

P. MACHIBRODA ENGINEERING LTD.

GEOLOGY OF THE OUTLOOK BRIDGE
SASKATCHEWAN

Report 0150-002 September 6, 1994

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September 15, 1994

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Senior Geotechnical Engineer
P. Machibroda Engineering Ltd.
P.O. Box 1321
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Re: Report on the Geology of the Outlook Bridge, Saskatchewan

Dear Mr. Eckel:

Enclosed are six copies of Report 0150-002 on the "Geology of the Outlook Bridge, Saskatchewan". The change on the Draft Copy of September 6, 1994 has been made. If you should have any other queries, please let me know.

I found the study very challenging and interesting and look forward to working with you again sometime.

Sincerely yours,

E.A. Christiansen



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

ASSOCIATION OF PROFESSIONAL ENGINEERS
OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
E.A. CHRISTIANSEN CONSULTING LTD.

NUMBER 505

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Geol.

2917

E.A.

SUMMARY

The South Saskatchewan River at control section 15-11 eroded through the glaciolacustrine deposits and tills of the Battleford and Floral formations of the Saskatoon Group, through tills of the Sutherland Group, through the Tertiary sediments and the Bearpaw Formation, through Unit 4 into Unit 3 of the Judith River Formation, a depth of about 85 m. The South Saskatchewan River Valley subsequently, was partly filled by 35 m of alluvial clay, silt, and pebbly sand. The Lea Park Formation which underlies the Judith River Formation is the base of exploration in the geological investigation.

Geotechnical consideration arising from the geological study includes the recognition of deformed bedrock, the presence of a fill in the west abutment of the Outlook bridge, and water infiltration and erosion of eolian deposits.

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1. INTRODUCTION

1.1 Objective

The objective of this investigation is to provide a geological framework for P. Machibroda Engineering Ltd. for their geotechnical study of the proposed Outlook bridge site. More specifically, the objective is to draw a cross section including three boreholes, one in each of the east and west uplands and one in the valley bottom as set forth in Project Proposal 0150-001-01.

1.2 Location

The Outlook bridge site (control section 15-11) is immediately upstream from the present bridge, about 2km southwest of the town of Outlook along Highway 15 (Drawing 0150-002-01).

1.3 Previous Work

Previous work on the bedrock geology of the Outlook area includes a study of the Bearpaw Formation by Caldwell (1968), a study of the Judith River Formation

by McLean (1971), and a study of the bedrock geology and topography by Christiansen and Meneley (1971). Previous work on the Quaternary deposits of the Outlook area includes a soil map by Ellis et al. 1968 and a paper on the history of deglaciation by Christiansen (1979).

1.4 Present Study

The present study includes the examination of cutting samples from boreholes 102, 104, and 106 (Drawing 0150-002-02, Appendix A) and cores from boreholes 102B, 105, 106, and 106A. Samples were selected from boreholes 102 and 104 for carbonate and textural analyses. Based on this information, geological logs were compiled on the geophysical logs for boreholes 102, 104, and 106. This would have completed the investigation as set forth in project proposal 0150-001-01.

While awaiting survey results, additional borehole information continued to become available. Borehole logs 103, 105, and 107 were photomechanically processed and compiled using field logs and geophysical logs, and borehole logs 108, 110-117, and 121 were photocopied

only to complete the cross section (Drawing 0150-002-02).

2. GEOMORPHOLOGY

Control sections 15-11 includes the uplands east and west of the South Saskatchewan River, east and west valley sides, a 290 m-wide flood plain, and the South Saskatchewan River (430 m wide) between the west valley side and the flood plain (Drawings 0150-002-01, 02). Terraces occur in the east valley side and in the west upland. The South Saskatchewan River valley is 1250 m wide and 50 m deep. Prior to alluvial sedimentation, the valley was about 85 m deep.

3. STRATIGRAPHY

3.1 Introduction

Proglacial sediments in the Outlook bridge site include the Cretaceous Montana Group and Tertiary sediments. The glacial deposits include the Quaternary Sutherland and Saskatoon groups (Fig. 1).

