GEOLOGY OF THE NIPAWIN DAM SITE (AXIS NO. 5) AREA AND A PROPOSAL FOR ADDITIONAL STUDIES

GEOLOGY OF THE NIPAWIN DAM SITE
E.A. CHRISTIANSEN CONSULTING LTD.
Box 3087, Saskatoon, Saskatchewan
S7K 3S9

Report 0035-001

for

CRIPPEN ACRES LIMITED
491 Portage Avenue
Winnipeg, Manitoba
R3B 2E4

May 2, 1979

E. A. Christiansen Consulting Ltd.
CONSULTING GEOLOGIST
BOX 3087
SASKATOON, SASKATCHEWAN, CANADA
S7K 3S9
PHONE 374-6700

May 2, 1979

Crippen Acres Limited
491 Portage, Avenue
Winnipeg, Manitoba
R3B 2E4

Attention: Mr. John McPherson

Dear Mr. McPherson:

Enclosed is a copy of Report 0035-001 on the "Geology of the Nipawin Dam Site (Axis No. 5) area and a proposal for additional studies". If you have any queries, please contact me.

Enclosed is also my Statement of Charges for work done on this report and copies of water analyses from the Swan River Group and the Viking Formation.

Sincerely yours,

E.A. Christiansen

SUMMARY

The Ashville Group is the bedrock beneath the proposed Nipawin Dam Site (Axis No. 5). At this site the Group is believed to be composed of a lower silt and clay, a middle sand and silt of the Viking Formation, and an upper silt and clay on which the glacial deposits were laid down. Because the bedrock in the vicinity of this site was glacially eroded, it is anticipated that the bedrock, particularly the upper silt and clay of the Ashville Group, will be slickensided and fractured.

The dam proposed at Axis No. 5 would rest mainly on interbedded till, sand, and gravel of the Floral Formation. Whether these sands and gravels are inter-till with continuity of intratill lenses is not known.

It is proposed to investigate the nature of the Viking and Floral Formations as these relate to the drainage of excess pore pressures and to examine particularly the upper silt and clay of the Ashville Group for slickensides and fractures. It is proposed to accomplish these objectives by test drilling and electric logging and examining cores from Crippen Acres drill holes along with carbonate, grain size, and X-ray diffraction analyses.

LIMITATIONS

The Saskatchewan Research Council (SRC) geological logs, except for SRC Armley, are based on sidehole cores, cutting samples, and electric logs and are believed to represent the geology at a specific site at the time studied. The other geologic logs (Samburg and Armley) are based on cutting samples and electric logs only which makes this information less reliable. The oil and mining company information is in the form of electric logs only and was used primarily for identifying the bedrock surface and bedrock deposits. The contact between glacial deposits, which was determined from geological logs, was projected through the most likely depth in the electric logs. The Crippen Acres logs were used to identify the bedrock surface and the Surficial Silt and Clay and Surficial Sand and Silt.

Straight lines drawn between adjacent logs in cross sections are to guide the eye from contacts in one log to another and do not represent the actual contact between geologic units nor do they imply the nature of these units is the same as at the actual sites where the information was obtained. Curved lines in cross sections represent the available geologic models that best fit the geologic information available at the time the cross sections were drawn. These lines do not necessarily represent the actual contacts between geologic units nor do they necessarily imply that the nature of these units is the same as at the sites where the information was obtained. Similarly, contour lines on the bedrock surface represent the available geologic models that best fit the information available at the time they were drawn. The degree of confidence of such interpretations will depend on the quality and quanity of information, the location of which is shown on the map and cross sections.

TABLE OF CONTENTS

Illustrations

Appendices

1. INTRODUCTION

1.1 Terms of Reference

This investigation was authorized by letter April 18, 1979 from Mr. W.R. McKay, Vice-President and General Manager, Crippen Acres Limited and by Mr. John McPherson who requested a report on the geology of the bedrock and glacial deposits of the Nipawin Dam Site (Axis No. 5) area and a proposal for further investigation of the following.

(1) Stratigraphy of the bedrock deposits to establish the geological framework for drainage of permeable sediments in the upper part of these deposits.

(2) Nature and geological processes by which the Ashville Group and possibly the upper part of the Swan River Group might be disturbed.

(3) Stratigraphy of glacial tills to establish the continuity of tills and intertill deposits which would serve as a geological framework for drainage of these sediments.

1.2 Location

The Nipawin Dam Site (Axis No. 5) is about three miles south of Nipawin (Figs. 1,2) on a meander of the Saskatchewan River in Section 18, Township 50, Range 14, West of the Second Meridian.

1.3 Previous Work

The geology of the bedrock and glacial deposits for the Nipawin Bridge (Fig. 2) was investigated by Christiansen and Meneley (1969). In this study, geological cross sections based on core descriptions, electric logs, and the carbonate content of tills were constructed for both proposed routes 2 and 5.

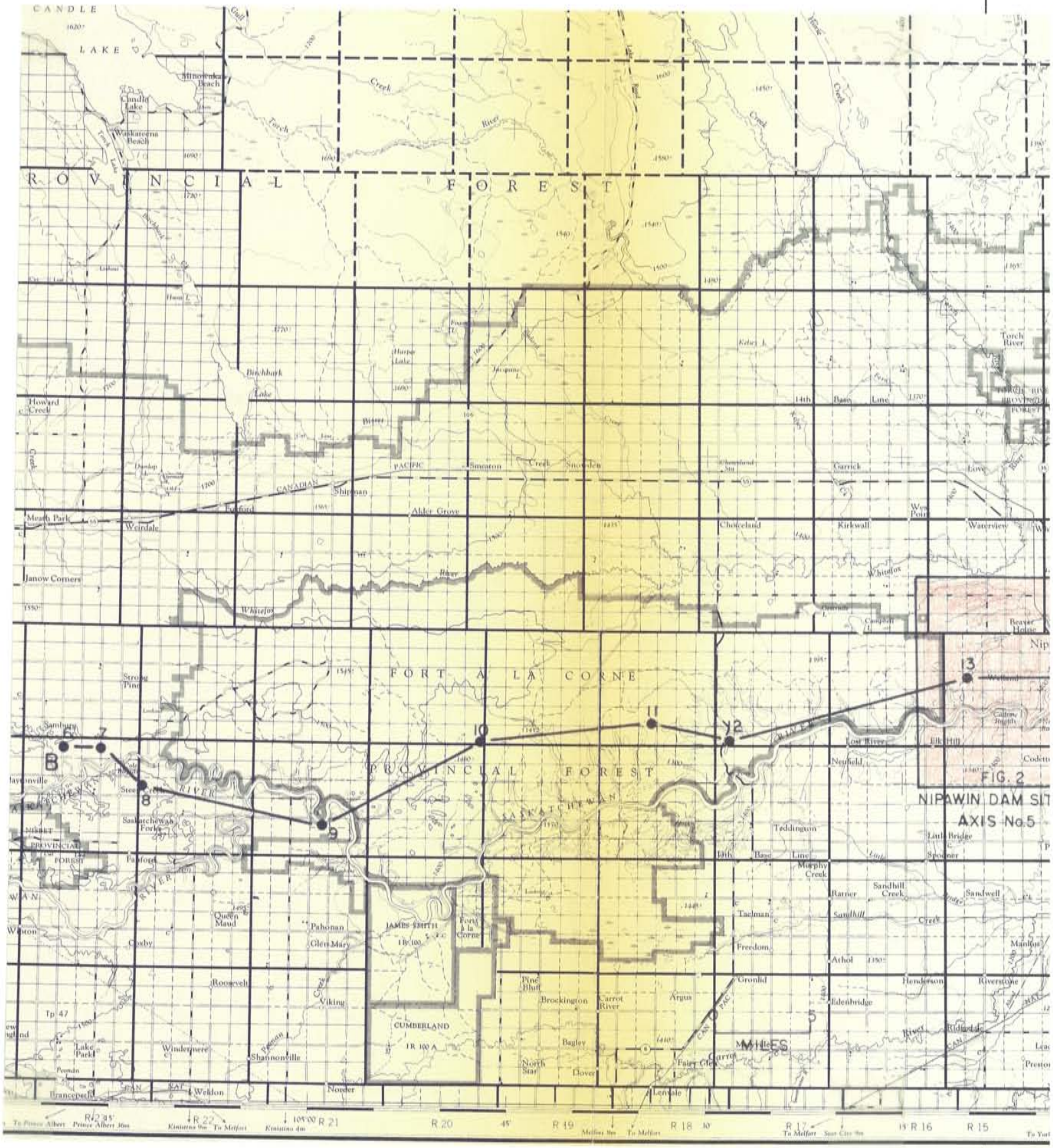


Figure 1. Map showing location of Nipawin Dam Site, Cross Section BB', and Figure 2.

