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GEOLOGIC REPORT ON A LANDSLIDE ALONG THE RAM RIVER ROCKY MOUNTAIN HOUSE AREA, ALBERTA

by

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Abstract

A landslide has occurred along the Ram River, approximately 1/2 mile southwest of the exploratory well Pacific Pan Am Phoenix 10-27-38-11 which was drilled in 1969. Reports by residents of the area confirm that the slide occurred between autumn 1972 and autumn 1973.

Although the exact sequence of events that resulted in the present configuration of the slide is uncertain, the most likely cause of the slide is slope instability due to undercutting by the Ram River. No evidence was found to indicate that the slide may have been caused by drilling of the exploratory well, however, the writers are uncertain of what type of evidence, if any, could be found to relate drilling of the well to the landslide.

INTRODUCTION

The Alberta Department of Lands and Forests contacted the Geology Division of the Research Council of Alberta and indicated that a landslide had occurred along the Ram River southwest of Rocky Mountain House.

An exploratory well — Pacific Pan Am Phoenix 10-27-38-11W5 — was drilled in the vicinity of the slide in 1969 and a blowout had occurred at a depth of approximately 11,700 feet. Lands and Forests requested assistance from the Geology Division of the Research Council of Alberta in determining if the landslide had been caused by drilling the well.

The writers examined the landslide in the field with Mr. D. Lyons of the Department of Lands and Forests and the following report summarizes the findings.

LOCATION AND ACCESS

The landslide occurred along the Ram River approximately 25 miles southwest of Rocky Mountain House (Fig. 1).

Legal description of the slide area is the SW 1/4, Sec. 27, Tp. 38, Rge. 11 W5.

The wellsite (Pan Am Phoenix 10-27-38-11 W5) is accessible by road from Rocky Mountain House and the slide, located approximately 1/2 mile southwest of the wellsite, can be reached by walking along a seismic line from the wellsite.

TIME OF OCCURRENCE OF LANDSLIDE

A local resident reported fishing in the area in late summer 1972 and the landslide had not occurred. The landslide was discovered by a resident who went fishing in the area about the beginning of October, 1973. This places time of occurrence of the landslide between autumn 1972 and autumn 1973.

GENERAL GEOLOGY

Bedrock Geology

The bedrock geology of the area has been mapped by Green (1972) on a scale of 1" = 20 miles. The area immediately west of the landslide has been mapped by Erdman (1950) on a scale of 1" = 1 mile.

In the vicinity of the slide, the bedrock consists primarily of buff to buff grey calcareous sandstone. Dark grey shale layers are often interbedded with the sandstone and conglomerate was observed near the base of a section. These rocks belong to the Paskapoo Formation which is Paleocene and Upper Cretaceous in age.

Based on mapping by Erdman (1950), the large northwest-southeast trending Stolberg Anticline occurs in the area. Both the landslide and the exploration well are located on the southwest limb of this anticline (Fig. 2). Data from the exploration well (see Appendix), indicates that carbonate rocks occur well below 10,000 feet.