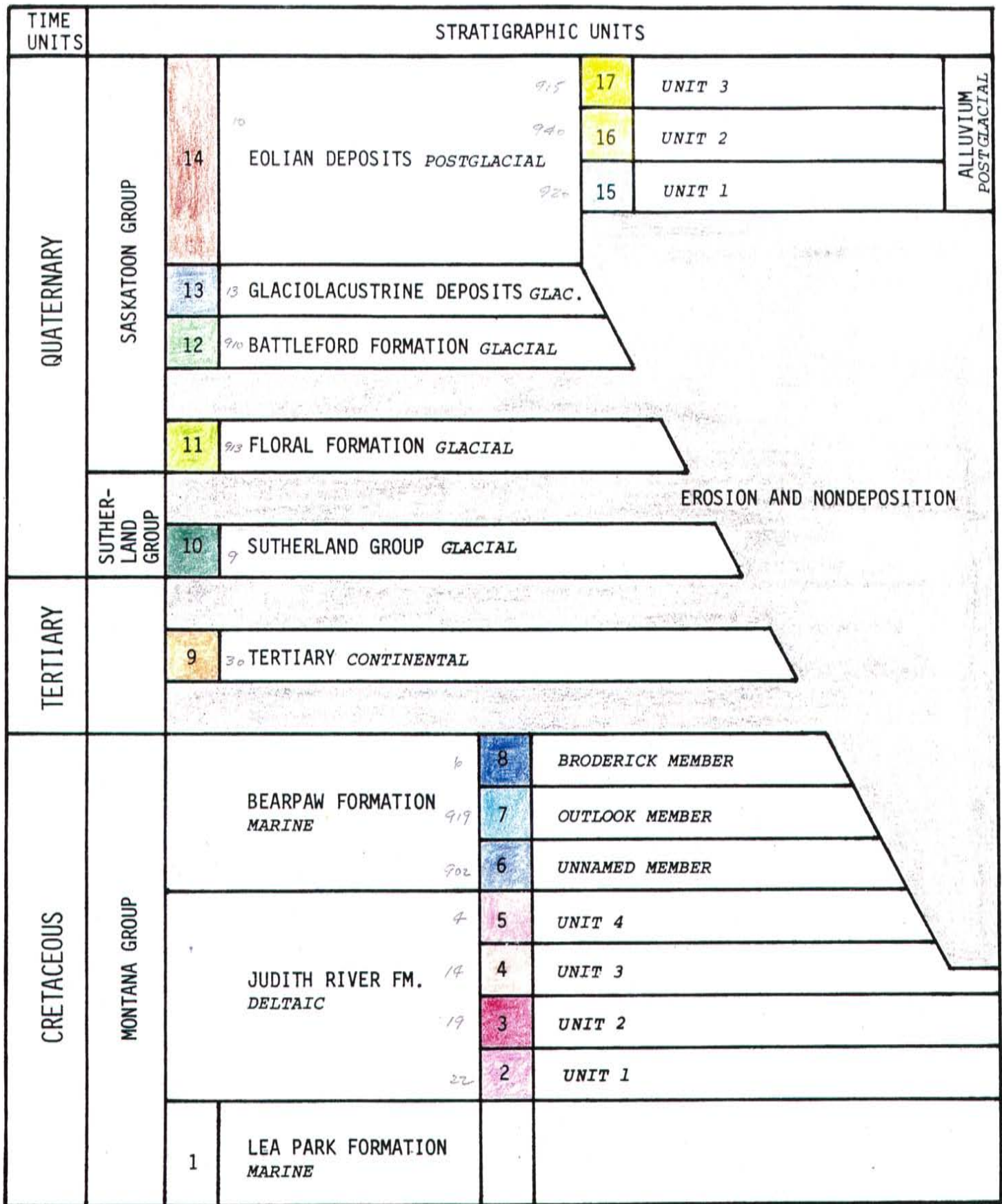


Figure 1. Stratigraphic chart. Note that the historical scale is not uniform.

3.2 Cretaceous System

3.2.1 Introduction

The Cretaceous System is composed of the Lea Park, Judith River, and the Bearpaw formations (Fig. 1, 0150-002-02). The Lea Park Formation is the base of exploration for the investigation of the Outlook bridge site.

3.2.2 Lea Park Formation

The Lea Park Formation is composed of gray noncalcareous, marine clay.

3.2.3 Judith River Formation

The Judith River Formation (McLean, 1971) is composed of 35 m to 60 m of interbedded clay, silt, and sand along with carbonaceous material. In the Outlook bridge site, the Judith River Formation is divided in 4 units. Unit 1 is composed of 20 m to 25 m of noncalcareous, gray clay which coarsens upward through silt, into silty sand in the upper part of the unit

(Drawing 0150-002-02). Unit 2 is composed of 5 m to 10 m of relatively clean, fine grained sand which constitutes the most permeable zone in the Judith River Formation. Unit 3 is composed of 5 m to 15 m of noncalcareous, gray, interbedded, very fine grained sand and silt. Unit 4 is composed of less than 1 m to 20 m of noncalcareous, carbonaceous, gray and brown, medium plastic sand, medium plastic to highly plastic silt, and highly plastic clay (Tables 1, 2). The contacts between the Lea Park and Judith River formations and between the units of the Judith River Formations are conformable (Fig. 1). Unit 1, units 2 and 3, and unit 4 are thought to be bottomset, foreset, and topset beds respectively, of a delta sequence.

