First Nations is likely) ii. Access in/out of flooded areas (9 votes) o Many communities/ homes have only one road in/out o Access/Egress with floods is impacted (remote locations are at high risk of being cut-off) o Montreal River bridge iii. Economy, Social and Infrastructure (5 votes) o Economy (e.g. wild rice) and northern activities impacted o Social impacts/ assistance o Homes, municipal and other infrastructure impacted o Tourism and economic impacts o Landscape modifications (e.g. clear-cutting for infrastructure, forestry, other reasons) increase food risks by changing ecosystem capacity and runoff patterns	i. Communications (24 votes) o Communications between government agencies (local – provincial – interactions): there is a strong need for effective, efficient communications between agencies (12 votes for this item alone) o Overall improvements to all communications (6 votes) o Local communications between and within local stakeholders ii. Knowledge (6 votes) o Best practices learned and applied from other jurisdictions o Emergency measures operations proactiveness applied effectively iii. Infrastructure and local capacity (6 votes) o Community sub-division drainage planned and implemented (some sub-divisions are at high risk of flooding due to insufficient drainage; this could also be a zoning issue in some cases, or an operational issue for water management) o Use of stand-by generators o Emergency power planned, and available

Table 34 La Ronge Yorkton wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Infrastructure (8 votes) o Loss of power o Loss of water o Homes lost o Loss of infrastructure ii. Economic and Social (6 votes) o Evacuations impacts on people; greater impacts on seniors o Loss of camping revenue, loss of tourism revenue o Private sector impacts also involve capacity of private sector to help in local response o Economic losses to local businesses (during event, and during recovery phases)	i. Planning and emergency response (28 votes) o Better evacuation planning and local input (essential in evacuation planning) o Evacuation in place incorporated into plans, with air purification systems to enable local presence and response to stay on-site to respond to fire impacts) o FireSmart is strengthened and has more local input as well as local funding o Parks have emergency plans in place o Maintain access and egress of critical roads (to enable implementation of emergency response plans and evacuations) o Plan for water supplies and measures to mitigate fires (sprinklers, pumps, water systems to strengthen local capacities and resilience) o Take politics out of response (this could be a planning item to help response follow established fire response and recovery protocols) ii. Communications (27 votes) o Communications of emergency plans (with a strong emphasis on local communications and information exchanges) o Better public education (especially at the local level, and with local considerations in mind) o Better exchange of information with local input (there is an emphatic need to include local

	decision-making and local communications capacities) o Better communications between agencies (at all scales, to improve responses and understanding of actions) o Better, and clearer leadership in communications (again with local input) iii. Local responses and local capacity (20 votes) o Prepare and defend with training of residents (there is an understanding of a need to fight fires with local responders, and to do so, they must be prepared) o Increase self-resilience o Local cross-training and effective use of local resources o Cross-train, communicate (inc. inter-disciplinary training, working together with all responders) o Stand-by fire crews

Other Natural Hazards

Other hazards identified by La Ronge stakeholders are noted in Table 35.

Table 35 La Ronge's other natural hazards identified

OTHER NATURAL HAZARDS (La Ronge Workshop)
- Drought, dry conditions leading to forest fires and ecosystem changes in the north - Pest infestations (insects, ecosystem shifts) - Plough winds - Forest disease - Forest health - Jurisdictional issues between federal and provincial governments (not a natural hazard, but identified as a challenge, particularly in the north, far from government centers)

La Ronge Stakeholders' Detailed List of Drought, Flood and Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

La Ronge stakeholders focused on flooding and fire, with no direct discussions on drought.

Flood

La Ronge stakeholders identified the following flood impacts and mitigations.

Table 36 Identified current flood impacts and mitigation strategies by La Ronge stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-Road Access is a major concern (this is significant in the north as road options are fewer and critical for brining supplies in for people and to sustain northern commerce); often concerns were expressed about one access road in/out of an area, making locations even more vulnerable and remote if they are cut off -Montreal River bridge -Road washouts (northern roads often tend to be at higher risk due to wetter conditions, freeze/thaw, etc.) -Homes -Economy -Social assistance -Municipal infrastructure -Isolation, leading to evacuation and recovery problems and challenges -Wild rice commerce affected -Tourism impacted -Critical road to mines and related risks	-Emergency power utilization more critical in the north, as re-establishing power is more difficult -Lift stations raised -More hydrometric stations to get better water flow data, and better flood forecasting data (earlier warning systems will protect people and communities) -Adopt best practices learned from other jurisdictions -Standby power generators (La Ronge, Air Ronge, Lac La Ronge First Nations) -Local collaboration with neighboring communities -Regional strategic planning (La Ronge, Air Ronge, Lac La Ronge First Nations) -Communities, need improvement (at all levels) -Community drainage for subdivisions -Communication between agencies; government (municipal, provincial, federal) -Learn from the past and historic events

-Stranded communities and people -Lack of monitoring leading to higher peak runoff of water -Water storage capacity -Recovery phase and political barriers -Debris flowing, dead heads -Flood hazards reduce fire risks and change resourced demands -Recovery challenges, big financial drain (local, business, regional; this is unique to the north as it is further away from distribution systems; Recovery costs more, and takes more time than in southern communities) -Uncertainty with emergency planning, who is one to go to? -Displacement of people and evacuations, where do people go? (many people are more remote, more isolated, and coordination challenges are more difficult) -Harvesting and trapping issues -Tourism impacts -Critical infrastructure risks and damages; when impacted, everything in the north is affected -Lack of water monitoring; 60% of the basin is not monitored -Ice jams and critical infrastructure	-Location communication is critical to provincial agencies regarding local knowledge and current situations (this is emphasised as the north is more remote, and timely, important decisions need to be made to support actual local conditions) -Sandbagging -Human safety is #1 priority -Emergency Measures Organizations and proactive actions -La Ronge outlet structure for water flow, fishways, stop logs structure, the fishways increase flow by 7%, (operations may be an issue with flooding, as water levels increase when it is operating, affecting water levels upstream)

La Ronge Stakeholders identified the following future flood impacts and mitigations (Table 37).

Table 37 Identified future flood impacts and mitigation strategies by La Ronge stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
-Freeze/Thaw issues are a real issue in the north, and more severe; affects culverts with blockages (which may require steaming to open up ice blockages to release water) -Infrastructure impacts -Water lines, storm drains -Wash outs -Extreme weather is common in La Ronge -Province is reactive rather than proactive -Loss of water, and sewer systems -Competition for resources will be an issue; the large geographic scale and intensity of this hazard, means competition between provinces and other regional areas affected; there is a concern the occurrences could be worse in the future due to climate change impacts) -hazards may cycle from one to the next, so preparedness needs to consider events recurring -Late ice, early fires -Inexperienced responders; concerns were expressed with military responders in 2015, who were not experienced, nor familiar with northern conditions; skill and coordination issues) -Fire programs are reduced when no fires occur, and then programs are reactive when fires recur -Extended power outages	-North is more self-sufficient than the south -Resources need to be available when they are required -Earlier (timely) calls for assistance - “the whole point of asking for help is to be getting the right kind of help” (Strategic, specific, skilled responses and responders) -North does have natural drainage systems -Alternate back-up power availability, “a self-sufficient community” -Backup communications systems; northern region vulnerability is real with one power grid line, one communication line (one fibre optic cable); if these go down the whole northern region is cut-off from communications between northerners and outside of the region -Northerners are “pretty self-sufficient” for an amount of time (by necessity) -Sense of community exists in the north, and people help each other out -People have heating systems (e.g. wood burning) which help if there is power loss -Hospitals are equipped in case of events occurring -Stand-by power generators -First Nations communities know who is most vulnerable within their communities

-Hypothermia, illness, human health impacts -Ice shoves are not problematic on northern lakes	-La Ronge (emergency) plan is up-to-date, but needs continual updating (La Ronge, Air Ronge, Lac La Ronge First Nations) -Pre-planning when proper foresight is available -Manipulation of natural systems is difficult

Wildfire

La Ronge stakeholders identified the following wildfire impacts and mitigations (Table 38).

