ACOUSTIC MONITORING OF EROSION AND SEDIMENTATION OF ST. CLAIR RIVER SEDIMENTS AT SARNIA, ONTARIO

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The St. Clair River RAP needs information about the stability of contaminated sediments in the Sarnia reach of the St. Clair River to test models of bottom-sediment resuspension and transport. NWRI was able to help by collecting data on bottom changes produced by erosion and sedimentation with a bottom-mounted acoustic system. The system was installed at 2 sites in the river in October 1997 and weekly readings on changes in the position of the sediment-water interface were collected until mid-December.

The equipment used for monitoring bed changes is a sediment-level meter developed at NWRI. It consists of a digital echosounder operated from a small launch and a pair of fixed echo-sounder transducers mounted on a weighted bottom frame sitting on the riverbed (Figure 1). Transducer cables are routed up the buoy line to the surface and

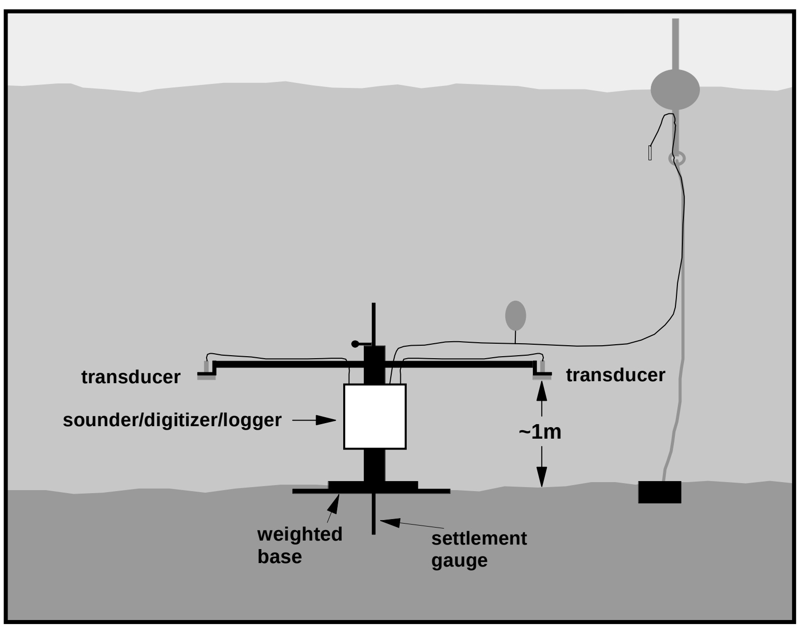

Figure 1. Acoustic sediment-level meter

terminated in underwater connectors. The digitizer is plugged into the connectors and its inboard microprocessor converts the two-way travel times from the transducer to the bottom to distances and logs the readings to memory. Changes in bottom elevation caused by the deposition or erosion of sediment can be read with a precision of a few mm.

The sites monitored were located just upstream of the First Street outfall and the Second Street submerged outfall. The First Street site has a water depth of 6.5 m and a bed sediment of thin muddy sand over gravel or glacial clay. The Second Street site is in 7 m of water on coarser sand. Strong currents (2-3 knots) were present at both sites at the time of installation.

The results of monitoring are summarized in Figure 2. Each weekly record consists of a series of 20 readings collected in less than a minute and then repeated once or twice to check for consistency. The data are plotted as residuals or differences from the original readings so that the values for the 2 transducers at one site can be compared. The zero line represents the starting elevation of the riverbed, positive values indicate sediment deposition, and negative values erosion.