3.2.4 Bearpaw Formation

The Bearpaw Formation, in ascending order, is composed of unnamed, Outlook, and Broderick members, (Drawing 0150-002-02; logs 102, 103). The unnamed member is composed at less than 1 m to 5 m of noncalcareous, gray, highly plastic (Table 1), marine clayey silt (Table 2). The Outlook Member, in ascending order, is composed of a silt, sand, silt, and sand sequence

Table 1. Liquid Limit of Sediments

Stratigraphic Unit	Number of Samples	Mean WL	SD
Battleford Formation	2	48.9	16.1
Floral Formation	3	30.0	1.6
Sutherland Group	6	47.1	2.5
Tertiary Silt	12	33.6	1.9
Bearpaw Fm. - Outlook Silt	10	52.1	4.0
- Outlook Sand	6	45.2	5.4
- Unnamed Clayey Silt	5	57.1	4.8
Judith River Fm. - Sand Interbeds	7	43.2	7.9
- Silt Interbeds	15	51.6	6.7
- Clay Interbed	1	62.8	--

Table 2. Texture of Sediments

Stratigraphic Unit	Number of Samples	% Sand		% Silt		% Clay	
		5.0-.071mm		.071-0.002mm		<0.002mm	
		X	SD	X	SD	X	SD
Eolian Silt	5	32.5	14.9	56.3	13.4	11.2	4.4
Glaciolacustrine Clay	1	8.5	--	25.5	--	66.0	--
Battleford Formation	1	33.0	--	36.5	--	30.5	--
Floral Formation	3	56.0	7.8	22.7	7.6	21.3	--
Sutherland Group	6	26.5	1.3	39.0	1.1	34.5	0.8
Tertiary Silt	15	2.9	0.5	71.7	9.7	25.4	5.8
Bearpaw Fm. - Outlook Silt	10	29.5	7.0	47.0	6.5	23.5	1.0
- Outlook Sand	6	53.3	9.2	30.3	6.4	16.4	3.5
- Unnamed Clayey Silt	5	23.0	4.8	43.5	8.9	33.5	6.1
Judith R. Fm. - Sand Interbeds	7	46.4	7.0	32.0	5.7	21.6	6.7
- Silt Interbeds	15	25.3	13.9	45.6	12.9	29.1	5.7
- Clay Interbed	1	2.0	--	43.0	--	55.0	--

(Drawing 0150-002-02, log 102). The sediments are composed of noncalcareous, marine, highly plastic silts and medium plastic sands (Tables 1, 2). In log 102, 1.5 m of noncalcareous gray, marine clayey silt of the Broderick Member is between the Outlook Member and Tertiary sediments. The contacts between the Judith River and Bearpaw formations and between the interbedded silt and sand units in the Bearpaw Formation are conformable.

3.3 Tertiary System

The Tertiary System is composed of less than 1 m to 30 m of predominately medium plastic (Table 1), calcareous silt (Table 2), which has a mean carbonate content of 21.4 ± 2.9 mL CO₂/g (Table 3). Clasts in diamictons and/or gravel at the base of the Tertiary sediments in borehole 103A are composed of ironstone, limestone, sandstone, chert, and petrified wood. Preconsolidation pressure (Table 4) of the apparently undeformed Tertiary sediments range from 3600 to 4600 kPa (Table 4). The preglacial nature of the clasts suggest that these sediment are preglacial. In as much as these sediments occur on uplands 50 m above

the preglacial Tyner Valley (Christiansen and Meneley, 1971) they are designated as Tertiary sediments rather than Empress Group, the preglacial component of which is restricted to preglacial valleys. A preglacial age of these sediments is confirmed by their preconsolidation pressures. The maximum preconsolidation pressures generated by glaciers is 1800 ± 200 kPa (Sauer *et al.* 1993) which is about one half of that measured for the Tertiary sediments (3600-4600 kPa).

Table 3. Carbonate Content of Sediments

Stratigraphic Unit	Number of Samples	Mean (mL CO ₂ /g)	SD
Battleford Formation	3	14.8	1.2
Floral Formation	5	25.0	2.5
Sutherland Group	19	12.6	3.1
Tertiary Silt	4	21.4	2.9

Table 4. Preconsolidation Pressures (provided by E.K. Sauer)

Stratigraphic Unit	Hole No.	Sample No.	Depth(m)	Wn	Wp	Wl	kPa
Tertiary Sediments	102B	LS4-566	10.1-10.5	16.3	19.9	49.4	4600
	106	507	15.3-15.7	23.7	19.3	34.2	<600
		510	18.3-18.6	19.1	19.4	32.1	3600
		513	21.4-21.7	17.3	18.3	33.1	4600
	106A	563	20.7-22.2	19.3	19.4	33.1	4200
Bearpaw Fm.							
Broderick Mbr.	102B	567	15.3-15.9	30.6	28.9	114	
Judith River Fm.							
	106A	564	22.7-23.1	19.4	17.3	61.4	8000
Unit 4		565	23.7-24.0	17.9	20.9	64.8	12000

3.4 Quaternary System

3.4.1 Introduction

The Quaternary System in the Outlook area is composed of the Sutherland and Saskatoon Groups (Christiansen, 1992).

3.4.2 Sutherland Group

The Sutherland Group is composed of less than 1 m to 24 m of medium plastic (Table 1) silty and clayey till (Table 2). The till has a mean carbonate content of 12.6 ± 3.1 ml CO_2/g (Table 3). The lower 12 m is gray, whereas the upper 12 m is olive gray and gypsiferous as a result of weathering. The carbonate content indicates that the tills of the Sutherland Group belong to either the Mennon and/or Warman formations (Christiansen, 1992). Consequently, the Sutherland Group is not divided into formations. The contact between the Tertiary sediments and the Sutherland Group is an erosional unconformity.

