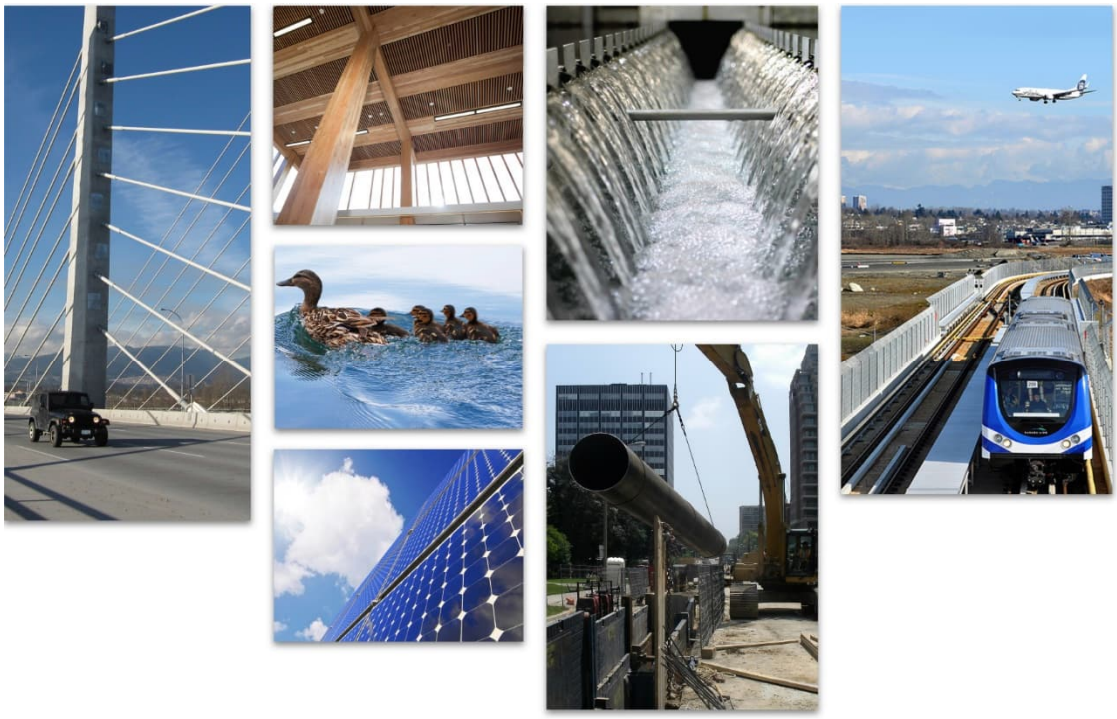
Associated Engineering | 75 YEARS

REPORT

Saskatchewan Conservation and Development Association
Saskatchewan Water Security Agency

Analysis of Wetland Migitation Policy Outcomes
Hydrology and Flooding



JANUARY 2023

EXECUTIVE SUMMARY

The Saskatchewan Conservation and Development Association (SCDA) retained a group of specialists in hydrology, water quality and wildlife ecology to assess the potential impact of wetland drainage on downstream flooding, downstream water quality, and wildlife habitat/population, respectively. Each specialist's report is intended to assist the Water Security Agency (WSA) in developing a wetland mitigation policy for the Province of Saskatchewan. Together, the specialists developed a set of wetland retention scenarios that included 10% decrements in wetland area from historical maximums, the current wetland area, and a floor scenario that prevented drainage on protected lands or soils with poor agriculture capability. The specialists then assessed the potential environmental impacts of the wetland retention scenarios on indicators related to their area of specialization. WSA provided and processed the data used in this study, which included Canadian Wetland Inventory (CWI), land use, soil capability, and protected areas, divided into quarter sections. The study area was limited to the extent of CWI coverage in Saskatchewan (approximately 40 million acres or 150,000 km^2). The work presented in this report is specific to the hydrology and flooding component of the project. The audience is assumed to have some technical knowledge of prairie hydrology.

The Contributing Drainage Area (CDA) method was used to predict the impact of wetland retention scenarios on runoff volumes for major and sub-sub basins within the study area. CWI coverage was nearly complete for areas of the Assiniboine, Qu'Appelle, and Souris river basins within Saskatchewan, which allowed for broad-scale estimates of the impact of wetland drainage in these major basins. More detailed estimates were possible for 36 sub-sub basins within the study area that had full or partial CWI coverage to support using the CDA method. General estimates of the impact of wetland retention scenarios on instantaneous peak flows were made based on log-log relationships between Effective Drainage Area (EDA) and instantaneous peak flow. Several limitations of the CDA method and CWI dataset used to complete this study are discussed within this report. Overall, the use of the CDA method and CWI dataset likely underestimated the impacts of wetland loss on streamflow in Saskatchewan due to the large spatial domain that needed to be analyzed in this project.

