

SASKATCHEWAN WATER CORPORATION  
GEOLOGY ALONG THE SSEWS CANAL  
MANITOU LAKE-DELLWOOD RESERVOIR

Report 0107-001      June 7, 1985



*E. A. Christiansen Consulting Ltd.*

CONSULTING GEOLOGIST

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June 7, 1985

Saskatchewan Water Corporation  
Box 310  
WATROUS, Saskatchewan  
S0K 4T0

Attention: Mr. W.E. Randall, Operations Manager, Water Supply Utility

Dear Mr. Randall:

Enclosed are six copies of Report 0107-001 on the "Geology along the SSEWS Canal, Manitou Lake - Dellwood Reservoir". If you have any queries please contact me.

Sincerely yours,

E.A. Christiansen

## SUMMARY

The Empress, Sutherland, and Saskatoon Groups overlie the Lea Park Formation bedrock along the SSEWS Canal between Manitou Lake and the Dellwood Reservoir. The base of exploration for canal seepage studies is the contact between the Floral and Battleford Formations of the Saskatoon Group. The Floral Formation is more clayey, less sandy, harder, and has a higher carbonate content than the Battleford Formation. The top of the Floral Formation, where weathered, is jointed and stained, whereas the Battleford Formation is massive and unstained.

The higher salt content of the upper 10 metres in testholes 02 and 03 is attributed to an aquifer lying between tills of the Sutherland Group and Floral Formation. Future investigations of canal seepage salinity should be done in the framework of the regional salinity conditions.



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## 1. INTRODUCTION AND OBJECTIVE

E.A. Christiansen Consulting Ltd. (EAC) was commissioned by the Saskatchewan Water Corporation (SWC) on May 7, 1985 (Consulting Agreement No. WSU-85A-02) to provide a geological framework along the SSEWS Canal between Manitou Lake and the Dellwood Reservoir. This study represents Phase 1 of the "Proposed seepage investigations, Manitou Lake - Dellwood Reservoir Canal" being conducted by SWC and includes:

- a) locate testhole sites along the Manitou Lake - Dellwood Reservoir supply canal right of way;
- b) drill 4 rotary testholes, collect cutting samples, and run geophysical logs including gamma, spontaneous potential, and point resistivity logs; the testholes will be drilled to a depth of about 250 ft or some lesser depth if a reliable stratigraphic marker can be identified in the field;
- c) describe samples and carry out laboratory carbonate analyses to characterize the physical properties of the till units present;
- d) compile the geological description and soil chemistry data on the geophysical logs of each testhole;
- e) compile a stratigraphic cross-section along the canal to show the correlation between stratigraphic units in the testholes;
- f) prepare a brief summary report characterizing the physical properties of each unit identified and the key characteristics for identifying such units in augerholes;
- g) submit 6 copies of the report and cross section not later than 15 days following completion of the test drilling program; and

h) obtained permission by telephone May 21, 1985 to include soil conductivity and mechanical analyses to identify the lithology and salinity of the sediments.

On April 30, 1985, four testhole sites were staked by Mr. Mart Cram, SWC and E.A. Christiansen, and between May 15 and 17, the four testholes were drilled, sampled, and geophysical logged. The location of the Manitou Lake-Dellwood Reservoir canal and SWC and FFIB logs are shown in Drawing 0107-001-01, and the Longitudinal section A-A' is shown in Drawing 0107-001-02. Photographs of the area and drilling operation are shown in Figures 1-3.

## 2. GEOLOGY

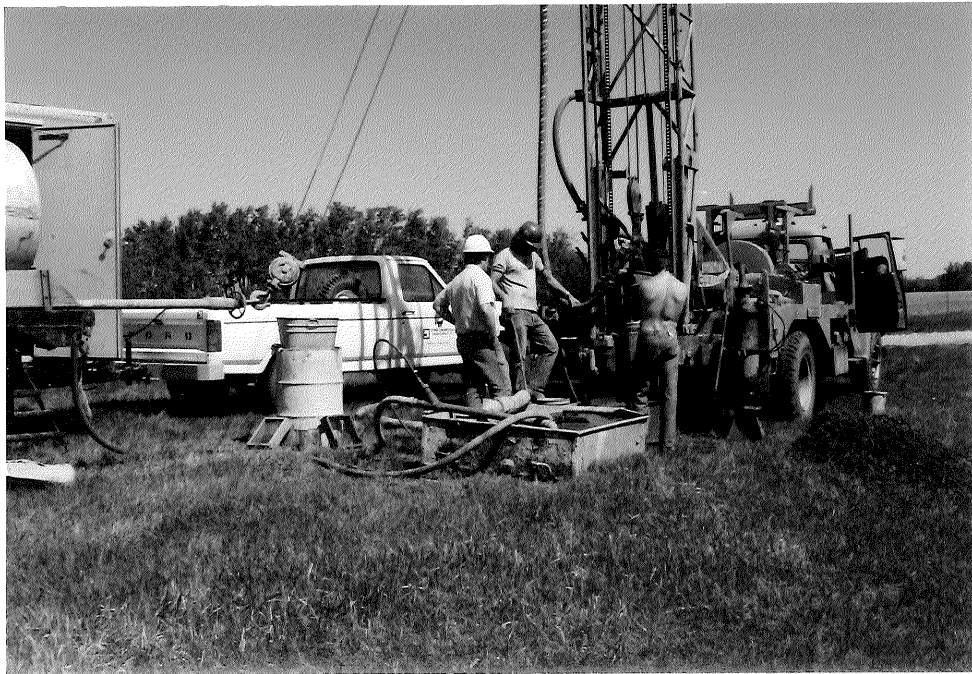
### 2.1 Introduction

Four FFIB logs (Drawing 0107-001-02, A-D) provided the geological framework within which the SWC testholes were drilled. From these FFIB logs, a change in electrical resistance was observed in the upper 30 metres; consequently, testholes 01, 02, 03, and 04 (Appendix 1) were drilled to 36, 31, 30, and 24 metres, respectively instead of a deeper marker bed of about 75 metres.

Contacts in Drawing 0107-001-02 are largely inferred and would require verification if a regional salinity study is conducted. Furthermore, the FFIB logs were projected to the canal; consequently, their position in the section is approximate.



A



B

Figure 1. Test drilling. (A) Test drilling at Site No. 03 along SSEWS Canal.  
Notice salt accumulation in foreground. (B) Test drilling equipment.

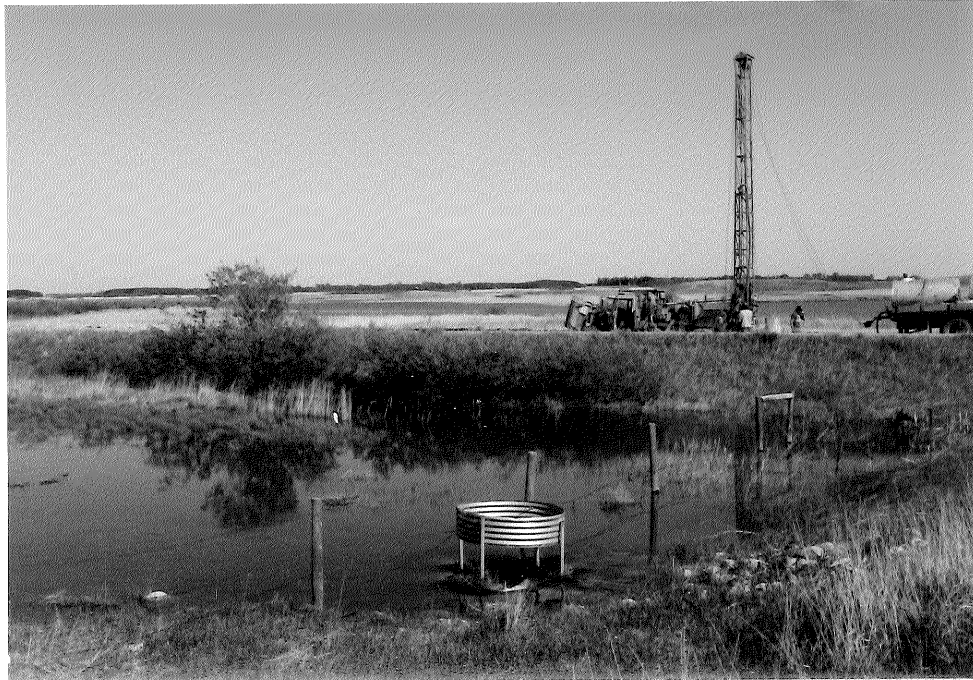


A



B

Figure 2. Sampling. (A) Driller catching samples with sieve from drilling fluid. (B) Driller placing cuttings on sample tray.



