Trow

SSM #28 (spare)

GEOTECHNICAL EVALUATION & SITE SURVEY
SUPERINTENDENT'S RESIDENCE
SAULT CANAL, SAULT STE. MARIE, ONTARIO
YOUR FILE NO. 6553-0035-52129

Trow

SSM # 28 (spare)

GEOTECHNICAL EVALUATION & SITE SURVEY
SUPERINTENDENT'S RESIDENCE
SAULT CANAL, SAULT STE. MARIE, ONTARIO
YOUR FILE NO. 6553-0035-52129

PREPARED FOR:

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

TROW CONSULTING ENGINEERS LTD.
Brampton, Cambridge, Hamilton, London, Markham,
North Bay, Ottawa, Sudbury, Thunder Bay, Timmins, Winnipeg

Project: SO6430G
Date: January 13, 1995

1074 Webbwood Drive
Sudbury, Ontario P3C 3B7
Phone: (705) 674-9681
Fax: (705) 674-8271

Trow Sudbury Branch

Trow Consulting Engineers Ltd.
1074 Webbwood Drive
Sudbury, Ontario P3C 3B7
Telephone: (705) 674-9681
Facsimile: (705) 674-8271

S06430G

January 12, 1995

Public Works and Government
Services Canada
Architecture & Engineering
111 Water Street, East
Cornwall, Ontario
K6H 6S3

ATTENTION: Mr. James Richardson, P.Eng.

Dear Sirs:

GEOTECHNICAL EVALUATION & SITE SURVEY
SUPERINTENDENT'S RESIDENCE
SAULT CANAL, SAULT STE. MARIE, ONTARIO
YOUR FILE NO. 6553-0035-52129

Further to your letters of September 21, and December 6, 1994, our proposals of November 10, and December 7, 1994, as well as your written authorization of December 8, 1994, we have completed the field work and geotechnical review in connection with water seepage problem in the above noted building. Our findings are summarized in the following paragraphs.

1.0 Site Description

The Superintendent's residence, a two storey building with full basement, is located on the St. Mary's Island in Sault Ste. Marie, between the Canal and the water intake channel for the Great Lakes Power Authority (see Photographs 1 to 4). Based on information provided by your office, the building had been experiencing flooding in the basement for at least ten years. Recently, the inflow of water has become extreme, resulting, at times, with 150 mm of standing water on top of the basement floor. The furnace has been raised about 200 mm and set on blocks to prevent water damage. There are electrical service

panels located in the basement, although the electrical servicing is well above floor level and the highest water table.

The basement walls are constructed of mortared sandstone, probably parged with cement. The floor is poured concrete slab on grade, with two sump pits. It was noted in the past that water was entering the basement predominantly from the sumps, not from the walls or through the floor. Presently the building is unoccupied. However, it is intended that the building will be occupied in the near future.

The purpose of the requested geotechnical evaluation was to determine the source of the flooding, and to recommend possible options to curtail the problem.

2.0 SCOPE OF WORK

According to your request, the scope of work may be summarized as follows:

(a) Provide a drawing (site plan) with all field dimensions, elevations, exact location of the building and exact location of the test pit, exact location of ALL services and utilities (above ground and below ground). This shall include electrical, sanitary, water, cable, telephone, septic tile bed, tanks and all other pipes, conduits and facilities.

(b) Dig test pit to investigate soil and subsurface conditions. Contact the General Works Manager at the Canal before starting any digging. It was mandatory that Public Works (James Richardson) be advised before excavation. (Archaeological resources were not anticipated adjacent to the foundation of the building, however, special precautions were still required.

(c) Provide six (6) copies of the final report, comprising the following:

1. A site plan indicating the exact location of the test pit and all topographic elevations.

2. Results of all test pit and laboratory testing.

3. Photographs taken during the on-site work.

4. Provide a discussion on the probable sources, and conclusions, pertaining to the water that is causing the basement flooding.