Table 38 Identified current wildfire impacts and mitigation strategies by La Ronge stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Infrastructure, homes, buildings, other -Highways -Resource pressures on people, stress -Staff stress (workers, responders) -Financial stress on people and region -Evacuations, greater impacts on seniors -Evacuation costs and financial impacts are incredibly high -Health impacts, smoke inhalation, respiratory -Parks impacted -Public safety threatened, including park visitors -Loss of power supplies, water supplies -Loss of tourism revenues (camping, outfitters) -Potential loss of life -Loss of businesses and economic activities	-Fires provide employment, local Responders -FireSmart program, local funding to implement -Highway hotline, started operating in summer -Evacuate “in place” (air purification) stay in same location (some resources) -Community emergency plans -Need better exchange of information with local input -Need better planning and communicate the “why” (of actions and decisions taken) (People emphasised that northerners and local contributions are essential in decision-making, as northerners know their local conditions and the northern people best; this cannot be neglected in actions taken.) -Parks have emergency plans -Need revised insurance structure

-Real estate transactions frozen until all fires are extinguished, and region declared safe -Overwhelming fire resources needed, human and equipment -Human stress, and anxiety -Private sector providing assistance, not carrying out business -Infrastructure loss, homes lost -Economic losses, businesses closed, local losses while supplies transported from other jurisdictions -More inter-agency conflict (institutional stress and challenge) -Local stress and conflict; Internal community blame, division, undermining of public confidence	-Implement "prepare and defend" and train and use local resources (i.e. strengthen local capacities to defend area from natural hazards) - "stand-by" fire crews; integrate with FireSmart -Maintain Access/Egress routes and roadways -Better public communications and inter-agencies communications -Better understanding of assets and resources at risk, and know who owns them or is responsible for them -FireSmart, but need more resources -Reduction of fuel sources (this is ongoing) -Northern self-resilience, increased public awareness and public support -Sprinkler lines and pumps (access and availability) -Mutual aid agreements -Emergency plans established, and implemented, continuously re-visited -Better evacuation planning and local input -Better communication and leadership; better chain of command; take the politics out of response -Cross-training and communications between different response agencies -More emphasis no local cross-training and effective use of local resources

La Ronge Stakeholders identified the following future wildfire impacts and mitigations (Table 39).

Table 39 Identified future wildfire impacts and mitigation strategies by La Ronge stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
-Immigration from Northern communities to La Ronge (i.e. movement and displacement of people within region, to the region's largest centre, La Ronge) -Jurisdictional issues about evacuations -Wrong (improper, incomplete) information about who is facing evacuation (confusion in communications and/or warnings/decisions) -Increased self-reliance (perhaps a perspective of needing to survive, no matter who assists or does not assist; attesting to northern realities) -Northern communities are more resilient, and more adaptable - Response costs increase substantially -Reallocation of social programs -Human and technical resources are depleted -Social unrest, lawlessness is possible -Impact on utilities -Parks are closed, loss of revenue, loss in tourism, risk of groups of people in parks who choose to stay during evacuations -Power outages have a positive impact in bringing people together (communal strength) -Access limitations create larger impacts -Greater impacts on vulnerable people -Evacuate the vulnerable and those with health problems first	-Require more self-reliance, and fire infrastructure (sprinklers, etc.) -Require back-up power and ability to self-generate power -Backup heating systems in homes -Federal training and planning with First Nations people -Need education and strengthening of communications plans -Need to look at evacuating differently, self-reliance in evacuations (likely a greater local input in evacuation decisions) -Require debriefing for the public -Stay and defend required (protect existing communities) -Need discussions about standards and requirements for evacuation -Priority setting (needs to be clearly established) -Better organization and communications -Better Access/Egress -Reconsider evacuations of local firefighters (as they are knowledgeable of local conditions) -Need inter-agency integration at multiple levels and agencies -Use more local knowledge, more local responders, local experience

-Single health region may not consider the unique Northern concerns adequately -Wind direction increases impact, if evacuations cannot go south, there will be a lack of Northern evacuation centers Limited access and transportation networks (difficulty in response and in obtaining supplies) -Evacuations (public protection) must be #1 top priority -Communications breakdowns add to problems; incorrect, wrong or misinformation through rumours/social media can compound problems, and put additional pressures on responders	-need better public communications, greater consistency -SaskAlert -More accurate mapping, made publicly available -Learn from past experiences (document and disseminate what worked, what did not work, what needs improvement, etc.)

Swift Current – 21 Stakeholders

Droughts, Floods and Wildfires

The Swift Current stakeholders identified agricultural losses and watershed impacts as key priorities for drought impacts, along with an increased risk of grassfires with drought. Mitigations relate largely to effective water management, source water protection and interaction with local stakeholders at the watershed scale. Flood impacts infrastructure, private property, dams and dam safety, buildings and transportation systems. The region is essentially a "water scarce" semi-arid climate, yet during recent wet years or flood events, runoff and drainage of floodwaters has become a consideration for landowners and communities. Emergency preparedness plans, along with improvements to engineering design and legislation on effective water management were seen as critical. Grass wildfires were seen as a high risk, and stakeholders were concerned about the rapid spread of grass fires, and the lack of aerial support to suppress grass fires. Improvements to incident command systems and social services responses were identified, along with dialogue between forest fire and fire commissioners for more effective disaster response.

Stakeholders identified drought and water shortages as common characteristics in this region. Water and watershed management are therefore crucial for this water scarce region. Education and awareness, and citizen engagement on watershed stewardship is seen to be essential. Droughts increase grassfire risks, and cause serious agricultural impacts affecting the industry, local economic activities and the communities in the region. Mitigations relay on effective water management, source water protection, public education and regional planning. While less common, recent floods and excessive wet conditions have caused very serious impacts to dams (threatening dam safety), highways, rural roads and transportation networks, as well as contaminating water sources. Flood mitigations rely on effective emergency preparedness and response plans, with local, provincial and federal planning. Engineering and legislation to ensure

infrastructure is at current standards is also seen to be critical flood mitigations. Wildfires in the south are essentially grassland fires (although Cypress Hills and other forested and parkland areas may also be at risk). Wildfires have serious human resource impacts on local volunteers. Much of the area is remotely populated, so disasters may affect individuals and communities, and unique areas. For example, access/egress and evacuation of people in Cypress Hills parklands could be very difficult should a disaster cut-off transportation or communications networks. Wildfire mitigations rely on effective coordination of responders and equipment. Communications, mobilization, local and inter-agency coordination are challenging due in part to rural remoteness. Advanced planning and preparedness is essential, along with training and mutual aid agreements being established well in advance of disaster occurrence.

Swift Current stakeholders' identified priorities for drought, flood and wildfire hazards are summarized in the following categories (Tables 40-42).

Table 40 Swift Current drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Education and Awareness (11 votes) o Communications impacts with disconnected information o Lack of local public acceptance of impacts of the hazard o Lack of local awareness of watershed stewardship groups o Increased water use during restrictions (to access water when allowed, and relates to misunderstanding of risk hazard) o Public education (lacking knowledge and or education) ii. Grassfires during drought (6 votes) o In past, aerial support was denied o Prairie grass fires may require aerial help for effective efficient suppression iii. Agricultural impacts (4 votes) o Ag impacts are significant o Crops and failure o Livestock feed and water o Water competition (irrigation and community supply)	i. Effective water management and source water protection plans (18 votes) o Source water protection plans (for water security of supply and water quality) o Water rationing o Water pricing (and value of water) o Water usage rates, pricing and public education o Watershed group Best Management Practices to safeguard water supplies o Alternate water supplies and backup supplies o Livestock exclusion from water bodies to protect water quality o Effluent irrigation for efficient use of wastewater and agricultural water needs ii. Public Education (9 votes) o Education of value of water conservation

	o Education of public of value of watershed groups and knowledge base

Table 41 Swift Current flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Infrastructure and Economics (8 votes) o Widespread property and infrastructure damages o Dam failure risks (e.g. Gravelbourg) o Livestock and agriculture impacts ii. Ecology and ecosystems (5 votes) o Contaminated water o Increased salinity	i. Emergency preparedness planning (27 votes) o Long-term Federal and Provincial mitigation planning (13 votes) o Emergency preparedness plans are required for all natural hazards, not just floods (7 votes) o Emergency response plans, improved response plans for parks, etc. o Better communication and transportation plans o SaskAlert ii. Engineering and legislation (2 votes) o More, better engineering to address flood risks o Enforcement of legislation to stop illegal drainage