A



B

Figure 3. Dellwood Reservoir. (A) Test drilling at Site No. 04. Notice Dellwood Reservoir in background and by-pass drainage entering "glory hole" in foreground. (B) SSEWS Canal below drop structure entering Dellwood Reservoir.

In ascending order the Quaternary deposits include the Empress, Sutherland, and Saskatoon Groups (Drawing 0107-001-02). The Empress Group (Whitaker and Christiansen, 1972) is composed mainly of silts lying between the bed-rock Lea Park Formation and tills of the Sutherland Group. Tills of the Sutherland Group (Christiansen 1968a), lying between the Empress and Saskatoon Groups, are less resistive than tills of the Saskatoon Group (testhole D, Drawing 0107-001-02). The Saskatoon Group is composed of the Floral and Battleford Formations and surficial silts and clays (Christiansen, 1968a,b). The testholes drilled in this study range in depth from 24 to 36 m and penetrated only the surficial silts and clays, Battleford Formation, and the upper part of the Floral Formation.

## 2.2 Floral Formation

Up to 30 m of Floral Formation was encountered during test drilling in testhole 01 (Drawing 0107-001-02). The till has a mean carbonate content of  $52 \pm 2$  mL CO<sub>2</sub>/g and a mean sand, silt, and clay content of  $37 \pm 2$ ,  $37 \pm 2$ , and  $26 \pm 1\%$ , respectively (Appendices 2 and 3). The till is dark gray where un-oxidized and olive gray where oxidized. In testholes 02 and 03 there is a noticeable increase in salt content toward the top of the Floral Formation.

## 2.3 Battleford Formation

The Battleford Formation is composed of 5 to 11 m of light-yellowish brown and gray, sandy till, the upper part of which is soft and difficult to sample with rotary drilling equipment. Tills of the Battleford



Formation have a mean carbonate content of  $45 \pm 6$  mL CO<sub>2</sub>/g and a mean sand, silt, and clay content of  $48 \pm 2$ ,  $32 \pm 3$ , and  $20 \pm 1\%$ , respectively. Tills of the Floral Formation are more clayey and less sandy than tills of the Battleford Formation and have a higher carbonate content. Because there is no overlap in the standard deviations, these differences are thought to be significant. The contact with the underlying Floral Formation is distinct.

#### 2.4 Surficial Silts and Clays

A few metres of silt and clay overly the Battleford Formation in test-holes 03 and 04. These silts and clays were deposited in glacial Last Mountain Lake (Greer and Christiansen, 1963). Although it is difficult to get good samples in the upper few metres, it appears that the contact between the silts and clays and underlying till is gradational. It is believed that the lacustrine silts and clays were mixed with ablation till deposits by collapse during the melting of glacier ice. Because of the uncertainty of contact between these silts and clays and the thinness of these stratified deposits, they have been included with the Battleford Formation in this study.



### 3. GEOTECHNOLOGY

Seepage problems along the Manitou Lake - Dellwood Reservoir reach of the SSEWS canal are related to localized seepage through ablation sediments in the upper Battleford Formation at Site Nos. 01-03 and through glacio-lacustrine sediments and ablation deposits in the Battleford Formation at Site No. 04. At investigation sites, it is recommended to drill one or two holes to the base of exploration as defined in Appendix 1 and Drawing 0107-001-02 and to drill the remaining holes to a higher base defined during the deeper drilling.

Detailed site investigations in the vicinity of Site Nos. 01-03 should focus on determining the thickness and physical properties of the ablation sediments which form the surficial deposits in the upper part of the Battleford Formation. Between Site No.03 and the pinch-out of the aquifer at the base of the Saskatoon Group between Site Nos.03 and 04 ( Drawing 0107-001-02) , salts are accumulating in the upper 10 m because of upward flow from this aquifer. Canal seepage through this previously deposited salt accumulation is the reason for serious salt build-up along the south side of the canal east of Site No. 03. Even if the canal seepage is mitigated, upward flow of water from the deep aquifer will result in continuing salt accumulation in the upper 10 metres, and mitigation is probably uneconomic. Eastward from this pinch-out of the aquifer, there is no salt accumulation in the upper 10 metres (Appendix 1, log No. 04). This lack of salt accumulation is the result of downward leaching and/or because of the absence of the deep aquifer and its associated upward flow.

#### 4. CONCLUSIONS

1. The base of exploration for canal seepage studies for the first one or two holes is the contact between the Floral and Battleford Formations. For additional holes the base of exploration can probably be raised to the base of the ablation zone in the upper part of the Battleford Formation.
2. The Floral Formation is more clayey, less sandy, harder, and has a higher carbonate content than the Battleford Formation. Where weathered, the top of the Floral Formation is jointed and stained, whereas the Battleford Formation is massive and unstained.
3. The higher salt content in the upper 10 m in testholes 02 and 03, is attributed to the aquifer lying between tills of the Sutherland Group and Floral Formation. The salt accumulation along the south side of the canal east of Site No. 03 is the result of canal seepage flowing through this previously deposited salt in the upper 10 m.
4. Mitigation of canal seepage by cutoff walls or canal linings is feasible, but mitigation of salt accumulation caused by upward flow is probably not economically feasible.

5. LITERATURE CITED

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

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

Greer J.E. and Christiansen, E.A. 1963. Geology and groundwater resources of the Wynyard area (72P), Saskatchewan Research Council, Geology Division. Report No. 3, 56 p.

Whitaker, S.H. and Christiansen, E.A. 1972. The Empress Group in southern Saskatchewan. Canadian Journal of Earth Sciences, v. 9, pp. 353-360.

Appendix 1. Geological logs.

01

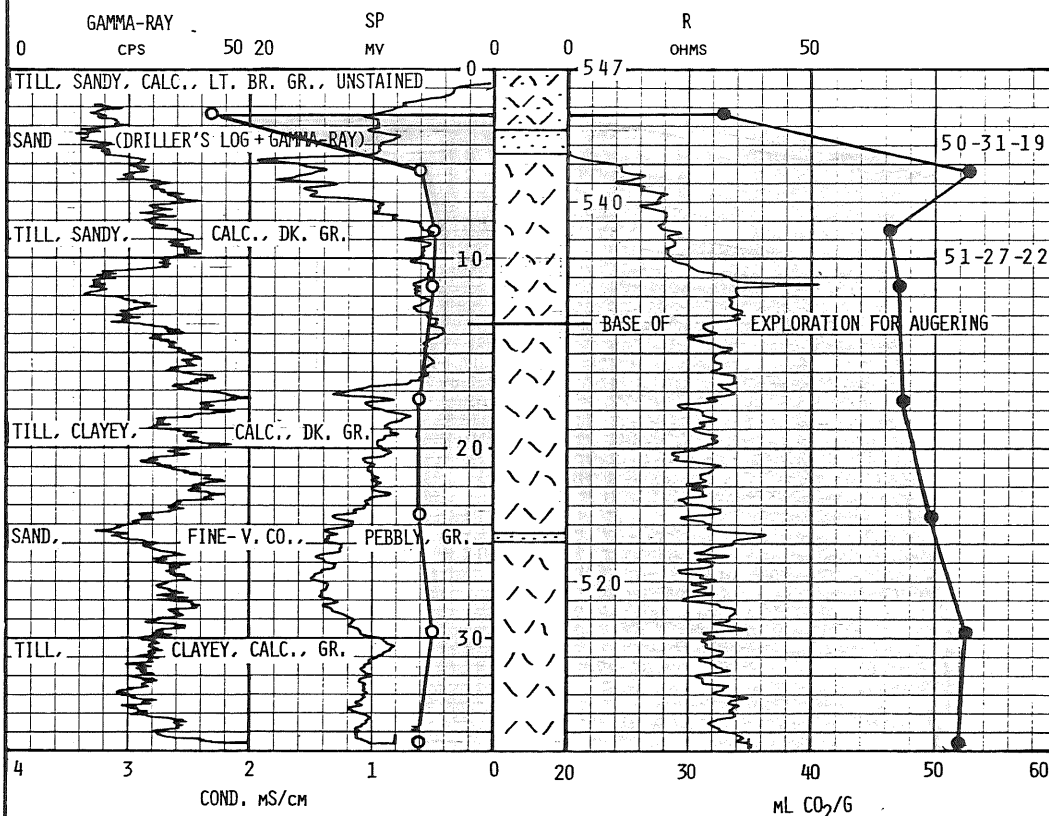
SWC 72P/13 1985  
 MANITOU - DELLWOOD  
 SW-13-27-32-26-W2  
 13:457500/5736200  
 SSEWS-85-RH-01

