

SASKATOON CHEMICALS LTD.

GEOLOGY OF THE SASKATOON CHEMICALS  
LTD. SITE

Report 0156-002      July 17, 1995



# *E. A. Christiansen Consulting Ltd.*

CONSULTING GEOLOGIST

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July 17, 1995

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P.O. Box 1586  
Saskatoon, Saskatchewan  
S7K 3R3

Attention: Mr. Robert W. MacLeod, P. Eng.

Dear Mr. MacLeod:

Enclosed are four copies of Report 0156-002 on the "Geology of the Saskatoon Chemicals Ltd. site". If you have any queries, please contact me.

I appreciate the opportunity to meet you and to conduct this interesting and challenging investigation.

Sincerely yours,

*E. A. Christiansen*  
E.A. Christiansen P. Eng., P. Geol.



ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN		
<b>CERTIFICATE OF AUTHORIZATION</b>		
E.A. CHRISTIANSEN CONSULTING LTD.		
NUMBER 505		PERMISSION TO CONSULT HELD BY:
DISCIPLINE	SASK. REG. No.	SIGNATURE
Geol.	2917	<i>EAC</i>



DRILLING RIG ON HOLE SH-05, SASKATOON CHEMICALS LTD. SITE.  
DOT IN UPPER RIGHT IS LOCATION OF PHOTO BELOW. 09-06-95



CONTACT BETWEEN THE RIDDELL MEMBER AND THE UPPER TILL  
OF THE FLORAL FORMATION. 09/06/95

E. A. Christiansen Consulting Ltd.



DRILLING RIG ON HOLE SH-05, SASKATOON CHEMICALS LTD. SITE.  
09/06/95



DRILLING RIG ON HOLE SH-05, SASKATOON CHEMICALS LTD. SITE.  
09/06/95

E. A. Christiansen Consulting Ltd.

## SUMMARY

The Saskatoon Chemicals Ltd. site is not in the Saskatoon Low collapse structure. The site was glaciated at least six times as indicated by the presence of six separate and distinct tills including the lower and upper tills of the Dundurn Formation, till of the Warman Formation, lower and upper tills of the Floral Formation, and till of the Battleford Formation.

Five aquifers occur in the Saskatoon Chemicals Ltd. site. These aquifers are in: (1) sands in the Judith River Formation, (2) sand and gravel in the Empress Group in a valley fill between the Bearpaw Formation and the lower till of the Dundurn Formation, (3) lower till, sand, and gravel unit of the Floral Formation, (4) sand in the Riddell Member except along the South Saskatchewan River valley where the sand is dewatered, and (5) the lower sand and gravel unit in the Sutherland valley fill. West of the Saskatoon Chemicals Ltd. office building, the lower till, sand, and gravel unit and the Riddell Member of the Floral Formation were removed during erosion of the Sutherland valley.

## TABLE OF CONTENTS

	<u>Text</u>	Page
1.	INTRODUCTION -----	1
	1.1 Objective -----	1
	1.2 Location -----	1
	1.3 Previous work -----	1
	1.4 Present study -----	1
2.	STRATIGRAPHY -----	5
	2.1 Introduction -----	5
	2.2 Bedrock sediments -----	5
	2.2.1 Judith River Formation -----	5
	2.2.2 Bearpaw Formation -----	5
	2.3 Glacial sediments -----	5
	2.3.1 Empress Group -----	5
	2.3.2 Sutherland Group -----	7
	2.3.3 Saskatoon Group -----	7
3.	STRUCTURE -----	10
4.	ORIGIN AND GEOLOGIC HISTORY -----	10
	4.1 Phase 1 -----	10
	4.2 Phase 2 -----	13
	4.3 Phase 3 -----	13
	4.4 Phase 4 -----	13
	4.5 Phase 5 -----	13
5.	GROUNDWATER GEOLOGY -----	14
6.	LITERATURE CITED -----	15

Illustrations

	Page
Figure	
1. Location map -----	2
2. Stratigraphic chart -----	6
3. History of deglaciation -----	11
4. Geologic history of glacial deposits -----	12

Table

1. Index of information -----	3
2. Carbonate content of tills -----	8

Drawing

0156-002-01. Location of cross sections A-A' and B-B' -----	in back
0156-002-02. Cross section A-A' -----	in back
0156-002-03. Cross section B-B' -----	in back

Appendix

A. Geologic logs compiled in this study -----	16
B. Carbonate content of tills -----	23

1. INTRODUCTION

1.1 Objective

The objective is to provide a geological framework for geoenvironmental investigations to be carried out at the Saskatoon Chemicals Ltd. site.

1.2 Location

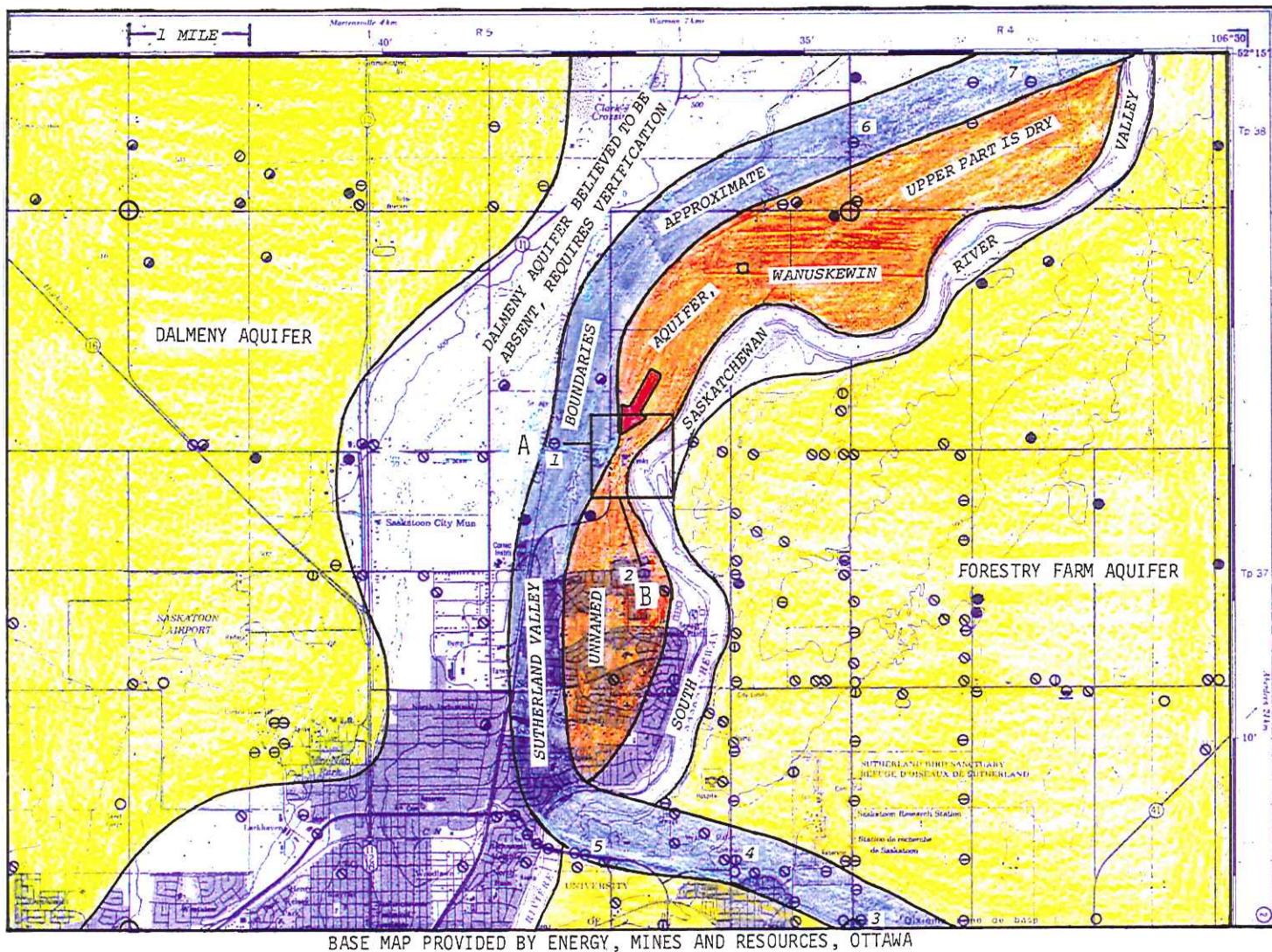
The Saskatoon Chemicals Ltd. site is between the Warman road and the South Saskatchewan River and south and north of 71 Street, east of the city limits of Saskatoon. (Fig. 1, Drawing 0156-002-01).

1.3 Previous work

Previous work on the geology of the Saskatoon area including the Saskatoon Chemicals Ltd. site includes: (1) a map of the geology and groundwater resources of the Saskatoon area (Christiansen, 1967), (2) a folio on the physical environment of Saskatoon (Christiansen, 1970), (3) a report on geology of the Saskatoon region (E.A. Christiansen Consulting Ltd., 1979), and (4) a paper on geotechnique of Saskatoon and surrounding area (Christiansen and Sauer, in press).

1.4 Present study

The present study includes: (1) the collection of samples and electric logs from one deep hole (SH-01) and four shallower holes (SH-02-05; Table 1, Appendix A) and the compilation of two cross sections (Drawings 0156-002-02, 03). Till samples were selected from the above holes for carbonate analysis (Appendix B) to aid in the identification of tills and intertill deposits.



