SUSITNA HYDROELECTRIC PROJECT

HYDROGRAPHIC SURVEYS CLOSEOUT REPORT

TASK 2: SURVEYS & SITE FACILITIES

FINAL DRAFT
OCTOBER 1981

Prepared by:

R&M CONSULTANTS, INC.

Prepared for:

ACRES

ALASKA POWER AUTHORITY

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TASK 2 - SURVEYS & SITE FACILITIES

SUBTASK 2.16 - CLOSEOUT REPORT
HYDROGRAPHIC SURVEYS

OCTOBER 1981

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ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
HYDROGRAPHIC SURVEYS

CLOSEOUT REPORT

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1 - INTRODUCTION

1.1 - Objectives

Study of downstream hydrographic conditions is a vital part of the total data collection effort during the feasibility study for the Susitna Hydroelectric Project, particularly because of potential project impact on the river flow regime.

Subtask 2.16, Hydrographic Surveys, was designed to provide field data relating to existing river gradient and cross-sectional configuration of the active floodplain along the Susitna River through the reach from Deadman Creek to Talkeetna. The cross-section data and Manning's roughness coefficients determined by bed material analysis were used directly in developing the Corps of Engineers HEC-2 water surface profile model (Subtask 3.06) and in preparing the interim report on sediment yield and river morphology studies (Subtask 3.07). In addition, the information gained through Subtask 2.16 can be used in environmental studies to help determine potential impacts on fisheries, as well as on vegetation communities and related game habitat areas due to proposed changes in flow regime caused by project development.

1.2 - Report Contents

The methodology and results of work carried out under Subtask 2.16 are presented in this report. It includes background information on selection of river cross-section locations, as well as plots and summarized field notes for each cross section surveyed. Also, a longitudinal profile of the river was developed using distances between the cross-sections measured from aerial photographs and bed elevations along the thalweg obtained from survey data of the main channel.

An example of the bed material analysis technique used in conjunction with field surveys is also included, along with a summary of the methodology used to obtain the bed material samples and the resulting grain-size distribution determined for each cross-section where sampling was done.

2 - SUMMARY

Subtask 2.16 involved survey of river cross-sections on the Susitna River from Deadman Creek to Talkeetna to define the river gradient and configuration of the active floodplain. The results will provide baseline data for engineering and riverine habitat assessment during the first phase of the feasibility study for the Susitna Hydroelectric Project.

During meetings held at R&M Consultants in early September of 1980, a multi-disciplinary task force established criteria for locating the proposed cross-sections, identified locations of special interest and delineated the cross-section lines on aerial photographs of the river. Field surveys began in September after final review and approval from the Buffalo office of Acres American, Inc.

Ground control surveys consisted primarily of third-order vertical control and scale-accuracy horizontal control. Vertical control was based on a National Geodetic Survey first-order level line running parallel to the Alaska Railroad tracks and on a first-order level line run by R&M under Subtask 2.09. The vertical control was used to establish elevations on aluminum survey caps set on the left (easterly) side of the river at each cross-section site. Elevations along the cross sections were determined through use of differential leveling and vertical angle leveling.

Key features measured or described during field survey of each section included such things as major breaks in slope of the land surface, geometry of all river channels, limits to vegetation and average bed material size along the exposed river bed.

In conjunction with the survey work, a preliminary analysis of bed material along the river was carried out using the "Grid-by-Number" technique described by Kellerhals and Bray in "Sampling procedure for coarse fluvial sediments".

Included in this closeout report are the results from that analysis with explanation of the methodology used to collect and analyze the samples. Also included are plots and summarized field notes for each cross-section surveyed. From survey coordinates the thalweg elevation in the main channel was defined and the longitudinal profile of the river between Devil Canyon and Talkeetna was drawn.

3 - SCOPE OF WORK

3.1 - Background

Discussions were held with a multi-disciplinary task force, including representatives from Acres American, Alaska Department of Fish and Game (A.D.F.&G.), R&M Consultants and Terrestrial Environmental Services (TES) in September of 1980 to select tentative river cross-section locations between Talkeetna and Devil Canyon. This reach was divided into five subreaches defined as:

- Portage Creek Confluence
- Gold Creek/Indian River Confluence
- Sherman/4th of July Creek
- Susitna River in the Vicinity of Curry
- Susitna River near the Chulitna - Susitna Confluence

For each subreach, cross-section locations marked on aerial photographs were based on some of the following criteria:

- available funding for the subtask
- requirements for the HEC-2 computer program, including hydraulic control points and characteristic cross-sections to describe channel geometry.
- apparent changes in river gradient
- ice jam considerations
- instream flow/fish habitat considerations, including stage relationships between the mainstem Susitna and selected side channels or sloughs, and fish passage at major tributaries
- identification of hydraulic and morphologic conditions of mainstem subreaches

The section of the river between Cross-Sections 13 and 18 appeared very similar in terms of channel characteristics (channel width, divided flow, etc.) to a section of approximately equal length between RM 122.0 to 115.40, Cross-Sections 18-19. To save the expense of additional field work, it was decided to superimpose data from surveys through the downstream section on the unsurveyed reach between Cross-Sections 18 and 19 for more complete modelling of the water surface profile.

After final review and approval by the Buffalo office of Acres American, Inc., 62 cross-section locations were defined for the reach between Talkeetna and Portage Creek. Figure 3.1 shows the location of the cross-section lines.

Appendix A includes correspondence and minutes from meetings relating to selection of cross section locations for Subtask 2.16.

Additional cross-sections between Portage Creek and Deadman Creek were surveyed in the spring of 1981 to extend the existing survey of the river channel. These cross-sections were originally included under Subtask 2.07, but have been described in this report for completeness.

In September 1981, Subtask 2.16 was expanded to include partial cross-sections in the river from Talkeetna to Cook Inlet, primarily to aid in navigation studies of the lower river. These cross-sections are included as Appendix C.

3.2 - Field Methods

3.2.1 - Control Surveys

The ground control surveys for the river cross-sections consisted primarily of third-order vertical control and scale-accuracy horizontal control.

A control point, monumented with a 5/8" x 30" rebar was set on the left side of the Susitna River on each cross-section line. Each rebar has a self-identifying 1½" aluminum survey cap fixed to the top. The locations of the control points and the alignment of the cross sections were pre-selected and marked on aerial photographs. Field locations of the control points were determined by reference to prominent local physical features. A few of the control points were photo-panelled to aid in location and scaling on later aerial photography. Cross-section alignment was set-out according to the pre-selected route marked on the aerial photographs. Methods used to layout the lines included use of compass bearings, reference to prominent features, and traverses from the railroad.

The cross-sections were stationed with the orgin (0+00) at some point on the left side of the river. The control point position fell at Station 0+00 or at a station of higher value. Stationing was oriented so that all cross-section points had non-negative station values.

Vertical control was based on a National Geodetic Survey (N.G.S.) first-order level line (Line 101; Quad 62149) that parallels the railroad and on a first-order level line run by R&M under Subtask 2.09 - Control Surveys. Third-order level loops were run between the first-order points and the control points set for each cross-section. This vertical control was used as a basis to determine elevations along each cross-section. Individual elevations along the cross sections

were ascertained by the use of differential leveling and vertical angle leveling.

3.2.2. - Procedures for Channel Survey

The control points served as reference marks for all subsequent surveys of the river. This includes not only those surveys carried out under Subtask 2.16, but also for freeze-up and breakup water surface measurements made during the winter of 1980-81 and miscellaneous surveys used in calibration of the HEC-2 model and river morphology studies.

The length and orientation of each cross-section was determined initially during the meetings in September, 1980 with the understanding that field adjustments would be made where needed to provide the best information on the hydraulic and morphologic conditions at each site.

The length of each line was determined by several different factors, primarily to ensure delineation of the floodplain boundaries and definition of all the river channels. At locations where the river was confined within the valley walls, the cross-section line ran from valley wall to valley wall with estimates of the valley wall height and slope. In broader reaches, when the river was less confined, the cross-section line extended across all major channels. Where the land surface sloped with a constant gradient away from the river, the survey extended up to 100 feet landward from the top of bank. If the land surface was terraced or of irregular grade, the line extended away from the river to the first major break in slope. For much of the river from Talkeetna to Gold Creek, the Alaska Railroad bed served as a good end point for the cross section line along the left bank.

To satisfy requirements for the HEC-2 water surface profile model, each cross-section was oriented perpendicular to flow of the river. In reaches of divided flow, it was often necessary to have angle points in the line to insure that cross-section lines would be perpendicular to flow in each channel. Field adjustments were made to correct errors in original orientation of the lines drawn on aerial photos with corrections noted on field maps and notes.

Appendix B includes a plot of each cross-section from Talkeetna to Deadman Creek with a summary sheet listing stations and elevations corresponding to the key features described below. For engineering and environmental purposes, each cross section included definition of:

- major breaks in slope of the land surface adjacent to the river channel (s)
- remnant channels in the river floodplain
- changes in dominant vegetation types through islands or along the banks
- elevation of ice scars on trees along the banks
- limits to vegetation for the major channels, as well as, for side channels or sloughs
- average bed material size and transitions in bed material type along the exposed river bed
- geometry of all river channels
- water surface elevations along the right and left edge of water on the date of survey for all channels and sloughs the line crossed.

At the end of each line, on the right bank, a temporary benchmark was established to close the survey. Some of these were simply prominent rocks along shore. However, at some cross sections, a nail was set in a tree or rebar driven into the ground along the top of the bank. These TBMs should be useful reference points for future work on the river. The 1"=500' scale mosaics produced from aerial photographs show the locations of the temporary benchmarks considered to have reliable survey coordinates. A set of these river mosaics has not been included with this report, but are available through R&M Consultants to those interested.

Upon completion of the field work for Subtask 2.16, a river thalweg profile was developed using elevations of the river bed determined during survey of the channel. The lowest measured point in the main channel was used for the thalweg elevation and distances from one cross-section to the next were scaled off the river mosaics. These elevations and distances are presented in Table 3.1. The points were plotted to produce the profile (Talkeetna to Portage Creek) shown in Figure 3.2. For interpretation, it is useful to compare this profile with Figure 3.1 showing locations of each cross section and changes in channel characteristics (single channel vs. divided flow, etc.)

3.2.3 - Bed Material Analysis

During survey of the cross-sections, preliminary analysis of the bed material along the river was carried out using the "Grid-by-Number" technique as described by Kellerhals and

Bray in "Sampling Procedures for Coarse Fluvial Sediments",[1]. In the above noted paper, several techniques were presented for sampling bed material. The "Grid-by-Number" technique was selected as the most acceptable, cost-effective means of determining the particle size of bed material along the Susitna from Portage Creek to Talkeetna. The sampling method employed a grid constructed from aluminum and wire measuring 60 cm by 60 cm, inside diameter, with a mesh of 5 cm squares. The grid was positioned over the selected sample area and a vertical photograph taken of the area. It was important to make the photograph as close to vertical as possible to reduce distortion and misrepresentation of grain dimensions. Selection of each sampling site was based on a subjective decision as to the best representation of average bed material through a particular reach. Table 3.2 describes the location of each grid photo with general notes on the gradation of material upstream and downstream or from left bank to right bank. Once the photograph was taken and developed, measurements were taken of the grains. The intermediate or b-axis was used to define grain size. In the photographs, this generally corresponded to the smaller visible axis. The grain located under alternating grid intersections was measured and used as one sample point. For each photograph, a minimum of fifty such points were measured, except in locations where large material size limited the possible number of sample points. The large grains often covered more than one grid intersection. In such a case, all but one intersection was discarded as a sample point and a substitute grain was randomly selected for each discarded grid intersection. This resulted in double counting of some grains, but overall, this approach prevented biasing the sample by unduly weighting the large grains. Grains smaller than approximately 8 mm were eliminated from the sample as being too small to accurately measure. When a small grain fell under a grid intersection, the nearest larger grain was measured instead.

Once all the sample points were measured a frequency analysis was run to determine the distribution of particle sizes at each cross section site. Grains were ranked from largest to smallest with the frequency of each size interval expressed as the number of grains falling into a given size category as a percentage of the total number of grains in the sample. Figure 3.3 is an example of the format used to present the grain size data. The graph at the top of the page shows results from the frequency analysis, with sample points measured from the grid photograph shown at the bottom of the page. The D16, D50, D84 values listed on the

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1 J. Hydraulics Div., ASCE, August, 1971.

sample sheet are one way of quantifying the distribution of grain sizes. The values are taken from the "best-fit" line drawn for the plot of grid sample points. They are interpreted as follows:

D_{16} = 16% of the material sampled is equal to or smaller than the reported size.

D_{50} = 50% of the material sampled is equal to or smaller than the reported size.

D_{84} = 84% of the material sampled is equal to or smaller than the reported size.

Table 3.3 lists the D_{16}, D_{50}, and D_{84} values for all the cross sections sampled.

In the field, a standard particle size classification recommended by the American Geophysical Union Subcommittee on Sediment Terminology was used. The size breakdown is as follows:

Material	Size in mm
Clay	0.00024 - 0.004
Silt	.004 - .062
Sand	.062 - 2.0
Gravel	2.0 - 64.0
Cobbles	64.0 - 250.0
Boulders	above 250.0
Bedrock	-

From these measurements and descriptions of bed material, Manning's 'n' roughness determinations were made for use in the HEC-2 model.

3.3 - Results

After completion of the field surveys and initial plotting of each cross-section from Portage Creek to Talkeetna, it was determined that more information was needed to accurately delineate the floodplain boundaries through certain reaches of the river. To accomplish this, field descriptions of the surface topography, USGS 1:63,360 topographic maps and Susitna River mosaics were used to extend certain cross-sections. Stations and elevations corresponding to the floodplain limits and beginning of the relatively steep valley walls were estimated. This data was included with field survey coordinates to provide input data for the HEC-2 model.

In some critical locations, this approach could not provide the detail needed for defining the topography of the land surface, especially in areas where cross-section lines crossed clear water sloughs of special interest for riverine habitat assessment.

Additional field work was defined to extend key cross-sections from the end points of the original survey. This data collected in March, 1981, gave better definition to the bed elevation and channel geometry of several clear water sloughs and tributaries, as well as to the slope of the land surface away from the main river channel. Snow cover on the land surface and ice cover in most side channels or sloughs hindered collection of descriptive information on vegetation types and especially bed material types in the channels.

Further data for the HEC-2 model was collected during survey of an additional six cross-sections between the lower end of Devil Canyon and Portage Creek, and 23 cross-sections between Devil Creek and Deadman Creek. The procedure for carrying out field surveys was the same as that used for the original cross-sections. However, no bed material analysis was carried out through these reachs. The river is confined within narrow bedrock valley walls. Material exposed along the channel bank is predominantly bedrock fragments accumulating at the toe of steep valley walls. There is very little river transported material deposited along the banks.

All of the cross-section data, including bed material analysis, was used in calibrating the HEC-2 model for varying flow levels under pre-project conditions. Results from this modelling effort will be presented under Subtask 3.06 - Hydraulic and Ice Studies.

Also, information gained on channel geometry, river gradient and bed material size distribution were utilized in sediment yield and river morphology studies (Subtask 3.07). The preliminary report refined the major sub-reaches in the Susitna from Devil Canyon to Talkeetna from those listed in Section 3.1 of this report. The definition of these sub-reaches was based on field data and observations relating to hydraulic and morphologic characteristics gathered since the September, 1980, meetings for Subtask 2.16. It also includes qualitative analysis of river behavior, past and present, with prediction of future changes in river morphology and behavior.

Results from Subtask 2.16 have provided baseline data for the above mentioned studies. As specific sites were identified as those deserving closer study for engineering or environmental reasons, additional field survey work can be carried out to provide more refined information. Local changes in river gradient, surface and subsurface bed material and the relation between mainstream and side channel or slough hydraulic characteristics can be more accurately defined.

TABLE 3.1

SUSITNA RIVER PROFILE DATA SUMMARY

CROSS SECTION	RIVER MILE	THALWEG ELEVATION
LRX-3	98.59	332.6
4	99.58	344.4
5	100.36	352.6
6	100.96	357.1
7	101.52	359.4
8	102.38	364.1
9	103.22	366.6
10	104.75	386.2
11	106.68	401.0
12	108.41	414.4
13	110.36	426.5
14	110.89	437.2
15	111.83	446.1
16	112.34	449.7
17	112.69	453.4
18	113.02	452.9
19	116.44	481.7
20	117.19	483.3
21	119.15	500.9
22	119.32	503.4
23	120.26	515.5
24	120.66	507.6
25	121.63	526.2
26	122.57	532.1
27	123.31	533.8
28	124.41	549.8

TABLE 3.1 (cont.)

CROSS SECTION	RIVER MILE	THALWEG ELEVATION
LRX-29	126.11	563.3
30	127.50	578.4
31	128.66	586.8
32	129.67	597.2
33	130.12	607.0
34	130.47	608.9
35	130.87	605.5
36	131.19	614.0
37	131.80	618.8
38	132.90	634.7
39	133.33	641.5
40	134.28	650.0
41	134.72	655.3
42	135.36	663.9
43	135.72	657.6
44	136.40	674.6
45	136.68	673.5
46	136.96	681.4
47	137.15	681.9
48	137.41	685.3
49	138.23	694.2
50	138.48	693.5
51	138.89	701.9
52	139.44	707.2
53	140.15	717.2
54	140.83	726.3
55	141.49	735.2

TABLE 3.1 (cont.)

CROSS SECTION	RIVER MILE	THALWEG ELEVATION
LRX-56	142.13	744.4
57	142.34	745.5
58	143.18	756.9
59	144.83	775.8
60	147.56	808.5
61	148.73	819.5
62	148.94	822.3
63	149.15	827.2
64	149.35	825.4
65	149.46	836.1
66	149.51	837.2
67	149.81	840.6
68	150.19	829.6

TABLE 3.2
GRID SAMPLE PHOTO LOCATIONS

Cross Section	Photo Location	Comments
LRX - 4	Far Right Channel, Left Bank, on Line - at Station 53+50	Coarser Material Along R/B of West Channel
LRX - 5	Center of Mid-Channel Bar - at Station 63+38, Uniform Material Size on the Bar	Larger Material on Both Left and Right Banks of Main Channels
LRX - 6	Grid on Mid-Channel Bar, Station Uncertain.	Cobbles 10-12" Diameter Scattered on the Bar
LRS - 7	No Photo	
LRX - 8	Main Channel - Left Bank, Exact Station Unknown but Between 31+13 and 31+26	Material on Right Bank Appears to Have Same Size Distribution
LRX - 9	Main Channel - Left Bank Station Between 20+83 and 21+87	D_{50} would be Slightly Larger than Indicated by Grid
LRX - 10	Main Channel - Left Bank Between 11+25 and 11+49	Good Representation of Bed Material
LRX - 11	Main Channel - Left Bank, between 20+30 and 20+74: (Closer to 20+30)	Large Rounded Boulders and Cobbles in the Channel U/S & D/S of x-sec. Line
LRX - 12	No Photo	
LRX - 13	No Photo	
LRX - 14	Upstream from X-Sec Line on Right Bank of East Channel	
LRX - 15	No Photo	
LRX - 16	Right (West) Channel - Left Bank, at Approx. Station 25+80	
LRX - 17	No Photo	

TABLE 3.2 - Continued

Cross Section	Photo Location	Comments
LRX - 18	Main Channel - Left Bank Between Stations 10+73 and 10+82	Large Boulders in the Vicinity of X-Sec.
LRX - 19	Main Channel - Left Bank Station 15+83 and 16+40	Good Representation of Material on Both Banks
LRX - 20	West Channel - Left Bank Upstream of X-Sec. Line near Station 34+00	Grid Shows Material in High Water Channel, Island Covered with Scattered Patches of Sand & Cobbles
LRX - 21	Left Bank Main Channel, Photo taken 200' Downstream of Line	Right Bank Material Larger, May Better Represent Material Moved at High Flow
LRX - 22	Right Bank Main Channel Between Station 16+58 and 16+78	Good Representation of Bed Material
LRX - 23	Right Bank, Main Channel Between Station 19+31 and 19+42	Good Representation of Bed Material Along this Shore
LRX - 24 & 25	No Photo	
LRX - 26	Left Bank Main Channel, Photo Taken Downstream of Line Approx. Between Station 25+13 and 25+38	Good Representation of Bed Material Along Left Bank Coarser Material on Right Bank, Including Small Boulders
LRX - 27	Left Bank Main Channel Between Station 23+23 and 23+48	Material Size Consistent Upstream and Downstream
LRX - 28	Left Bank East Channel Between Stations 11+96 and 12+28	Good Representation of Bed Material
LRX - 29	Left Bank Main Channel Between Stations 34+66 and 35+32	Good Representation of Bed Material Upstream and Downstream
LRX - 30	On Mid-Channel Bar, Station Uncertain for Photo, Assumed to be Approx. 22+00	Best Representation of Bed Material, Left Bank Protected by Rip-Rap

TABLE 3.2 - Continued

Cross Section	Photo Location	Comments
LRX - 31	Left Bank Main Channel, Set Downstream of Line on Cobble Bed in Dry High Water Channel Between Islands	Good Representation of Material Along Shore
LRX - 32	Left Bank Main Channel	Right Bank Material Coarser Overall
LRX - 33-39	No Photos	
LRX - 40	Left Bank - Main Channel	Does not Represent Larger Cobbles Onshore
LRX - 41	No Photo	
LRX - 42	Left Bank Main Channel	Uniform Cobble Bed
LRX - 43	Left Bank Main Channel Between Station 27+74 and 29+00	
LRX - 44	Left Bank - Main Channel on Wide Exposed Cobble Bed	
LRX - 45	No Photo	
LRX - 46	Far Left Bank Between Station 11+23 and 11+72	Material Smaller than Exposed Grav. & Cob. on Downstream end of Island
LRX - 47	No Photo	
LRX - 48	Right Bank of Main Channel Between Station 22+79 and 23+30	
LRX - 49	Left Bank - Main Channel	Large Cobbles and Boulders Scattered Along the Bed, not Represented by Grid
LRX - 50	Right Bank Main Channel Near Station 14+80	Photo Taken Where Right Channel of Indian River Joins The Susitna
LRX - 51	Right Bank Main Channel Between Station 16+57 and 16+70	

TABLE 3.2 - Continued

Cross Section	Photo Location	Comments
LRX - 52	No Photo	
LRX - 53	Right Bank Main Channel Near Station 24+00	Good Representation of Bed Material, a few Boulders Along Shore. Right Bank Material Much Coarser than Left Bank
LRX - 54	Right Bank Main Channel Between Station 21+04 and 21+31	Bed Material on Right Bank Coarser than Left Bank
LRX - 55	Right Bank Main Channel	Same as LRX - 54
LRX - 56	Right Bank Main Channel Between Station 22+71 and 22+93	
LRX - 57	Left Bank Main Channel Between Station 11+14 and 11+26	Right Bank has Some Larger Material
LRX - 58	Right Bank Main Channel	
LRX - 59	Left Bank Main Channel	
LRX - 60-68	No Photos	

TABLE 3.3

SUSITNA: LOWER RIVER CROSS SECTIONS
BED MATERIAL DISTRIBUTION ANALYSIS

LRX Number	D_{16} (mm.)	D_{50} (mm.)	D_{84} (mm.)
4	13	25	46
5	12	21	39
6	20	47	112
8	19	45	112
9	14	32	72
10	58	94	152
11	18	43	100
14	20	36	66
16	8	26	92
18	12	36	110
19	47	80	132
20	16	38	92
21	26	49	95
22	8	21	58
23	22	48	108
26	25	54	113
27	19	43	100
28	13	31	68
29	32	59	110
30	33	64	122
31	28	49	84
32	19	43	100
40	20	46	110
42	15	38	94
43	19	44	94
44	14	35	88
46	29	53	100
48	21	56	155
49	26	53	112
50	18	53	160
51	44	88	170
53	86	125	188
54	18	43	105
55	178	220	265
56	29	73	183
57	20	47	110
58	62	112	200
59	26	66	170

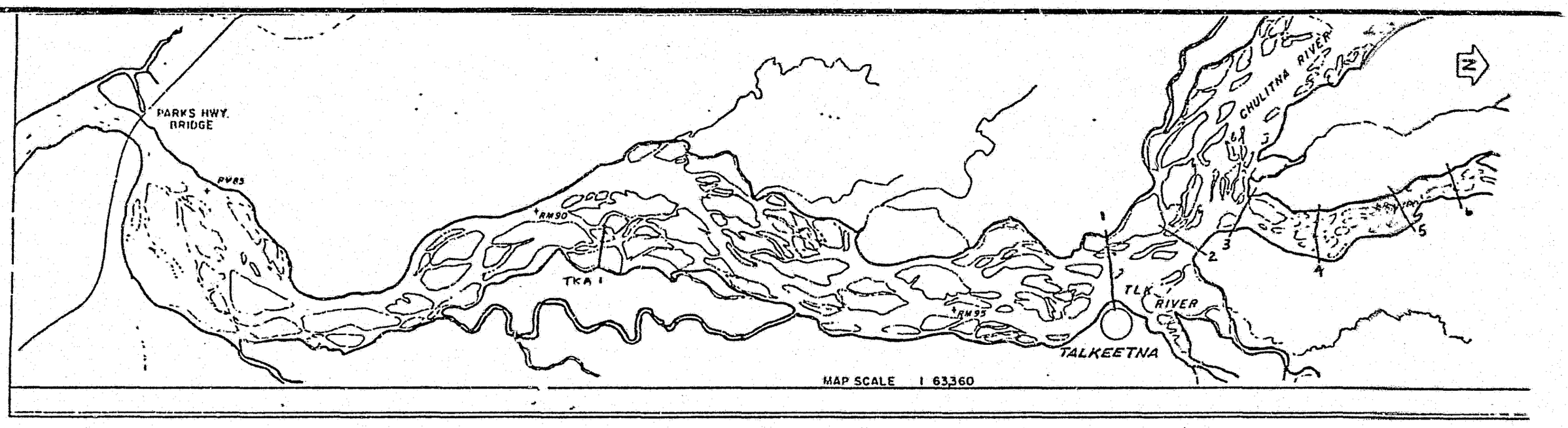

PLATE 2

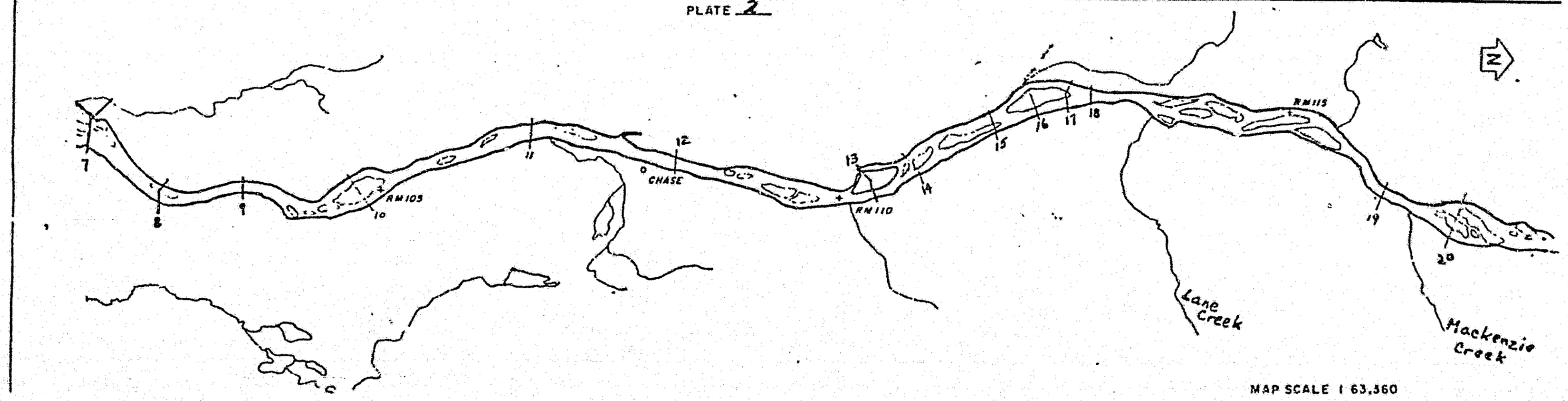

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FIGURE 3.1 RIVER CROSS-SECTION LOCATIONS

