Hazard Resilience Strategies

Geological Hazards

(related to soil and earth)

In order to avoid repetition, resiliency factors which only apply to human-caused hazards are in italics.

Natural and Human Caused

Dust and Sand Storms

- Ensure community officials check regularly with weather and air quality monitoring agencies such as Environment Canada to anticipate dust and sand storms generated locally or generated elsewhere that may blow into the community in order to issue appropriate warnings in order to issue appropriate warnings.
- Ensure community-based dust and sand storm exercises have taken place in the community-at-large (e.g., table-top or full-scale exercises).
- Ensure farmers minimize deep tillage in areas susceptible to dust and sand storms.
- If the dust and sand storms are severe or persist for an extended period, ensure the community has plans to evacuate residents (especially those with respiratory diseases) to a designated shelter with dust-free air.
- *In order to prevent dust and sand storms ensure communities have implemented appropriate strategies to reduce erosion, deposition (collection of dirt deposits) and desertification including: re-vegetation of eroded areas with trees, shrubs or grasses that are indigenous to the area; stabilization of dunes and slopes with branches or other materials pushed into the sand in a grid pattern; and establishment of wind breaks to control wind erosion.*

- *In order to prevent dust and sand storms communities be sure to limit businesses that use significant amounts of water (such as agricultural irrigation and houses with gardens that require large inputs of water) in areas susceptible to drought and desertification; where community gardens are present, ensure the use of drought resistant or low water-demand plants is encouraged along with the application of organic materials to maintain soil fertility or other appropriate urban landscaping practices.*
- *In order to prevent local dust and sand storms ensure communities have regulations that require farmers to, and limit land uses that, remove or alter vegetation (e.g., over-cultivation of agriculture, livestock over-grazing) or that require planting of vegetation on lands susceptible to wind erosion and desertification.*
- Ensure there is a warning system in place to notify emergency response personnel of potential dust and sand storms.
- Ensure there is a warning system in place to notify residents of dust and sand storms and to advise them to seek stable shelter for all family members and to shelter domesticated animals/pets; ensure community response plans provide public shelters and make them available during dust/sand storms.
- When dust and sand storms are forecast, ensure the community and power company have a shared plan in place to coordinate the shut off community electrical power to non-essential regions of the grid to avoid electrical fires (electricity to medical facilities, law enforcement and government should be maintained and backup generators in place).
- Ensure the community has in place a means to consult with Traditional Knowledge holders and subject matter experts about dust storms and traditional mitigation, response and warning systems.

Erosion, Deposition (collection of dirt deposits) and Desertification Natural and Human-Caused

- Ensure community officials check frequently with weather forecasting agencies such as Environment Canada to anticipate dry weather and wind storms that may cause wind erosion and dust and sand storms in order to issue warnings.
- Ensure community has completed mapping of areas susceptible to erosion, deposition and desertification and shared the maps with community members.
- Ensure community-based discussions have taken place in the community-at-large (e.g., table-top or full-scale exercises) regarding erosion, deposition (collection of dirt deposits) and desertification.
- Ensure communities have policies or regulations in place to prevent local erosion, deposition (collection of dirt deposits) and desertification, and limit land uses that remove or alter vegetation (e.g., over-cultivation of agriculture, livestock over-grazing)
- Ensure communities have policies in place that require planting of vegetation on lands susceptible to wind erosion and desertification.
- Ensure communities have policies or regulations in place to limit activities that use significant amounts of water (such as resource extraction/mining and houses with gardens that require large inputs of water) in areas susceptible to drought and desertification, including community gardens.
- Ensure communities have established wind breaks to control wind erosion, particularly in mining sites after closure.
- Ensure communities have policies or regulations in place to provide for the re-vegetation of eroded areas with trees, shrubs or grasses that are indigenous to the area;

stabilization of dunes and slopes with branches or other materials pushed into the sand in a grid pattern.

- Ensure communities have enacted models to assess soil erosion.
- Ensure communities have a soil conservation program in place, especially conservation tillage in farming areas.

Expansive Soils

- Ensure community-based discussions have taken place in the community-at-large regarding the potential for expansive soils, including specific consultation with traditional knowledge holders and subject matter experts.
- Ensure community has completed mapping of areas susceptible to expansive soils and shared the maps with community members.
- *Ensure most residents living in areas with expansive soils have been educated about these hazards and know that structures built on expansive soils can be better protected if water does not infiltrate soils next to the foundation. This can be prevented by: maintaining soil sloping away from the building; placing gardens, grasses and trees requiring watering away from the building; and ensuring swimming pools and pipes do not leak moisture into soils near the foundation*.
- Ensure the community has geo-technical experts (experts in soil behavior and earth materials) regularly inspect and monitor areas susceptible to expansive soils.
- *Ensure the community requires new developments to have land checked by geo-technical professionals for expansive soils and if present the community has regulations that limit construction or require engineering techniques to prevent building foundation damage, such as building foundations beneath the zone of water content fluctuation and adding non expansive materials to the soil;* Ensure existing structures affected by these expansive soils (e.g., adjacent properties) are updated to meet equal standards.
- Ensure the community has a means to consult with Traditional Knowledge holders and subject matter experts about the presence of expansive soils within the community to help with community planning.