Table 42 Swift Current wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Human Resource impacts (9 votes) o Difficulty in accessing local human resources o Use of local volunteers o Workload and stress on volunteers o Challenge to evacuate Cypress Hills park	i. Resource coordination and efficiencies (24 votes) o Mobilization of neighboring fire departments (11 votes) o Better Forest Fire and Fire Commissioner (grass fire) coordination (6 votes) o Communications between Incident Command Systems and Emergency Social Services

	to have common language for effective coordination of emergency response (small and larger communities) o Better inter-agency coordination and communications o Water conservation o High volume, low pressure water systems ii. Planning in advance (8 votes) o Better succession planning for skilled emergency management responders o Awareness training o Communications and access to resources established in advance o Mutual aid agreements established in advance o Land-use may impede fire suppression; challenges in constructing fireguards could be reviewed/planned

Other Natural Hazards

Other hazards identified by Swift Current stakeholders are noted in Table 43.

Table 43 Swift Current's other natural hazards identified

OTHER NATURAL HAZARDS (Swift Current Workshop)
- Tornados - Plough winds - Severe winter storms (e.g. transportation impacts) - Aquatic invasive species - Invasive plant species (and other invasive species) - Ice storms, and ice storms combined with high winds - Zebra mussels - Volcanic eruptions (Yellowstone National Park) - Hail and extreme summer storms - Poor water quality - Mountain Pine Beetle - Lightning

Swift Current Stakeholders' Detailed List of Drought, Flood, Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

Swift Current stakeholders identified the following drought impacts and mitigations (Table 44).

Table 44 Identified current drought impacts and mitigation strategies by Swift Current stakeholders

Drought Impacts (Current Scenario)	Drought Mitigations (Current Scenario)
-Swift Current Watershed, water quality impacts, depletion of soil moisture, groundwater depletion, impacts to crops, towns -Gravelbourg, financial impacts to communities and rural populations, impacts to town water supply, are there back up supplies that SaskWater can provide? -Villages, potential aquifer depletions and loss of water, groundwater under direct influence of surface water lead to high contamination risks (and are risky sources as backup water supplies) -Rural Municipalities would need backup water supplies for livestock, and may need to downsize herds (due to lack of water and lack of feed/loss of pasture) -Closed watershed basins are more vulnerable -Communication and confusion, as there is a lack of knowledge of where your water comes from, and how secure existing water supplies might be -water competition for recreational use (e.g. boating) -Emergency Management and Fire Safety will have a high demand on services to respond to	-Source water protection plans, with risks identified; Water Security Agency plans are in place with risks identified -Public education of water conservation -Water rationing -Implement ranking system for Water Security Agency plans -Trucked (hauled) water brought into the local affected areas to address water shortages (this is useful for some water uses, say domestic, but not all uses) -Help with building infrastructure and water supply, particularly when needed for public safety -Rural water pipelines have improved local and regional water security (and in some cases, been very critical for some regions) -Adjust water use priorities (e.g. less street sweeping, less recreational use of water in pools, rinks) -Develop water storage schemes to collect water in good years (dames, infrastructure) -Water pricing established to promote conservation (use more, charge more)

water shortages and other emergencies resulting from drought -Agricultural impacts occur -Increased fire risks (grass fires, bush fires; 2015 was a particularly bad year for fires) -some locations are high fire risk (e.g. long grasses at Saskatchewan Landing); Moose Jaw had high grass fire risk, and homes were threatened -Lack of knowledge (and lack of local knowledge) of just how bad grass fires are and how rapidly they spread, particularly with high winds in open, exposed areas; unfortunately, grass fire response often denied from aerial assistance fire suppression responses -Fire response in droughts need alternate water sources (that may be some distance away, such as Lake Diefenbaker pumping, hauling) -Cannot plough fire guards -Enforcement of water restrictions; sometimes water use increases with water restrictions (people overuse on days they have access) -Ban local fires, wood burning fires -Increase public education -Local acceptance of impacts (i.e. improve the local knowledge and understanding of drought impacts); there is little awareness of watershed stewardship groups and their information and knowledge base -More land drained increases drought risk (draining planning issues?) -Droughts often seen more wind, which increases the impacts of drought (need for wind protection and shelterbelts?)	-Establish incentives for water conservation -Education about watersheds, best management practices for individuals, farms, rural communities, larger communities -Find alternate water supplies, greater water security -Livestock exclusion (from water sources to maintain water quality) -Effluent irrigation as effective wastewater and water management (Swift Current and Moose Jaw use effluent irrigation) -Demand for water bombers to fight fires in drought regions -Water management confusion, who is managing water during scarcity and drought, clear authorities are required -Alternate, new water supply lines from lakes to rural populations (farms, e.g. use/expansion of the Farm and Ranch Water Infrastructure Program to increase rural water security) -Secondary water options may need to be considered (dugouts, sloughs? but this of course must also consider water quality and safety for intended use to avoid negative impacts of using unsafe water even for livestock or other uses) -Crop insurance, but this mitigation is not able to be utilized with extended droughts (e.g. 3 yr. drought will have no crop insurance help)

-Shallow seeding during wet years increases erosion risks and loss of organic matter (farm practices may be challenged when hazards cycle from wet to dry) -Economic threat (e.g. crops, agriculture from drought, and farm equipment from grass fire risks) -Higher energy consumption, stress on systems -Drought is an opportunity for maintenance and repair of road infrastructure -Potash industry will lack water supply -Water competition between irrigated agriculture, community water and other users -Competition with other industry, such as co-generation power plants -Tourism impacts, and economic impacts to local affected communities reliant on tourism -Livestock impacts, beef prices go up, relocation costs -Increased pesticide use, to control insects such as grasshoppers -Failure of dry land crops (rain dependent, non-irrigated crops, but also losses on irrigated crops due to heat stress) -Serious local economic impact occurs with one crop loss regionally (trickle down effect) -Recovery time is long	

Swift Current Stakeholders identified the following future drought impacts and mitigations (Table 45).

Table 45 Identified future drought impacts and mitigation strategies by Swift Current stakeholders

Drought Impacts (Future Scenario)	Drought Mitigations (Future Scenario)
-High impact in health sector, systems, hospitals cannot cope with high load -Water dependent industries are hit hard -Hydropower (co-generation) decreases, power outages increase -Agriculture moves further northward -Ecosystems change, different vegetation, invasive species -Soil degradation and erosion -Recreational impacts (less recreational water, less hockey, golf, pool water use, etc.) -Depleted government resources -Government organizations under severe pressure -Taxed (overwhelmed) governance systems -Relocation and/or abandonment of smaller communities, perhaps even out of the province (loss of people and economic activities) -Conflict between people and neighbours regarding water use -Divided communities and conflict on water use and management -Increase in national and regional divides --Smaller sized livestock herds	-Need long-term water management and storage systems -Need better infrastructure planning, water pipeline infrastructure expanded to more secure water sources -Changes to landscaping (home, golf courses) -Need Different crop types and practices to be more drought tolerant -Prioritize water uses -Rainy day funds (i.e. have funding available to address water scarcity and drought as a hazard) -Strong leadership needed -Can cope with losses from 2-3 years of water scarcity/drought, but beyond that, farm more vulnerability occurs

-Interprovincial and international conflict (water flows and water management conflicts) -Crop insurance system failure (due to high demand and multi-year drought, system cannot help all affected) -Social supports are taxed -Economy suffers (less economic activity and direct impacts occur)	

Flood

Swift Current stakeholders identified the following flood impacts and mitigations (Table 46).