BOREHOLE NO. SSEWS-85-RH-01 NTS 72-P/13  
 LAND LOCATION SW-13-27-32-26-W2  
 UTM COORD. 13:457500E/5736200N  
 GRD. ELEV. 546.990 M DEPTH 120 FEET  
 DATE DRILLED MAY 15 TO MAY 15, 1985  
 COND. WATER 300 MICROSIEMENS/CM AT 25° C  
 COND. MUD 500 MICROSIEMENS/CM AT 25° C  
 SPECIFIC GRAVITY MUD \_\_\_\_\_  
 SUPERVISOR E.A. CHRISTIANSEN  
 ASST SUPERVISOR \_\_\_\_\_  
 LOGGED BY T. WERBOVETSKI  
 INSTRUMENT WIDCO 1500  
 PROBE ELECTRIC \_\_\_\_\_  
 PROBE GAMMA \_\_\_\_\_  
 PROBE CALIPER \_\_\_\_\_  
 DATE LOGGED MAY 15, 1985  
 TIME OF LOGGING 1830 HRS TO 2030 HRS  
 DRILL OPERATOR J. JASNOCH  
 CONTRACTOR INTERNATIONAL WATER SUPPLY  
 REMARKS GEOPHYSICAL LOGGING CONTRACTOR:  
P. MACHIBRODA ENGINEERING LTD.

PROJECT MANITOU LAKE-DELLWOOD RESERVOIR  
 CONTROL SECTION \_\_\_\_\_  
 STATION 20+90 M OFFSET \_\_\_\_\_  
 CUTTING SAMPLE INTERVAL 5 FEET  
 CORE SAMPLE INTERVAL \_\_\_\_\_  
 FROM \_\_\_\_\_  
 CASING DEPTH 0-23.5 FEET  
 CASING WALL THICKNESS \_\_\_\_\_  
 WATER OR MUD LEVEL \_\_\_\_\_  
 ABANDONMENT CEMENT PLUG 0-22 FEET  
 BIT SIZE 9 7/8" INTERVAL 0-21 FEET  
 BIT SIZE 6 1/4" INTERVAL 21-120 FEET  
 BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_  
 TYPE OF DRILL RIG FATLING HOLEMASTER 1250

	DEPTH	SCALE	SPEED
SP.	35.6 M	20 MV	
RES.	35.6 M	50 OHMS	
GAMMA	35.5 M	100 cps/20	8 M/MIN
CAL			

GAMMA TIME CONSTANT (T.C.) 3 SECONDS  
 GEOLOGY BY E.A. CHRISTIANSEN CONSULTING LTD.



02

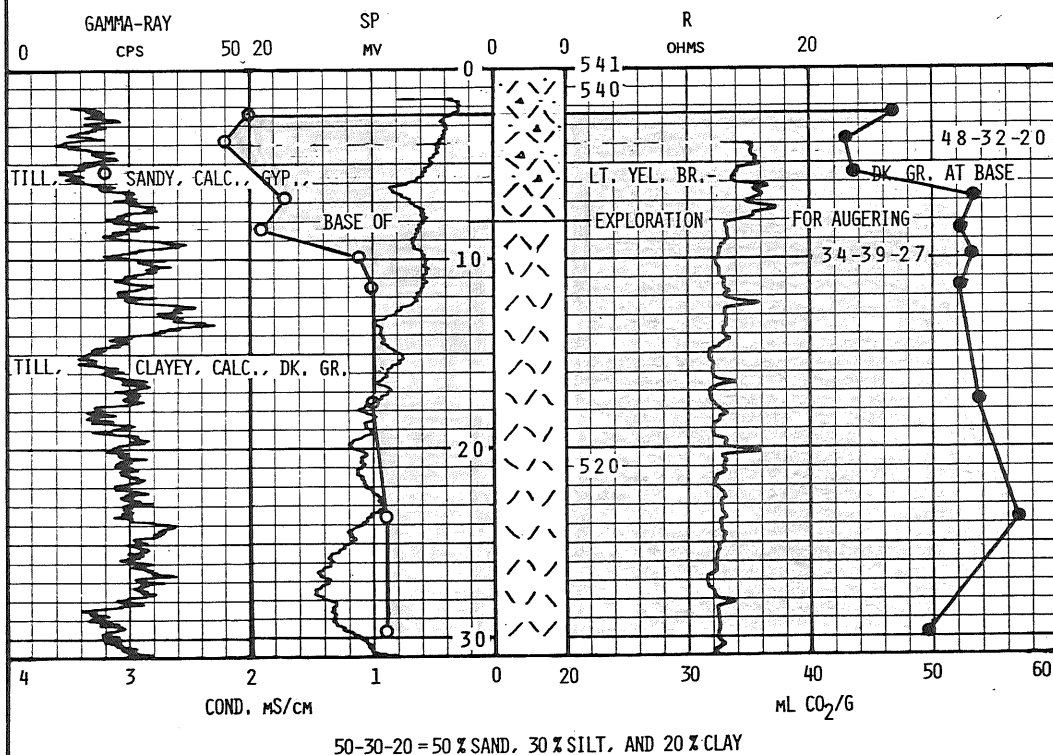
SWC 72P/14 1985  
MANITOU - DELLWOOD  
SW-05-22-32-25-W2  
13:467200/5733700  
SSEWS-85-RH-02

BOREHOLE NO. SSEWS-85-RH-02 NTS 72-P/14  
LAND LOCATION SW-05-22-32-25-W2  
UTM COORD. 13:467200E/5733700N  
GRD. ELEV. 540.610 M DEPTH 101 FEET  
DATE DRILLED MAY 16 TO MAY 16, 1985  
COND. WATER 450 MICROSIEMENS/CM AT 25° C  
COND. MUD 2200 MICROSIEMENS/CM AT 25° C  
SPECIFIC GRAVITY MUD \_\_\_\_\_  
SUPERVISOR E.A. CHRISTIANSEN  
ASST SUPERVISOR \_\_\_\_\_  
LOGGED BY T. WERBOVETSKI  
INSTRUMENT WIDCO 1500  
PROBE ELECTRIC \_\_\_\_\_  
PROBE GAMMA \_\_\_\_\_  
PROBE CALIPER \_\_\_\_\_  
DATE LOGGED MAY 16, 1985  
TIME OF LOGGING 1900 HRS TO 2030 HRS  
DRILL OPERATOR J. JASNOCH  
CONTRACTOR INTERNATIONAL WATER SUPPLY  
REMARKS GEOPHYSICAL LOGGING CONTRACTOR:  
P. MACHIBRODA ENGINEERING LTD.

PROJECT MANITOU LAKE-DELLWOOD RESERVOIR  
CONTROL SECTION \_\_\_\_\_  
STATION 136+70 M OFFSET \_\_\_\_\_  
CUTTING SAMPLE INTERVAL 5 FEET  
CORE SAMPLE INTERVAL \_\_\_\_\_  
FROM \_\_\_\_\_  
CASING DEPTH \_\_\_\_\_  
CASING WALL THICKNESS \_\_\_\_\_  
WATER OR MUD LEVEL \_\_\_\_\_  
ABANDONMENT CEMENT PLUG 0-30 FEET  
BIT SIZE 6 1/4" INTERVAL 0-101 FEET  
BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_  
BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_  
TYPE OF DRILL RIG FALLING HOLEMASTER 1250

	DEPTH	SCALE	SPEED
SP.	31.0 M	20 MV	
RES.	31.0 M	20 OHMS	
GAMMA	31.0 M	100cps/20 DIV.	8 M/MIN
CAL			

GAMMA TIME CONSTANT (T.C.) 3 SECONDS  
GEOLOGY BY E.A. CHRISTIANSEN CONSULTING LTD.