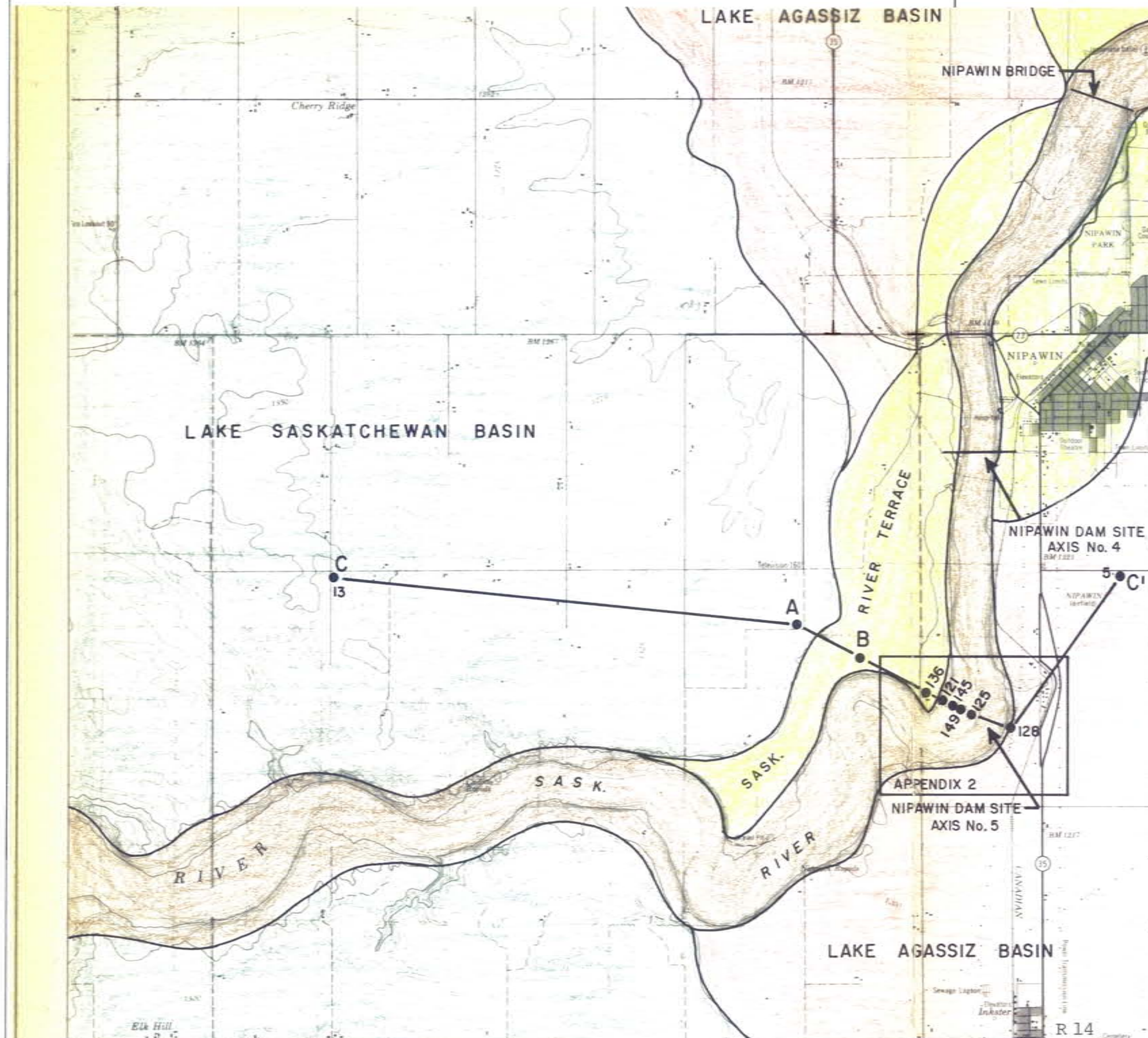


Figure 2. Map showing location of Nipawin Dam Site Axis Nos. 4 and 5, Cross Section CC', proposed Testholes A and B, and Appendix 2.

The geology of the bedrock and glacial deposits of the Nipawin area was further investigated by Christiansen (1973) who prepared a map showing the bedrock geology and topography and who divided the glacial deposits into mainly till, surficial silt and clay, and surficial sand and silt. Cross section BB' on this map crosses the Saskatchewan River at Axis No. 4 of the formerly proposed dam site which is about two miles north of the presently proposed site (Fig.2).

The history of the last deglaciation of southern Saskatchewan and adjacent areas including the Nipawin area was prepared by Christiansen (1979). This publication deals with the history and origin of the surficial stratified drift which covers the uplands adjacent to the Saskatchewan River near Nipawin.

Geological and electrical logs from the Saskatchewan Research Council (SRC); the Family Farm Improvement Branch (FFIB), Saskatchewan Agriculture; and oil and mining companies along with drill hole logs from Crippen Acres provided the subsurface information for this study.

1.4 Present Study

Two regional cross sections (Drawings 0035-001-01,02) and a more detailed cross section through the Nipawin Dam Site (Drawing 0035-001-03) were constructed. The regional cross sections provide the regional geological framework, whereas the more detailed one focuses on the geology of the dam site. These cross sections were constructed by taping matte positive logs on the cross section paper which enabled the geologist to have all of the information before him when making his interpretations and to show the reader the basis for these interpretations.

A map of the bedrock topography of the west half of 63E-5 and the east half of 73H-8 is shown in Drawing 0035-001-04.

2. BEDROCK STRATIGRAPHY

2.1 Introduction

The relationship of the regional bedrock stratigraphy to the Nipawin area is shown in Drawing 0035-001-01. These bedrock deposits include: Paleozoic Sediments, Swan River and Ashville Groups, and the Lea Park Formation and Upper Colorado Group.

2.2 Paleozoic Sediments

The Paleozoic Sediments are composed mainly of limestone, dolomite, and red shales. The upper contact of these sediments represents the base of geological exploration for the Nipawin Dam Site.

2.3 Swan River Group

Near the Nipawin Dam Site (Drawing 0035-001-01, Testhole 5; Appendix 4), the Swan River Group is composed of a lower predominantly sand unit and an upper interbedded sand and silt unit. Drawings 0035-001-02 and 03 suggest that these units occur under the dam site. The Swan River Group overlies the Paleozoic Sediments disconformably in the Nipawin area.

2.4 Ashville Group

According to Jones (1961), the Lower Colorado shale, which occurs between the Blairmore Formation and the Second White Speckled Shale of the Upper Colorado Group in southwestern Saskatchewan, is separated into two shale units by the Viking Formation. In the Nipawin area, the Lower Colorado Group is called the Ashville Group, and the Blairmore Formation is called the Swan River Group. Because the Viking Formation of Jones (1961) is similar in stratigraphic position and lithology to the intra-Ashville sand and silt unit in the Nipawin area (Drawing 0035-001-01), this Formation has been extended to the study area (Drawing 0035-001-01). Moran and Whitaker (1969) also mapped the intra-Ashville sandy unit in Testhole 2 (Drawing 0035-001-01) as Viking Formation. Because Christiansen (1973) encountered this sand in only the Nipawin part of the Prince Albert map region, he assigned the sand to the Swan River Group. According to testhole 5 (Drawing 0035-001-01, Appendix 4), the Ashville Group is composed of a lower, gray, noncalcareous silt; a middle, interbedded, silty, gray, pyritic, fine-grained sand and gray, noncalcareous silt with concretionary zones (Viking Formation); and an upper gray, non-calcareous clay with glauconitic zones.

2.5 Lea Park Formation and Upper Colorado Group

The Lea Park Formation and Upper Colorado Group is not present in the Nipawin area. Farther south, however, this unit is composed of lower calcareous, white speckled shales and an upper noncalcareous silt and clay (Drawing 0035-001-01).

3. BEDROCK SURFACE TOPOGRAPHY

The bedrock surface of the Prince Albert region, which includes the Nipawin area, forms a broad, featureless plain between uplands to the north and south of the region (Christiansen, 1973). In the Nipawin area, the broad plain exhibits relief of about 60 feet (Drawing 0035-001-04). The bedrock surfaces of the Prince Albert region and the Nipawin area are believed to be the result of glacial erosion which will be considered in more detail in Chapter 5.

