Performance Indicator Summary

Performance indicator: Total length of flooded roads quantified by road type

Technical Workgroup: Coastal TWG – Lower river

Research by: Environment Canada, Meteorological Service of Canada – Hydrology (Bernard Doyon *et al.*)

Modeled by: B. Doyon (in the Flood Damage Assessment System), and also B. Werick (in the STELLA Shared Vision Model)

Activity represented by this indicator: For a given water level, this Performance Indicator allows the appraisal of the total length of flooded roads within the St. Lawrence River 100-year floodplain. The two dominant types of roads that are being flooded are also quantified.

Link to water levels: A route segment is considered to be flooded as soon as the water level is higher than the road elevation.

Importance: We believe that economic PI are not sufficient to fully describe the impacts of a flood on communities and therefore societal PI – such as the total length of flooded roads quantified by road type – have been developed to form the basis of a socio-economic assessment tool for flooding. As a result, some PI measure the damage in terms of dollars while others account for societal aspects of the damage. However, they all reflect direct damage.

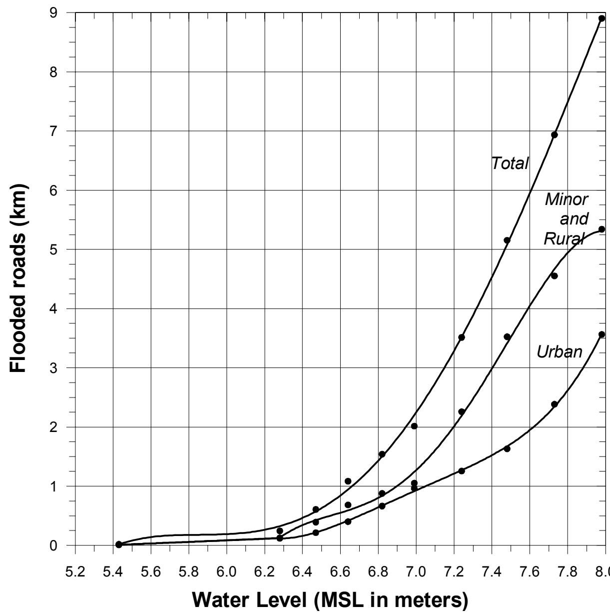
The total length of flooded roads is an important PI that translates societal stress in figures. The two dominant types of roads that are being flooded are also important because they indicate if critical roads such as a highway are affected by the flood.

Performance Indicator Metrics: Length (in kilometers).

Temporal validity: Unless some major engineering structures are constructed along the coast – such as a dike or a road that would prevent water from passing beyond desirable limits – causing drastic changes to the floodplain's extent, the temporal validity of this PI is 20 to 25 years. After this period, new roads will likely have been constructed and the impact functions will need to be updated.

Spatial validity: One impact function has been developed for every municipality where at least one building lies within the 100-year floodplain. Each impact function is geo-referenced and associated with a specific hydrometric station. The impact functions are not interchangeable.

Links with hydrology used to create the PI algorithm: Each impact function is constructed by aggregating the length of flooded roads for a given municipality at different water levels. Once the curve is complete, the total length of flooded roads for a municipality is simply obtained by reading on the graph the length corresponding to the water level observed at the associated hydrometric station.



As with the other impact functions, this function is also site-specific, *i.e.* it allows appraisal of the total length of flooded roads for a given municipality. Thus, the function must be solved at the location of its corresponding hydrometric station.

The Algorithm: The total length of flooded roads can be evaluated at any time during a simulation and for any water level. However, it would be more appropriate to assess the total length of flooded roads at the moment the water level is peaking. Assessing the total length of flooded roads associated with the maximum water level provides a better understanding of the extent of the damage resulting from the flood.

Validation: The validation of the impact functions refers to the validation of the digital elevation model (DEM) of the river bed and the riparian areas. It also refers to the calibration and validation of the hydrodynamic model which has been successfully done for high water flow conditions as well as low water flow conditions (Morin and Bouchard, 2000). The difference between simulated water levels and the observed water levels is usually within 3 cm.

Documentation and References:

Côté, J.-P., Carrier, B., Doyon, B., Roy, N., Morin, A. and É. Dallaire (2003). Plaine inondable du fleuve Saint-Laurent de Cornwall à Trois-Rivières: atlas du territoire. Technical Report MSC Quebec Region – Hydrology RT-127, Environment Canada, Ste-Foy, 34 pages + 16 descriptive data cards (in French).

Doyon, B., Dallaire, É., Roy, N., Morin, A. and J.-P. Côté (2004). Estimation des dommages résidentiels consécutifs aux crues du fleuve Saint-Laurent. Technical

Report MSC Quebec Region – Hydrology RT-133, Environment Canada, Ste-Foy, 41 pages (in French).

Doyon, B., Morin, A., Roy, N., Dallaire, É. and J.-P. Côté (2004). Assessment of Flood Damage: Impact Functions for the Lower St. Lawrence. Technical Report MSC Quebec Region – Hydrology RT-128, Environment Canada, Ste-Foy, 27 pages + Appendix.

Morin, J. and A. Bouchard (2000). Les bases de la modélisation du tronçon Montréal – Trois-Rivières. Scientific Report MSC Quebec Region – Hydrology RS-100, Environment Canada, Ste-Foy, 56 pages.

Risk and uncertainty assessment: With a hydrodynamic model producing water levels with a 3 cm precision, the uncertainty linked with the impact functions representing this PI is relatively low. We believe that the impact functions provide a good assessment of the total length of flooded roads for the specified range of water levels.

However, it must be said that roads represent tiny structures when compared to the global study area. From this perspective, parts of such small features could have been missed by the finite element mesh supporting the DEM. Consequently, some route segments could be absent from the DEM – in terms of road's elevations – which would result in a slight overestimation of the length of flooded roads.