Table 46 Identified current flood impacts and mitigation strategies by Swift Current stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-Home and cottage damage -Vulnerable populations have greater impacts, inc. seniors, disable, injured people -Large-scale crop damage (flooded crops could mean complete crop loss and economic impacts to affected farms and regions) -Roads and infrastructure closed, damaged -Destroyed power infrastructure/power outages, power poles in water are affected -Illegal drainage compounds the problem -People are lost, stressed, tired -Infrastructure shut down, widespread damage to infrastructure including private property -Contaminated water (for municipal uses, human water needs)	-Dam protection during flood -Reservoirs for drought needs (may be now affected with too much water, and at risk of flood damages) -Hydrology studies (and need for more) to better understand how to "get rid of water" (effective water management and decisions; note that Water Security Agency is involved in water management, and the comment may also relate to an interest in strengthening local knowledge and understanding of water management) -SaskPower has identified priority infrastructure (to secure or recover critical power systems and supply) -Flood zoning bylaws in parks -Parks have flood planning, but requires significant updating)

-Larger impacts on smaller communities, e.g. power restoration is prioritized to larger communities first -Environmental damage, downstream impacts, releases of effluent from wastewater systems (lagoons, overwhelmed community wastewater systems/pipes) -Park infrastructure at risk -Slumping and corresponding infrastructure damage/ utility damage -Erosion and beach loss -Lagoons filled, overwhelmed (increased risk of infrastructure damage and environmental damages from overland flooding of wastewater) -Impacts to municipal resources, human, technical, equipment (community administration, operations and responses) -Agricultural crop losses -No community access in the Year 2010 (this may refer to June 2010 flooding in Swift Current and Maple Creek) flood meant some people required rescuing -Some people were stranded in parks, including clients and parks staff -Transportation disruptions (Highway # 1 west bound lanes destroyed, June 2010; affecting local, provincial and inter-provincial transportation) -Eroded shorelines and impacts on migratory birds (other ecosystems impacts) -Potential dam failure (risks increase) near Gravelbourg -Some local evacuations	-Emergency Flood Damage Reduction Program (Water Security Agency) -Dykes built to enhance flood protection; improved planning for flood protection of communities -Dams have developed extensive protocols with extensive partners, communications plans, for emergency flood protection and response; there are response call and notification lists when at risk of flooding -Emergency power systems/supplies are needed -Need utility infrastructure backup systems for water supplies and wastewater (management strategies during floods) -Beaver control needed -Improved zoning bylaws preventing water encroachment (and reducing flood risks to developments, commercial activities, etc.) -Better RM roads (and dependability of RM infrastructure) to allow community access -Municipal Emergency Plans (established for all type of natural disasters, not just floods) -Communication of emergency management plans -Long-term federal-provincial government mitigation planning -SaskAlert; could be improved -SaskPower and SaskParks have ISC training and do mock scenarios (Insurance Councils of Saskatchewan) -SaskPower keeps a list of “sensitive customers”

-Livestock impacts -Large impacts on seniors	-Critical not to wait too long to ask for assistance (i.e. implement timely responses) -Need to strengthen self-resilience (local, rural, community, regional) -Lagoon releases in fall when water is lower (as an option to manage overwhelming lagoon systems from floodwaters) -Water drainage studies needed (study excess water conditions even for the semi-arid normally water-scare region) -Culvert maintenance and replacement (in consideration of drainage, watershed-scale studies to ensure strategic management and replacement, e.g. installing larger culverts helps locally, but discharges more water volume downstream) -Establish evacuation plans for flooding -Update emergency planning for parks, and conduct scenarios to "test the planning" -Sand bagging -Built dyking systems in Gravelbourg -Establish zoning by-laws, to above the 1:500 flood event (for developments, designs) -Better communications and transportation options -SaskAlert -Rural people tend to be more self-resilient and often have their own generators, pumps, dykes, etc. -Better flood insurance -More efficient use of resources (studies, data) -Improved dyking systems

	-Study of how existing infrastructure affects flooding (roads, railway lines, etc. some believe that CP rail lines contributed to flooding -More engineering -Enforce illegal drainage -Recognize the flood problem at the municipal level -Access to existing data and studies (share knowledge) -Emergency plans need to be current -Legislation requiring emergency plans and enforcement

Swift Current Stakeholders identified the following future flood impacts and mitigations (Table 47).

Table 47 Identified future flood impacts and mitigation strategies by Swift Current stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
-Current experiences may not be enough (may not be sufficient experience for our responses) -Public pressure on dam operations and operators -Manpower experience is unknown -Evacuations of people during power failures -People are reliant on stores and restaurants (may not have emergency supplies so are less resilient without them) -Public pressure and misinformation, incorrect forecasting or no information -Communications challenges; crowd communications online (risk of	-72-hour emergency kit (for personal and household needs); need to take personal responsibility to self-protection and cannot wait for government to help; increase public awareness to strengthen self-resiliency -Increase self-resilience by having own equipment (pumps, etc.) -Use Twitter and Electronic media, but don't assume everyone has access (and mitigate for miscommunication or incorrect communications) -Need to plan for more extreme events (more severe, more frequent flooding)

misinformation with social media or spreading of incorrect information) -Infrastructure standards questionable for future scenarios (improved standards may be required with new impacts) -roads are not built for today's equipment (larger equipment in use today) -Building in hazardous areas and flood plains -Keeping up with technology, automation failure risks -Cannot force people to use money for mitigation (e.g. some will improve their personal resilience by mitigating risks, yet others won't)	-Use innovative technologies in mitigation (e.g. early warning systems) -Use warnings, alerts, evacuation plans

Wildfire

Swift Current stakeholders identified the following wildfire impacts and mitigations (Table 48).

Table 48 Identified current wildfire impacts and mitigation strategies by Swift Current stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Overwhelmed by fire -Public safety -Evacuation -Widespread geographic exposure requires greater assistance and response -Volunteer firefighters utilized, associated stresses, exhaustion, lost income -Cypress Park has lack of resources, as fire response team leaves the area during high risk season (likely helping in other areas); evacuation is difficult in the park; park cold be	-Need for better succession planning (of those skilled in fire suppression and emergency response) -Need better communications and allocations of resources between agencies, municipal, provincial governments -Land-use is an impediment, cannot plough land to build fireguards -Better utilization of mitigating measures for railways, wheel sparks are an issue (causing or potentially causing grass fires) -FM radio and evacuation sirens are now utilized in parks, but staffing issues exist, who

lost in a manner of minutes; access/egress is a challenge with one road in/out) -Competing interest for equipment is a problem; equipment availability if not in area -Lack of knowledge or understanding of area, may not know where to find water sources for fire suppression -Mountain pine beetle increases fire risks -Lack of resources and finances and rely heavily on volunteers -Climatic differences in different locations in Saskatchewan -Stress -Where to evacuate a large number of people (e.g. City of Moose Jaw?) -Coordination of local resources is challenged and difficult, farmers, RMs, fire departments, local rural communities, etc. -Drought makes firefighting difficult when water supplies are depleted -Air quality and smoke, perpetuated problems with wind effects; no ability to neutralize or mitigate widespread smoke impacts -Mobilizing of equipment is difficult -Livestock food supplies impacted -Depletion of water sources, and greater demand on water treatment -Lack of potable water -Human-caused fires are preventable -Anxiety is heightened for fire risk in Cypress Hills park during dry periods	will turn on the warning system in the middle of the night? -Fire breaks currently exist around oil rigs -Forest fire and fire commissioner branch need better coordination with one another -Some farmers have water tankers, leaf blowers, other equipment, etc. and may lend equipment to help with fire suppression -Need high pressure, low volume water lines -Mutual aid agreements help with quick response, and coordination -ICS (incident command system) needs to be used in coordination with ESS (emergency social services); need common language and response approaches, and could be applied in small or large communities -Mobilizing neighbouring fire departments -Fireguards (in prairie region) -Prepare for fire, e.g. a 3-yr. drought increasing the planning needs for responding to heightened prairie fire risks -Potable water stations (backup) -Awareness training -Carry fire extinguishers and other equipment (to help reduce human-induced fire risks) -Controlled burns (in prairie region) -Water conservation strategy needed -Prioritize areas to deal with prairie grass fires and risks (some areas may be allowed to burn to rejuvenate ecology) -Mobile sprinklers and fire suppression equipment/strategies in critical areas

-Rolling topography is problematic for fire suppression -Oil rigs may lack a plan to address fire risk and suppression	-Communications and access to resources; use landlines and satellite phones (e.g. prepare for risk of loss of cell phone towers)

Swift Current Stakeholders identified the following future wildfire impacts and mitigations (Table 49).