4. GLACIAL STRATIGRAPHY

4.1 Introduction

The glacial deposits in the Nipawin area were divided into the Sutherland and Saskatoon Groups, the latter of which was subdivided into the Floral and Battleford Formations and Surficial Stratified Drift.

4.2 Sutherland Group

The Sutherland Group, which was named by Christiansen (1968b), is composed of up to 100 feet of till (Drawing 0035-001-02). The till is less calcareous and has a lower electrical resistance than the tills of the Saskatoon Group (see electrical logs and carbonate curves on the electric logs in Drawing 0035-001-02). Where the weathered zone in the upper part of the Sutherland Group is preserved (Testholes 6,8,10; Drawing 0035-001-02), the till has a unique olive-gray color with yellowish-brown staining and gypsum crystals. Gray, unoxidized till rests directly on gray, unoxidized bedrock in the western part of Drawing 0035-001-02.

4.3 Saskatoon Group

4.3.1 Introduction

The Saskatoon Group, which was named by Christiansen (1968b), is composed of the Floral and Battleford Formations and Surficial Stratified Drift. In the Nipawin area, the Saskatoon Group ranges in thickness from 0 to 450 feet.

4.3.2 Floral Formation

The Floral Formation, which was named by Christiansen (1968b), is composed of 0 to 200 feet of till, sand, and gravel. Where the weathered zone in the upper part of the Formation is preserved, the deposit is hard and jointed with yellowish-brown staining on the joint surfaces. The lower contact is disconformable with the Sutherland Group.

4.3.3 Battleford Formation

The Battleford Formation, which was named by Christiansen (1968a), is composed of a lower, hard till and an upper, soft till (Drawings 0035-001-02,03). The lower till is 0 to 100 feet thick and is gray massive, and sugary in appearance. The lower till has a lower carbonte content that the underlying Floral Formation and the overlying upper till of the Battleford Formation (Drawings 0035-001-02,03).

The upper till of the Battleford Formation is composed of 0 to 20 feet of soft, massive till which has a much higher carbonate content that the underlying lower till. The unconsolidated nature of the upper till and its conformable contact with the overlying Surficial Silt and Clay suggest this unit is an ablation till released from the glacier during melting. The upper till was encountered only in Testholes 5 and 13 (Drawing 0035-001-02,03) and probably represents a local re-advance during the last deglaciation.

4.3.4 Surficial Stratified Drift

The Surficial Stratified Drift in the Nipawin area, which is up to 180 feet thick, was deposited in Lake Saskatchewan and Lake Agassiz (Fig. 2). The Surficial Stratified Drift in the Lake Saskatchewan Basin is composed of a lower Surficial Silt and Clay and an upper Surficial Sand and Silt (Drawings 0035-001-02,03), whereas the Surficial Stratified Drift in the Lake Agassiz Basin is composed of a lower and upper Surficial Silt and Clay and a lower and upper Surficial Sand and Silt (Drawing 0035-001-03). Exposures along the Saskatchewan River west of the Nipawin airport indicate at least part of the uppermost sand in Testhole 5 (Drawing 0035-001-03, Appendix 4) is of wind-blown origin.

Christiansen (1979) showed that most of the Surficial Stratified Drift in the Lake Saskatchewan Basin in the Nipawin area was derived from the North and South Saskatchewan Rivers and that most of the Surficial Stratified Drift in the Lake Agassiz Basin in the Nipawin area was derived from the Saskatchewan River. Christiansen (1979) also demonstrated that the Surficial Stratified Drift was deposited primarily be the process of "regressive offlap".

Where the North and South Saskatchewan Rivers entered Lake Saskatchewan at Fort a la Corne, for example, deltaic sands were deposited and lacustrine silts and clays were deposited probably as far east as Nipawin. When the lake level fell to about 1250 feet and Lake Agassiz came into existence, a new delta was formed at Nipawin where the Saskatchewan River emptied into Lake Agassiz (Fig. 3). These deltaic sands were laid down on the previously

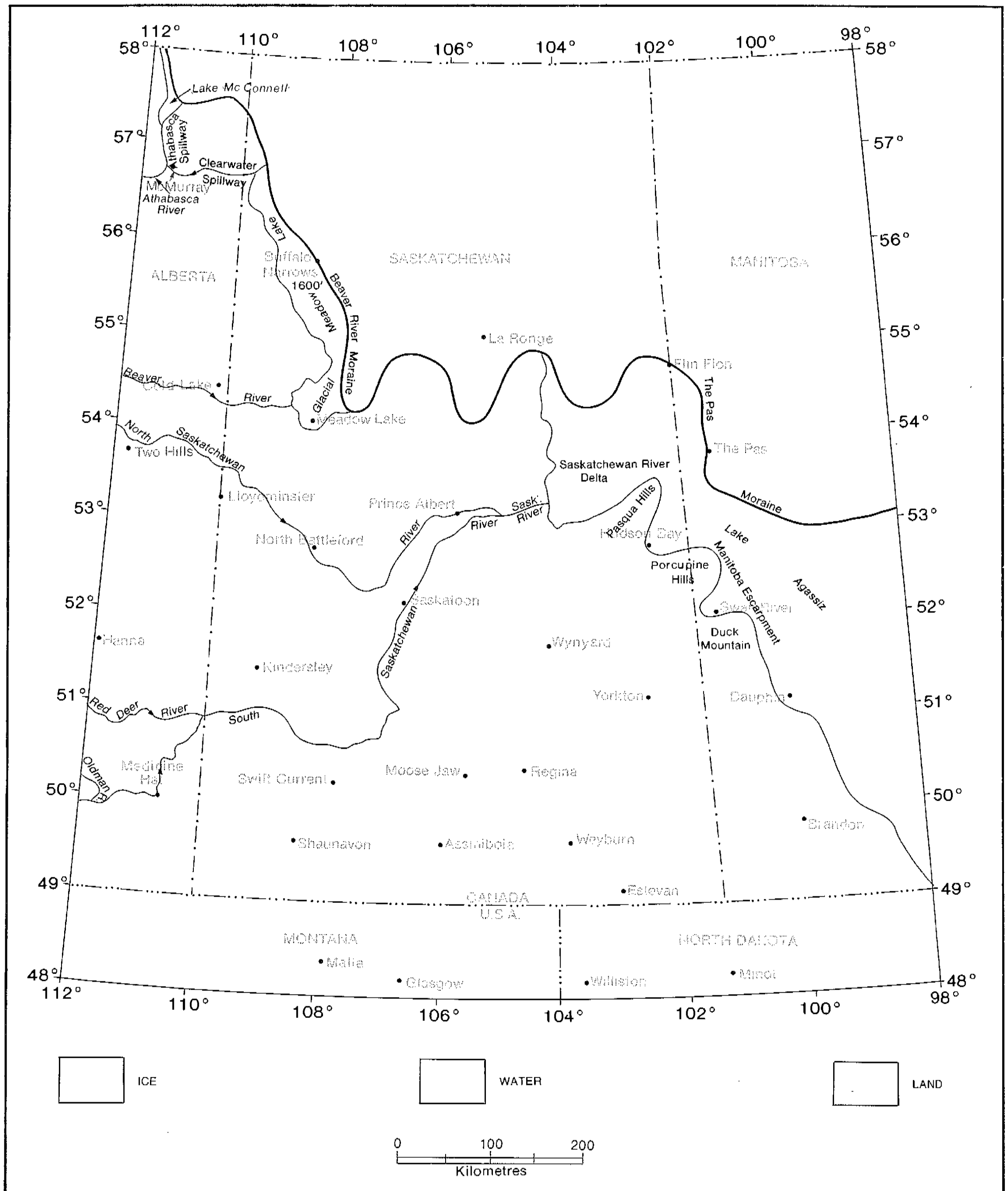


Figure 3. Saskatchewan River Delta forming where the Saskatchewan River emptied into Lake Agassiz about 11,000 years ago. From Christiansen (1979). Nipawin is on this Delta.

deposited silt and clay by the process called regressive offlap. The upper Surficial Silt and Clay and its sand cover may represent a rise in the level of Lake Agassiz in response to a re-advance of the glacier followed by a decline in the lake level as the ice receded.

5. GLACIAL EROSION

Because glacial erosion is believed to have been an important process in the origin of the bedrock and till surfaces and may have affected the shear resistance of the upper part of the bedrock, this process will be considered herein.

Christiansen (1971) concluded that the tills in southern Saskatchewan were derived from the progressive stripping of bedrock by glacial erosion. The fact that the upper part of the bedrock is unweathered in the Nipawin area suggests that the weathered zone must have been removed by glacial erosion prior to the deposition of the Sutherland Group.

