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BATHYMETRY AND DEPTH STABILITY OF THE RANDLE DREDGE SITE, HAMILTON HARBOUR

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MANAGEMENT PERSPECTIVE

This work was done as part of the GL2000 Program for the assessment and remediation of contaminated sediments in Hamilton Harbour. It is part of the Remedial Action Plan Program (Stream 1.1 RAPS/AOCS). The work was begun and completed in 1998.

This report describes the results of a survey of the bathymetry and its stability at a Hamilton Harbour contaminated-sediment site which is slated for dredging in 1999. Data are needed for the planning of the dredging program. A procedure employing an acoustic mapping system was used to map the bathymetry and to confirm that its seasonal changes were less than the accuracy of the survey procedure.

Abstract

Contaminated sediments in the Randle Reef area of Hamilton Harbour adjacent to the Stelco outfall are scheduled to be dredged in 1999. Bathymetric data for the site are needed to plan the dredging survey and to determine whether the bathymetry is affected by bottom disturbance by waves and local shipping.

A RoxAnn seabed-classification system was used for detailed mapping of the bathymetry of the site. Repeated surveys on successive days at the end of July 1998 established that the survey error was 10 cm. A final survey in early November showed no significant differences from the earlier data and no evidence of bottom disturbance by shipping or wave or current action.

The RoxAnn system proved to be a effective survey tool. More than 4000 data points were collected along a survey track 8 km long in just over an hour, and reliable position data were assured by the continuous display of launch position on the survey software.

1. Introduction

Contaminated sediments at the Randle site opposite the Stelco dock in Hamilton Harbour are slated to be dredged in the near future. This study was undertaken on behalf of the local RAP to map the bathymetry and to determine whether it was affected by wave action or local ship traffic. Detailed bathymetry of the site is required by the dredging contractor to plan removal. Bottom disturbance is a concern because of the possibility of remobilization of exposed sediments after dredging and because it limits the use of depth data from earlier detailed surveys.

Depth data were collected with the RoxAnn seabed-classification system which records and displays georeferenced data at 1-second intervals. Replicate surveys were run on successive days at the end of June 1998 to measure the survey error and a final survey was then conducted in early November 1998 to record the over-summer change in the depth distribution.

2. Survey Procedure

Sounding surveys were run on July 30, July 31 and November 5, 1998 from the launch Puffin. Figure 1 shows the survey area and track lines. Traverses were run with a 5-m spacing along lines parallel to the Stelco Pier. Navigation was by differential GPS with corrections provided by the shore-reference site on the roof of CCIW. Static checks of accuracy at local benchmarks indicated that it was sub-metre. It is assumed that the dynamic accuracy is in the range of 2-4 m.

The survey sounder used was the Atlas Deso 10, a two-transducer system which simultaneously collects depths with 210kHz and 30kHz transducers. The depth data were recorded with the survey program, Microplot, which is generally used for bottom-classification surveys with the RoxAnn acoustic seabed-classification system (Rukavina and Caddell 1997, Rukavina 1998). This permitted one-second data to be logged to the laptop computer running the program and a continuous check on the stability of GPS readings. The surveys were run at speeds of 2-3 m/s and 2-3 m is the data spacing along the lines.

3. Data Analysis

Because of differences in water temperature between the July and November surveys, the depth difference had to be adjusted to compensate for the effect of temperature on sound velocity. This is generally done during the survey by taking a barcheck at known depths and using the data to correct for temperature. In this case, the bar-check equipment was not available at the time of the survey and approximate adjustments had to be made afterwards. Temperature profiles were available only in the centre of the basin for November and in the centre of the basin and at 2 southshore sites in July. Average July temperatures for the 6-9 m depth range averaged 17.9°C; the November temperature was constant throughout the depth range at 7.8°C. The effect of the temperature difference on water depth was to decrease the July depths by about 2 cm and reduce the November depths by about 21 cm.