5. Provide a recommendation and course of action for curtailing the flooding problem.

6. Provide a Class "C" construction cost estimate for the future construction work.

3.0 FIELD WORK

The field work, including a detailed site survey, excavation of a test pit and a geotechnical review of the area, had been carried out on December 12, and 13, 1994.

3.1 Site Survey

As requested, a detailed site survey was completed in the vicinity of the superintendent's residence, in order to identify the location of the building and all connecting services on the property. The surveying comprised the measurement of horizontal lengths and distances of the building and other objects on the property as well as pertinent geodetic elevations (water, ground, floors etc.) in the area. The results of this study is shown on the attached site plan, Drawing 1.

3.2 Test Pit Excavation and Field Observations

Because of the presence of numerous buried service pipes and cables around the building, we could excavate only one test pit, near the north-east corner of the residence, immediately adjacent to an exterior stairwell (see Drawing 1, and Photographs 11 to 14). The test pit was excavated using a rubber tired backhoe. The sloughing soil (bouldery fill) and an adjacent manhole made the digging extremely difficult. Nevertheless, the excavation extended to approximately 2.7 m below grade, 0.8 m below basement level.

In the test pit, reddish-brown heterogeneous fill was intercepted, extending down to the foundation level of the building. It is likely, that this fill (comprising silt, clay, sand and rock fragments up to "boulder" sizes) had been dumped around the foundation wall at the time of the construction of the dwelling. Neither weeping tile nor damp-proofing on the foundation wall was encountered. The backfill was wet because of poor drainage conditions around the building. Water seepage was intercepted at the bottom of the test pit, approximately 0.5 m below the basement floor level.

Although a "clean" exposure of the foundation level was not possible, because of the continuous sloughing of the surrounding fill into the narrow pit, it is assumed that the building is founded on the underlying horizontally jointed, reddish, sandstone bedrock, approximately 0.8 m to 1 m below basement level.

Visual examination of the house indicated, that there are no settlement related cracks on the foundation walls. An "opening" joint, however, exists between the exterior basement stairwell and the house which is probably related to differential movement (see Photographs 9 and 10). A small part of the stairwell had been founded on the bedrock (adjacent to the building), but a major part on the loose backfill. Compression of the fill under the stairwell's weight has probably occurred and resulted in the differential settlement and cracking at the joint.

4.0 DISCUSSIONS

Based on our review of the geotechnical conditions (soil, rock, and groundwater) in the immediate vicinity of the building, it is evident that the water seepage into the basement is predominantly groundwater related, with an additional minor water seepage through the walls at a few locations.

4.1 Groundwater Related Seepage

The survey result indicated that the water level in the canal was located just slightly below the basement floor level (but above the bottom of the sumps). Although the water level was deeper in the adjacent head race channel, the groundwater in the building area is generally located near the basement's floor. This can be related to the fact, that the overburden (fill) and the underlying horizontally jointed bedrock is permeable. As such, the groundwater level generally follows the fluctuation of the water level in the canal.

Your local forces had noted that water entering into the basement was generally occurring during strong westerly wind. Their observation is probably correct. There is a unique phenomenon in the area of the Great Lakes and their connecting channels, referred to as SEICHE effects. When storms pass over the lakes the water level rises at one end and falls at the other end of the lake due to changes in barometric pressure and the wind forces. The difference in water level has been measured more than 1 m in many instances. Once the storm passes in a few days, the water level resumes back to normal. As far as we can ascertain, there is normally not a significant variation in the water level due directly to seasonal variations.

As is visible on photographs 15 and 16, the water level in the canal may rise approximately 0.5 m above the recently noted elevation. With the higher water level there may be an estimated 0.2 m of water in the basement, which coincides with the reported sporadic water seepage problems.