3.4.3 Saskatoon Group

The Saskatoon Group includes Floral and Battleford formations and glaciolacustrine, eolian and alluvial deposits. The Floral Formation is composed of less than 1 m to 7 m of stony, medium plastic (Table 1), sandy (Table 2), gypsiferous, grayish brown, till which is stained yellowish brown and which has a mean carbonate content of 25.0 ± 2.5 mL CO₂/g. The contact between the Sutherland Group and the Floral Formation is nonconformable.

The Battleford Formation is composed of less than 1 m to 3 m of stony, medium plastic (Table 1), grayish brown, unstained silty and clayey till (Table 2). The mean carbonate content of till of the Battleford Formation is 14.8 ± 1.2 mL CO₂/g (Table 3). The contact between the Floral and Battleford formations is nonconformable.

The glaciolacustrine deposits are composed of less than 1 m to 2 m of grayish brown, gypsiferous, varved silt and clay. The contact between the Battleford Formation and the glaciolacustrine deposits is conformable.

The eolian deposits (hand augered borehole 104C), in ascending order, are composed of 1.7 m of strongly calcareous, grayish brown, silt and 1.2 m of fine grained sand (Table 5). The deposits thin from 5 m in borehole 105 to 3 m in borehole 104C. The thinning away from the river suggests that the sand bars in the alluvium are, at least in part, the source of the eolian deposits. It is thought that the lower silt unit in the eolian deposits was derived from deltaic deposits south of Outlook and that the upper sand unit was derived from alluvial sand bars in the South Saskatchewan River. The contact between the glaciolacustrine and eolian deposits is conformable.

The alluvium in the South Saskatchewan River valley is up to 36 m thick (Appendix B, log 4-70) and, in ascending order, is composed of 3 units. Unit 1 is composed of less than 1 m to 6 m of silt and clay with sand interbeds; unit 2 is composed of less than 1 m to 8 m of fine--to medium grained sand with silt interbeds; and unit 3 is composed of less than 1 m to 22 m of fine--to coarse grained, pebbly sand (Appendix B, log 4-70). The upward coarsening of the alluvium

Table 5. Texture of Eolian Deposits

Hole No.	Sample	Depth (ft)	% Sand	% Silt	% Clay
	No.		5.0-0.071mm	0.071-0.002mm	<0.002mm
104C	1	2-3	58	36	6
	2	4-5	26	64	10
	3	6-7	22	66	12
	4	8-9	33	49	18
105	LS4-407	3.05-3.5 m	24	66	10

suggests prograding deltaic rather than fluvial sedimentation at least for Units 1 and 2 and the lower part of Unit 3. The base of the alluvium is indicated by a gravel deposit which lies on an erosional unconformity. Presently, the South Saskatchewan River is eroding the westside of the valley (Drawing 0150-002-02) and deflation from the sand bars in the river continues.

4. GEOTECHNICAL CONSIDERATIONS

4.1 Introduction

During the geological study of the Outlook bridge site, several geological observations were made which may have geotechnical implications. These observations include deformed bedrock, the occurrence of fill in the west abutment, and water infiltration and erosion of eolian deposits.

4.2 Deformed Bedrock

4.2.1 Introduction

Deformed bedrock was identified visually and/or by preconsolidation measurements. In the case of Cretaceous Judith River and Bearpaw formations, the original preconsolidation pressures ranged from 10000 to 13000 kPa (Sauer et al. 1990). The original preconsolidation pressure for Tertiary sediments is not known.

4.2.2 Unit 4 of the Judith River Formation

Brecciated shale (field log) was encountered in cutting samples between 21.75 m and 24.4 m (LS4-514, 515) in borehole 106. In borehole 106A between 23.7 m to 24.0 m (LS4-565), Unit 4 of the Judith River Formation is at its original preconsolidation pressure of 12000 kPa (Table 4). Although Unit 4 of the Judith River Formation between 22.7 m and 23.1 m (LS4-564) in borehole 106A (Table 4) shows no visual signs of deformation, the sample's preconsolidation pressure has been reduced to 8000 kPa. Fractured shale (field log) was encountered in core between 41.75 m and 42.5 m (LS4-445) in borehole 105 which presumably

accounts for the complete loss of circulation mud during the drilling of this interval. In borehole 111, 8 m of shale (field log) between 10 m and 18 m, presumably from Unit 4 of the Judith River Formation, overlies gravel similar to the basal gravel in the alluvium. The stratigraphic position of the gravel is confirmed in the electric log (Drawing 0150-002-02). For the shale to overlie glacial gravel, it must be deformed. It is believed that the deformation is related to landslide activity in the ancestral valley side which is now covered with alluvium.