03

SWC 72P/14 1985  
 MANITOU - DELLWOOD  
 NE-14-25-32-25-W2  
 13:471300/5736400  
 SSEWS-85-RH-03

BOREHOLE NO. SSEWS-85-RH-03 NTS 72-P/14  
 LAND LOCATION NE-14-25-32-25-W2  
 UTM COORD. 13:471300E/5736400N  
 GRD. ELEV. 538.420 M DEPTH 101 FEET  
 DATE DRILLED MAY 17 TO MAY 17, 1985  
 COND. WATER 470 MICROSIEMENS/CM AT 25° C  
 COND. MUD 1400 MICROSIEMENS/CM AT 25° C  
 SPECIFIC GRAVITY MUD \_\_\_\_\_  
 SUPERVISOR E.A. CHRISTIANSEN  
 ASST SUPERVISOR \_\_\_\_\_  
 LOGGED BY T. WERBOVETSKI  
 INSTRUMENT WIDCO 1500  
 PROBE ELECTRIC \_\_\_\_\_  
 PROBE GAMMA \_\_\_\_\_  
 PROBE CALIPER \_\_\_\_\_  
 DATE LOGGED MAY 17, 1985  
 TIME OF LOGGING \_\_\_\_\_ TO \_\_\_\_\_  
 DRILL OPERATOR J. JASNOCH  
 CONTRACTOR INTERNATIONAL WATER SUPPLY  
 REMARKS GEOPHYSICAL LOGGING CONTRACTOR:  
P. MACHIBRODA ENGINEERING LTD.

PROJECT MANITOU LAKE-DELLWOOD RESERVOIR

CONTROL SECTION \_\_\_\_\_

STATION 197+10 M OFFSET \_\_\_\_\_CUTTING SAMPLE INTERVAL 5 FEET

CORE SAMPLE INTERVAL \_\_\_\_\_

FROM \_\_\_\_\_

CASING DEPTH \_\_\_\_\_

CASING WALL THICKNESS \_\_\_\_\_

WATER OR MUD LEVEL \_\_\_\_\_

ABANDONMENT CEMENT PLUG 0-30 FEETBIT SIZE 6 1/4" INTERVAL 0-101 FEET

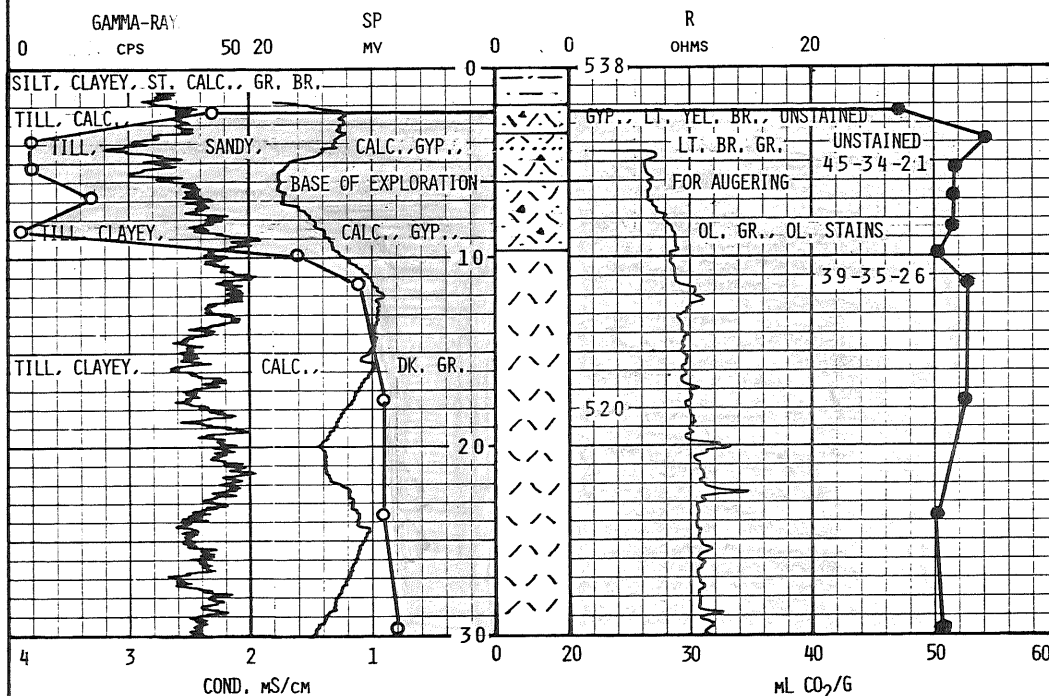
BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_

BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_

TYPE OF DRILL RIG FAILING HOLEMASTER 1250

DEPTH SCALE SPEED

SP.	30.6 M	20 MV	
RES.	30.6 M	20 OHMS	
GAMMA	30.5 M	100cps/20 DIV.	
CAL.			

GAMMA TIME CONSTANT (T.C.) 3 SECONDSGEOLOGY BY E.A. CHRISTIANSEN CONSULTING LTD.

50-30-20 = 50 % SAND, 30 % SILT, AND 20 % CLAY

SASKATCHEWAN  
 WATER  
 CORPORATION

04

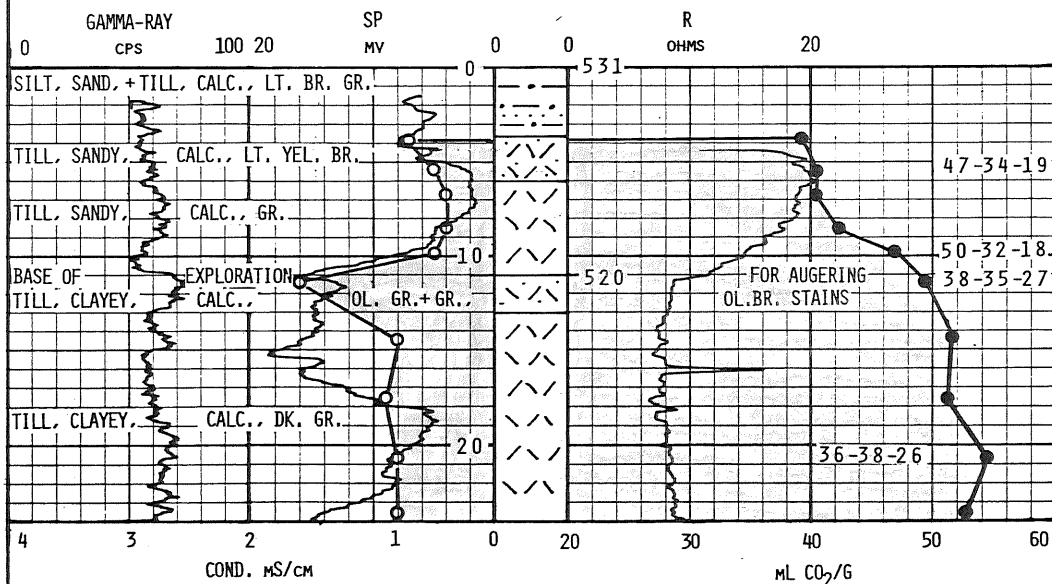
SWC 72P/14 1985  
MANITOU-DELLWOOD  
SW-10-04-33-24-W2  
13:476250/5739000  
SSEWS-85-RH-04

BOREHOLE NO. SSEWS-85-RH-04 NTS 72-P/14  
LAND LOCATION SW-10-04-33-24-W2  
UTM COORD. 13:476250E/5739000N  
GRD. ELEV. 530.740 M DEPTH 81 FEET  
DATE DRILLED MAY 17 TO MAY 17, 1985  
COND. WATER 470 MICROSIEMENS/CM AT 25° C  
COND. MUD 740 MICROSIEMENS/CM AT 25° C  
SPECIFIC GRAVITY MUD \_\_\_\_\_  
SUPERVISOR E.A. CHRISTIANSEN  
ASS'T SUPERVISOR \_\_\_\_\_  
LOGGED BY T. WERBOVETSKI  
INSTRUMENT WIDCO 1500  
PROBE ELECTRIC \_\_\_\_\_  
PROBE GAMMA \_\_\_\_\_  
PROBE CALIPER \_\_\_\_\_  
DATE LOGGED MAY 17, 1985  
TIME OF LOGGING 1700 HRS TO 1800 HRS  
DRILL OPERATOR J. JASNOCH  
CONTRACTOR INTERNATIONAL WATER SUPPLY  
REMARKS GEOPHYSICAL LOGGING CONTRACTOR:  
P. MACHIBRODA ENGINEERING LTD.