Depths also had to be adjusted for differences in water level between the survey periods. Data for all surveys were corrected to the IGLD 1985 datum using the water-level gauge in Lake Ontario at the entrance to the harbour. According to the Canadian Hydrographic Service, this generally represents the harbour level to within a few cm unless there is a wind setup. Peak wind speeds for the survey periods were all too low to introduce a significant error in the level data.

The RoxAnn position data were checked for GPS errors and bad data were removed. All corrected depth data within the area selected for comparison (Figure 1) were then imported into the program Surfer for analysis. Surfer can produce contour maps of depth and of depth differences (residuals) between two surveys. Bathymetric maps were prepared for all the surveys and the map of residuals for July 30 and July 31 was used as a measure of total survey error. In all cases Surfer's contouring was done by kriging using the default values.

4. Results and Discussion

Figure 2 shows the contoured bathymetry for the July 30 and 31 surveys. Depth ranges from a minimum of 6 m at the south-central edge of the site to greater than 9 m in its northeast corner. The associated morphology (Figure 3) is a shallow mound in the southwestern part of the area separated by a steep slope from a deeper hummocky surface with a gentler northeastern slope. Figure 4 is the contour map of differences between the two surveys. Positive depth differences indicate deepening, negative depth differences shoaling. Because of the one-day interval between surveys, it is assumed that the differences recorded are a measure of the survey error rather than real depth changes. Most of figure 4 is roughly equally divided between two classes: 0 to 10 cm and 0 to -10 cm. The average difference in depth is 0.0076 m. The differences are symmetrical about 0 and represent a survey error of ±10 cm. The larger changes occurring as a band across the south part of the area are not real but result from insufficient data in areas of high gradient.

Figure 5 is the map of the change in depth between the July 31 and November 5 surveys. Differences range from -10 cm to +20 cm. Most of the area is in the 0-10 cm range. Average depths are 8.07 m and 7.99 m respectively for July and November. The difference of 8 cm is within the error range of ±10 cm for each survey and does not represent a significant change.

5. Conclusions

A series of sounding surveys was used to measure the bathymetry at the Randle dredge site and to check for possible differences caused by bottom disturbance by shipping or wave action. Replicate surveys in July 1998 were used to determine the survey error and their results were then compared with those from the final survey in November 1998. The November data showed no significant difference in average depth and no evidence of bottom disturbance during the 3 months of the shipping season. Although the data are limited, they suggest that site bathymetry is stable and that remobilization of exposed contaminated sediments after dredging is unlikely to be a problem. The stable bathymetry also means that detailed data collected in earlier surveys should still be useful for site characterization.

Water depths at the site range from 6 to 9 m. Bottom morphology consists of a shallow mound in the southwestern part of the area separated by a steep slope from a deeper hummocky surface with a gentler northeastern slope.

The surveys confirmed that the RoxAnn seabed-classification system was an effective tool for depth monitoring. RoxAnn was able to collect the equivalent of more than 4000 point depths along a survey track of 8 km in just over an hour and with an error of ±10 cm.

6. Acknowledgements

Tech Ops personnel Tod Breedon and Dave Gilroy served as coxswains for the surveys. Brian Trapp (AERB/NWRI) operated the RoxAnn system. Water-level data were obtained from the local office of the Canadian Hydrographic Service. Contractor, Marilyn Dunnett assisted in the reduction of the data. The study was funded by Environment Canada's Great Lakes 2000 Cleanup Fund.

7. References Cited

Rukavina, N.A. and S. Caddell 1997. Applications of an acoustic sea-bed classification system to freshwater environmental research and remediation in Canada. *In* Proceedings, Fourth International Conference on Remote Sensing for Marine and Coastal Environments, Orlando, Florida, March 1997.

Rukavina, N.A. 1998. Experience with a single-beam seabed-classification system in environmental surveys of river and lake sediments. In: Proceedings Canadian Hydrographic Conference 1998, Victoria, BC, March 12, 1998.

