R&M CONSULTANTS, INC.

ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

SUSITNA HYDROELECTRIC PROJECT
PLAN OF STUDY

TASK 2

ACCESS ROADS
SUBTASK 2.10

INTERIM REPORT #1

ALTERNATIVE ACCESS CORRIDOR SELECTION

Prepared For:

ALASKA POWER AUTHORITY
and
ACRES AMERICAN, INCORPORATED

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HARZA-EBASCO
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CONTENTS

SUSITNA HYDROELECTRIC PROJECT
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A. INTRODUCTION

The Susitna Hydroelectric Project has been under study for some time. The U.S. Corps of Engineers has done extensive work on the project but progress was slow. In late 1979 the Alaska Power Authority selected Acres American, Incorporated, to conduct feasibility studies and prepare the FERC license application if the project was determined to be feasible.

Subtask 2.10 of the plan of study is the location study necessary to determine the most desirable location for an access route and the most economical transporation mode or modal split. R&M Consultants has been selected as a subconsultant to Acres American, Incorporated to conduct the access study and other tasks.

The plan of study calls for analysis of three general routes to provide access to potential dam sites. In addition consideration must be given to using road, railroad or a combination of both to serve the project. This report is presented for the purpose of documenting the methods by which the three recommended route corridors were selected.

B. SUMMARY

The study to date has been held to definition of well defined general corridors within the broad General corridors discussed in the plan of study, and which still satisfy the requirements of the plan of study with regard to location. Alignment design criteria were proposed to Acres American. The response to the proposed criteria was a request to use more stringent design criteria generally conforming to primary highway design criteria. Using this criteria a number of possible alignments were sketched on one-inch to the mile contour maps. All alternatives were designed to serve both the Devils Canyon and the Watana Dam sites. Other potential dam sites could be served with only minor changes if other sites should prove to be desirable. All alternatives were compared and the three routes showing the most advantageous grade, alignment and length characteristics were recommended for photography. As an additional check the three most promising corridors were flown by helicopter to provide the project team with a close look at actual ground conditions.

The three most promising corridors are shown in Appendix A. These three corridors allow consideration of a number of transporation alternative plans including certain attractive stage construction and modal split options. These options will be examined in detail during later phases of the access study. It is recommended that Alternates A, B, C and R as detailed on page 13 of this report be approved as the selected access corridor alignments and that these provide the basis for all further access studies. The proposed railroad alignment is within the limits of corridor 2 as recommended and must be considered as a viable alternative at this time.

C. DESIGN PARAMETERS

In order to be able to make a valid comparison between alternatives a basis for that comparison must be established, with this thought in mind, proposed design ciriteria were developed and submitted to Acres American. The criteria submitted are shown in Table 1.

TABLE 1

ORIGINAL PROPOSED DESIGN CRITERIA

	Road	Railroad
Design Speed	30 mph	N/A
Maximum Grade	10%	2.5%
Maximum Curvature	19°	10°
Design Loading	HS-20	E 50

Design criteria such as these are used to establish guidelines for design. The designer normally attempts to provide horizontal and vertical alignment that is better than the mimimum alignment such limits would provide. In order to maintain a schedule and have possible corridors identified for photography, work began on a number of possible alignments prior to approval of the proposed criteria. While the corridor definition work was in progress correspondence was received asking that roadway criteria be adopted that would essentially conform to a 50-60 mile per hour design speed. The recommended design parameters for the railroad were accepted. Later correspondence from Acres American confirmed roadway design criteria for 60 mile per hour design speed. The relatively high roadway design parameters are required because of the size and weight of certain components of the dams that must be manufactured and imported to the site. The required parameters are given in Table 2.

TABLE 2

APPROVED ROADWAY DESIGN PARAMETERS

Design Speed	60 mph
Maximum Grade	6%
Maximum Curvature	5°
Design Loading (Construction Period)	80 Kip Axle & 200 Kip total
Design Loading (After Construction)	HS-20

APPROVED RAILROAD DESIGN PARAMETERS

Maximum Grade	2.5%
Maximum Curvature	10°
Loading	E-50.*

D. STUDY PROCEDURE

The Sustina Hydroelectric Project is located on a section of the Susitna River that is remote wilderness. Earlier studies by government agencies had generated some contour mapping in the vicinity of the proposed dam sites. The only other available contour information was USGS mapping on a one-inch (1") equals one (1) mile scale with one-hundred foot (100') contour intervals. To aid the project team in selecting possible routes a low level helicopter flight was made in late March, 1980. A mosaic was then made of the USGS mapping from Gold Creek and the Parks Highway through the Watana site and out to the Denali Highway north of Watana. Using the preliminary design parameters and information gained from the overflight of the project area, a number of possible alignments were laid out on the map mosaic.

The various alternatives were split into convienent segments. Some of these segments were unique while others could be common to two (2) or more alternatives. Each segment was analized for grades on a section by section basis. Each curve was checked for degree of curve and deflection angle. Each curve and each identifiable gradient section were then tabulated. The various segments

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* The Alaska Railroad has indicated that the current system load rating is E-50.

considered were combined to provide a total of thirty-three (33) possible alignment alternatives that could conceivably be constructed to provide access to one or both of the principle dam sites. The principle damsites were identified in the early stages of the study as Devils Canyon and Watana. The various combination of segments makin_ up potential access routes were compared. The alignment identified as being the most attractive within each of the three (3) general corridors required by the plan of study was selected for further work. A low level reconnaissance flight with part of the environmental team was made April 30, 1980 to review the proposed corridor alignments prior to the photographic flights. Valuable input for future anlalysis was gained, and there was nothing identifed that would force a major line change at this early stage of the work.

On May 15, 1980 the proposed corridor alignments were presented to representatives of Acres American. Photographic flights of the proposed corridors were approved at that meeting.

E. ALTERNATIVES

For the purpose of analysis the proposed general corridors are identified as follows:

Corridor 1	°	On the north side of the Susitna River between the Parks Highway and the Watana Dam site.
Corridor 2	°	On the south side of the Susitna River between the Parks Highway and Watana Dam site.
Corridor 3	°	Connecting Watana Dam site with the Denali Highway to the north.

A number of alternative segments were considered within each of these three (3) general corridors. The alternative segments within the respective corridors are discussed below and shown in Appendix A.

1. <u>CORRIDOR 1</u>

a. <u>Alternative 1-A</u>. This alternative begins at Watana Camp, and then proceeds north to a crossing of Tsusena Creek. After leaving Tsusena Creek the line proceeds through a pass at four-thousand foot (4000') elevation into the upper reaches of Devils Creek. As the line leaves Devils Creek it follows the side slope around just to the north of High Lake while gradually dropping in elevation and reaches the bluffs at Devils Canyon very near the Devils Canyon Dam site. From Devils Canyon Dam site the line traverses around into the Portage Creek drainage and, after crossing Portage Creek parrallels a winter sled trail to a crossing of the Alaska Railroad at Chulitna Pass and on to the Parks Highway.

This alternate crosses the highest ground at just over four-thousand foot (4000') elevation near the head of Devils Creek. Through various sections it also crosses some of the most difficult terrain of any route investigated, particularly in crossing Portage Creek. The entire section from just above Devils Canyon across Portage Creek and out to the vicinity of the cabins on the west side of Portage Creek is side hill construction in very steep and broken terrain.

Preliminary grades are generally within criteria except for a few short sections. A preliminary check indicates that the grade problems should be solvable with minor adjustments of the line and some heavy earthwork.

Alternative 1-A has a number of curves that exceed the desired degree of curve parameter. As stated above this line traverses some very difficult terrain in the Devils Canyon through Portage Creek section. Because of this it may be difficult to eliminate all of the tight curve problems without a number of costly structures.

b. Alternative 1-B is an alternate segment in Corridor 1 beginning at point 6 on sheet 6 and rejoining 1-A at point 4 on sheet 4 of Appendix A. This alternate segment utilizes a pass into Devils Creek immediatley south of the pass used by alternate 1-A. The pass utilized makes it possible to hold the high point of the line to just over three-thousand four-hundred foot (3400') elevation.

As originally laid out 1-B has about two-thousand feet (2000') that exceed the six percent (6%) grade parameter. These areas can be eleminated during refinement of the alignment.

There are a few curves on this alternate that exceed the five degree (5°) parameter. These involve drainage crossings where changes in grade and some grading work will enable the designer to comply with approved guidelines.

c. Alternate 1-C is a totally new line between Watana Dam site and alternate 1-B at its crossing of Devils Creek (See point 5 on sheet 4 of Appendix A). This alternate follows the river and would provide water level access to the reservoir of Devils Canyon Dam.

The preliminary layout includes several relatively short sections that exceed the desired maximum grade. A few of these grade problems may be eleminated by refining the line, however it may not be possible to eliminate all of the steeper sections.

Alternate 1-C includes at least three (3) curves that would be difficult and costly to flatten enough to comply with the desired criteria.

Alternate 1-C is the longest of the three (3) lines between Watana and Devils Creek and would require at least three (3) bridges.

d. Alternate 1-D is an alternative crossing of Portage Creek that uses switch backs and relatively steep grades to shorten the stream crossing. (See point 2 on sheet 5 to point 3 on sheet 4 of Appendix A.) A thirty (30) mile per hour alignment is possible but nothing better. This alternate is effectively eleminated for this reason.

2. CORRIDOR 2

a. Alternate 2-A begins at Watana Dam site on the south side of the river. The line proceeds southerly past the west end of Fog Lakes and across Fog Creek to the north end of Stephan Lake with good line and grade. The line climbs toward the high ground west of Stephan Lake at a comfortable grade to the top of the Chunilna Creek drainage. (See point 15 sheet 10 of Appendix A.) From there the road stays on the high ground at elevations of about three-thousand four-hundred feet (3400') to a point immediatley south of VABM CHUNILA (See sheet 8 of Appendix A) with good line and grade. From that point the line decends via steep grade and very tight switch backs to the Railroad at Sherman. This line is approximately fifty-six point six miles (56.6) in length.

Grades for the most part are acceptable on the altermate 2-A with the exception of the climb from Sherman through the switch backs. It will be difficult to improve signifcantly on that section. Another problem with 2-A that must be considered is that a nine (9) mile plus spur must be constructed to serve Devils Canyon Dam. This spur is alternate 2-C and a part of 2-B. (See sheet 9 of Appendix A.)

b. Alternate 2-B begins as 2-A flattens out after climbing out of the Stephan Lake basin. (See point 15 on sheet 10 of Appendix A). This segment travels northerly along the top edge of a deep narrow drainage for about six (6) miles (see point 13 sheet 10 Appendix A) where it turns westerly and crosses into and desends an unnamed drainage to Devils Canyon Dam site where it can connect with 2-I.

Much of alternate 2-B exceeds acceptable grades and several curves exceed the acceptable degree of curve. This would be a thirty (30) mile per hour segment without question and the segment would include one (1) major bridge.

c. Alternate 2-C is the segment that connects 2-A with 2-B about three (3) miles south of Devils Canyon. (See point 11 and 12 sheet 9 Appendix A.) The section is six (6) miles long and a major part exceeds grade criteria. The line has good horizontal alignment but grades make this alternate very questionable.

d. Alternate 2-D is a segment that connects 2-A at Sherman with the Parks Highway by a pass through the ridge on the west side of the Susitna River. The segment would require a major bridge and a crossing of the mainline railroad. This segment can completley satifsy desired criteria. (See sheet 7 of Appendix A.)

e. <u>Alternate 2-E</u> is a segment that begins at Sherman and goes north essentially parrallal to the mainline railroad to connect with 1-A at Chulitna. This segment was addressed in order to provide alternative points of connection with the Parks Highway should some alternate within corridor 2 be ultimately selected. Only a portion of this segment would be used. A major river bridge may be required depending on what portion of the segment may be used. (Point 7 sheet 7 to point 1 sheet 2 of Appendix A.)

The grades can be kept within desired limits with some heavy grading in two (2) short sections. The hoizontal alignment is within criteria.

f. <u>Alternate 2-F</u> is a segment that would provide for a shorter roadway crossing of Fog Creek. The segment connects with 2-A on both ends and would require a high bridge approximately five-hundred fifty feet (550') long over Fog Creek. (Point 20 to 23 sheet 12 of Appendix A.) Grades are good throughout the segment. One (1) curve as shown is too tight. The curve could be brought into conformance by skewing the bridge across the creek and some grading work on the bridge approaches.

g. <u>Alternative 2-G</u> is a segment intended to connect 2-B with 2-I at Devils Canyon Dam site by essentially paralleling the railroad line 2-R. (Point 12 sheet 10 to point 10 sheet 9 of Appendix A.) 2-G begins about five-hundred feet (500') in elevation above 2-R then parallels the rail line 2-R at a somewhat steeper gradient to connect with 2-I at Devils Canyon Dam site. This segment is located in some difficult terrain. Some heavy cuts and fills will be required and at least one (1) major bridge will be required across the side drainage just upstream from Devils Canyon Dam site.

h. Alternate 2-H is a segment of roadway that goes up over a small bluff just upriver from the present railroad bridge at Gold Creek to avoid some difficult construction going around the face of the bluff. Both grade and alignment criteria can be satisfied. This segment is shown connecting with 2-E in two different ways. This is to indicate what might be required for connecting with Parks Highway using either 1-A or 2-D.

i. Alternate 2-I is a roadway following exactly on the railroad alignment 2-R from Devils Canyon Dam site to 2-H just above Gold Creek. (Point 10 sheet 9 to point 9 sheet 8 of Appendix A.) All design criteria for the roadway are satisfied.

j. Alternate 2-R is the railroad alignment between Gold Creek and Watana Dam site on the south side of the river. The rail line is within criteria the entire length. The maximum curvature is about eight degrees (8°) and the ruling grade is about two point three percent (2.3%). The most difficult terrain is from Devils Canyon Dam to the Stephan Lake basin divide. One (1) major bridge will be required near Devils Canyon and one (1) or more minor bridges are likely. There is a six (6) mile section on one side of a north-south drainage that will be full bench cut in rock and may require snow sheds to keep the tracks open in winter (see sheet 10). This line appears to be the only feasible possibility for rail access from Gold Creek to Watana.

3. CORRIDOR 3

a. Alternate 3-A begins at Watana Dam site and proceeds northeast up the west side of Deadman Creek then through a saddle into the upper Butte Creek drainage and along the west shore of Butte Lake to the Denali Highway. This alternate is the shortest connection to an existing highway. Only two (2) short sections that exceed four percent (4%) grade. The sharpest curve on the preliminary line is six degrees (6°).

b. <u>Alternate 3-B</u> coincides with 3-A from Watana Dam site to the first crossing of Deadman Creek about five point five (5.5) miles northeast of the dam site (see point 22 on sheet 13 of Appendix A). This alternate then proceeds easterly into the Watana Creek drainage and then northeasterly through a saddle into the lower end of Butte Creek drainage. The line traverses the west side of the Butte Creek valley passing west of Snodgrass Lake and connecting with the Denali Highway near the Susitna River Bridge. This alternate is slightly longer than 3-A and otherwise meets all design parameters.

F. ANALYSIS

With the various segments identified and estimates made of grades and curvature a total of thirty-three (33) combinations were developed and compared. The criteria used to compare the alternative combinations are as follows:

- Overall length to be constructed;
- Average grade;
- Average deflection per mile.

The tabulation of this comparsion is included in Appendix B.

The alternatives identified as being most favorable based on length, alignment and grade are as follows:

For Corridor 1. Parks Highway to Watana Dam site - North side
Use combination 2, Segments 1-A and 1-B

Overall Length	64.9 Miles
Average Grade	2.4%
Deflection Per Mile	7°06'±

This Corridor will be identified as Alternate A in further studies.

For Corridor 2. Parks Highway to Watana Dam Site - South Side
Use Combination 33, Segments 2-A; 2-F; 2-B; 2-G; 2-H; 2-E; 2-I

Overall Length	66.5 Miles
Average Grade	2.2%
Deflection Per Mile	4.°50°±

This Corridor will be identified as Alternate B in further studies.

For Corridor 3. Watana Dam to Denali Highway
Use combination 10 - Segment 3-A

Overall Length	39.1 Miles
Average Grade	1.3%
Deflection Per Mile	1°30'±

This Corridor will be identified as Alternate C in further studies.

