CANADIAN CONSULTING ENGINEERING AWARDS 2023

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LEBRET REVISED FLOOD HAZARD MAP

LOCATION: LEBRET, SK CLIENT/OWNER: VILLAGE OF LEBRET LEAD CONSULTANT: ASSOCIATED ENGINEERING SUBCONSULTANT: DHI WATER & ENVIRONMENT





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PROJECT SUMMARY

The lakeside Village of Lebret in southeastern Saskatchewan attracts residents, tourists, and developers; however, flood risk has limited economic development. The Village engaged Associated Engineering to analyze and update its flood hazard map. Associated's project team employed an innovative approach, adapting advanced coastal wave analysis methods to the Prairies to improve delineation of flood-prone areas. The revised flood hazard map allows Lebret to confidently manage economic development while protecting public safety, property, and the environment.



INNOVATION

Situated along the shores of Mission Lake in southeastern Saskatchewan, the Village of Lebret faces annual flood risk during spring runoff. In 2011, a 1:100-year flood event prompted the Village to issue a voluntary evacuation order.

To protect public safety and property, development in the Village is guided by a flood hazard map developed by the province's Water Security Agency (WSA) in 2013. The map outlines land where Lebret could or could not develop: flood fringe vs the floodway. Although appropriate methods were used to create Lebret's flood hazard map, the Village wanted to update the map using advanced methodologies to better delineate the flood fringe. In addition to improving flood risk mitigation, the revised map could allow for more land development. The Village engaged Associated Engineering to develop a revised flood hazard map on a short timeline so it could take advantage of 50% funding from WSA.

Associated Engineering followed a detailed, analytical approach to lake bathymetry (depth measurement) and wind and wave height analysis with uprush (lake surge) calculations. The project team used computer modelling for a more precise examination of wind direction and wind probability and resulting wave heights at each transect (cross section), rather than simply applying a single value for the entire area. The team applied the bathymetry combined with the surface LiDAR and, using the 1:100year flood level from the WSA, completed a detailed spectral wave analysis. Wave action is a significant consideration in the mapping process, as waves can greatly influence determination of the flood fringe. Associated Engineering noted that the typical methods to determine wave uprush over a crest proved somewhat unreliable when applied to Prairie waves and the flat topography on the shore. This finding prompted the use of an alternate method to develop a "splash zone", which better reflects the potential impact in a particular flat area set just below the wave uprush elevation. The project team assessed techniques used on the west coast and effectively adapted them to this Prairie application.

Adapting this technology, originally developed for oceanfront properties, was key to completing the revised flood hazard map on time and providing the Village with the desired level of accuracy and reliability for future development. Associated Engineering's innovative adaption of coastal techniques for flood mapping in the Prairies is believed to be a first. This innovation is a model for flood hazard mapping in other Prairie communities.



COMPLEXITY

A major challenge for the team was the short timeline to update the flood hazard map. The project was awarded late 2021 and had to be completed by March 31, 2022 for the Village to receive 50% project funding from WSA. Managing the tight schedule required consideration of the critical path tasks, such as the bathymetric survey of Mission Lake.

The existing map was developed using limited bathymetry readings taken in 1953 and no detailed wind or wave analysis. Developing the new map required a detailed bathymetric survey of the lake depths to be completed in November 2021, before lake freeze-up. The team fast-tracked the bathymetric survey, which required numerous bathymetric readings of the lake bottom at many transect locations. The last of the readings were taken just after the first snowfall in mid-November. The team compiled survey, LiDAR and bathymetry data into digital elevation model (DEM) files; obtained local and regional wind data; performed extreme value analysis (EVA) on wind data to determine extreme wind speeds and directions; developed an event-based Spectral Wave Model to determine the wave climate based on those extreme wind speeds and directions; extracted the significant wave height where the water level meets the land of each transect and estimated the resultant wave effects (i.e. setup and runup); and developed the flood hazard maps by plotting the respective floodway and flood-fringe locations for each transect.

Collaborating with the WSA, the team adapted advanced coastal modelling techniques to develop Lebret's revised, more reliable flood hazard map.



SOCIAL AND ECONOMIC BENEFITS

With its location on the shores of Mission Lake, heavy spring run-offs present an annual flood threat to the Village of Lebret. To mitigate this risk, Saskatchewan's Water Security Agency developed a flood hazard map for the Village in 2013, which was incorporated into their official community plan. This map allowed only a small flood fringe area within the Village to be developed.

The Village of Lebret's new flood hazard map has increased the WSAapproved flood fringe area. The map clearly defines and regulates land which cannot be developed (the floodway) and area that can be developed (the flood fringe), provided that certain measures are taken. The Village is now better equipped to advance development in their community with greater confidence that development will not be impacted by major floods. This allows the Village to expand economic development and help in developing their land assets for future population growth. The Village can also investigate and implement appropriate mitigation measures to protect public safety, property, and the natural environment from potential flood events.

Associated Engineering's innovative adaptation of advanced coastal wave analysis methodologies for flood hazard assessment to the Prairies is a unique application that other lakeside communities in the Prairies can employ to improve identification of flood-prone areas and mitigation of flood risk.

The project timeline required that regulatory approvals be streamlined. The collaborative relationship established between the Village and the WSA, which was both a key regulatory stakeholder and funding agent, will benefit future projects in the region.



ENVIRONMENTAL BENEFITS

Natural disasters and extreme weather events, such as major flooding can pose a significant threat to the natural environment, destroying vegetation, habitat, and wildlife.

Lebret's revised flood hazard map will be instrumental in planning for and mitigating the impact of future flood events on the natural environment. The Village, residents, and developers can make informed decisions on landuse planning to protect both the natural and built environment.

For example, using the map and its improved delineation of the floodway and flood fringe, the Village can make decisions on flood mitigation activities, like dyking, to protect the shoreline, wetlands, vegetation, natural habitat, birds, and wildlife. In doing so, tourists, seasonal cottage owners, permanent residents, and commercial developers can continue to enjoy the natural assets in the picturesque Qu'Appelle Valley.



MEETING CLIENT'S NEEDS

The Village of Lebret believed that the precision of their previous flood hazard map, created in 2013, could be improved, and wanted to develop an updated map. A revised flood hazard map could allow the Village to expand development, enhance public safety, and protect property and the environment.

The Village awarded the project to Associated Engineering in late 2021, and stipulated a tight schedule for completing the revised flood hazard map so that it could take advantage of 50% funding from WSA, if the work was completed by March 31, 2022.

The existing map was developed using limited bathymetry readings from 1953 and without any detailed wind or wave analysis. Associated Engineering's plan included a detailed bathymetric survey of lake depths, to improve the accuracy of the flood hazard map. To meet the deadline, the project team fast-tracked the bathymetric survey, completing the work before Mission Lake froze in the winter. Adapting coastal wave analysis techniques, the team undertook detailed wind and wave analysis of the lake.

The Associated team completed the Lebret revised flood hazard map on time and on budget, to the complete satisfaction of both the Village of Lebret and the Water Security Agency. The collaborative work environment that our team fostered with the client and the regulator enabled the project to be completed in this short timeline. The revised flood hazard map provides the Village with assurance of the areas that can be safely developed, while protecting the public and built and natural assets.