Figures

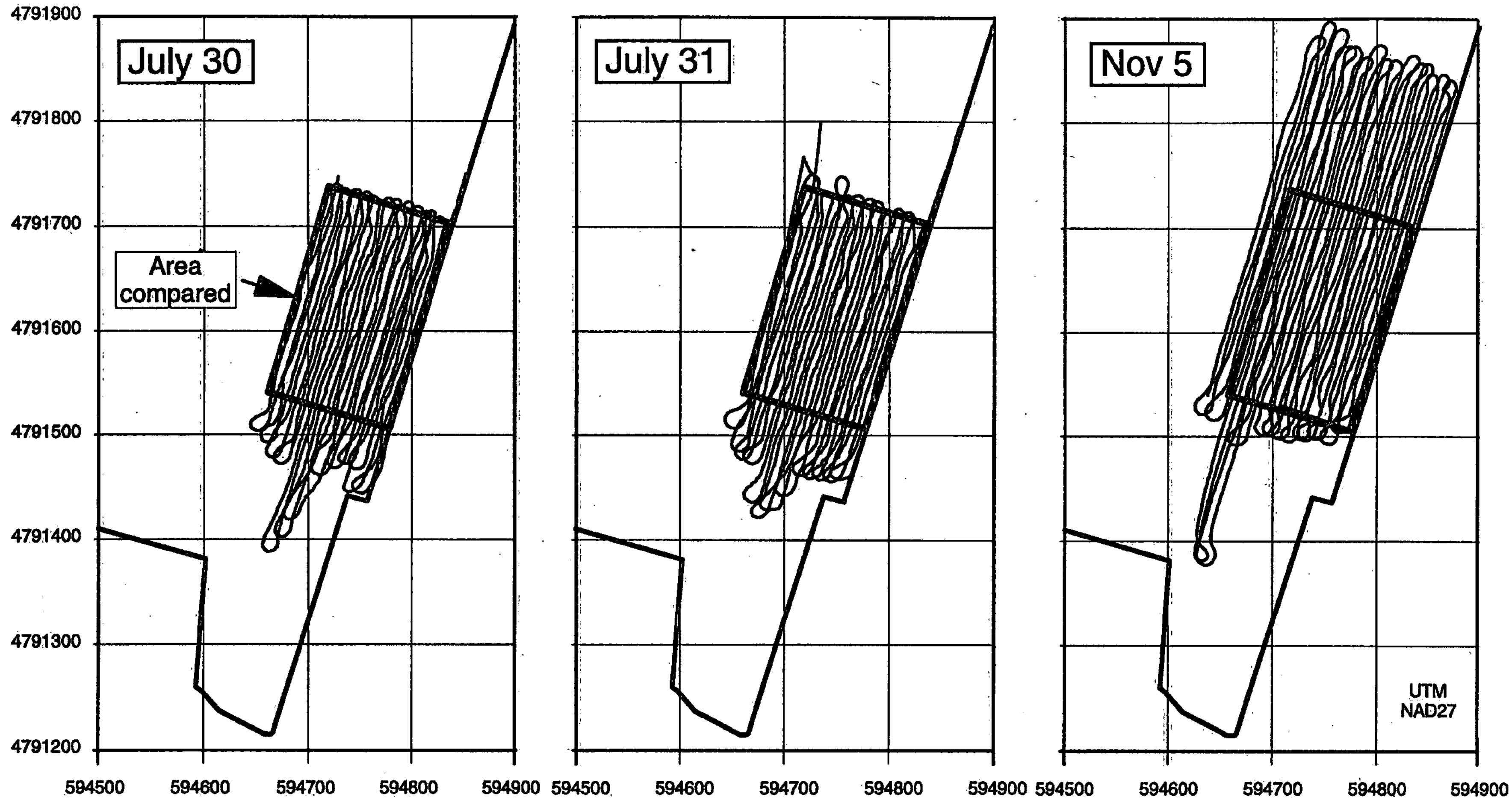

Figure 1. Survey area and RoxAnn sounding tracks