Table 49 Identified future wildfire impacts and mitigation strategies by Swift Current stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
-Tourism impacted, Economy impacted, $100s millions economic impacts -Human migration, mental health issues -Agriculture will be greatly impacted, with direct and indirect economic impacts, supply chains, farm equipment, maintenance, livestock, etc. (all pose serious rural economic impacts to affected communities and regions) -Food supply for people and communities -People are not very self-sufficient today (i.e. impact may even be greater than that of past large-scale hazards, such as the 1920s-30s widespread droughts or past fire hazards) -Mountain pine beetle increases fire risks -Air quality (smoke, human health risk) -Great disconnect between RMs (due to severity of hazard)	-Technological advances may assist in future -Need to revamp urbanization plans (development and resiliency?) -Need successful political "downloading," engage effective provincial programs with better coordination of agencies, with clear top-down command styles but vice-versa, with bottom-up local communications and knowledge (local integration, input, intelligence and response authorities, all designed to engage more effective, efficient large-scale responses)

Regina – 58 Stakeholders

Droughts, Floods and Wildfires

Stakeholders at the Regina workshop placed a strong emphasis on drought's broad impacts, including institutional challenges managing water, water competition, water scarcity and ecological impacts. Mitigations were identified as long-term water management planning and

implementation. Flood impacts include damages to infrastructure, the economy, the environment and society at large. Flood mitigations rely on better preparedness plans, improved legislation, zoning and enforcement, and knowledge and education programs. Wildfires impact infrastructure, the economy, social structures and the environment. Mitigations were identified with FireSmart programming, knowledge and communications, zoning and development planning.

Regina's stakeholders were concerned about big-picture policy impacts, the danger or risk of dismantling past successful programs and institutional knowledge bases (e.g. the closure of the federal government's soil and water conservation programs developed and delivered by the former Prairie Farm Rehabilitation Administration of Agriculture and Agri-Food Canada [1935-2013]; the loss of historical knowledge from past water management and disaster risk reduction activities, etc.). Learning from past successes, continual advancement of science and policy, enhancing academic and institutional knowledge bases were seen as essential ingredients in dealing with natural disasters, especially with compounded impacts from climate change.

Stakeholders stated drought causes institutional challenges in management water, with water competition and conflict, water scarcity and ecological impacts. Stakeholders identified drought as having widespread impact to agriculture and regional economies. Most droughts slow down the economy, and not generally "catastrophic" [although multi-year droughts could become so]. There is degradation on soil and ecosystem health, and improper development during dry times, when construction on dry floodplains may occur. Drought impacts infrastructure (soil shrinkage, foundation impacts) and causes ecosystem degradation with reduced water quality and water supplies. Ecosystem impacts from drought may affect drinking water supplies for people, and create water competition. Mitigations for drought involve proactive and effective watershed management, water resource management, public education and water stewardship, and an engaged, responsible citizenry. Severe droughts may require backup or alternate water supplies. Institutional responses are also critical in water management and water conservation.

Stakeholders identified flood impacts to infrastructure and economic activities, environmental degradation, and community and social impacts. Stakeholders identified flood impacts to agriculture, runoff and drainage problems in flatland areas, and water conflicts between neighbours (communities and landowners). Floods have significant impacts to major transportation systems, communities, buildings, dams, other infrastructure, industry, causing earth movement and slumping, soil swelling, stranding agricultural animals, and causing ecosystem degradation (e.g. pollutant transport). Mitigations involve protective infrastructure, engineering of infrastructure to current codes, flood risk planning, regional watershed management, zoning and enforcement of regulations and policies, responsible planning and development.

Wildfire impacts critical infrastructure, communications and transportations systems, cascading infrastructure losses, animals and livestock, and human health with smoke and degraded air quality. Mitigations include FireSmart preparedness programs, Mutual Aid Agreements, knowledge and communications and effective zoning and development.

Regina stakeholders identified priorities for drought, flood and wildfire hazards are summarized (Tables 50-52).

Table 50 Regina drought impacts and mitigations identified priorities

Drought Impacts	Drought Mitigations
i. Institutional challenges managing water (18 votes) o Hierarchy of needs o Interjurisdictional challenges o Possible use of other potentially poor water sources (e.g. Quill Lakes) o Stressed water conveyance systems ii. Water competition (9 votes) o Between farmer and rural communities (irrigation vs. communities) o Between industry and communities (People's needs vs Potash) iii. Water scarcity and ecological impacts (6 votes) o Less water for municipalities, agriculture, industry o Less water for fire suppression (e.g. grass fire risk increases) o Ecological impacts (Qu'Appelle River system suffers, wetlands dry up)	i. Water management planning (15 votes) o Water allocations o Water management inc. the need to address water competition issues during scarcity, drought o Communications o Local, provincial, federal o Plan for alternate water sources during scarcity o Drought planning should be continuous, anticipatory o Improve farm and rural water utilities, water conveyance, municipal supplies o Knowledge retention o Improve farm and rural water utilities, water conveyance, municipal supplies o Strengthen engagement of stakeholders, inc. watershed stewardship and conservation groups o Public Education and informed social perceptions (drought is real)

Table 51 Regina flood impacts and mitigations identified priorities

Flood Impacts	Flood Mitigations
i. Infrastructure and Economy (20 votes) o Homes damaged or destroyed o Loss of Sask Power lines o Buildings, dams, water and wastewater systems, municipal and commercial infrastructure o Roads, highways, transportation systems	i. Preparedness plans (32 votes) o Coordination and better interagency collaboration, with shared resources (agriculture, Water Security Agency, Watershed organizations, working with communities, provincial government)

- Agricultural lands, crops, livestock

ii. Environmental damage (15 votes)
- Earth movement and slumping of soil leading to infrastructure damage or impairment of lands, shorelines, buildings (e.g. cottages), etc.
- Degradation of water quality (surface and ground water) leading to contaminated water systems for people, livestock, etc.
- Contamination of lakes affecting recreation, cottages, etc.

iii. Societal impacts (5 votes)
- Taxed human resources dealing with flood
- Stress of affected populations affected
- Anxiety

- Conveyance structures, culverts, pipelines and water storage to handle excess water (use as storage for drought); back-up power
- Local municipal and rural municipality plans incorporated into provincial plans
- Local mitigation programs
- Emergency management response plans in place
- Emergency management training (practice to be ready for events)
- Centralized provincial resources available to help communities

ii. Legislation, Zoning and Enforcement (16 votes)
- Drainage planning, zoning and enforcement of illegal drainage
- Water conveyance systems and interconnections with ecosystems
- Property buy-out in flood-prone locations (e.g. Moose Jaw property buy-out)

iii. Knowledge and Programs (14 votes)
- Mapping (land base, water, to assist with zoning and flood protection strategies)
- Provincial water quality protection programs
- Mitigation programs
- Coordination with federal program

iv. Education and Communications (7 votes)
- Better communications with citizens (rural, urban), communities, province

Table 52 Regina wildfire impacts and mitigations identified priorities

Wildfire Impacts	Wildfire Mitigations
i. Infrastructure and economy (9 votes) o Loss of electricity, power o Livestock loss o Cascading infrastructure losses o Loss of communications towers o Lost or damaged infrastructure ii. Social (4 votes) o Lack of trained people o People challenged to address the aftermath o Rural people isolated iii. Environmental (3 votes) o Smoke and air quality o Grass overgrowth (fuel source risk)	i. FireSmart preparedness programs (19 votes) o Emergency management plans to address fire o Mutual Aid Agreements o Industry willing to assist o Controlled burns o Fire breaks ii. Knowledge and Communications (12 votes) o Public education o Coordination of government agencies o Water Security maps made available for regional and local use (to find water sources to use in fire suppression) iii. Zoning and development (3 votes) o Control structure locations o Set-backs o Communications at the local level (with fire depts., and others to ensure effective responses)

Other Natural Hazards

Other hazards identified by Regina stakeholders are noted below.