For Railroad
Use 2-R on the south side of the river from Gold Creek to Watana Dam site. This closely follows the preferred road alignment for Corridor 2.

Overall Length	58 Miles
Average Grade	1.5%
Deflection Per Mile	5°11'±

This line will be identified as Alternate R in further studies.

G. RECOMMENDATION

Based on the preceeding analysis it is recommended that Alternates A, B, C and R as detailed in section F be approved for further analysis. These alignments satisfy the established design creteria and the requirements of the plan of study. One of these alignments or portions of more than one will satisfy the forseeable concerns pertaining to project access.

APPENDIX A

PROPOSED CORRIDORS

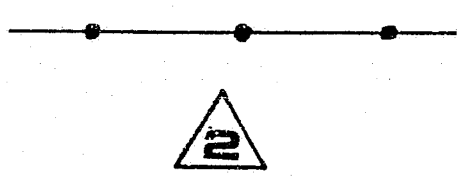
SUSITNA

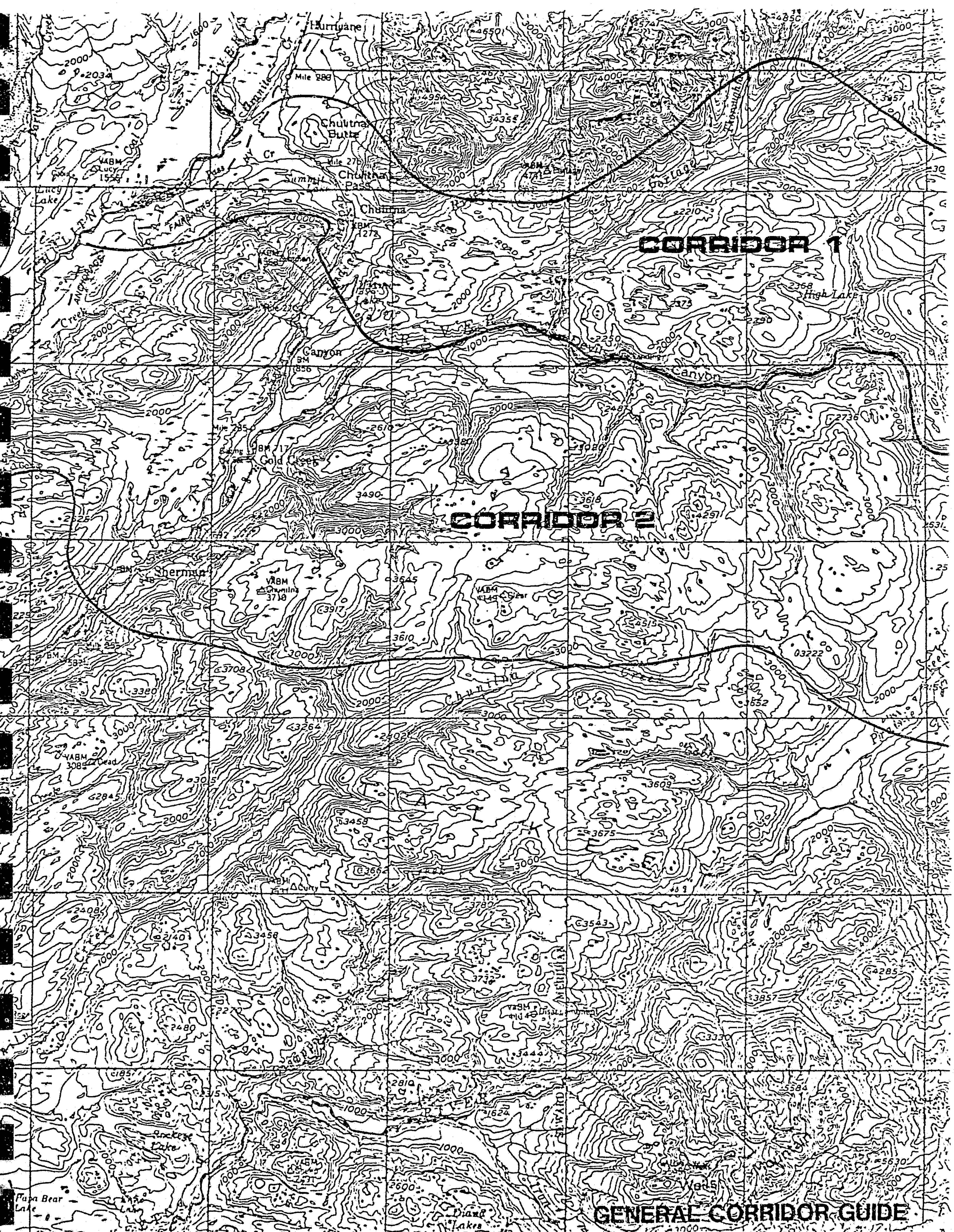
ACCESS CORRIDORS

SUSITNA DAM

INDEX

Recommended Road Way Alignment
For Each Corridor

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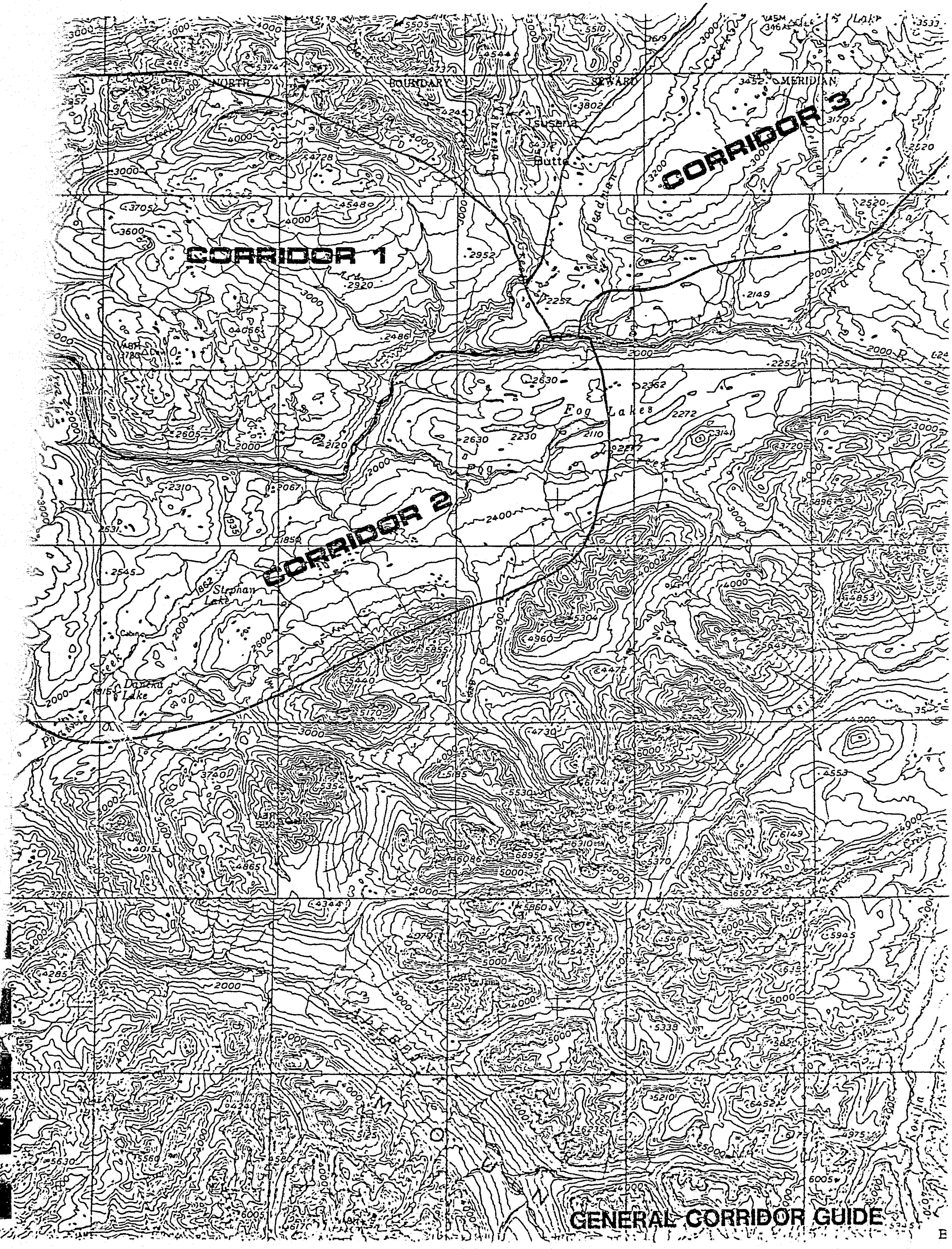
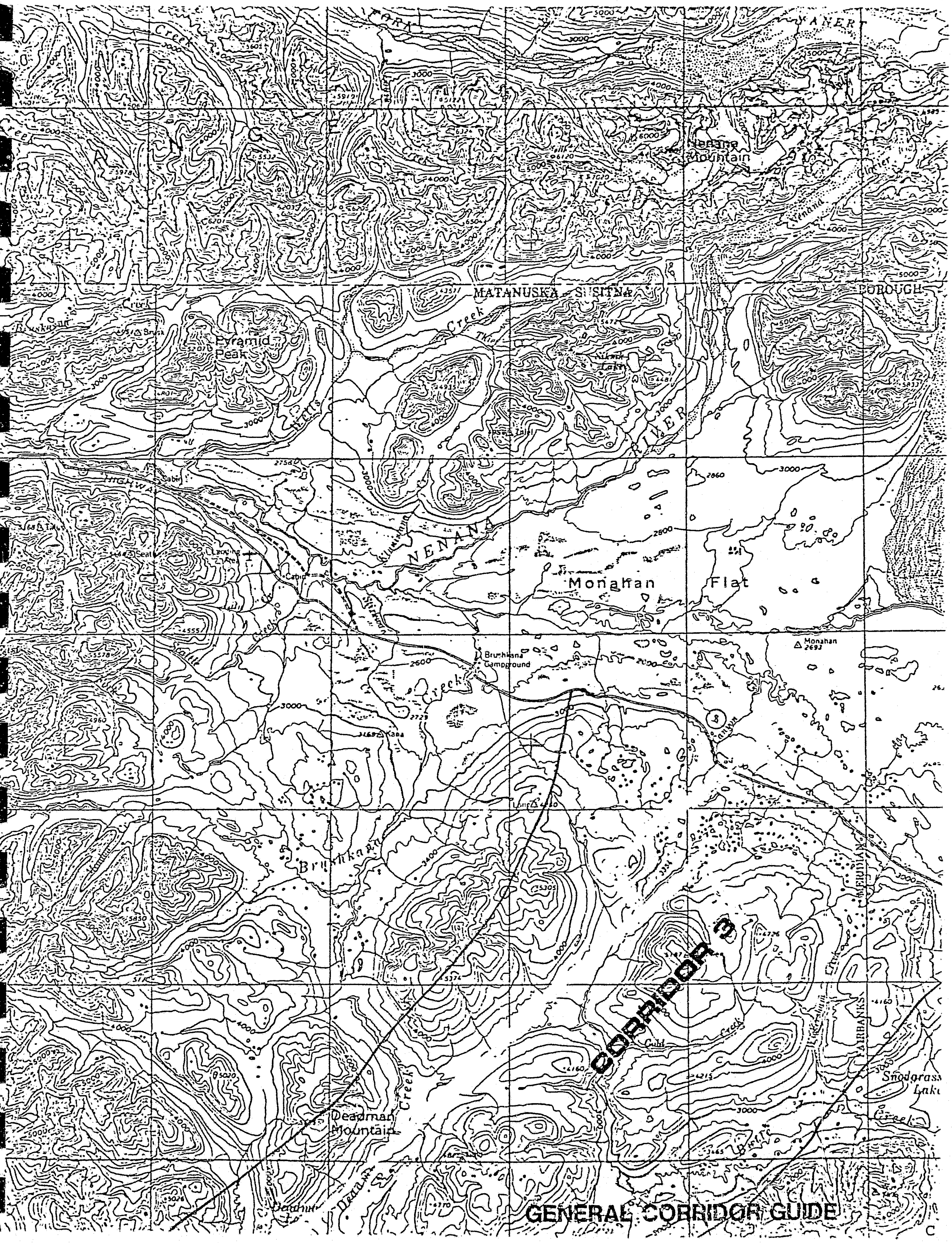
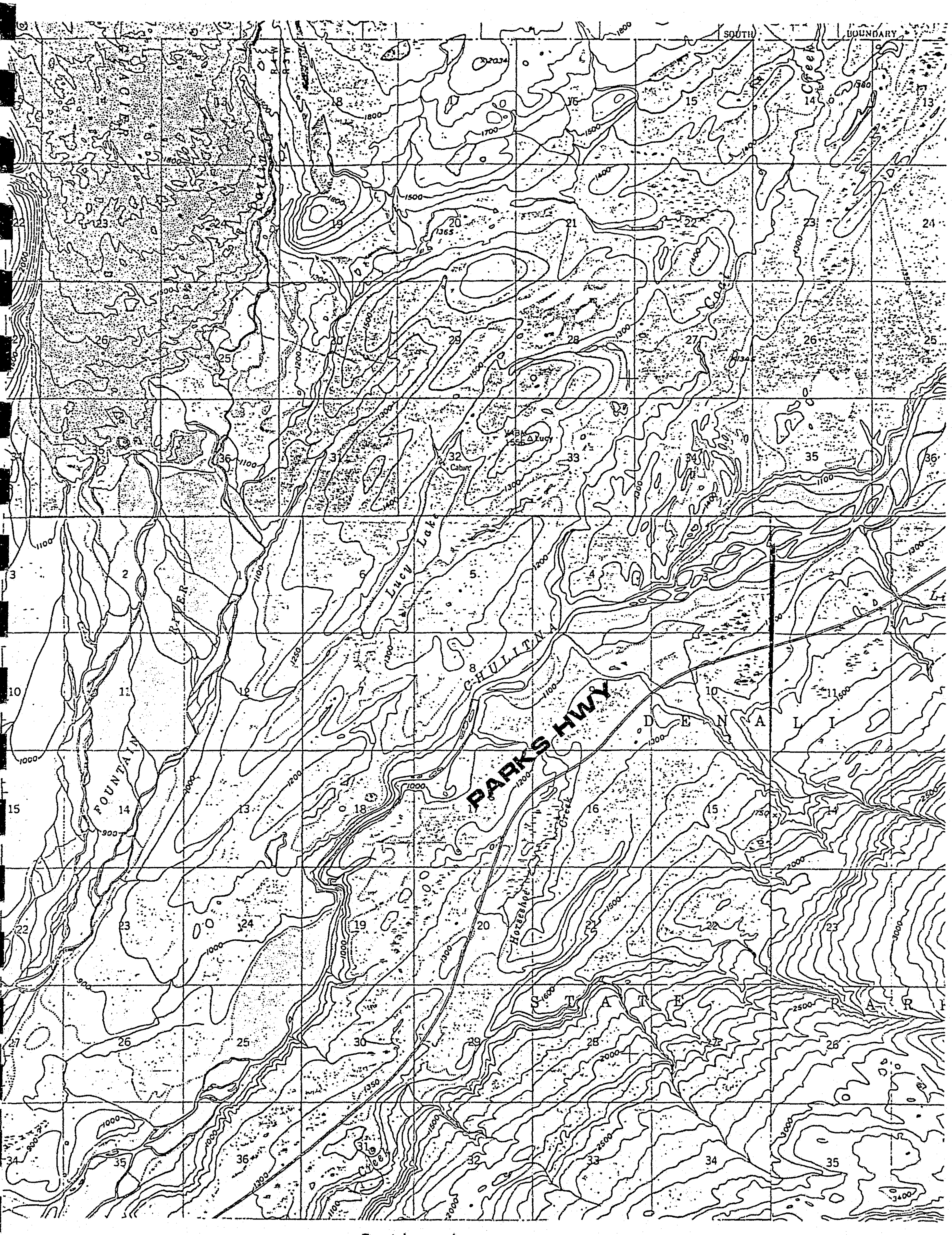
Mile 280
Chulitna Butte
Chulitna Pass
Summit Lake
Lucy Lake
Chulitna
CORRIDOR 1
High Lake
Canyon
Devil Canyon
Gold Creek
CORRIDOR 2
Sherman
Papa Bear Lake
Watana
GENERAL CORRIDOR GUIDE