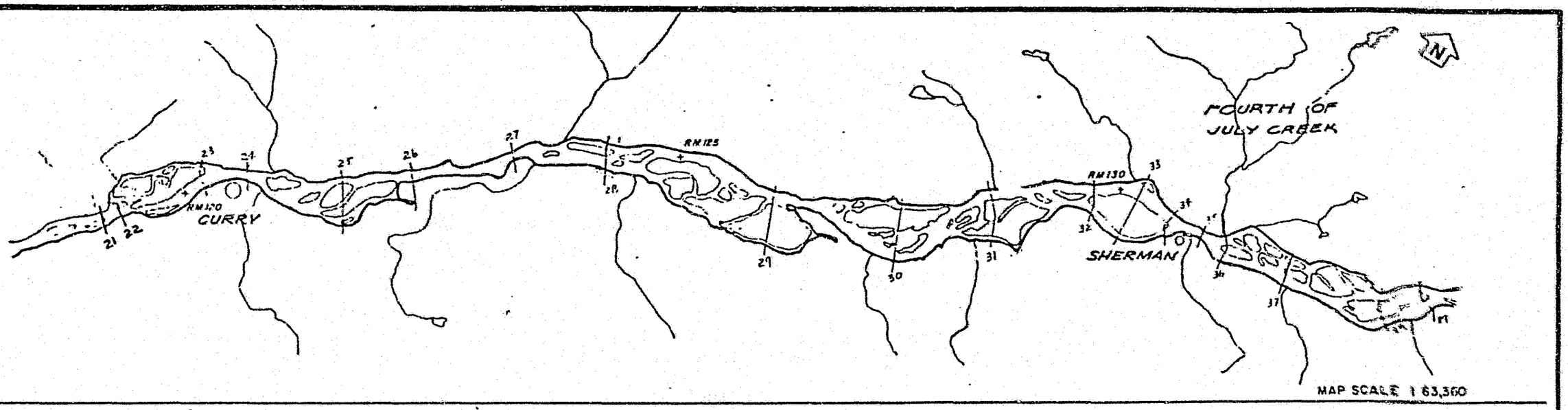

PLATE 4

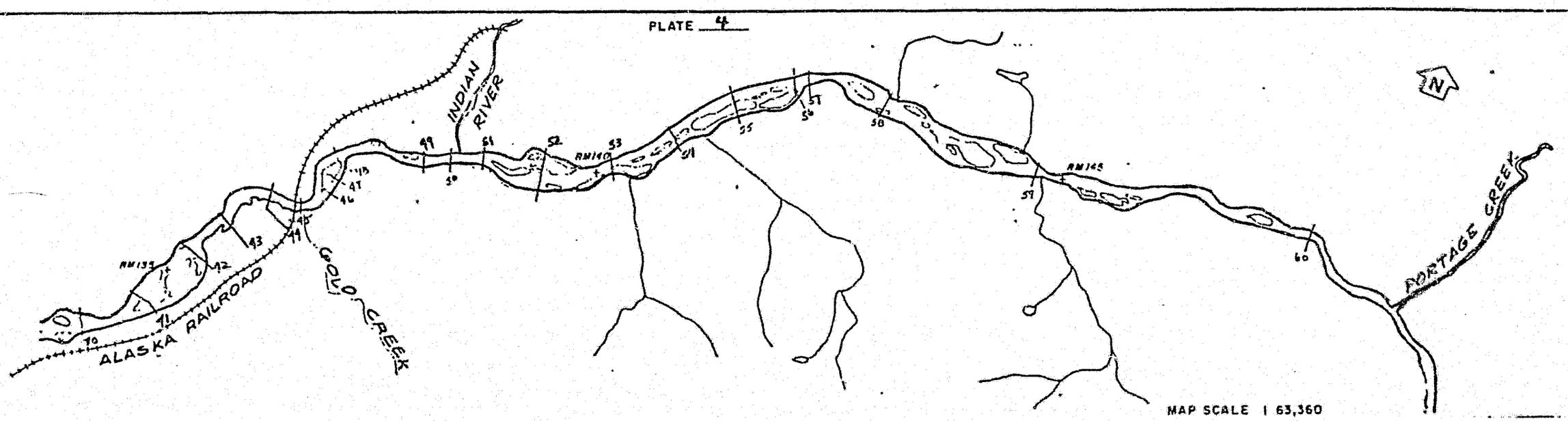

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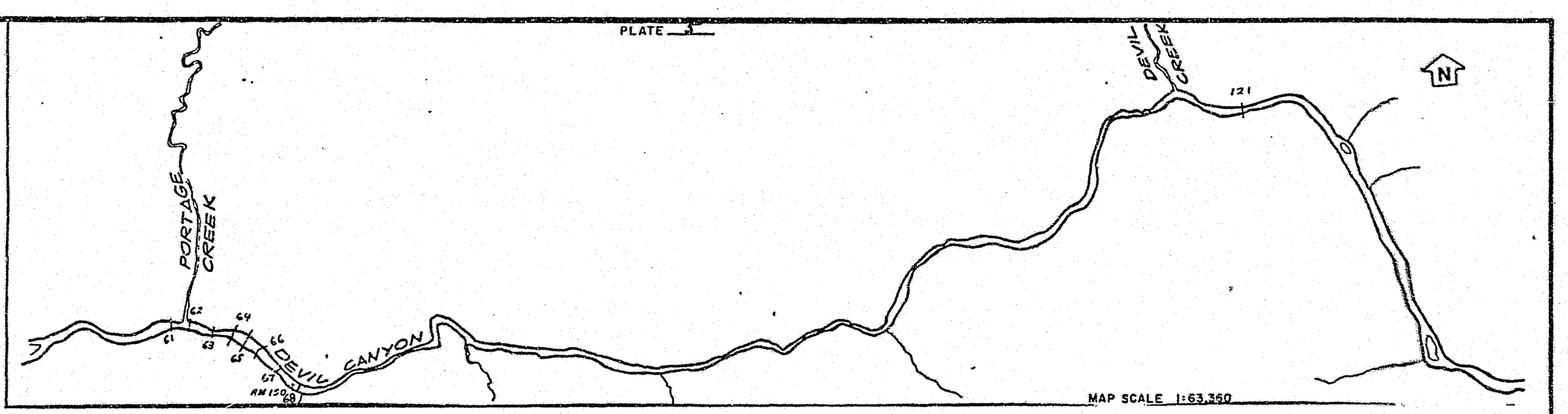
FIGURE 3.1 CONTINUED



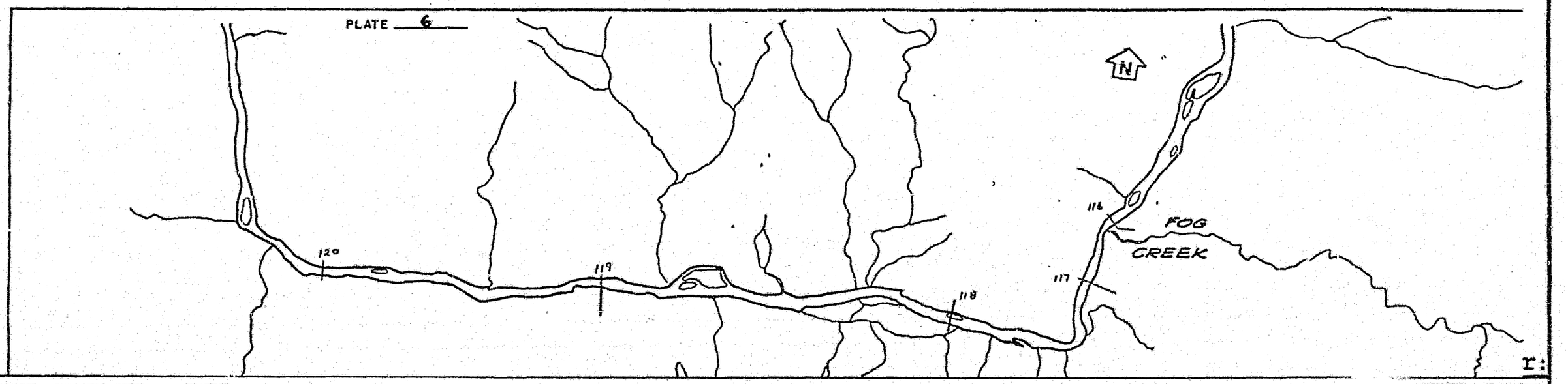


FIGURE 3.1 CONTINUED

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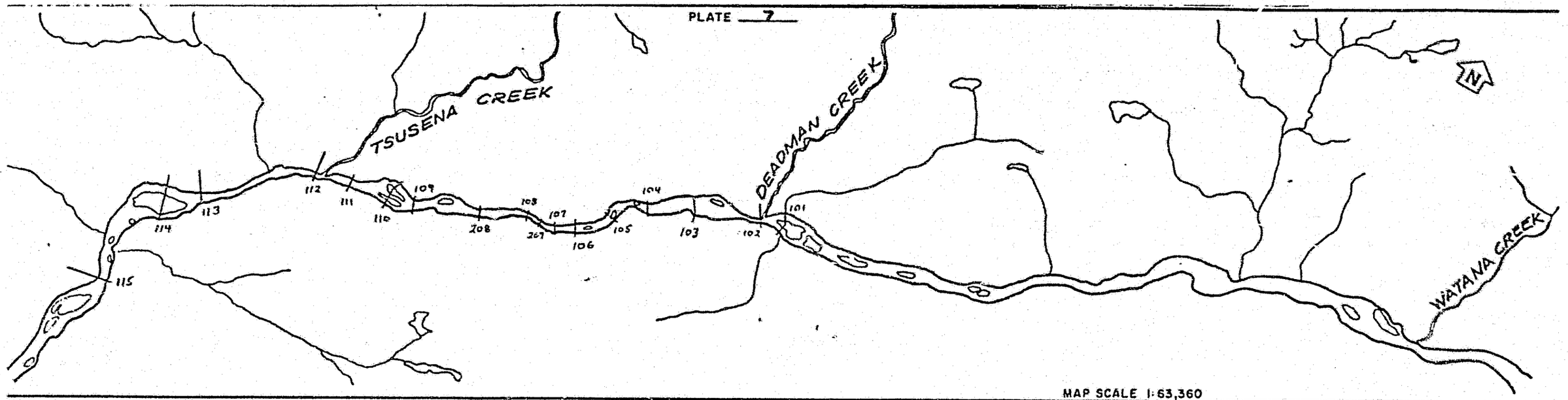
ACRES

PLATE 7



MAP SCALE 1:63,360

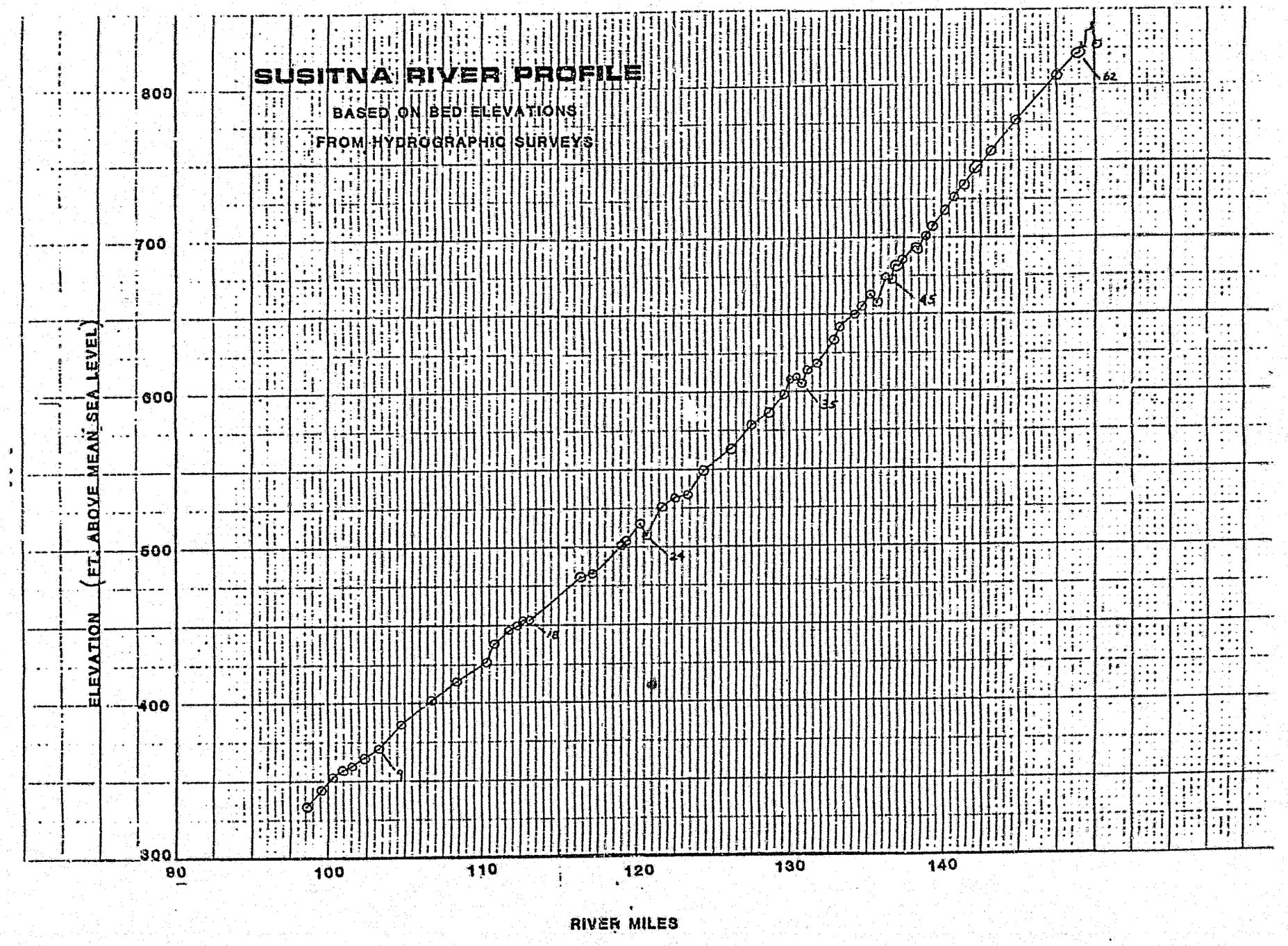
Prepared by:

R&M CONSULTANTS, INC.

FIGURE 3.1 CONTINUED

Prepared for:

ACRES



Prepared by:

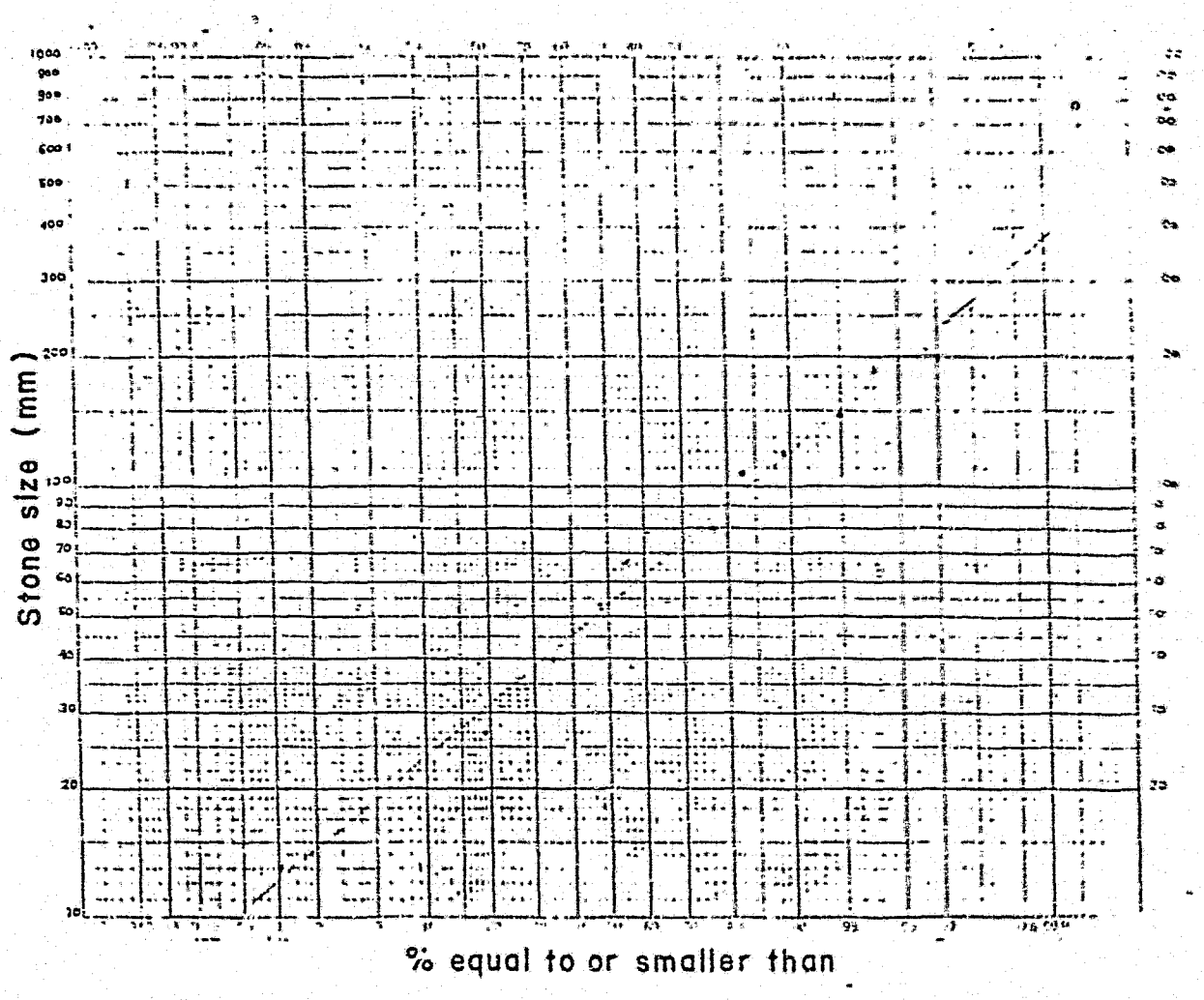
R&M CONSULTANTS, INC.

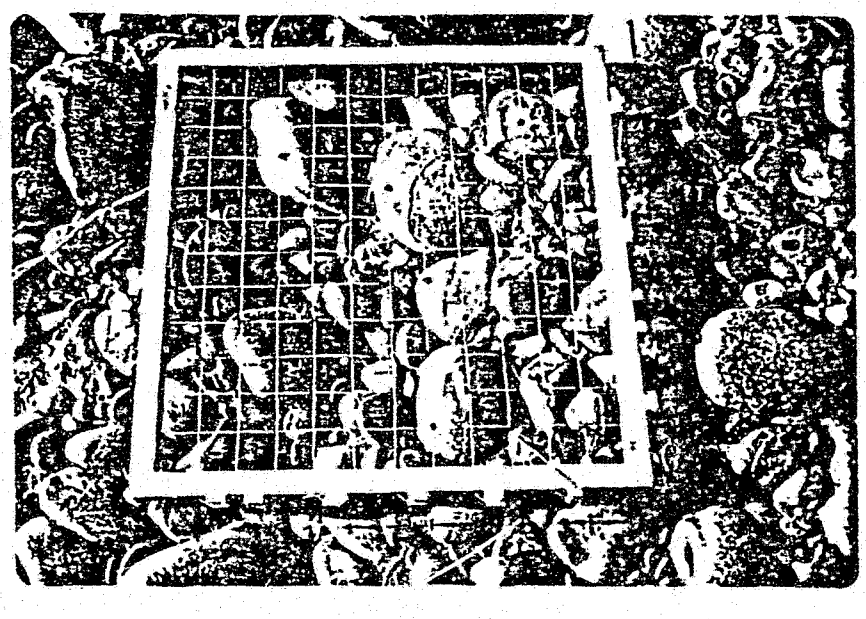
LONGITUDINAL RIVER PROFILE FROM DEVIL CANYON TO TALKEETNA

FIGURE 3.2

Prepared for:

ACRES





LRX- 46

D_{15} = 29 mm

D_{50} = 53 mm

D_{84} = 100 mm

Prepared by:

R&M CONSULTANTS, INC.

SAMPLE OF BED MATERIAL ANALYSIS DATA SHEETS

FIGURE 3.3

Prepared for:

AGRES

APPENDIX A

CORRESPONDENCE AND MINUTES FROM MEETINGS RELATED TO SUBTASK 2.16

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

ENGINEERS
GEOLOGISTS
PLANNERS
SURVEYORS

September 9, 1980 R&M No. 052216

Re: Review of Meeting on Monday, September 8, 1980 Concerning Subtask 2.16, Hydrographic Surveys

The meeting included:

Brent T. Drage - R&M
Leslie Griffiths - R&M
Woody Trihey - Special Consultant to Acres
Tom Trent - ADF&G
Christopher Estes - ADF&G
Bob Williams - T.E.S.
Bob Krogseng - T.E.S.

Milo Bell is also involved in the Lower Susitna studies, but could not be in Anchorage for the meeting.

The objective of the meeting was to locate river cross sections to be surveyed from Talkeetna to Portage Creek, which would provide baseline data for engineering design purposes and instream flow studies.

An outline is attached summarizing key items covered during the meeting. Review of detailed discussion on each agenda item is included in the following pages.

RIVER CROSS SECTIONS - TALKEETNA TO DEVIL CANYON

1. Develop Cross Section Location Criteria
   - Hydraulic modeling
   - Ice process model
   - In-stream flow model
   - Fisheries studies
   - Sedimentation and Water Quality Modeling
   - River Moplology Studies
2. Identify Reaches and Specific Locations Deserving Special Interest
   - Portage confluence
   - Gold Creek/Indian River confluence
   - Sherman/4th July Creek
   - Curry
   - Chase to Chulitna confluence
   - Side Sloughs
   - Tributeries
3. Preliminary Cross Section Layout on 1" = 4,000' Mosaic
   - Group x-section's through specific interest reaches
   - Satisfy main-stem geometry requirements for Item 1
4. Cross Section Layout on 1" = 500' Blow-Ups
   - Refine for engineering hydraulics
   - Refine main-stem hydraulics for in-stream flow
   - Arrive at agreement with multi-disciplinary task-force considering time frame and budget limitations
   - Derive field procedures and data collection format
5. Field Trip by Multi-Disciplinary Task-Force
   - Finalize section locations
   - Refine field procedures
6. Office Debriefing of Task-Force

ITEM 1: DEVELOP CROSS SECTION LOCATION CRITERIA

Data collected from the river cross section surveys will be used in the future as input for hydraulic modeling, ice process modeling. sedimentation and water quality modeling, instream flow studies and fisheries studies.

1. Hydraulic Modeling - Cross section survey data will be used in the HEC-2 computer program developed by the Corps of Engineers for modeling water surface profiles under varying flow conditions. Ideally, a continuous water surface profile should be generated from Devil's Canyon to the mouth of the Susitna River. However, the scope of this phase of the hydrographic surveys covers only the reach from Devil's Canyon to Talkeetna.

   Acres American, Inc. has adapted the model to account for ice cover in the winter months. Woody Trihey questioned whether the adapted model took into account the change from open-channel flow to pipe flow or pressurized flow resulting from the presence on an ice cover. A closer review of the model will be necessary to determine if additional modifications to the program need to be made.

2. Ice Process Modeling - The ice cover process model developed by Acres American Inc. will be used in addition to the HEC-2 program to ensure that potential problems such as frazil ice accumulation, ice jamming and flooding are addressed in engineering design work. The reach of river in the vicinity of Gold Creek has been identified as one of primary importance in this regards. Cross sections located upstream and downstream of the railroad bridge crossing the Susitna River at Gold Creek should provide data on channel geometry

and other river characteristics which will improve understanding of the processes of generation and collection of frazil ice at freeze-up and locations of ice jams during river breakup.

3. Sedimentation and Water Quality Modeling - Recommendations were made to expand the scope of work to include more detailed data collection of water quality and suspended sediment, especially in sloughs and tributaries of the Susitna River. This data would be utilized in fisheries and instream flow studies to make correlations between stream flow and water quality and to predict post-project effects on sedimentation and water quality downstream of the proposed Devil's Canyon dam.

4. Instream Flow and Fisheries Studies - The IFG incremental approach will be used for instream flow studies. Hydrographic surveys will provide basic data on the physical parameters for each of the representative reaches. More detailed breakdown of the reaches into subreaches or microhabitats in the future will be based, in part, on the correlation between hydraulic parameters and species distribution or available habitat area.

The water surface profile will be modeled using the WSP program. It is similar to the HEC-2 program, except that it requires water surface elevations recorded at the time of survey to remain constant across the channel. Survey work in the past has shown this does not always hold true. In reaches with divided flow and sloughs, water surface elevations may vary from channel to channel. Adjustments will have to be made during operation of the program to account for this problem.

ITEM 2: IDENTIFY REACHES AND SPECIFIC LOCATIONS DESERVING SPECIAL INTEREST

The tributaries and reaches of river listed below were identified as being of primary importance for engineering design work:

- The Susitna River upstream and downstream of Gold Creek.
- The Susitna River in the vicinity of Sherman.
- The Chulitna - Susitna - Talkeetna confluence near the town of Talkeetna.
- Major tributaries: Portage Creek, Indian River, and 4th of July Creek.

These locations are generally compatible with areas of interest for fisheries studies. In addition, small tributaries and sloughs are of special interest for fish habitat studies.

ITEM 3: PRELIMINARY CROSS SECTION LAYOUT ON 1" = 4,000'
MOSAIC

The original scope of work planned for 60 cross sections to be located along the length of the Susitna River from Portage Creek to Talkeetna.

Based on needs for engineering studies and compatible requirements for environmental studies the river was divided into five reaches defined by changes in channel characteristics and gradient. These reaches were defined as:

- Portage Creek confluence
- Gold Creek/Indian River confluence
- Sherman/4th of July Creek
- Susitna River in the vicinity of Curry
- Susitna River from Chase to the Chulitna confluence

These divisions may need to be re-evaluated after completion of field work if no significant difference is found in physical parameters between certain reaches or if areas of change in channel gradient are more precisely defined.

For each of the river segments listed above, cross section lines were laid out to describe the river through that reach, including hydraulic control points, location of sloughs and tributaries, flood plain delineation, division of flow and general channel characteristics.

In some specific locations, adjustments were made to eliminate the need for additional cross sections.

At the Whiskers Creek confluence, a staff gage could be set up that would tie into known water surface elevations surveyed at a cross section upstream.

Temporary bench marks tied into the level control network could be established near the entrance to sloughs of particular interest for fisheries studies. This would facilitate more detailed survey work done in the future.

Above Chase, two adjacent segments of approximately equal length appeared very similar on the photos in terms of channel characteristics. Both were areas of divided flow with comparable channel widths. It was agreed that only one segment of the river would contain cross section during this preliminary phase of the study. Data from the surveys would be superimposed on the unsurveyed segment upstream for modeling the water surface profile. If field work and data analysis showed this approach to be invalid additional cross sections would need to be added in this reach.

Likewise, hydraulic parameters for a straight, narrow segment above the Chulitna confluence will be simulated based on surveys of two other straight, narrow segments in the reach from Chase to the Chulitna confluence.

A total of 64 river cross sections were drawn onto the 1" = 4,000' mosaic. Also, two additional cross section location on the Susitna River downstream of the Susitna-Chulitna-Talkeetna confluences were recommended by Ian Hutchison of Acres American, Inc. during a phone conversation with Brent Drage on Tuesday, September 10th. A complete outline of proposed cross section locations developed by Acres American, Inc. in Buffalo should be on hand for comparison and review at the meeting on Wednesday, September 11th.

ITEM 4: CROSS SECTION LAYOUT ON 1" = 500' BLOW-UPS

Cross section locations were transferred from the 1" = 4,000' mosaics to 1" = 500' blow-ups with some refinements. Locations of hydraulic control points, such as channel constrictions and apparent changes in channel gradient, were better defined and cross sections positioned accordingly. Refinements were also made in cross section locations to better establish correlation between water surface elevations in the main stem, major tributaries and sloughs for instream flow studies. Also, whenever possible, cross section lines were adjusted to facilitate field operations.

It was generally agreed that completion of cross section surveying would take about five weeks. Work is scheduled to begin the last week of September and should be finished by the first week of November.

Survey results and other data collected at the cross section will be incorporated into a report to be used in the future for data analysis, as outlined in Item 1. One report will be prepared for each of the characteristic reaches defined. The proposed format is outlined below:

1. Introduction

   - Reach location referenced to river miles along channel thalweg.

   - Photo mosaic of the reach showing cross section locations.

   - Summary of features: key cultural features, hydraulic controls and environmental features.

- Summary of report contents.

2. Regime Analysis

- Description of channel characteristics.
- Analysis of behavior - past and present.
- Projection of future behavior assuming natural conditions, without the project.

3. Transects

- Plot of cross section, including list of x and y coordinates.
- Record of water surface elevation at the time of survey.
- Calculated hydraulic parameters.
- Vegetation limits and general classification.
- Miscellaneous features including: bedrock outcrops, bar formation, debris accumulations, ice scars, etc.
- Description of bed material.
- Photographs of each site to illustrate cross section characteristics.

ITEM 5: FIELD TRIP BY MULTI-DISCIPLINARY TASK-FORCE

Cross section locations will be finalized during a field trip on Tuesday, the 9th of September by a multi-disciplinary group, including Brent Drage (R&M), Milo Bell (special consultant to Acres), Bob Williams (T.E.S.) and Christopher Estes (ADF&G). Their recommendations will be reviewed in a final meeting on Wednesday, the 10th of September.

052216

OFFICE MEMORANDUM

TO:	Brent T. Drage R&M Consultants	*Date:*	September 17, 1980
FROM:	Ian Hutchison	*File:*	P5700.11.10
SUBJECT:	Susitna Hydroelectric Project Subtask 3.03 Bed Material Sampling		

We have reviewed the "Grid-by-Number" technique you have proposed to utilize for collecting river bed material samples in the Susitna. We agree with the procedure for use in the Susitna Studies. We assume that bank material samples will also be taken at the river sections. The data collected should be incorporated in the field data logs which should be sent to us regularly.

I.P.G. Hutchison

GK:cmt

ACRES

OFFICE MEMORANDUM

TO: Brent T. Drage *Date:* September 9, 1980

FROM: I. Hutchison *File:* P5700.11.10

SUBJECT: Susitna Hydroelectric Project
Subtask 2.16 - Hydrographic Survey

Further to our telecon yesterday we enclose a marked up Xerox copy of the 1" = 4000' scale photographs of the Susitna River between Portage Creek and Talkeetna confluence showing recommended locations of river-transects to be surveyed under Subtask 2.16.