Table 53 Regina's other natural hazards identified

OTHER NATURAL HAZARDS (Regina Stakeholders)
- Hail - Tornados - Insects - Disease (animal and human, e.g. foot & mouth for livestock, West Nile virus, Lyme disease, new Vector borne diseases - Wind Events - Ice Storms - Blizzards (frequency, severity) - Severe weather (severe storms)

- Rapid changes in weather (wind, rain); weather warning systems
- Slumping of land
- Heat days (power load, but also impacts on people, animals, crops, etc.)
- Human mitigation (perhaps the reference is for mitigation measures leading to unintended impacts or consequences?)

Regina Stakeholders' Detailed List of Drought, Flood and Wildfire Impacts and Mitigations

The following tables list in more detail, the stakeholders' identified impacts and mitigations for current and future scenarios. (the priorities listed previously were identified from these lists).

Drought

Regina stakeholders identified drought impacts and mitigations in Table 54.

Table 54 Identified current drought impacts and mitigation strategies by Regina stakeholders

Drought Impacts (Current Scenario)	Drought Mitigations (Current Scenario)
-Water management and stressed conveyance -Water competition, industry vs. community -Water managers may have to intervene: user to user, sector to sector competition – no defined provincial protocols -Drought doesn't destroy – it defers (e.g. slows down agriculture) -Ag irrigation water suppressed -Help needed for irrigators -Municipal supplies affected -Economic impacts – rural, farming, retail -Loss of markets (reduced agricultural exports) -Water quality deterioration -Less water for people and livestock -Water supply depletion (surface/aquifer)	-Public education -Water conveyance systems (e.g. Diefenbaker diversion to Buffalo Pound Lake) -Farm drainage regulation -Lessons learned from the past - Rural water pipelines (water supply/quality) - Knowledge of secure water supplies -Academic knowledge (U of Regina; U of Saskatchewan) -Water Security Agency water supply pumping program, although concern exists this program is now decommissioned -Proactive planning (drought preparedness) -Farm and Ranch Water Infrastructure Program for secure livestock water supplies -Sask Irrigation Branch

-Severe water loss could impact crop production and livestock production -Soil quality degradation -Increased grassfire risks -Opportunity for road maintenance (not wet) -Ecosystem effects (dry wetlands) -Improper development in dry times (e.g. building in dry floodplains) -Infrastructure damage to buildings, natural gas lines, water lines (soil contraction in dry periods, then expansion in wet) -Community, social and political tension caused by water shortages -Interprovincial water management impacts, international and inter-jurisdictional impacts -Loss of tourism from impacted lakes -Pressure on government agencies to ensure access to water supply and quality water (provincial and federal, e.g. WSA, EC) -Increased vulnerability of a variety of stakeholders, sectors and communities -Ecological impacts in rivers, lakes (minimum ecological flows are not well understood) -Overuse of potable water in urban communities -Lack of fire-fighting water in town reservoirs that are depleted -Program budget impacts (local, provincial, federal) -Propagation of transport of hazardous contaminants	-Watershed Stewardship Groups, although concern over threat of losing funding -25 Year Water Security Plan (Sask), and there is a need to implement and continue actions --Succession planning (of knowledgeable people) and deliberate plans to retain past documentation is needed -Temporary pipelines for water supplies -Consider drought management plans in the same way we consider flood management plans -Consider provincial water allocation and water management plans for drought situations -Upper Qu'Appelle water supply conveyance to multiple users -Water Storage and delivery systems -Some communities have backup plans; water quality also needs to be considered with water supply scarcity Most standard engineering considers 3-year water supplies (e.g. communities) -Water Conservation Programs are needed, along with clear jurisdictional responsibilities and lead agency -WSA and existing watershed groups can be strengthened through stakeholder engagement -Need to improve our knowledge of groundwater supplies -Need for more public education (e.g. FloodSmart, FireSmart, DroughtSmart) -Social perception of Drought seems to take a backseat to flood and fire natural disasters

-Qu'Appelle River system suffers; communities suffer -Industry curtails water use, recognizing hierarchy of needs (e.g. human) - Infrastructure not sufficient for mass migration (e.g. like the 1920s-30s droughts)	- Continuous drought planning is needed (i.e. even if not in current drought state); plans should also be continuously revisited (updated)

Regina Stakeholders identified future drought impacts and mitigations (Table 55).

Table 55 Identified future drought impacts and mitigation strategies by Regina stakeholders

Drought Impacts (Future Scenario)	Drought Mitigations (Future Scenario)
-Quality of life is greatly diminished -Landscape and environment is different than last severe drought (20s-30s) so learning from the past may not be adequate -May become a food importer rather than exporter -Sources of nutrients will change (e.g. protein from lentils) -Conventional agriculture will not be sustainable -Human migration will be a huge stressor, social dynamic will change, access to health care -Spread of disease with human migration -Individual and community mental health, need for support systems -Warmer weather allows for growth of higher value crops -Intergenerational conflict over water allocations	-Different crops need to be grown (drought tolerant, higher value with longer growing season) -Research for crops is needed (drought resistant, continuous cropping) -Disaster relief should consider mitigation, research, innovation for adaptation, improved agriculture water management, etc. -Seek opportunities with continual adaptation/re-adaptation, recognizing climate change variability risks -"necessity is the mother of invention" -Public institutions need to be proactive, responsive -Learn from knowledge base with respect to disease risk from Lyme disease, West Nile (e.g. insect disease could increase and will need to anticipate types/species and consider treatment) -Dismantling existing programs and knowledge base is risky and could have negative consequences (e.g. removal of shelterbelts, cessation of pasture programs, less research on soil/water conservation,

-Massive unemployment with industries dependent on water -Stock market crash as severe drought has widespread impacts -Crop insurance may be stopped -Economy fails -Greater demand on emergency response resources	closure of PFRA-Prairie Farm Rehabilitation Administration was targeted programming to address prairie water scarcity and sustainable agriculture) -Integration of ecosystem management should be considered with agricultural practices – grazing plans, soil conservation, wetland preservation -Mitigation policy/legislation is needed/ need to capture best management practices knowledge and disseminate to public and industry -Public education is needed of (drought risks) as a natural hazard, must combat disinterest and doubt, and need to engage society -Individual preparation is necessary with acceptance, buy-in, proactive planning at all levels (individual, community, RMs, province, federal)

Flood

Regina stakeholders identified flood impacts and mitigations (Table 56).

Table 56 Identified current flood impacts and mitigation strategies by Regina stakeholders

Flood Impacts (Current Scenario)	Flood Mitigations (Current Scenario)
-agricultural production/land flooded (seeding delay) -communities flooded -conflict between neighbours (e.g. agricultural and urban drainage moving water to another location) -financial impacts on federal programs -rail and road transportation systems taken out or potentially delayed during loss of use/repairs	-Community plans, by-laws, zoning, drainage plans, SGI incentives to protect individual homeowners and loss prevention, flood insurance is being offered now -Rail system mitigation plans/track controls, raising of rail lines, upgrading and strategic planning -Mining industry has protective dykes and provincial protocols are being established to protect mines -Maintenance programs