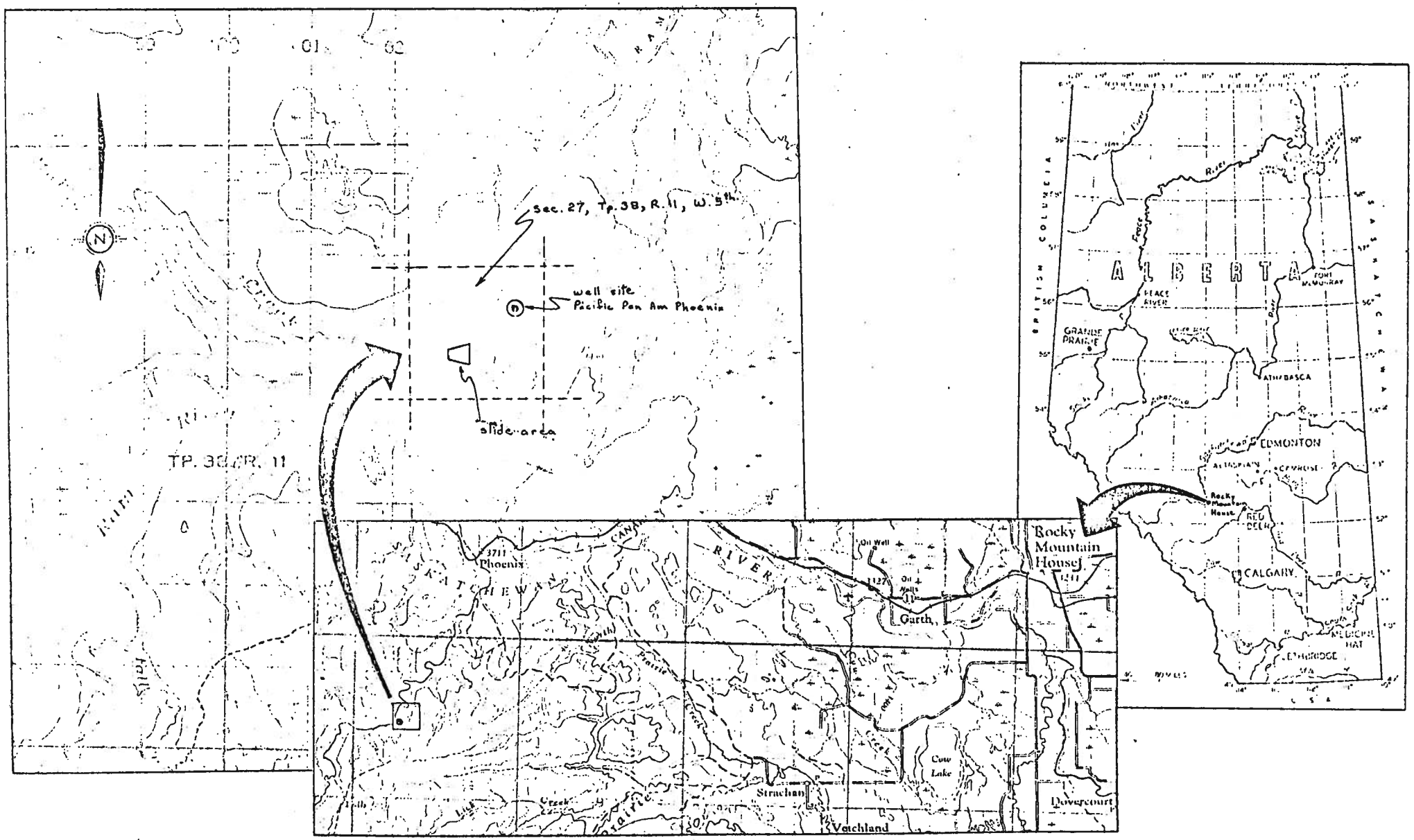

Figure 1. Location map of landslide along Ram River and exploration well

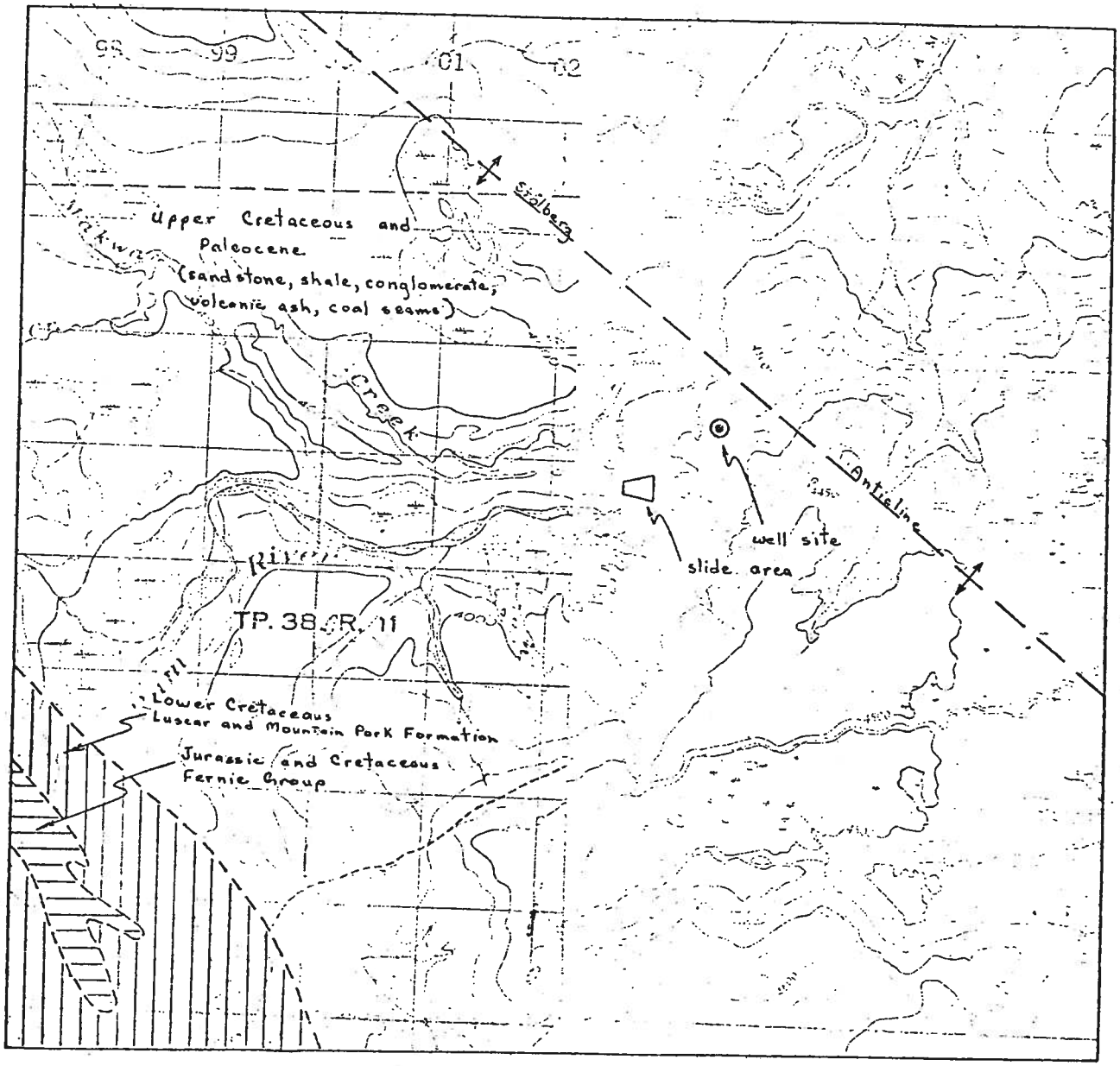

Figure 2. Bedrock geology in the vicinity of the landslide after Erdman (1950)

Surficial Geology

In the vicinity of the wellsite, the surficial deposits consist of hummocky moraine composed of glacial till. Near the landslide, hummocky lacustrine silts and clays are present. Geologic sections exposed by the slide revealed a stony till overlying bedrock with a thickness ranging from 10 to 60 feet. In certain localities the till is overlain by hummocky lacustrine silts and in others the lacustrine sediments have been removed by erosion. A thin layer of colluvium generally occurs on most of the slopes along the banks of the Ram River.

Coarse sand and gravel bars and terraces are present along the valley of the Ram River throughout the area.

DESCRIPTION OF THE LANDSLIDE

The geomorphology of the area, as interpreted from topographic maps and air photographs is schematically shown on figure 3. A vegetated slope in which two gullies were cut by surface water runoff was being undercut by the Ram River (Fig. 3).

The configuration of the area subsequent to the slide (based on field observations) is schematically shown on figure 4. The area has been subdivided into sections 1 to 9 and each of the sections is described separately. Photographs of the slide area are included in the Appendix and a geologic cross section is included on figure 5.

Section 1

The upper portion of the slope consists of colluvium underlain by hummocky lacustrine silts and clays. Till and bedrock are present below these surface deposits. Much evidence of slope instability is present in terms of bent and overturned trees as well as numerous apparently recent slump scars. Surface water is ponded in many of the slump scars and depressions.