We have retained the transects selected by you to the extent possible. Changes we have made result from a need to better meet the following engineering requirements.

1. To model the river reach adequately for prediction of pre- and post-project water levels, velocities as well as growth rate, extent and stability of ice-cover, and river temperature regime.

2. To derive reservoir operational constraints imposed by downstream requirements with respect to water quality, and allowable fluctuations in water levels and discharges.

3. To assess morphological changes due to project operation.

4. To provide adequate data for assessment of environmental impact of the project on fisheries habitat.

Effectively, the alterations we have made distribute the transects more uniformly over the entire reach instead of concentrating on two ends. We have still attempted to retain several features like islands, sloughs which may be of interest to fisheries studies and incorporated new sections which are hydrauically significant.

We have marked the transects in green in the attached copy which is the only one available with us at this time. Please mark up a copy and return to us as soon as possible for our records. We appreciate that the exact location of the transects has an element of flexibility dependent on actual field conditions encountered.

for I. Hutchison

GK:ccv
Attachment

cc: J.D. Lawrence G. Krishnan File
J.W. Hayden K. Young

Registered
Professional
Engineer

MILO C. BELL
Consulting Engineer
BOX 23
MUKILTEO, WASHINGTON 98275

052276
Close

September 19, 1980

Mr. Brent T. Drage
R & M Consultants, Inc.
5024 Cordova
Box 6087
Anchorage, Alaska 99502

Dear Brent:

I have already expressed my approval of the transect locations taken below the Susitna dam sites. These may not all be needed for fisheries uses. I will examine the flight pictures and list those that I believe will give the desired information. Some time in the future lateral transects will be needed to define useful gross areas for fish production.

I have read the three papers you furnished me covering the in-stream measurements for spawning, rearing and food production. If this is the approach that ADF&G will approve and use, a number of field tests and measurements will be required to satisfy the program. It basically uses depth and velocity as major factors with refinements of light penetration and temperature in the scoring system. The substrata is also given major weight in scoring. The latter is somewhat more difficult to obtain in deep rivers.

The behavior of the adult fish in this river system must be known in order to set limiting velocities, and the depth below and above, for which zero is assigned and the area beyond given no value.

Timing of the fish runs and expected temperatures can be determined, along with water clarity. Any factor, such as low oxygen, which would result in a score of zero gives a no value for any area. Food producing and rearing areas depend on similar physical factors. In general, then, areas may be both spawning and food producing or food producing and rearing. In the Susitna there may be wintering areas for young fish requiring special measurement as their effectiveness depend on ground water sources.

To obtain the above data,conditions at more than one flow level are required. You stated that perhaps three transects could be measured at different flow levels until freeze-up time. I shall suggest three such areas after I have had a chance to study the pictures.

Sincerely yours,

Milo

c.c. Mr. Clinton Atkinson
Mr. Robert Williams

APPENDIX B

PLOTS AND SUMMARIZED FIELD NOTES FOR CROSS-SECTIONS FROM DEADMAN CREEK TO TALKEETNA

LIST OF ABBREVIATIONS USED ON CROSS SECTION PLOTS AND SUMMARIZED FIELD NOTES

STA. = Station
ELEV. = Elevation
R.R. or Ak. R.R. = Alaska Railroad
G.S. = Groundshot

CH. or CHAN. = Channel
MC = Main Channel
HW = High Water
L/B = Left Bank
LOB = Left Overbank
R/B = Right Bank
ROB = Right Overbank
EOW = Edge of Water
D/S = Downstream
U/S = Upstream

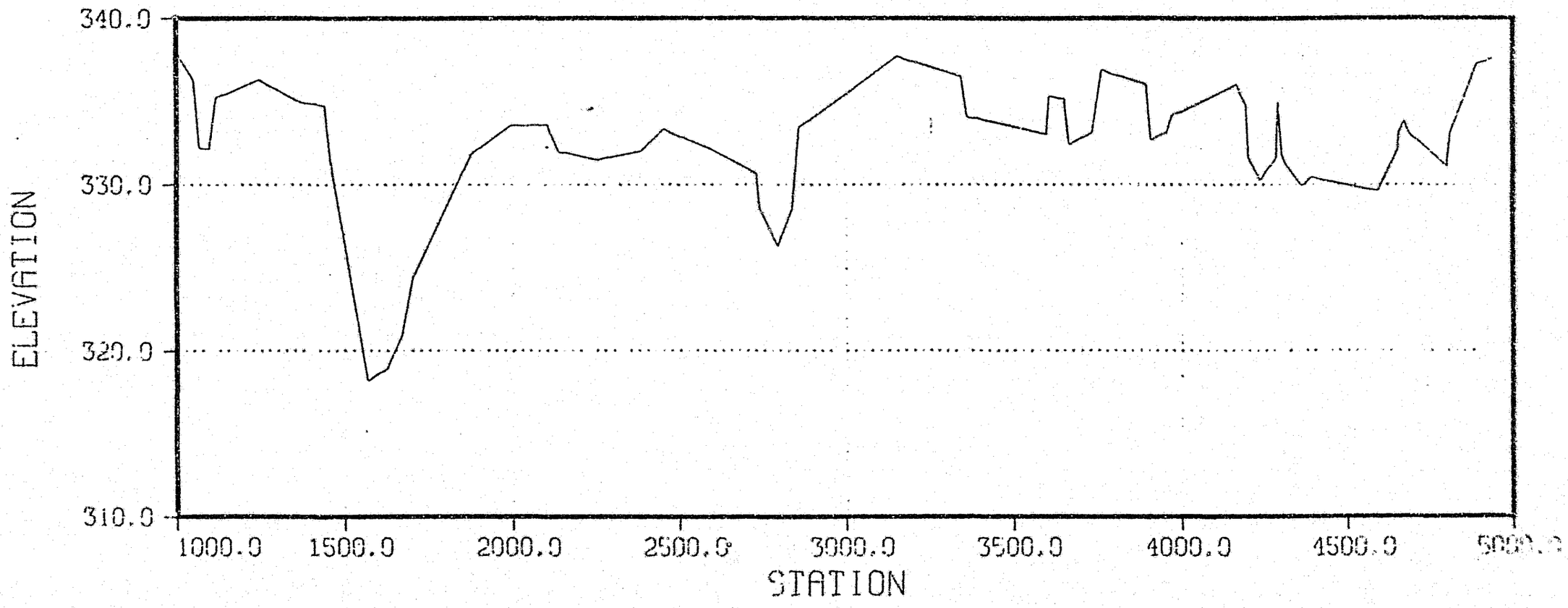
TRAN. or TRANS. = Transition
BOUL. = Boulder
COB. = Cobble
GRAV. = Gravel
RX = Rock
DIAM. = Diameter
FRAG. = Fragment

VEG. = Vegetation
ALD. = Alder
B/R. = Birch
CW = Cottonwood
SPR. = Spruce
WIL. = Willow

r24/l1

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION NUMBER 1.



* SEE ATTACHED SUMMARY SHEETS FOR DESCRIPTION OF VEGETATION & BED MATERIAL

LRX - 1

DATE OF SURVEY: NOVEMBER 14, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	338.0			EDGE OF WILLOWS
10+52	336.3			TOP OF BANK - RIP-RAP
10+68	332.2			SAND
18+74	331.8			SMALL COBBLES
19+90	333.5			COB. BED WITH ACCUMULATED DEBRIS
27+31	330.6			STILL ON COBBLE BED
31+50	337.7			SPARSE WILLOWS & SAND
36+06	335.3			SAND, LOG JAM & ACCUMULATED DEBRIS
37+61	336.9			SAND & SPARSE WILLOWS
39+09	332.7			COBBLES
41+63	336.0			SAND
41+93	334.7			COBBLES
42+90	334.9			D/S TIP OF SAND BAR

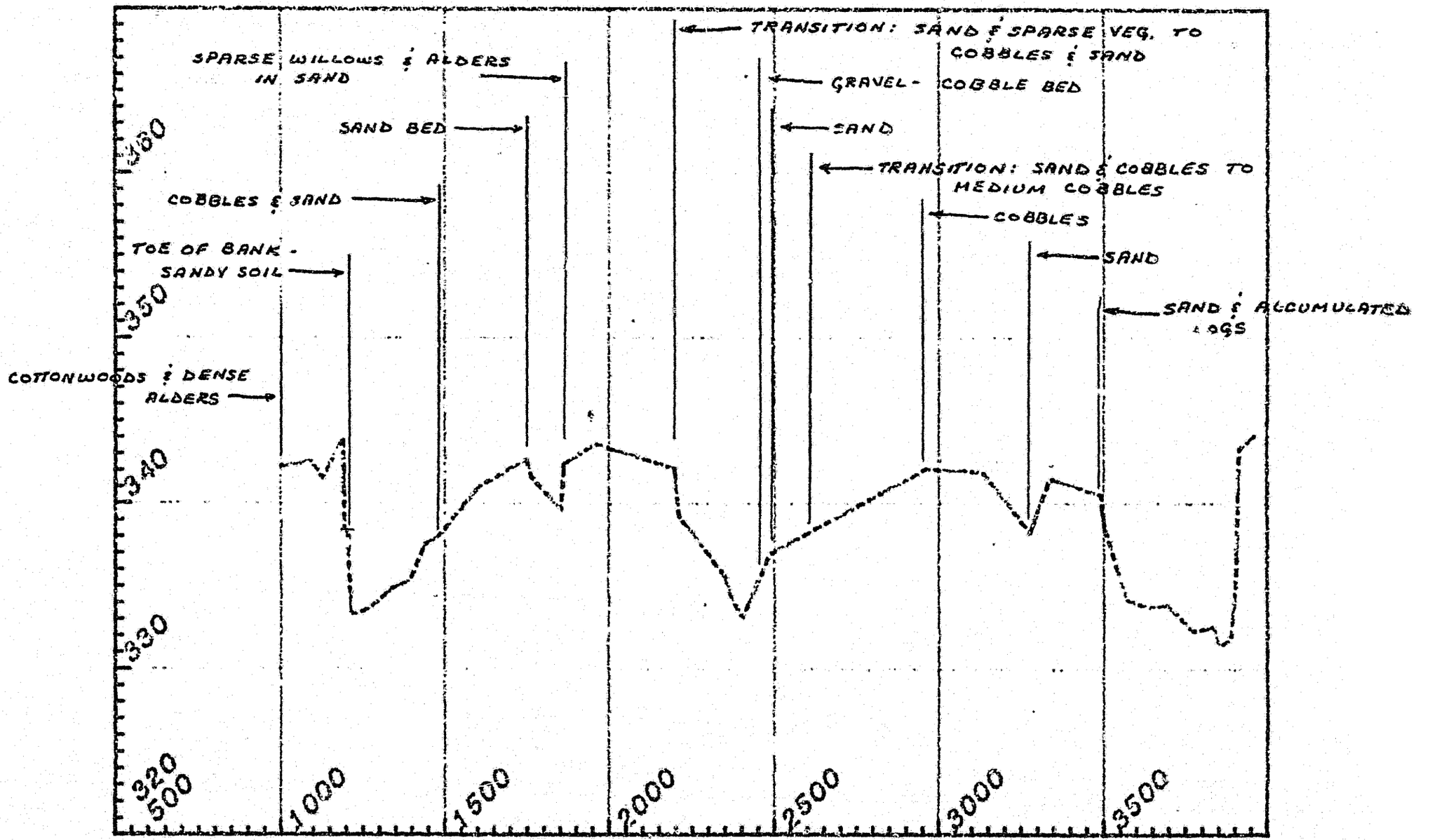
LRX - 1

DATE OF SURVEY: NOVEMBER 14, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
46+70	333.8			GRAVEL BAR
48+88	337.2			EDGE OF VEG. - MATURE CW. & ALDER

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 2



LRX - 2

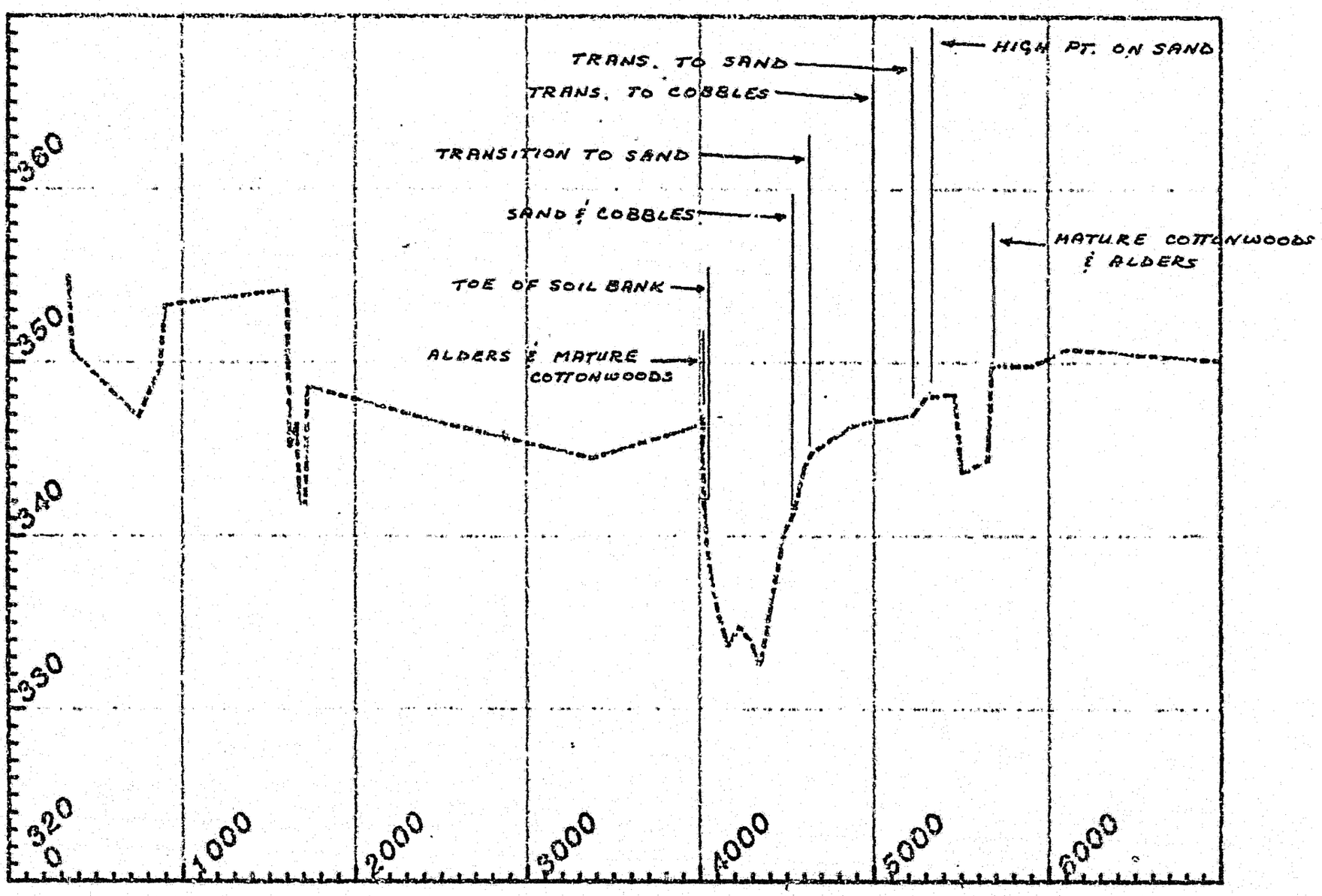
DATE OF SURVEY: NOVEMBER 19, 1980

STATION	ELEV	MANNINGS 'n'		DESCRIPTION
10+00	342.2			COTTONWOODS & DENSE ALDERS
11+90	343.9			TOP OF BANK
11+95	338.4			TOE OF BANK - SANDY TOPSOIL
14+82	338.0			COBBLES & SAND
17+99	342.7			ESTIMATED HIGH POINT - SHOULDER OF HIGH WATER CHANNEL - SAND BED
18+61	342.4			RIGHT TOP OF BANK - SPARSE WILLOWS & ALDERS IN SAND
19+56	343.6			HIGH POINT OF ISLAND - SAND BED
21+96	342.1			TOP OF BANK - MIDDLE CHANNEL TRANSITION: SAND & SPARSE VEG. TO COBBLES & SAND
24+58	335.7			GRAVEL - COBBLE BED
24+85	337.0			SAND
25+97	338.2			TRANSITION: SAND & SMALL COBBLES TO MEDIUM COBBLES
29+58	342.1			ESTIMATED HIGH POINT - COBBLES
31+31	341.9			HIGH POINT - LOGS ACCUMULATED
32+76	338.2			SAND - LOW POINT
34+91	340.2			SAND & ACCUMULATED LOGS

NO OTHER DESCRIPTION OF BED MATERIAL OR VEGETATION TO END RIGHT BANK @ 39+61

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 3



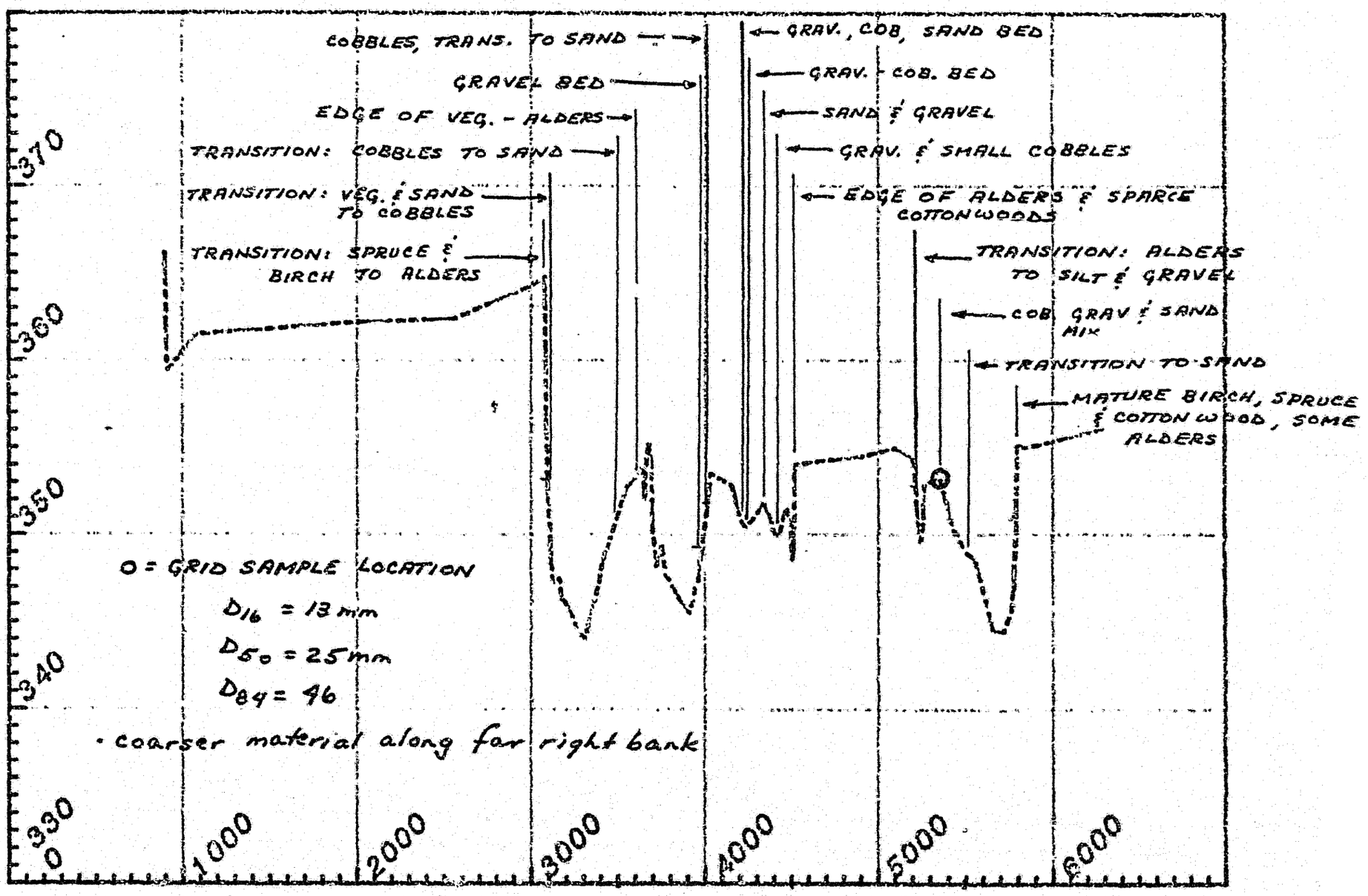
LRX - 3

DATE OF SURVEY: NOVEMBER 13, 1980
MARCH 24, 1981 (extension in left overbank)

STATION	ELEV	MANNINGS 'n'		DESCRIPTION
16+00	354.2			LEFT TOP OF BANK
16+57	346.5			SHOULDER ON SHELF
16+72	341.9			TOE OF SMALL CHANNEL
17+08	341.9			TOE OF SMALL CHANNEL - ON ICE
17+20	348.6			TOP OF BANK - SMALL CHANNEL
40+18	346.9			TOP OF BANK - ALDERS & MATURE COTTONWOODS
40+24	342.0			TOE OF BANK - TOP SOIL
45+39	341.4			SAND & COBBLES
46+93	344.8			TRANSITION TO SAND
50+02	346.6			TRANSITION TO COBBLES
52+29	347.0			TRANSITION TO SAND
53+01	348.0			HIGH POINT ON SAND
54+63	348.2			SHOULDER OF SMALL CHANNEL
55+02	343.6			LOW POINT
56+74	349.9			TOP OF BANK - COTTONWOODS & ALDERS

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 4



LRX - 4

DATE OF SURVEY: OCTOBER 4, 1980

	STATION	ELEV	MANNING'S 'n'		DESCRIPTION
HIGH WATER CHANNEL	30+77	364.8			TOP OF BANK, TRANSITION: SPRUCE & BIRCH TO ALDERS
	30+94	353.2			TRANSITION: VEG. & SAND TO COBBLES
	34+92	351.0			TRANSITION: COBBLES TO SAND
	36+14	353.4			EDGE OF VEG - ALDERS
	36+65	354.5			TOP OF BANK
HIGH WATER CHANNEL	39+79	349.2			GRAVEL BED
	40+17	351.8			COBBLES, TRANSITION TO SAND
	40+31	353.5			HIGH POINT ON SAND
	41+53	352.8			TOP OF BANK - HIGH WATER CHANNEL
	42+05	350.7			GRAVEL, COBBLE & SAND BED
HIGH WATER CHANNEL	42+24	350.4			GRAVEL & COBBLE BED
	43+40	351.8			HIGH POINT - SAND & GRAVEL
	44+16	349.9			GRAVEL & SMALL COBBLES
	45+15	353.3			TOP OF BANK - EDGE OF ALDERS & SPARCE COTTONWOODS
	51+00	355.0			HIGH POINT ON ISLAND
	52+18	352.6			TRANSITION: ALDERS TO SILT & GRAVEL
	53+50	353.3			COBBLES (75%) & CLEAN SAND (25%)

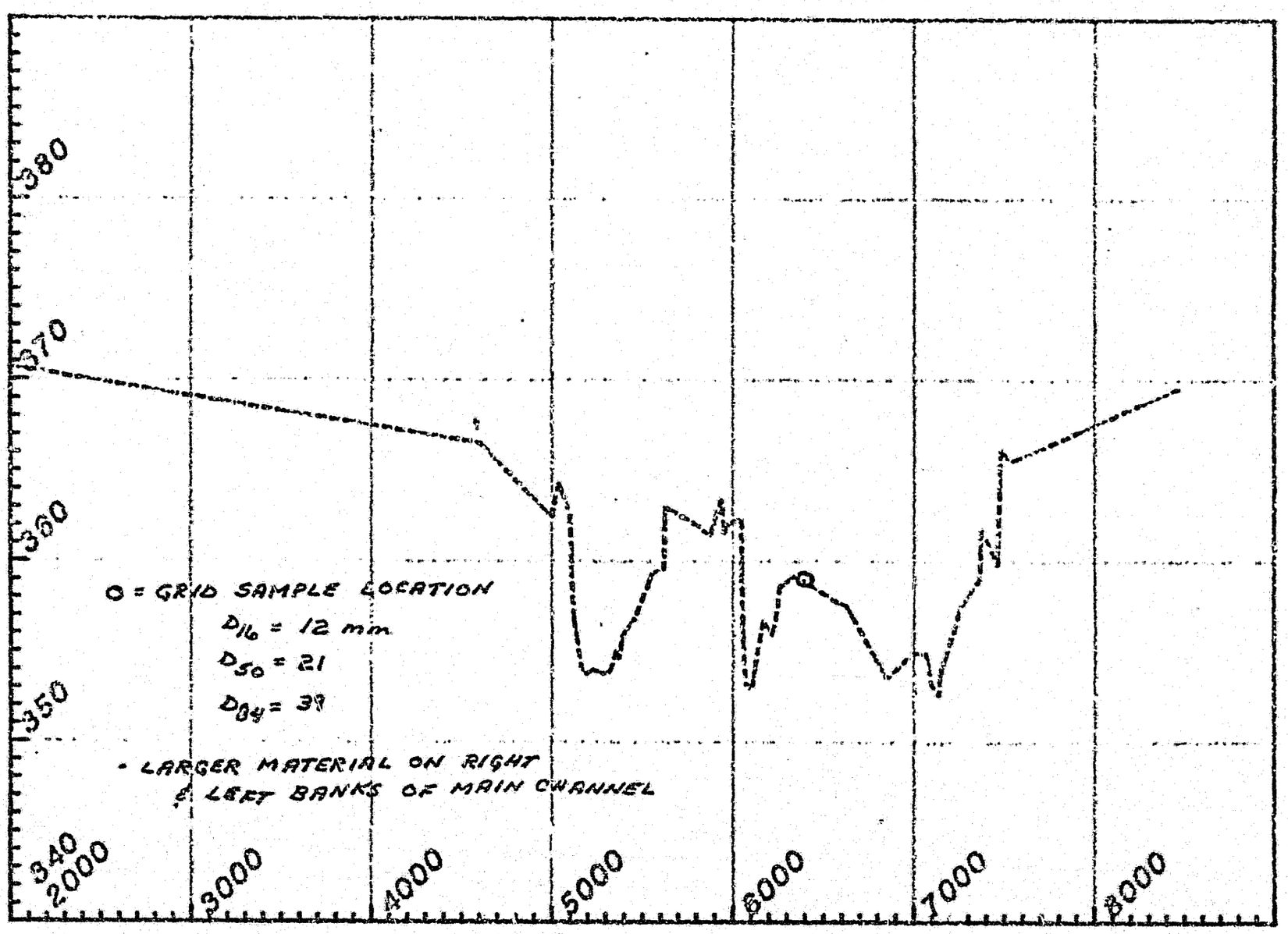
LRX - 4 - CONTINUED

DATE OF SURVEY: OCTOBER 9, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
54+99	349.0			COBBLE, GRAVEL, SAND MIX
57+92	350.5			TRANSITION: COBBLES TO SAND
57+99	355.2			TOP OF BANK - MATURE BIRCH, SPRUCE, & COTTONWOODS, SOME ALDERS
65+00	357.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS--SECTION Number 5



SEE ATTACHED SUMMARY SHEETS FOR DETAILS ON VEGETATION AND BED MATERIAL

LRX - 5

DATE OF SURVEY: OCTOBER 5, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
50+35	364.3			HIGH POINT - FERNS
51+00	362.5			TOP OF BANK
51+21	356.9			TRANSITION: VEG. TO GRAVEL, COBBLE, AND SAND PATCHES
51+58	354.4			GRAVEL - COBBLE BED
HIGH WATER CHANNEL				
54+54	356.8			TRANSITION TO SAND
54+98	357.9			BEGIN HORSETAILS IN SAND
55+56	359.4			BEGIN WILLOWS IN SAND
56+27	363.0			TOP OF BANK - MODERATE DENSITY COTTONWOODS
60+90	362.4			TOP OF BANK - MAIN CHANNEL, EDGE OF VEGETATION
60+98	358.1			TRANSITION: SOIL TO COBBLES & SOME GRAVEL
61+39	355.4			GRAVEL BAR
61+68	356.7			SAND, GRAVEL AND SCATTERED COBBLES