4.1 Rainwater Related Seepage

In addition to the rising groundwater, there are visible signs of some minor water seeping through foundation walls in the area of an underground storage space, attached to the west wall of the building (Photograph 8). This seepage is possibly due to lack of damp-proofing behind the foundation walls. Similar signs of water seepage (patches of

very expensive & would damage much of the historic (?) fabric of the building foundation/basement.

loss of a 6" basement head room would aggravate ~~an already~~ the low heights already in the basement.

archaeology must approve & schedule excavation & recording in their workplan.

attached now ...

"efflorescence" deposit, a salt residue common in concrete due to the movement of water through the concrete) were noted around the basement's side door, in the previously noted exterior stairwell (Photographs 9 and 10).

5.0 RECOMMENDATIONS

Based on our general knowledge of the area and the results of our investigation it is evident, that the water entering into the basement through the sumps is related to the occasional rise of groundwater level mainly from SEICHE effects. In order to curtail the problem it would be necessary to install perimeter and underfloor weeping tile systems around the building and beneath the floor slabs. Such an extensive and costly procedure may, however, be prohibitive in comparison to the assumption that occasional water entering into the basement may be acceptable. It may be more suitable to construct a higher "table" floor in the basement, i.e. above the highest water level at least to the furnace and other facilities.

With regard to surface water seeping into the basement through the walls at two locations, (exterior stairwell and underground storage place) we would suggest the removal of backfill from behind those walls and then adequate damp proofing and repairs. Alternatively these exterior structures may be demolished and the original foundation walls reinstated.

The initial scope of work requested a class "C" construction cost estimate for the rehabilitation work. Since curtailing the flooding problem may comprise anything from some minor repair work up to a major drainage system construction, we did not complete a construction estimate at this time. Once you have selected an acceptable rehabilitation procedure (by taking into account all circumstances), however, we will be pleased to provide a cost estimate for your reference.

In the interim, we trust that this report is suitable for your purposes. Should you, however, have any questions, please do not hesitate to contact this office.

Yours very truly,

TROW CONSULTING ENGINEERS LTD.

L. Bodi, P.Eng.
Geotechnical Engineer

I.W. Gore, P.Eng.
Vice President Northern Region

LB:jt61
Encl.
Dist: Public Works and Government (6)
Services Canada
Mr. James Richardson, P.Eng.

Trow

PHOTOGRAPHS

PHOTOGRAPH #1

Superintendent's Residence
(South end with the main entrance)