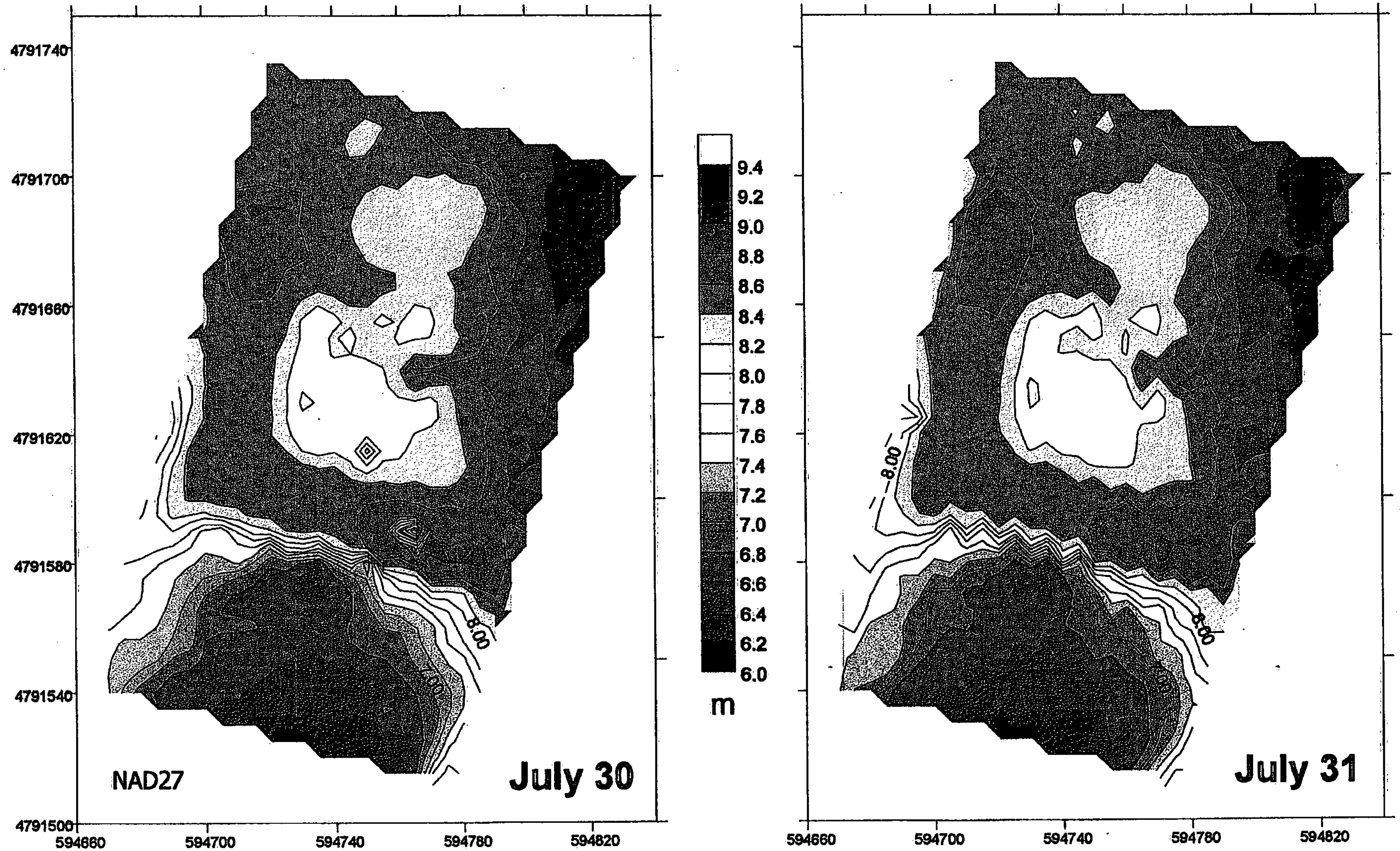

Figure 2. Bathymetry, July 30 and 31, 1998