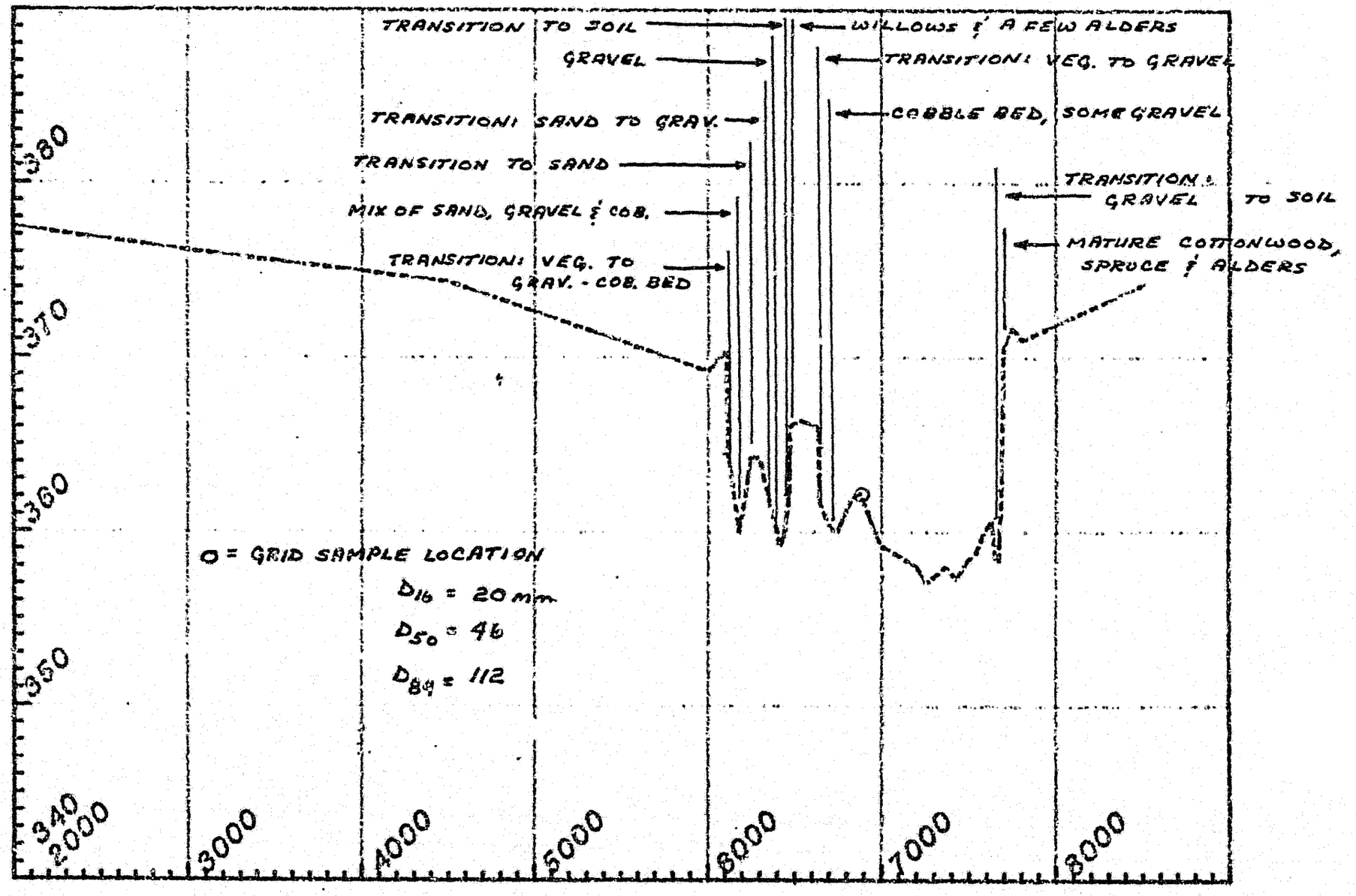
LRX - 5 - CONTINUED

DATE OF SURVEY:

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
62+34	356.7			EDGE OF SAND
62+60	358.6			HIGH POINT - ON SAND
63+38	359.2			COARSE GRAVEL
66+23	357.5			GRAVEL & SMALL COBBLES
73+63	357.1			GRAVEL - COBBLE MATERIAL TOE OF TOPSOIL BANK
73+67	361.8			TOP OF BANK - VEG - COTTONWOODS, SPRUCE, FERNS & GRASSES
79+76	366.2			TOP OF HIGHER TERRACE - BEGIN ALDERS IN COTTONWOOD - SPRUCE STAND

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 6



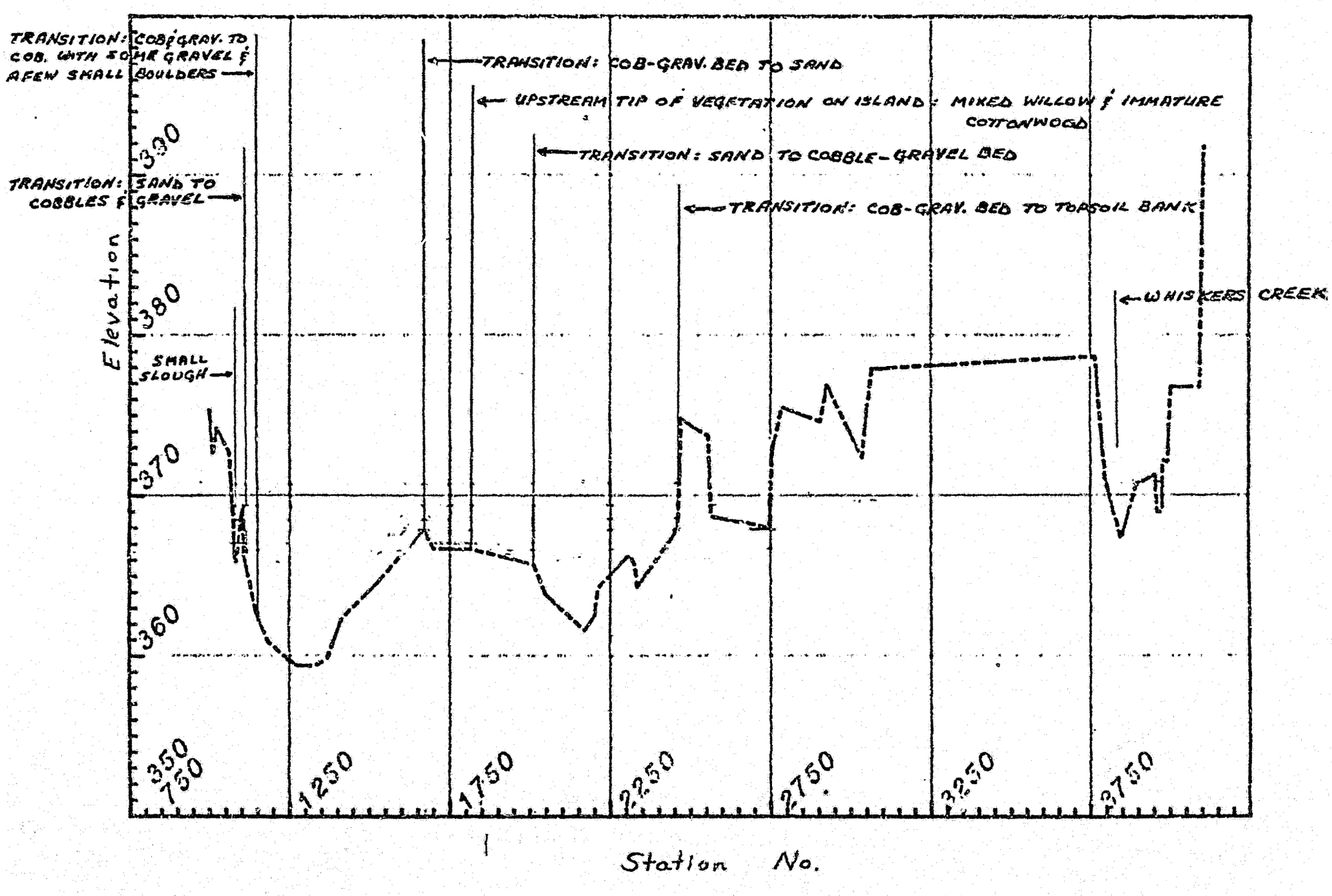
ARX - 6

DATE OF SURVEY: OCTOBER 6, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
61+04	370.4			TOP OF BANK
61+14	364.4			TRANSITION VEG. TO GRAVEL - COBBLE BED
61+77	359.9			LOW POINT IN HIGH WATER CHANNEL MIX OF SAND, GRAVEL & COBBLE
62+46	364.3			TRANSITION TO SAND.
63+50	361.8			TRANSITION SAND TO GRAVEL
63+95	360.1			GRAVEL
64+63	361.9			TRANSITION TO SOIL
69+71	366.1			TOP OF BANK - WILLOWS, A FEW ALDERS
65+28	366.4			HIGH POINT ON ISLAND
66+34	364.9			TRANSITION: VEG. TO GRAVEL
67+39	359.9			COBBLE BED, SOME GRAVEL
76+77	360.79			TOE OF BANK - TRANSITION - GRAVEL TO SOIL
76+96	370.6			TOP OF BANK - MATURE COTTONWOOD SPRUCE & ALDERS

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 7



.NO GRID ANALYSIS FOR BED MATERIAL

LRX - 7

DATE OF SURVEY: OCTOBER 6, 1980
MARCH 26, 1981 (RIGHT EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+60	372.7			TOP OF BANK - SMALL SLOUGH
10+82	365.9			LOW POINT IN SLOUGH
11+01	369.2			TOP OF BANK - MAIN CHANNEL (ON SAND)
11+05	366.4			TRANSITION TO COBBLES & GRAVEL (TOE OF LEFT BANK)
11+26	364.5			COBBLES & A FEW SMALL BOULDERS
16+67	367.9			TRANSITION: COB. & GRAV. TO SAND - HIGH POINT ON ISLAND.
18+12	366.7			UPSTREAM TIP OF VEGETATION ON ISLAND: MIXED WILLOW & IMMATURE COTTONWOOD.
20+12	365.7			TRANSITION TO GRAVEL - COBBLE BED.
22+10	369.2			GRAVEL & SOME COBBLES
23+11	366.3			GRAVEL
23+34	364.3			LOW POINT - 60% COBBLE, 40% GRAVEL
24+58	367.9			TRANSITION: COB - GRAV. TO TOPSOIL BANK
24+69	374.9			TOP OF BANK
25+55	373.7			TOP OF BANK - SIDE CHANNEL
27+45	368.0			LOW POINT IN SIDE CHANNEL
27+55	372.9			RIGHT TOP OF BANK - SIDE CHANNEL

LRX - 7 (CONTINUED)

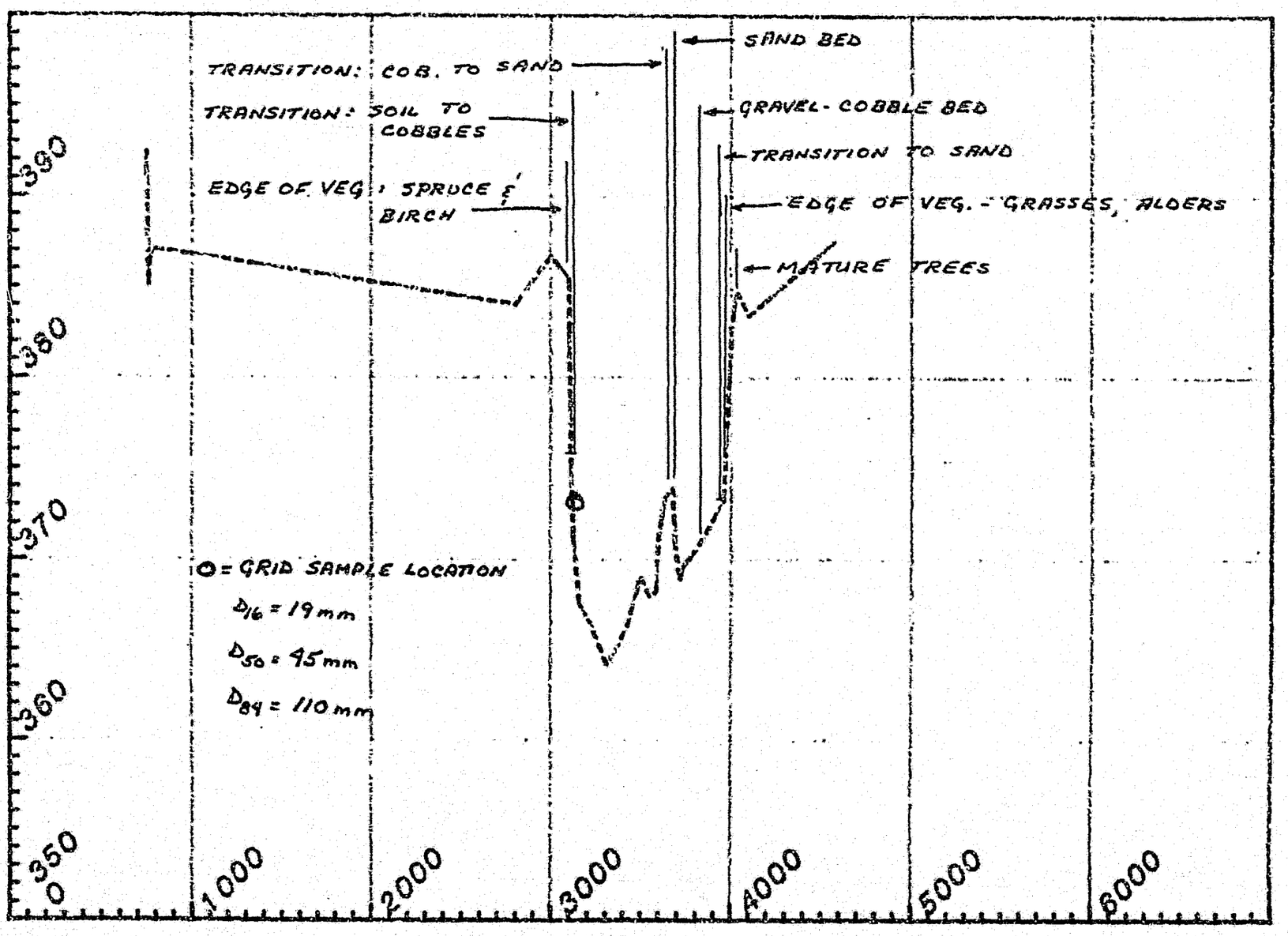
DATE OF SURVEY: OCTOBER 6, 1980
MARCH 26, 1981 (EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
37+65	378.7			LEFT TOP OF BANK AT CONFLUENCE OF TWO SMALL CHANNELS
38+45	367.3			CENTER OF 1st CHANNEL
38+95	370.7			RIGHT BANK OF 1st CHANNEL
39+55	371.3			LEFT BANK - 2nd CHANNEL
39+80	372.2			RIGHT BANK
40+95	376.8			TOE OF BLUFF
41+05	391.8			APPROXIMATE TOP OF BLUFF

Whiskers Creek

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 8



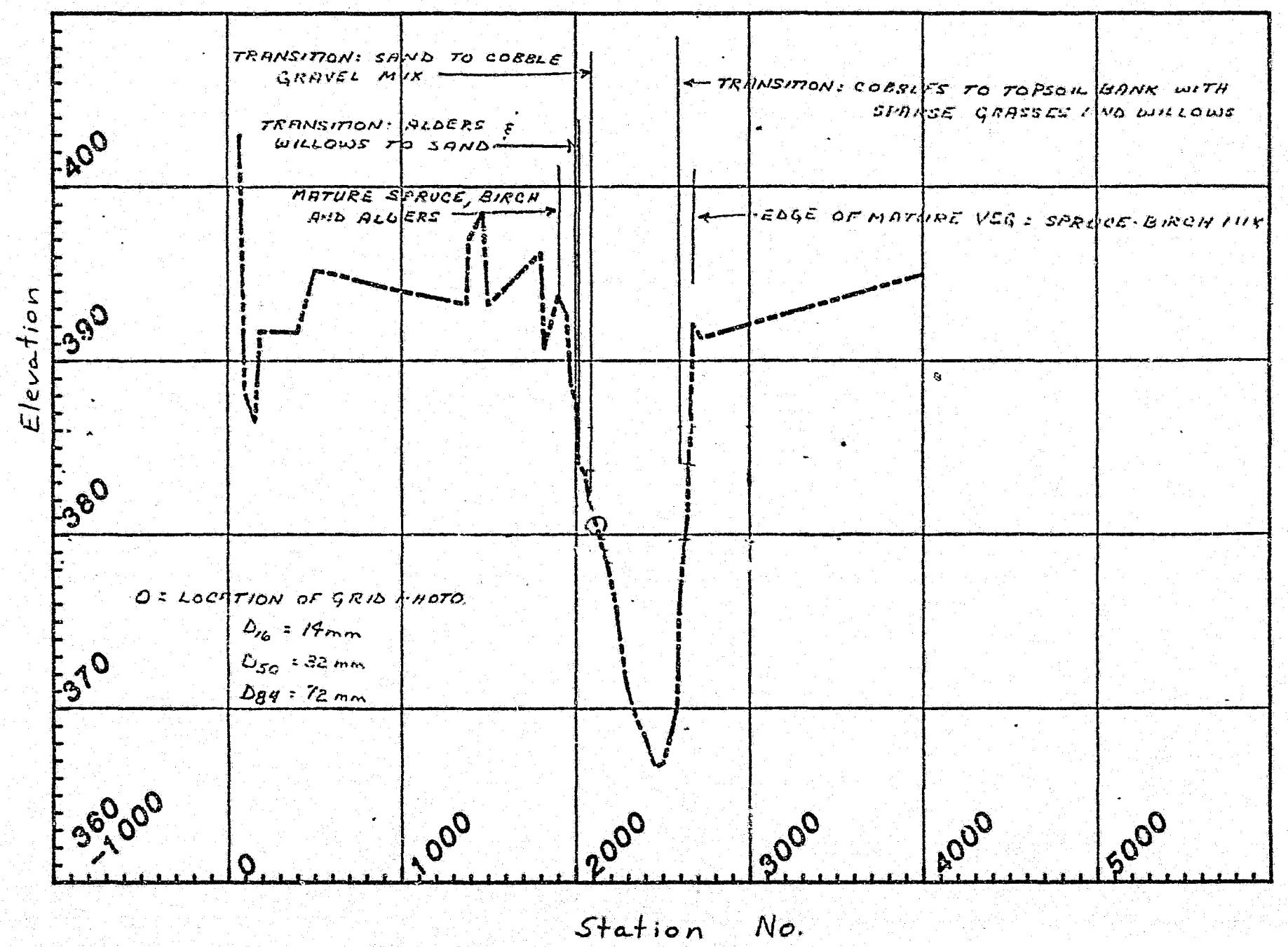
LRX - 8

DATE OF SURVEY: OCTOBER 6, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
31+03	385.4			TOP OF BANK - EDGE OF VEG - SPRUCE & BIRCH
31+13	375.6			TRANSITION: SOIL TO COBBLES
36+40	373.5			TRANSITION: COBBLES TO SAND
36+80	373.9			TOP OF BANK - SAND
38+26	370.89			GRAVEL & COBBLE BED
39+60	373.3			TRANSITION TO SAND
39+69	375.7			EDGE OF VEGETATION - GRASSES, ALDER
40+08	383.0			TOP OF BANK - MATURE TREES

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 9



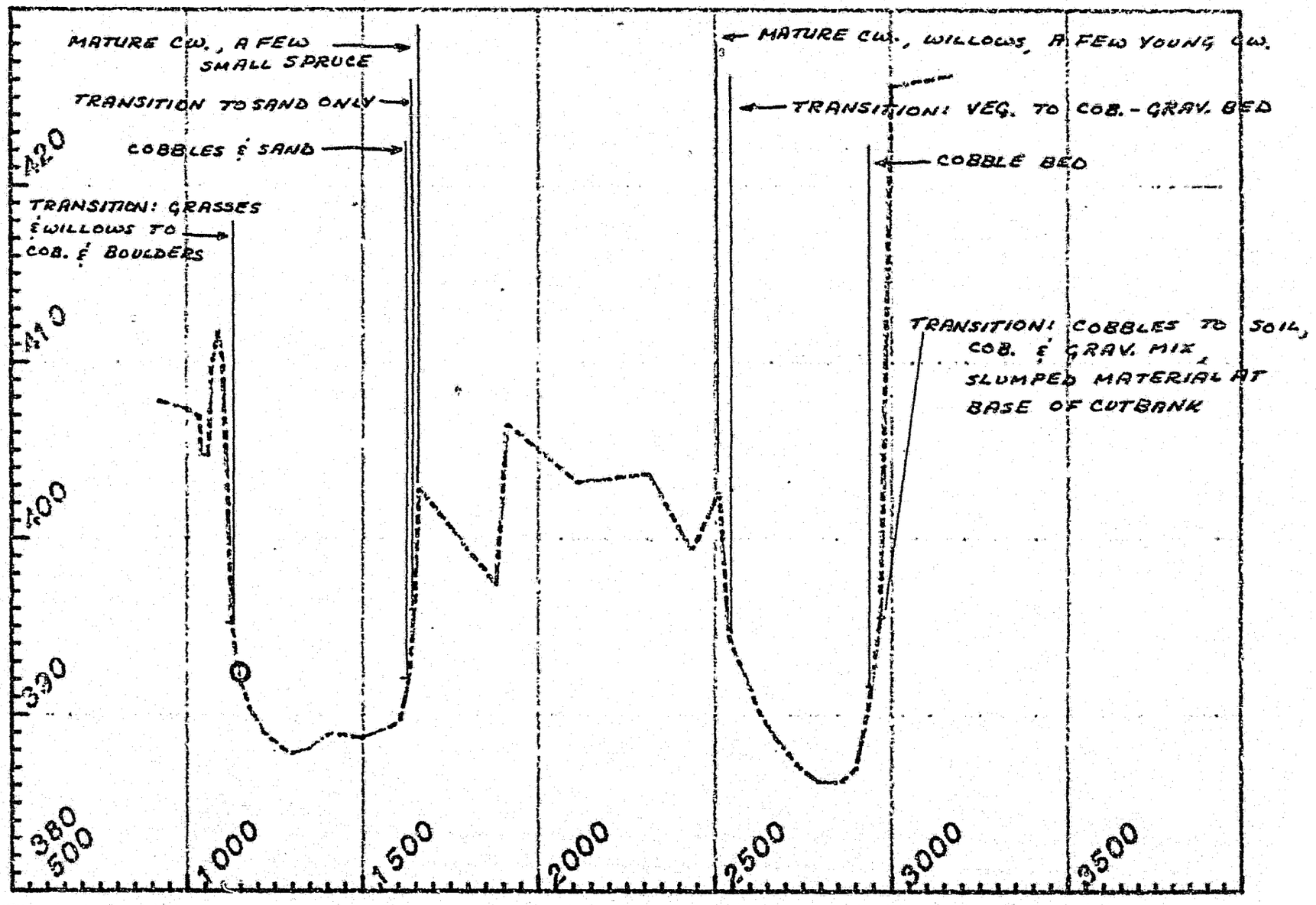
LRX - 9

DATE OF SURVEY: OCTOBER 7, 1980
MARCH 27, 1981 (Left bank extension)

STATION	ELEV.	MANNINGS 'n'		DESCRIPTION
0+70	402.95			CENTERLINE OF R.R.
19+00	393.7			MATURE VEG: SPRUCE - BIRCH MIX
20+03	387.6			TOP OF BANK
20+12	384.1			TRANSITION ALDERS TO SAND
20+83	381.6			TRANSITION: SAND TO GRAVEL-COBBLE BED
26+38	381.0			COBBLE BED, ~SAME SIZE AS LEFT BANK
26+56	386.1			TRANSITION: COBBLES TO TOPSOIL BANK w/ SPARSE GRASSES & WILLOWS
26+73	392.1			TOP OF BANK - MATURE VEG. OF SPRUCE & BIRCH

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 10



O = GRID SAMPLE LOCATION

D_{16} = 58 mm

D_{50} = 99

D_{84} = 152

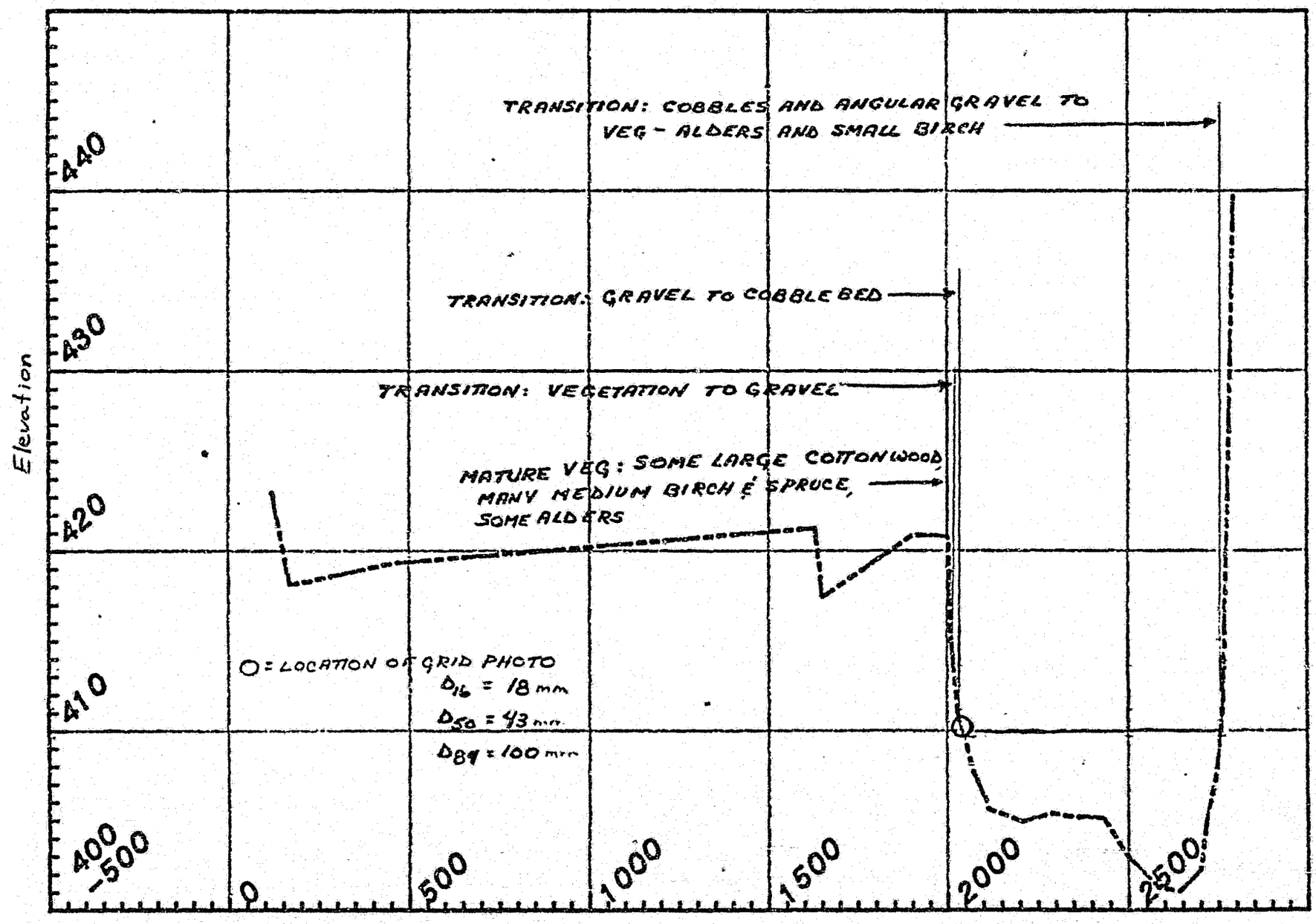
LRX - 10

DATE OF SURVEY: OCTOBER 7, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+88	411.8			CENTERLINE R.R.
11+00	410.1		MC	TOP OF BANK
11+25	395.0			TRANS. GRAS. & WIL. → COB. & ~~SAND~~ BOULDERS
16+30	391.94			COB & SAND
16+46	395.8			TRANS. TO SAND ONLY
16+58	402.7			TOP OF BANK ON ISLAND - MATURE CW, A FEW SMALL SPR.
19+10	406.5			HIGH PT. ON ISLAND
25+08	402.66			TOP OF BANK - WEST CHANNEL
25+40	394.4			(VEG: MATURE CW, A FEW ~~BIRCH~~ YOUNG CW, & WILL.) TRANS. VEG → COB & GRAV. BED
29+35	390.52			COB. BED
29+67	395.5			TRANS. COB → SOIL, COB & GRAV. MIX - SLUMPED MATERIAL AT BASE OF CUTBANK
30+00	425.7			TOP OF BANK