4.2.3 Broderick Member of the Bearpaw Formation

The Broderick Member of the Bearpaw Formation between 15.3 m and 15.9 m (LS4-567) in borehole 102B is brecciated. The fact that the water content ($W_n=30.6$, Table 4) is higher than the plastic limit ($W_p=28.9$, Table 4) confirms that the Broderick Member of the Bearpaw Formation (LS4-567) is deformed (Sauer, 1984).

4.2.4 Tertiary Sediments

The Tertiary sediments between 15.3 m and 15.7 m (LS4-507) in borehole 106 are soft and have a preconsolidation pressure of less than 600 kPa (Table 4). The remaining 3 samples in borehole 106 and the one in borehole 102B from the Tertiary sediments (Table 4) have a mean preconsolidation pressure of 4250 ± 473 kPa. It is not known whether these firmer Tertiary sediments are at their original preconsolidation pressure. The presence of deformation in the underlying Judith River Formation, presumably the result of glacial action (Sauer et al. 1990, 1993), suggests that the firmer Tertiary sediment are not at their original preconsolidation pressure.

4.2.5 Origin of Deformation

The deformation in boreholes 102B, 105, 106, 106A are believed to be the result of glacial shear as described by Sauer et al. (1990, 1993). The deformation in borehole 111 may be the result of a landslide as suggested by the proximity of the borehole to the ancestral South Saskatchewan River valley which is now filled with alluvium.

4.3 Fill

The anomalous stratigraphic position of "till" (field log) in the upper 5 to 6 m in borehole 115 (LS4-1057 to 1059) in the west abutment of the Outlook bridge site prompted a visit to the site by B.F. Eckel, P. Machibroda Engineering Ltd. and E.A. Christiansen, E.A. Christiansen Consulting Ltd. on July 25, 1994 to investigate the anomaly. The loose, mixed, and organic nature of the deposit confirmed that the so called "till" is a fill which was pushed over the valley wall in the proposed abutment area. Subsequently, the fill was investigated by P. Machibroda Engineering Ltd. by drilling four augerholes (PMEL 1-4) in the vicinity of borehole 115.

4.4 Water Infiltration and Erosion of Eolian Deposits

Infiltration of water from rainfall, snowmelt, and irrigation is high in the eolian deposits, particularly in the upper sand unit (Table 5, Sample 1) which will enhance groundwater recharge and subsequent discharge in the valleyslope. The lower silt and upper sand units in the eolian deposits are susceptible to water erosion.

5. ACKNOWLEDGMENT

Preconsolidation pressure measurements in Table 4 were provided by E. Karl Sauer who also read the section on bedrock deformation.

6. LITERATURE CITED

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Appendix A. Index of Logs in Cross Section A-A¹.

Borehole	Northing (m)	Easting (m)	Elevation (m)
102	1180.306	1126.980	525.256
103	1170.598	1298.860	521.820
104	1165.469	2599.333	541.966
105	1113.912	2292.860	521.239
106	1122.107	2021.059	495.185
107	1127.627	1925.560	494.399
115	1172.324	1393.939	501.653

Borehole	Station (m)	Offset	Elevation (m)
108	1+777.7	1.5m Lt. C.L.	494.34
110	1+708.9	ON C.L.	494.60
111	1+641	ON C.L.	493.50
112	1+574.5	1 m Rt. C.L.	493.14
113	1+507.5	ON C.L.	492.80
114	1+413	ON C.L.	493.99
115	1+852.1	ON C.L.	501.683
116	1+143.7	6 m Rt. C.L.	495.875
117	1+273.7	1 m Rt. C.L.	494.605
121	Surveyed by P.M. relative to C.L. Highway and borehole 105.		

Appendix B. Geologic Logs.