TESTHOLES

- Ⓐ Electric logs, cutting samples, and cores
- Ⓑ Electric logs and cutting samples
- Ⓒ Electric and driller's logs
- Ⓓ Electric and/or gamma-ray logs
- Ⓔ Augerhole logs

WELLS AND PIEZOMETERS

- Ⓐ Electric logs, cutting samples, and cores
- Ⓑ Electric logs and cutting samples
- Ⓒ Electric and driller's logs
- Ⓓ Electric and/or gamma-ray logs
- Ⓔ Augerhole logs
- Ⓕ Well inventories

Figure 1. Map showing aquifers, buried intertill valley, and location of Drawing 0156-002-01 and parts of cross section A'A' and B-B'. Sutherland valley sediments were encountered in holes 1 and 3-7.

Table 1. Index of information.

ZONE 13 - NAD 27 UTM GRID COORDINATES				
STATION ID *	EASTING	NORTHING	GROUND ELEVATION (MSL)	TOP OF PIPE ELEVATION
EX-01A	389401.83	5784304.88	491.97	
MW02	389406.93	5784395.49	500.07	500.63
MW03	389452.82	5784420.76	499.60	500.90
MW04	389673.82	5784716.15	499.64	500.76
MW16	389337.40	5784234.23	500.49	501.16
MW19	389307.30	5784166.96	499.83	501.21
MWTA	389481.10	5784547.17	500.48	501.58
MW20	389198.84	5784271.43	500.37	501.07
SH-05	389441.41	5784274.72	473.55	
SH-01	389367.43	5784335.08	499.84	
SH-02	389585.67	5784627.06	499.58	
SH-03	389201.86	5784632.85	498.93	
SH-04	389277.62	5784528.03	500.44	
WATER			470.25	

**SKETCH PLAN  
showing  
Test Hole and  
Monitor Well Location  
SASKATOON CHEMICAL SITE**

Survey completed June 15th, 1995

\* EX Exposure

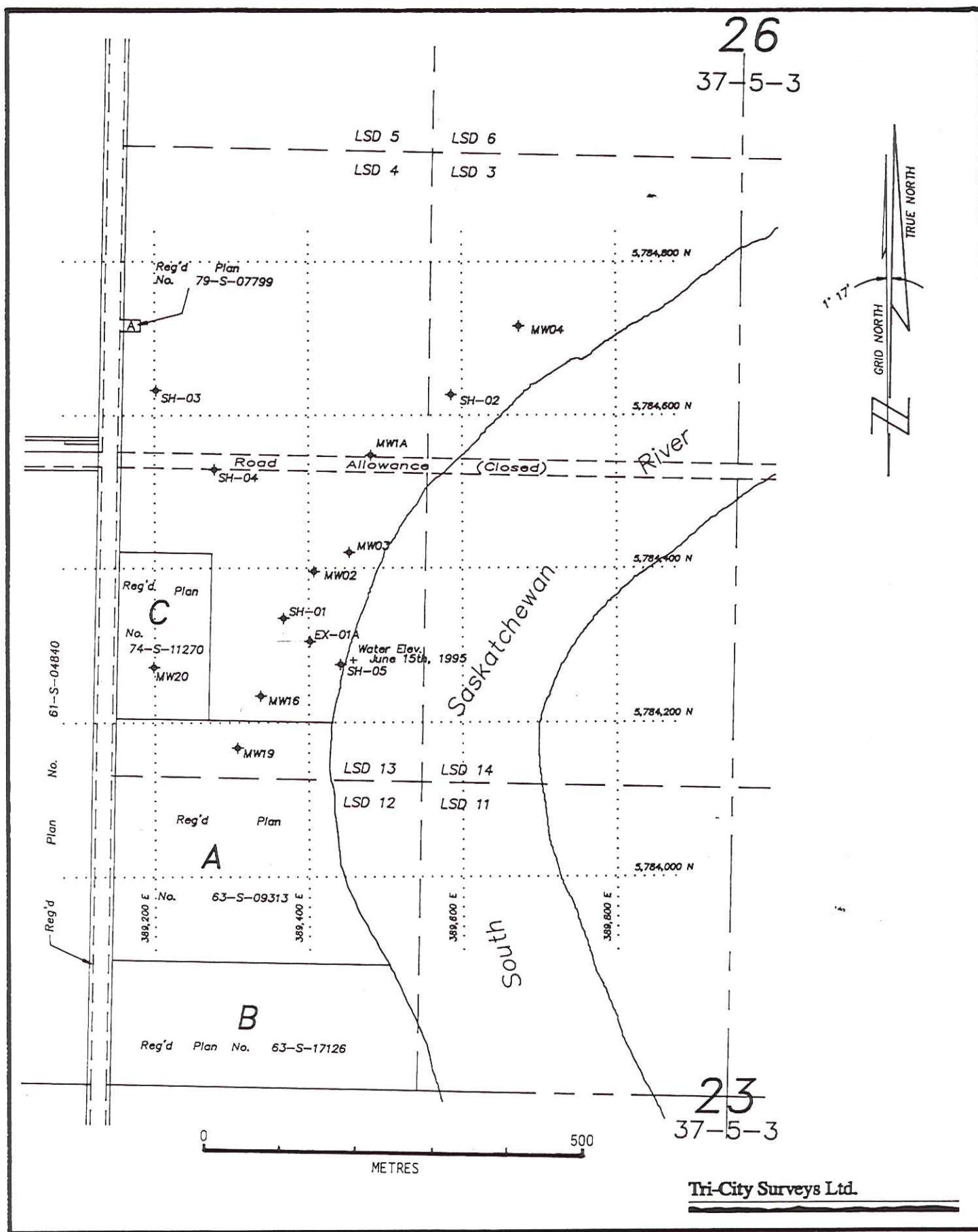
MW Monitor well by Beckie (1975)

SH Stratigraphic hole (Drilled in this study)

HOLE NO.	NAME	LOCATION
1	MITCHELL Saskatoon	SW-02-27-37-05-W3
2	SRC Saskatoon	NW-14-14-37-05-W3
3	CAL Forestry Farm	SW-04-06-37-04-W3
4	SRC Sutherland	SW-12-01-37-05-W3
5	C+A 42nd St. bridge 04	NW-09-03-37-05-W3
6	UMA Saskatoon 04	SW-12-06-38-04-W3
7	UMA Saskatoon 09	SW-02-08-38-04-W3

(over)

Table 1 continued



2. STRATIGRAPHY

2.1 Introduction

Bedrock and glacial sediments were encountered during the test drilling program. Bedrock sediments include the Judith River and Bearpaw formations, and the glacial deposits include Empress, Sutherland, and Saskatoon groups (Fig. 2).

2.2 Bedrock sediments

2.2.1 Judith River Formation

The Judith River Formation is composed of more than 27m of nonmarine, deltaic sand, silt, carbonaceous material, and concretionary zones (Appendix A, log SH-01; Drawings 0156-002-02, 03). The base of the Judith River Formation was not penetrated during the drilling program because the contact between the Judith River and Bearpaw formations provides a structural marker bed for the study.

2.2.2 Bearpaw Formation

The Bearpaw Formation is composed of up to 18m of gray, marine, noncalcareous silty clay and clayey and sandy silt (SH-01, 02, 03). The contact between the Judith River and Bearpaw formations is conformable.

2.3 Glacial sediments

2.3.1 Empress Group

The Empress Group (Whitaker and Christiansen, 1972) is composed of stratified sediments between bedrock and the oldest till (Drawing

TIME UNITS		STRATIGRAPHIC UNITS		
		GROUP	FORMATION	DEPOSIT
QUATERNARY	PLEISTOCENE	SASKATOON		13 Glaciolacustrine silt and clay
			12 Battleford	Till
			Floral	11 Upper till, sand, + gravel
				10 Silt and clay
				9 Sand and gravel
				8 Riddell Mbr. sand
				7 Lower till, sand, + gravel
			6 Warman	Till
			Dundurn	5 Upper till
				4 Lower till
		SUTHERLAND	3 Empress	Sand and gravel (Glacial)
			2 Bearpaw	Silt and clay
			1 Judith River	Sand and silt
CRETACEOUS	MONTANA			

Figure 2. Stratigraphic chart. Pleistocene nomenclature from Christiansen (1992).

0156-002-02, 03, log SH-01). The Empress Group is composed of less than 1m to 7m of sand and gravel. In cross sections A-A' and B-B', the extent of the Empress Group is inferred. The contact between the Bearpaw Formation and the Empress Group is an erosional unconformity.

### 2.3.2 Sutherland Group

The Sutherland Group (Christiansen, 1992) is composed of the Dundurn and Warman formations (Drawings 0156-002-02, 03). The Dundurn Formation is composed of lower and upper till units. The lower till unit is composed of 20-32m of gray to dark gray unoxidized till. The upper till unit is composed of 10-19m of till, the upper part of which is oxidized. The lower till has a mean carbonate content of  $25.22 \pm 2.35$  mL CO<sub>2</sub>/g, whereas the upper till has a mean carbonate content of  $31.96 \pm 2.26$  mL CO<sub>2</sub>/g (Table 2).

The Warman Formation is composed of less than 1m to 10m of clayey, gypsiferous, gray and olive, mottled till. The till has a mean carbonate content of  $21.32 \pm 4.24$  mL CO<sub>2</sub>/g (Table 2). Where present, The Warman Formation (Drawing 0156-002-02, log SH-04; Drawing 0156-002-03, log SH-02) is an excellent marker bed because of its lower carbonate and higher clay content. All contacts in the Sutherland Group are nonconformable.