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 11



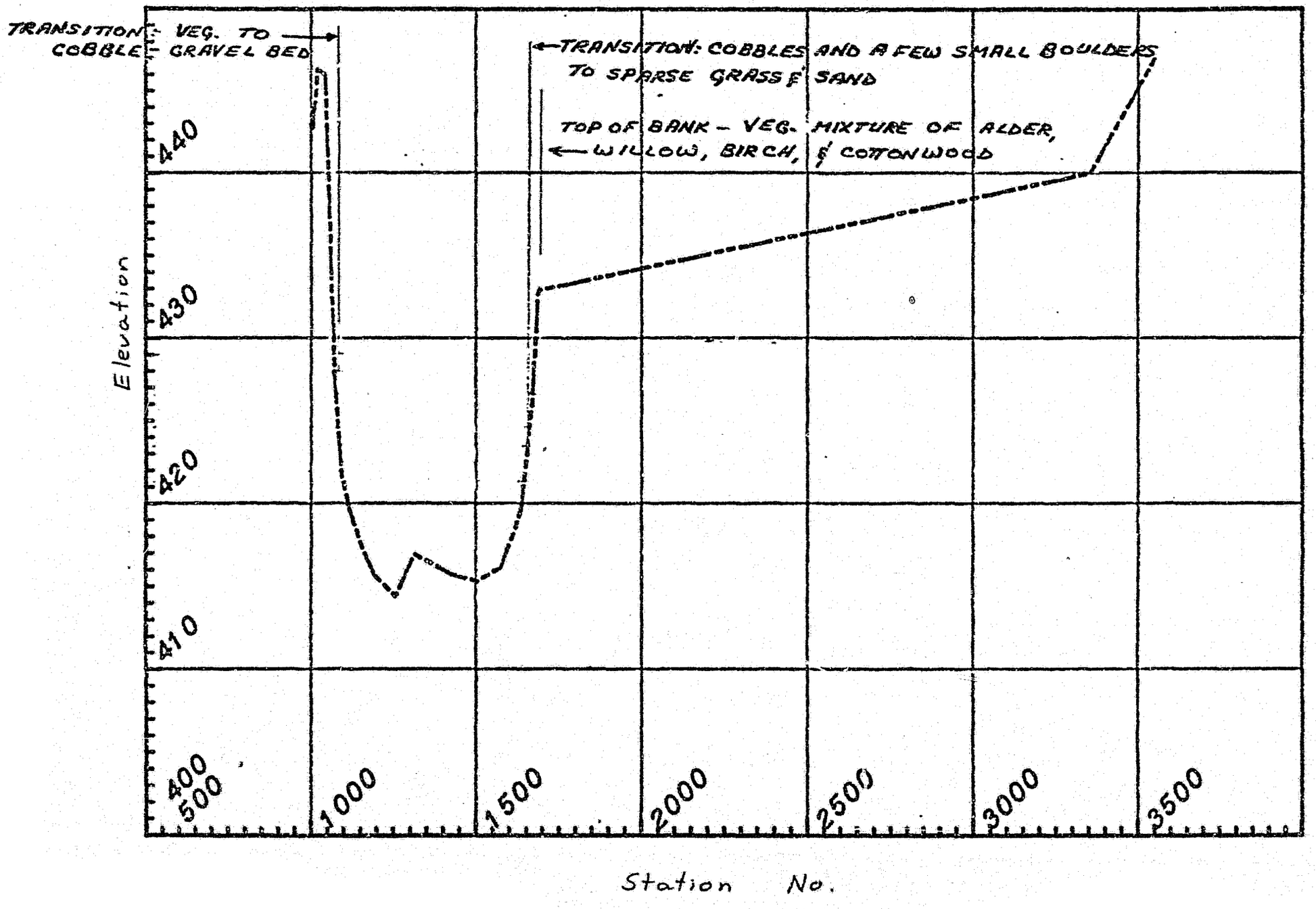
LRX - 11

DATE OF SURVEY: OCTOBER 11, 1980
MARCH 26, 1981 (LEFT EXTENSION)

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
1+20	423.2			CENTERLINE OF AK. R.R.
20+03	420.8			TOP OF BANK - MATURE VEGETATION OF LARGE (15" DBH) COTTONWOOD, MANY MEDIUM BIRCH & SPRUCE, SOME ALDERS.
20+10	415.2			TOE OF BANK - TRANSITION: VEGETATION TO GRAVEL
20+30	412.9			TRANSITION: GRAVEL TO COBBLE
20+74	407.7			COBBLE BED W/ A FEW LARGE ROUNDED BOULDERS
27+46	407.8			COBBLES, ANGULAR GRAVEL, COAL FRAGMENTS
27+63	411.6			TRANSITION TO VEGETATION: ALDERS, GRASSES, SMALL BIRCH (TOE OF BANK STATION)
27+75	422.0			-
28+73	503.1			TOP OF BLUFF, BIRCH & SCATTERED SPRUCE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 12



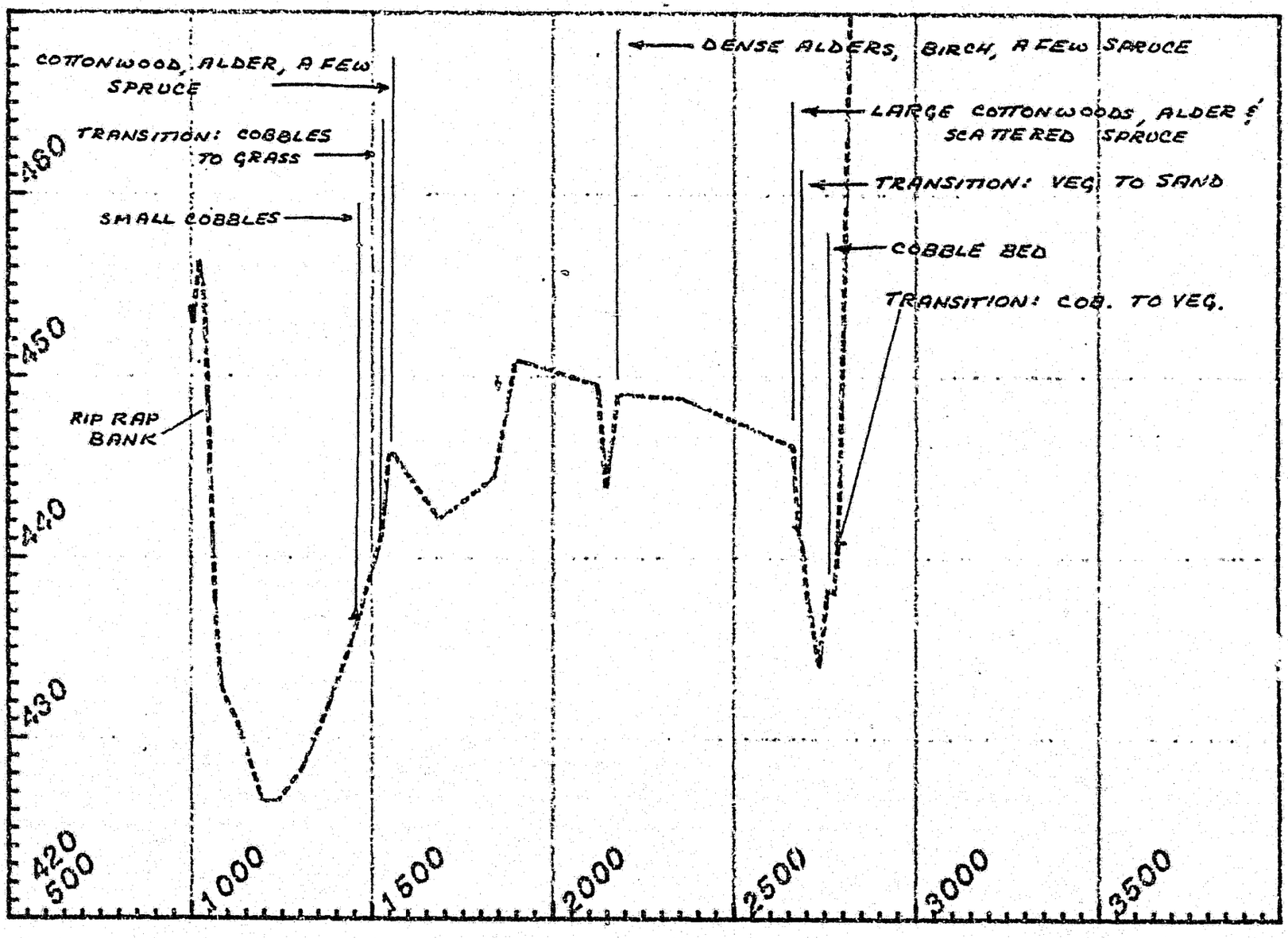
LRX - 12

DATE OF SURVEY: OCTOBER 12, 1980

STATION	ELEV.	MANNING'S 'n'	DESCRIPTION
10+20	446.3		CENTERLINE OF R.R.
10+93	446.0		TOP OF BANK - MAIN CHANNEL - WILLOWS
10+71	427.9		TRANSITION: VEGETATION TO COB-GRAV BE
16+96	421.8		COBBLES & A FEW SMALL BOULDERS
16+70	426.5		TRANSITION TO SPARSE GRASS & SAND
16+86	432.6		TOP OF BANK - SPARSE VEG - MIXTURE OF ALDER, WILLOW, BIRCH & COTTONWOOD
33+55	440.0		ESTIMATED TOE OF BLUFF
35+50	447.0		ESTIMATED - ON SLOPE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 13



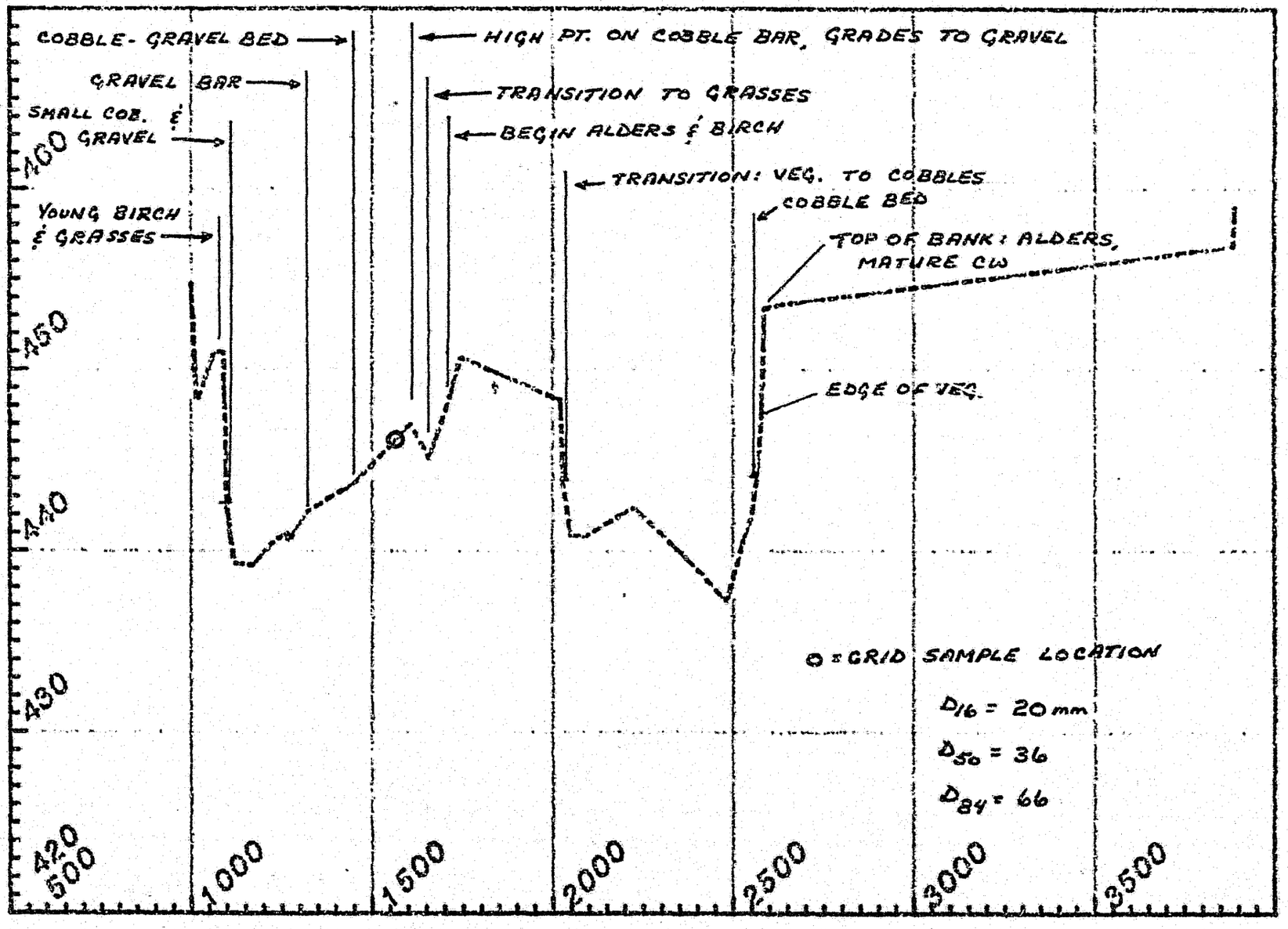
LRX - 13

DATE OF SURVEY: OCTOBER ~~8~~ 7 & 9

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+23	456.3		MC	CENTERLINE R.R.
10+39	454.1			TOP OF BANK - SPARSE WILLOW & GRASS
10+71	436.41			ANGULAR RIP-RAP, SOME LARGE ROUNDED BOULDERS IN CHANNEL
14+60	436.47			90% SM. COBBLES, A FEW BOULDERS, MIXED W/ GRAV. & SAND
15+28	441.2			TRANS. COB → GRASS
15+~~55~~ 48	445.4		MC	TOP OF BANK : CW, ALD. & A FEW SPR.
~~18~~ +98	450.9		ROB	HIGH PT ON ISLAND
21+81	499.0			DENSE ALDERS & ~~BIRCH~~, A FEW SPR.
26+64	445.7			TOP OF BANK - SIDE CHAN. (VEG: LARGE CW, ALD, SCATTERED SPR.)
26+76	441.5			TRANS. VEG → SAND
27+59	438.3			COB. BED
27+87	440.7			TRANS. COB → VEG (ALD., WL, GRAS.)
28+22	470.9		ROB	TOP OF BANK (VEG: SPR & BIRCH) (TERRACE BENDS OFF TO THE ~~NORTH~~ WEST

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 1 4



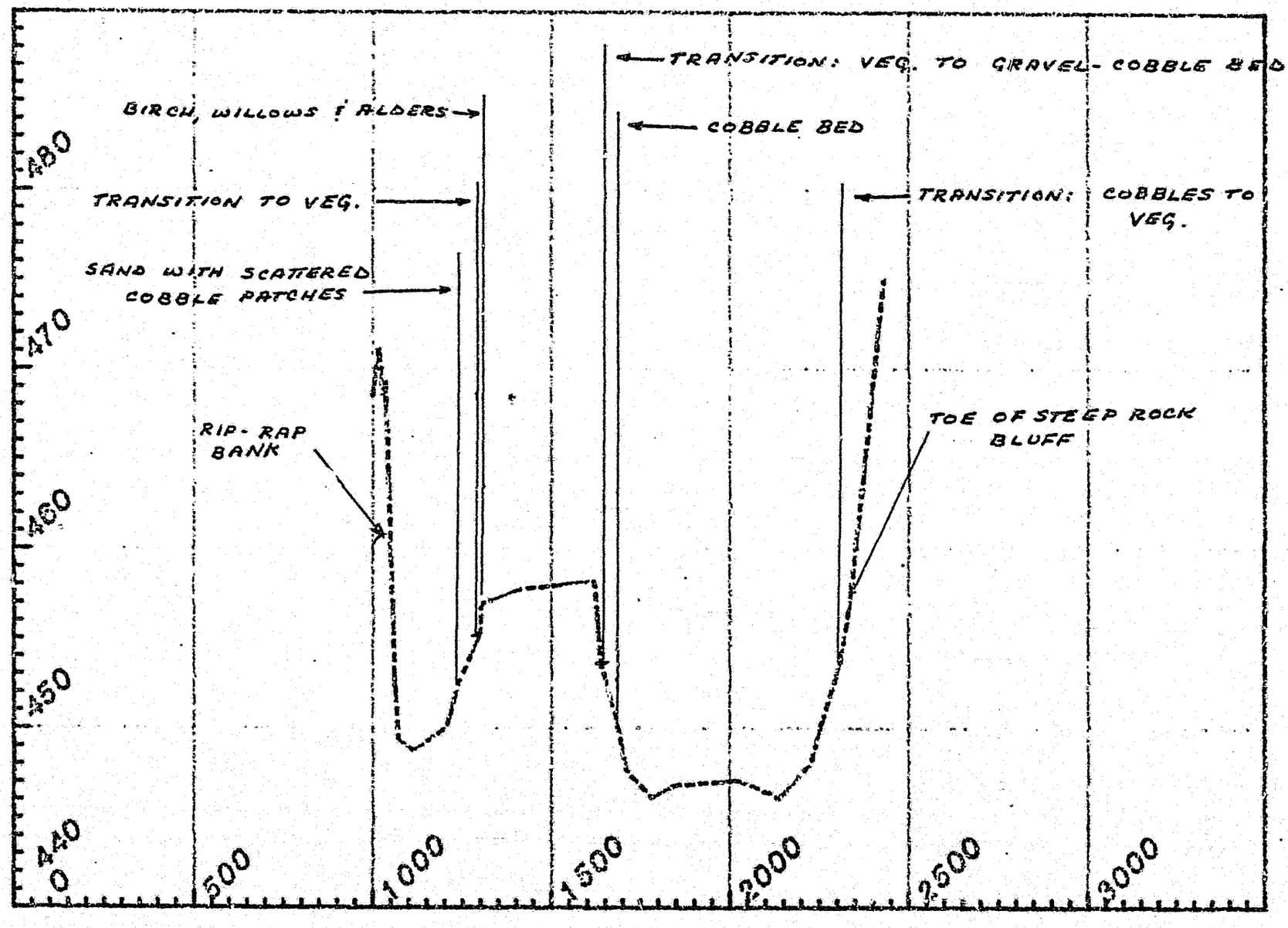
LRX - 14

DATE OF SURVEY: OCTOBER 9

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	454.7		LOB	SHOULDER OF R.R.
10+90	450.9			TOP OF BANK - YOUNG BIRCH, GRASS.
10+99	442.49			SMALL COB., GRAV., ACCUMULATED DEBRIS AT TOE OF BANK, SIGNS OF SLUMPING
13+22	442.2			GRAV. BAR
14+52	443.77			COB & GRAV. (85%) (15%), COB. UNIFORM 6" DIAM
16+06	447.0			HIGH PT. ON COB. BAR GRADES TO GRAV
16+56	445.1			TRANS TO GRASS
			LOB	
17+18	448.7		~~ALG~~	BEGIN ALD. & ~~BIR~~ BIR.
17+42	450.6		MC	
20+~~28~~ 21	448.3			TOP BANK - MAIN CHANNEL
20+28	443.71			TRANS. VEG → GRAV & COB
25+65	444.07			COB. BED
25+78	447.6			EDGE OF VEG
25+85	453.4		MC	TOP OF BANK - VEG (ALD., MATURE CW, GRAS.)
			ROB	- CONSTANT GRADE TO BASE OF HIGHER TERRACE TO WEST
38+85	456.8			TOE OF HIGHER TERRACE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 15



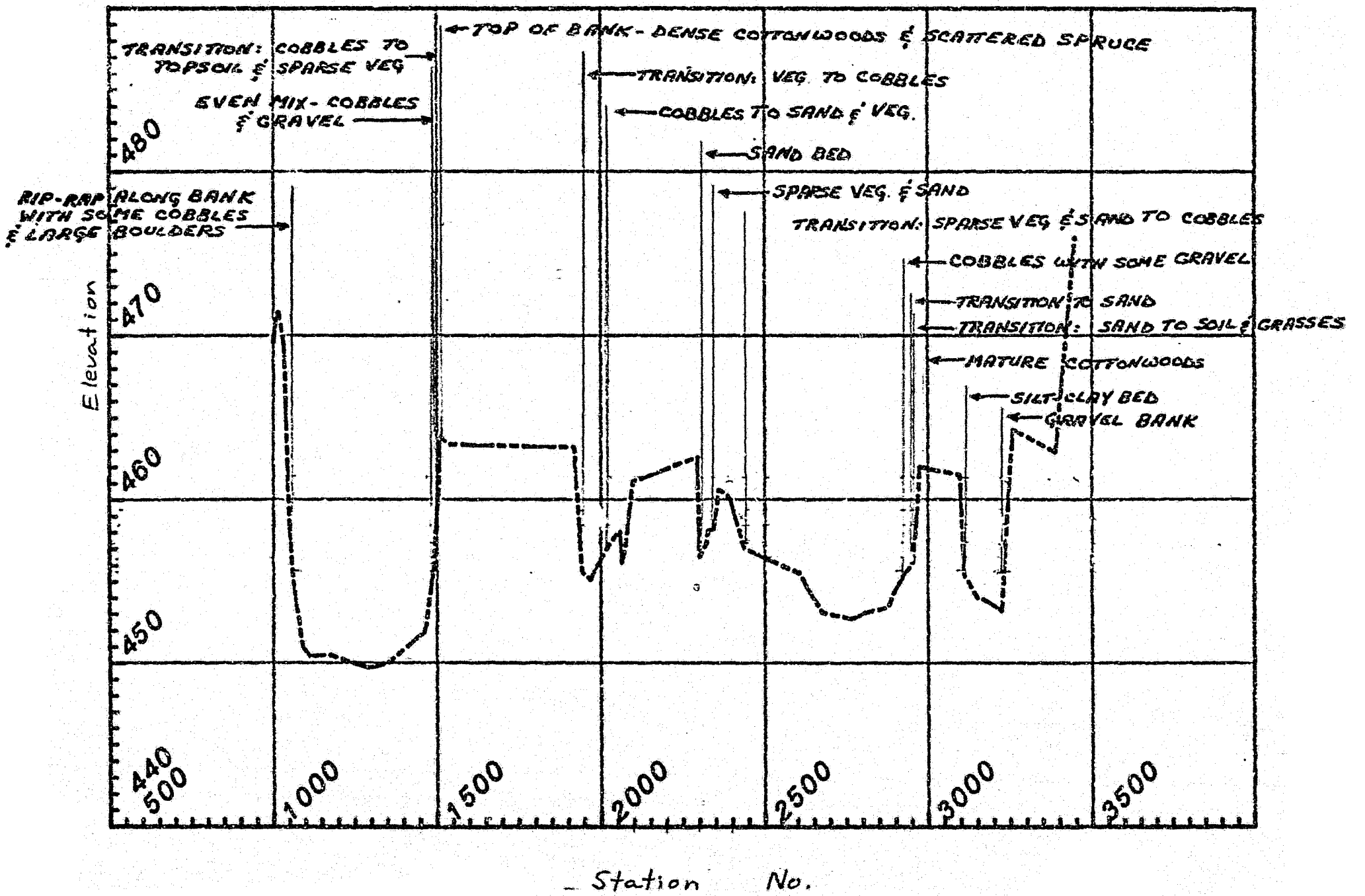
LRX - 15

DATE OF SURVEY: OCTOBER 9

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+16	471.1		LOB	CENTERLINE R.R.
10+35	469.3			TOP BANK - ARTIFICIAL, ANGULAR RIP-RAP TO WATER'S EDGE
12+35	452.39			SAND, w/ SCATTERED PATCHES OF COBBLES
12+98	455.2			TRANS. TO VEG. (WILLOWS)
13+00	456.7			TOP OF BANK VEG: BIRCH, WILLOW, ALD.
			LOB	
16+21	457.9		MC	TOP OF BANK - MAIN CHAN.
16+38	453.5			TRANS. VEG → GRAV & COB.
16+85	450.23			COBBLES
23+12	453.8			TRANS. COB → VEG (WIL., BIRCH, FEW SPRUCE
23+40	457.5			TOE OF STEEP BLUFF
			MC	
24+30	475.0		MC	(PROJECTED STA. & ELEV. ON SLOPE OF BLUFF)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 16



LRX - 16

DATE OF SURVEY: OCTOBER 10

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+16	471.6		MC	CENTERLINE R.R.
10+33	469.5			TOP OF BANK
10+49	458.7			COB., ANGULAR RIP-RAP, LARGE BOULDER:
14+87	455.24			EVEN MIX COB & GRAV.
15+05	460.7			TRANS. TO SPARSE VEG - GRASSES & WILLOWS
15+09	463.9		MC ROB	TOP OF BANK - DENSE CW, SCATTERED SPR.
19+19	463.2			TOP OF BANK - HIGH WATER CHANNEL
19+43	455.6			VEG: ALDERS, FERNS, WILLOWS TRANS. VEG → COB
20+17	457.0			TRANS COB → SAND & VEG (WIL, HORSETAIL
20+96	461.1			TOP OF BANK: LARGE CW, ALD., WIL.
22+95	462.6			TOP OF BANK - 2ND H.W. CHANNEL
23+01	456.5			EDGE OF VEG. SAND BED CHAN.
23+44	458.2			SPARSE VEG. & SAND
23+59	460.6			HIGH POINT - TOP OF BANK
24+37	457.0			TRANS. SAND & VEG → COB.
29+27	455.49			COBBLES w/ SOME GRAV.
29+51	456.0			TRANS. TO SAND

LRX - 16 - continued

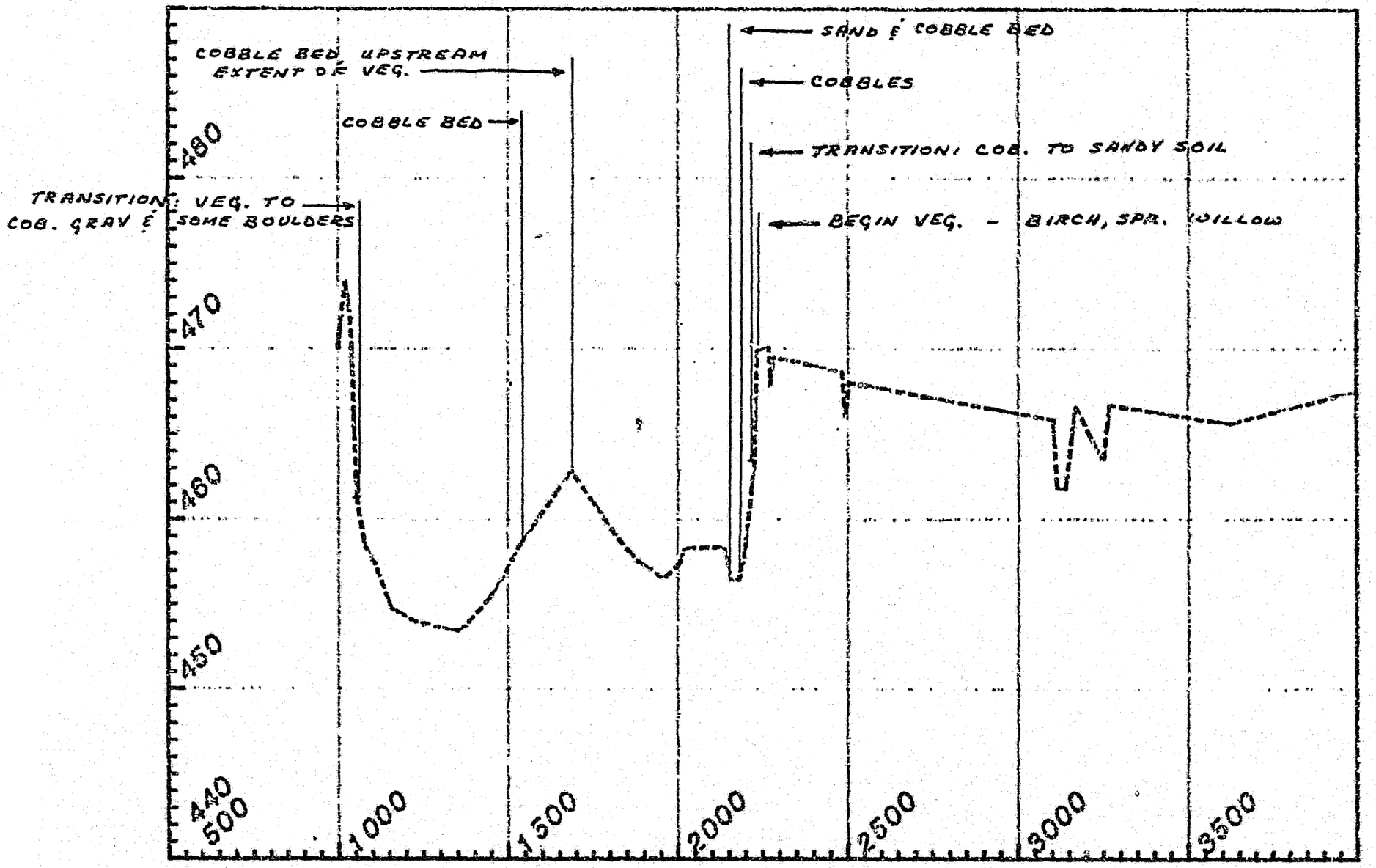
DATE OF SURVEY: OCTOBER 10

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
29+64	458.6			SAND → TOPSOIL & GRASSES
29+74	462.0			TOP OF BANK - LARGE CW
30+98	461.5			TOP OF BANK - SIDE SLOUGH
31+12	455.34			TOE OF BANK - SILT/CLAY BED
32+31	455.34			GRAV. BANK
32+59	464.3			TOP OF BANK
33+90	462.9		ROB	TOE OF BLUFF VEG.: BIRCH, SPR.
34+50	476.0			(calculated STA & elev. ON SLOPE of BLUFF)