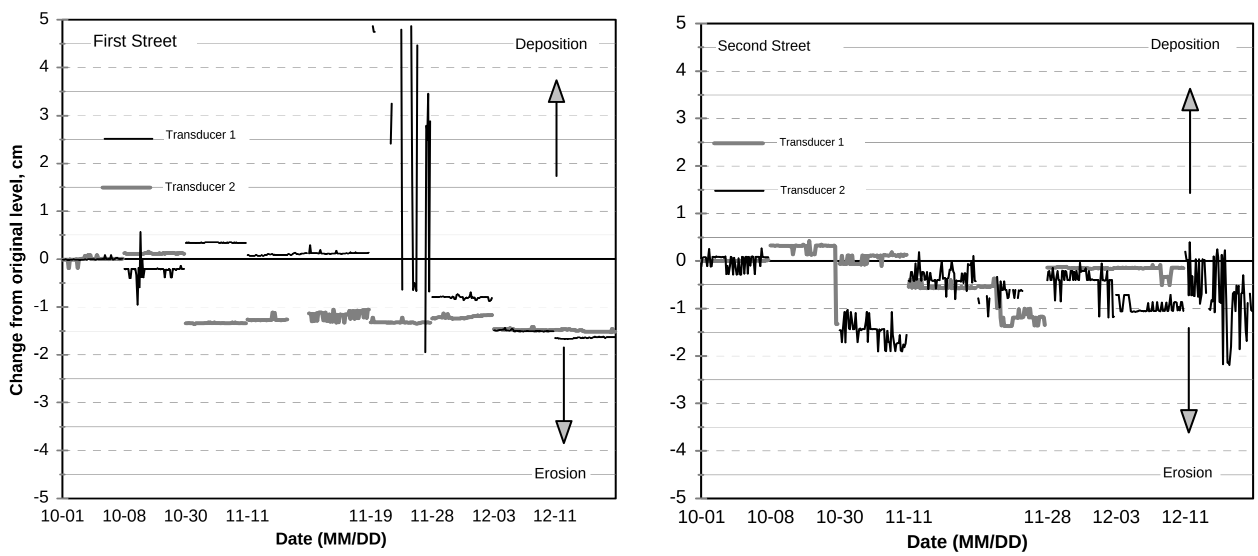

Figure 2. Changes in bed level

At the First Street site, data from transducer 1 showed little variation until November 19 and then very large positive oscillations likely caused by a suspended object. This was followed by a gradual increase in erosion to the end of the monitoring period and a net loss of about 1.6 cm. Data from transducer 2 were stable until October 30 and then dropped about 1.3 cm as the result of erosion. Readings were stable again until the end of November and then dropped slightly as erosion increased in December. Net loss was 1.5 cm.

At the Second Street site, transducer 1 recorded slight deposition through October, erosion of 0.5 - 1.0 cm in mid-November, and then recovery to just below the original bed position. Net loss was about 2 mm. Transducer 2 was unstable and its data were edited to remove extreme values. It shows erosion in the range of 0 to 2 cm and a net loss of about 1 cm.

The data collected to date are too limited to serve as a proper test of the RAP sediment-transport models. They do demonstrate, however, the feasibility of acoustic monitoring for tracking minute changes in bed level caused by erosion and sedimentation, and its potential for providing independent data for model confirmation. The system tested requires site visits for collection of data and is more suited to a less dynamic environment where bed changes are slow enough to be adequately monitored by occasional visits. NWRI has an acoustic logger which is self-contained and which can be programmed to collect data at intervals from 1 minute to 10 days for a period of a few to several months. It has been used successfully in the St. Lawrence River during the past year and is currently operating through the winter under the ice. Consideration should be given to installing a similar system in the St. Clair River during the next field season for extended monitoring. This has the advantage of being independent of weather and site visits, of providing more continuous data, and of having an integrated OBS sensor which can record suspended-sediment concentration. Studies conducted by the RAP during the past field season have demonstrated that bed erosion by ship traffic can raise contaminant levels in near-bottom water. If further studies of this type are coordinated with detailed bottom monitoring, it may be possible to develop a useful relationship between the amount of erosion and the associated rise in contaminant levels and to predict the frequency of significant release of contaminants.

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