SHT 72-0/06 1994
OUTLOOK BRIDGE
NO.102
NE-16-08-29-08-W3
13-355300E/5704400N
TESTHOLE

1180.306 m N / 1126.980 m E
ASSUMED DATUM

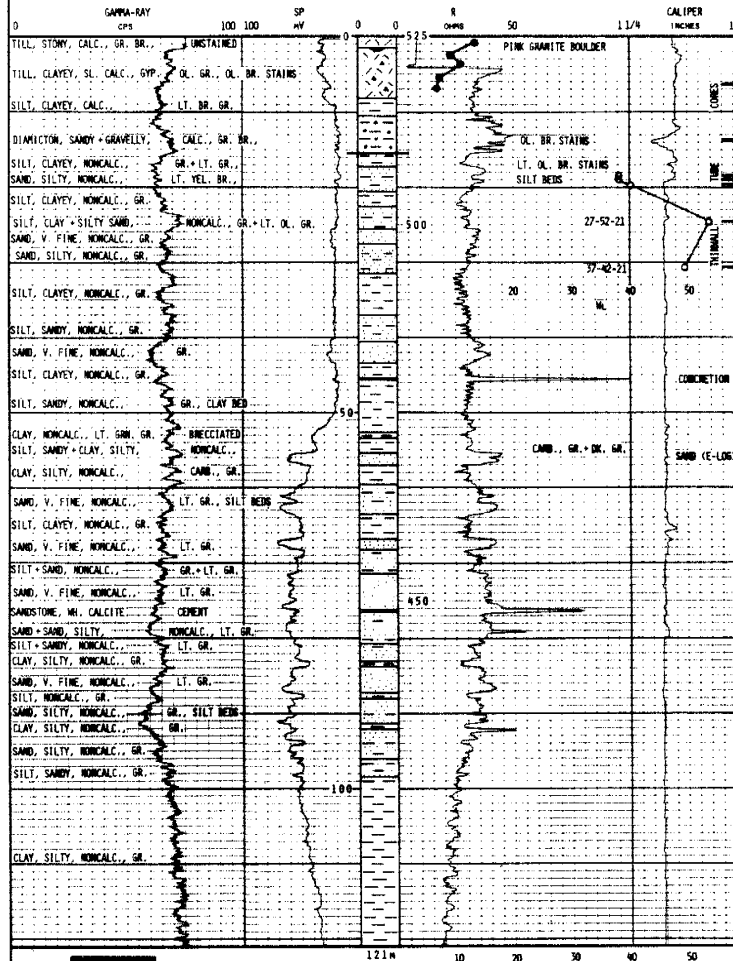
BORHOLE NO.	102	WTS	72-0/06
LAND LOCATION	NE-16-08-29-08-W3		
UTM COORD	13-355300E/5704400N		
GRID ELEV	525.256 m	DEPTH	121.95 m
DATE DRILLED	MARCH 8 TO MARCH 9, 1994		
COND WATER	100	MICROSHENCK-CH AT 25°C	
COND MUD	1000	MICROSHENCK-CH AT 25°C	
SPECIFIC GRAVITY MUD			
SUPERVISOR	L. SINCLAIR		
ASST SUPERVISOR			
LOGGED BY	L. SINCLAIR		
INSTRUMENT	WIDCO 1500		
PROBE ELECTRIC			
PROBE GAMMA			
PROBE CALIPER			
DATE LOGGED	MARCH 9, 1994		
TIME OF LOGGING	0900 HRS. TO 1100 HRS.		
DRAWN OPERATOR	B. MILLER		
CONTRACTOR	ASS'T OPERATOR: M. MINCHUM		
REMARKS			

PROJECT	OUTLOOK BRIDGE SITE
CONTROL SECTION	15-11
STATION	0+000
CUTTING SAMPLE INTERVAL	1.5 m
CORE SAMPLE INTERVAL	
FROM	
CASING DEPTH	10.35 m
CASING WALL THICKNESS	
WATER OR MUD LEVEL	POST IN HOLE
BIT SIZE	4 1/2" WALWAC
INTERVAL	0-121.95 m
BIT SIZE	
INTERVAL	
TYPE OF DRILL RIG	1250 FALLING

DEPTH	SCALE	SPEED
BP 121.9	1000 HV	15 m/min
RES 121.9	50 OHMS	15 m/min
GAMMA 121.9	0-100 CPS	8 m/min
CAL 121.9	1 1/4" x 1 1/4"	12 m/min

GAMMA TIME CONSTANT (TC) 5 SECONDS
GEOLOGY BY E.A. CHRISTIANSEN 11/04/94

CUTTING SAMPLE DESCRIPTION



Saskatchewan
Highways and
Transportation

50-30-20 = 50% SAND (5.0-0.75 mm), 30% SILT (0.75-0.002 mm), 20% CLAY (<0.002 mm)