Slough 6A (ADF&G)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 17



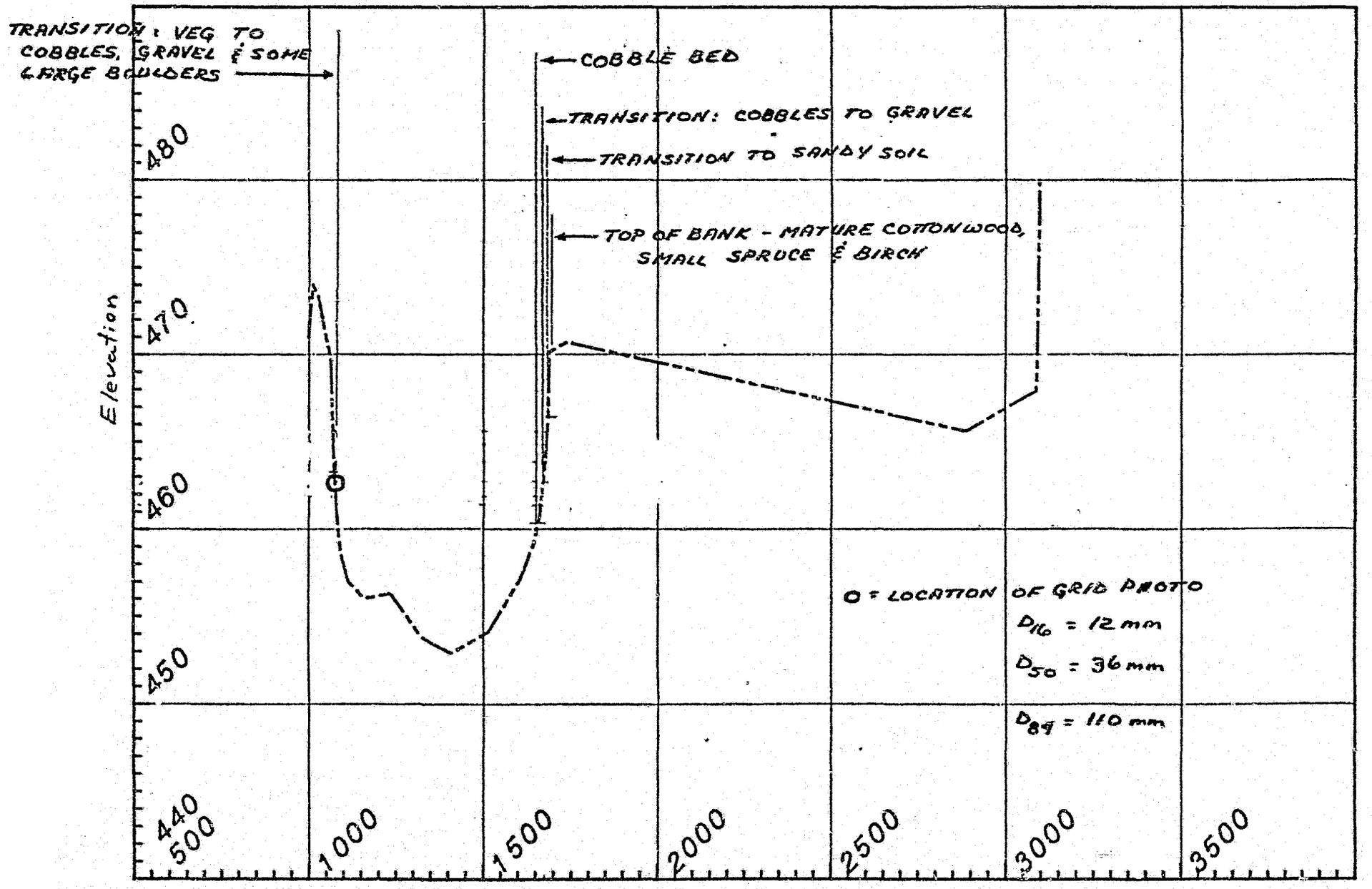
LRX - 17

DATE OF SURVEY: OCTOBER 10, 1980
MARCH 27, 1981 (RIGHT EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+20	473.9		MC	CENTERLINE R.R.
10+36	471.6			TOP OF BANK
10+53	461.2			TRANS. VEG → COB, GRAV & SOME BOULDERS
15+31	458.9			COBBLE BED
16+83	462.88		MC ROB	HIGH PT. ON ISLAND, (U/S EXTENT OF VEG.) COBBLE BED
21+58	456.4			TOE OF PARTIALLY EXPOSED BAR - SAND & COB.
21+81	456.5			COBBLES
22+26	463.3			TRANS. COB → SANDY SOIL
22+33	469.9		ROB	BEGIN VEG - BIRCH, SPR., GRASS., WIL. TOP OF BANK

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 18



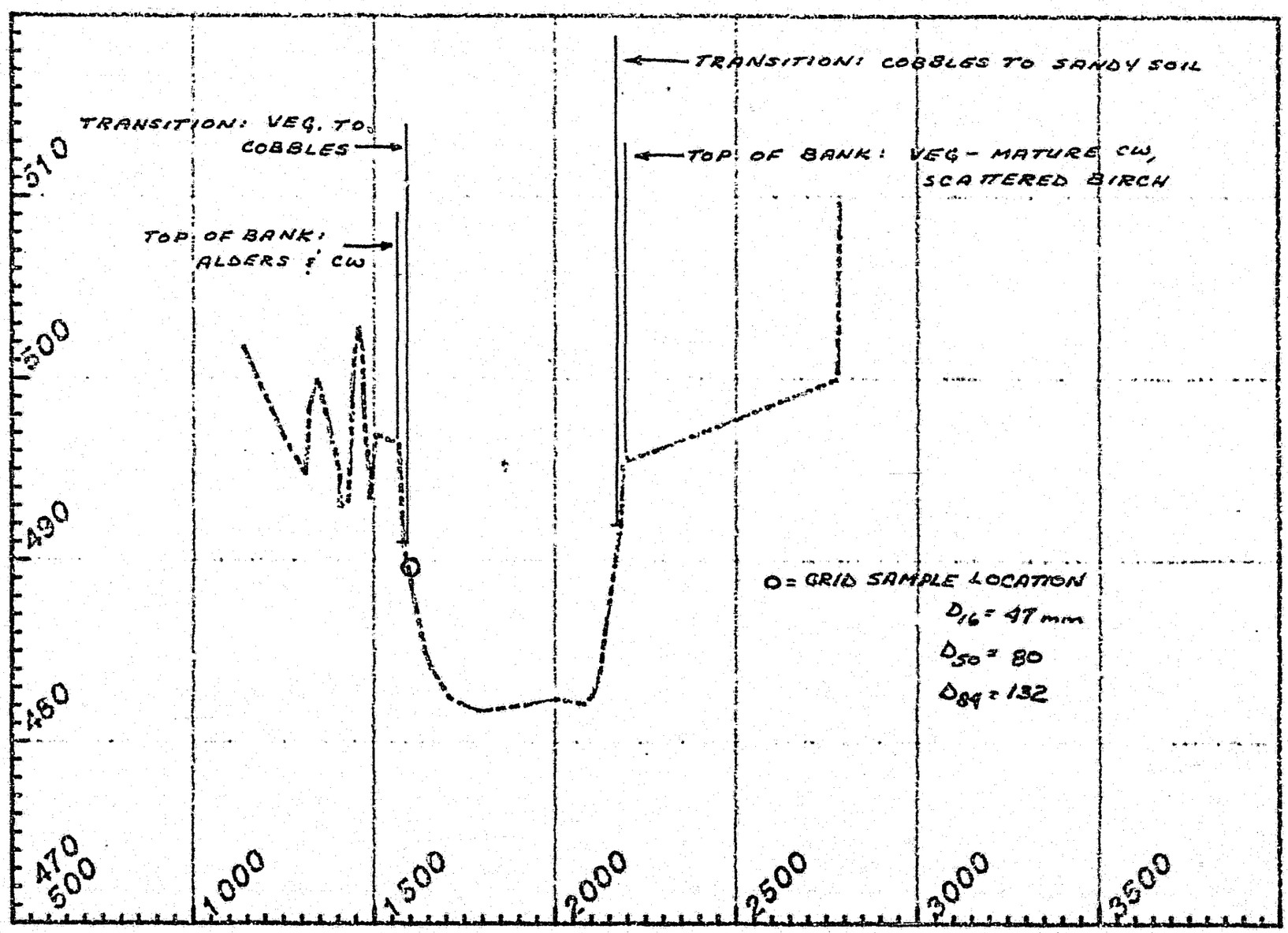
LRX - 18

DATE OF SURVEY: OCTOBER 10, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+13	474.0			CENTERLINE OF RAILROAD
10+69	469.7			TOP OF BANK - GRASSES, IMMATURE BIRCH
10+73	463.4			TRANSITION: VEG. TO COBBLE, GRAVEL & SOME BOULDERS
16+61	460.7			COBBLE BED
16+72	462.9			TRANSITION: COBBLES TO GRAVEL
16+86	466.3			TRANSITION TO SANDY SOIL
16+89	470.1			TOP OF BANK - MATURE COTTONWOOD, SMALL SPRUCE AND BIRCH
30+90	467.9			ESTIMATED TOE OF BLUFF
30+97	480.0			ESTIMATED - ON SLOPE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 19



LRX - 19

DATE OF SURVEY: NOV. 9 (WATER) NOV. 16 (LAND)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
14+57	502.8			CENTERLINE R.R.
15+68	496.4		MC	TOP OF BANK - ALDERS & CW
15+83	490.9			TRANS. VEG → COBBLES
21+80	491.8			TRANS. COB → SANDY SOIL
21+90	495.4		MC	TOP OF BANK - VEG: MATURE CW, SCATTERED BIRCH
25+00	497.8			G.S. ON SLOPE (estimated)

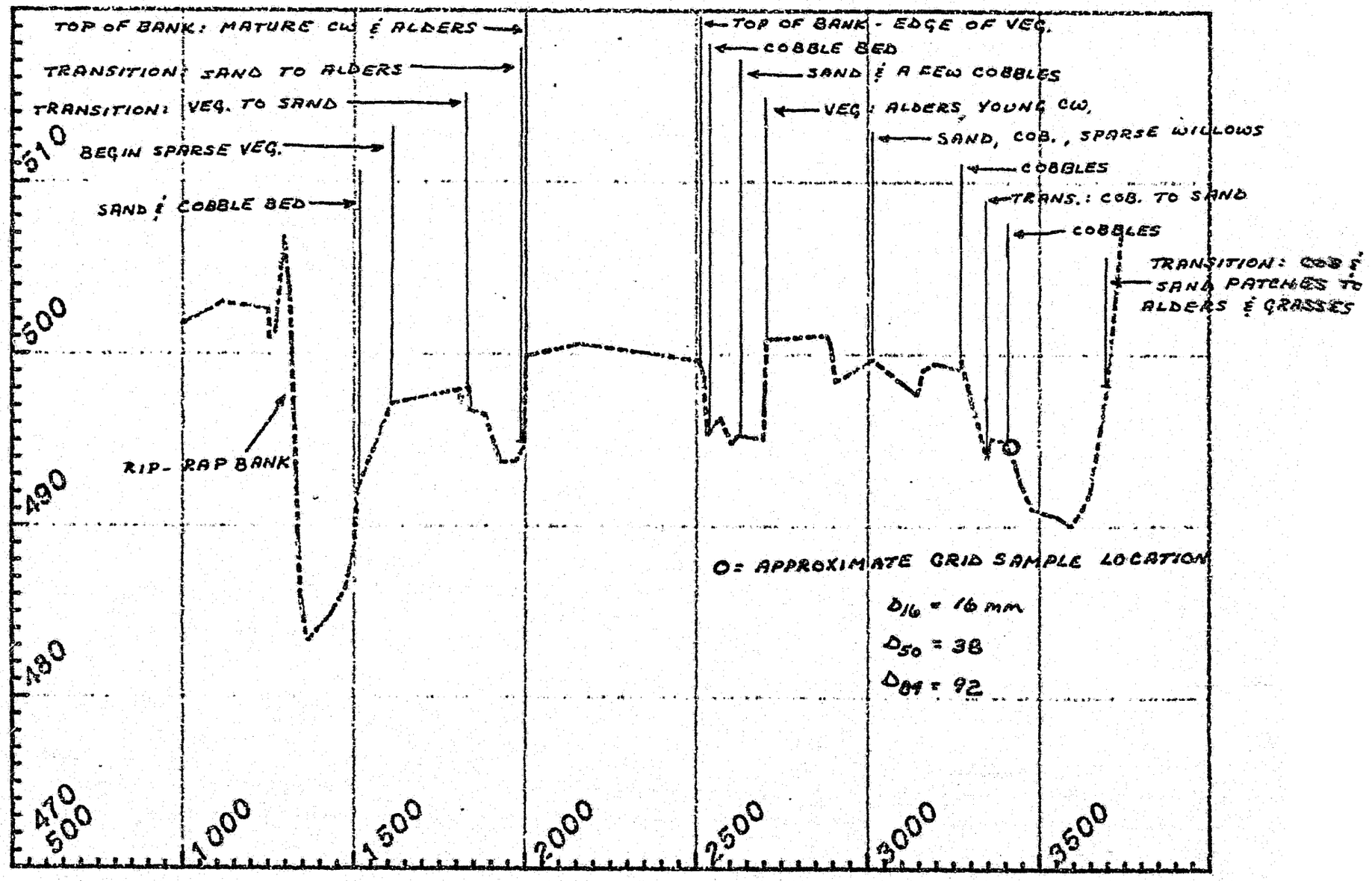
LRX - 19

DATE OF SURVEY: NOV. 9 (WATER) NOV. 16 (LAND)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
14+57	502.8			CENTERLINE R.R.
15+68	496.4		MC	TOP OF BANK - ALDERS & CW
15+83	490.9			TRANS. VEG → COBBLES
21+80	491.8			TRANS. COB → SANDY SOIL
21+90	495.4		MC	TOP OF BANK - VEG: MATURE CW, SCATTERED BIRCH
25+00	497.8			G.S. ON SLOPE (estimated)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 20



. GRID PHOTO SHOWS MATERIAL IN HIGH WATER CHANNEL UPSTREAM OF X-SECTION LINE

LRX - 20

DATE OF SURVEY: NOV. 9 & 16

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
12+95	506.8			CENTERLINE R.R
13+12	503.8		MC	TOP OF BANK -RIP RAP TO E.O.W.
15+12	492.3			SAND & COBBLE BED
16+09	497.15			BEGIN SPARSE VEG - WILLOWS
18+35	498.1			END VEG → SAND
19+94	494.7			TRANS. SAND → VEG: ALDERS
20+01	499.9			TOP OF BANK - MATURE CW & ALDERS
21+51	500.6		MC ROB	HIGH POINT - " "
~~22+89~~	~~501.12~~			~~TRANS. TO ALL ALDERS~~
HIGH WATER CHAN. 25+09	499.6			TOP OF BANK - H.W. CHANNEL EDGE OF VEG.
25+32	495.3			COBBLES
26+20	495.3			SAND & A FEW COB.
27+04	500.9			TOP OF BANK - VEG: ALDERS, YOUNG CW.
28+80	501.1			TOP OF BANK - WEST CHANNEL VEG.
30+12	499.7			SAND, COBBLES, SPARSE WIL.
32+69	499.7			COBBLES
33+44	494.0			TRANS. COB → SAND
33+99	494.9			COBBLES

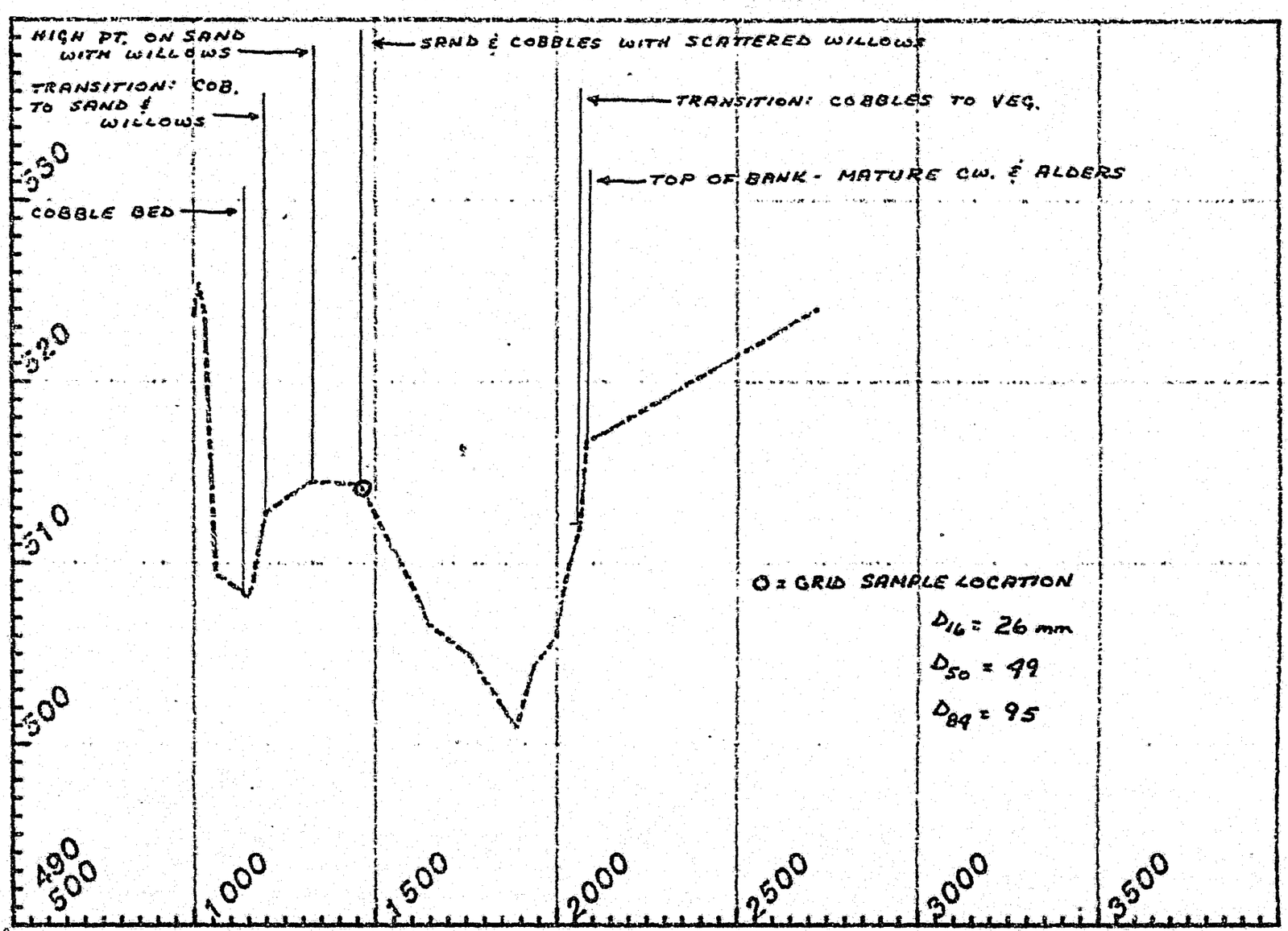
LRX-20 - continued

DATE OF SURVEY:

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
37+00	498.1			TRANS. COB. & PATCHES OF SAND → ALDERS & GRASSES
37+23	502.9			TOE OF BLUFF
37+40	507.0		ROB	[redacted] VEG: BIRCH, A FEW SPRUCE (calculated point on slope of bluff)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 21



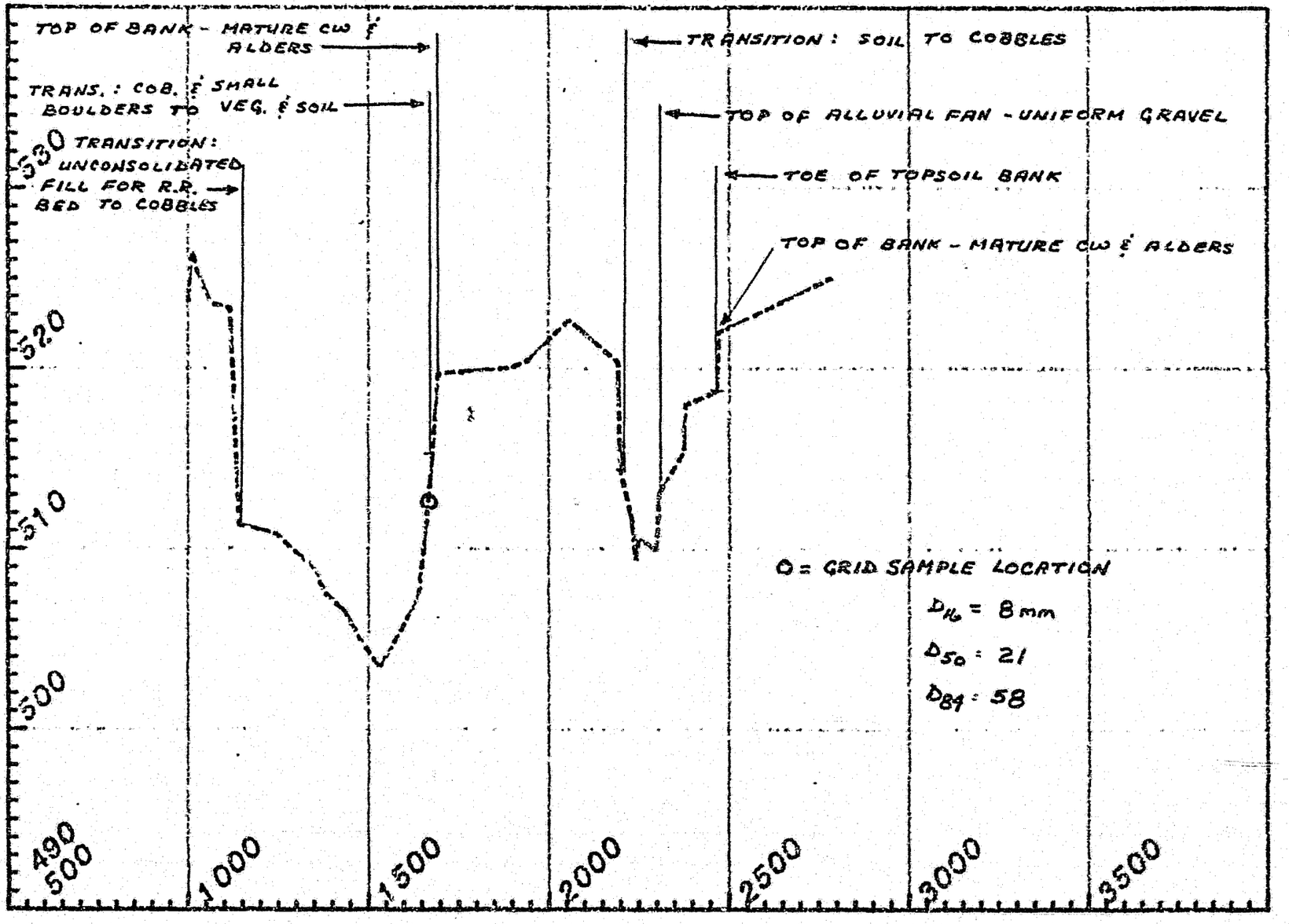
LRX - 21

DATE OF SURVEY: NOV. 8, & 15

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+14	525.4		LOB	CENTERLINE R.R.
10+29	523.8			TOP OF BANK - HIGH WATER CHANNEL
11+34	508.4			COBBLE BED
11+97	512.8			~~TOP OF BANK~~ TOP OF BANK
13+19	514.5		LOB MC	TRANS. COB → SAND & WILLOWS HIGH PT ON SAND w/ WILLOWS
14+57	514.31			SAND & COBBLES w/ SCATTERED ~~COB~~ WILLOWS
20+63	512.0			TOE OF BANK TRANS. COB → VEG.
20+82	516.7		MC	TOP OF BANK - MATURE CW & ALDERS
21+32	517.2			(FLOODPLAIN FOR CREEK ENTERING FROM WEST) (CONSTANT GRADE TOWARD ROCK BLUFF TO THE WEST)
27+20	524.0			estimated

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 22



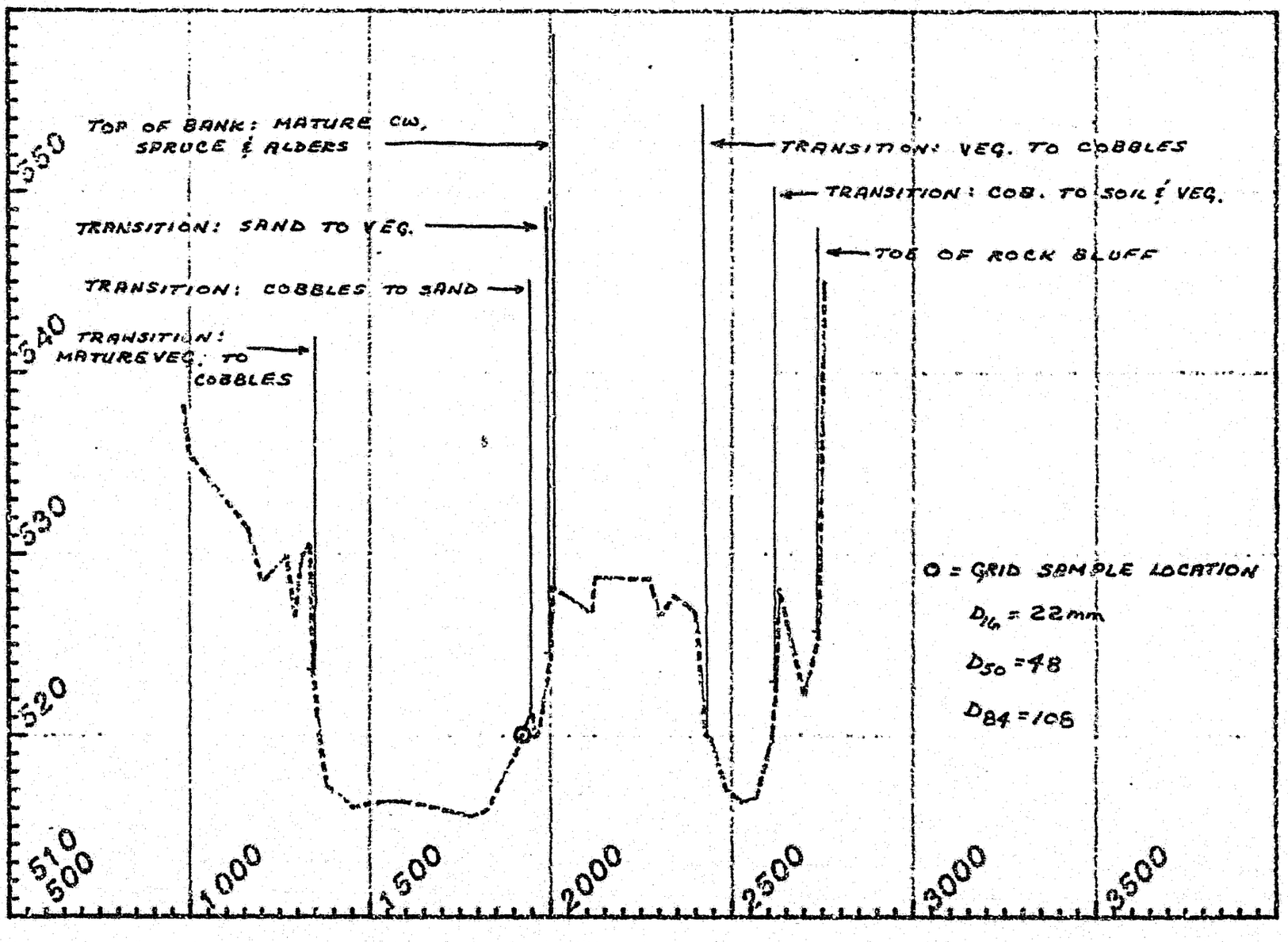
LRX - 22

DATE OF SURVEY: NOV. 8 & 16

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
			MC	
10+13	526.5			CENTERLINE R.R.
11+16	523.3			TOP OF BANK - UNCONSOLIDATED FILL FOR R.R.
11+40	511.3			TRANS. FILL → COBBLES
16+78	515.0			TRANS. COB & SMALL BOULDERS → VEG & SOIL
16+93	519.7		~~MC~~ ROB	TOP OF BANK MATURE CW (UP TO 5' DIAM), ALDERS
20+56	522.7		MC ROB	HIGH PT ON ISLAND
21+93	520.3			TOP OF BANK - SIDE CHANNEL
21+99	514.3			TRANS. SOIL → COBBLES (THICK SAND BED)
23+05	513.1			TOP OF ALLUVIAL FAN - UNIFORM GRAVEL
24+65	518.7			TOE OF TOPSOIL BANK
24+72	522.0			TOP OF BANK - MATURE CW & ALDER
27+80	525.0			estimated point