According to Christiansen and Whitaker (1976), glacial erosion is accomplished mainly by by glacial thrusting. Glacial thrusting occurred near the margin where drift and/or bedrock were eroded from the base of the glacier and carried upward along diverging flowlines (Fig. 4). This model explains the origin of the upward facing concave surfaces shown in Drawing 0035-001-02; explains the absence of the lower till of the Battleford Formation east of the Saskatchewan River south of Nipawin (Drawings 0035-001-02,03); and explains the eroded depression in the bedrock surface near Nipawin (Drawing 0035-001-04).

Beneath an ice-thrust depression south of Prince Albert, the upper 100 feet of bedrock exhibits slickensides and fractures (Fig. 5). The frequency of these structures diminishes with depth into bedrock.

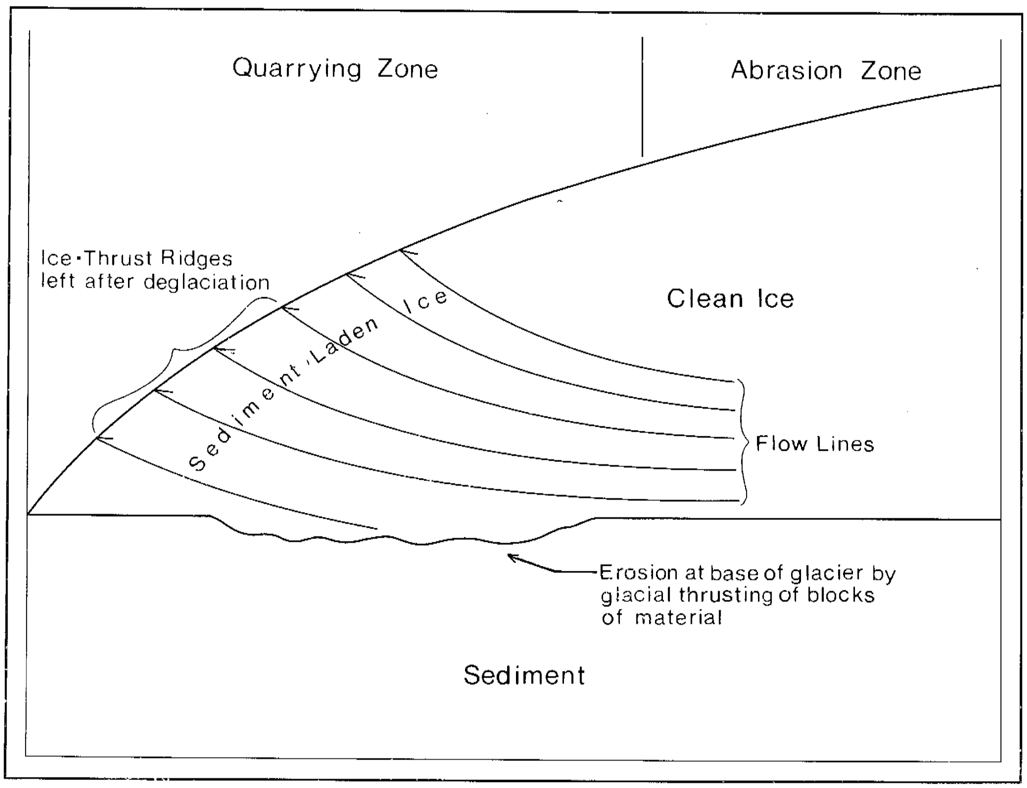


Figure 4. Schematic diagram showing the process of glacial thrusting.
From Christiansen and Whitaker (1976).

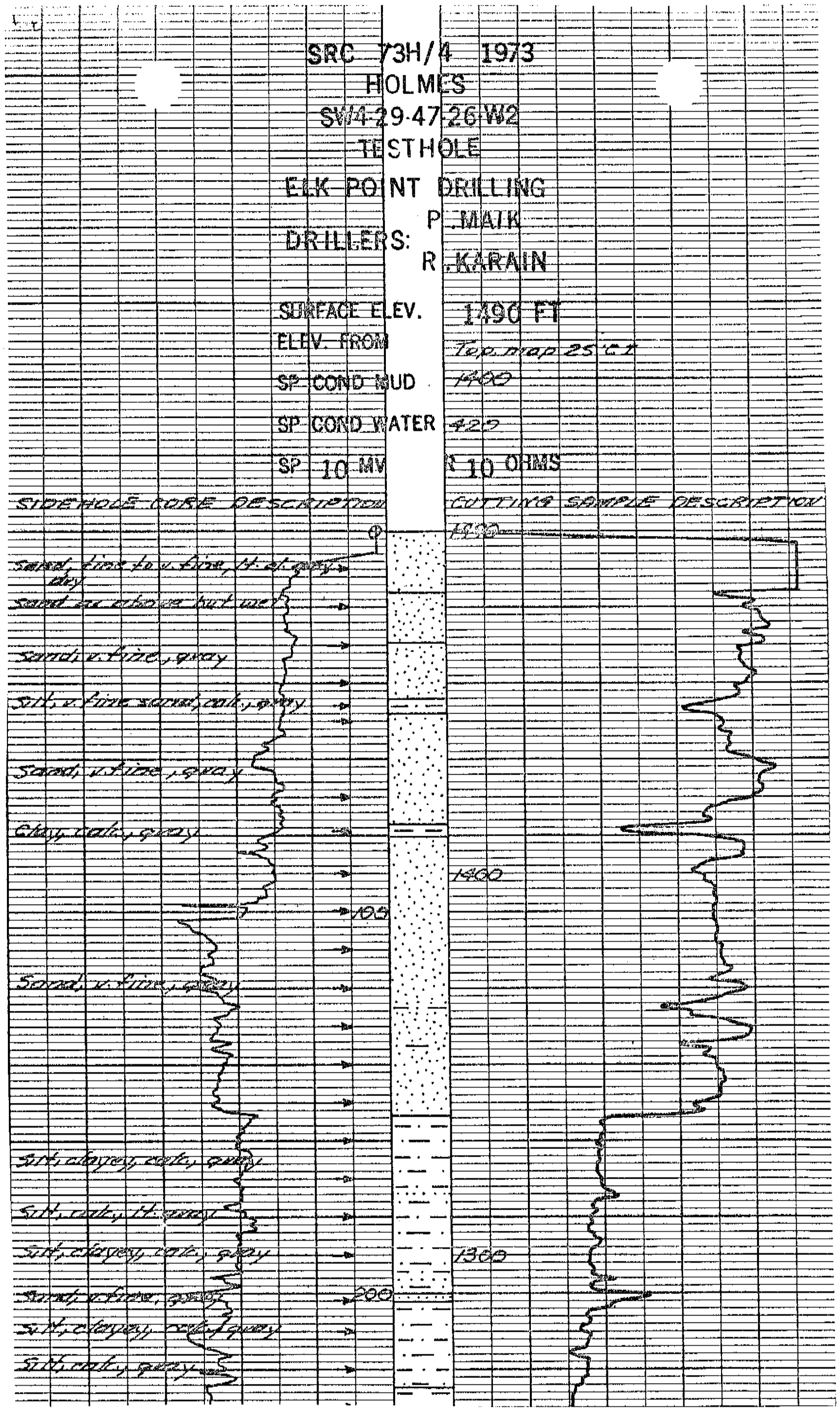


Figure 5. Log of testhole in ice-thrust depression near Prince Albert.
Log continued on next page.