PHOTOGRAPH #2

East Wall of Building

PHOTOGRAPH #3

West Wall of Building

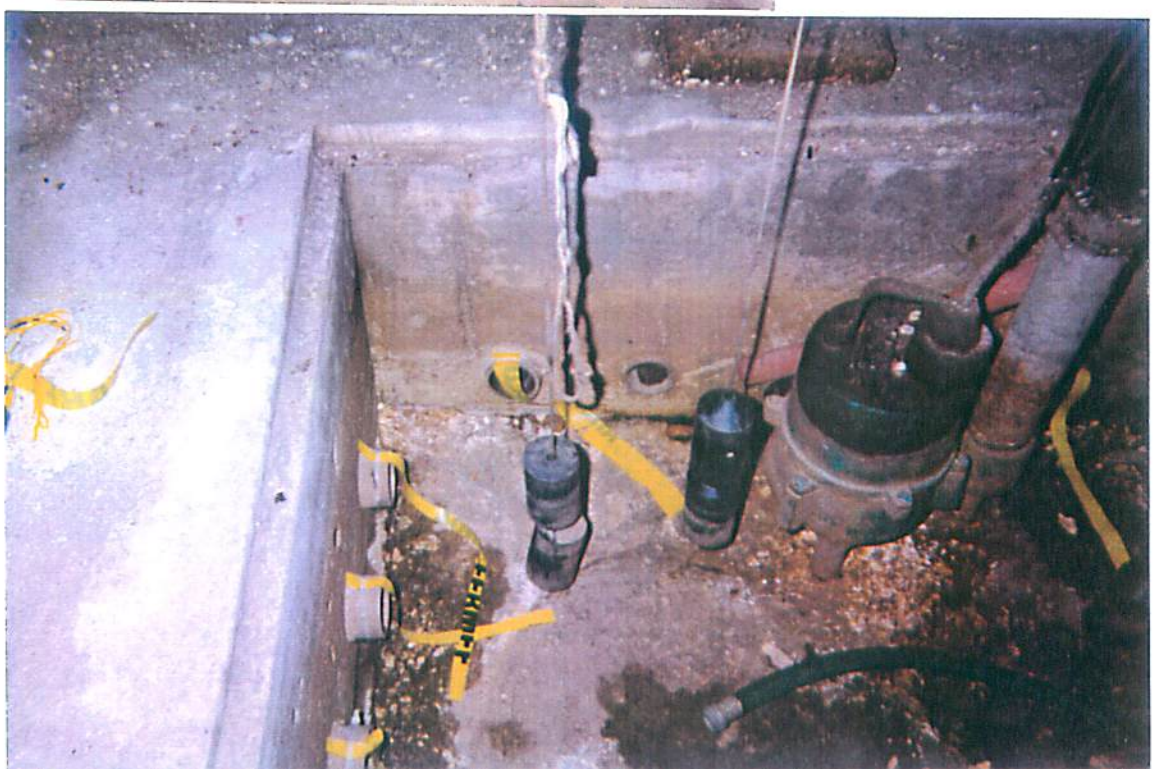
PHOTOGRAPH #4

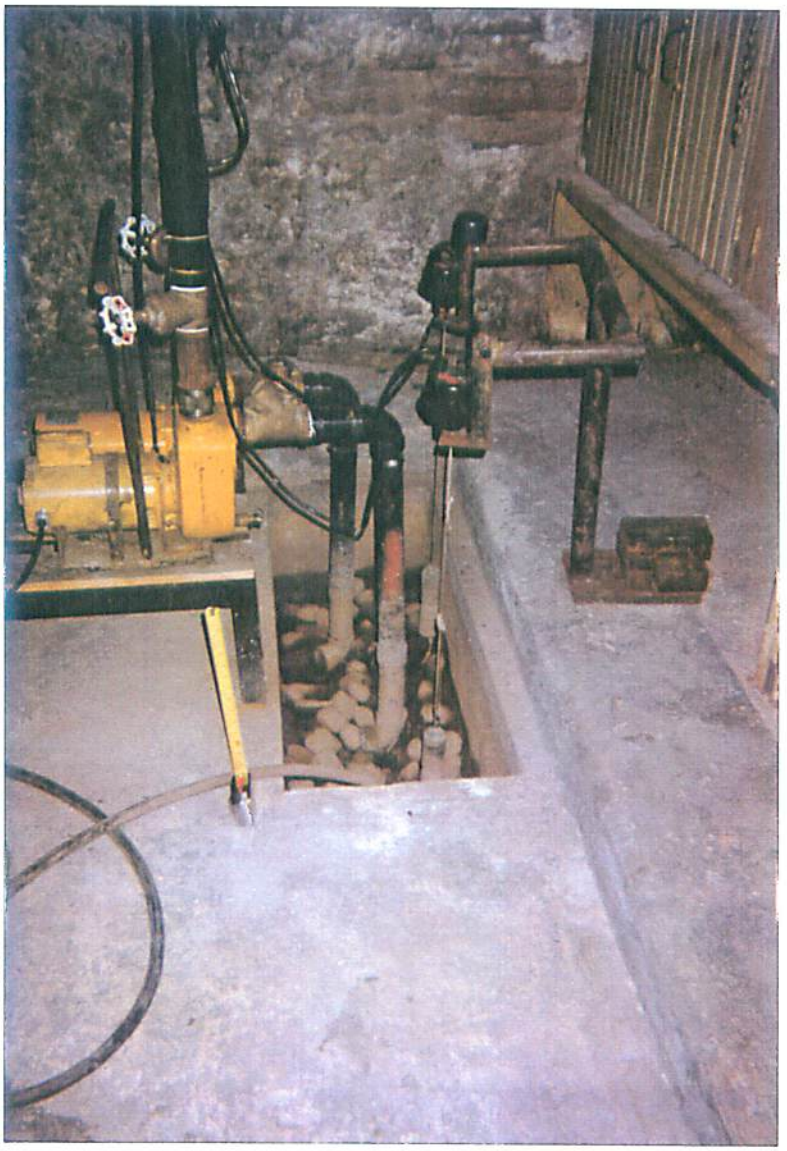
The Main Entrance

Trow

PHOTOGRAPH #5 & #6

Sump #2





PHOTOGRAPH #7

Sump #1

(Note the wet gravel fill at the bottom of the sump)

PHOTOGRAPH #8

