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BY

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This brief account lists the dimensions, and the soil and climatic conditions concerned in a large landslide which occurred along the South Nation River in Eastern Ontario.

Ce bref récit donne les dimensions ainsi que les conditions climatiques et celles du sol en rapport avec un éboulement de grande importance qui est survenu sur les rives de la rivière South Nation dans l'est de l'Ontario.

During the night of 16–17 May 1971 a large landslide, involving nearly 70 acres (28 ha), occurred along the South Nation River 4 miles (6.4 km) north of the village of Casselman, Ontario, and about 30 miles (~48 km) east of Ottawa. The landslide occurred in 80-ft (24-m) high clay slopes, left a scar about 2100 ft (~640 m) along the river bank, and extended 1600 ft (~490 m) back from the river. Debris from the landslide was carried both upstream and downstream from the slide, filling nearly 8000 ft (~2450 m) of river bed to a depth that will raise the river level more than 36 ft (>11 m) before it overtops.

Figure 1 is an oblique aerial view of the site looking downstream. The landslide scar is on the right (east) bank of the river. On the left bank, immediately upstream, is the scar of an old landslide that took place within the memory of the residents of the area and has been dated as 28th February 1910.

The old landslide scar, which extends about 1000 ft (~300 m) back from the river and is about 1500 ft (~460 m) wide, occurred during an unseasonal spring-melt according to newspaper accounts. The ground surface in the old cavity is reasonably level at an elevation about 50 ft (~15 m) below the upland elevation of 210 ft (64 m). The cavity material consists of about 10 ft (~3 m) of silty, fine sand over silty clay. Other old scars in the area have been left as pasture land and show a sharply undulating surface.

The present landslide occurred during a heavy thunderstorm and is believed to have started after 11:00 p.m. A power failure occurred about midnight, when trees being carried along in the landslide debris knocked down power lines spanning the river downstream from the slide. Figure 2 is a view of the downstream end of the debris, showing many trees still in an upright position. The disrupted power line is located in the middle of the photograph.

The landslide occurred at the end of the snow-melting season. The winter of 1970–71 deposited an all-time record snowfall in the area (170 in. (432 cm)), and melting was gradual, allowing the maximum amount of infiltration into the soil. Water was observed standing in the fields in the surrounding countryside at the time of the landslide.

Figure 3 is a view of the cavity formed by the landslide. The succession of individual failures

[1]Because of its importance to the geotechnical community the editor has waived normal review procedures in order that this report could appear in the August issue of the Canadian Geotechnical Journal.

[2]N.R.C.C. No. 12042.

FIG. 1. Oblique aerial view of the South Nation River landslide.

are well preserved by sod on the sand horizon overlying the clay. Figure 4 is a closer view of the succession of slips and shows the back scarp, which is about 30 ft (~9 m) high.

The landslide occurred in an area known physiographically as the Russell and Prescott sand plains. A surficial cover of banded silty, fine sand, generally 6 to 20 ft (1.8–6 m) thick, overlies an extensive postglacial (Champlain Sea) deposit of marine clay. Beneath the marine clay is a deposit of silty till overlying limestone bedrock of the Ordovician-aged Ottawa Formation. A major fault, extending from Ottawa to Montreal, passes a few miles south of the landslide.

During the past 3 years, eight possible bridge sites were investigated within 5 miles (8 km) of the landslide. The geotechnical reports on these sites were made available to the writers by the Ontario Department of Transportation and Communication. One of the sites was approximately 1500 ft (~460 m) south of the landslide (crossing the old scar), and 300 ft (91 m) farther south an investigation pertaining to a county road crossing was in progress at the time of the landslide. This latter investigation included river level and piezometer observations before and after the landslide. The above reports lead to the conclusion that the slopes at the proposed crossings were only marginally stable and that alternative sites or extensive stability measures were recommended.

From data contained in the reports noted above, together with preliminary field surveys and available topographic maps, the cross

FIG. 2. View of debris in the river downstream from the landslide.