### 2.3.3 Saskatoon Group

The Saskatoon Group is composed of less than 1m to 43m of till and stratified deposits including the Floral and Battleford formations and glaciolacustrine silt and clay.

Table 2. Carbonate content of tills at the Saskatoon Chemicals Ltd. site.

Stratigraphic Unit	No. of Samples	Mean mL CO <sub>2</sub> /g	Standard Deviation mL CO <sub>2</sub> /g
Battleford Formation	7	38.07	4.36
Floral Formation Upper till	14	32.88	5.11
Floral Formation Lower till	19	36.70	4.39
Floral Formation	33	35.08	5.07
Saskatoon Group	40	35.60	5.08
Warman Formation	8	21.32	4.24
Dundum Formation Upper till	29	31.96	2.26
Dundum Formation Lower till	23	25.22	2.35
Dundum Formation	52	28.98	4.06
Sutherland Group	60	27.96	4.84

The Floral Formation is up to 36m thick and is composed of a lower till, sand, and gravel unit; Riddell Member; gravel, sand, silt, and clay in the Sutherland valley fill; and an upper till, sand, and gravel unit. The lower till, sand, and gravel unit is up to 12m thick. In holes SH-01, 02, and 04 (Drawings 0156-002-02, 03), this lower unit is composed mainly of till. In the monitor wells in Drawing 0156-002-03, however, this lower unit is composed of apparently distinct beds sand and gravel and till. These sands and gravels are saturated (Drawing 0156-002-03; monitor wells 1A, 02, 03, 04, 16, 19).

The Riddell Member (SkwaraWoolf, 1981) is composed of up to 11m of fine-medium grained, light brownish gray, dry sand (See monitor wells in Drawing 0156-002-03). This sand becomes a silt in SH-02. Whether this silt unit is a facies change or a separate stratigraphic unit is unknown.

The Sutherland valley fill is composed of a lower unit of sand and gravel and an upper unit of silt and clay (Drawing 0156-002-02, logs 1 and SH-03). The lower sand and gravel unit is an aquifer. The valley is either a subglacial or proglacial valley. The fining upward of the valley fill suggests that the valley is subglacial.

The upper till, sand, and gravel unit is composed mainly of till, up to 22m thick in log 1(Drawing 0156-002-02). Locally, this unit has interbeds of sand and gravel (Drawings 0156-002-02, 03; log SH-01). The carbonate content of the lower and upper tills are  $36.70 \pm 4.39$  and  $32.88 \pm 5.11$  mL CO<sub>2</sub>/g, respectively. All contacts between units in the Floral Formation are nonconformable.

The Battleford Formation is composed of up to 3m of soft, massive, grayish brown and light brownish gray till which has a mean carbonate content of  $38.07 \pm 4.36$  mL CO<sub>2</sub>/g. The contact between the Floral and Battleford formations is unconformable.

The surface of the Saskatoon Chemicals Ltd. site is covered with a veneer of up to 3m of glaciolacustrine silt and clay that was deposited in glacial Lake Saskatchewan (Fig. 3). The contact between the Battleford Formation and the glaciolacustrine silt and clay is conformable.

### 3. STRUCTURE

According to Christiansen and Sauer (in press), the Saskatoon Chemical Ltd. site is immediately north of the Saskatoon Low. This conclusion is verified by hole SH-01 which penetrated the structural marker horizon between the Judith River and Bearpaw formations at or near its original elevation.

### 4. ORIGIN AND GEOLOGIC HISTORY

The origin and geologic history are depicted in five phases showing the reconstruction of cross section A-A' (Fig. 4). The origin and geologic history of the glaciolacustrine silt and clay is shown also in plan in Figure 3.

#### 4.1 Phase 1

During phase 1 (Fig. 4), a bedrock valley was eroded into the Bearpaw Formation (2) in the vicinity of hole SH-01 (Drawing 0156-002-01-03). This unnamed valley was filled subsequently with glacial sands and gravels of the Empress Group (3).

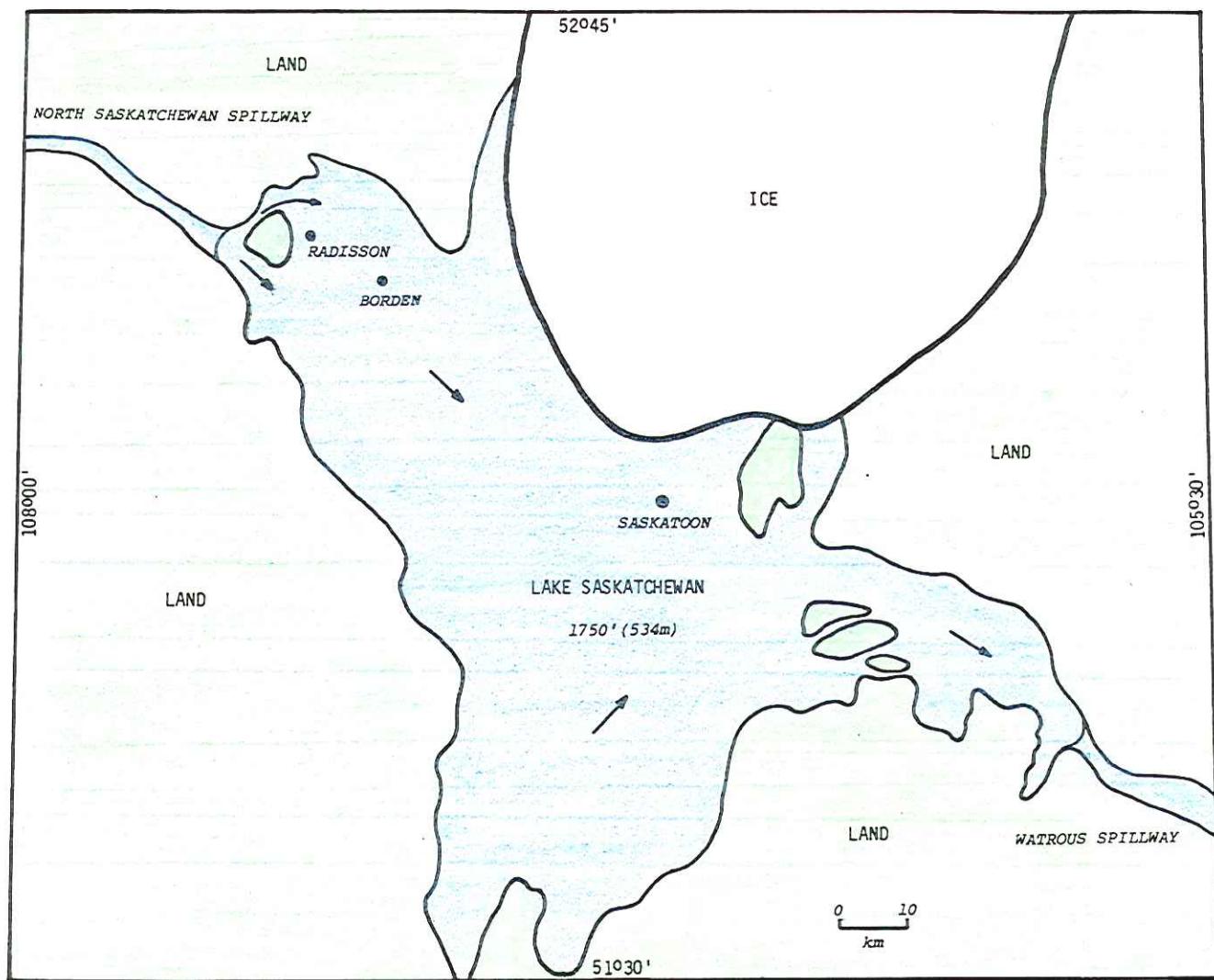


Figure 3. History of deglaciation of the Saskatoon region including the Saskatoon Chemicals Ltd. site from Christiansen (1979).