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 23



LRX - 23

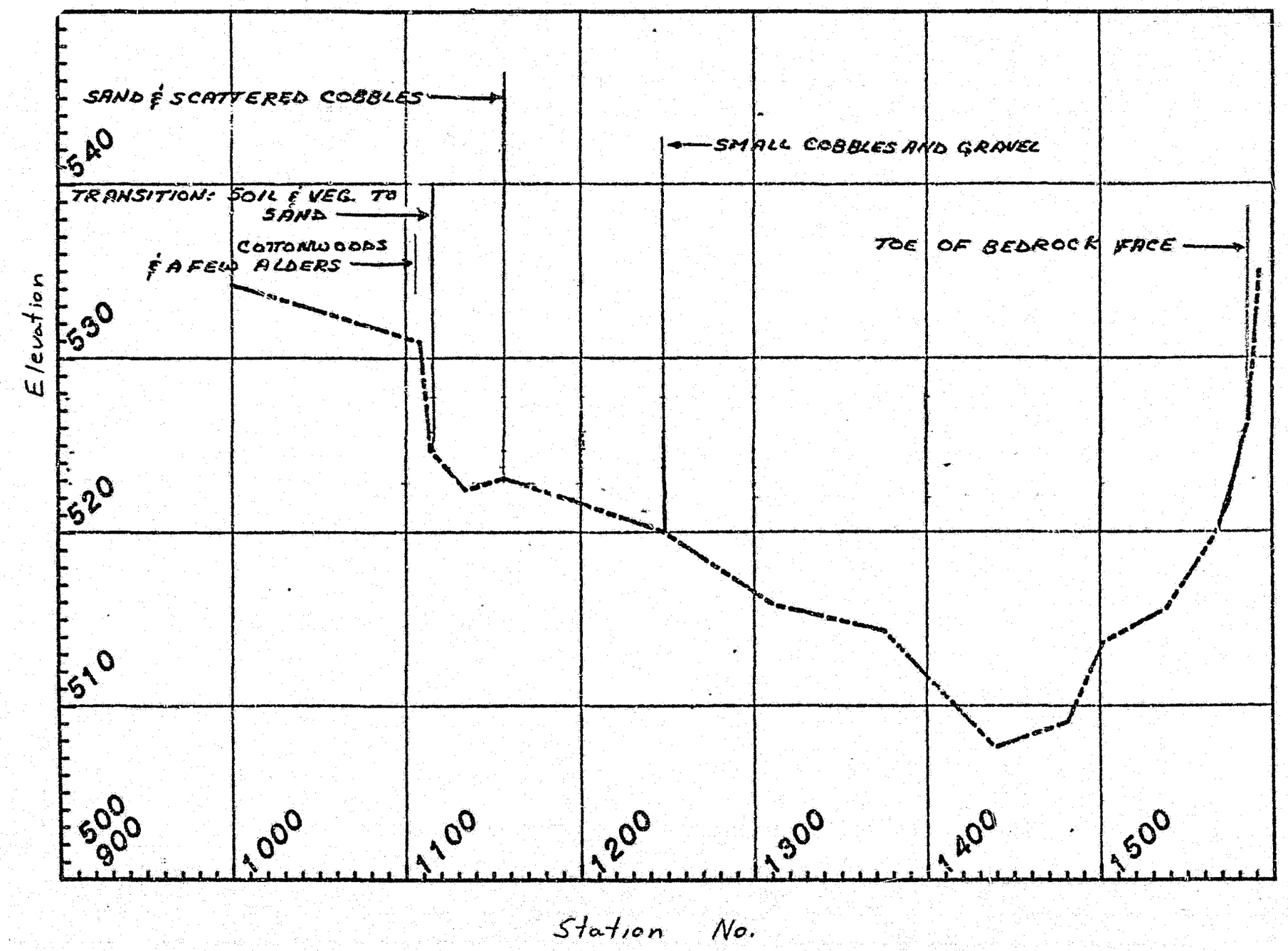
DATE OF SURVEY: NOV. 8 & 19

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+84	538.1			CENTERLINE R.R. -WEST TRACKS
			MC	
13+37	530.6			TOP OF BANK - MATURE CW & BIRCH
13+45	523.5			TRANS. MATURE VEG → COBBLES
19+42	521.0			TRANS. COB. → SAND (HIGH POINT)
20+03	524.5			TRANS. SAND → VEG. (TOE OF ISLAND)
20+08	528.2		MC	TOP OF BANK
			ROB	MATURE CW, SPRUCE & ALDERS
~~22+75~~	~~528.6~~			
24+03	526.7			TOP OF BANK - H.W. CHANNEL
24+30	520.1			TRANS. VEG → COB.
26+24	523.0			TOE OF SMALL ISLAND
				TRANS. COB → SOIL & VEG.
26+32	528.1			HIGH PT. ON ISLAND
27+03	522.2			LOW PT IN SPRING ALONG TOE OF BLUFF
27+43	525.7		ROB	TOE OF BLUFF

estimated

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 24



- No grid photograph

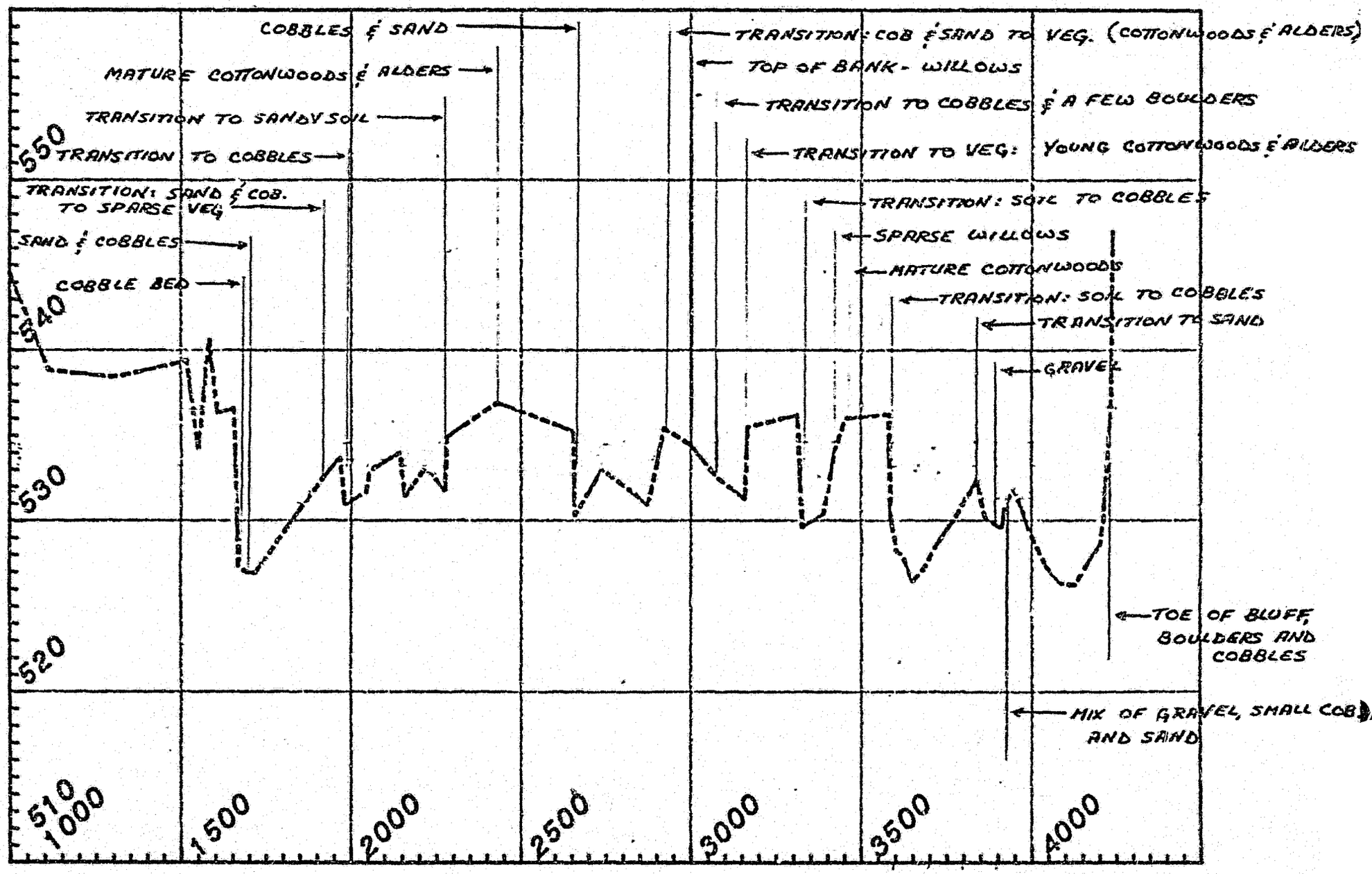
LRX - 29

DATE OF SURVEY: NOVEMBER 8, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
11+08	530.9			TOP OF BANK - COTTONWOODS, AFEW ALDERS
11+14	524.7			TOE OF BANK - TRANSITION OF SOIL & VEG. TO SAND
11+56	523.1			SAND & SCATTERED GRAVEL
12+97	520.0			SMALL COBBLES & GRAVEL
15+86	526.5			TOE OF BEDROCK FACE - NEARLY VERTICAL, ANGULAR ROCK ACCUMULATED AT THE TOE, FEW RIVER TRANSPORTED COBBLES

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 25



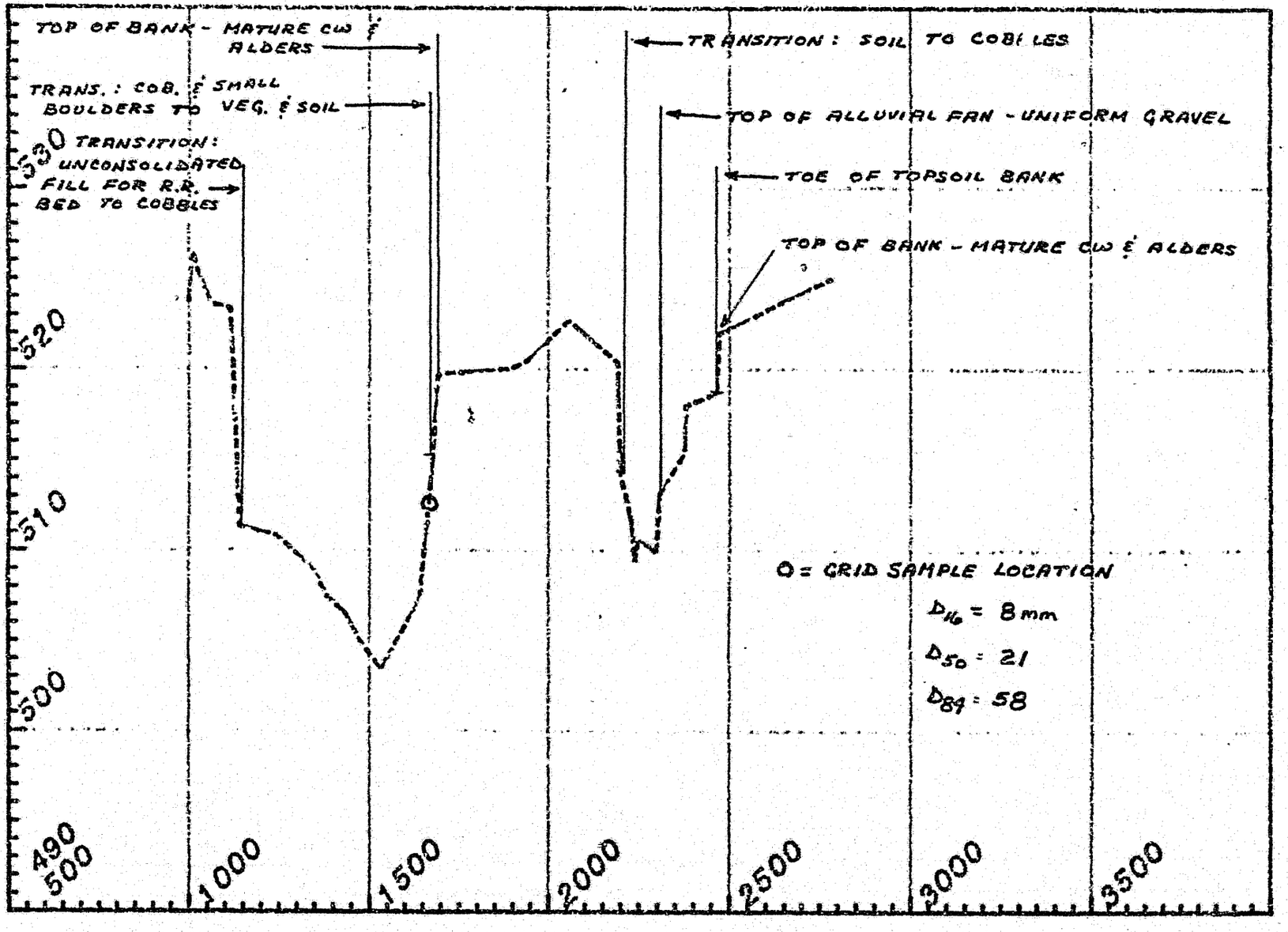
LRX - 25

DATE OF SURVEY: NOV. 7 & 17

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
15+82	540.67		LOB	CENTERLINE R.R.
16+53	536.6			TOP OF BANK - SPARSE VEG - GRASSES,
16+67	527.3			COBBLE BED
16+94	526.9			SAND & COBBLES IN SPRING BED
19+17	532.6			TRANS. COB & SAND → SPARSE VEG
19+80	530.9			TRANS. TO COBBLES
22+73	531.7			TRANS. TO SANDY SOIL
22+78	534.9			TOP OF BANK - MATURE CW & ALDER (1ST ISLAND)
24+28	536.9			HIGH PT. ON VEG. ISLAND
26+54	535.4			TOP OF BANK - HW CHAN. (VEG. & SOIL)
26+58	530.3			COBBLES & SAND - TOE OF BANK
29+21	535.4			TOP OF BANK TRANS COB & SAND → VEG.: SCATTERED CW & AL
30+00	534.4			TOP OF BANK - HW CHANNEL - WILLOWS
30+71	532.6			TRANS. TO COB & A FEW BOULDERS
31+67	535.5			TOP OF BANK TRANS. COB → VEG: (YOUNG CW & ALDERS)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 22



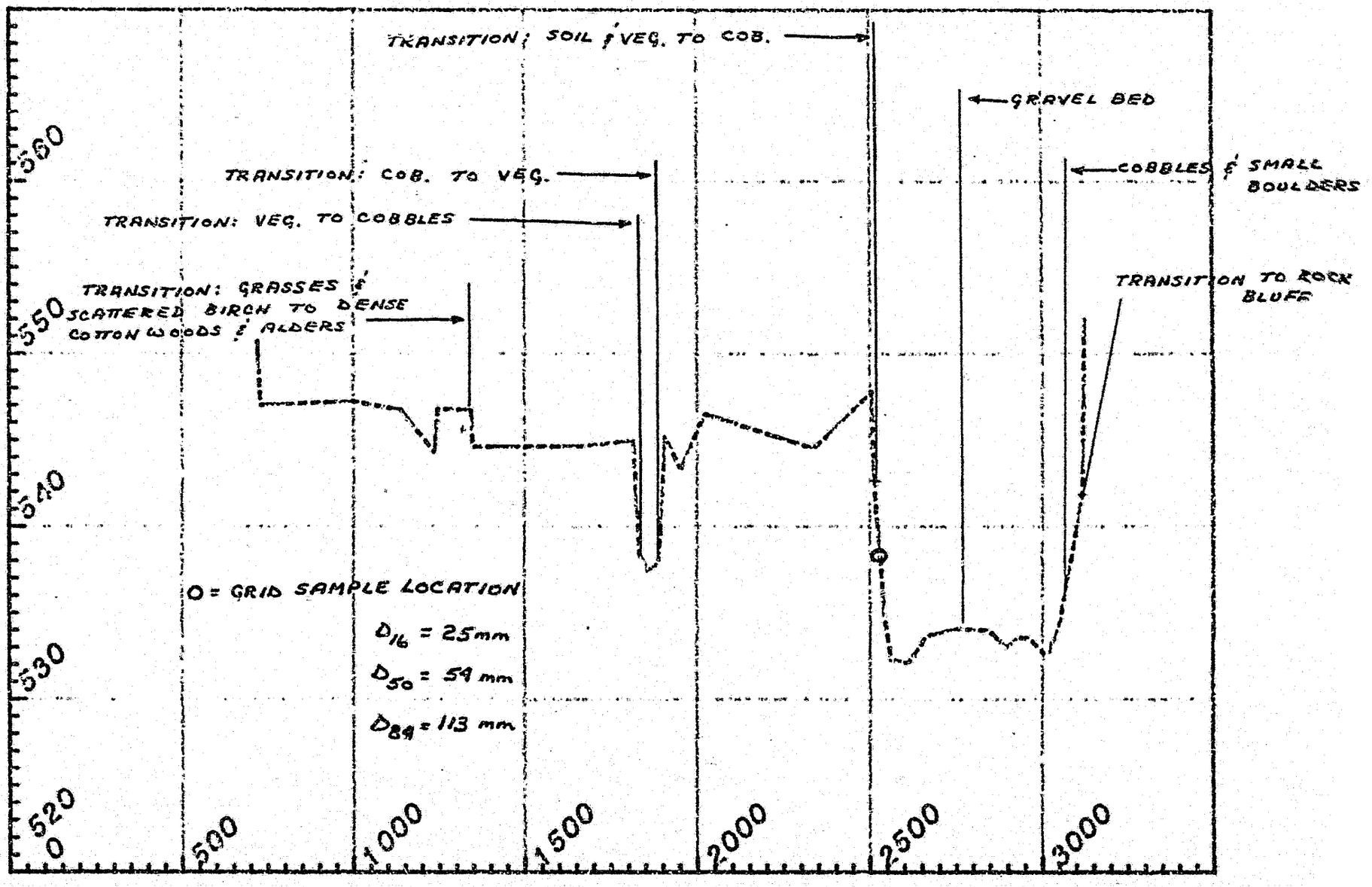
LRX - 25 - continued

DATE OF SURVEY:

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
33+13	536.2			TOP OF BANK - H.W. CHANNEL
33+25	529.2			EDGE OF VEG. TRANS. SOIL → COBBLES
34+22	534.2			TOP OF BANK - SPARSE WILLOWS
34+52	536.0			BEGIN MATURE VEG - CW.
35+81	536.2		LOB MC	TOP OF BANK - MAIN CHANNEL
35+86	530.2			TRANS. SOIL → COBBLES
37+57	529.7			GRAVEL BAR
37+69	530.0			SMALL COB. & GRAV. (UNIFORM SIZE 0.2'-0.
38+39	532.4			TRANS. TO SAND
39+03	529.6			GRAVEL BAR
39+20	530.9			MIX OF GRAV., SMALL COB. & SAND ON SHOULDER OF BAR
42+32	536.6		MC	TOE OF BLUFF BOULDERS & COBBLES SLOPE VEG = BIRCH, SPR., GRASSES., WILLOWS.
42+50	540.0			(estimated)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 26



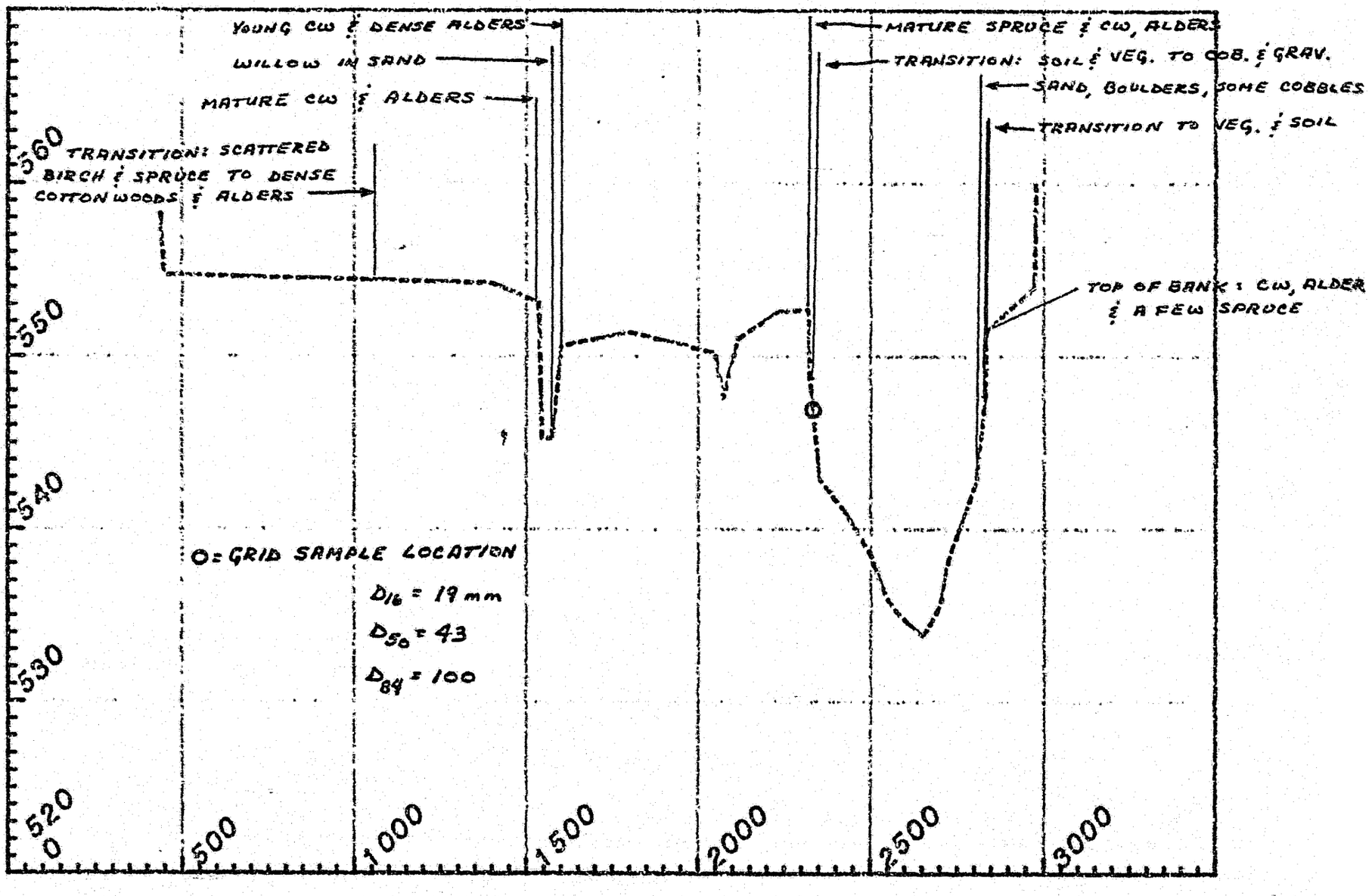
LRX - 26

DATE OF SURVEY: NOV. 7 (WATER) NOV. 17 (LAND)

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
7+20	550.7 ~~549~~		LOB	CENTERLINE R.R.
13+43	546.7		↓	TRANS. GRAS. & SCATTERED BIRCH → DENSE CW & ALDERS
18+16				
18T33	538.4			TRANS. VEG → COBBLES, TOE OF BANK
18+88	537.9			TRANS. COB → VEG (CW, ALD. SPR.)
25+07	547.8		MC	TOP OF BANK
25+13	542.4			TRANS. SOIL & VEG → COB.
27+49	534.1			GRAVEL BED (AVG. DIAM 2")
30+63	535.8			COB & SMALL BOULDER
31+18	541.58			TRANS. TO ROCK BLUFF, VEG = GRASS & CL
			MC	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 27



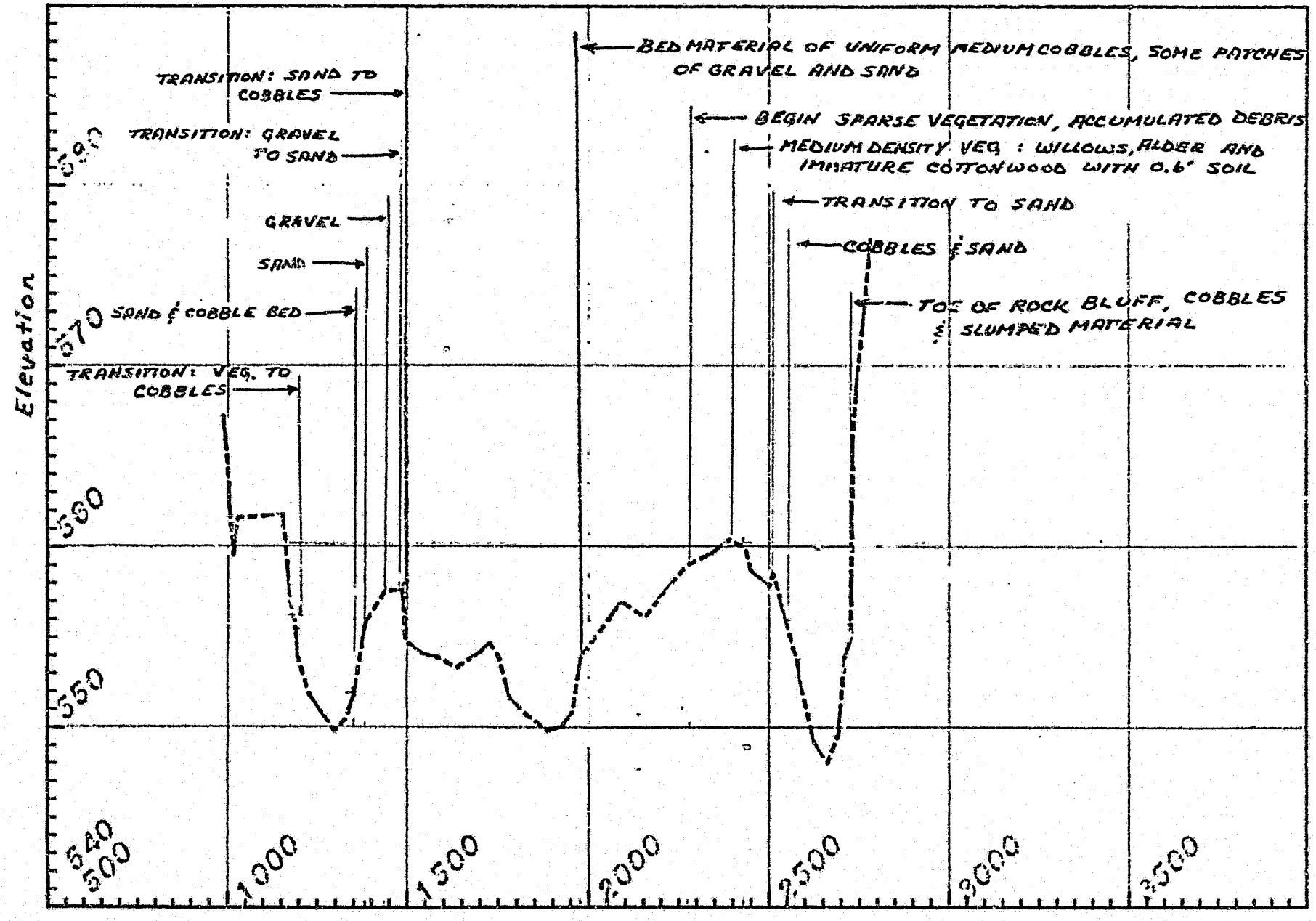
LRX - 27

DATE OF SURVEY: NOV. 7 & 17

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
4+40	558.2			CENTERLING R.R.
			LOB	
10+70	554.6			TRANS. SCATTERED BIRCH & SPR. → DENSE CW & ALDERS
15+35	553.11			TOP OF BANK - SLOUGH
				MATURE CW & ALDER
15+75	545.3			WILLOWS ON SAND
16+00	550.6			TOP OF BANK - YOUNG CW & DENSE ALD.
			LOB MC	
23+20	552.7			TOP OF BANK - MAIN CHAN.
23+23	548.8			MATURE SPR. & CW, ALDERS
				TRANS. SOIL & VEG → COB & GRAV
28+05	542.8			SAND, BOULDERS, SOME COBBLES
28+32	547.7			TRANS. TO VEG & SOIL
28+35	551.5		MC ROB	TOP OF BANK - CW, ALDER, A FEW SPR
29+75	554.0			TOE OF TERRACE
30+20				
~~30+50~~	560.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 28



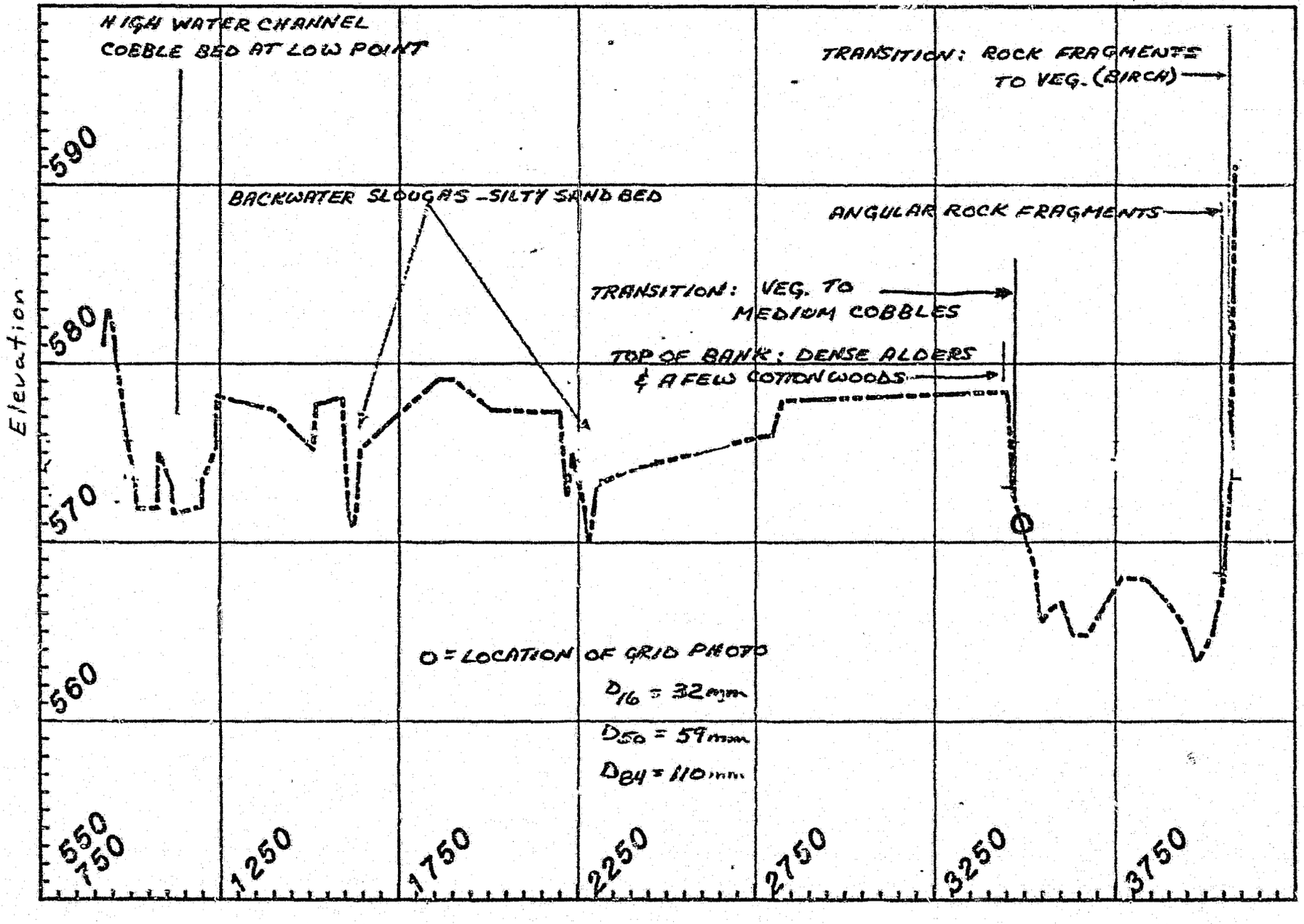
LRX - 28

DATE OF SURVEY: NOV. 7th

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+87	567.2			CENTERLINE R.R
11+53	561.8		LOB	TOP OF BANK SCATTERED ALD, CW & SPR w/ FERNS
11+78	556.2			TRANS. VEG → COB
13+50	551.81			SAND & COB.
13+81	555.8			SAND
14+38	557.6			SHOULDER OF MID-CHAN. BAR TRANS. SAND → GRAV.
14+86	557.6		LOB MC	TRANS. GRAV → SAND TOP OF BANK HW CHAN.
14+94	554.8			TRANS. SAND → COB.
17+26	554.7			TOP OF BANK - MAIN CHANNEL COB. BED
19+78	553.93			UNIFORM MED COBBLES, SOME GRAV & SAND
21+52	~~556.1~~ 5561			LARGE COB & SAND (IN BANDS PARALLEL TO SHORELINE)
22+72	559.0			BEGIN SPARSE VEG.
23+44	559.7			ABUNDANT DEBRIS ACCUMULATED NEAR TRANS. TO MATURE VEG - WIL. & CW
23+90	560.4		MC ROB	HIGH PT. ON ISLAND - [redacted] VEG: WIL, YOUNG ALDERS, ACCUMULATED DEBRI
24+33	559.4			EDGE OF VEG - MED. DENSITY TRANS. TO SPARSE YOUNG WILLOW
25+03	557.8			TRANS. TO ~~SPARSE YOUNG WILL~~ SAND
25+66	554.4			COB & SAND
27+26	555.0		ROB	TOE OF ROCK BLUFF COB, SLUMPED MATERIAL
27+90	557.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 29