PROJECT MANITOU LAKE-DELLWOOD RESERVOIR  
CONTROL SECTION \_\_\_\_\_  
STATION 259+50 M OFFSET \_\_\_\_\_  
CUTTING SAMPLE INTERVAL 5 FEET  
CORE SAMPLE INTERVAL \_\_\_\_\_  
FROM \_\_\_\_\_  
CASING DEPTH \_\_\_\_\_  
CASING WALL THICKNESS \_\_\_\_\_  
WATER OR MUD LEVEL \_\_\_\_\_  
ABANDONMENT CEMENT PLUG 0-30 FEET  
BIT SIZE 6 1/4" INTERVAL 0-81 FEET  
BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_  
BIT SIZE \_\_\_\_\_ INTERVAL \_\_\_\_\_  
TYPE OF DRILL RIG FALLING HOLEMASTER 1250

	DEPTH	SCALE	SPEED
SP.	24.3 M	20 MV	
RES.	24.3 M	20 OHMS	
GAMMA	24.1 M	100 CPS/10 DIV.	
CAL.			

GAMMA TIME CONSTANT (T.C.) 3 SECONDS  
GEOLOGY BY E.A. CHRISTIANSEN CONSULTING LTD.



50-30-20 = 50 % SAND, 30 % SILT, AND 20 % CLAY

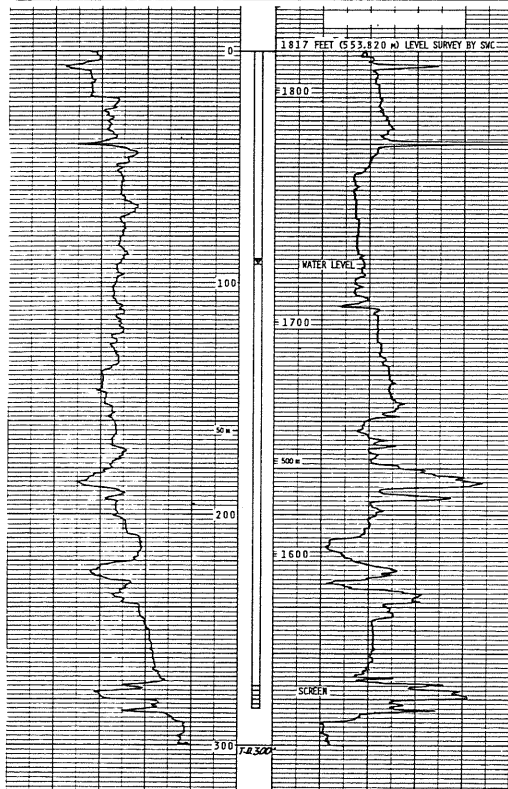
SASKATCHEWAN  
WATER  
CORPORATION



**ELECTRIC LOG**  
TEST DRILLING ASSISTANCE PROGRAM

ACQUISITION NO. 72-71  
SHEET NO. 0000

DRILLING CONTRACTOR: COMPANY NAME SW 4-33-32-26 W2 Section 26  
CONTRACTOR'S TELEPHONE NUMBER 304-33-32-26  
CONTRACTOR'S ADDRESS Box 604  
SIGNATURE: NAME AND DATE Watrous Sask  
OWNER'S NAME James D. Leake  
OWNER'S TELEPHONE NUMBER 304-33-32-26  
OWNER'S ADDRESS Box 65  
TESTHOLE: MUNICIPAL LAND LOCATION SW 33-32-26 W2  
RURAL NAME (MUNICIPALITY OR LOCAL GOVERNMENT DISTRICT) (U.S. OR CANADIAN RESERVATION) SW 33-32-26 W2  
DRILLER'S NAME Wanda Street  
LOGS: DEPTH (FEET) 300  
CONDUCTIVITY (OHMS PER FOOT) 300  
CONDUCTIVITY (OHMS PER FOOT) 300  
DATE TESTHOLE COMPLETED 9/18/78  
DATE TESTHOLE LOGGED 9/18/78  
TRADE NAME OF LOGGER Wanda  
SIGNAL NO. OF LOGGER 24  
ACQUISITION DATE 9/18/78  
SPONTANEOUS POTENTIAL 10 LOG SCALES 10



LINE NO.	FROM (FEET)	TO (FEET)	DRILLER'S LOG AND PROCEDURE RECORD
0	0	4	Silt, brown
4	4	6	Till, brown
6	6	7	Sand
7	7	38	Till, brown
38	38	39	Till, grey
39	39	41	Rock
41	41	54	Till, grey, sandy
54	54	112	Till, grey
112	112	160	Till, grey, sandy
160	160	182	Till, grey
182	182	190	Sand
190	190	193	Till, grey
193	193	195	Sand
195	195	210	Silt, grey
210	210	224	Till, grey
224	224	228	Sand, fine
228	228	234	Till, grey
234	234	239	Sand, fine
239	239	271	Till, sandy grey
271	271	272	Rock
272	272	274	Till, grey
274	274	286	Sand
286	286	300	Shale, grey Non Calc
Well description			
Packer casing dia 5", length 274'			
Screen dia 4", length 10', slot 0.12"			
Well bottom 286'			
Water level 92'			
Dynamometer 150' after 5 hrs at 7160'			
Recommended 10 1600' from 286'			
CONTRACTOR: <u>Baylee Drilling Ltd</u>			
DRILLER'S LOG BY: <u>Nacelle Street</u>			

B

**ELECTRIC LOG**  
TEST DRILLING ASSISTANCE PROGRAM

ACQUISITION NO. 6116  
GROUP NO. 0001

FAMILY FARM IMPROVEMENT BRANCH  
SASKATCHEWAN DEPARTMENT OF AGRICULTURE  
1818 WINNIPEG STREET, REGINA, S4S 0B8

DRILLING CONTRACTOR'S COMPANY NAME: Hayter Drilling Ltd. 727/4

0.1 CONTRACTOR'S TELEPHONE NUMBER 727/4 CONTRACTOR'S ADDRESS Regina, Sask.

0.2 SIGNATURE NAME AND DATE Hayter Drilling Ltd. CONTRACTOR'S ADDRESS Regina, Sask.

0.3 OWNER'S NAME W. J. O'Neil OWNER'S ADDRESS Regina, Sask.

0.4 SIGNATURE NAME AND DATE W. J. O'Neil OWNER'S ADDRESS Regina, Sask.

1 TESTHOLE: MUNICIPAL LAND LOCATION W. J. O'Neil NAME AND ADDRESS OF LOCAL MUNICIPALITY DISTRICT (LID) OR INDIAN RESERVATION (LID) W. J. O'Neil