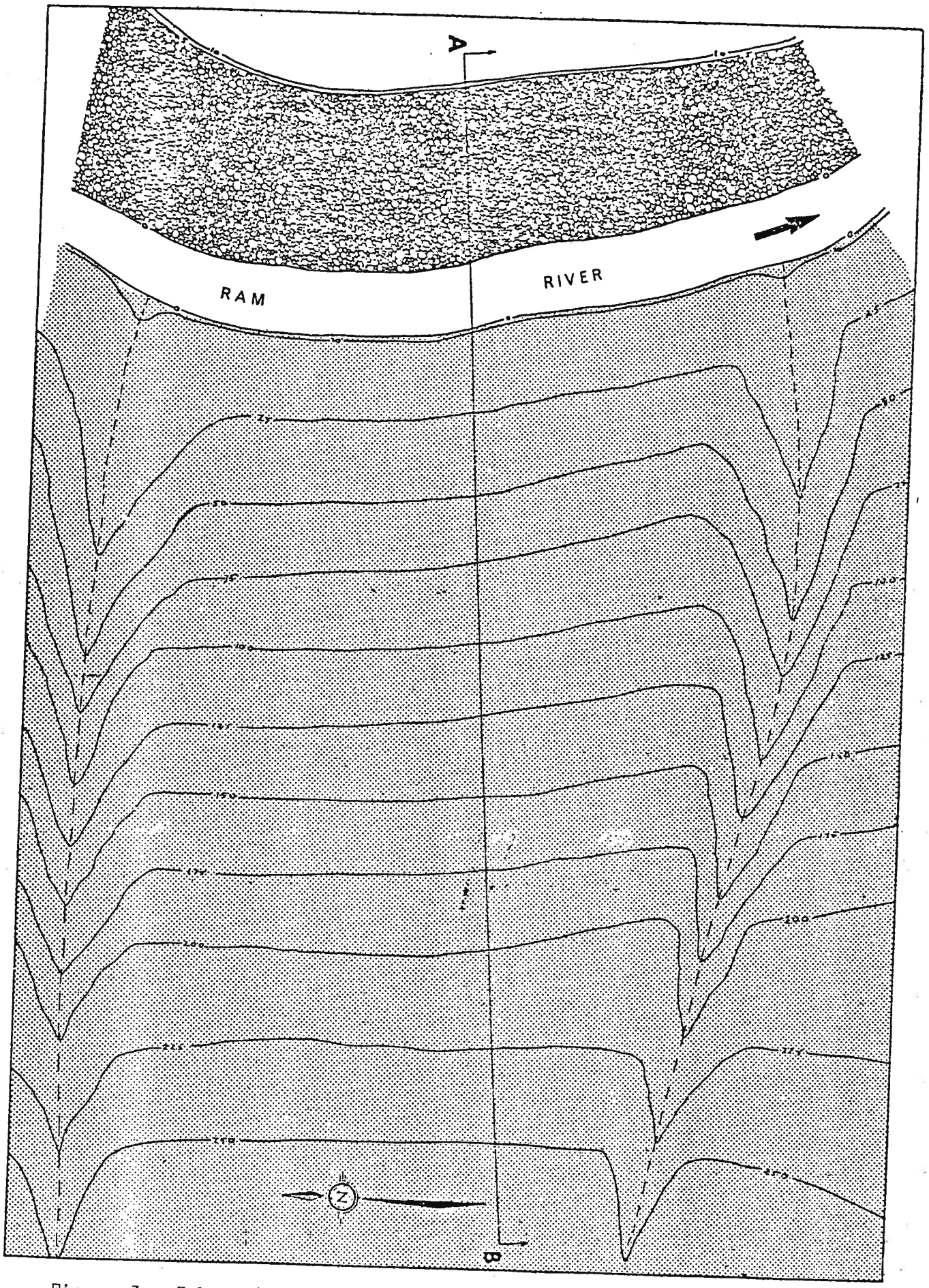

Figure 3. Schematic diagram of topograph of the area prior to the landslide

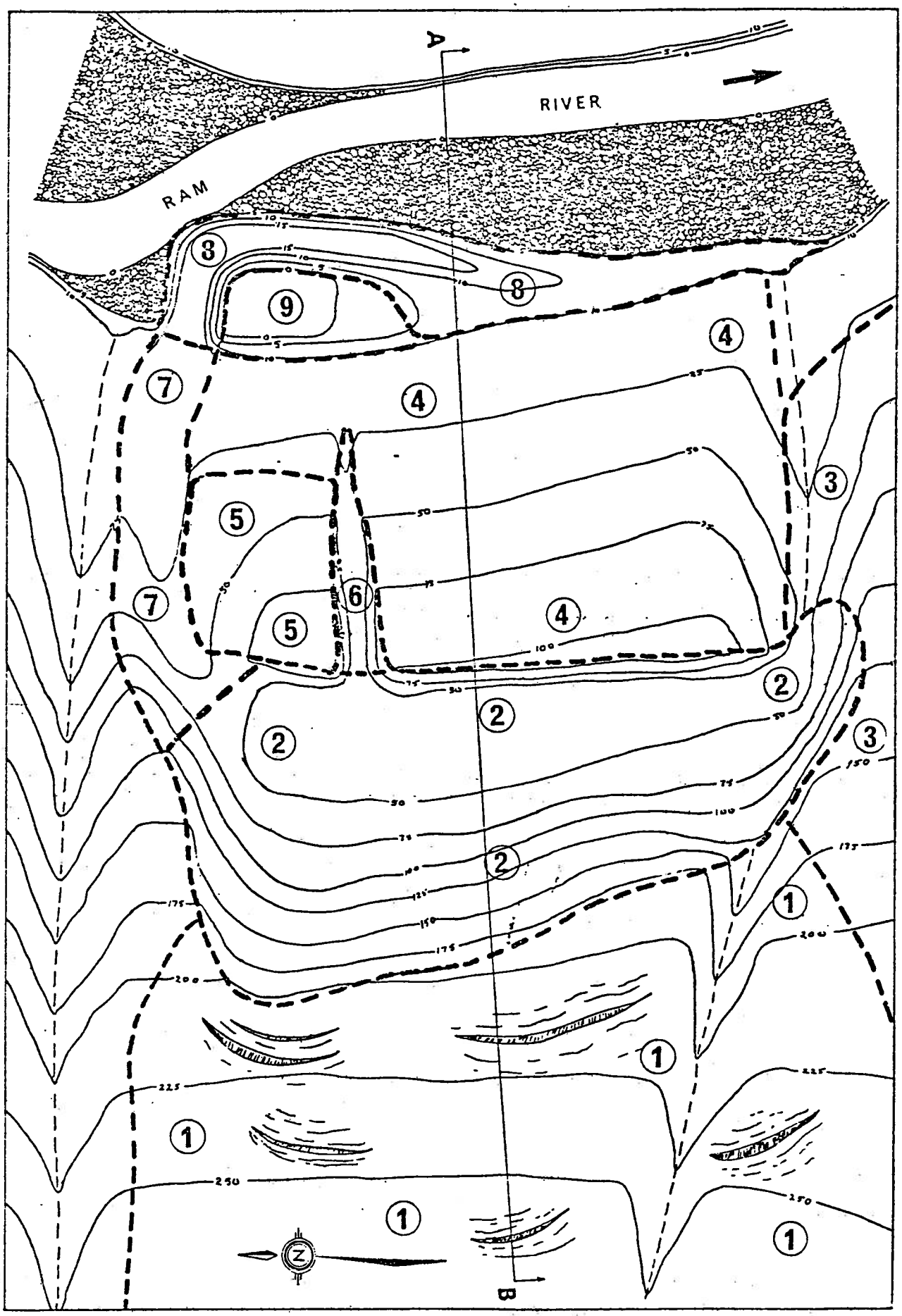

Figure 4. Schematic diagram of slide area

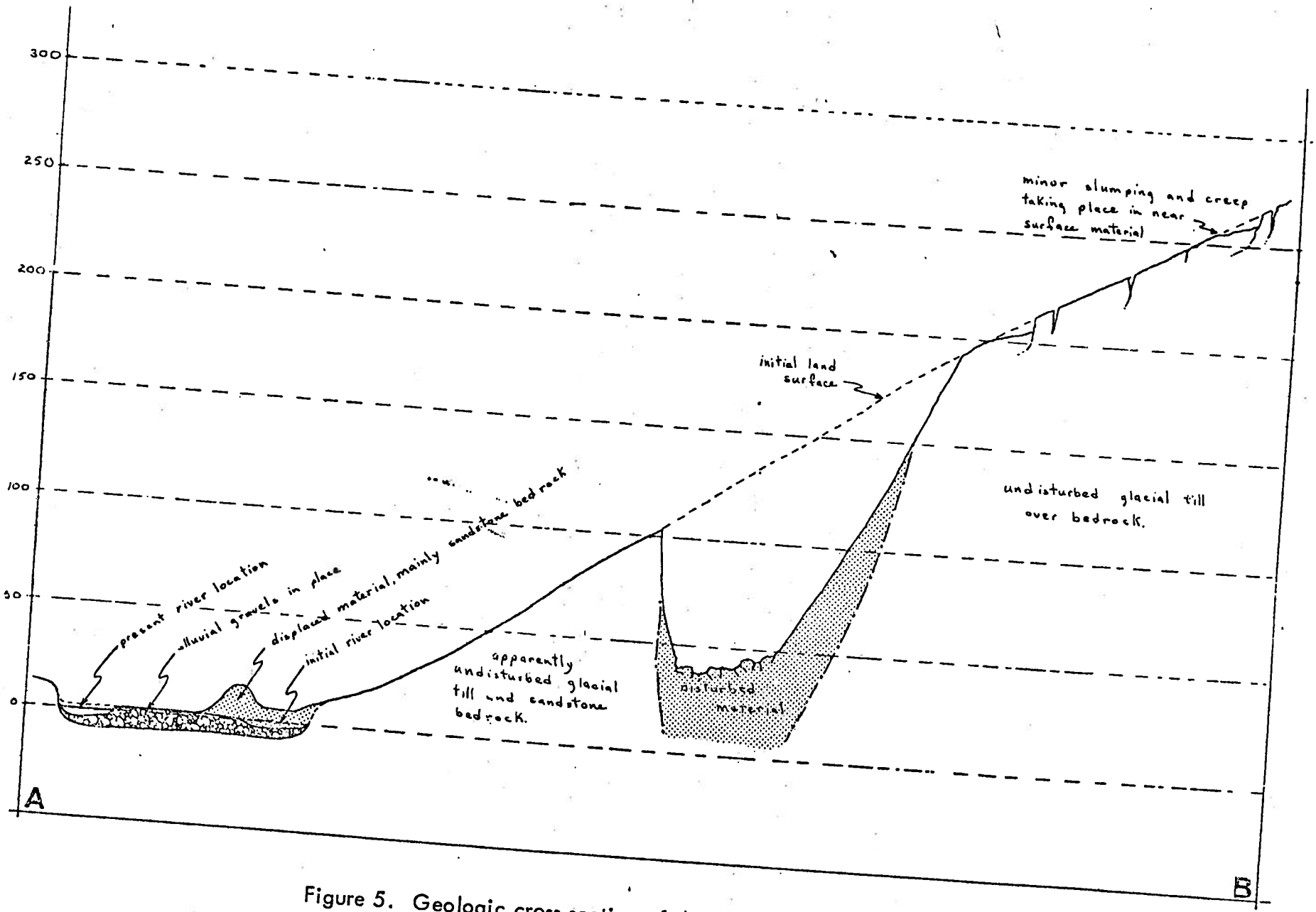

Figure 5. Geologic cross section of slide area. Location of cross section shown on figure 4.

Section 2

Section 2 is a major depression separated from sections 1 and 4 by relatively steep banks. The banks consist of highly jointed and fractured sandstone with minor shale and conglomerate. The bedrock is overlain by till, lacustrine sediments and colluvium. No slickensides were observed on the banks surrounding the depression. The base of the depression consists of bedrock overlain by large slabs of bedrock that have broken off the banks and alluvium deposited by surface water running off the slopes. Many chunks of the broken bedrock had well developed slickensides indicating movement along failure planes. Water is present in many of the lows in this area.

Section 3

The gully that existed prior to the slide has been somewhat disrupted but no evidence exists for a significant slide in this area as most of the trees are still in place.

Section 4

Section 4 has a near vertical east bank and the surface slopes gradually to the river as shown in the geologic cross section. Tree cover occurs over most of the slope and appears relatively undisturbed.

Section 5

Section 5 consists of a slump block that has broken away from section 4 leaving a crevasse like opening (labelled section 6).