Gravitational Mass Movements (Landslides)

Natural and Human-Caused

- Ensure communities have regulations that prohibit development, limit land use, or require appropriate hillside development practices for buildings located in landslide hazard areas (which have been identified and mapped), such as grading slopes to reduce steepness, using structural systems to increase slope resistance, or dewatering and redirecting drainage.
- Ensure the community has regulations that prohibit development, limit land use, or require structural reinforcements for buildings that must remain in debris hazard areas, such as reinforced walls and safe interior spaces.
- Ensure community officials and residents check frequently with weather forecasting agencies such as Environment Canada and have experts monitor conditions and issue warnings related to major events that may trigger debris flows, such as frequent rolling stones or the presence of erodible material in the debris-flow source-areas in combination with heavy precipitation.

- *Ensure communities work with utility companies to ensure that underground wiring or culverts do not lead to an increased risk of landslides down slope*.
- Ensure community-based landslide, debris avalanche, flow and torrent exercises have taken place in the community-at-large (e.g., table-top or full-scale exercises).
- *In developed areas, ensure communities and landowners have been educated about landslide and debris hazards and have implemented appropriate strategies to reduce risk such as: avoiding blasting or slope alteration, directing surface and groundwater away from unstable areas possibly through a drainage system or dam, keeping or planting drought-resistant vegetation on slopes to stabilize soils, placing gardens, grasses and trees requiring watering away from slopes, ensuring swimming pools and pipes do not leak moisture into slope soil, and installing retaining walls to stabilize slopes*.
- *In developed areas subject to slope instability and debris hazards, ensure communities have used structural measures to redirect, or retain landslides, debris avalanches, flows and torrents away from roads and developments using debris flow breakers, drop structures (to assist with flow control), debris rakes, retention basins, deflection structures, or tunnels.*
- Ensure the community has prohibited human activity in areas which pose a high risk of landslide, debris avalanches, flows and torrents and enforces this.
- Ensure there is a warning system in place to notify emergency response personnel of a potential landslide, debris avalanche, flow or torrent.
- Ensure there is a warning system in place to notify residents of a potential landslide, debris avalanche, flow or torrent including evacuation route signage in multiple languages and an effective alert system (e.g., horn/siren or social media notification).
- Ensure the community has a local Search and Rescue (SAR) team of volunteers in the community or nearby that is trained and involved in emergency response activities.
- Ensure there is a warning system in place to notify local professional Search and Rescue (SAR) team and volunteers of potential landslides.
- Ensure there is a means through which Traditional Knowledge holders and subject matter experts engage with decision makers to make plans and develop evacuation routes based on historical knowledge of landslides and other mass movement events.

Land Subsidence and Sinkholes

Natural and Human-Caused

- Ensure communities have regulations that prohibit development, limit land use, or require development buffers in areas susceptible for land subsidence or sinkholes.
- Ensure community members have been educated about subsidence and sinkhole hazards and high risk areas to encourage voluntary land use restrictions and support for hazard mitigation planning.
- Ensure community monitors check regularly with geologists and monitor areas at risk of land subsidence and sinkholes.
- Ensure community-based land subsidence and sinkhole exercises have taken place in the community-at-large (e.g., table-top or full-scale exercises).
- The community has a local Search and Rescue (SAR) team of volunteers in the community or nearby that is trained and involved in emergency response activities.
- There is a warning system in place to notify Search and Rescue (SAR) volunteers of potential sinkholes or land subsidence events.

- The community consults Traditional Knowledge holders about past sinkholes and land subsidence events to aid in community and emergency planning.
- *In areas subject to subsidence and sinkhole risk, ensure communities require or appropriate strategies to reduce hazards by: limiting rainwater infiltration by directing runoff and/or making ground surfaces impermeable; using flexible pipes; and preventing the decline of the water table.*
- *In areas subject to subsidence and sinkhole risk, ensure communities require or appropriate strategies for erosion and sedimentation control such as using special building foundations; reinforcing road and railway infrastructure; and limiting further development through covenants, easements or land purchase; Ensure existing structures affected by these expansive soils (e.g., adjacent properties) are updated to meet equal standards.*
- Prior to issuing building or road permits, ensure communities require professional engineering/environmental experts conduct an assessment to identify existing and potential subsidence and sinkhole areas.
- Ensure there is a warning system in place to notify emergency response personnel of potential sinkholes or land subsidence.
- Ensure there is a warning system in place to notify residents of potential sinkholes or land subsidence.
- Communities have completed mapping of areas susceptible to sinkholes and land subsidence and shared the maps with community.

Submarine Slides

Natural and Human-Caused

- Ensure communities have completed underwater mapping of areas susceptible to submarine slides and shared the maps with community, fishers and trappers.
- Ensure community-based coastal surge exercises associated with submarine slides have taken place in the community-at-large (e.g., table-top or full-scale exercises).
- Ensure dredging has taken place to avert potential submarine slides and/or *dredging activities are monitored and assessed for their potential to cause submarine slides.*
- Ensure evacuation routes for coastal surges associated with submarine slide are marked with visible signage in multiple languages.
- Ensure plans are in place to develop and preserve coastal forests that act as protection against coastal surges associated with submarine slides.
- Ensure residents are educated about submarine slides and associated coastal surges and know how and where to evacuate.
- Ensure there is a warning system in place to notify emergency response personnel of potential submarine slides.
- Ensure there is a warning system in place to notify residents of potential submarine slides and areas at risk to associated surges.

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