CORRIDOR 1
CORRIDOR 2
CORRIDOR 3
NORTH
BOUNDARY
SEWARD
MERIDIAN
Tsusena
Butte
Deadman
Fog Lakes
Stephan Lake
Danana Lake
Cabin
GENERAL CORRIDOR GUIDE



MATANUSKA - SUSITNA
BOROUGH
Pyramid Peak
Nenana Mountain
NENANA
RIVER
Monahan Flat
Monahan
2693
Brushkana Campground
Deadman Mountain
Snodgrass Lake
CORRIDOR 3
GENERAL CORRIDOR GUIDE

C



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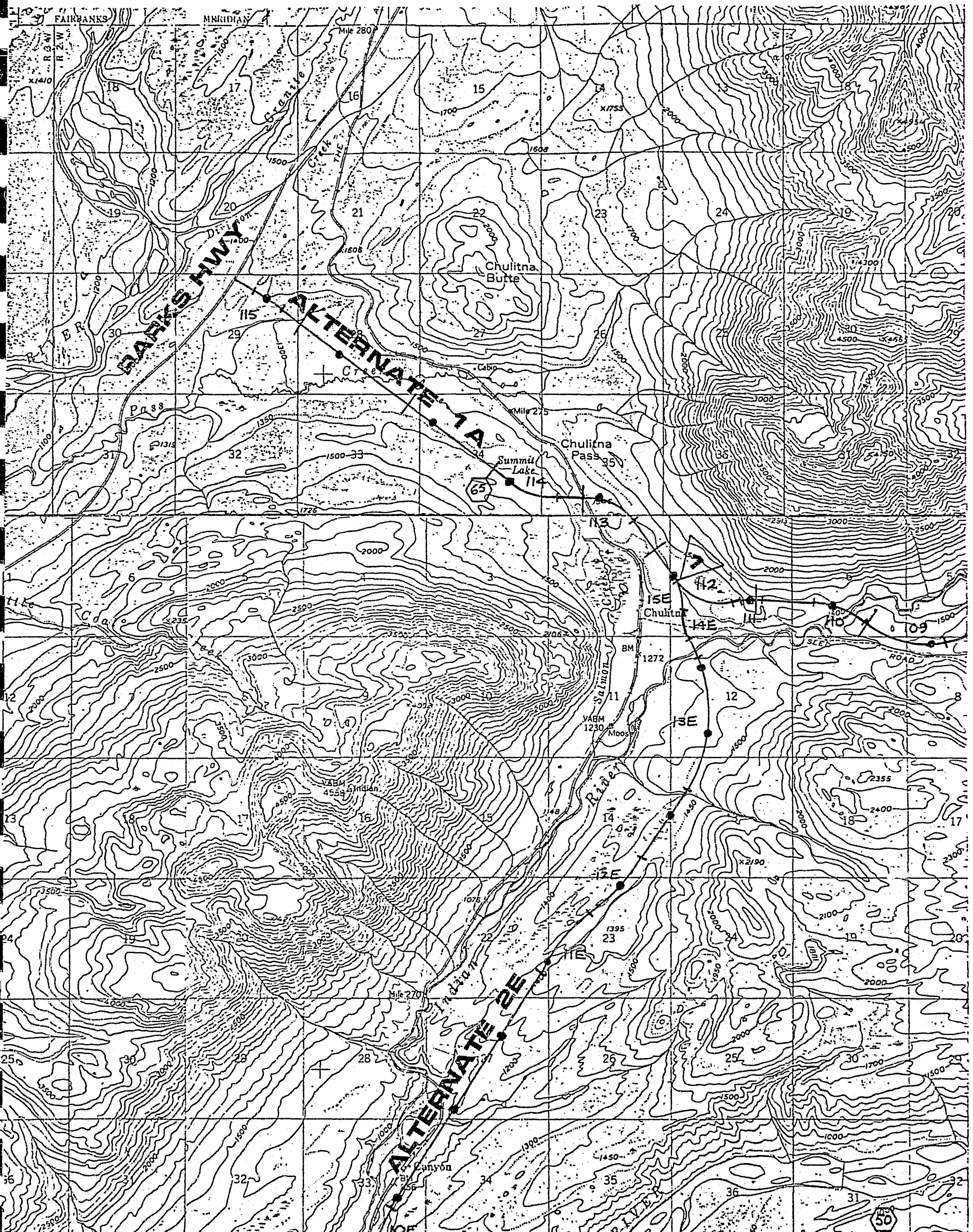

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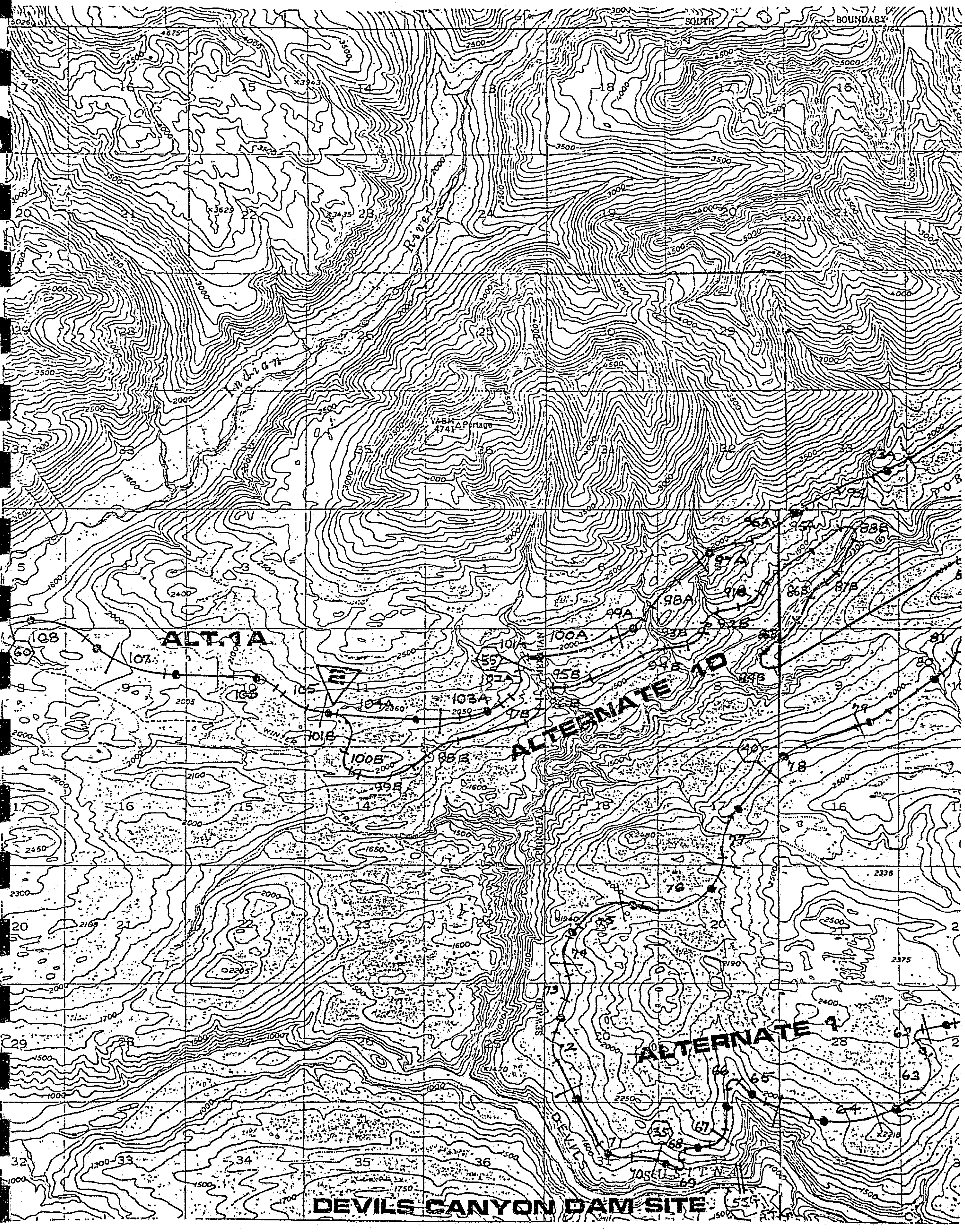

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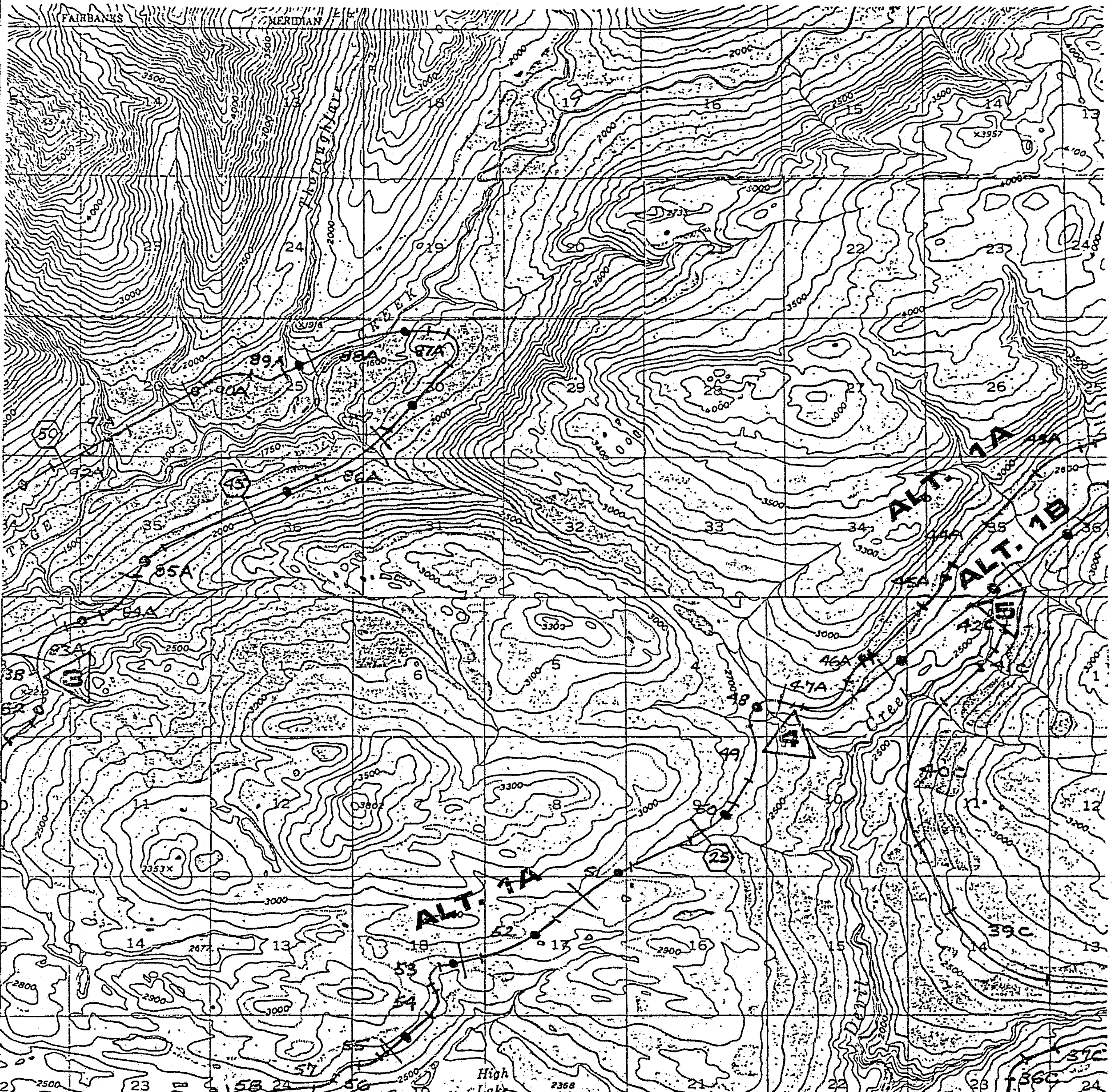

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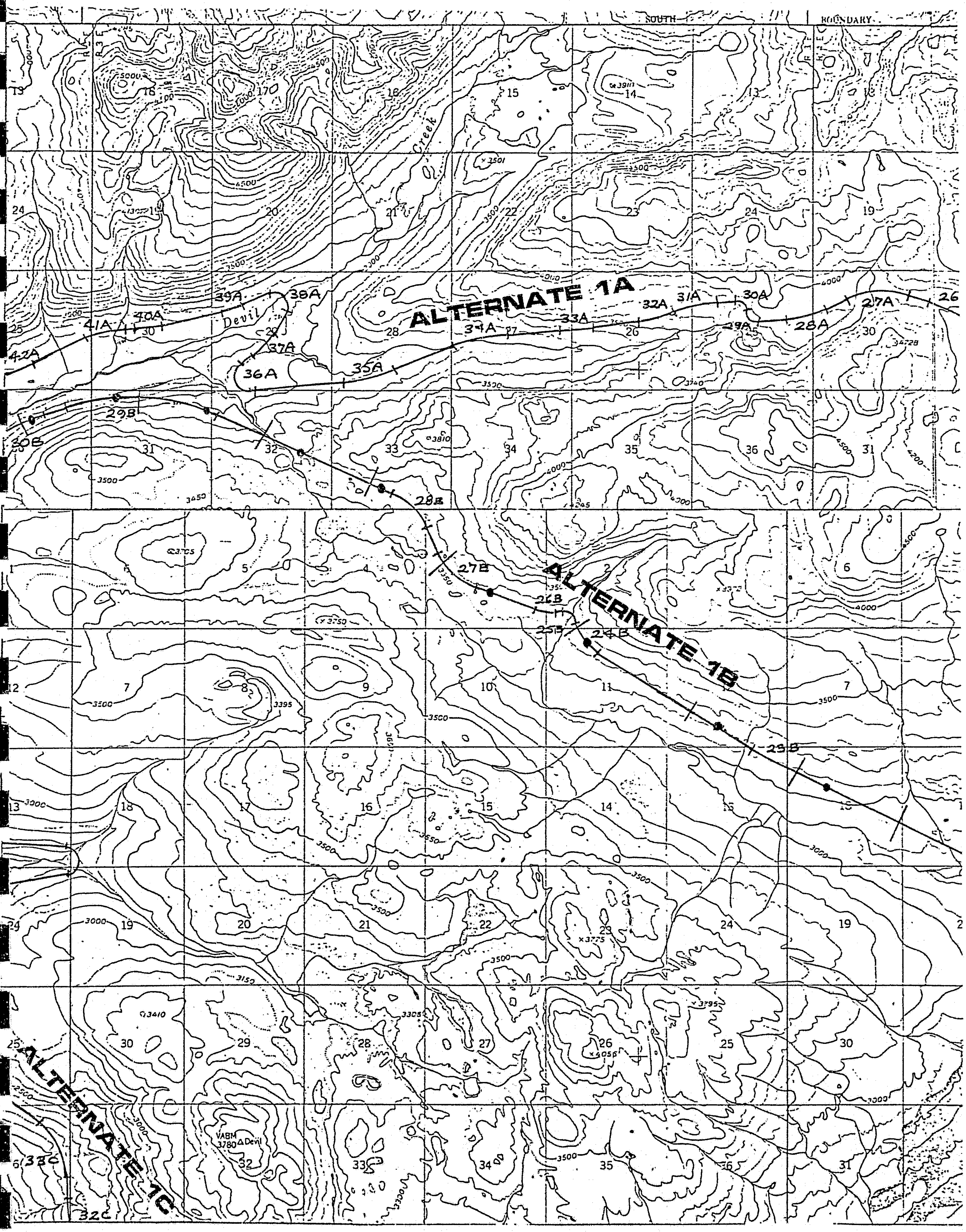