Section 7

Section 7 is a major elongate low that slopes downward to the Ram River. Large slabs of bedrock with well developed slickensides are present in this low as well as crumpled shale, and glacial deposits. Where present, the trees are broken and bent indicative of downslope movement.

Slickensides indicative of downslope movement (to the west) are well developed in bedrock exposures on the south side of section 7.

Section 8

Section 8 consists of an elongate ridge of slickensided slabs of sandstone, crumpled shale, and surficial deposits. Driftwood has been incorporated within the rubble. The top of the ridge is estimated to be 10 to 15 feet above present river level. The ridge trends approximately east-west and then turns almost at right angles and trends north-south.

Section 9

Section 9 is a depression behind the elongate ridge (section 8) which used to be the old river channel. The slide blocked this channel and caused the Ram River to incise a new channel as shown on figure 5.

INTERPRETATION OF THE LANDSLIDE

Several possible explanations for the landslide have been considered. The sequence of events, probable cause and complicating factors of each explanation are presented below.

A. Block Glide

1. Sequence of events

(a) A landslide occurred along section 7 depositing the elongate ridge labelled 8 and diverting the Ram River. Since that time the river has cut a new channel as shown on figure 5. Nearly horizontal slickensides on the sides of section 7 indicate that the movement was downslope towards 8.

(b) Removal of material from 7 caused instability of the slope allowing section 4 to separate from section 1 and to move downslope by block glide resulting in the depression labelled 2. No slickensides were observed on the near vertical sides of section 2 which is consistent with the interpretation that section 4 moved

away from section 1. Also many highly slickensided chunks of bedrock were found in the bottom of 2 as would be the case if section 4 moved by block glide.

(c) Section 5 broke off from section 4 and fell into section 7.

(d) The instability of section 1 is now due to removal of material from section 2.

2. Cause

A possible cause of the slide is undercutting of the natural slope by the Ram River. The occurrence of landslides along undercut banks is a common geologic occurrence.

3. Complications

(a) An examination of air photographs of a twenty mile stretch of the Ram River in the area failed to reveal any other major slides. This suggests that the sandstone bedrock is not prone to slumping and slides and is capable of standing in near vertical cliffs. The slope of the bank at section 7 was approximately 45 degrees.

(b) The essentially undisturbed trees present on slope 4 agrees with the block glide theory but a zone of disturbed trees and broken bedrock would be expected somewhere near the bottom of section 4. Only a minor upturn of the old river bank indicating a slight moyement was observed.

(c) If section 4 has not moved appreciably by block glide, then it is difficult to explain the origin of the large depression labelled 2.

B. Subsidence

1. Sequence of events

(a) Section 2 dropped nearly vertically.

(b) Instability caused by event (a) triggered the debris slide in section 7 and resulted in the deposition of 8. This diverted the Ram River to its new location. Slickensides present on the sides of section 7 indicate a downslope movement of material from 7.

(c) Section 5 broke loose from section 4 and fell into section 7.

(d) The instability in section 1 is now due to removal of the material from section 2.

2. Cause

The only possible cause for this type of sequence is the removal of material from beneath section 2.

3. Complications

(a) The bedrock at the slide location is Upper Cretaceous sandstone and shale which extends to a depth of several thousand feet. It is considered unlikely that subsurface caverns would have formed in this type of material. No mining activity has occurred in the area.

(b) No vertical slickensides were found on the freshly exposed sides of section 2.

(c) It would be expected that the forest cover present on section 2 prior to the subsidence would be found at the bottom of the depression but only scattered trees and broken stumps were present.

C. Debris Slide

1. Sequence of events

(a) The material from sections 2 and 7 both flowed out through section 7 and was deposited at section 8. This flow diverted the Ram River and caused it to cut a new channel. Slickensides present on the sides of section 7 indicate a downslope movement of material from 7.

(b) Section 5 broke off of section 4 and fell into section 7.

(c) Instability in section 1 is now due to removal of material from section 2.

2. Cause

A possible cause is the undercutting of the natural slope by the Ram River.

3. Complications

(a) As was noted in A, the original bank of the river at this point was not as steep as at many other locations in the area and the sandstone bedrock appears relatively stable material.

(b) Because of the slope, part of section 2 should have gone down the valley through section 3. Section 3 is completely undisturbed.