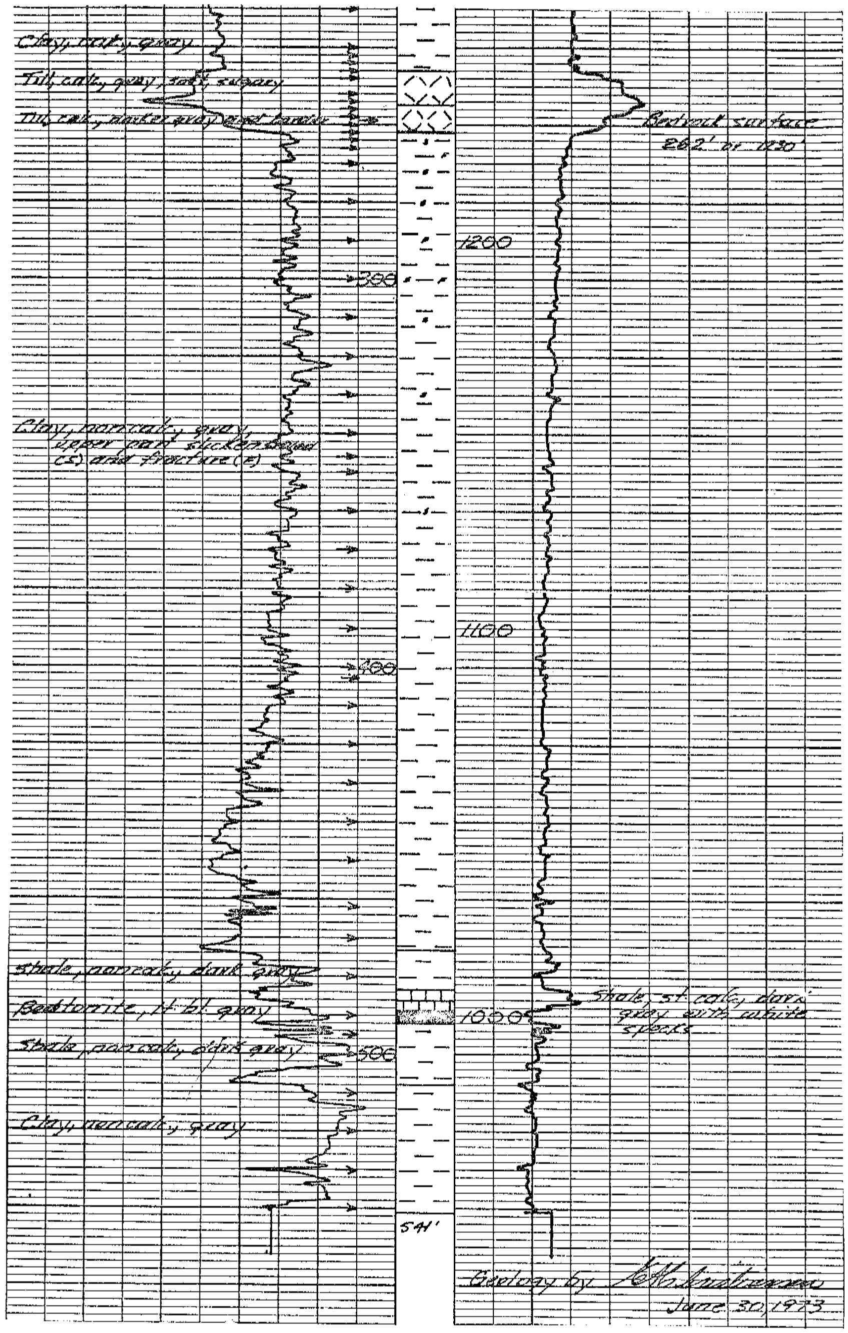


Figure 5. Log continued from page 13. "S" and "F" in log denotes slickensides and fractures in bedrock.

These slickensides and fractures are believed to have formed by movements when the depression was being formed by ice thrusting. The diminishing number of slickensides with depth into bedrock beneath the surface of the ice-thrust depression is attributed to a diminishing stress field inposed by the glacier.

6. GEOTECHNOLOGY

6.1 Introduction

The Terms of Reference call for consideration of the following problems in the Nipawin Dam Site area: (1) bedrock stratigraphy as it relates to drainage of excess pore pressure, (2) geological prosesses which may affect the strength of the bedrock, and (3) continuity of tills and intertill sands and gravel as they relate to drainage of excess pore pressure.

6.2 Bedrock Stratigraphy

The Viking Formation is the uppermost bedrock sand in Testholes 11 and 5 (Drawing 0035-001-02),and because of the continuity of this Formation in Saskatchewan and Alberta, is is likely to be present beneath the Nipawin Dam Site area. Acquisition of additional information on the lithology of this Formation beneath the dam site is proposed.

6.3 Geological Process Affecting Strength of Bedrock

Glacial erosion by thrusting may have affected the strength of the bedrock silts and clays. The evidence cited above strongly suggests the bedrock surface in the Nipawin area was glacially eroded with the formation of a glacially eroded depression in the Nipawin Dam Site area (Drawing 0035-001-04). Because of such glacial erosion, slickensides and fracturing are anticipated in the upper silt and clay unit of the Ashville Group. Most of the deformation is expected in this silt and clay because of its relative low shear resistance and its proximity to bedrock surface which was the main shearing surface. To establish whether the upper bedrock was disturbed by glacial thrusting, examination of core and test drilling is proposed.

6.4 Glacial Stratigraphy

Drawing 0035-001-02 and 03 suggest a dam at Axis No. 5 would be built mainly on the Floral Formation which is an interbedded till, sand, and gravel. From existing information, it is not possible to establish whether the sands and gravels in this Formation have continunity. To establish whether such continuity exists, test drilling, electric logging, and carbonate analyses are proposed.

7.3 Costs

1. Test drilling and electric logging*		
a. Mobilization-Watrous to Nipawin and return-500 miles @ $3.50 --------------------	$	1750.00
b. Test drilling and electric logging 2080 feet (Drawing 0035-001-03) plus 420-foot contingency = 2500ft. @ $2.50 -------		6250.00
c. Power, sustenance, additives, cementing of Testhole D and supplying trailer for geologist -----------------------------------		2000.00
		10000.00
Handling charge of 5% if contractor is paid by E.A. Christiansen Consulting Ltd. -----		500.00
		10500.00
2. Professional fees		
a. Examine core from drill holes 136,121, 145,149,125, and 128 - 30 hrs. @ $50.00 -----		1500.00
b. Travel Saskatoon to Nipawin and return, locate sites, supervise test drilling and electric logging, compile logs-100 hrs. @ $50.00 ------------------------------------		5000.00
c. Preparation of report 60 hrs. @ $50.00 ------		3000.00
		9500.00
3. Laboratory Analyses		
a. Carbonate analyses of core and cuttings of tills-200 @ $10.00 ----------------------		2000.00
b. Grain size analyses of bedrock-10 @ $20.00 --		200.00
c. X-ray diffraction of bedrock-10 @ $10.00 ----		100.00
		2300.00
4. Other expenses		
a. Sustenance and travel - 13 days @ $100.00		1300.00
b. Photo mechanical and drafting for report ----		1000.00
		2300.00
Total		24600.00
Contingency 10%		2460.00
		27060.00

* Price quoted from Hayter Drilling Ltd. with Carl Higgins as driller (Appendix 5).

8. LITERATURE CITED

Christiansen, E.A. 1968a. A thin till in west-central Saskatchewan, Canada. Canadian Journal of Earth Sciences, v. 5, p. 329-336.

Christiansen, E.A. 1968b. Pleistocene stratigraphy of the Saskatoon area, Saskatchewan, Canada. Canadian Journal of Earth Sciences, v. 5, p. 1167-1173.

Christiansen, E.A. 1971. Tills in southern Saskatchewan, Canada. *In* Till. *Edited by* R.P. Goldthwait. Ohio State University Press, p. 167-183

Christiansen, E.A. 1973. Geology and groundwater resources of the Prince Albert area (73H), Saskatchewan. Saskatchewan Research Council, Geology Division, Map 15.

Christiansen, E.A. 1979. The Wisconsinan deglaciation of southern Saskatchewan and adjacent areas. Canadian Journal of Earth Sciences (in press).

Christiansen, E.A. and Meneley, W.A. 1969. Geology and hyrology of proposed bridge routes 2 and 5, near Nipawin. Saskatchewan Research Council, Geology Division for the Saskatchewan Department of Highways.