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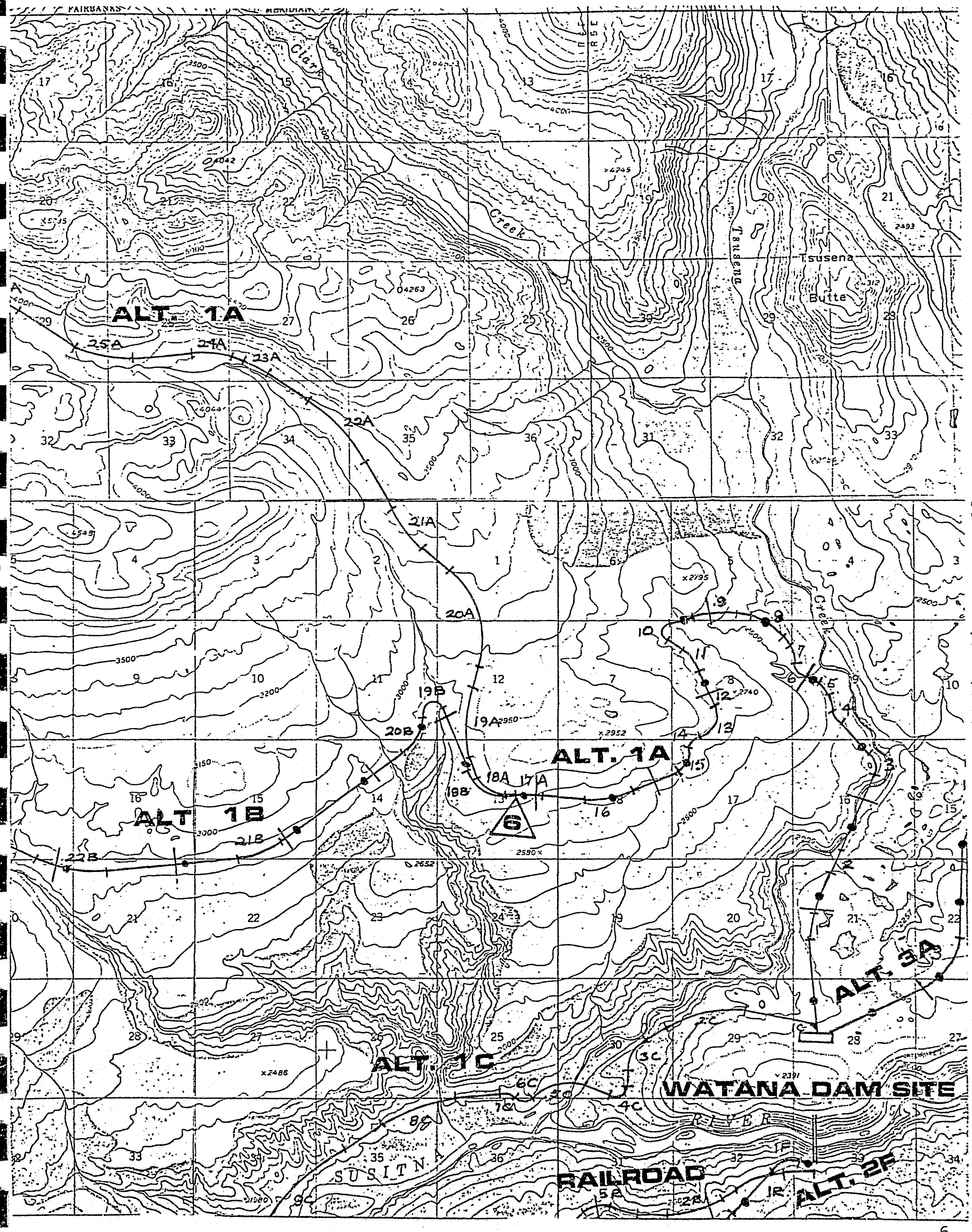

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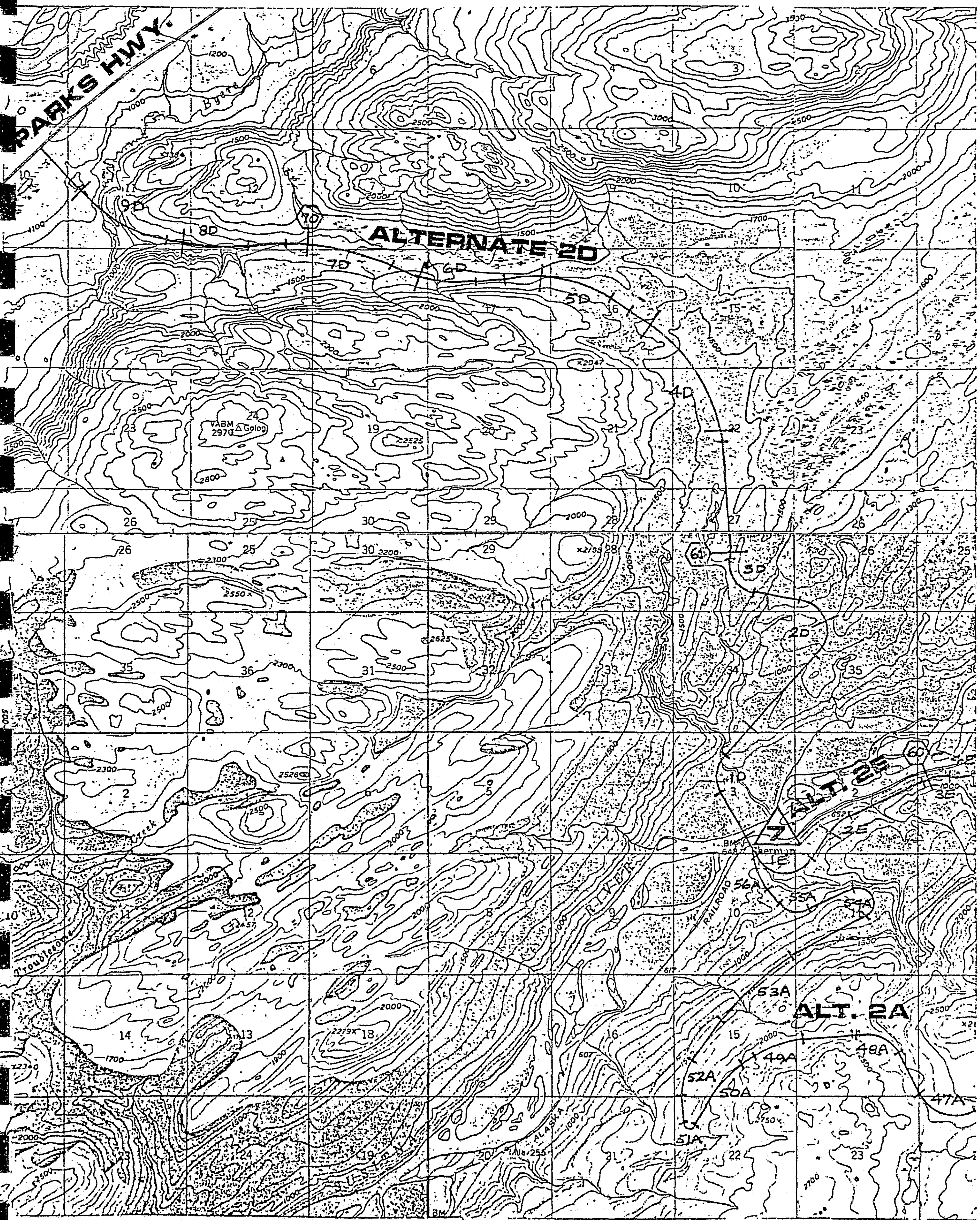

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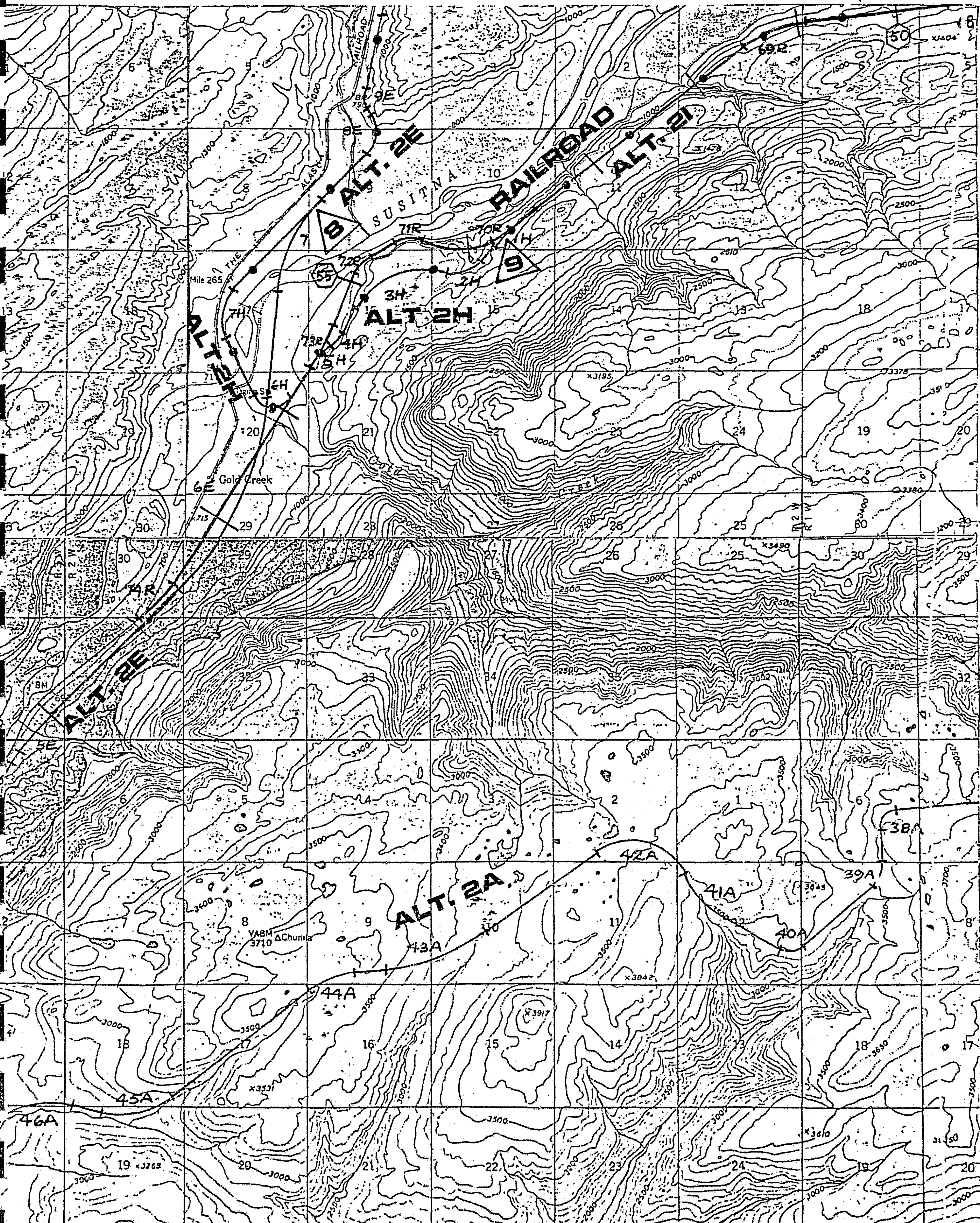

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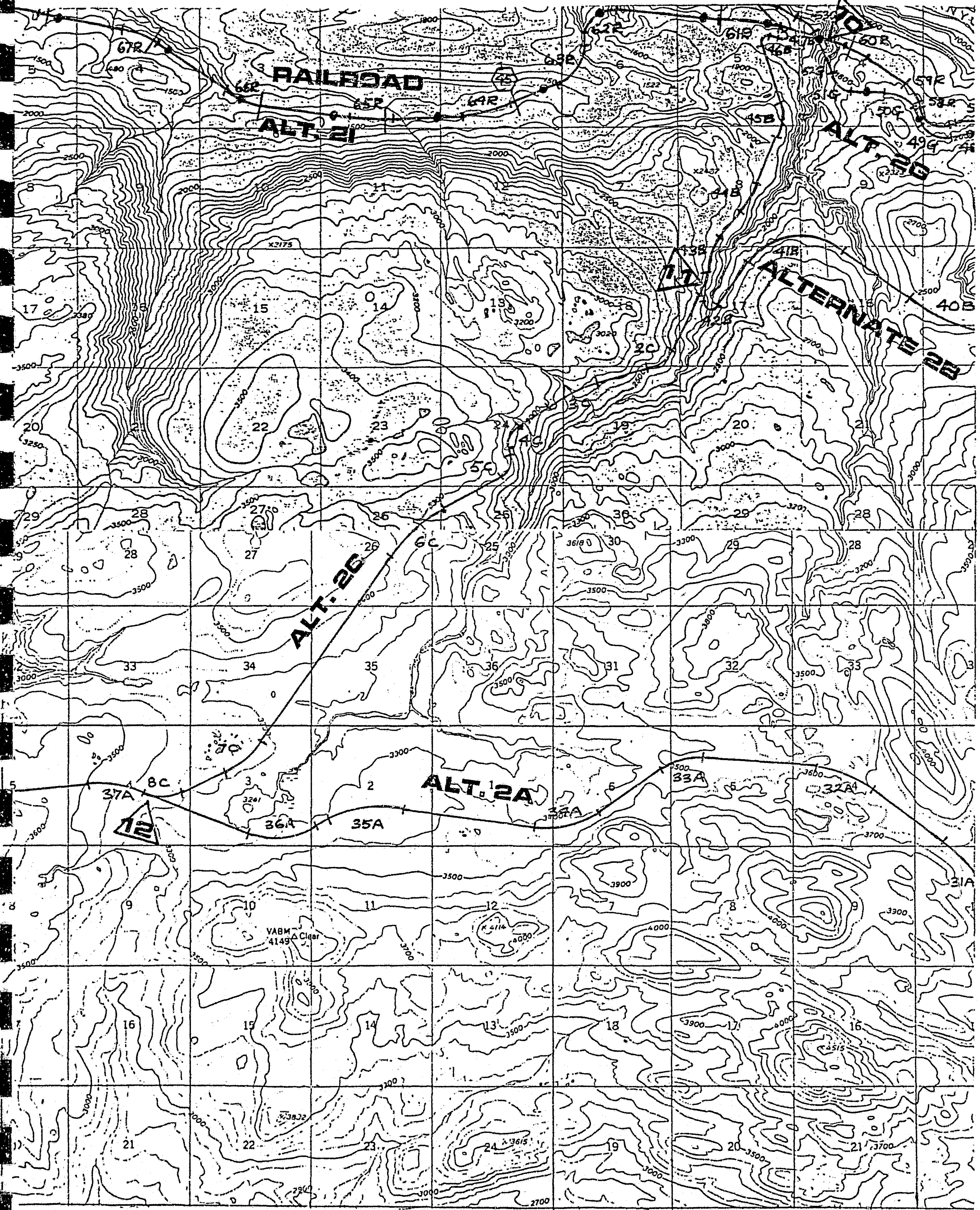