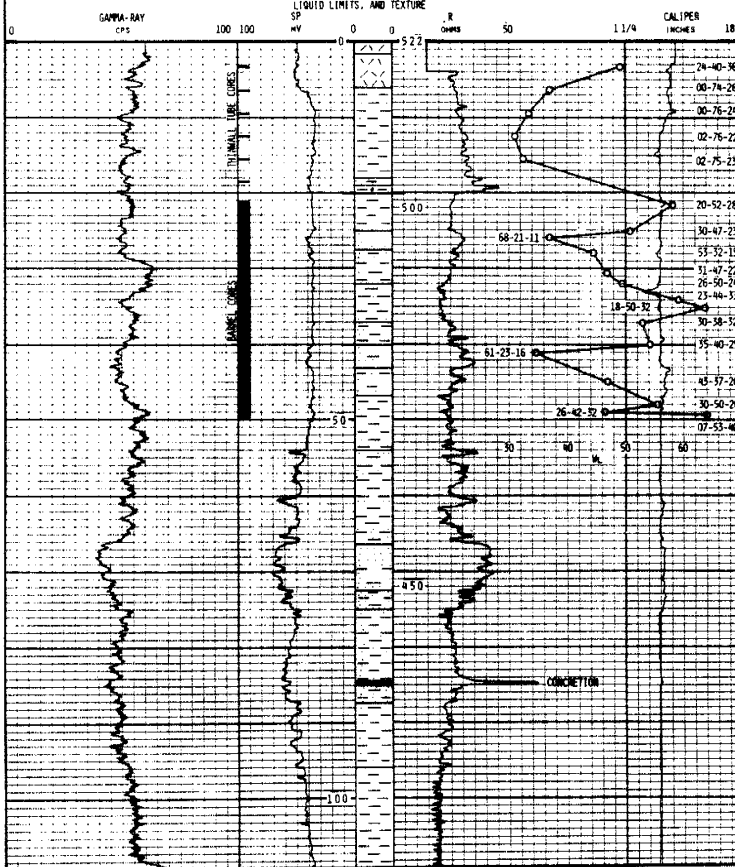
● CO₂ ○ W_L

SHT 72-0/06 1994
OUTLOOK BRIDGE
NO.103
NW-13-09-29-08-W3
13-355500E/5704400N
TESTHOLE

1170.500 N / 1200.000 E
ASSUMED DATUM

BOREHOLE NO.	103	WTS	72-0/06	PROJECT	OUTLOOK BRIDGE SITE
LAND LOCATION	13-355500E/5704400N	CONTROL	SECTION	13-11	
UTM COORD	13-355500E/5704400N	STATION	OFFSET		
GRD ELEV	521.820 m	DEPTH	100.25 m	CUTTING SAMPLE INTERVAL	1.5 m
DATE DRILLED	MARCH 2 TO MARCH 12, 1994	CORE SAMPLE INTERVAL		3.05 m	
COND WATER	100 MICROSIEMENS/CM AT 25°C	FROM CONTINUOUS	21.7-59.82 m		
COND MUD	1000 MICROSIEMENS/CM AT 25°C	CASING DEPTH	7.3 m		
SPECIFIC GRAVITY MUD		CASING WALL THICKNESS			
SUPERVISOR	L. SINCLAIR	WATER OR MUD LEVEL	POST IN HOLE		
ASST SUPERVISOR		ARMOURMENT			
LOGGED BY	L. SINCLAIR	BIT SIZE	4 1/2" DIA. I.D.C.	INTERVAL	0-21.7 m
INSTRUMENT	WILD 1500	BIT SIZE	DEBISOR C. AL.	INTERVAL	21.7-59.82 m
PROBE ELECTRIC		BIT SIZE	3 1/2" DIA. I.D.C.	INTERVAL	59.82-72.0 m
PROBE GAMMA		TYPE OF DRILLING	1250 FALLING		
PROBE CALIPER					
DATE LOGGED	MARCH 19, 1994				
TIME OF LOGGING	1630 HRS. TO 1800 HRS.				
DRILL OPERATOR	M. MILLER				
CONTRACTOR	ASS'T OPERATOR: M. HINCHUK				
REMARKS					

STRIP LOG FROM L. SINCLAIR'S FIELD LOG, GEOPHYSICAL LOGS,
LIQUID LIMITS, AND TEXTURE



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109 m

50-30-20 = 50% SAND, 30% SILT, 20% CLAY
SAND(S.D-0.75mm), SILT(0.71-0.002mm), CLAY(K0.002mm)