(c) The volume of material present in section 8 is approximately equivalent to that missing from section 7 but it is definitely much less than that from section 7 plus section 2. The Ram River may have eroded part of the material but from the ·bris pile appeared to have undergone only minor erosion and the presence of es in the debris suggests that the river has not removed any significant amount he material.

No slickensides were seen on the freshly exposed sides of section 2.

SUMMARY

The writers feel that sequence A is the most plausible explanation for the landslide. The flow of material from section 7 and subsequent deposition of section 8, the breaking off of section 5 from section 4 and fall into section 7, and the present instability of section 1 are common events in all three theories and appear to be correct. More extensive field work including some exploratory drilling would be necessary to answer all the questions.

The reason for the unusual 90 degree angle made by the debris pile remains unexplained. Ice has been suggested as a possible reason for the deflection but a more competent material would be required to stop a mass of this magnitude.

No evidence was found in the field to indicate that the slide may have been related to drilling of the exploratory well; however, the writers are uncertain what evidence if any would be found on surface or could be obtained to establish a connection between drilling of the well and occurrence of the slide. It was noted that circulation was lost in the well at a depth of 350 feet (see Appendix) indicating a permeable zone at that depth.

Extensive instability of the river banks along the Ram River is not expected; however, further failures may occur in the area of the present slide because the slopes have been oversteepened.

REFERENCES CITED

Erdman, D.A. (1950): Alexo and Saunders Map Areas, Alberta; G.S.C. Memoir 254, 100 pages.

Green, R. (1972): Geological Map of Alberta; Res. Coun. Alberta, Map 35, scale 1 inch = 20 miles.

APPENDIX

LSD 10 Sec. 27 Twp. 38 Rge. 11 W 5 Mer. | C 68-1957

STATUS SUSPENDED

Co-ords. S 2155 W 1462 (CROWN)

Field W. C.

Co. PACIFIC PETROLEUMS Name PACIFIC PAN AM PHOENIX 10-27-38-11

Spud	Completed	T.D.	KB	Gr.	Prod Z	Grav	INITIAL POTENTIAL	PROV. ALTA
1-1-69	RR 23-10-69	15817	4051	4032				

FORM	Tops	Subsea	Net Pay
EDM	2191	1860	
B R	6134	- 2083	
L P	7652	- 3601	
CARD ZO	9286	- 5235	
CARD SD	9408	- 5357	
BLKSTN	9682	- 5631	
VIK ZO	10464	- 6413	
VIK SD	10536	- 6485	
BL	10644	- 6593	
GLAUC SD	11104	- 7053	
CAD	11418	- 7367	
FERN	11628	- 7577	
NORD	11835	- 7785	
ELK	11915	- 7864	
SHUNDA	11998	- 7974	
PEK	12160	- 8109	
BNFF	12295	- 8244	
EX	12912	- 8861	
WAB	12941	- 8890	
NIS	13736	- 9685	
IRE	14020	- 9969	
LED	14190	-10139	
BH L	15030	-10979	
E P	15514	-11463	
CAMB	15688	-11637	
T.D.	15817	-11766	

LOGS: E, BHCS GRN

PROJ. T.D.: 15,100 BH L

CSG: 13 x 1523 C 1525
7 x 10930 C 650 P.B.T.D. 10515
LOST CIRC @ 350

SUSPENDED: OCTOBER 23 1969 PREV. REPORTED ABANDONED IN ERROR.

CORES: NIL

DRILL STEM TESTS:
12152-12294 (PEK) OP 3/90 SI 30/90 MINS. HP 7090' SUL G C SLTY WTR, 540' INHIBITOR & G C DRLG MUD.
5539-5427 FP 618-842 SIP 4598-4533. REC
13268-13320 (NIS) MISRUN. PACKER SEAT FAILED REC 1500' WTR CUSH, 1670' DRLG FLUID.
13295-13340 (NIS) MISRUN. PACKER SEAT FAILED REC 2000' WTR CUSH, 1640' DRLG FLUID.
14205-14550 MISRUN. UNABLE TO REACH BOTTOM
14210-14696 MISRUN. USED & REC 2000' WTR CUSH. REC NIL

Contr. PETROLIA Date: 23-10-70 P T 653

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