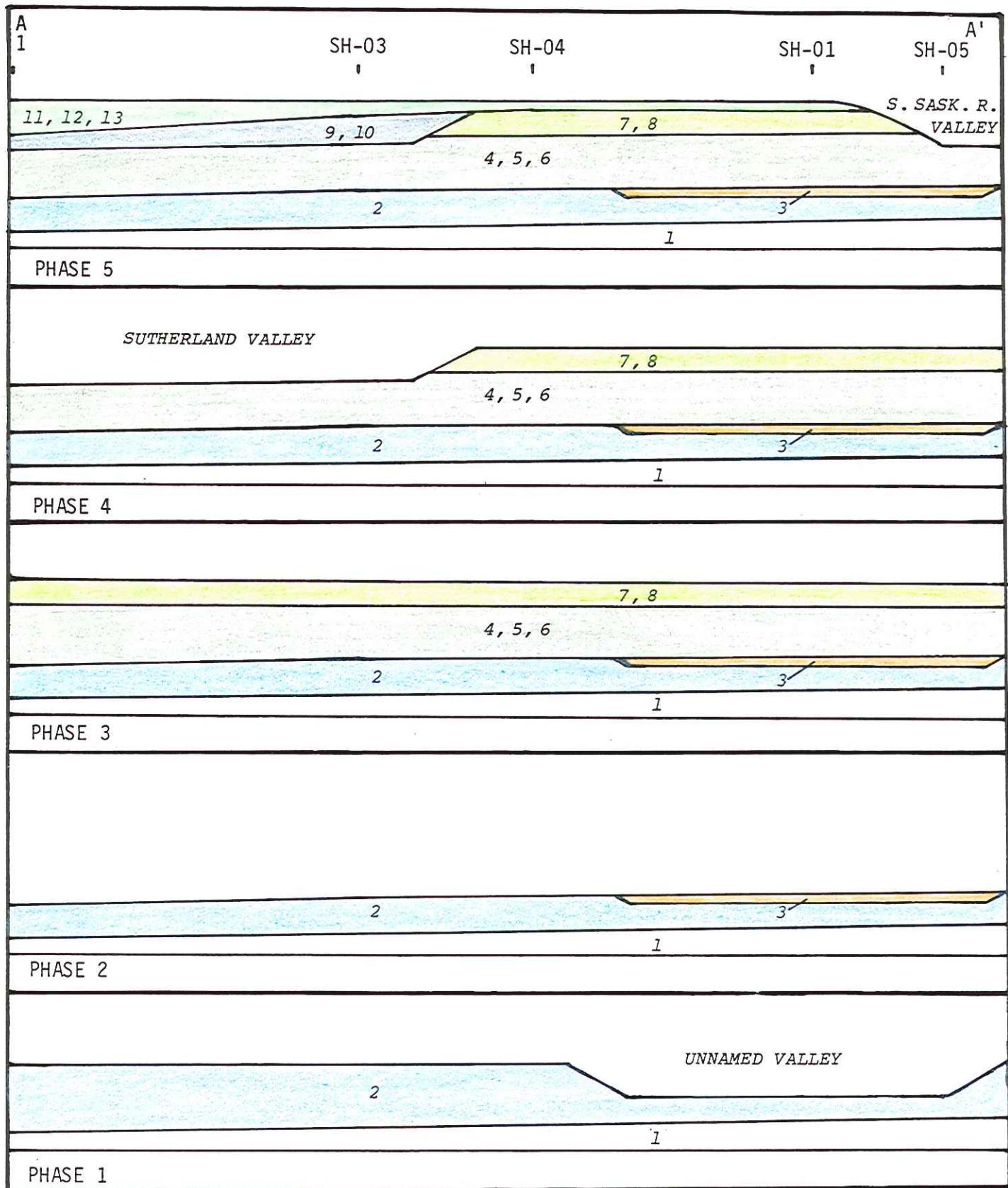


Figure 4. Geologic history of glacial deposits. See Fig. 2 for explanation numbers.

4.2

Phase 2

During phase 2, the Empress Group and Bearpaw Formation were glacially eroded leaving the Empress Group and Bearpaw Formation as they appear today in the vicinity of hole SH-01 (Fig. 4).

4.3

Phase 3

During phase 3, the lower and upper tills of the Dundurn Formation (4, 5), Warman Formation (6), and the lower till, sand, and gravel unit (7) and Riddell Member (8) of the Floral Formation were deposited.

4.4

Phase 4

During phase 4, the Sutherland valley was eroded through the Riddell Member (8) and the lower till, sand, and gravel unit (7) of the Floral Formation, the Warman Formation (6) into the upper till (5) of Dundurn Formation. Between phases 4 and 5, the Sutherland valley was filled with gravel and sand (9) and silt and clay (10). The fining upward of the sediments suggests a subglacial origin for the valley and its fill.

4.5

Phase 5

During phase 5, the Sutherland valley fill (9, 10) was covered with the upper till, sand, and gravel unit (11), the Battleford Formation (12), and the glaciolacustrine silt and clay unit (13). The glaciolacustrine sediments were brought into Lake Saskatchewan by the South and North Saskatchewan rivers (Fig. 3). The Watrous spillway provided the drainage for Lake Saskatchewan at this time. During the final drainage of the lake, the South Saskatchewan River commenced its erosion of the valley.

## 5. GROUNDWATER GEOLOGY

Four aquifers are present in the Saskatoon Chemicals Ltd. site: (1) Empress Group in the vicinity of hole SH-01, (2) lower till, sand, and gravel unit of the Floral Formation, (3) Riddell Member, and (4) the basal sand and gravel unit in the Sutherland valley fill (Drawings 0156-002-02,03). Heads in the Empress Group are being recorded in monitor well MW-20, whereas heads in the lower till, sand, and gravel aquifer are being recorded in monitor wells MW-1A, 02, 03, 04, 16, and 19 (Drawing 0156-002-03).

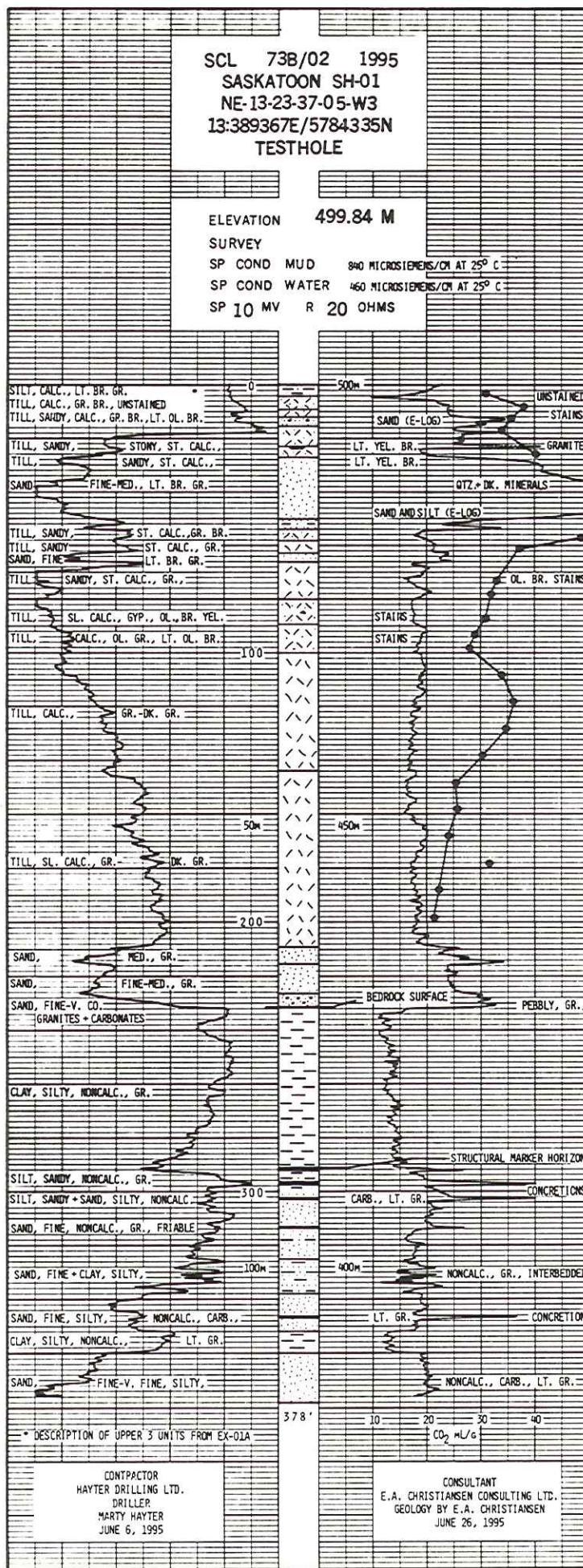
The sand in the Riddell Member near the South Saskatchewan River valley in cross section B-B' is dry as indicated by the high electrical resistance and low heads in monitor wells MW-1A, 02, 03, 04, 16, and 19 (Drawing 0156-002-03). Inland from the valley, however, water occurs in the Riddell Member at the hole SH-04 site (Ms. K. Kingdon, Sentar, personal communication).

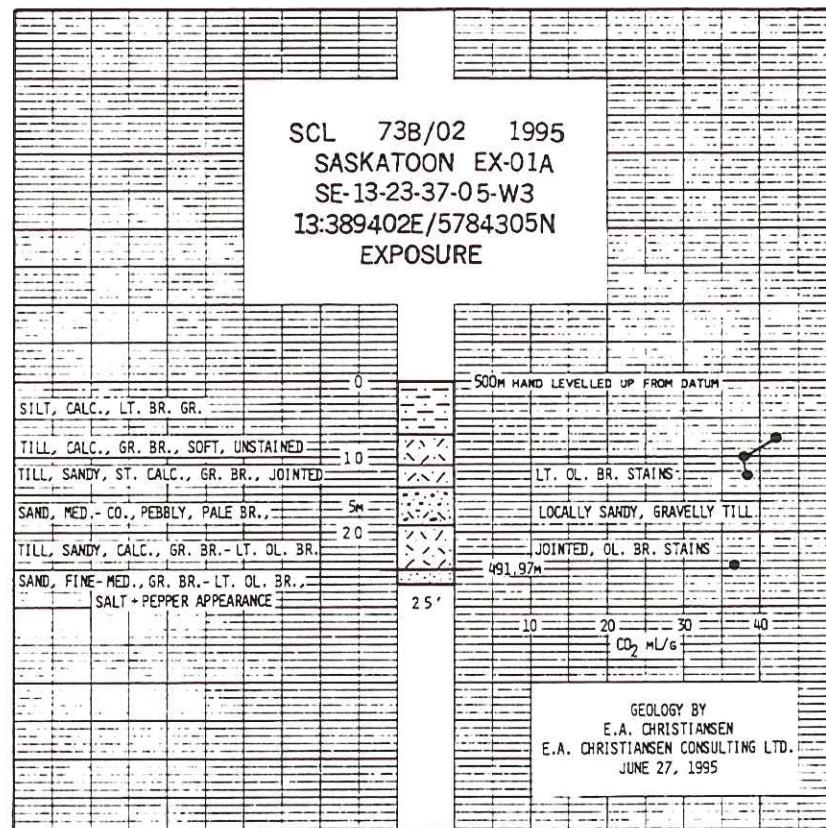
The lower sand and gravel unit in the Sutherland valley fill is an aquifer. A monitor well was installed by Sentar at the SH-03 site to record the head and water quality of this aquifer.