-taxed human resources at institutions (e.g. Water Security Agency, Saskatchewan Government Insurance, Provincial Disaster Assistance Program, Emergency Flood Management and Fire Safety, public utilities)	-LiDAR surveys (topographic, flood prone spatial data) and grant programs for mapping
-Slumping, earth movements e.g. Regina Beach	-Water Security Agency had an Agricultural flood management strategy
-Damage to homes	-Back-up power systems are in place (for some applications)
-Industry and railways cannot source/deliver products (needed for communities and economy)	-Mapping is useful (there is a need for more)
-Insurance losses	-Public education and awareness exists but more is needed to educate about risk assessment, planning and value
-Energy production systems impaired (SaskEnergy, SaskPower)	-Communications plans, need improved plans involving industry, communities, government
-Watershed impacts	-Mutual aid agreements need to be expanded so resources can be shared
- Infrastructure damage	-Provincial enforcement needed for zoning
-Damage to dams and water storage reservoirs	-Property buy-outs (e.g. Moose Jaw bought property in flood plain, restricts flood plain development)
- Business and economic losses	-Community dyking (e.g. Lumsden)
-Road systems need reconstruction	-Local Emergency Operations Centre
-Lagoons impaired, and contamination risk	-Drainage to Qu'Appelle system
-Cropland wiped out, agricultural losses, and contamination risks to crop lands	-Provincial water quality programming
-Lake debris and contamination transport	-Shock chlorination of contaminated wells
-Loss of recreational boating/tourism	-Sealing of abandoned wells protect aquifers
-Human health, mental stress	-Engineering and infrastructure design codes (e.g. SK Flood control level is 1:500 flood event)
-Economic losses	-Culverts and water infrastructure
-Drop in property values	-Local emergency plans, evacuation plans for communities, affected RMs, farms, etc.
-Stranded livestock, access to feed, safe water for animals impaired	

-Road reconstruction requires time (up to 5 yrs.) -Lakefront/river front properties at very high risk, frightening to residents/personal risks -Dams are at risk -May take up to 10 years for reclamation of flooded/waterlogged land -Rebuilding is very costly -Public safety at risk, inc. water quality contamination; e.g. contaminated aquifers -Impaired or destroyed ecosystems	-Need to enforce illegal drainage -Need inter-agency integration (Ag/WSA/RM/watershed groups) -need centralized flood resources for communities -Federal flood risk planning -Responsible planning and development – build in safe areas and to safe elevation in flood prone areas -Maintenance of existing roads, culverts, water systems are critical -Needs for animal shelters (livestock, pets)

Regina Stakeholders identified future flood impacts and mitigations (Table 57).

Table 57 Identified future flood impacts and mitigation strategies by Prince Albert stakeholders

Flood Impacts (Future Scenario)	Flood Mitigations (Future Scenario)
-Communications collapse without power or cell towers -Chaos after evacuation -Water and wastewater problems without power -Large impact on cities; rural areas are more resilient -Major impacts to infrastructure -No heating due to loss of power -Ice jams -Increased home flooding -Traffic congestion, chaos	-Need a governance structure incorporating Public, Private, NGOs to address extreme events (with a proactive emphasis) -Need improved communications and response planning/staging areas -Need to ensure response and support services are adequately supported -Need to be proactive with predictive models, and communicate information quickly, efficiently -Push notifications – Sask Alert system -Need public education to inform and communicate actions of what to do and what not to do in such emergencies

-Business losses -Misinformation on social media -Reduced access to critical infrastructure including transportation systems, water systems -Loss of potable water -Food and supplies shortages caused by transportation systems interrupted -mass evacuations	- Backup power supplies are critical - Water collection areas (dry dams) -More planning demands -More mapping needed - Scenarios modelling and tabletop exercises with computer programs would be useful to visualize and model risks and responses

Wildfire

Regina stakeholders identified wildfire impacts and mitigations (Table 58).

Table 58 Identified current wildfire impacts and mitigation strategies by Regina stakeholders

Wildfire Impacts (Current Scenario)	Wildfire Mitigations (Current Scenario)
-Invasive species risks, inc. aquatic invasives -Loss of power/gas supply to homes and critical infrastructure (water supply, wastewater treatment) -Livestock losses -Transportation impaired (road, rail, bridges) including loss of visibility -Infrastructure damages or losses -Taxation increases -Challenges to deal with the aftermath -Degradation of Service Canada programs -Evacuations	-Contingency plans exist across Canada -Rural areas are more independent and self-reliant -Industry is willing to help -Irrigation equipment may be used to fight fires -Development and zoning standards decrease fire risk -FireSmart programs -Emergency management plans -Fire flows designed as part of community water supplies -Regional collaboration with Emergency Management responses

-Communications systems are impaired or lost (towers, communications lines, inc. 911 emergency calling) -Drain on resources and emergency responders -Air quality impact on human heath, hospitals overwhelmed, hard on seniors especially -Grassfires may propagate if there are no firebreaks (e.g. continuous cropping) -No livestock feed or shortages occur -Contamination of lakes, rivers, soils -Lack of water for firefighting -Jurisdictional challenges, conflicts -Public stress levels increase -Impairs recreational areas, tourism -Infrastructure loss, even post fire event -Rural isolation when transportation impaired -Rapid movement of grass fires, but also often rapid burnout -High grassfire risk in Lumsden valley (crops, riparian zones, brush, bush) -Seniors may need to be moved out of threatened areas (problematic evacuations for vulnerable people in seniors' homes, hospitals) -Fire fighters in rural areas are volunteer and may not be available to fight fires -Sometimes access to the fire is interrupted -Damaged or destroyed infrastructure needs to be replaced, but can be constructed to new codes (to be more resilient)	-Canadian Pacific Railway has fire plans and use controls when rails grind (sparks)/ water trucks are available -Fireguard in place can be widen and designed more strategically -Controlled burns manage fire -Education, knowledge and communications plans -Civil service teams in place; resources could be expanded with others willing to assist -Coordination of other levels of government -Contact 3rd parties when needed (request timely help from others) -Coordination of local responders, trained volunteers; shared resources -More controlled firebreaks -Mutual aid agreements and volunteers trained for various fires (grasses, bush, deadwood) -Emergency Operations Centers; Provincial Emergency Coordination Center /Wildfire Center is always operational, with 8-10 staff - Generally, the south is more local responders, and the northern have -Provincial Disaster Assistance Program provides guidance (post-event and recovery) -Federal resources used when necessary; Public Safety Canada can bring in army if needed -Forecasting (Environment Canada) -Aerial support is province wide

	-Water Security Agency maps can identify water source availability; lakes, sloughs, other supplies -maps, LiDAR of susceptible areas -Communications with local fire departments/meetings -Access/egress should have at least two routes (to evacuate, and to fight fires)

Regina Stakeholders identified future wildfire impacts and mitigations (Table 59).

Table 59 Identified future wildfire impacts and mitigation strategies by Regina stakeholders

Wildfire Impacts (Future Scenario)	Wildfire Mitigations (Future Scenario)
-Egress of affected areas impaired or stopped -Tourism losses, recreation, fishing, -Maintenance of roads delayed, risk to wooden bridges severe -Some areas vulnerable by critical roads/bridges (esp. if there is only one road into and out of the area affected) -Protection of people -Wetlands and ecosystems affected -Massive evacuations – people, pets, livestock -Stress on government services -Communications, Internet impaired -Hospital systems overwhelmed -Crop insurance claims -Intensive livestock operations affected -Limited animal feed/may need to sell off	-Water Security Agency can assist with water sourcing; know where water is; PFRA inventories of water supplies information sources -Business continuity plans would be beneficial (in recovery phase for temporary operations) -Business risk management programs -PFRA funded programs in crisis (PFRA no longer exists); cost-shared federal-provincial programs would be beneficial (water supplies) -Equipment to fight forest fires -FireSmart (inc. around homes) -Leaf blowers to control small fires -Portable pumps, wells, sprinkler systems, dugouts -Construct more fuel breaks, firebreaks -Test emergency management plans, keep plans current

-Wind issues -Loss of power lines -Stressed responders -No natural fire barriers allow fire to propagate -Civic buildings overwhelmed with evacuees -Compassion fatigue -Resources are taxed (financial, human, infrastructure) -Enforcement of plans/policies	-Reciprocal healthcare agreements -Army and federal resourced trained experts to assist -72-hour survival kits needed, inc. radios, landlines - Education and persuasion -Planning and Act, before crisis

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APPENDICES

Appendix 1 Saskatchewan Flood and Natural Hazard Risk Assessment

Pre-workshop Input from Invited Stakeholders

The request form for stakeholder input was sent to select individuals / agencies by Saskatchewan Ministry of Government Relations to ensure a diversity of stakeholder input and returned via email.

