Performance Indicator Summary

Performance Indicator(s): Annual structure costs

Technical Workgroup: Coastal TWG – Lower River

Research by: Pacific International Engineering Corp. (Michael Davies and Neil MacDonald)

Modeled by: Neil MacDonald (in the CPE and SRM models) and also Bill Werick (in the STELLA Shared Vision Model)

Activity represented by this indicator: Cost of shore protection.

Link to water levels: The cost of shore protection is related to water levels in two ways. Firstly, to limit overtopping, the required elevation of a structure is related to the statistics of the extreme water levels. Secondly, the life of the structure is related to the scour at its toe, which is related to water levels in a complicated manner somewhat similar to erosion.

Importance: Water levels can have an effect on the structural integrity (primarily through undermining by scour), which affects lifespan, and functionality (with respect to overtopping), which affects structure size. Both have cost implications and, since most of the shore downstream of Montreal is protected, the economic impact of even minor changes in water level regime can be large.

Performance Indicator metric(s): Cost (in dollars)

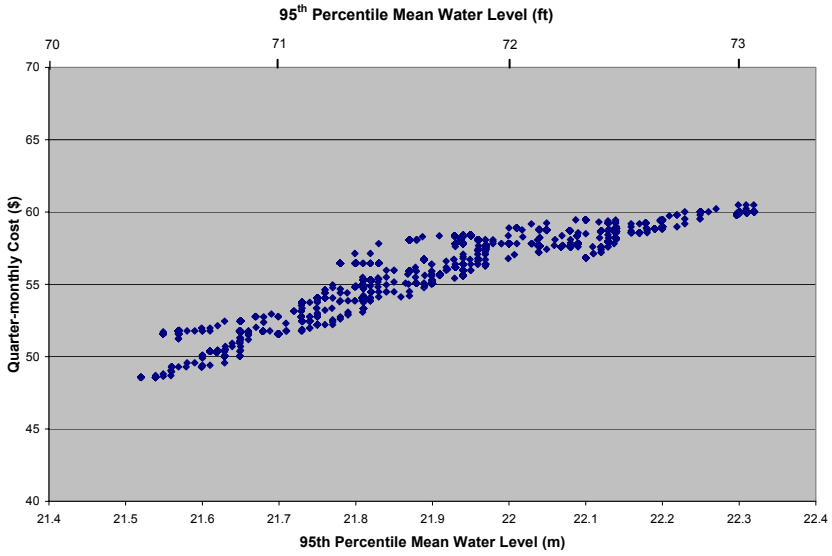
Temporal validity: This performance indicator will remain valid until there are substantial changes in the extent of shore protection, such as the protection of currently unprotected areas.

Spatial validity: Each structure was placed into one of 80 structure zones. These zones were selected on the basis of location and similarity of hydrodynamic conditions (local wind wave, river flow and level, and shipping climate). The scour modeling was done using a locally representative bed slope and structure toe depth. Average soil conditions were assumed for each site.

Links with hydrology used to create the PI algorithm: The performance indicator is strongly linked to water levels. The scour component utilizes local hydrodynamic data (mean river flows, wind waves, ships waves) from each of the 80 structure zones. The overtopping component also includes the influence of hourly fluctuations.

The algorithm: The scour at a structure is determined from a set of polynomial equations with coefficients that vary according to water level. Required structure crest elevation is computed from the higher statistics of the maximum quarter-monthly water levels using a moving 10-year window. These are combined with data on structure locations and type in order to compute the change in the annual equivalent cost of shore protection.

Validation: A detailed survey was undertaken to document the individual shore protection structures along the river. Scour modeling was validated by comparison of the rate of bed downcutting to those of unprotected eroding sites in the vicinity. The broad-scale performance indicator equations (SRM model) used in the SVM model were validated by comparison with the results of the detailed modeling. The statistics of the water level fluctuations used for determination of structure crest elevation were compared to those from more detailed models.



Documentation and references:

Davies, M.H. and MacDonald, N.J. (2002). *Erosion Processes in the Lower St. Lawrence River: Data Needs and Physical Processes Final Report*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR.

Davies, M.H., MacDonald, N.J., Timpano, M.E., and Boisvert, A. (2003). *Shoreline Response – Data and Models*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR.

Davies, M.H. and MacDonald, N.J. (2004). *Shoreline Response Lower St. Lawrence River*. Report prepared by Pacific International Engineering Corp. under contract to Environment Canada, MSC-QR, 2 volumes.

Risk and uncertainty assessment: There is more uncertainty in the scour calculations than in the erosion calculations upon which they are based for two reasons. Firstly,

calculations were performed on a zonal basis using representative conditions, rather than for each individual shore protection structure on the river. Secondly, there is little calibration data available. The costs for each structure are based on the annual operating costs and, therefore, do not distinguish between newly-constructed structures and those nearing the end of their lifespan.