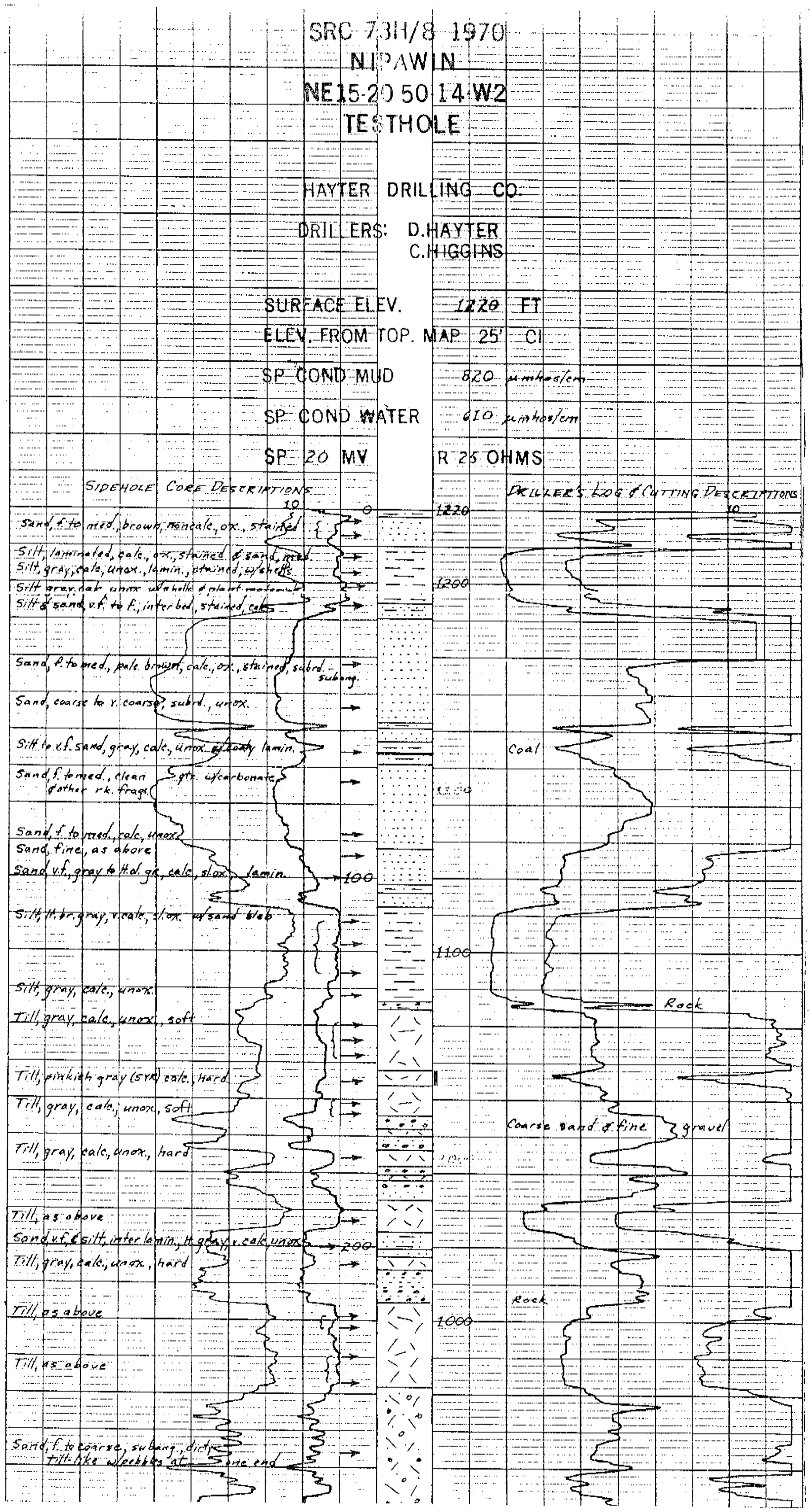
Christiansen, E.A. and Whitaker, S.H. 1976. Glacial thrusting of drift and bedrock. *In* Glacial Till. *Edited by* R.F. Legget Royal Society of Canada, Special Publication 12, p. 121-130.

Jones, H.L. 1961. The Viking Formation in southwestern Saskatchewan. Saskatchewan Department of Mineral Resources, Report 65.

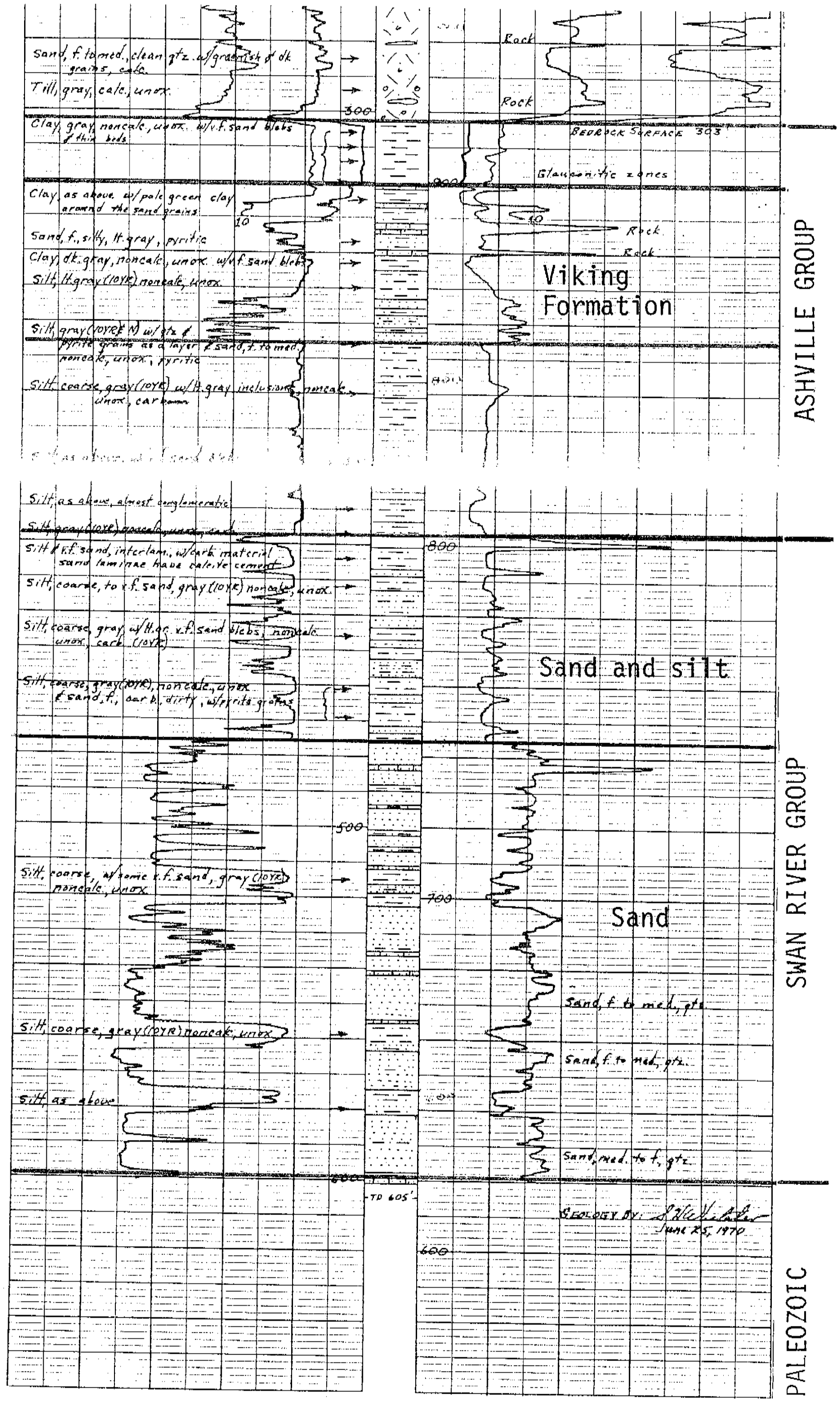
Moran, S.R. and Whitaker, S.H. 1969. Geology and groundwater resources of the Hudson Bay area (63C,D), Saskatchewan. Saskatchewan Research Council, Geology Division, Map 8.

APPENDIX 1. NAME AND LOCATION OF LOGS.

Log No.	Name	Location
1	BA Boxall	1-10-46-15-W2
2	SRC Runciman	SW4-17-46-14-W2
3	SRC Armley	NW12-14-47-14-W2
4	Pinkney #2 Petrocan	12-16-50-14-W2
5	SRC Nipawin	NE15-20-50-14-W2
6	EPD Samburg	NW13-33-49-23-W2
7	Midwest Prince Albert	11-35-49-23-W2
8	SRC Cole Rapids	NW13-19-49-22-W2
9	HB Sayese #1	10-10-49-21-W2
10	SRC Fort a la Corne	SE1-1-50-20-W2
11	Imp. Cal. Stan. Fort a la Corne	8-9-50-18-W2
12	SRC Gronlid Ferry	SW7-6-50-17-W2
13	SRC Cadotte Rapids	NW13-20-50-15-W2
14	SDH Nipawin	SW15-9-51-14-W2



Appendix 4. Log of SRC Nipawin NE15-20-50-14-W2 Testhole.
Log continued on next page.



Appendix 4. Log continued from page 23 showing bedrock units.