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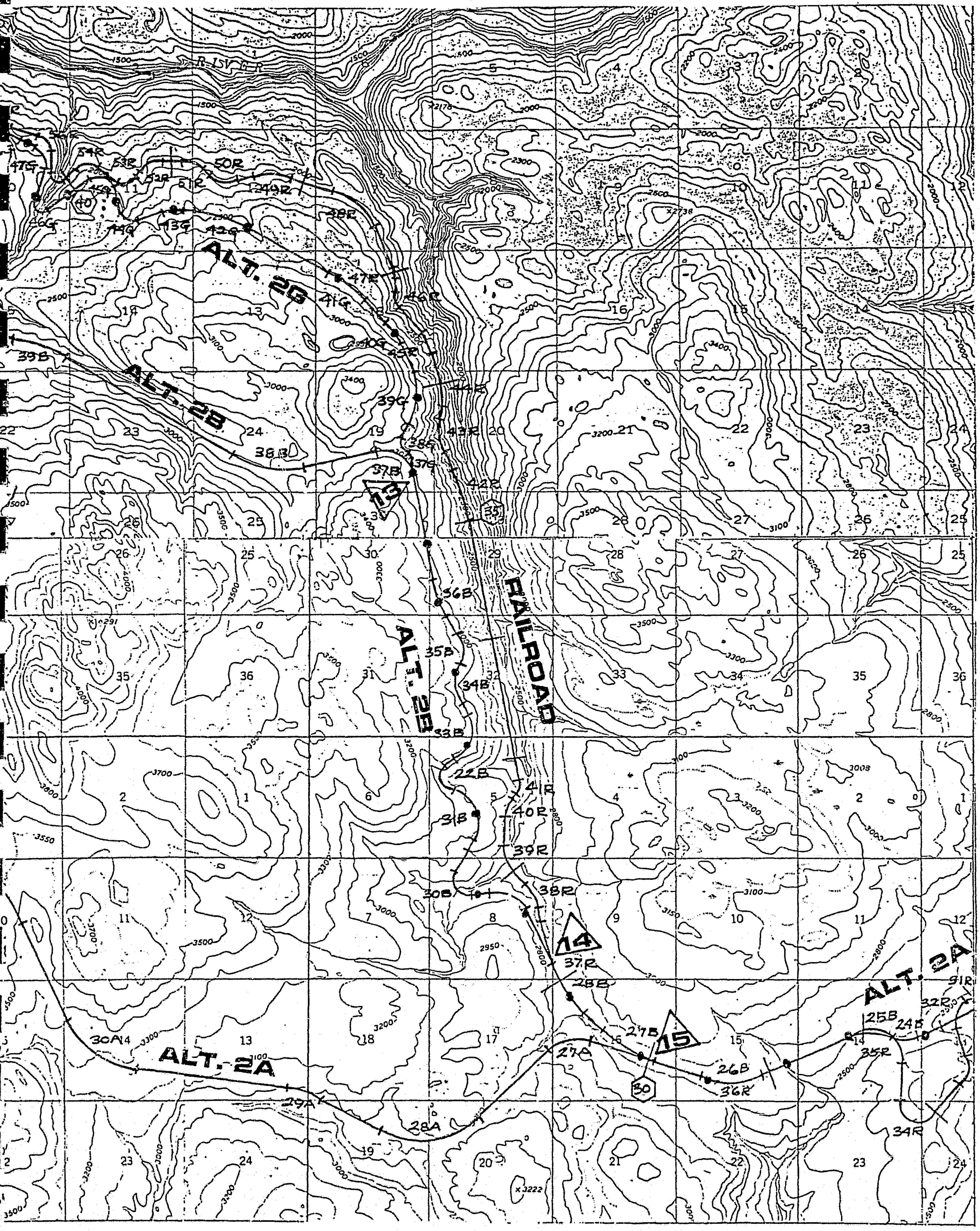

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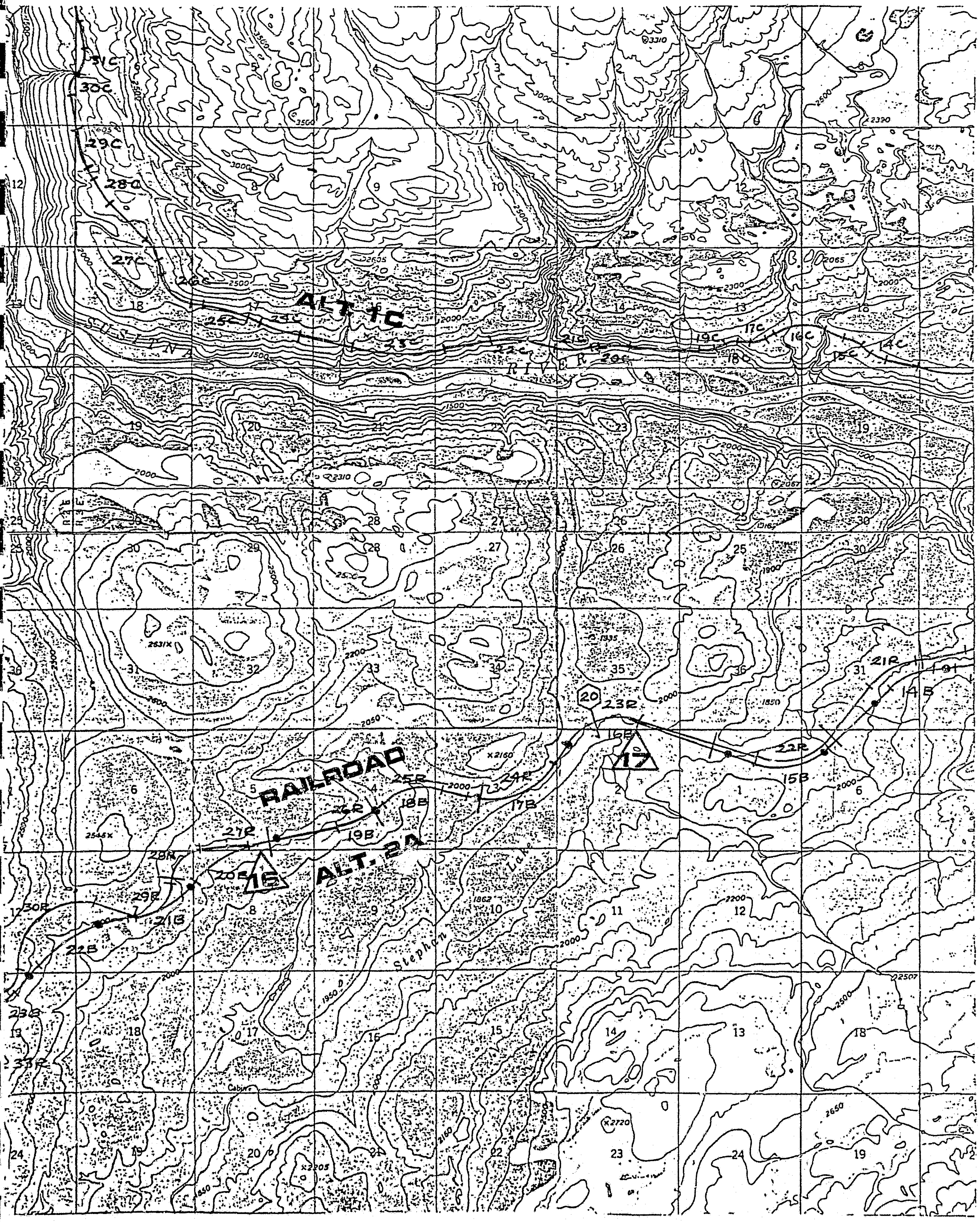

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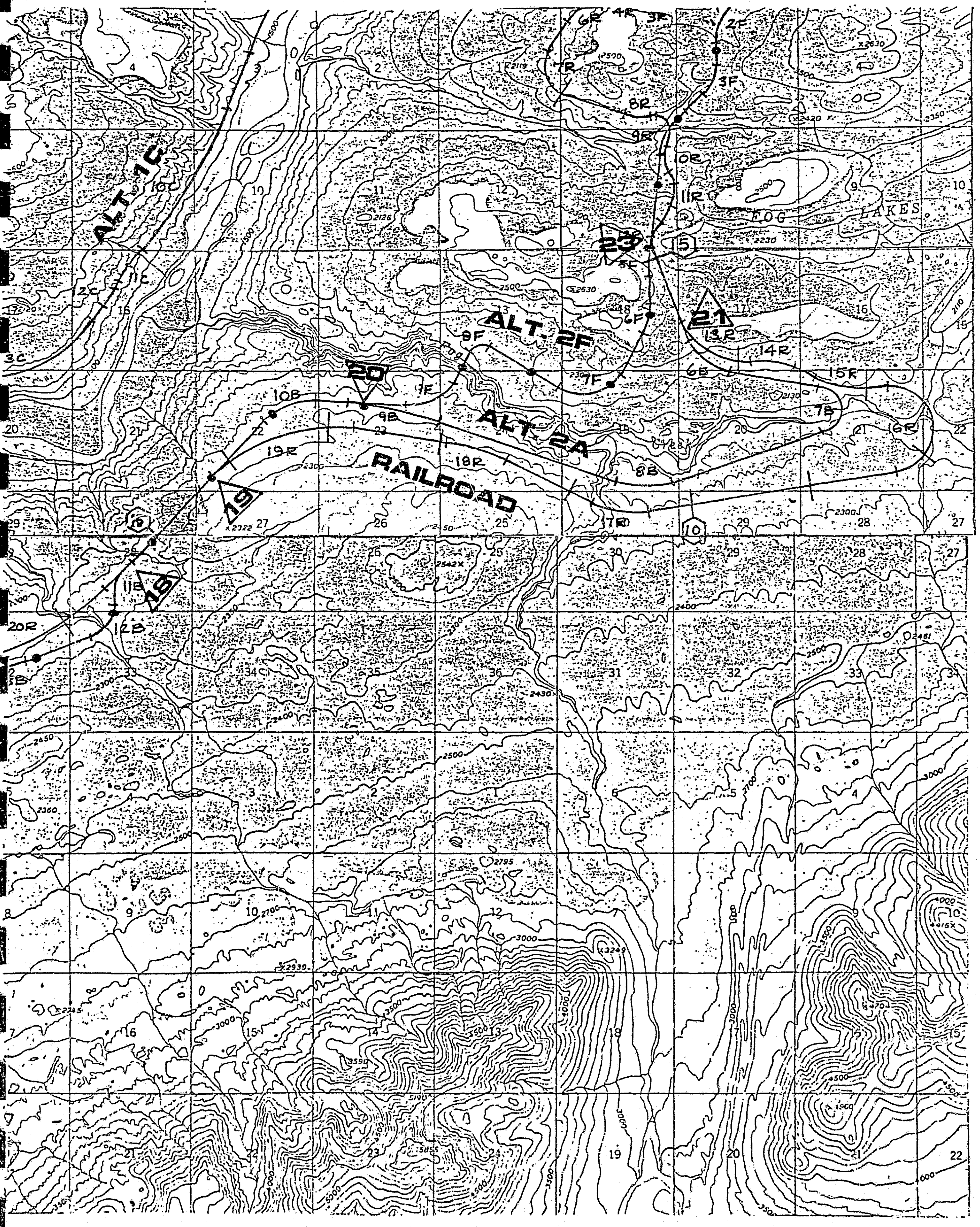

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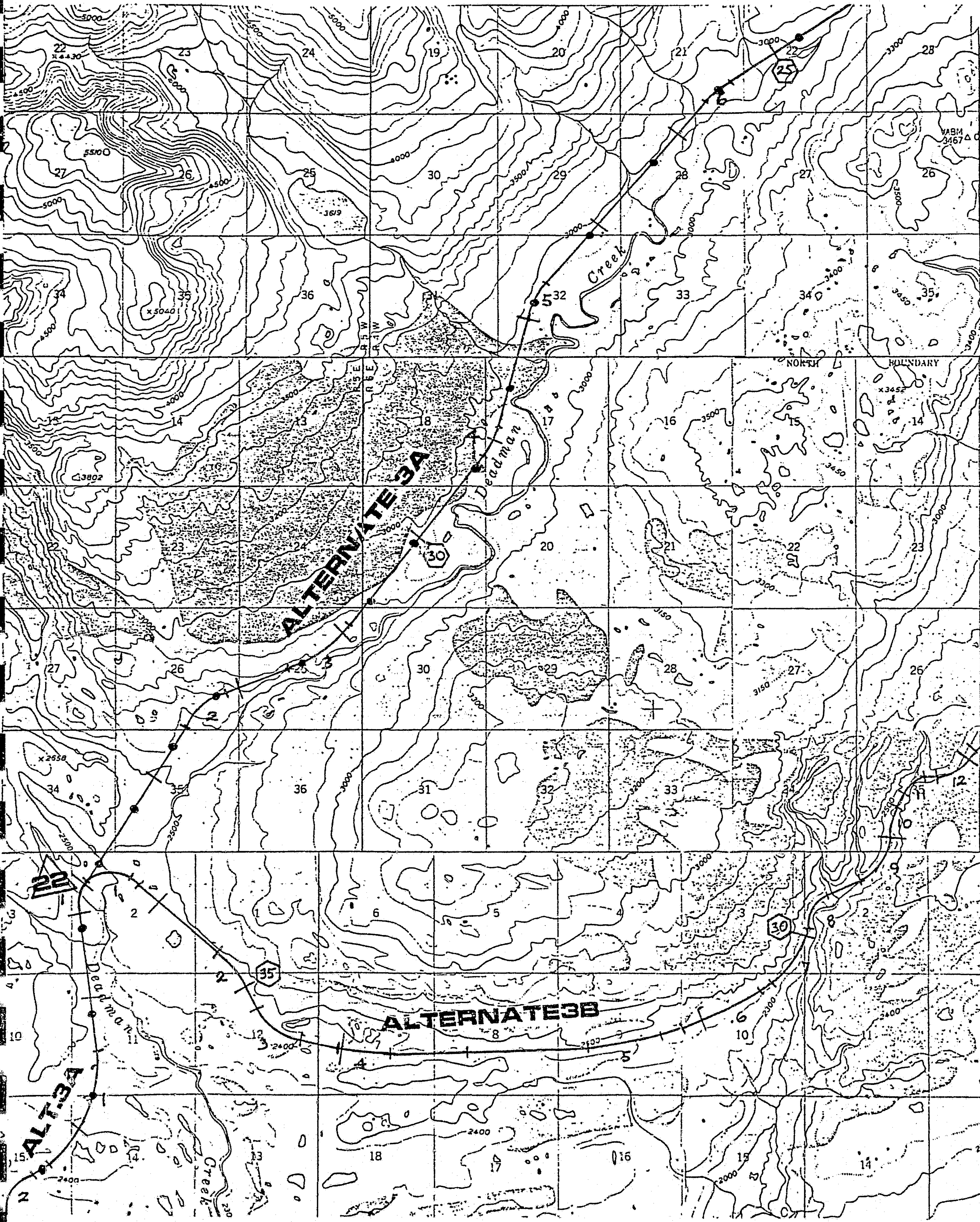

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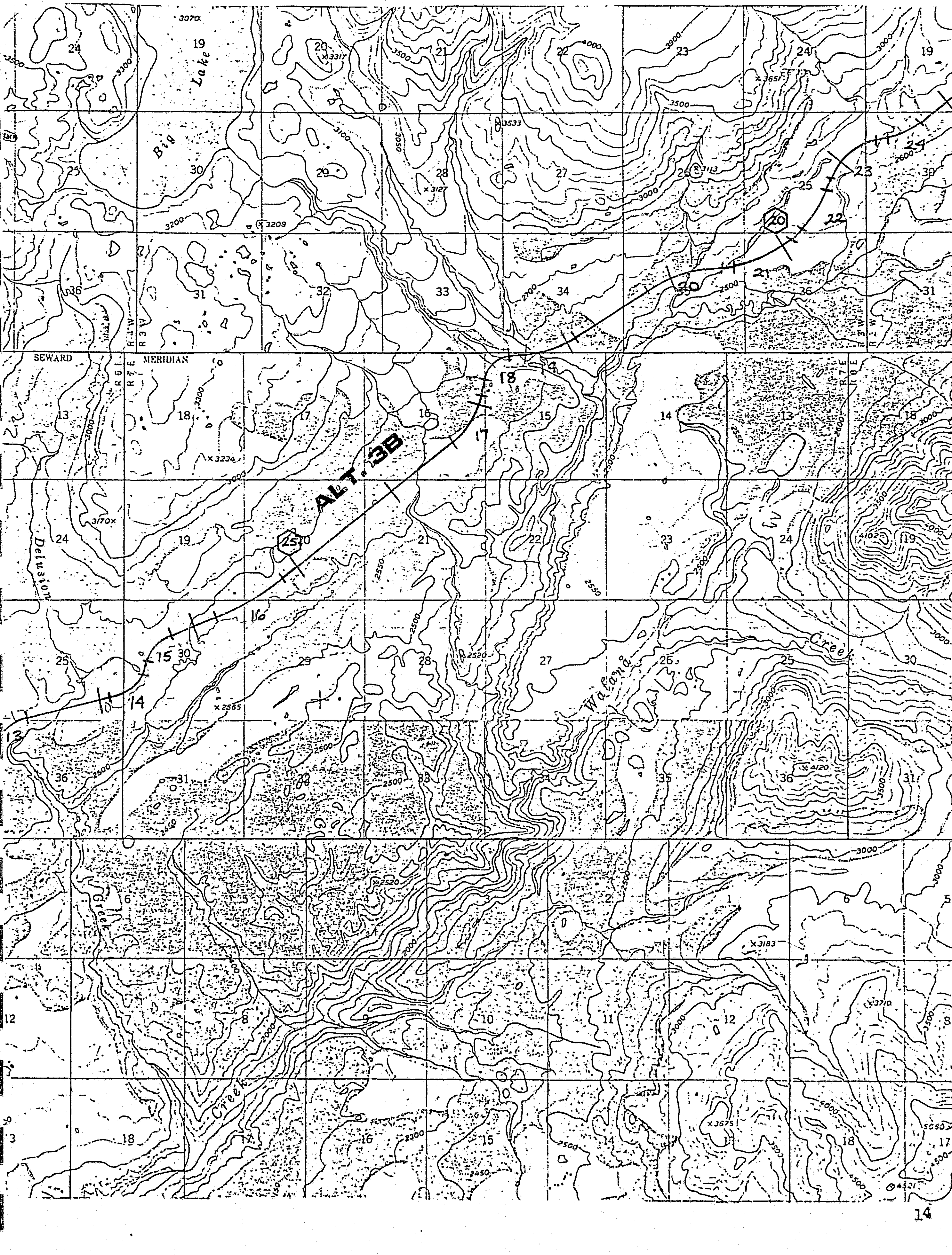