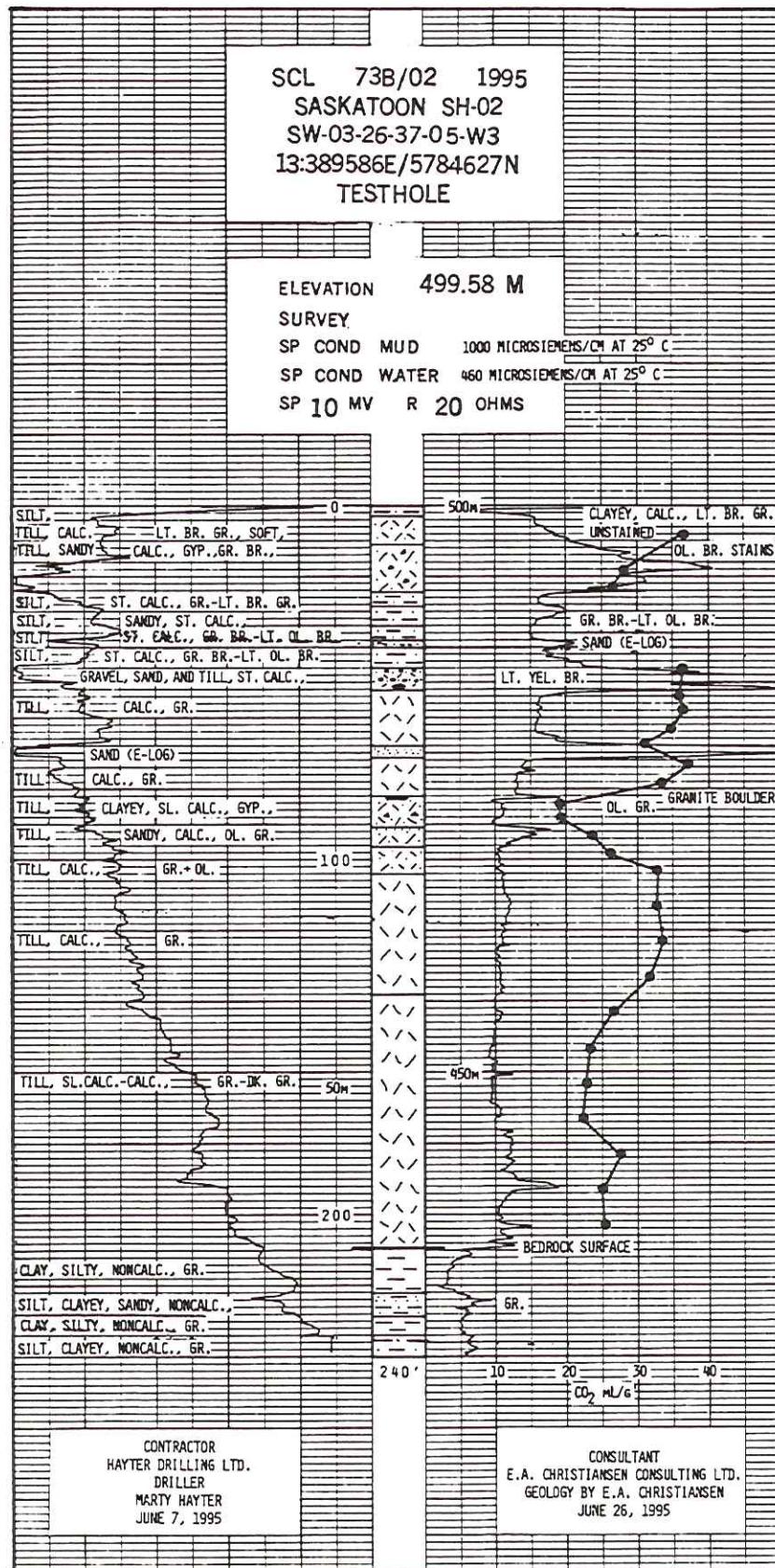
6. LITERATURE CITED

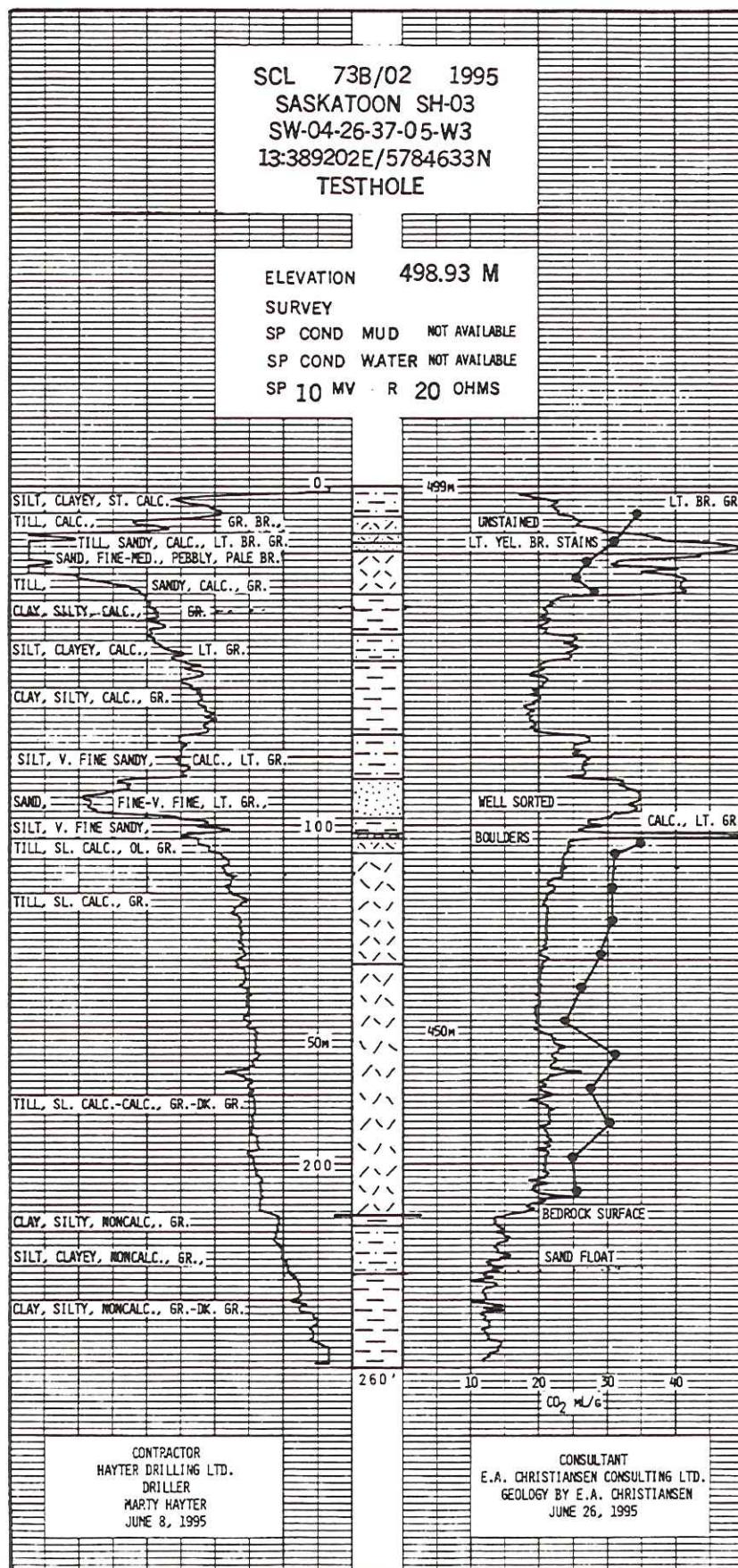
- Beckie, V. 1975. Monitor well installation and ground-water geohydrology evaluation program. Prepared for Prince Albert Pulp CO., Ltd., Saskatoon Chemicals Div. by J.D. Mollard and Associates Limited, Regina, Saskatchewan.
- Christiansen, E.A. 1967. Geology and groundwater resources of the Saskatoon area (73-B), Saskatchewan. Saskatchewan Research Council, Geology Division Map No. 7.
- Christiansen, E.A. Editor, 1970. Physical environment of Saskatoon, Canada. National Research Council of Canada Publication Number 11378, Ottawa, Canada, 68p.
- Christiansen, E.A. 1979. Geology of the Saskatoon region, Saskatchewan. Prepared for Saskatchewan Municipal Affairs by E.A. Christiansen Consulting Ltd., Consulting Report 0016-002, 62p.
- Christiansen, E.A. 1992. Pleistocene stratigraphy of the Saskatoon area, Saskatchewan, Canada: an update. Canadian Journal of Earth Sciences, 29:1767-1778.
- Christiansen, E.A. and Sauer, E.K. Geotechnique of the Saskatoon and surrounding area, Saskatchewan, Canada. Canadian Journal of Earth Sciences. In press.
- SkwaraWoolf, T. 1981. Biostratigraphy and paleoecology of Pleistocene deposits (Riddell Member, Floral Formation, Late Rancho-  
LaBorean), Saskatoon, Canada. Canadian Journal of Earth Sciences, 18:311-322.
- Whitaker, S.H. and Christiansen, E.A. 1972. The Empress Group in southern Saskatchewan. Canadian Journal of Earth Sciences, 9:353-360.