Underground Storage Space "Attached" to the West Side of the Building

(Note the result of water seepage on the walls and floor slab)

PHOTOGRAPH #9

Exterior Stairwell Attached to the East Side of the Building

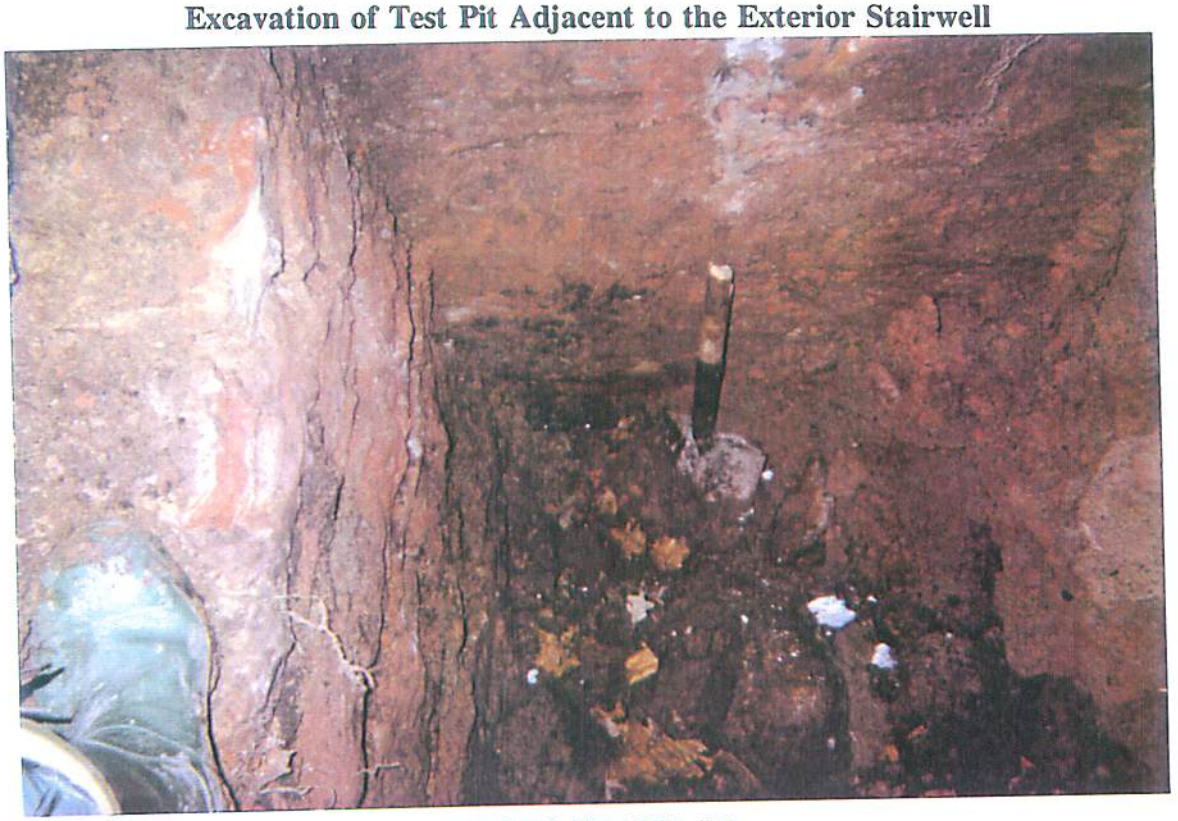
PHOTOGRAPH #10

Opening of Joint Between the Stairwell Wall and the Building as a Result of Differential Settlement