FIG. 3. Aerial view of cavity formed by the landslide.

section and geotechnical profile at the landslide site have been reconstructed as shown in Fig. 5. The river water level had risen as much as 26 ft (8 m) (to elevation 172 ft (52.4 m)) during spring floods at the location of the landslide. Piezometer readings indicate a rise in groundwater levels as the river level rose. After about one week of flooding, the river level dropped quite rapidly but the groundwater pressures in the slopes remained high. The river level had dropped to about elevation 145 ft (~44 m) at the time of the slide, but the general groundwater level was nearly coincident with the ground surface (elevation 210 ft (64 m)) over most of the lower part of the slope. It is not known whether there were artesian groundwater pressures in any part of the slope at the time of the slide. Groundwater seepage was noted on 3 June 1971 near the bottom of the gullies flanking the landslide; the approximate elevation of this seepage is indicated on Fig. 5.

Amid the grassy top surfaces of the retrogressive slices evident in the photographs there are pinnacles of gray clay pushed up by the rotation. These clay pinnacles seem to indicate that the failure did not extend into the till layer. Average properties of the gray clay layer, as obtained from the investigations noted above, are as follows:

plastic limit	– average 30%
liquid limit	– average 70%
natural moisture content	– average 70%
sensitivity	– 10 to 100%
undrained shear strength	– 0.5 kg/cm^2
apparent overconsolidation	– 1 kg/cm^2