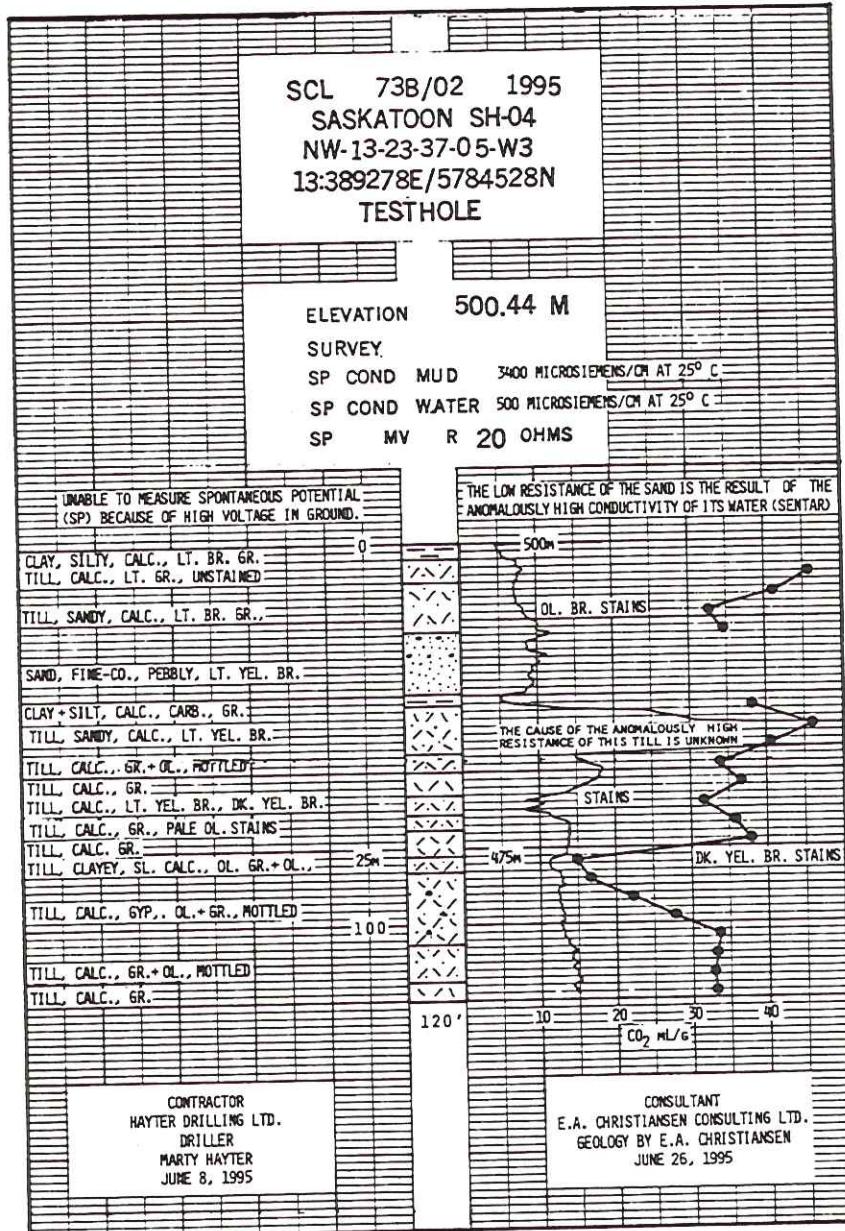
Appendix A. Geologic logs compiled in this study.

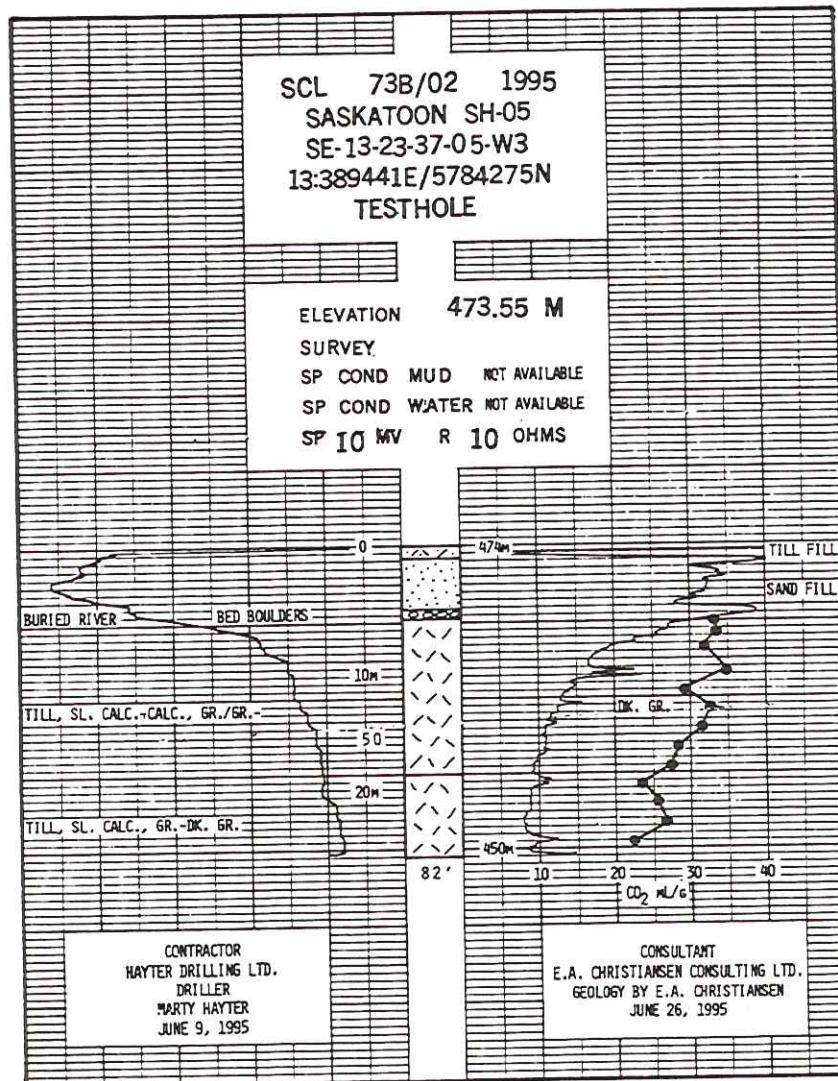












Appendix B. Carbonate content of tills.

REPORT

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HOLE SCL SASKATOON SH-01

M137 CHRISTIANSEN JUNE 20/95 (24) PG. 1337 [0.5 GM BR DIG.]

1 %Ca BY AA OT95.40

2 %Mg BY AA

3 Wt% DOLOMITE=COL.2\*7.5852

4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973

5 TOTAL Wt% CO<sub>3</sub> (COL.3+COL.4)

6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)

7 CO<sub>2</sub> FROM CALCITE=COL.4\*2.238

8 CO<sub>2</sub> FROM DOLOMITE=COL.3\*2.429

9 TOTAL CO<sub>2</sub>=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
BR	5.29	1.58	11.98	6.71	18.69	1.79	15.01	29.11	44.12
S 1 3'	3.51	1.27	9.63	3.54	13.17	2.72	7.92	23.40	31.31
S 2 8'	3.92	1.76	13.35	2.54	15.89	5.25	5.69	32.43	38.12
S 3 12'	3.76	1.60	12.14	2.80	14.94	4.33	6.27	29.48	35.75
S 4 18'	3.68	1.47	11.15	3.14	14.29	3.55	7.02	27.08	34.11
S 6 27'	4.60	1.59	12.06	4.94	17.00	2.44	11.06	29.29	40.35
S 12 57'	6.31	1.46	11.07	9.75	20.82	1.14	21.81	26.90	48.71
S 13 61'	4.54	1.30	9.86	5.99	15.85	1.65	13.40	23.95	37.35
S 15 73'	4.10	1.09	8.27	5.75	14.02	1.44	12.87	20.08	32.95
S 16 78'	3.98	1.07	8.12	5.53	13.65	1.47	12.39	19.71	32.10
S 18 87'	3.99	0.93	7.05	6.14	13.19	1.15	13.73	17.13	30.87
S 19 93'	3.59	0.97	7.36	4.97	12.33	1.48	11.13	17.87	29.00
S 20 98'	3.50	0.92	6.98	4.95	11.93	1.41	11.08	16.95	28.04
S 22 108'	4.58	0.91	6.90	7.69	14.59	0.90	17.21	16.77	33.98
S 24 118'	4.92	0.93	7.05	8.46	15.51	0.83	18.93	17.13	36.06
S 26 128'	4.31	1.17	8.87	5.95	14.82	1.49	13.31	21.56	34.86
S 28 138'	3.85	0.95	7.21	5.70	12.91	1.26	12.76	17.50	30.27
S 30 148'	3.30	0.76	5.76	5.11	10.88	1.13	11.44	14.00	25.44
S 32 158'	3.23	0.84	6.37	4.61	10.98	1.38	10.31	15.48	25.79
S 34 168'	3.18	0.70	5.31	5.06	10.37	1.05	11.32	12.90	24.22
BR	5.22	1.60	12.14	6.45	18.58	1.88	14.43	29.48	43.91
S 36 178'	3.87	1.12	8.50	5.05	13.55	1.68	11.31	20.64	31.95
S 38 188'	2.84	0.70	5.31	4.21	9.52	1.26	9.42	12.90	22.32
S 40 198'	2.71	0.70	5.31	3.89	9.20	1.37	8.70	12.90	21.59

REPORT

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EXPOSURE NUMBER SCL EX-01A

M139 CHRISTIANSEN JUNE 20/95 (5) PG. 1339 [0.5 GM REG. DIG.]