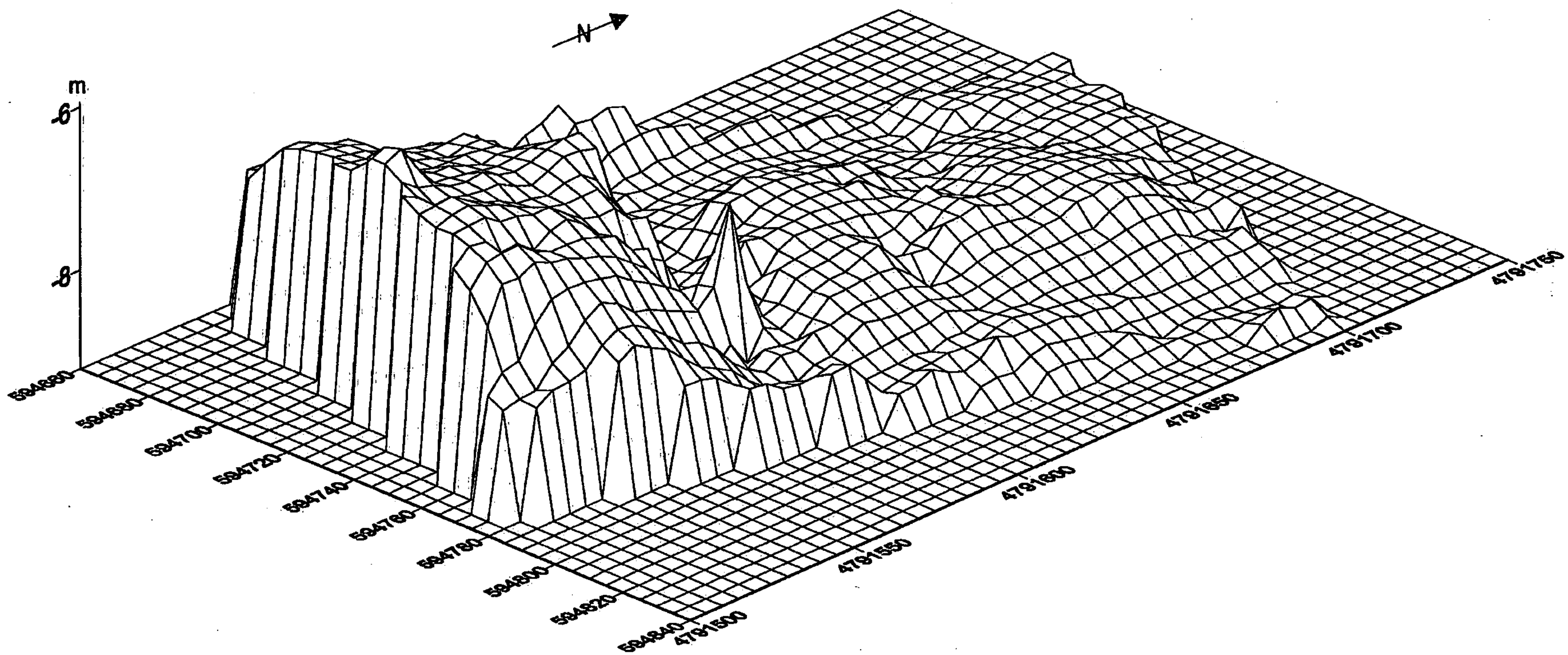

Figure 3. Site morphology

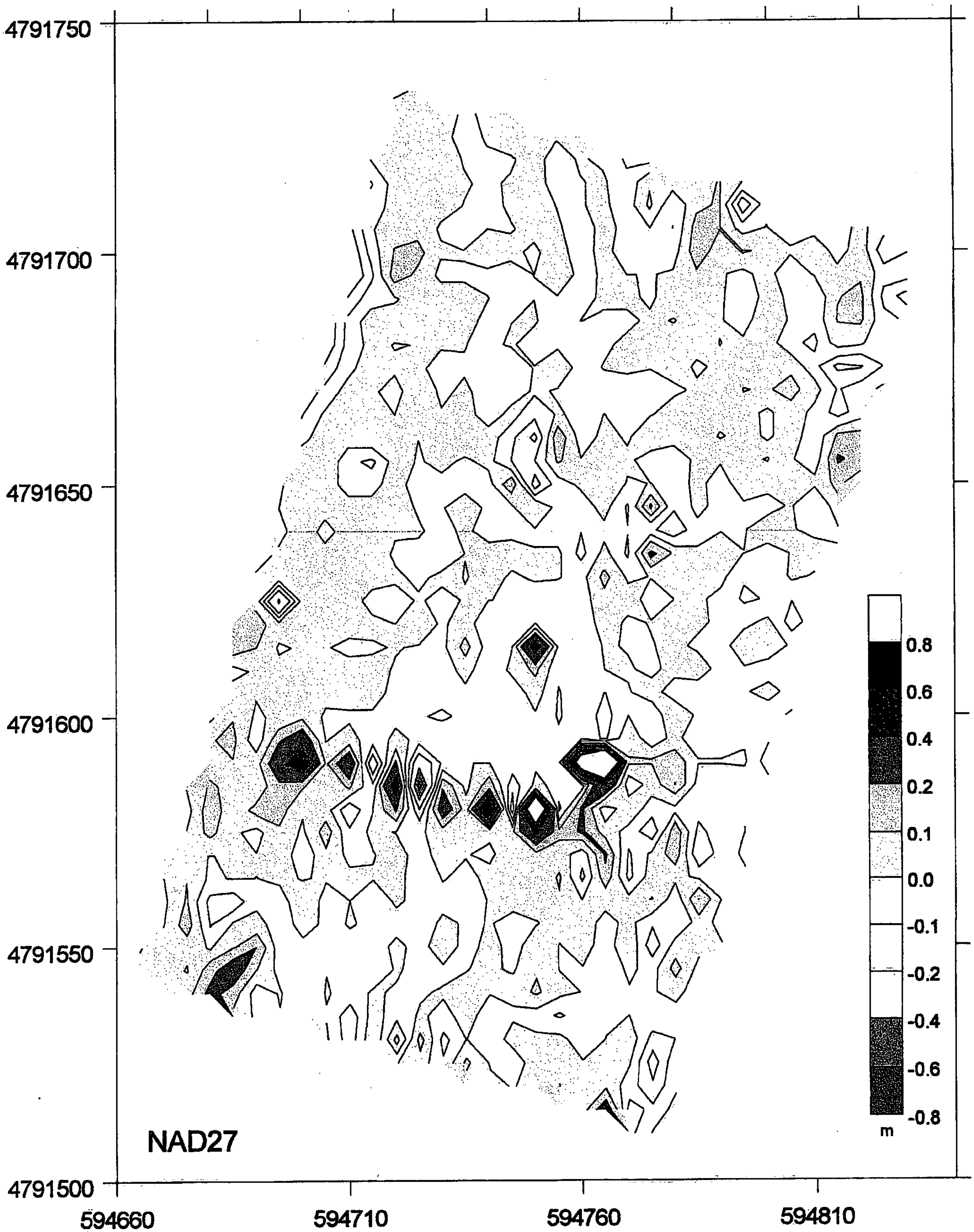