APPENDIX 5. TEST DRILLING AND ELECTRIC LOG QUOTATION.*

1.	Mobilization	$ 3.50/mile
2.	Test drilling and electric logging	2.50/foot
3.	Extra work	75.00/hour
4.	Standby	60.00/hour
5.	Power	250.00/week
6.	Mud	8.00/50 lbs
7.	Weight material	12.00/100 lbs
8.	Lost circulation material	12.00/bag
9.	Cement	5.50/sack
10.	Sustenance	25.00/man day

* Provided April 26 by Mr. Dale Hayter, Hayter Drilling Ltd., Watrous Saskatchewan by telephone. Written quotation to follow.

GEOLOGICAL FIELD TRIP OF THE NIPAWIN DAM SITE, AXIS NO. 5

by

E.A.CHRISTIANSEN CONSULTING LIMITED
Box 3087, Saskatoon, Saskatchewan
S7K 3S9

Report 0035-002

for

CRIPPEN ACRES LIMITED
491 Portage Avenue
Winnipeg, Manitoba
R3B 2E4

June 4, 1979

ELECTRIC LOGGING

The electric logs of the bedrock and lower drift form Coreholes 168 and 169 agree very well with the SRC Nipawin Testhole (Report 0035-001, Appendix 4, Testhole 5). It is difficult to evaluate the remainder of the electric logs for these coreholes because intervals of suspended casing occur in the drift in both holes.

BEDROCK STRATIGRAPHY

1. The electric logs and core descriptions by Mr. Ray agree very closely indicating the electric log is recording the lithology accurately.
2. The core recovered from the upper clay in the Ashville Group is highly slickensided and appears to be completely remolded. The core recovery in the upper part of this clay, immediately beneath the drift, was poor suggesting that this part of the clay is even more disturbed than the highly slickensided zone mentioned above. Further attempts to sample this zone of poor core recovery should be made.
3. It is recommended that your firm consider placing the production well deeper into the Swan River Group because, according to the SRC Nipawin Testhole (Report 0035-001, Appendix 4, Testhole 5), the Group is more permeable in the lower part. In any case, a testhole should be drilled to limestone and electric logged, and the screened interval should be chosen on the basis of this information.
4. The bedrock geology of the dam site correlates very closely with the regional bedrock geology in Report 0035-001.

GLACIAL GEOLOGY

1. An exposure was examined by Messrs. Smith and Ray and the writer in which two tills, separated by a boulder pavement, were noted.
2. It appears that Crippen Acres upper till is the Battleford Formation

and their middle and lower tills belong to the Floral Formation with their lower till being correlative with the less resistive till at the base of the drift in the SRC Codette Testhole (Report 0035-001, Appendix 4, Testhole 13).

3. It is recommended that the above mentioned exposure and the one on the east bank of the valley be measured, sampled, and surveyed and that the geology of these sections be related to Crippen Acres coreholes and the regional geology shown in Report 0035-001. Total carbonates on at lest 4 samples from each till unit from both exposures are required to establish correlation to the regional geology.
4. The main problem which remains in the glacial stratigraphy is the continuity of the Floral sands and gravels. If weathering zones or lithologic differences do not exist in the Floral tills, it can be assumed that the Formation is composed of a mixture of till, sand, and, gravel which has only limited continuity. If, however, the hydrological test of this Formation which is planned shortly suggests continuity, further stratigraphic studies of this Formation should be undertaken using cutting samples and electric logs to determine the nature of this continuity.

June 4, 1979
Date

E.A. Christiansen
E.A. Christiansen

GEOLOGICAL FIELD TRIP OF THE NIPAWIN DAM SITE, AXIS NO. 5

by

E.A. CHRISTIANSEN CONSULTING LTD.

Box 3087, Saskatoon, Saskatchewan
S7K 3S9

Report 0035-003

for

CRIPPEN ACRES LIMITED

491 Portage Avenue
Winnipeg, Manitoba
R3B 2E4

July 30, 1979

Introduction

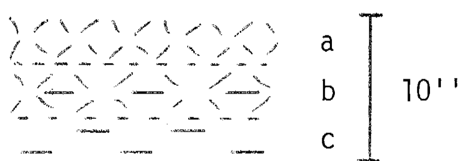
A sample from each zone between 145 and 166 feet in Shaft No.2 (DH 175) was examined. These zones, which were defined by Manuel Reyes, are as follows:

	Depth (Feet)
Bedrock surface --------------------------------	145
Highly plastic clay -----------------------------	145-147
Slickensided in all directions with vertical joints between 152-154 ----------------------------------	147-154
Shale and glauconitic sandstone ------------------	154-166

Description of Samples

The block sample from 145 feet, taken by the contractor for shear strength tests, and the grab samples from 152 and 166 feet, obtained by Manuel Rayes, were examined.

Description of Sample from 145 feet



a. Till, calcareous, dark gray (wet)

b. Till as above and clay, noncalcareous, black (wet) with pebble float, highly slickensided in all directions, appears to be brecciated, but it is difficult to be certain in such highly plastic materials.

c. Clay, noncalcareous, black when wet, slickensided in all directions and appears to be completely remolded.

Interpretation of Sample from 145 feet

The mixing of till and bedrock is common at the contact between glacial and bedrock deposits. Such mixing is typical of glacial thrusting resulting in repetition of till and bedrock. As over-thrusting proceeds, shearing takes place, and slickensides would be expected to form in the clay and mixed clay and till. Although the shear planes would form initially in a nearly horizontal plane, these planes would tend to rotate because of the drag along the shear planes which would explain the many orientations and curvatures of these shearing surfaces.

Description of Sample from 152 feet

This grab sample was taken by Manuel Reyes because of the uniqueness of vertical joints between 152-154 feet. The sample is composed of clay, noncalcareous, black (wet), less plastic and much less slickensided than at 145 feet. The slickensided surfaces are much less shiny and less well developed. When pieces of this sample are broken, the newly exposed surfaces in most cases do not exhibit slickensides.

Interpretation of Sample from 152 feet

This sample is much less slickensided than at 145 feet, and the slickensided surfaces are much poorer developed. Clearly, this sample had not been deformed to the degree suffered by the 145-foot sample. Although the origin of the vertical joints in the zone between 152-154 is uncertain, they may be related to glacial drag as the severity of thusting diminishes.

Description of Sample from 161 feet

This grab sample was taken by Manuel Reyes. The sample is composed of interbedded black, noncalcareous, highly slickensided clay and fine grained, quartzose sand. The slickensides are more planar than above.

Interpretation of Sample from 161 feet

The slickensides in the clay interbeds are more planar than at 145 and 152 feet suggesting that the deformation is less intense resulting in slips without drags and remolding as in the 145-foot sample.

Origin of Slickensides between 145 and 166 feet

The following observations suggest that these sediments were deformed by glacial thrusting:

1. The bedrock surface of the region is glacially eroded (see report 0035-001).
2. The mixed till and clay zone between till and bedrock is slickensided suggesting that the glacial thrusting that formed the mixed zone also formed the slickensides.
3. The dam site is in the southeast flank of an ice-thrust depression (drawing 0035-001-04).