(Poor foundation of the stairwell)

PHOTOGRAPH #11

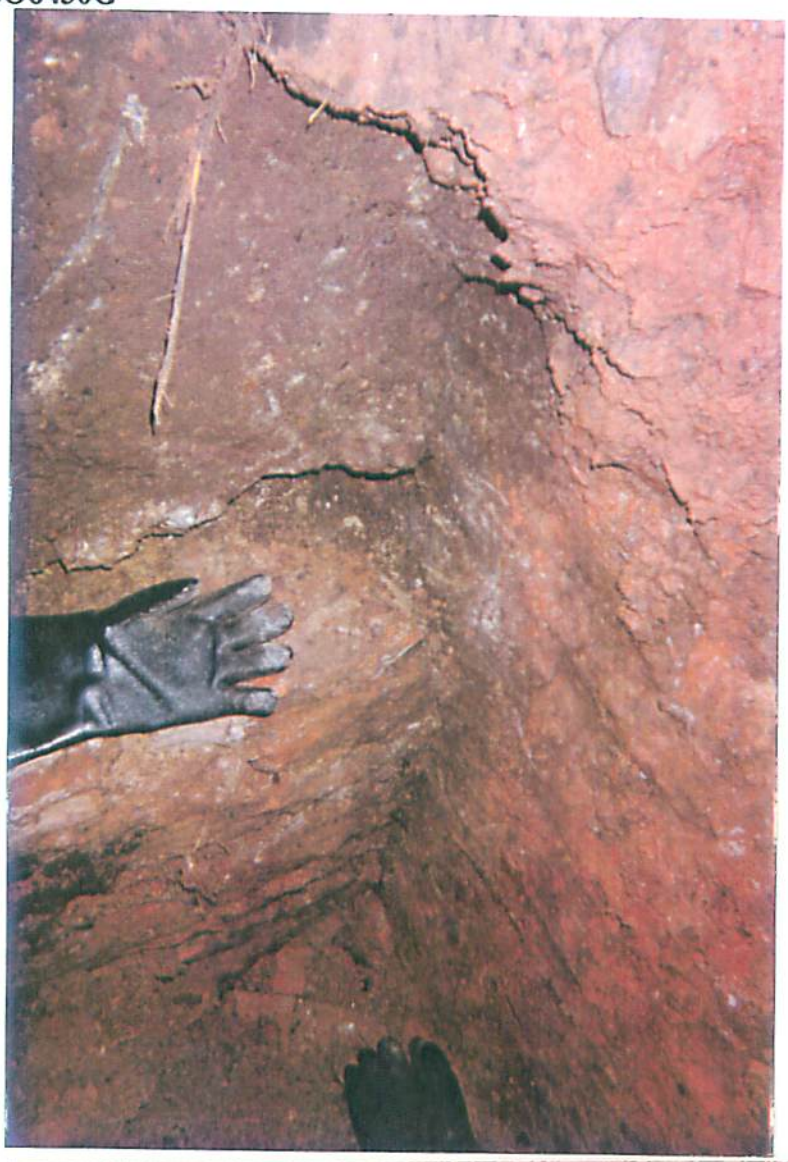
Excavation of Test Pit Adjacent to the Exterior Stairwell