0.5 DRILLER'S NAME W. J. O'Neil DATE TESTHOLE COMPLETED 12/17/73

0.6 LOCAL OPERATOR'S NAME W. J. O'Neil DATE TESTHOLE LOGGED 12/17/73

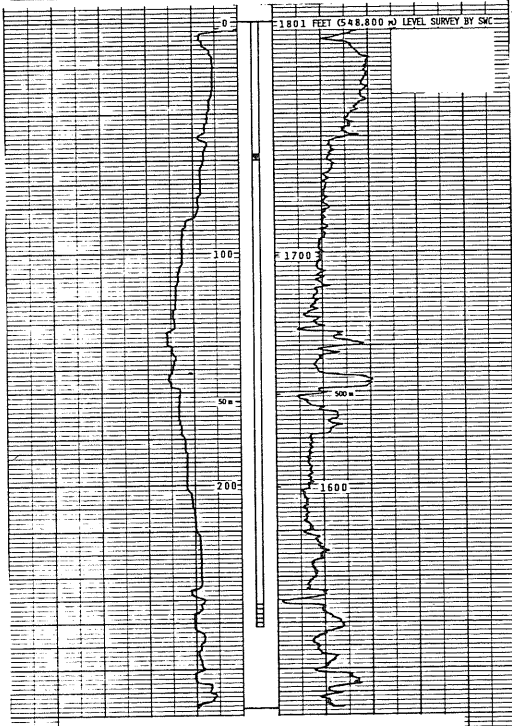
0.7 CONTRACTIVITY (DRILLING TIME) 1.60 CONTRACTIVITY (DRILLING TIME) 1.60

0.8 DEPTH DRILLED 1.60 DEPTH LOGGED 1.60

0.9 SITE CHARACTERISTICS W. J. O'Neil TYPE OR MODEL OF LOGGER W. J. O'Neil

1.0 SPONTANEOUS POTENTIAL W. J. O'Neil ACQUISITION DATE 12/17/73

**LOG SCALES**



**DRILLER'S LOG**  
TEST DRILLING ASSISTANCE PROGRAM

ACQUISITION NO. 6116  
GROUP NO. 0001

FAMILY FARM IMPROVEMENT BRANCH  
SASKATCHEWAN DEPARTMENT OF AGRICULTURE  
1818 WINNIPEG STREET, REGINA, S4S 0B8

TESTHOLE: MUNICIPAL LAND LOCATION W. J. O'Neil DATE TESTHOLE COMPLETED 12/17/73

LINE NO.	FROM	TO	DRILLER'S LOG AND PROLOGUE RECORD
0	0	22	till, br.
22	41	41	till, grey
41	134	134	grey, silty, till
134	139	139	sand & silt
139	150	150	till, silty, grey
150	155	155	sand & gravel
155	244	244	till, grey, sandy
244	248	248	sand
248	250	250	till, grey, silty
250	267	267	sand & gravel
267	274	274	silty, grey, till
274	275	275	gravel
275	276	276	silty, grey, till
276	277	277	rock

CONTRACTOR: HAYTER DRILLING SHEET 1

DRILLER'S LOG BY: W. J. O'Neil

C

**ELECTRIC LOG**  
**TEST DRILLING ASSISTANCE PROGRAM**

ACQUISITION NO. 5762  
GROUP NO. 0000

FAMILY FARM IMPROVEMENT BRANCH  
KANSAS STATE DEPARTMENT OF AGRICULTURE  
1818 WINSTON STREET, NEBUSA, MO. 65118-044

DRILLING CONTRACTOR: COMPANY NAME Hayter Drilling Ltd NE 7-36-32-25W2 Verified B.

CONTRACTOR'S TELEPHONE NUMBER 322944-5616 ON TH CONTRACTOR'S ADDRESS Box 604

OWNER'S NAME Cliff Hokenmehl OWNER'S ADDRESS Walcus road

TESTHOLE: MUNICIPAL LAND LOCATION SE 36-32-25W2 DATE TESTHOLE COMPLETED 15/10/80

DRILLER'S NAME Gerald Gray DATE TESTHOLE LOGGED 15/10/80

LOGGING OPERATOR'S NAME Gerald Gray TRADE NAME OF LOGGER Widco

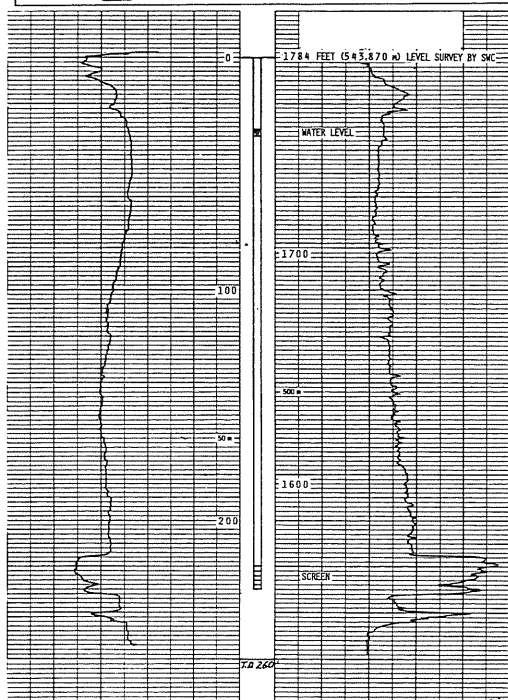
CONDUCTIVITY: DRILLING FLUID 1000 CONDUCTIVITY: DRILLING WATER 850

DEPTH: DRILLED 250' TYPE OF MUD Water

BIT DIAMETER 4-7/8" SERIAL NO. OF LOGGER 1200

SPONTANEOUS POTENTIAL 10 SINGLE-POINT RESISTANCE 16

LOG SCALES



LINE NO.	FROM (FEET)	TO (FEET)	DESCRIPTION
0	0	2	Sand
2	2	18	Clay, brown, silty
18	18	30	Till, brown, silty
30	30	32	Sand, grey
32	32	155.5	Till, grey
155.5	155.5	157	Rock
157	157	188	Till, grey
188	188	236	Sand
236	236	240	Till, grey
240	240	242	Sand
242	242	260	Till, grey
Log does not match (Footage)			
Well description			
Casing - dia 3", length 220'			
Screen - dia 3", length 10', slot .015"			
Well bottom 250'			
Water level 30'			
Drawdown 30' after 3 hrs at 150 GPM			
Recommended 20 GPM from 150'			
CONTRACTOR: <u>Hayter Drilling Ltd</u>			
DRILLER: <u>Gerald Gray</u>			

(D)

**ELECTRIC LOG**  
TEST DRILLING ASSISTANCE PROGRAM

72P/14

ACQUISITION NO. 16547  
GROUP NO. 0000

FAMILY FARM IMPROVEMENT BRANCH  
BARABATCHMAN DEPARTMENT OF AGRICULTURE  
1414 WASHINGTON STREET, DES MOINES, IOWA

DRILLING CONTRACTOR'S COMPANY NAME SKB-4-33-2412

0.1 SKB-4-33-2412 Drilling Log No. 16547

0.2 CONTRACTOR'S TELEPHONE NUMBER 804-1724 CONTRACTOR'S ADDRESS 804-1724

0.3 OWNER'S NAME SKB-4-33-2412 OWNER'S ADDRESS 804-1724

0.4 CONTRACTOR'S TELEPHONE NUMBER 804-1724 CONTRACTOR'S ADDRESS 804-1724

0.5 TEST HOLE NO. 16547 TEST HOLE DATE 10/10/74

0.6 TEST HOLE LOCATION 16547 TEST HOLE DATE 10/10/74

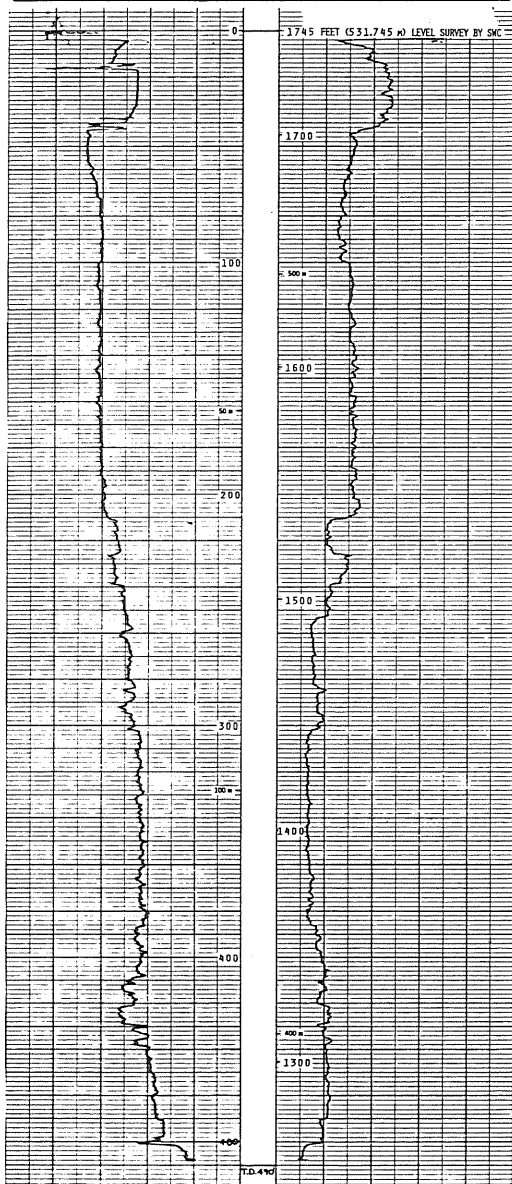
0.7 TEST HOLE LOCATION 16547 TEST HOLE DATE 10/10/74