1 %Ca BY AA OT95.40

2 %Mg BY AA

3 Wt% DOLOMITE=COL.2\*7.5852

4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973

5 TOTAL Wt% CO<sub>3</sub> (COL.3+COL.4)

6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)

7 CO<sub>2</sub> FROM CALCITE=COL.4\*2.238

8 CO<sub>2</sub> FROM DOLOMITE=COL.3\*2.429

9 TOTAL CO<sub>2</sub>=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
--	-----	-----	-------	--------	--------	--------	--------	--------	--------

BR	5.15	1.62	12.29	6.19	18.48	1.98	13.86	29.85	43.70
S 1002 7.5'	4.32	1.95	14.79	2.76	17.55	5.36	6.18	35.93	42.10
S 1003 10'	4.02	1.68	12.74	3.12	15.87	4.08	6.99	30.95	37.94
S 1004 12.5'	3.99	1.76	13.35	2.72	16.07	4.91	6.08	32.43	38.51
S 1009 24.5'	4.36	1.34	10.16	5.37	15.54	1.89	12.02	24.69	36.71

REPORT

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HOLE SCL SASKATOON SH-02

M138 CHRISTIANSEN JUNE 20/95 (27) PG. 1338 [0.5 GM REG. DIG.]  
 1 %Ca BY AA OT95.40

2 %Mg BY AA

3 Wt% DOLOMITE=COL.2\*7.5852

4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973

5 TOTAL Wt% CO3 (COL.3+COL.4)

6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)

7 CO2 FROM CALCITE=COL.4\*2.238

8 CO2 FROM DOLOMITE=COL.3\*2.429

9 TOTAL CO2=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
BR	5.19	1.54	11.68	6.62	18.30	1.76	14.82	28.37	43.19
S 78 8'	4.10	1.50	11.38	4.06	15.44	2.80	9.09	27.64	36.73
S 80 18'	3.16	1.14	8.65	3.20	11.85	2.70	7.16	21.00	28.16
S 81 23'	2.90	1.14	8.65	2.55	11.20	3.39	5.70	21.00	26.71
S 86 48'	4.35	1.30	9.86	5.51	15.37	1.79	12.33	23.95	36.29
S 87 53'	4.39	1.22	9.25	5.94	15.19	1.56	13.29	22.48	35.77
S 88 58'	4.53	1.19	9.03	6.41	15.44	1.41	14.35	21.93	36.28
S 89 63'	4.24	1.20	9.10	5.65	14.75	1.61	12.64	22.11	34.75
S 90 68'	3.80	1.04	7.89	5.21	13.10	1.51	11.66	19.16	30.82
S 91 73'	4.50	1.30	9.86	5.89	15.75	1.68	13.17	23.95	37.12
S 93 78'	4.05	1.19	9.03	5.21	14.24	1.73	11.67	21.93	33.60
S 94 83'	2.28	0.70	5.31	2.81	8.12	1.89	6.29	12.90	19.19
S 95 88'	2.34	0.70	5.31	2.96	8.27	1.79	6.63	12.90	19.53
S 96 93'	3.00	0.77	5.84	4.32	10.16	1.35	9.67	14.19	23.86
S 97 98'	3.37	0.79	5.99	5.16	11.16	1.16	11.56	14.56	26.11
S 98 103'	4.18	1.03	7.81	6.20	14.01	1.26	13.87	18.98	32.85
S 100 113'	4.17	1.04	7.89	6.13	14.02	1.29	13.72	19.16	32.88
S 102 123'	4.34	1.03	7.81	6.60	14.41	1.18	14.77	18.98	33.74
S 104 133'	3.92	1.06	8.04	5.43	13.47	1.48	12.14	19.53	31.67
S 106 143'	3.30	0.89	6.75	4.58	11.33	1.47	10.24	16.40	26.64
BR	5.12	1.61	12.21	6.16	18.37	1.98	13.78	29.66	43.44
S 108 153'	2.93	0.77	5.84	4.15	9.99	1.41	9.28	14.19	23.47
S 110 163'	2.81	0.77	5.84	3.85	9.69	1.52	8.61	14.19	22.80
S 112 173'	2.71	0.77	5.84	3.60	9.44	1.62	8.05	14.19	22.24
S 114 183'	3.28	1.02	7.74	3.99	11.73	1.94	8.93	18.79	27.73
S 116 193'	3.06	0.86	6.52	4.10	10.62	1.59	9.18	15.85	25.02
S 118 203'	3.13	0.84	6.37	4.36	10.73	1.46	9.75	15.48	25.23

SASKATCHEWAN RESEARCH COUNCIL GEOCHEMICAL LAB

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HOLE SCL SASKATOON SH-03

M140 CHRISTIANSEN JUNE 20/95 (18) PG. 1340 [0.5 GM REG. DIG.]

- 1 %Ca BY AA OT95.40
- 2 %Mg BY AA
- 3 Wt% DOLOMITE=COL.2\*7.5852
- 4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973
- 5 TOTAL Wt% CO<sub>3</sub> (COL.3+COL.4)
- 6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)
- 7 CO<sub>2</sub> FROM CALCITE=COL.4\*2.238
- 8 CO<sub>2</sub> FROM DOLOMITE=COL.3\*2.429
- 9 TOTAL CO<sub>2</sub>=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
BR	5.18	1.58	11.98	6.43	18.42	1.86	14.39	29.11	43.50
S 127 8'	3.66	1.54	11.68	2.80	14.48	4.17	6.27	28.37	34.64
S 129 18'	3.47	1.27	9.63	3.44	13.07	2.80	7.69	23.40	31.09
S 131 22'	2.87	1.19	9.03	2.27	11.29	3.98	5.08	21.93	27.00
S 132 28'	2.76	1.06	8.04	2.53	10.57	3.18	5.66	19.53	25.19
S 133 32'	3.03	1.20	9.10	2.63	11.73	3.47	5.88	22.11	27.99
S 147 105'	4.62	1.00	7.59	7.42	15.01	1.02	16.61	18.42	35.03
S 148 108'	3.97	0.95	7.21	6.00	13.21	1.20	13.43	17.50	30.94
S 150 118'	3.74	1.05	7.96	5.02	12.98	1.59	11.23	19.35	30.57
S 152 128'	3.75	1.06	8.04	5.00	13.04	1.61	11.19	19.53	30.72
S 154 138'	3.64	0.93	7.05	5.26	12.32	1.34	11.77	17.13	28.91
S 156 148'	3.22	0.87	6.60	4.46	11.06	1.48	9.98	16.03	26.01
S 158 158'	3.13	0.74	5.61	4.77	10.38	1.18	10.68	13.63	24.31
S 160 168'	3.87	1.02	7.74	5.47	13.20	1.42	12.23	18.79	31.02
S 162 178'	3.26	1.01	7.66	3.98	11.64	1.92	8.91	18.61	27.52
S 164 188'	3.55	1.13	8.57	4.21	12.78	2.03	9.43	20.82	30.25
S 166 198'	3.11	0.82	6.22	4.39	10.61	1.42	9.83	15.11	24.93
S 168 208'	3.18	0.83	6.30	4.52	10.82	1.39	10.13	15.29	25.42

SASKATCHEWAN RESEARCH COUNCIL GEOCHEMICAL LAB

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HOLE SCL SASKATOON SH-04

M141 CHRISTIANSEN JUNE 20/95 (22) PG. 1341 [0.5 GM REG. DIG.]

1 %Ca BY AA OT95.40  
 2 %Mg BY AA  
 3 Wt% DOLOMITE=COL.2\*7.5852  
 4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973  
 5 TOTAL Wt% CO<sub>3</sub> (COL.3+COL.4)  
 6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)  
 7 CO<sub>2</sub> FROM CALCITE=COL.4\*2.238  
 8 CO<sub>2</sub> FROM DOLOMITE=COL.3\*2.429  
 9 TOTAL CO<sub>2</sub>=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
BR	5.33	1.59	12.06	6.76	18.82	1.78	15.14	29.29	44.43
S 180 8'	5.76	1.46	11.07	8.37	19.45	1.32	18.74	26.90	45.64
S 181 13'	4.83	1.54	11.68	5.72	17.40	2.04	12.81	28.37	41.18
S 182 18'	3.64	1.35	10.24	3.53	13.77	2.90	7.90	24.87	32.78
S 183 23'	3.83	1.45	11.00	3.59	14.59	3.06	8.05	26.72	34.76
S 187 43'	4.35	1.53	11.61	4.56	16.17	2.54	10.21	28.19	38.40
S 188 48'	5.27	1.80	13.65	5.75	19.40	2.37	12.87	33.16	46.03
S 189 53'	4.49	1.66	12.59	4.38	16.97	2.88	9.80	30.58	40.38
S 190 58'	4.15	1.18	8.95	5.51	14.46	1.63	12.32	21.74	34.06
S 191 63'	4.62	1.20	9.10	6.60	15.70	1.38	14.76	22.11	36.87
S 192 68'	3.71	1.21	9.18	4.28	13.46	2.14	9.59	22.29	31.88
S 193 73'	4.39	1.23	9.33	5.90	15.23	1.58	13.20	22.66	35.86
S 194 78'	4.51	1.39	10.54	5.54	16.08	1.90	12.40	25.61	38.01
S 195 83'	1.66	0.62	4.70	1.59	6.30	2.95	3.57	11.42	14.99
S 196 88'	2.05	0.56	4.25	2.81	7.06	1.51	6.30	10.32	16.62
S 197 93'	2.76	0.75	5.69	3.80	9.49	1.50	8.52	13.82	22.33
S 198 98'	3.40	0.97	7.36	4.50	11.85	1.64	10.06	17.87	27.94
S 199 103'	4.51	0.93	7.05	7.43	14.49	0.95	16.64	17.13	33.77
S 200 108'	4.52	0.86	6.52	7.75	14.27	0.84	17.34	15.85	33.18
BR	5.16	1.54	11.68	6.55	18.23	1.78	14.65	28.37	43.02
S 201 113'	4.40	0.92	6.98	7.20	14.18	0.97	16.11	16.95	33.07
S 202 118'	4.18	1.10	8.34	5.91	14.25	1.41	13.23	20.27	33.49

REPORT

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HOLE SCL SASKATOON SH-05

M142 CHRISTIANSEN JUNE 20/95 (14) PG. 1342 [0.5 GM REG. DIG.]