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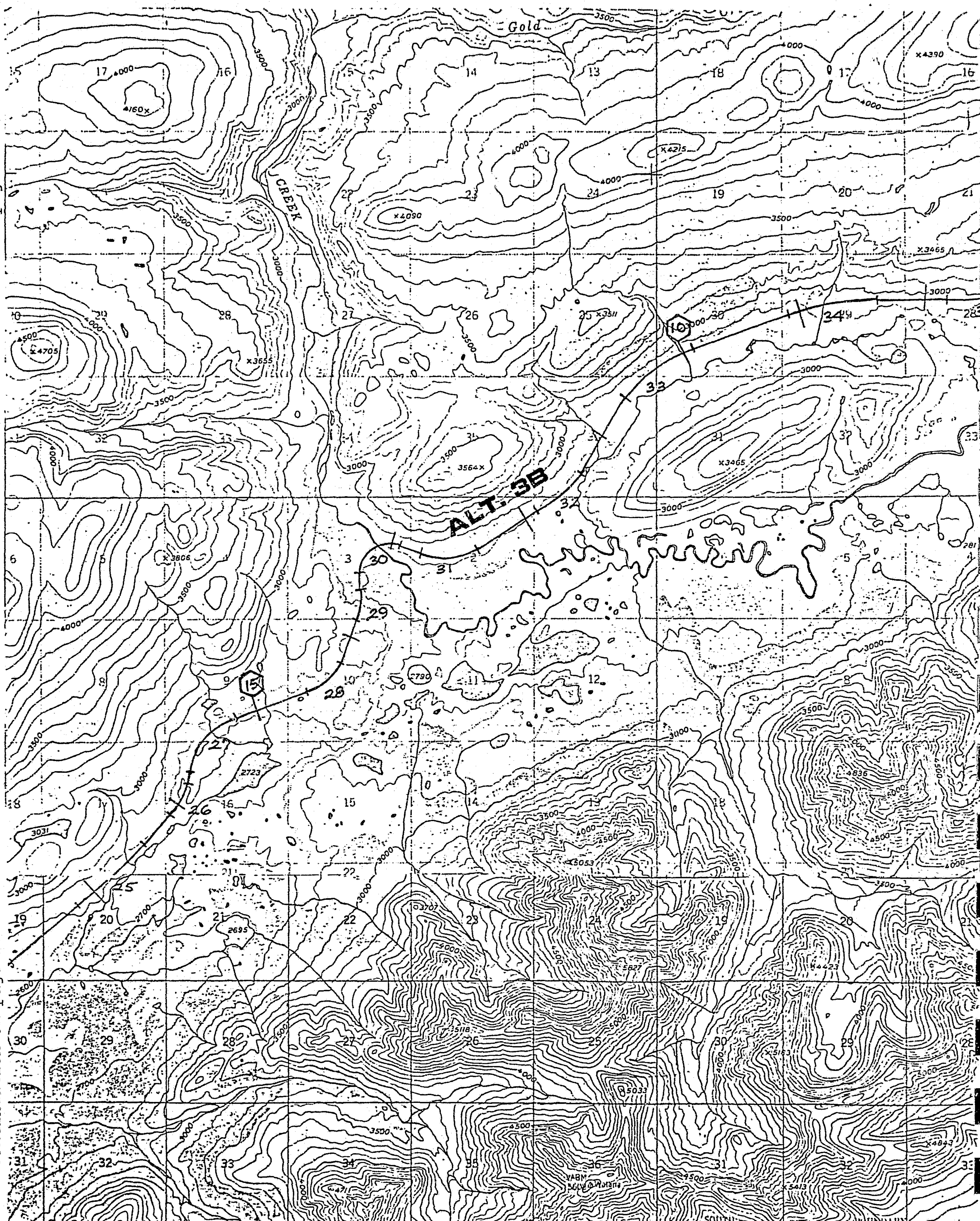

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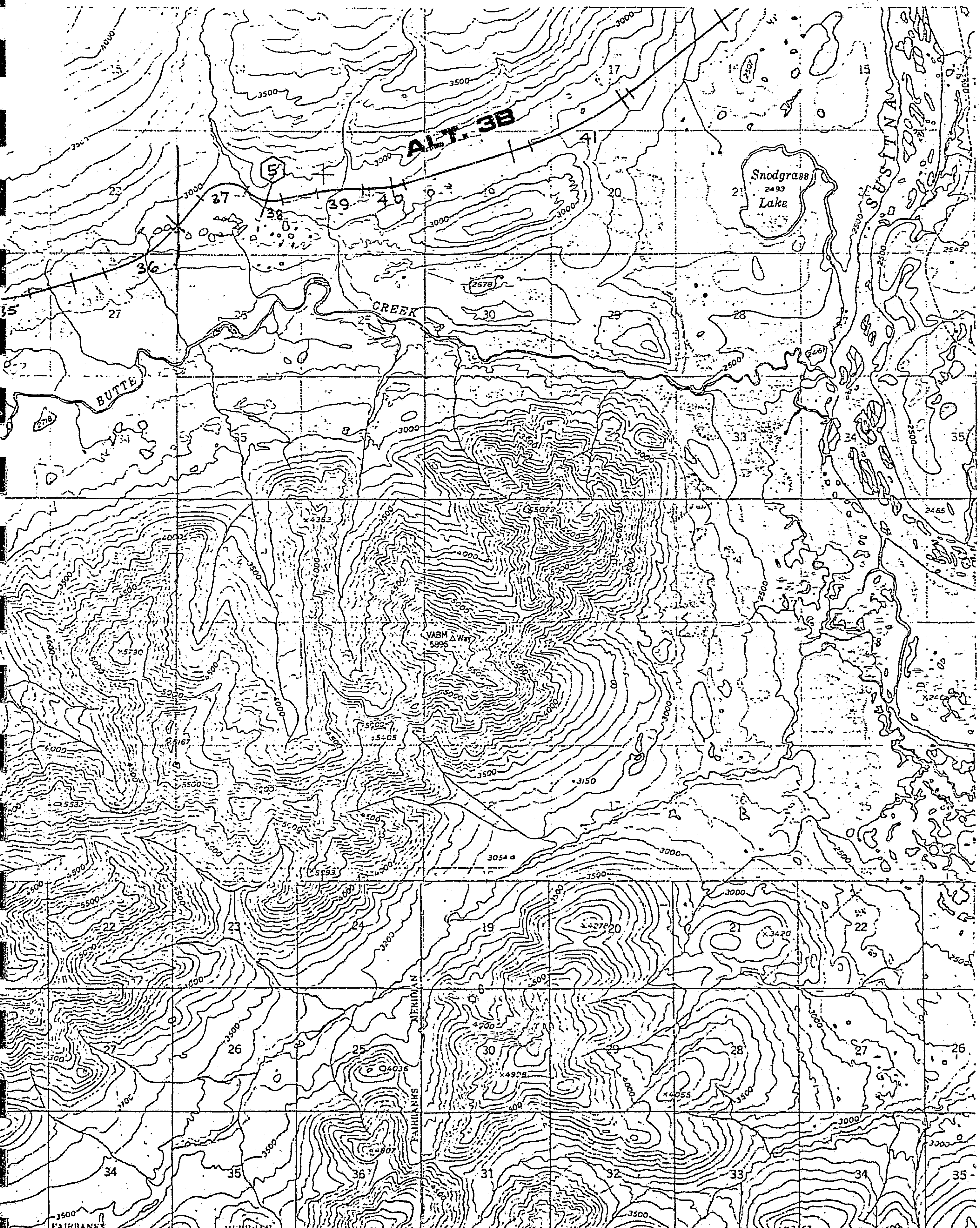

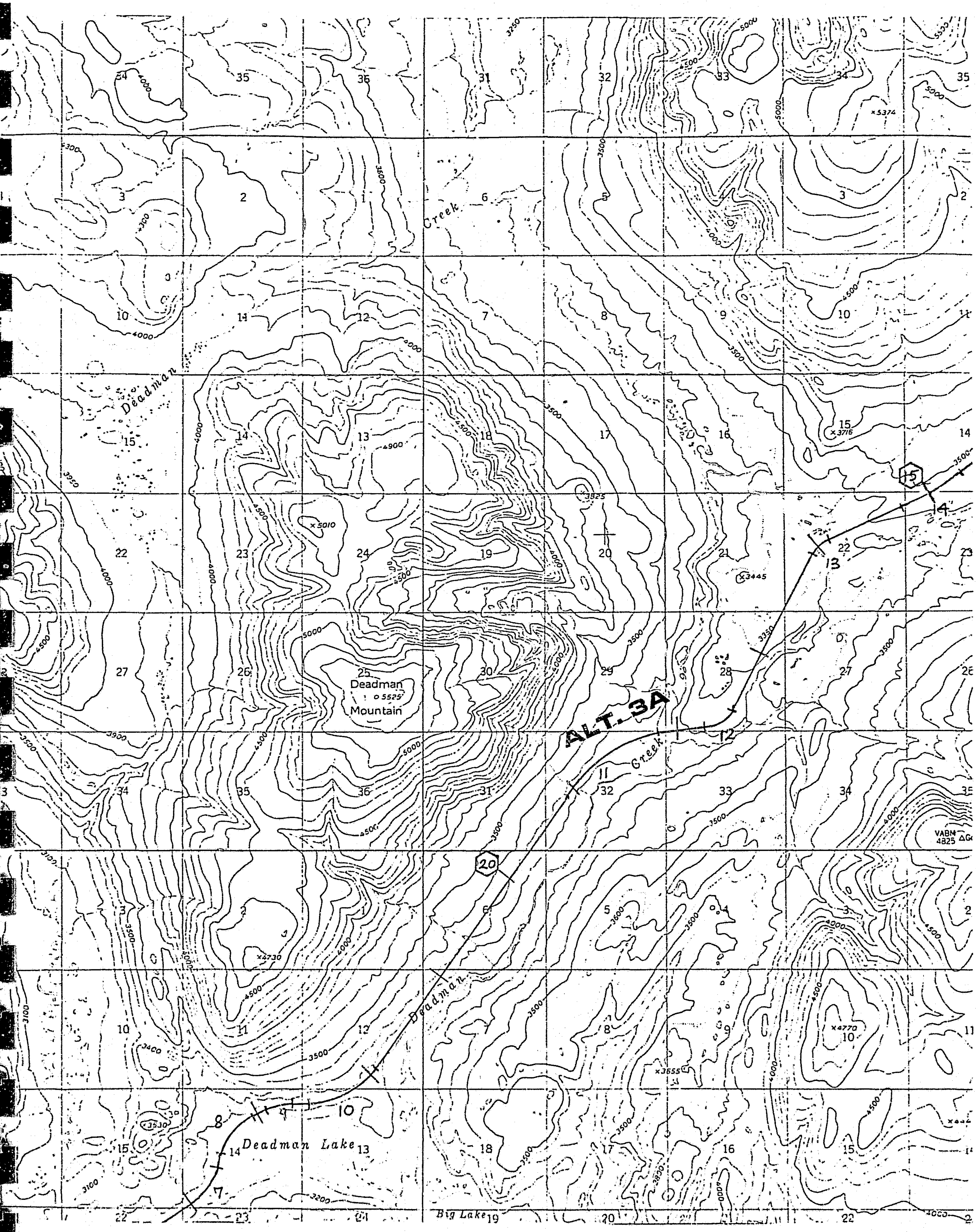

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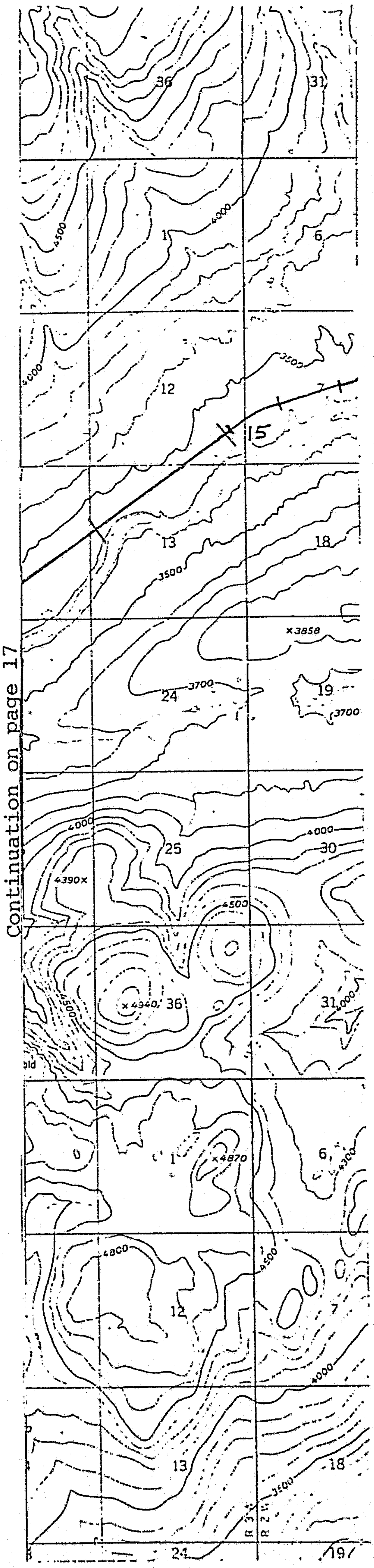