0.8 TEST HOLE LOCATION 16547 TEST HOLE DATE 10/10/74

0.9 TEST HOLE LOCATION 16547 TEST HOLE DATE 10/10/74

1.0 TEST HOLE LOCATION 16547 TEST HOLE DATE 10/10/74

LOG SCALES



TEST HOLE NO.	TEST HOLE DATE	TEST HOLE LOCATION
16547	10/10/74	16547
DEPTH	RESISTIVITY	LOG AND PROCEDURE RECORD
0	18	fill beam
10	25	fill beam
20	43	fill beam
30	73	fill beam
40	80	fill beam
50	83	fill beam
60	90	fill beam
70	270	fill beam
80	288	fill beam
90	370	fill beam
100	400	fill beam
110	400	fill beam
120	400	fill beam
130	400	fill beam
140	400	fill beam
150	400	fill beam
160	400	fill beam
170	400	fill beam
180	400	fill beam
190	400	fill beam
200	400	fill beam
210	400	fill beam
220	400	fill beam
230	400	fill beam
240	400	fill beam
250	400	fill beam
260	400	fill beam
270	400	fill beam
280	400	fill beam
290	400	fill beam
300	400	fill beam
310	400	fill beam
320	400	fill beam
330	400	fill beam
340	400	fill beam
350	400	fill beam
360	400	fill beam
370	400	fill beam
380	400	fill beam
390	400	fill beam
400	400	fill beam
410	400	fill beam
420	400	fill beam
430	400	fill beam
440	400	fill beam
450	400	fill beam
460	400	fill beam
470	400	fill beam
480	400	fill beam
490	400	fill beam
500	400	fill beam
510	400	fill beam
520	400	fill beam
530	400	fill beam
540	400	fill beam
550	400	fill beam
560	400	fill beam
570	400	fill beam
580	400	fill beam
590	400	fill beam
600	400	fill beam
610	400	fill beam
620	400	fill beam
630	400	fill beam
640	400	fill beam
650	400	fill beam
660	400	fill beam
670	400	fill beam
680	400	fill beam
690	400	fill beam
700	400	fill beam
710	400	fill beam
720	400	fill beam
730	400	fill beam
740	400	fill beam
750	400	fill beam
760	400	fill beam
770	400	fill beam
780	400	fill beam
790	400	fill beam
800	400	fill beam
810	400	fill beam
820	400	fill beam
830	400	fill beam
840	400	fill beam
850	400	fill beam
860	400	fill beam
870	400	fill beam
880	400	fill beam
890	400	fill beam
900	400	fill beam
910	400	fill beam
920	400	fill beam
930	400	fill beam
940	400	fill beam
950	400	fill beam
960	400	fill beam
970	400	fill beam
980	400	fill beam
990	400	fill beam
1000	400	fill beam
1010	400	fill beam
1020	400	fill beam
1030	400	fill beam
1040	400	fill beam
1050	400	fill beam
1060	400	fill beam
1070	400	fill beam
1080	400	fill beam
1090	400	fill beam
1100	400	fill beam
1110	400	fill beam
1120	400	fill beam
1130	400	fill beam
1140	400	fill beam
1150	400	fill beam
1160	400	fill beam
1170	400	fill beam
1180	400	fill beam
1190	400	fill beam
1200	400	fill beam
1210	400	fill beam
1220	400	fill beam
1230	400	fill beam
1240	400	fill beam
1250	400	fill beam
1260	400	fill beam
1270	400	fill beam
1280	400	fill beam
1290	400	fill beam
1300	400	fill beam
1310	400	fill beam
1320	400	fill beam
1330	400	fill beam
1340	400	fill beam
1350	400	fill beam
1360	400	fill beam
1370	400	fill beam
1380	400	fill beam
1390	400	fill beam
1400	400	fill beam
1410	400	fill beam
1420	400	fill beam
1430	400	fill beam
1440	400	fill beam
1450	400	fill beam
1460	400	fill beam
1470	400	fill beam
1480	400	fill beam
1490	400	fill beam
1500	400	fill beam
1510	400	fill beam
1520	400	fill beam
1530	400	fill beam
1540	400	fill beam
1550	400	fill beam
1560	400	fill beam
1570	400	fill beam
1580	400	fill beam
1590	400	fill beam
1600	400	fill beam
1610	400	fill beam
1620	400	fill beam
1630	400	fill beam
1640	400	fill beam
1650	400	fill beam
1660	400	fill beam
1670	400	fill beam
1680	400	fill beam
1690	400	fill beam
1700	400	fill beam
1710	400	fill beam
1720	400	fill beam
1730	400	fill beam
1740	400	fill beam
1745	400	fill beam

Appendix 2. Carbonate analyses.

SASKATCHEWAN SOIL TESTING LABORATORY

DATE:04/06/85

SPECIAL ANALYSIS

D\*CHRSTNSN-E\*CO3.I84-5843/5882

\*\*\*E.A. CHRISTIANSEN\*\*\*

\*\*\*\*\*

SAMPLE #	CLIENT SAMPLE NUMBER	CO2 Equiv mls/gm
----------	----------------------	---------------------

\*\*\*\*\*

I 184-5843	RH-01 5-10	32.8	I
-----			
I 184-5845	RH-01 15-20	52.7	I
-----			
I 184-5846	RH-01 25-30	46.3	I
-----			
I 184-5848	RH-01 35-40	47.1	I
-----			
I 184-5849	RH-01 55-60	47.5	I
-----			
I 184-5850	RH-01 75-80	49.9	I
-----			
I 184-5851	RH-01 95-100	52.5	I
-----			
I 184-5852	RH-01 115-120	52.1	I
-----			
I 184-5853	RH-02 5-10	46.9	I
-----			
I 184-5854	RH-02 10-15	43.0	I
-----			
I 184-5855	RH-02 15-20	43.9	I
-----			
I 184-5856	RH-02 20-25	53.4	I
-----			
I 184-5857	RH-02 25-30	52.1	I
-----			
I 184-5858	RH-02 30-35	53.4	I
-----			
I 184-5859	RH-02 35-40	52.1	I
-----			
I 184-5860	RH-02 55-60	53.8	I
-----			
I 184-5861	RH-02 75-80	56.7	I
-----			
I 184-5862	RH-02 95-100	49.7	I
-----			
I 184-5863	RH-03 5-10	47.1	I
-----			
I 184-5864	RH-03 10-15	54.1	I
-----			
I 184-5865	RH-03 15-20	51.9	I
-----			
I 184-5866	RH-03 20-25	51.7	I
-----			
I 184-5867	RH-03 25-30	51.7	I
-----			
I 184-5868	RH-03 30-35	50.2	I
-----			
I 184-5869	RH-03 35-40	52.7	I
-----			

COMMENT:

SASKATCHEWAN SOIL TESTING LABORATORY

DATE:04/06/85

SPECIAL ANALYSIS

D\*CHRSTNSN-E\*CO3.I84-5843/5882

\*\*\*E.A. CHRISTIANSEN\*\*\*

\*\*\*\*\*

I	I	I	I
I SAMPLE #	I CLIENT SAMPLE NUMBER	I CO2 Equiv	I
I	I	I ml/gm	I

\*\*\*\*\*

I I84-5870	RH-03 55-60	52.5	I
------------	-------------	------	---

I I84-5871	RH-03 75-80	50.1	I
------------	-------------	------	---

I I84-5872	RH-03 95-100	50.8	I
------------	--------------	------	---

I I84-5873	RH-04 10-15	39.3	I
------------	-------------	------	---

I I84-5874	RH-04 15-20	40.4	I
------------	-------------	------	---

I I84-5875	RH-04 20-25	40.2	I
------------	-------------	------	---

I I84-5876	RH-04 25-30	42.1	I
------------	-------------	------	---

I I84-5877	RH-04 30-35	46.7	I
------------	-------------	------	---

I I84-5878	RH-04 35-40	49.7	I
------------	-------------	------	---

I I84-5879	RH-04 45-50	51.9	I
------------	-------------	------	---

I I84-5880	RH-04 55-60	51.4	I
------------	-------------	------	---

I I84-5881	RH-04 65-70	54.3	I
------------	-------------	------	---

I I84-5882	RH-04 75-80	52.8	I
------------	-------------	------	---

COMMENT:

Appendix 3. Mechanical analyses.