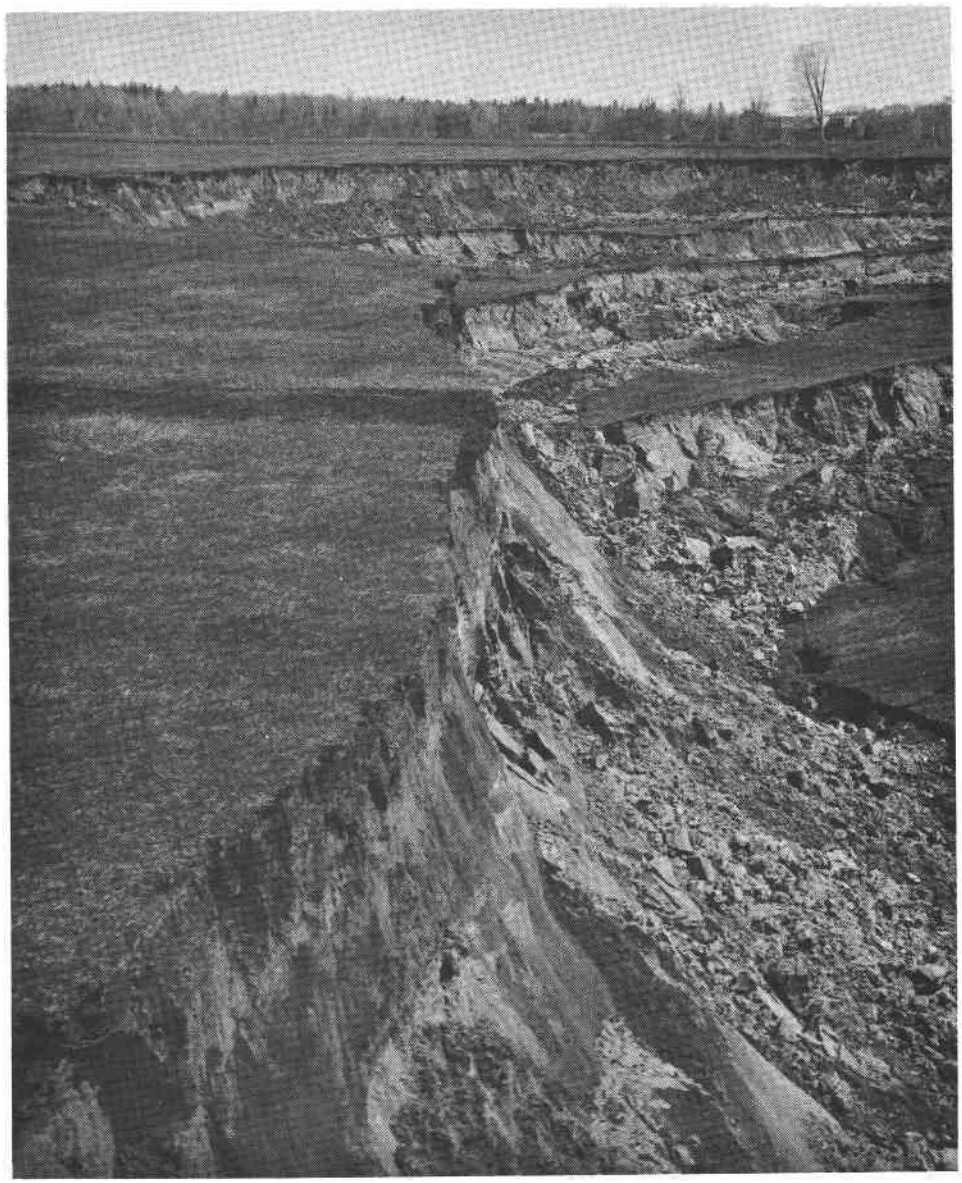

FIG. 4. View of back scarp of the landslide.

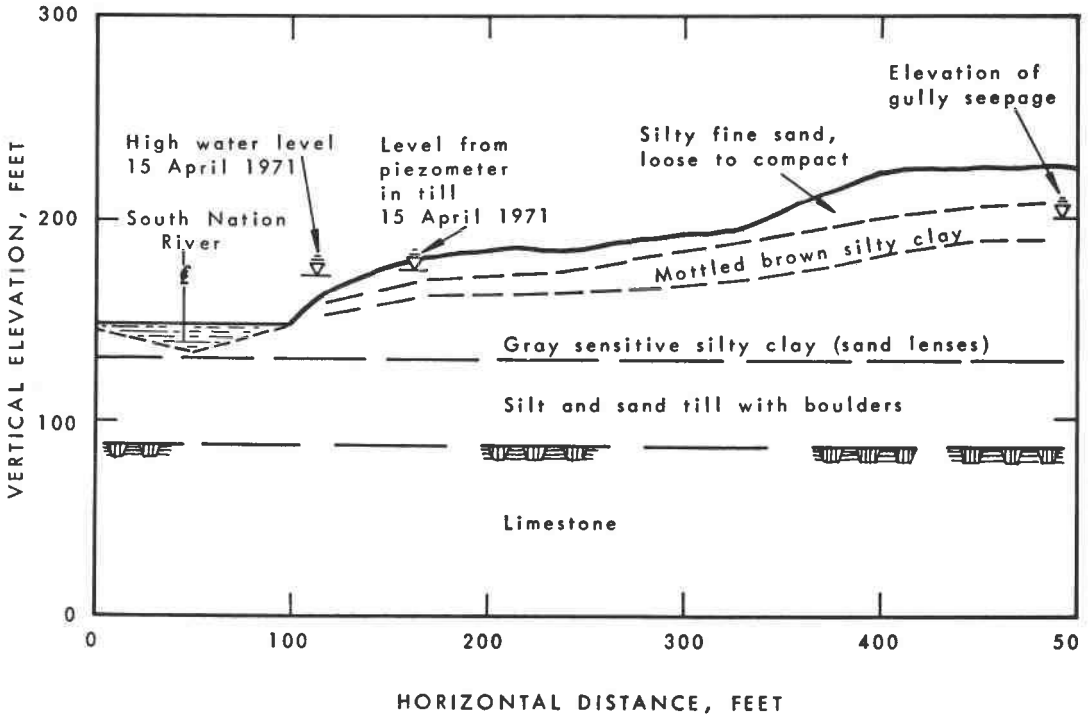

FIG. 5. Cross section and geotechnical profile of the site of the South Nation River landslide.

drained strength parameters – $C' = 0.2$ kg/cm^2
$\varphi = 23°$
bulk density – 1600 kg/cm^3

Concluding Statement

A number of individuals and organizations are combining their resources to carry out complete investigations of this landslide. Field studies were begun immediately following the slide, and identification of the factors contributing to the extensive retrogression of this landslide will be one of the primary objectives of this study.

Acknowledgments

Information for this brief account has been gathered from several engineering consultant reports prepared for the Ontario Department of Transportation and Communications (formerly Ontario Department of Highways). This note is a contribution from the Division of Building Research, National Research Council of Canada, and is published with the approval of the Director of the Division.