PHOTOGRAPH #12

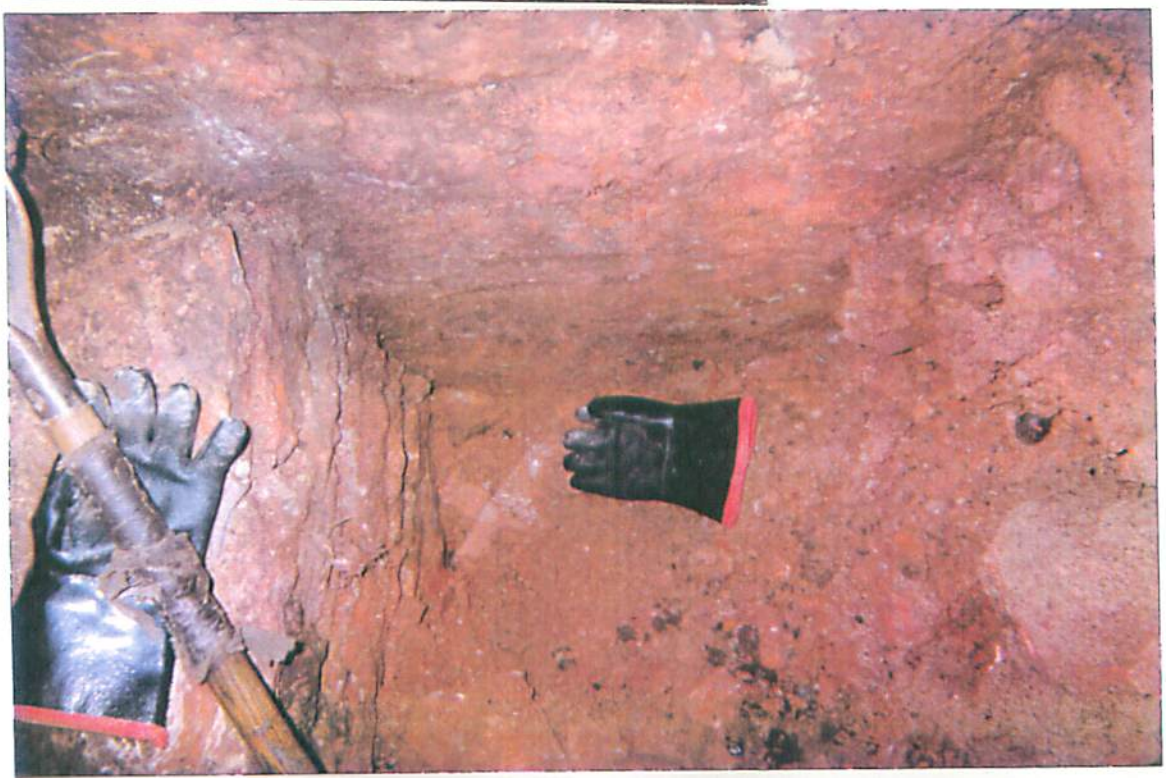
Test Pit with the Exposed Building's and Stairwell's Foundation Wall