## SASKATCHEWAN SOIL TESTING LABORATORY

DATE:28/05/85

MECHANICAL ANALYSIS

D\*CHRSTNSN-E\*MEC.I84-5844/5881

\*\*\*A.E. CHRISTIANSEN\*\*\*

*****					
SAMPLE #	CLIENT SAMPLE NUMBER	SAND	SILT	CLAY	
		percent	percent	percent	
*****					
I84-5844	RH-01 10-15	50.0	31.4	18.6	
I84-5847	RH-01 30-35	50.7	27.3	22.0	
I84-5854	RH-02 10-15	47.5	32.5	20.0	
I84-5858	RH-02 30-35	34.0	38.6	27.4	
I84-5865	RH-03 15-20	45.0	33.5	21.5	
I84-5869	RH-03 35-40	38.4	35.3	26.3	
I84-5874	RH-04 15-20	46.8	33.9	19.3	
I84-5877	RH-04 30-35	50.2	31.4	18.4	
I84-5878	RH-04 35-40	37.6	34.9	27.5	
I84-5881	RH-04 65-70	35.5	37.9	26.5	

COMMENT:

Appendix 4. Salinity analyses.

## SASKATCHEWAN SOIL TESTING LABORATORY

DATE:28/05/85

FERTILITY ANALYSIS

D\*CHRSTNSN-E\*ROU.I84-5843/5882

\*\*\*E.A. CHRISTIANSEN\*\*\*

*****			
SAMPLE #	CLIENT SAMPLE NUMBER	CONDUCT	
		$\mu\text{S/cm}$	
*****			
I84-5843	RH-01 5-10	2.3	
I84-5845	RH-01 15-20	0.6	
I84-5846	RH-01 25-30	0.5	
I84-5848	RH-01 35-40	0.5	
I84-5849	RH-01 55-60	0.6	
I84-5850	RH-01 75-80	0.6	
I84-5851	RH-01 95-100	0.5	
I84-5852	RH-01 115-120	0.6	
I84-5853	RH-02 5-10	2.0	
I84-5854	RH-02 10-15	2.2	
I84-5855	RH-02 15-20	3.2	
I84-5856	RH-02 20-25	1.7	
I84-5857	RH-02 25-30	1.9	
I84-5858	RH-02 30-35	1.1	
I84-5859	RH-02 35-40	1.0	
I84-5860	RH-02 55-60	1.0	
I84-5861	RH-02 75-80	0.9	
I84-5862	RH-02 95-100	0.9	
I84-5863	RH-03 5-10	2.3	
I84-5864	RH-03 10-15	3.8	
I84-5865	RH-03 15-20	3.8	
I84-5866	RH-03 20-25	3.3	
I84-5867	RH-03 25-30	3.9	
I84-5868	RH-03 30-35	1.6	
I84-5869	RH-03 35-40	1.1	

COMMENT:

SASKATCHEWAN SOIL TESTING LABORATORY

DATE:28/05/85  
D\*CHRSTNSN-E\*ROU,I84-5843/5882

FERTILITY ANALYSIS  
\*\*\*E.A. CHRISTIANSEN\*\*\*

*****			
SAMPLE #	CLIENT SAMPLE NUMBER	CONDUCT	
		$\mu$ S/cm	
*****			
I84-5870	RH-03 55-60	0.9	
-----			
I84-5871	RH-03 75-80	0.9	
-----			
I84-5872	RH-03 95-100	0.8	
-----			
I84-5873	RH-04 10-15	0.7	
-----			
I84-5874	RH-04 15-20	0.5	
-----			
I84-5875	RH-04 20-25	0.4	
-----			
I84-5876	RH-04 25-30	0.4	
-----			
I84-5877	RH-04 30-35	0.5	
-----			
I84-5878	RH-04 35-40	1.6	
-----			
I84-5879	RH-04 45-50	0.8	
-----			
I84-5880	RH-04 55-60	0.9	
-----			
I84-5881	RH-04 65-70	0.8	
-----			
I84-5882	RH-04 75-80	0.8	
-----			

COMMENT:

DRAWING 0107-001-01. LOCATION MAP.

RGE. 26 W 2nd.  
RGE. 25  
TWP. 33  
TWP. 32

0 MILE 1  
0 Km 1

- SWC testholes
- ⊙ Testhole with driller's and electric logs
- Wells with driller's and electric logs

Drawing 0107-001-01

LAND OWNERSHIP			
NO	REVISION	DATE	CK
1		2/73	

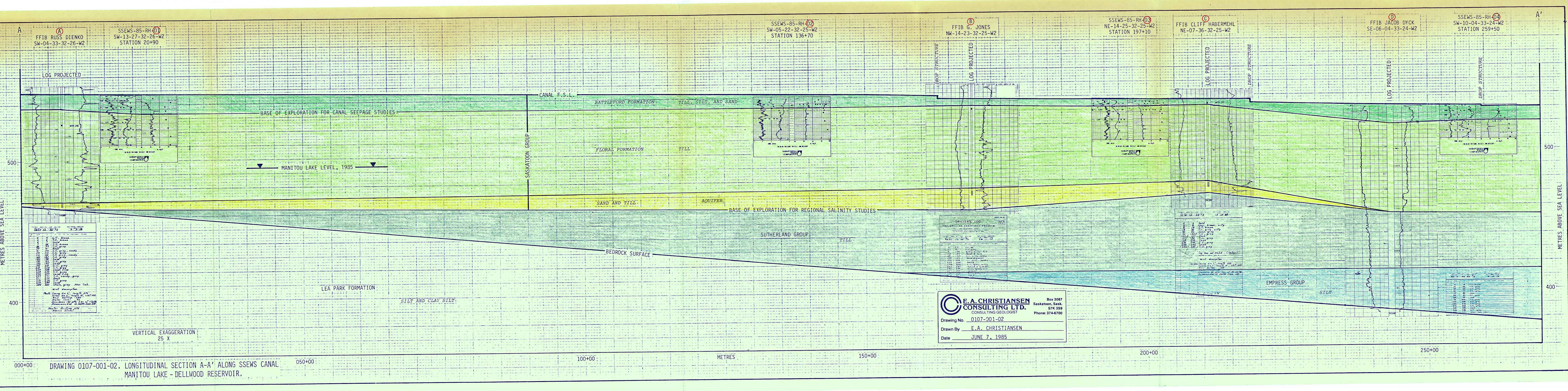
LEGEND	
Final Canal Location	Control Structure
Parallel Drainage	Diversion Structure
Bridge (Municipal Road)	Canal Inlet Drop
Bridge (Farm Crossing)	Canal Culvert
Tunnel Liner	Cross Drainage Culvert
Parallel Drainage Culvert	Comb. Farm Crossing and Canal Culvert
Inlet Chute	
Pipeline Discharge Outlet	

SASKATCHEWAN WATER SUPPLY BOARD

SASKATOON-SOUTHEAST WATER SUPPLY SYSTEM  
LOCATION PLAN  
OF CANAL SYSTEM  
ZELMA RES. TO DELLWOOD RES.

Scale 2" = 1 mi.  
Submitted Approved  
DATE MAY 1972  
Drawn Checked  
PLAN No. WS1-R17





DRAWING 0107-001-02. LONGITUDINAL SECTION A-A' ALONG SSEWS CANAL  
MANITOU LAKE - DELLWOOD RESERVOIR.

**E.A. CHRISTIANSEN**  
CONSULTING GEOLOGIST  
Box 3087  
Saskatoon, Sask.  
S7K 3S9  
Phone: 374-6700  
Drawing No. 0107-001-02  
Drawn By E.A. CHRISTIANSEN  
Date JUNE 7, 1985