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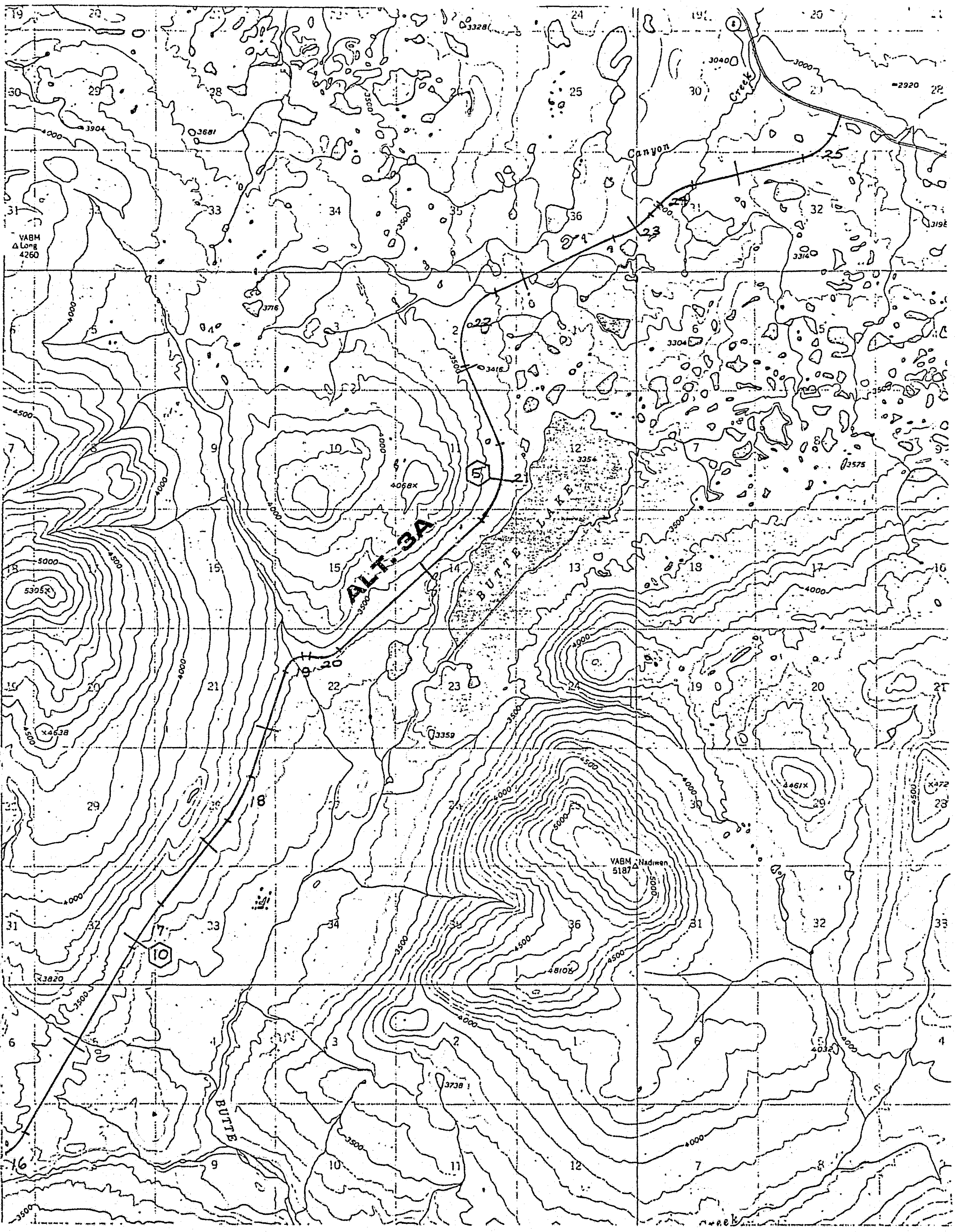

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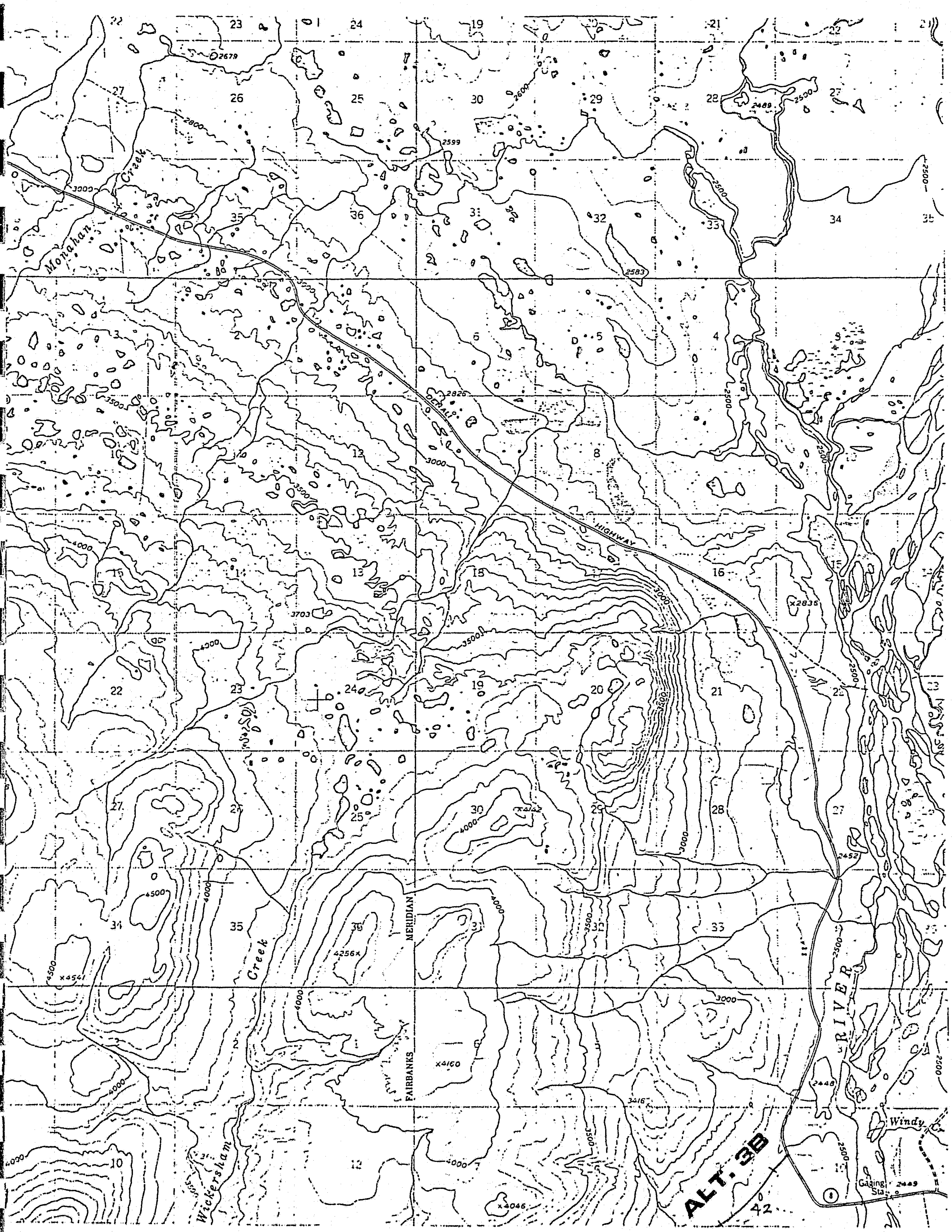

Continuation on page 16

APPENDIX B

ALTERNATIVE COMPARISON

	Distance (Miles)	Average Grade %	Sum of Deflections
Alternative 1-A	68.6 Miles	2.51%	492° 34.15'
Alternative 1-B	16.95 Miles	1.91%	57° 09.92'
Alternative 1-C	27.28 Miles	2.10%	163° 36.76'
Alternative 1-D	8.77 Miles	4.19%	125° 57.41'
Alternative 2-A	56.6 Miles	2.72%	154° 29.53'
Alternative 2-B	11.91 Miles	3.32%	79° 07.83'
Alternative 2-C	6.04 Miles	5.08%	26° 15.78'
Alternative 2-D	10.55 Miles	3.32%	16° 47.84'
Alternative 2-E	15.73 Miles	2.09%	35° 15.94'
Alternative 2-F	4.74 Miles	2.09%	22° 15.88'
Alternative 2-G	8.17 Miles	4.49%	152° 30.42'
Alternative 2-H	7.64 Miles	1.91%	24° 00.90'
Alternative 2-I	12.13 Miles	1.13%	18° 30.53'
Alternative 3-A	39.09 Miles	1.26%	59° 15.72'
Alternative 3-B	41.98 Miles	1.15%	93° 9.49'
Railroad (2R)	58.0 Miles	1.48%	299° 58.86'
Alternative 1-A - Curve 17 Three 41A	20.67 Miles	2.43%	89° 27'
Alternative 1-A - Curve 1 Three 41A	27.80 Miles	2.48%	111° 41.81'
Alttenative 1-A - Curve 63 To Hwy.	30.18 Miles	2.64%	155°9.85'

North of Susitna River Access Roads (Corridors 1 and 3)

		Distance (Miles)	Average Grade	Defl. Mile	Sum of Deflections
1.	Alternative 1-A - Wastana Camp to Parks Hwy.	68.6 Mi.	2.51%	7° 10.82'	492° 34.15'
2.	Alternative 1-A, 1-B - Watana Camp to Parks Hwy.	64.8 Mi.	2.37%	7° 05.66'	460° 17.07'
3.	Alternative 1-A, 1-C - Watana Camp to Parks Hwy.	68.08 Mi.	2.35%	7° 59.86'	544° 29.10'
4.	Alternative 1-A, 1-D Base Camp to Anch/Fbk. Hwy.	64.27 Mi.	2.70%	8° 29.59'	545° 51.[illegible]3'
5.	Alternative 1-A, 1-B, 1-D Watana Camp to Parks Hwy.	60.55 Mi.	2.58%	8° 28.90'	513° 34.04'
6.	Alternative 1-A, 1-C, 1-D Watana Camp to Parks Hwy.	63.75 Mi.	2.54%	9° 22.61'	597° 46.07'
7.	Alternative 1-A, 3-A - Devils Canyon to Denali Hwy.	77.50 Mi.	1.83%	5° 07.09'	396° 39.52'
8.	Alternative 1-A, 1-B, 3-A - Devils Canyon to Denali	73.79 Mi.	1.67%	4° 56.29'	364° 22.94'
9.	Alternative 1-A, 1-C, 3-A - Devils Canyon to Denali Hwy.	76.98 Mi.	2.22%	5° 49.63'	448° 34.47'
10.	Alternative 3-A - Watana Camp to Denali Hwy.	39.09 Mi.	1.26%	1° 30.96'	59° 15.72'
11.	Alternative 3-B - Watana Camp to Denali Hwy.	41.98 Mi.	1.15%	2° 13.15'	93° 09.40'
12.	Alternative 1-A, 3-B - Devils Canyon to Denali Hwy.	80.39 Mi.	1.73%	5° 21.36'	430° 33.[illegible]9'
13.	Alternative 1-A, 1-B, 3-B - Devils Canyon to Denali Hwy.	76.68 Mi.	1.58%	5° 11.64'	398° 16.71'
14.	Alternative 1-A, 1-C, 3-B - Devils Canyon to Denali Hwy.	79.86 Mi.	1.59%	6° 02.49'	482° 28.74'

South of Susitna River (Corridor 2)

	Distance (Miles)	Average Grade	Defl. Mile	Sum of Deflections
15. Alternative 2-A - Watana To Sherman	56.6 Mi.	2.72%	2° 43.77'	154° 29.53'
16. Alternative 2-A, 2-D - Watana To Parks Hwy.	67.15 Mi.	2.81%	2° 33.05'	171° 17.37'
17. Alternative 2-A, 2-E - Watana To Parks Hwy.	76.51 Mi.	2.52%	2° 33.11'	195° 14.77'
18. Alternative 2-A, 2-F - Watana To Sherman	54.79 Mi.	2.81%	3° 00.09'	164° 26.93'
19. Alternative 2-A, 2-F, 2-D - Watana To Parks Hwy.	65.34 Mi.	2.89%	2° 46.43;	181° 14.77'
20. Alternative 2-A, 2-F, 2-E - Watana To Gold Creek	74.69 Mi.	2.58%	2° 44.84'	205° 12.17'
21. Alternative 2-A, 2-B, 2-C - Watana To Sherman	59.47 Mi.	3.26%	4° 02.91'	240° 45.96'
22. Atlternative 2-A, 2-F, 2-B, 2-C - Watana To Sherman	57.66 Mi.	3.36%	3° 57.73'	228° 27.48'
23. Alternative 2-A, 2-B, 2-C, 2-D - Watana To Parks Hwy.	70.02 Mi.	3.85%	3° 40.71;	257° 33.80'
24. Alternative 2-A, 2-F, 2-B, 2-C, 2-E - Watana To Parks Hwy.	77.56 Mi.	3.00%	3° 28.26'	269° 12.72'
25. Alternative 2-A, 2-B, 2-G, 2-H - Watana To Gold Creek	51.66 Mi.	2.38%	5° 32.25'	286° 04.2'
26. Alternative 2-A, 2-B, 2-G, 2-H, 2-D - Watana To Parks Hwy.	68.50 Mi.	2.09%	4° 04.18'	278° 46.48'

South of Susitna River (Continued)

		Distance (Miles)	Average Grade	Defl. Mile	Sum of Deflections
27.	Alternative 2-A, 2-B, 2-G, 2-H, 2-E - Watana To Parks Hwy.	68.25 Mi.	2.17%	4° 36.27'	314° 15.28'
28.	Railroad, Watana to Gold Creek	58.01 Mi.	1.48%	5° 10.27'	299° 58.86'
29.	Alternative 2-A, 2-B, 2-C, 2-E - Watana To Parks Hwy.	79.37 Mi.	2.93%	3° 32.82'	281° 31.2'
30.	Alternative 2-A, 2-F, 2-B, 2-G, 2-D - Watana To Parks Hwy.	68.21 Mi.	3.35%	3° 35.74'	245° 15.32'
31.	Alternative 2-A, 2-F, 2-B, 2-G, 2-H - Watana To Gold Creek	49.85 Mi.	2.33%	5° 56.30'	296° 1.6'
32.	Alternative 2-A, 2-F, 2-B, 2-G, 2-H, 2-D - Watana To Parks Hwy.	66.69 Mi.	2.41%	4° 54.59'	327° 26.39'
33.	Alternative 2-A, 2-F, 2-B, 2-G, 2-H, 2-E, 2 -I Watana to Parks Hwy.	66.44 Mi.	2.22%	4° 50.79'	324° 12.18'

APPENDIX C

PERTINENT CORRESPONDENCE

R&M
R&M CONSULTANTS, INC. 5024 CORDOVA ■ BOX 6087 ■ ANCHORAGE, ALASKA 99502 ■ PH. 907-279-0483 ■ TLX. 090-25360
ENGINEERS
GEOLOGISTS
PLANNERS
SURVEYORS

April 15, 1980

R&M No. 052210

Jim Gill
Acres American, Inc.
2207 Spenard Road
Anchorage, Alaska 99503

Re: Susitna Hydroelectric Project, Subtask 2.10, Access Road/Rail Road

Dear Mr. Gill:

Work has began on definition of the flight corridors for the subject task. Early agreement on certain basic parameters is necessary. These parameters are maximum grades, minimum curve radius and/or degree of curve.

The following values are proposed:

Parameter	Road (30 mph Design)	Railroad
Maximum Grade	±10%	±2.5%
Maximum Degree of Curve	19°	10°

These parameters will be used unless instructions to the contrary are received. If there are any questions, please contact this office.

Sincerely,

R&M CONSULTANTS, INC.

Brent T. Drage

Brent T. Drage, P.E.
Susitna Project Coordinator

BTD:NG/dj/SUSI 1-W

May 1, 1980
P5700.11.10
T.131

Mr. Brent Drage
R&M Consultants, Inc.
5024 Cordova Street
P.O. Box 6087
Anchorage, AK 99503

Dear Brent:

Susitna Hydroelectric Project
Access Road Requirements

In reference to your letter of April 15, 1980 (R&M No. 052210) regarding access road parameters, we have the following comments.

The road parameters proposed:

a.) 30 mph design
b.) 10% max grade
c.) 19° max curve

are unacceptable.

For several reasons, some of which are not completely defined, we recommend the following parameters. The design speed has not been exactly established; however, it will be 50 mph or 60 mph.

a.) 50 mph design	a.) 60 mph design
b.) 7% max grade	b.) 6% max grade
c.) 7.6° max degree of curve	c.) 5° max degree of curve

The access road will be approximately 60 miles in length. It will be used during and after construction. Because of the 60 mile length, a 30 mph design would make an unseemingly long and boring ride. The use of the highway after construction has not been definitely established however, this road becoming a main highway in that region is very possible. The above reasons are oversimply stated, however the 50 or 60 mph design will be studied more carefully and documented during the scheduled sub task.

The railroad parameters stated:

a.) 2.5% max grade
b.) 10° max degree of curve

are acceptable. It is envisioned at this time the rail line to the site would be only a spur line and not a main line.