1 %Ca BY AA OT95.40

2 %Mg BY AA

3 Wt% DOLOMITE=COL.2\*7.5852

4 Wt% CALCITE=(COL.1-(COL.2\*1.6486))\*2.4973

5 TOTAL Wt% CO<sub>3</sub> (COL.3+COL.4)

6 WT%DOLOMITE/Wt% CALCITE (COL.3/COL.4)

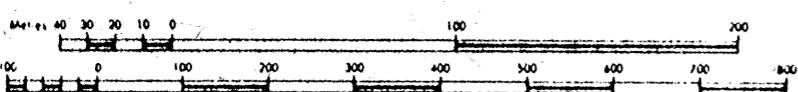
7 CO<sub>2</sub> FROM CALCITE=COL.4\*2.238

8 CO<sub>2</sub> FROM DOLOMITE=COL.3\*2.429

9 TOTAL CO<sub>2</sub>=COL.7+COL.8

	%Ca	%Mg	WT%DO	WT%CAL	C03TOT	D0/CAL	CO2CAL	CO2DOL	CO2TOT
BR	5.29	1.58	11.98	6.71	18.69	1.79	15.01	29.11	44.12
S 206 20'	4.15	1.09	8.27	5.88	14.14	1.41	13.15	20.08	33.23
S 207 23'	4.33	1.02	7.74	6.61	14.35	1.17	14.80	18.79	33.59
S 208 28'	4.00	1.05	7.96	5.67	13.63	1.41	12.68	19.35	32.03
S 209 33'	4.22	1.23	9.33	5.47	14.80	1.70	12.25	22.66	34.91
S 210 38'	3.62	1.00	7.59	4.92	12.51	1.54	11.02	18.42	29.44
S 211 43'	4.25	0.96	7.28	6.66	13.94	1.09	14.91	17.69	32.60
S 212 48'	3.93	1.02	7.74	5.61	13.35	1.38	12.57	18.79	31.36
S 213 53'	3.60	0.89	6.75	5.33	12.08	1.27	11.92	16.40	28.32
S 214 58'	3.41	0.91	6.90	4.77	11.67	1.45	10.67	16.77	27.44
S 215 63'	2.94	0.78	5.92	4.13	10.05	1.43	9.24	14.37	23.62
S 216 68'	3.19	0.83	6.30	4.55	10.84	1.38	10.18	15.29	25.47
S 217 73'	3.49	0.78	5.92	5.50	11.42	1.07	12.32	14.37	26.69
S 218 78'	2.71	0.79	5.99	3.52	9.51	1.70	7.87	14.56	22.42

389000 E SE SW 389200 E

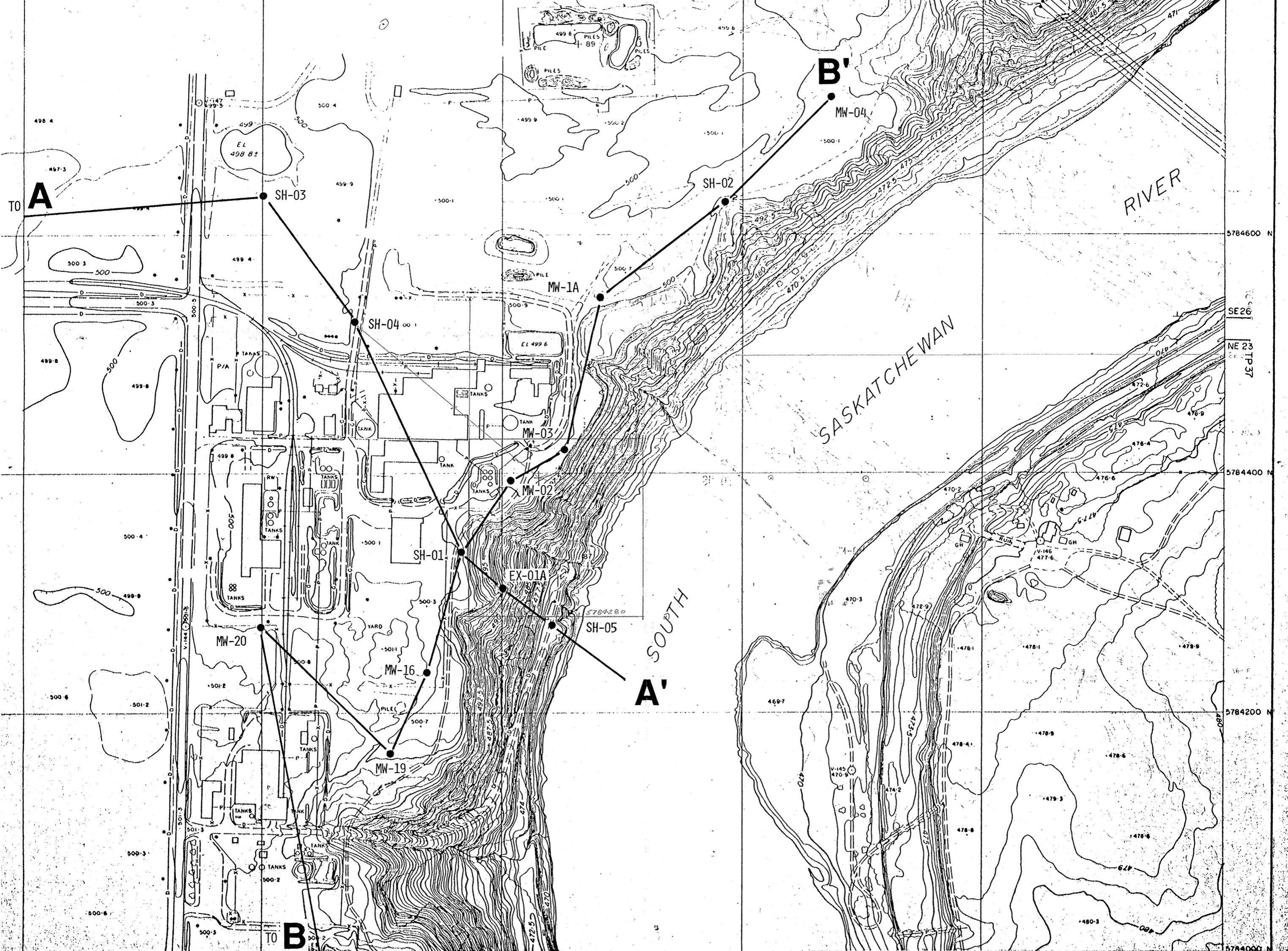


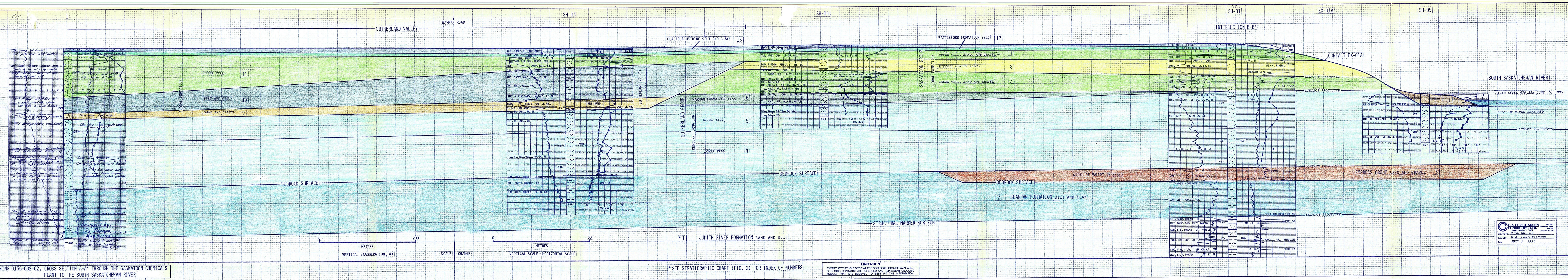
CONTOUR INTERVAL 2.0 METRES WITH 1.0 METRE  
INTERPOLATED CONTOURS.

- SH-02 STRATIGRAPHIC HOLE DRILLED IN THIS PROGRAM
  - EX-01A EXPOSURE
  - MW-02 MONITOR WELL INSTALLED BY J.D. MOLLARD AND ASSOCIATES  
LIMITED FOR SASKATOON CHEMICALS LTD.

BASE MAP BY MEEWASIN VALLEY AUTHORITY, SASKATOON

DRAWING 0156-002-01, MAP SHOWING LOCATION OF CROSS SECTIONS A-A' AND B-B'





G 0156-002-02. CROSS SECTION A-A' THROUGH THE SASKATOON CHEMICALS  
PLANT TO THE SOUTH SASKATCHEWAN RIVER.