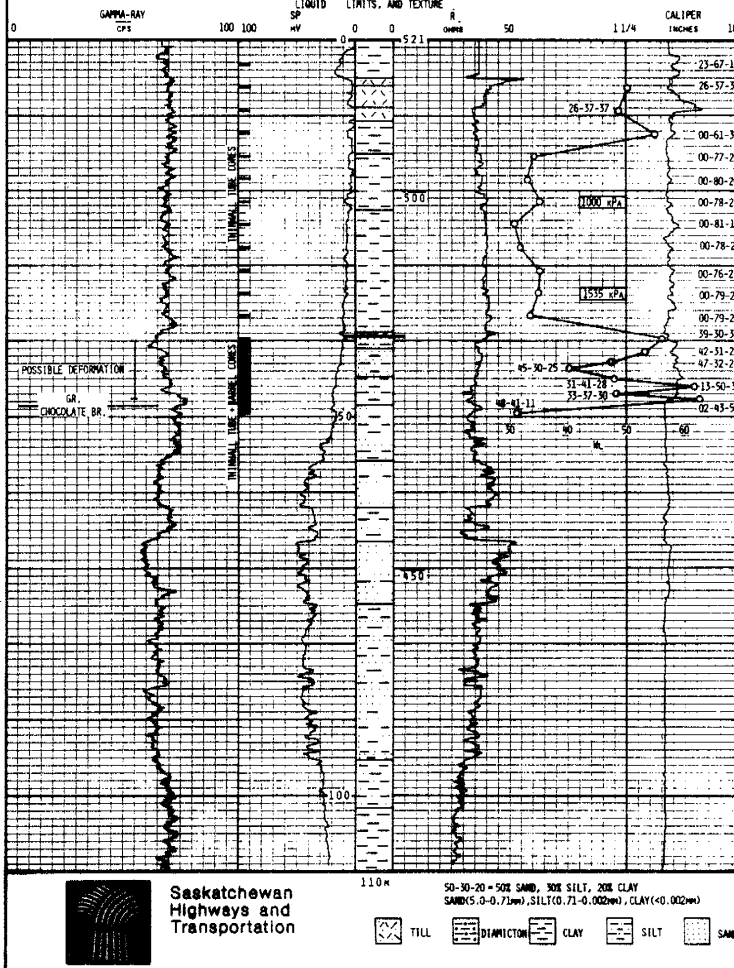


SHT 72-0/06 1994
OUTLOOK BRIDGE
NO.105
NE-15-09-29-08-W3
13:356500E/5704300N
TESTHOLE

1113.912 m N / 2292.860 m E
ASSUMED DATUM

BOREHOLE NO. 105	WTS 72-0/06	PROJECT OUTLOOK BRIDGE SITE
LAND LOCATION NE-15-09-29-08-W3		CONTROL SECTION 15-11
UTM COORD 13 356500E 5704300N		STATION 00P51
GRD ELEV 521.235 m	DEPTH 109.75 m	CUTTING SAMPLE INTERVAL 1.5 m
DATE DRILLED MARCH 16 TO MARCH 21 1994		CORE SAMPLE INTERVAL 1.05 m AND VARIOUS
COND WATER 100	MICROSIEMENS/CM AT 25°C	FROM 0-109.75 m
COND MUD 1000	MICROSIEMENS/CM AT 25°C	CASING DEPTH
SPECIFIC GRAVITY MUD		CASING WALL THICKNESS
SUPERVISOR L. SINCLAIR		WATER OR MUD LEVEL
ASST SUPERVISOR		ABANDONMENT POST IN HOLE
LOGGED BY L. SINCLAIR		BIT SIZE 4 1/2" WALDRAC
INSTRUMENT WISON 1500		BIT SIZE 4 1/2" WALDRAC
PROBE ELECTRIC		BIT SIZE 4 1/2" WALDRAC
PROBE GAMMA		TYPE OF DRILL PIPE 1250 FALLING
PROBE CALIPER		
DATE LOGGED MARCH 16 1994		
TIME OF LOGGING 1500 HRS TO 1730 HRS		
DRILL OPERATOR A. MILLER		
CONTRACTOR		
REMARKS ASST OPERATOR: M. KIMONIK		

STRIP LOG FROM L. SINCLAIR'S FIELD LOG, GEOPHYSICAL LOGS,
LIQUID LIMITS, AND TEXTURE

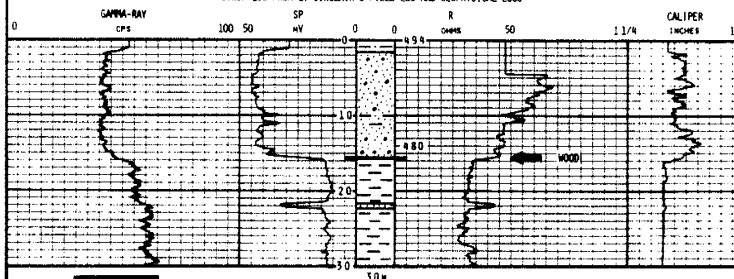


SHT 72-0/06 1994
OUTLOOK BRIDGE
NO. 107
NE-14-09-29-08-W3
13:356100E/5704300N
TESTHOLE

1127.627 M N / 1925.560 M E
ASSUMED DATUM

BOROHOLE NO.	107	WTS	72-0/06	PROJECT	OUTLOOK BRIDGE SITE
LAND LOCATION	NE-14-09-29-08-W3	CONTROL	SECTION 15-11	STATION	OFFSET
UTM COORD	13:356100E/5704300N	CUTTING SAMPLE INTERVAL	1.5 m	CORE SAMPLE INTERVAL	
GRID ELEV	594.190 m	FROM		CASING DEPTH	
DATE DRILLED	APRIL 22 TO APRIL 27, 1994	CASING WALL THICKNESS		WATER OR MUD LEVEL	
CONC. WATER	200 MICROSIEMENS/CM AT 25° C	ABANDONMENT		BIT SIZE	INTERVAL
CONC. MUD	200 MICROSIEMENS/CM AT 25° C	BIT SIZE	INTERVAL	TYPE OF DRILL BIT	1250 FAILING
SPECIFIC GRAVITY MUD		DEPTH	SCALE	SPEED	
SUPERVISOR	L. SINCLAIR	SP	30 m	30 m	15 m/min
ASST SUPERVISOR		RES	30 m	30 m	15 m/min
LOGGED BY	L. SINCLAIR	GAMMA	30 m	0.100 cps	8 m/min
INSTRUMENT	W1000 1500	CAL	30 m	1.1/8-18"	15 m/min
PROBE ELECTRIC		GAMMA TIME CONSTANT (TC) 5 SECONDS			
PROBE GAMMA		GEOLOGY BY E.A. CHRISTIANSEN 07/08/94			
PROBE CALIPER					
DATE LOGGED	APRIL 27, 1994				
TIME OF LOGGING	1430 HRS TO 1500 HRS				
DRILL OPERATOR	A. MILLER				
CONTRACTOR					
REMARKS	ASST. OPERATOR: M. HINCHUK				

STRIP LOG FROM L. SINCLAIR'S FIELD LOG AND GEOPHYSICAL LOGS



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GRAVEL CLAY SILT SAND