Saskatchewan Flood and Natural Hazard Risk Assessment (Ver. 170503)

Pre-workshop Input from Invited Stakeholders

Background:

Natural hazards affect people, places and the economy. Northern **fires** near La Ronge displaced over 13,000 people in 2015, and burned 1.6 million hectares of forest. From 2010 to 2016, **excessive wet conditions and flooding** affected many Saskatchewan people and communities (damaging infrastructure, impairing economic activities, flooding productive and recreational land). In the 1920s-30s **droughts** caused severe environmental damage as well as social and economic unrest; in 2001-02, **drought and water scarcity** caused a $5.8 billion drop to Canada's GDP, with a $1.6 billion drop to Saskatchewan's agriculture.

The **Saskatchewan Flood and Natural Hazard Risk Assessment** project (see fact sheet provided) is investigating Saskatchewan's exposure and resiliency to **natural hazards**. This work will add knowledge to help prioritize **mitigation measures** to reduce risks and impacts from natural hazards.

Pre-workshop Input from Invited Stakeholders – Your input adds valuable information to this project

1. **Select the group or group(s) that best fit who you represent and identify who you represent:**
   - ☐ Communities (local municipalities; rural municipalities, etc.)_____
   - ☐ First Nation(s)_____
   - ☐ Industry (Business, Sectors, Industry Associations, etc.)_____
   - ☐ Provincial Government_____
   - ☐ Federal Government_____
   - ☐ Academia_____
   - ☐ Non-government organizations (SUMA, SARM, Watershed Groups, Environmental Orgs, Other NGOs, etc.)_____
   - ☐ Emergency Preparedness, Disaster Response, Insurance Industry_____

2. **What historic natural hazards have directly affected your interests** (i.e. past experience)**:**
   i. Natural hazard:
      - ☐ Fires
      - ☐ Floods/Excessive Wet Conditions
      - ☐ Drought/Water Scarcity
      - ☐ Other (please define)
   ii. Provide any details you recall (date, season, area, how frequent it recurs)

3. **What Impacts did historic natural hazards have on you/your area of interest?** (describe the impacts, with examples if possible, and any unique factors/reasons for some impacts).

4. **What mitigation measures do you/your interest currently practice?** (e.g. flood/fire/drought preparedness measures/plans; list examples, explain how these mitigation measures help)

5. **Based on historic exposure, are current natural hazard mitigation measures adequate?** (e.g. existing protection, preparedness plans, infrastructure that reduces risk, institutional capacity and programs, etc.)?

   i. **Yes or No**
   ii. **Explain why and describe any geographic area at greater risk** (e.g. area and hazard):

   iii. **What do you think is needed to strengthen capacity to reduce natural hazard risks to people, the economy, the environment?** (give examples of what is needed, how it will help)

6. **Are you concerned about changing risk exposures into the future? Yes or No?**
   i. **Which natural hazards are you most concerned about for future risks (e.g. future trends)?**
      - ☐ Fires
      - ☐ Floods/ Excessive Wet Conditions
      - ☐ Drought/Water Scarcity
      - ☐ Other (please define)
   ii. **Explain why and describe any geographic area at future risk** (area and specific hazard):

   iii. **What mitigation measures do you think are needed to be better prepared for future natural hazards?** (provide examples to explain what is needed, and how it may help).

7. **What are the most significant natural hazards facing Saskatchewan's people, and economy and environment?** (List and briefly describe why)

8. **List any general comments, concerns you have about natural hazards in Saskatchewan:**

Appendix 2 Stakeholder Workshop Agenda

SASKATCHEWAN FLOOD AND NATURAL HAZARD WORKSHOP

INTRODUCTION – 09:00-9:15

i. MGR Jason Rumancik
ii. Darrell Corkal PPT

HISTORIC NATURAL HAZARDS – our experiences and knowledge (plenary)– 09:15 - 10:15

i. **Drought** – Virginia Wittrock, Elaine Wheaton 15 min.
ii. **Flood** – Bob Halliday 15 min
iii. **Fire** – Mark Johnston (or Virginia Wittrock) 15 min
iv. Plenary Discussion – Q&A 15 min

HISTORIC NATURAL HAZARDS – LOCAL & STAKEHOLDER KNOWLEDGE Breakout Groups – 10:30-11:30

i. ***Drought*** – Facilitator: Elaine Wheaton; Recorders: MGR
ii. ***Flood*** – Facilitator - Bob Halliday; Recorders: MGR
iii. ***Fire*** – Facilitator - Mark Johnston (or V. Wittrock); Recorders: MGR

HISTORIC NATURAL HAZARDS - STAKEHOLDER INSIGHTS (Plenary) 11:30-12:00 – Darrell Corkal - facilitation

i. **Impacts:** variability, range, risk
ii. **Mitigation Measures**- challenges, needs
iii. **Concerns/Needs** – what would help for improved preparedness
iv. **OTHER NATURAL HAZARDS?**
    - Drought, Flood, Fire, Excessive Wet Conditions
    - Hail, Slumping/Landslides, Tornado, Wind
    - Ice/Snow/Blizzard, Insects and Diseases (crop, animal, human)
    - heat stress (crop, animal, human), earthquake, etc., other?
v. **Maps –** identification of risk areas
vi. **Priority ranking exercise** on all Hazard/Mitigation Stakeholder Input

Lunch 12:00 -13:00 (extend the Other Natural Hazards, Maps, Priority Ranking exercise/PosterViewing)

FUTURE NATURAL HAZARDS - WHAT MIGHT THE FUTURE PRESENT? 13:00 – 13:30

- **Presentation by Virginia Wittrock – 13:30, a future scenario for Saskatchewan**

FUTURE SCENARIOS – LOCAL & STAKEHOLDER KNOWLEDGE Breakout Groups – 13:30-15:00

i. ***Drought*** – Facilitator: Elaine Wheaton; Recorders: WSA, MGR
ii. ***Flood*** – Facilitator - Bob Halliday; Recorders: WSA, MGR
iii. ***Fire*** – Facilitator - Mark Johnston (or V. Wittrock); Recorders: WSA, MGR
iv. ***Other Natural Hazards*** – e.g. Ice Storm/ Tornado

FUTURE NATURAL HAZARDS - STAKEHOLDER INSIGHTS (Plenary) 15:00-15:30 – Darrell Corkal - facilitation

i. **Future Impacts:** variability, range, risk
ii. **Existing and Future Mitigation Measures**- challenges, needs
iii. **Future Natural Hazards Concerns/Needs** – what would help for improved preparedness
iv. **OTHER FUTURE NATURAL HAZARDS?**
    - Drought, Flood, Fire, Excessive Wet Conditions
    - Hail, Slumping/Landslides, Tornado, Wind
    - Ice/Snow/Blizzard, Insects and Diseases (crop, animal, human)
    - heat stress (crop, animal, human), earthquake, etc., other?
v. **Maps –** identification of risk areas
vi. **Priority ranking exercise** on all Hazard/Mitigation Stakeholder Input

CLOSURE – 15:30 – 16:00

i. Darrell Corkal Overview of Day's Findings
ii. MGR Jason Rumancik Adjournment

Appendix 3 Workshop Evaluation Form

Saskatchewan Flood and Natural Hazard Risk Assessment Stakeholder Workshop

Please answer the following questions to the best of your ability. We value your feedback and use it to continually improve our work. Please **circle the response** that best describes your level of agreement with each of the following statements.

1. Overall, the workshop was a productive use of my time.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. I learned more about flood/natural hazards, risks and mitigation.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. As stakeholders, we contributed our knowledge on impacts and mitigation.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. The Small Breakout Groups were effective in stimulating discussion.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. The Plenary Sessions helped advance ideas for disaster risk & preparedness.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. I believe there is a need to increase resiliency for floods and natural hazards.

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. What did you like most about the workshop?

8. What did you dislike about the workshop?

9. Other comments?