ACRES AMERICAN INCORPORATED
Buffalo New York 14202
Telephone 716-853-7525 Telex 91-6423 ACRES BUF
Other Offices: Columbia, MD Pittsburgh, PA Raleigh, NC Washington, DC

Probable wheel loadings for the access road are as follows. After construction AASHTO Standard HS 20 loadings and vehicles will apply. During construction of the project, the road will experience heavier loadings. The possibility of 200 ton transporters with maximum axle loads in the order of 80,000 lbs exists. These wheel loadings will be better defined during the scheduled sub task. As additional data and information is obtained, it will be forwarded to you.

If you have any questions, please feel free to contact this office.

Sincerely,

John D. Lawrence
Project Manager

TWG/rm

052210

SUSITNA HYDROELECTRIC PROJECT

May 19, 1980
P5700.11.10
T00119A

Mr. John Lawrence
Liberty Bank Building
Main at Court
Buffalo, New York 14202

Dear John:

Access Roads

On Thursday, May 15, 1980, we met with Brent Drage, Bob Dortch and Norm Gutcher of R & M Consultants, to discuss the access road alignments. We are transmitting, with this letter, one copy of the selected alignments to be flown this month as a result of those discussions. We are also transmitting a copy of a letter from Norm Gutcher outlining a number of questions which need to be answered relative to the access road study.

With respect to access road design criteria and the concerns raised by Chuck Debelius in his memo of May 6, 1980, we have discussed and resolved this matter to what we believe to be an acceptable criteria. The alignments chosen by R & M Consultants, as shown on the attached maps, are based on their original 30 mph criteria. However, most of the routes meet our more recent criteria of 50-60 mph. We believe this to be the best compromise and does not penalize the economics of the road alignments by utilizing the 50-60 mph criteria throughout.

One route not chosen for further study warrants specific comment. This route is on the south side of the river and goes straight over the top of the high country to the south. It was R & M's recommendation that due to difficulty in keeping the grade down on the initial section of the route as well as deep snow conditions over much of the alignment that this route not be pursued further.

There are a number of options which can be further studied from a transportation economics point of view. These include extending the railway to Cantwell and comparing the economics of the combined rail/truck system for supply of construction materials. This could be compared to a southerly route of either truck only or a rail/truck combination. These studies, of course, would only address the construction phase of the project and some consideration must also be given to the distance to the Watana site if the shortest access to the Denali Highway was utilized making the driving distance from Anchorage the longest.

The other option worth considering, which has merit from an environmental point of view, is to use the Denali Highway route to Watana

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and a route north or south of the river to the Devils Canyon site at some future date without connecting the two sites. This in effect would restrict access to the area or would allow it, if desireable, connecting the two, providing general public access in a complete loop.

One final note. Does FERC have an interest in the access road? There has been a suggestion that they will have it reviewed by FWHA.

Please give the questions from R & M your earliest consideration so that they can proceed with their work activities.

Sincerely,

James D. Gill
Resident Manager

JDG/ja

Enc: 2

cc: C. Debelius
R & M Consultants

R&M
R&M CONSULTANTS, INC. 5024 CORDOVA ■ BOX 6087 ■ ANCHORAGE, ALASKA 99502 ■ PH. 907-279-0483 ■ TLX. 090-25360
ENGINEERS
GEOLOGISTS
PLANNERS
SURVEYORS

May 12, 1980

R&M No. 052210

ALASKA POWER AUTHORITY SUSITNA
FILE P5700
SEQUENCE NO.
INITIAL / INFORM. / ACTION — JEG, JKL, VTS, WCC, TES, R&M, ADF&G

Acres American
2207 Spenard
Anchorage, Alaska

Attention: Jim Gill

Re: Task 2.10 - Access Road

Dear Mr. Gill:

Work on the subject task has progressed to the point that three possible alignments will be ready for review during the week of May 12, 1980. The three alignments to be reviewed are those which are to be flown and photographed later this month.

During the time work has been underway a number of considerations have come to mind that will have bearing on the transportation mode and route finally selected. The Susitna dam project will require a large scale continuous stream of supplies. This supply effort will be a major item in the overall project cost. Listed below are a number of items that may effect the final selection of transportation mode and route.

- Will both Watana and Devils Canyon dams be built at the same time?
- If both dams are not built at the same time which dam will be built first and what will be the anticipated time between construction of the two dams?
- What is the anticipated length of time required for construction?
- What is the anticipated population of the construction camp?
- What is the estimated rate of flow of supplies for the construction camp and crew.
- Where will the camp and crew supplies come from?
- What is the length of the annual construction season estimated to be?
- What will be the probable size and mix of the construction equipment fleet?

- What is the estimated fuel requirements for the construction fleet and camp?

- What might be a reasonable rate of flow of spare parts for the construction equipment?

- What type of construction materials will be required and in what quantity?

- Where will items such as fuel, cement, aggregate, steel and machine parts come from?

- Is it reasonable to include the proposed rail line from Valdez to Fairbanks as a possible supply corridor. This rail link has been discussed and may be in the serious planning stages. If implementation were to occur in timely fashion this may provide the shortest overland distance to the Watana Site from a deep water port facility.

In addition to the above questions pertaining to the long range project evaluation, we have a couple of questions, the answers to which, may impact our current scope of work and time frame.

- Who is responsible for the economic and environmental analysis necessary to determine the most desirable transportation mode or modal mix and supply route, and how will they relate to R&M Consultants' technical analysis of the access corridors?

- Will the location study have to meet FHWA standards and, if so, which standards?

It is realized that answers to all of these questions will not come immediately. The answers are, however, necessary input to the analysis and must be provided prior to preparation of the final location study report. It is important that we know as soon as possible, what agency standards must be met and who is to conduct the economic analyses.

If you have any questions please let us know.

Sincerely yours,

R&M CONSULTANTS, INC.

Norman K. Gutcher

Norman K. Gutcher
Senior Civil Engineer

NKG/dj/L1-N

05 2210

June 6, 1980
P5700.11.10
T.189

052000

Mr. Brent Drage RTD
R&M Consultants, Inc.
5024 Cordova Street
P.O. Box 6086
Anchorage, Alaska 99503

Dear Brent:

Susitna Hydroelectric Project
Access Road Requirements

I understand my letter of May 1 may have been misunderstood. This letter is to clarify the matter and inform you of Acres current requirements for access road route selection, pending more detailed studies at a later date.

It is perhaps unfortunate that the stated speed requirements have been allowed to confuse the issue. Speed is not of concern at this time, since any required speed restrictions may eventually be imposed on a particular route. We are not in a position at this time to make a final judgement on such speed restrictions. It is more important, in fact essential, to insure that the road grades and bends are such as to allow transportation of the kinds of equipment we envisage for construction of the Susitna Project.

You are therefore directed to insure that the selected access road routes for survey purposes will generally have a 6% maximum grade and a 5^{0} maximum degree of curve. Relaxation of these requirements to 7% and 7.6^{0} respectively will be accepted locally if warranted for reasons of economy.

We look forward to receiving your preliminary proposals for access road route selection for our review and approval.

Sincerely,

John D. Lawrence
Project Manager

JDL/jmh

August 13, 1980
P5700.11.10
T00252A

052210

R & M Consultants Incorporated
5024 Cordova Street
Anchorage, Alaska 99503

Attention: Norman Gutcher

Dear Norman: Access Roads

We regret the long delay in answering your letter of May 12, 1980. The specific answers to your questions are as follows:

1. The Watana and Devil Canyon Dams will not be built at the same time.

2. Watana dam would be built first followed by the Devil Canyon dam several years later.

3. Since our own studies have not advanced far enough to make definite schedules our current best estimate of the construction period would be as outlined in the Corps of Engineers report, a copy of which is attached. You will note the revisions made to the schedule by the Corp in their 1979 report.

4 - 12. All of the information requested is not available at this time. We do not believe that it is in fact needed at this stage. It should be sufficient to know that the route must be capable of carrying large vehicles up to 60 ft. length, with a gross weight of 200 tons (40 ton wheel loads) and that the route would be subjected to moderately high traffic volumes.

13. Since the proposed Valdez-Fairbanks rail line is only in the planning stages, it should not be assumed to be available. However, we should discuss it in the study report and state whether it would be worth considering as an alternative, should it materialize.

14. As outlined in the POS, TES are responsible for environmental aspects associated with the access route. We expect R&M to coordinate their input. We should be kept informed of what goes on and will certainly assist should R&M have any problems.

The objective of R&M's Subtask 2.10 activities are clear; i.e. to "define alternative access routes; evaluate technical, economic and environmental factors for each, and recommend the best alternative". We therefore expect R&M to undertake the necessary preliminary transportation cost studies in order to recommend a route. These cost studies could be based on average unit transportation and handling costs, and consideration of other aspects such as recreational access, reliability, land ownership, capability for handling large pieces of equipment (e.g. dimensions, weight, etc..). R&M should, however, do some sensitivity analyses, possibly including an alternative rail/road configuration (to a lower level of detail) in the route selection report.

15. Acres will be providing R&M with details of FERC requirements and State permitting requirements. We expect R&M to ensure that all permitting requirements and applicable rules and regulations are taken into account in this study.

Sincerely,

James D. Gill
Resident Manager

JDG/ja

Enclosures

CONSTRUCTION SCHEDULE

OMB COMMENT

> The 11-year construction schedule for the Watana project, based on preliminary inspection of comparable projects, appears to be on the short side. A longer schedule of 14 years appears more reasonable because of (1) normal slippages and (2) a 3-year peak construction schedule that calls for more work to be put in place on a single site than the Corps has ever accomplished in similar time periods. This should be reexamined and its effects on the project B/C ratio calculated.

GENERAL

The construction schedule has been reanalyzed and lengthened from 10 to 14 years. The Watana dam and powerplant will take 10 years to construct, an increase of 4 years over the previous schedule. The Devil Canyon project construction will require 8 years rather than the previously estimated 5 years. There will be 4 years of concurrent construction to meet power-on-line dates.

DIVERSION PLANS

The time for Watana diversion works construction and stream diversion has been extended to 3 years from the previously estimated 2 years, because the construction access to the tunnel portals requires extensive rock cuts and added time. The start of construction of the diversion works for the Devil Canyon dam has been delayed from the 5th to the 7th year of Watana construction because it is dependent on stream regulation by the upstream Watana dam.

MAIN DAMS

Foundation preparation at Watana would be delayed to the 4th year as a result of the extended diversion requirements which would delay the start of cofferdam construction. Watana embankment construction, scheduled to begin in the 5th year and continue into the 10th, would require 6 years instead of the previously estimated 3 years, based on construction seasons of 5 months with average daily placement rates of 80,000 cubic yards. Water impoundment would start in the 8th year with power-on-line in October of the 10th year. The reservoir filling would continue beyond the power-on-line date and would depend on the rates of inflow and power generation.

Foundation preparation for Devil Canyon dam would start in the 9th year, a 2 year delay from the earlier estimate. Concrete placement and dam completion would begin in the 10th year and require 5 years, an increase of 2 years over the earlier schedule. Impoundment would commence in the 13th year and end with a full reservoir in October of the 14th year.

EFFECT OF DELAY

The presently scheduled power-on-line dates are 1994 for Watana and 1998 for Devil Canyon. These were previously scheduled for 1986 and 1990 respectively. These dates include the result of the changes in assumed congressional construction authorization from July 1980 to October 1984 and the revised construction schedule. Transmission line construction could be completed in 1991, permitting connection of the Anchorage and Fairbanks load centers in advance of Watana power-on-line. The economic evaluation is based on this longer 14-year construction schedule and the delayed power-on-line dates.

Even with the longer 14-year construction period, additional construction delays are possible. The impacts, however, would be minimized by the recommended two-stage construction sequence. If significant delays were experienced on Watana, the start and schedule of Devil Canyon construction could be adjusted with minimal cost impact. Delays in Devil Canyon construction would have no effect on Watana's schedule.

The project's economic justification has been analyzed to assess the impact of construction delays that would extend the power-on-line dates. As an example, a 2-year delay in Watana completion was evaluated. The primary effect on project cost would be the accumulation of additional interest during construction. The 2-year delay increases average annual costs by about $17 million.

The delay of Watana power-on-line would also affect project benefits, although the change would be small. The impact on benefits is due to the mix and schedule of thermal plants coming on line prior to Watana and to the rate of load growth during the years after power-on-line. For a 2-year delay, equivalent average annual power benefits would be reduced about $4 million.

The net change in project economics would be an increase in total annual costs to $245 million and a reduction in annual benefits to $320 million. This decreases the benefit-cost ratio from 1.42 to 1.31.

Analysis shows that the construction period would have to be prolonged at least an extra 9 years before the Susitna project would become uneconomic.

careful scheduling, planning, and the use of temporary, heated enclosures where construction situations would permit.

Preconstruction Planning for the Selected Plan: A period of about four years is estimated for preconstruction planning. The work scheduled for this period includes an economic reanalysis, detailed environmental and archaeological surveys, topographic surveys, and explorations and foundation investigations for the Devil Canyon and Watana damsites.

A 52-mile pioneer road from Gold Creek to the Watana damsite would be constructed during preconstruction to allow heavy exploration equipment into the project area to facilitate the preconstruction investigations.

Construction Schedule for the Selected Plan:

General: The construction period for the selected plan is estimated to be 10 years, 6 years for Watana Dam and powerplant, and 5 years for Devil Canyon Dam and powerplant. Construction period for transmission facilities is 3 years. Concurrent construction will be required to meet power-on-line schedules. The following paragraphs describe the sequence of construction for the selected plan's projects.

Diversion Plans: Construction of the diversion works would start in the winter of the first year for Watana and the winter season of the fifth year for Devil Canyon. The diversion works could each be completed in two years.

Main Dams: Site clearing and foundation preparation would start in the third year with material placement scheduled from the fourth into the sixth year of construction for Watana Dam. The diversion tunnel would be closed in spring of the final construction year and Watana reservoir would fill to its normal full pool elevation by fall to supply power-on-line the following winter.

Clearing and foundation preparation for Devil Canyon would start in the seventh year with material placement beginning in the eighth year and continuing into the tenth year of construction. The diversion tunnel would be closed in spring of the tenth year and the reservoir would be filled by fall of the tenth year.

Powerhouses: Construction of underground powerhouses would be concurrent with the main dams of both projects; and excavation and installation of mechanical and electrical equipment would continue year-round. Four generating units would be installed in the Devil Canyon powerplant and three generating units in the Watana powerplant. Power-on-line (POL) for Watana is scheduled for 1986 and Devil Canyon POL is scheduled for 1990.

Vehicle access to the powerplant is provided by a service road across the top of the dam and an all-weather road on the right side of the river. The road will be 2.3 miles long including a 2,100-foot tunnel.

The Devil Canyon switchyard is located on the left bank of the river immediately downstream of the rockfill section of the dam.

The major portion of the lands within the reservoir area were withdrawn for power purposes in 1958. The Devil Canyon Dam powersite withdrawal includes all lands below the 1,500-foot contour elevation. Devil Canyon reservoir would have a surface area of 7,550 acres at normal full pool elevation of 1,450 feet. The minimum power pool level would be at elevation 1,275, while the maximum elevation produced by the design flood would be 1,455 feet. The reservoir would extend about 28 miles upstream to about 2 miles below the Watana damsite. The reservoir area, confined within the Susitna River canyon, is narrow.

Devil Canyon damsite will be 27 road miles from the Parks Highway and 37 road miles from Watana.

Tentative sites have been selected for temporary construction camps as well as for permanent facilities for operating personnel. The temporary construction camps will consist of units reused from the construction of Watana Dam.

OPERATION PLAN

For study purposes the reservoirs were operated to provide optimum power operation during the average year. To maintain maximum powerhead, Devil Canyon was given priority by providing storage releases from Watana as necessary. Watana was operated to maintain the Devil Canyon maximum pool and to provide additional capacity and energy.

During the first five years of operation, prior to the completion of the Devil Canyon project, Watana would be operated to provide capacity and generation as demanded to the limits of its capability. Full pool conditions would usually occur during the summer months of July through October (the most severe historic floods have usually occurred during the spring snowmelt of May and June). Devil Canyon reservoir is expected to remain full almost 100 percent of the time.

CONSTRUCTION SCHEDULE

Construction Season: The outdoor construction season at Devil Canyon and Watana damsites is about six months and could be extended by