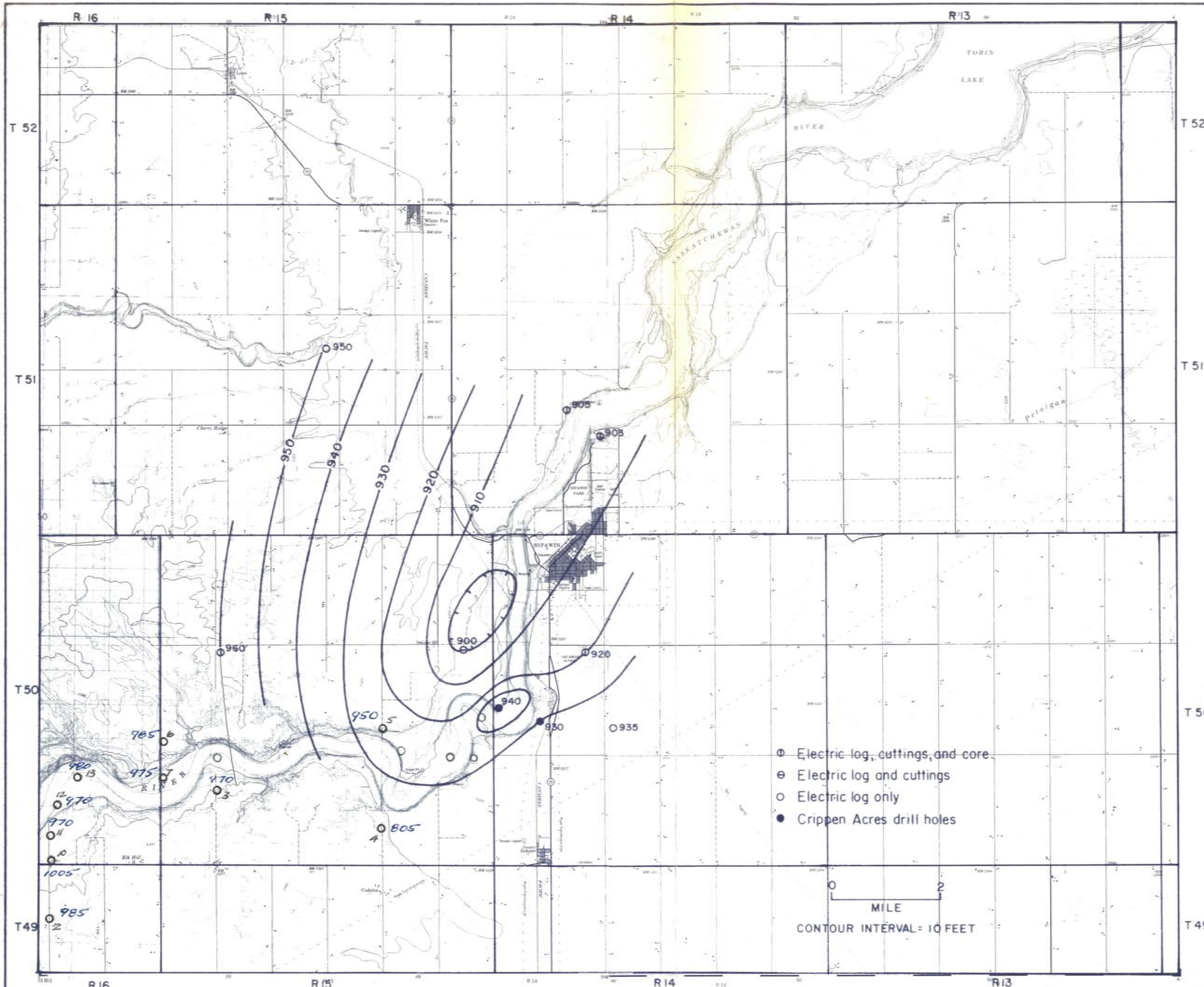
4. The most highly slickensided and deformed sediment is nearest the bedrock surface.
5. Remolding of bedrock such as that exhibited in the 145-147-foot interval requires considerable deformation which, presumably, would require more movement than that provided by the alternate mechanism of rebound.

RECOMMENDATIONS

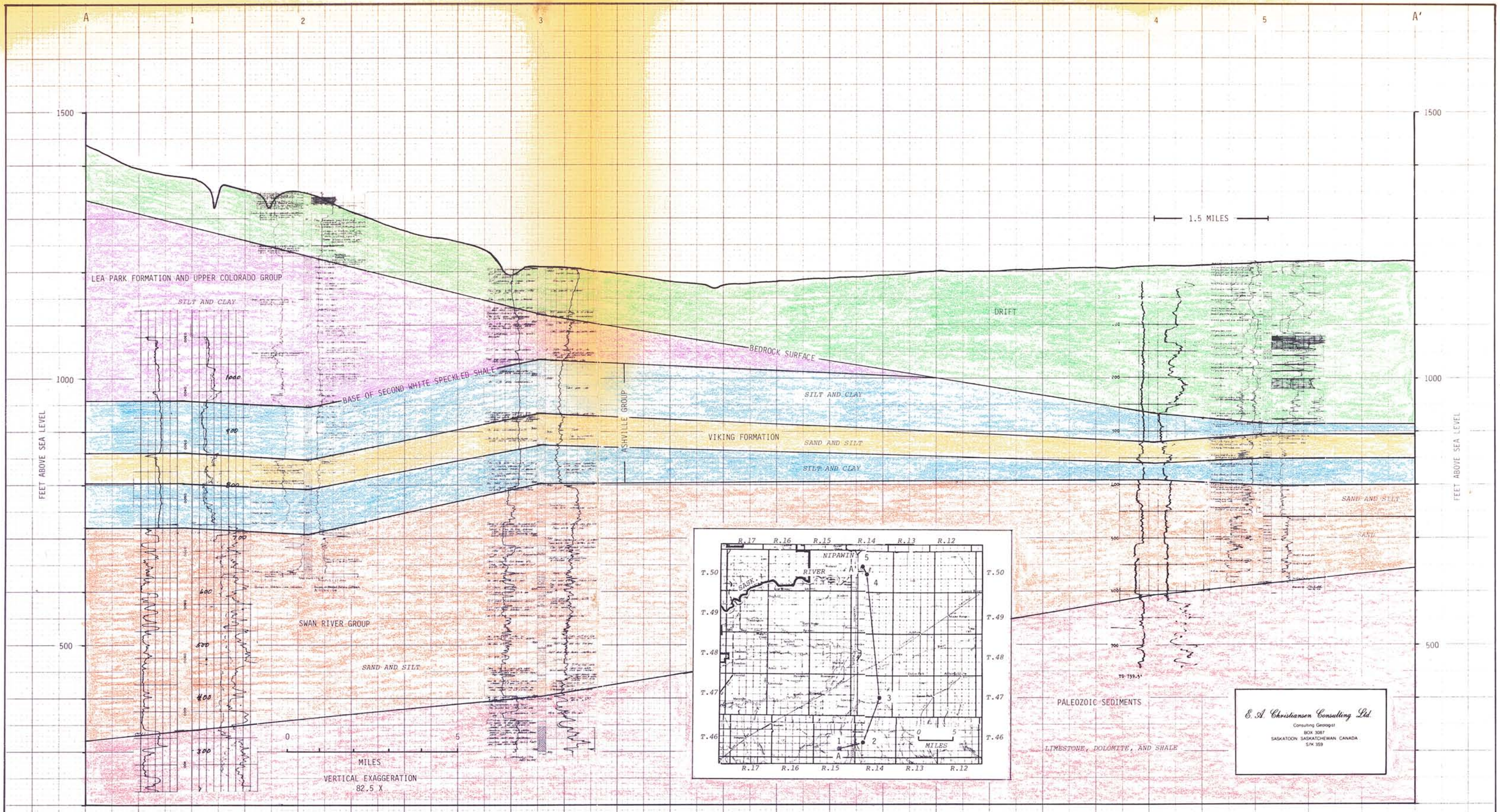
1. Study of samples from 145,152, and 161 feet suggest the degree of slickensiding may be related primarily to the clay content of the bedrock. To test this hypothesis, I recommend that samples at 1-foot intervals between 145 and 166 feet be analysed for grain size and clay mineral content. The less severely slickensided sediment in the 152-foot sample may be less disturbed because of grain size rather than remoteness from the bedrock surface.

2. A cross section should be drawn from the Hayter Well (DH 167), through the west exposure, through the dam site including coreholes,electric logged holes, and Shaft No.2 (DH 175), through the east exposure, and anchored to the SRC Codette and Nipawin testholes. This cross section should be drawn by taping matte positive logs directly on the cross section paper. Such a cross section will tie the site geology to the regional geology, and would serve as a reference during construction.

3. The continuity of sands and gravels still remains as the main problem in the glacial stratigraphy. If this problem is not resolved prior to construction, it must be assumed that continuity may exist. Even if the Floral sands and gravels have limited regional continuity, the continuity at the dam site may be sufficient to cause problems if not detected. Such continuity may not be detected by the pump test recently conducted.



Drawing 0035-001-04. Bedrock topography of the Nipawin area. Base map by Energy, Mines and Resources, Ottawa.



DRAWING 0035-001-01 - CROSS SECTION AA'

1 - SEE APPENDIX 1 FOR NAME AND LOCATION OF LOGS

DRAWING 0035-001-02 - CROSS SECTION BB'
SEE FIGURE 1 FOR LOCATION OF CROSS SECTION.

DRAWING 0039-001-06. CROSS SECTION BB'
REVISED AFTER DRAWING 0035-001-02.

5 - SEE APPENDIX 1 IN REPORT 0035-001 FOR NAME AND LOCATION OF LOGS.

DRAWING 0035-001-03 - CROSS SECTION CC'
SEE FIGURE 2 FOR LOCATION OF CROSS SECTION

A - E PROPOSED TESTHOLES
SEE FIGURE 2 AND APPENDIX 2
FOR LOCATION OF TESTHOLES

5,13 - SEE APPENDIX 1 FOR NAME AND LOCATION OF LOGS
145 - SEE APPENDICES 2 AND 3 FOR LOCATION AND LITHOLOGY OF LOGS