Trow



PHOTOGRAPH #13 & #14

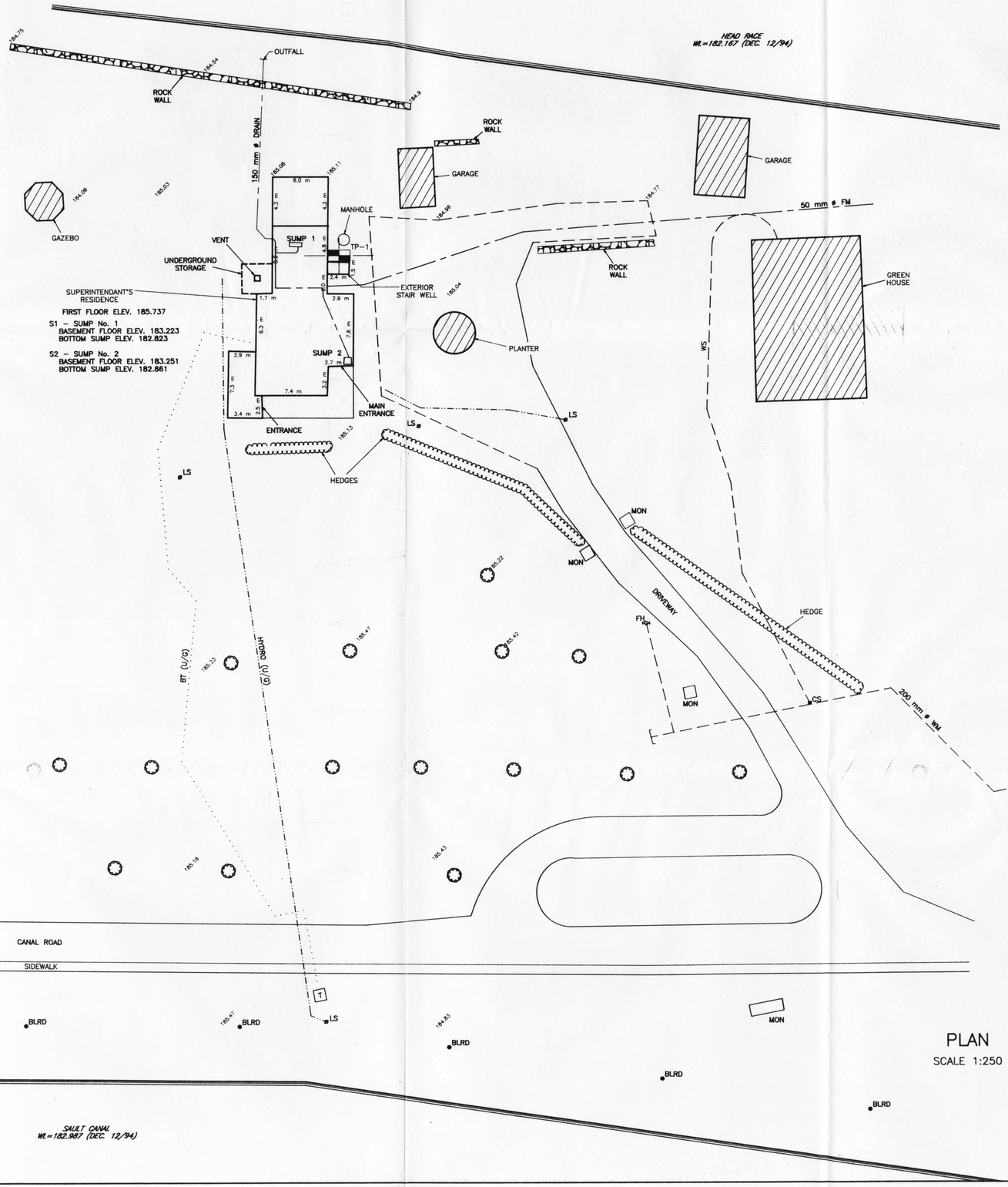
Test Pit
(Note the water seepage at the bottom of the pit)



PHOTOGRAPH #15 & #16

Sandstone Masonry Wall along the Canal

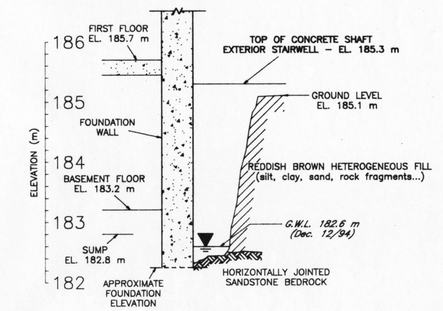
(Note the damage on the wall around the water level)



PLAN
SCALE 1:250

LEGEND

- TEST PIT
- LS LIGHT STANDARD
- MON MONUMENT
- 185.11 GROUND SURFACE ELEVATION
- FH FIRE HYDRANT
- TREE



TEST PIT
SCALE 1:50

Trow
GEOTECHNICAL EVALUATION

SUPERINTENDENT'S RESIDENCE
SAULT CANAL
SAULT STE. MARIE, ONTARIO

PROJ. No. S06430G	DATE: DECEMBER 1994	DWG. No. 1