The Assiniboine, Qu'Appelle, and Souris river basins responded similarly to the series of wetland retention scenarios considered in this study, although sub-sub basin results varied within these major basins. The key results in these major basins include:

- 80% wetland area retention was predicted to increase runoff volumes by approximately 40 to 45% for events with 1:2 year return periods, 10 to 15% for events with 1:10 year return periods, and 3 or 4% for events with 1:100 year return periods. Instantaneous peak flows were predicted to increase by approximately 25 to 30%, with slightly lower increases as flood volume increases. These increases in runoff volume and peak flow were considered to be manageable in terms of erosion and flood risk, and/or infrastructure damage. This level of wetland area retention likely reflects the average "current" wetland area retention in the Assiniboine, Qu'Appelle and Souris river basins, which is overestimated in this study (see reasons below).
- 50% wetland area retention was predicted to increase runoff volumes by approximately 100 to 110% for events with 1:2 year return periods, 35 to 40% for events with 1:10 year return periods, and 10 or 11% for events with 1:100 year return periods. Instantaneous peak flows were predicted to increase by approximately 65 to 75%, with slightly lower increases as flood volume increases. These increases in runoff volume and peak flow were considered to present significant erosion and flood risks and potentially damage existing infrastructure. A wetland mitigation policy target of 50% retention of historical wetland areas could present serious challenges for the province without additional requirements to reduce runoff volumes and peak flows.

- Throughout this report, “current” estimates of wetland area retention often exceed 80%, which contradicts several previously published estimates of wetland loss in the Prairies. The overestimation of “current” wetland area retention in this study is likely due to an assumption that “farmed” wetlands and 50% of the area of “partially-drained” wetlands were included in the calculation of the “current” wetland area. The calculation of “current” wetland areas only impacts the “current” wetland retention scenario. All other wetland retention scenarios presented in this report are for 10% decrements from the “historical” wetland area.

The CDA method was found to be insufficient for predicting the impact of wetland retention scenarios in the northeast region of the province. In this region, the ratio of effective to gross drainage areas (CDA ratio) is high (> 0.6), so the CDA method underestimates increases in EDA, which are used to predict changes in runoff volume and peak flow rates. The CDA method does not account for the impacts of wetland drainage when it occurs in the historically defined EDA, nor does it consider the efficiencies of runoff transportation to streamflow when channel improvements are made within the EDA. Importantly, wetland area retention is the lowest in this region of the province, so the actual impact of wetland drainage on runoff volumes and peak flows could be quite high. More research and/or modelling work is needed to better understand wetland drainage impacts in this region.

Additional policy options, beyond simply choosing a percentage-point wetland retention target, were considered in this project. These were: 1) wetland size exclusions and 2) flow controls. Allowing wetland size class exclusions from potential wetland policy scenarios was found to have the following impact:

- Excluding wetlands less than 0.5 acres in size (Class 1 and 2) from a wetland policy could reduce the wetland area retained in Saskatchewan by up to 20% more than the intended policy level (i.e., a policy that states “retain 80% of historical wetland area, excluding Class 1 and 2 wetlands”, could result in 60% retention of historical wetland area). Excluding wetlands less than 5 acres in size (i.e., keep all Class 5 wetlands and allow the rest to be drained) could result in only 40% retention of historical wetland area in Saskatchewan.
- Throughout this report, wetland sizes are used as a proxy for wetland permanence classes based on information provided by the Water Security Agency. It is important to note that wetland size is not synonymous with wetland class. Wetland size was used as a proxy for the wetland permanence class in this analysis because the wetland permanence class is not provided in the CWI dataset. Further examination of existing data may provide better approximations of the impact of wetland size or permanence class exclusions on prairie hydrology as part of wetland mitigation policy development.

Using flow controls (i.e., small culverts to reduce flows) as a beneficial management practice (BMP) to reduce the impact of increased peak flows caused by drainage projects was found to:

- Decrease peak flows for high frequency, low volume events in small drainage project areas and should continue to be used at the network scale to reduce peak flows. However, erosion risk can remain high at the outlet of flow controls, so extra erosion control measures should be included in the drainage project design.

Finally, wetland policy decisions require an evaluation of trade-offs. The results presented in this report should be considered in concert with the results of the reports by Dwight Williamson (Water Quality Specialist) and Bob Clark (Wildlife Habitat Specialist) and should also consider social and economic trade-offs within Saskatchewan and in neighbouring jurisdictions. The results presented in this report also do not include the potential impacts of future climate change. This is an important limitation of this work and a topic that should be considered as part of Saskatchewan’s wetland mitigation policy development.