Figure 4. Survey error, differences between July 30 and 31 surveys

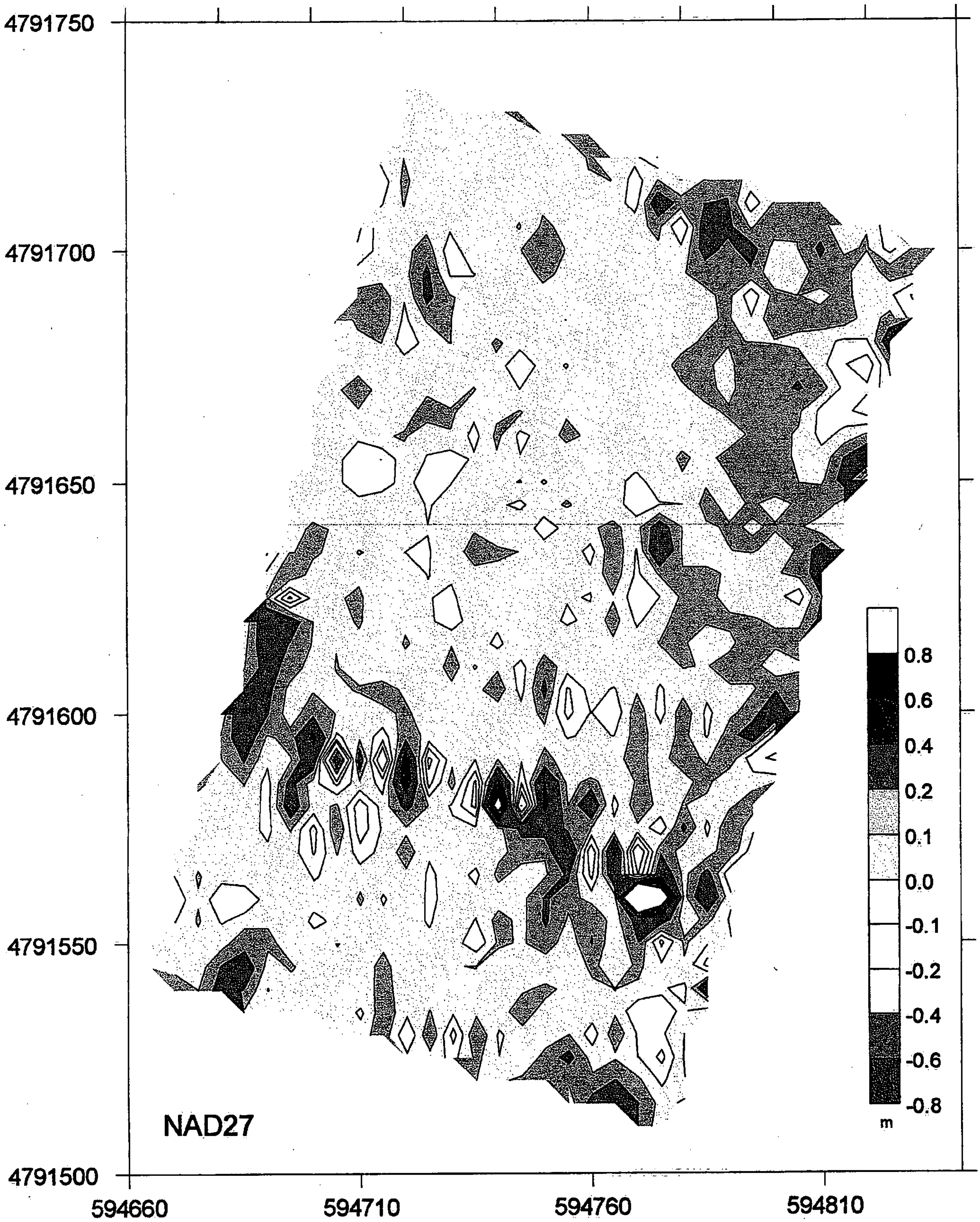

Figure 5. Depth change, July 31 to November 5

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