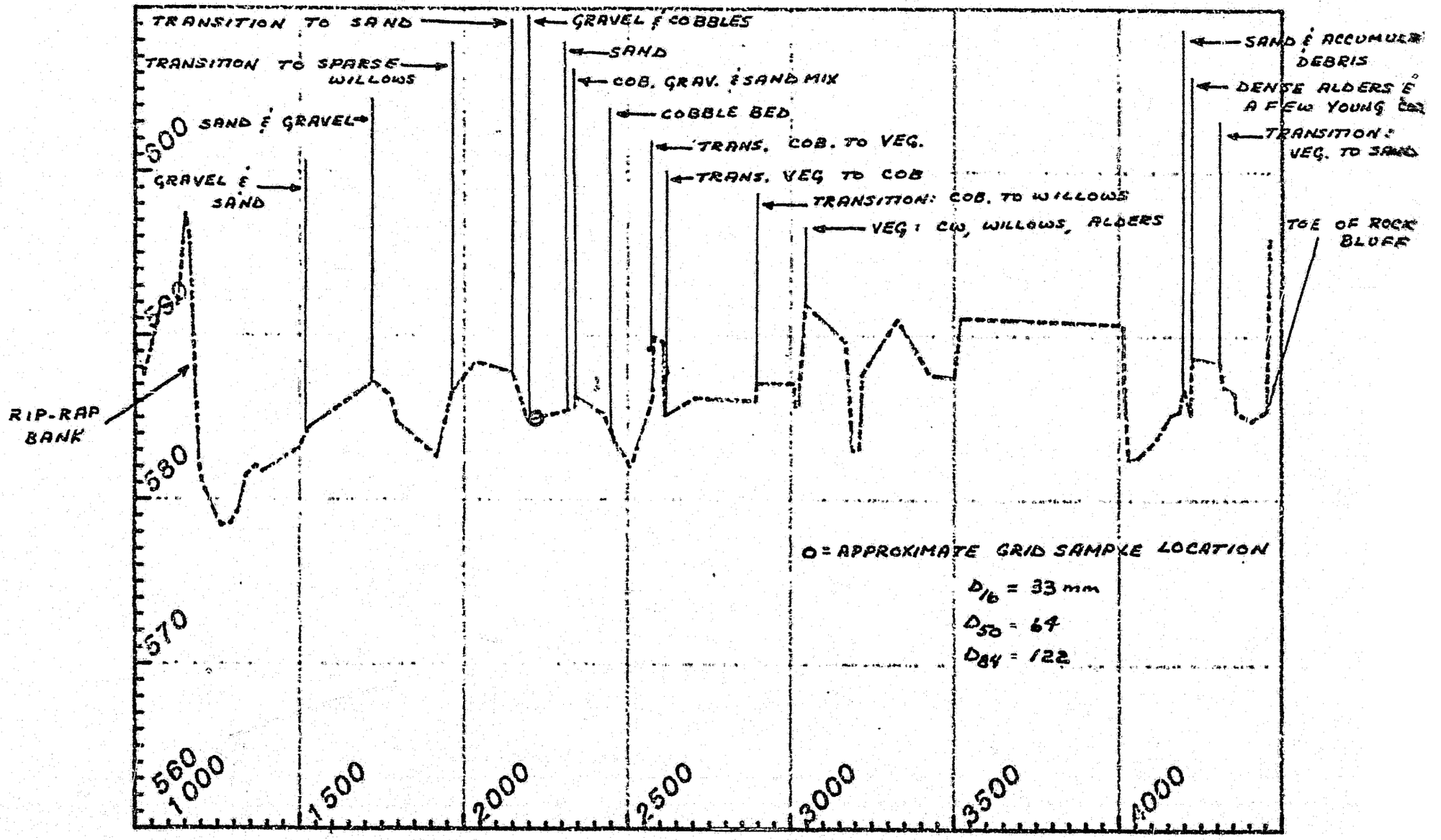
LRX - 29

DATE OF SURVEY: NOV. 6 (WATER) NOV. 17 (LAND)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+40	583.1			CENTERLINE - ALASKA RAILROAD
10+00	574.9		LOB	WILLOWS
11+20	571.6			COBBLES IN HIGH WATER CHANNEL
12+00	572.0			BEGIN SPARSE VEG - WILLOW & SANDY SOIL
12+40	578.2			TOPSOIL & VEG: MATURE CW. & ALD.
14+00	577.4			CW, ALD. & SPR.
16+20	570.8			BACKWATER SLOUGH - LOW PT - SILTY SAND
16+52	575.70			MATURE CW - UP TO 5' DIAM. & ALDERS
18+59	579.1			ALDERS, FEW COTTONWOODS
20+08	577.4			LARGE BIRCH, A FEW SPRUCE
22+80	569.9			LOW PT. IN BACKWATER SLOUGH - SILTY SAND
23+03	573.2			ALD. & MATURE CW. (UP TO 5' DIAM).
			LOB	
34+99	578.4		MB	TOP OF BANK - DENSE ALDERS, A FEW CW.
34+66	572.9			TRANS. VEG → MED. COBBLES
40+52	568.36			ANGULAR SHALE FRAGMENTS (UP TO 2' DIAM.)
40+70	573.5			TRANS. RX. FRAG. → VEG. (BIRCH)
40+80	580.0		MC	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 30



LRX - 30

DATE OF SURVEY: NOV. 6 (WATER) NOV. 18 (LAND)

	STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
	11+50	597.4			CENTERLINE R.R.
	11+64	595.9		MC	BEGIN RIP-RAP (MAX. DIAM. 6"; AVG. D. 2")
	15+27	584.4			GRAVEL & SAND
	17+25	587.2			TOP OF BANK - HIGH PT ON SAND & GRAV.
HW CHAN	19+61	586.5			TRANS. TO SPARSE WIL. (TOP OF BANK)
	21+49	587.7			TRANS TO SAND
	21+92	584.8			GRAV & COB
	23+39	585.6			SAND
	23+90	586.3			COB., GRAV & SAND
	24+98	584.2			COB.
	25+80	589.9			TRANS. COB. → VEG (YOUNG CW & SPR SEEDLINGS)
	26+10	589.6			TOP OF BANK
HW CHAN	26+13	585.1			VEG → COB.
	28+95	587.1			TRANS. TO WIL. (TOP OF BANK)
	30+95	591.9		MC ROB	TOP OF BANK - CW., WIL. ALD. (MAIN CHAN.)
	31+68	589.6			TOP OF BANK
	31+88	583.0			TRANS. VEG. → ICE COVERED CHANNEL MATERIAL ?
LW CHAN	32+08	583.0			CHANNEL MATERIAL → VEG.
	32+19	587.7			TOP OF BANK
	33+27	591.0			MATURE CW, SPR & ALDER - HIGH PT.
	35+01	587.4			LOWPOINT
	35+21	591.1			SHOULDER - VEG.

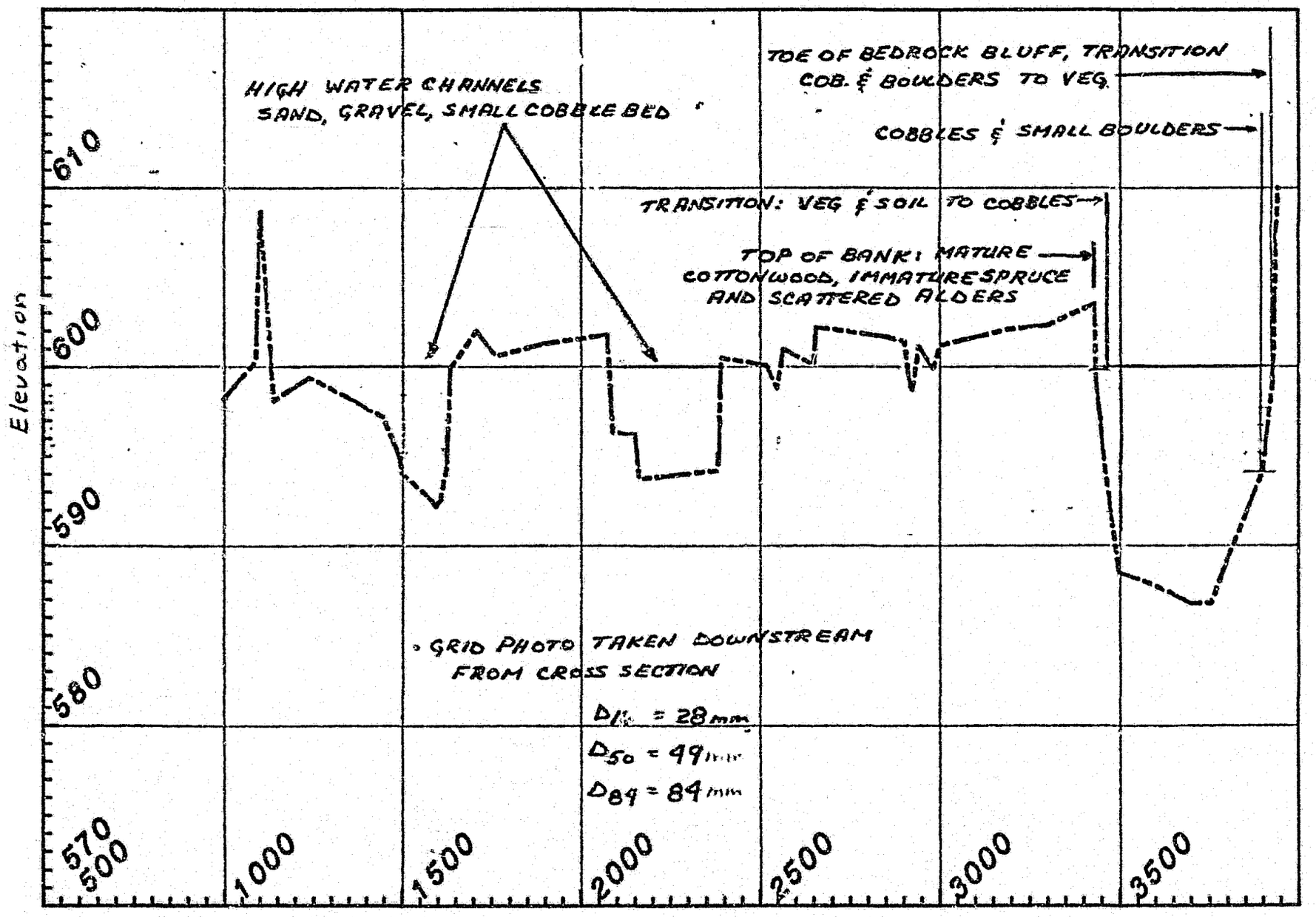
LRX - 30 - continued

DATE OF SURVEY:

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
90+19	590.7			TOP OF BANK - SIDE CH.
90+19	585.0			TRANS. VEG → CHAN. MATERIAL (? UNDER I[redacted]
91+99	586.8			SAND & ACCUMULATED DEBRIS ON EDGE OF ISLAND
92+25	588.7			HIGH PT. - DENSE ALDERS, A FEW YOUNG CW
93+11	588.3			TRANS. VEG → SAND
93+55	586.5			SAND W/ ACCUMULATED DEBRIS (LARGE C[redacted]S)
94+56	585.97			TOE OF NEARLY VERTICAL ROCK BLUFF
99+61	596.0		ROB	VEG: SCATTERED SPRUCE & BIR.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 31



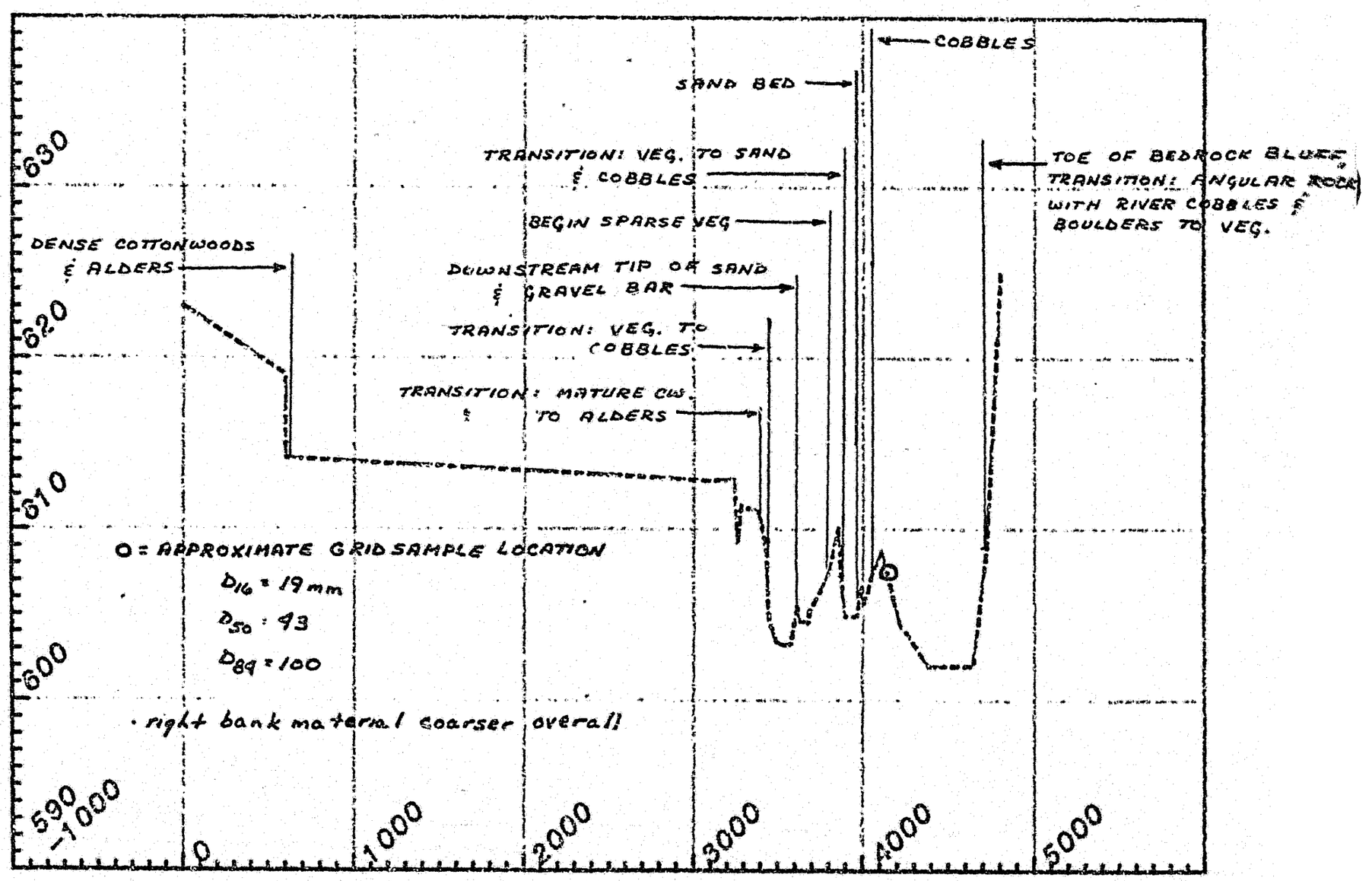
LRX - 31

DATE OF SURVEY: NOV. 6 (WATER) NOV. 18 (LAND)

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
11+05	608.7			CENTERLINE R.R.
11+23	603.5		LOB	
11+91	598.1			DENSE VEG - CW & ALD.
14+99	597.2			EDGE DENSE VEG. - TOP OF BANK
				BEGIN SAND & COBBLES
HIGH WATER CHANNEL 15+81	592.55			SAND
16+07	592.55			SAND & COBBLES
16+94	599.9			VEG = ALD., SCATTERED SPRUCE & CW.
20+73	601.8			TOP OF BANK
20+88	596.3			TRANS. VEG → SAND
HIGH WATER CHANNEL 21+62	593.7			GRAV & COBBLES
23+81	594.2			TRANS. TO WILLOW & YOUNG CW
23+91	600.5			TOP OF BANK
25+18	600.1			ALDERS
25+48	598.8			TRANS. : ALD → MED. TO LARGE CW.
29+13	599.7			MATURE CW → DENSE ALDERS
29+82	599.9			ALD. → MATURE CW w/ SCATTERED ALD. & SP.
34+32	603.5		LOB MC	TOP OF BANK
34+39	599.8			TRANS. VEG & SOIL → COBBLES
38+98	594.05			COB & BOULDERS
39+27	599.1			TRANS. COB & BOUL. → VEG (CW, ALD., REL SPRUCE
				TOE OF BLUFF
39+40	610.0		MC	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 32



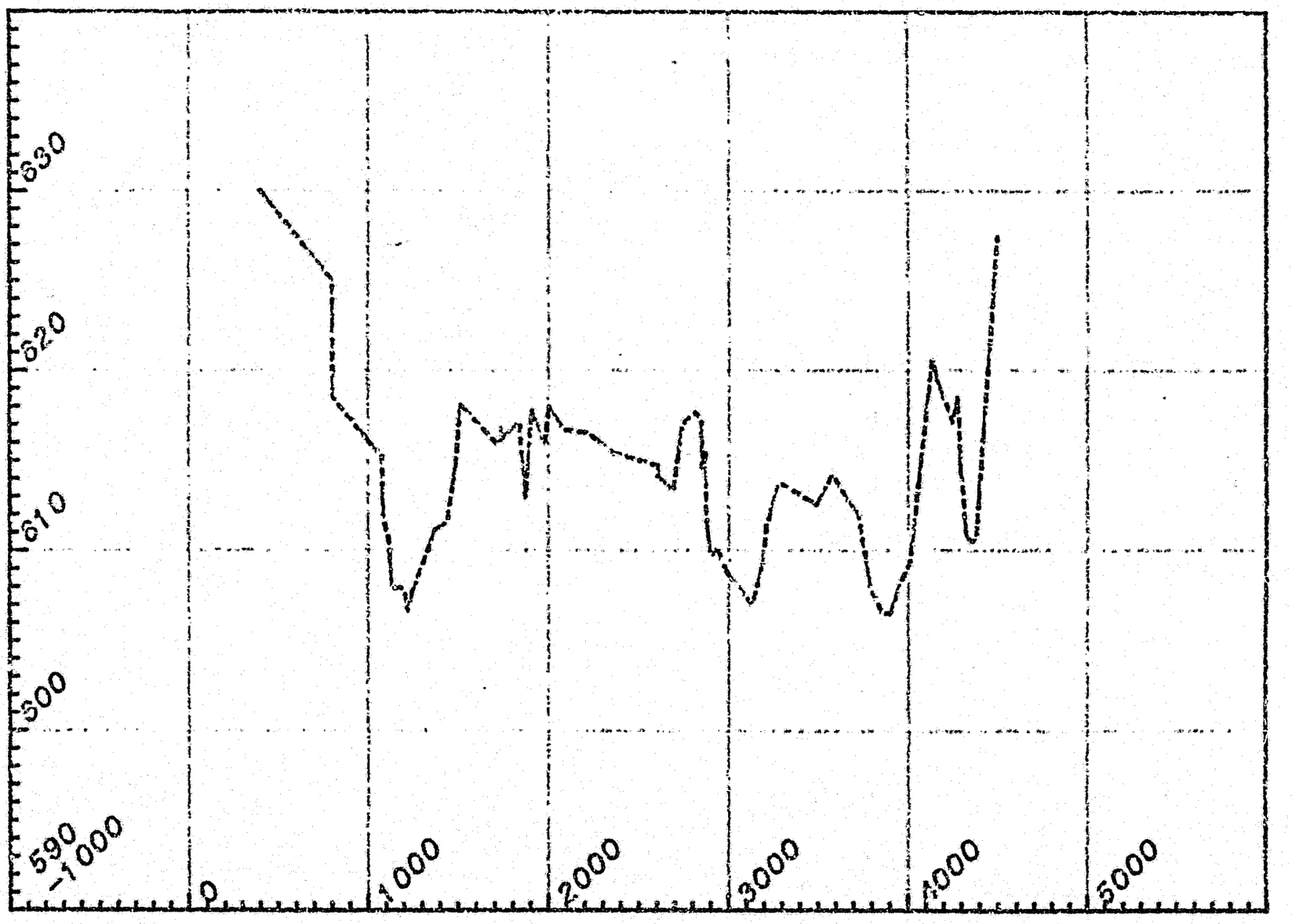
XRX - 32

DATE OF SURVEY: NOV. 6 (WATER) NOV. 18 (LAND)

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
0+00	623.0			CENTERLINE OF ALASKA RAILROAD
6+00	619.0			SPARSE BIRCH, SPRUCE & GRASSES
6+02	619.1			TRANSITION TO DENSE CW. & ALDERS
33+91	611.0			TRANSITION = MATURE CW. TO ALDERS
34+33	608.7			TRANSITION: VEG. TO COBBLES
36+11	605.5			DOWNSTREAM TIP OF SAND & GRAVEL BAR
37+90	607.2			BEGIN SPARSE VEG. - WILLOWS
38+54	610.1			HIGH POINT ON ISLAND
38+72	607.2			TRANSITION = VEG. TO SAND & COBBLES
39+80	606.3			SAND BED
40+46	607.1			COBBLES
47+21	608.9			TOE OF BEDROCK BLUFF, TRANSITION: ANGULAR ROCK WITH RIVER COBBLES & BOULDERS TO VEG. (COTTONWOODS, ALDERS, A FEW SPRUCE)
98+00	625.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 33



* SEE ATTACHED SUMMARY SHEET FOR DEFINITION OF VEGETATION & BED MATERIAL

LRX - 33

DATE OF SURVEY: NOVEMBER 1, 1980

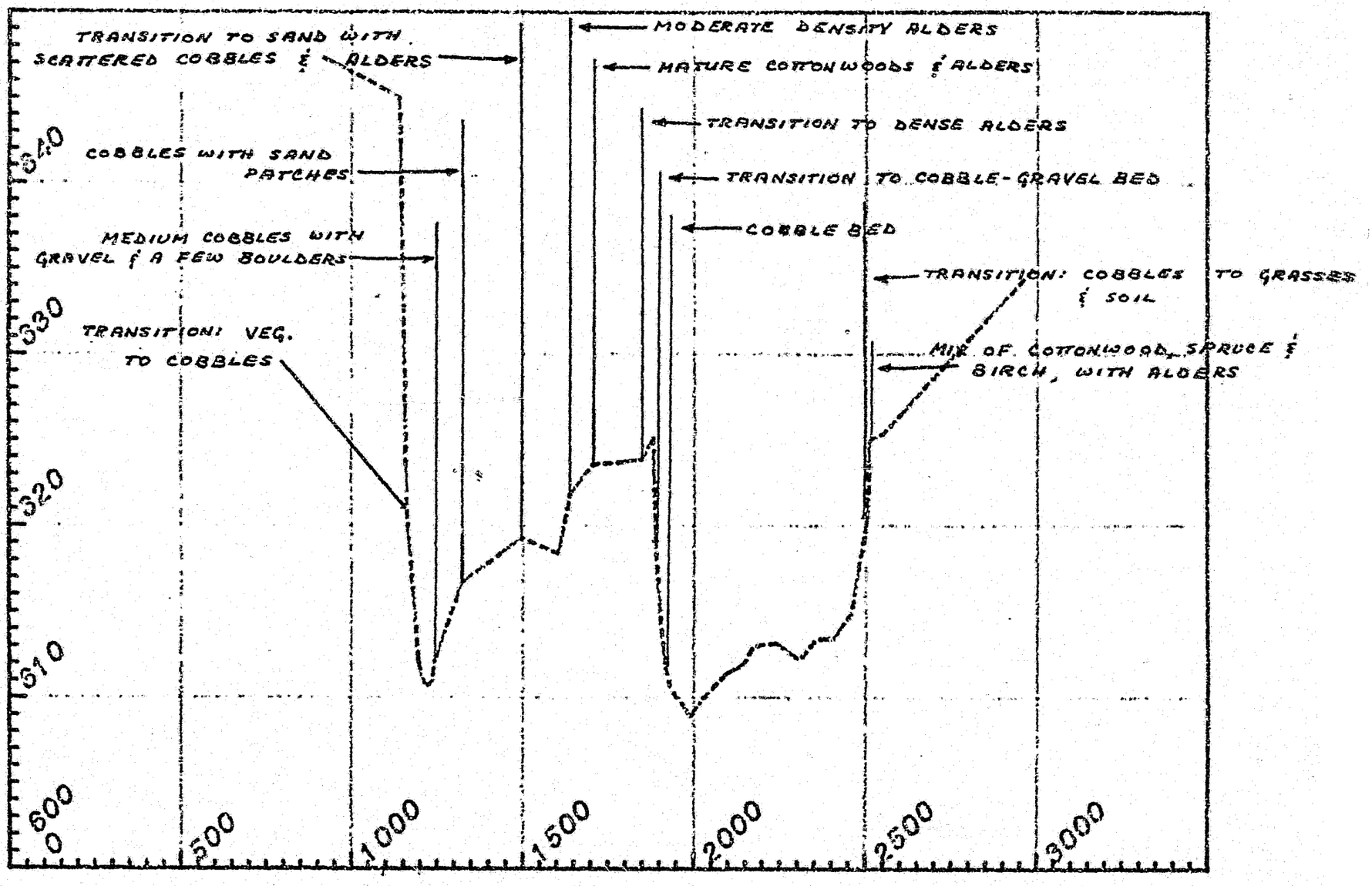
STATION	ELEV	MANNING'S 'n'		DESCRIPTION
09+00	630.0			CENTERLINE R.R.
08+00	625.0		LOB	BIRCH, WILLOW & GRASS, SPARSE SPRUCE
08+03	618.5			TRANS TO YOUNG CW & DENSE ALDERS
10+77	615.2			TOP OF BANK - YOUNG CW & DENSE ALD.
10+84	611.9			TRANS. VEG → SAND & SPARSE VEG.
11+12	610.6			TRANS.. TO COB.
12+41	607.55			SMALL - MED. [illegible]
13+72	611.1			TRANS TO SAND & SPARSE WIL.
19+42	611.6			TRANS. TO DENSE ALD., WIL., CW.
15+12	618.1			TRANS. TO MATURE CW & ALD.
17+15	615.9			CW, ALD. & A FEW SPR.
18+70	612.9			ALDERS - LOW PT. - REMNANT
19+81	615.8			TRANS. TO CW & SPR. MIX.
20+03	618.0			CW, ALD. SCATTERED SPR.
20+86	616.7			SPR., ALD. SCATTERED CW
26+07	614.7			SPR., ALD - NO CW
28+18	617.7		LOB MC	SPR., ALD., A FEW BIRCH (BEGIN MAIN. CH.)
28+76	612.9			TRANS. VEG & SOIL → SAND
34+92	612.5			LOW PT. - COBBLES IN SAND

DATE OF SURVEY: NOVEMBER 1, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
35+80	614.2			FALLEN TREES ACCUMULATED AMONG SPARSE YOUNG WIL & SAND
37+93	608..01			SAND & COBB.
38+57	606.5			SMALL COB. BED
41+34	620.6		MG ROB	TRANS. COB. → TOPSOIL ; VEG
41+60	619.5			MATURE CW, SCATTERED SPR. & ALD.
42+50	617.1			ALDERS
42+96	614.4			TRANS. TO SAND
95+37	610.69			COB. & GRAV.
94+06	614.0			SAND & COB → VEG.: ALD. & GRASS.
95+00	627.5		ROB	TOE OF NEARLY VERTICAL BEDROCK BLUFF

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 34



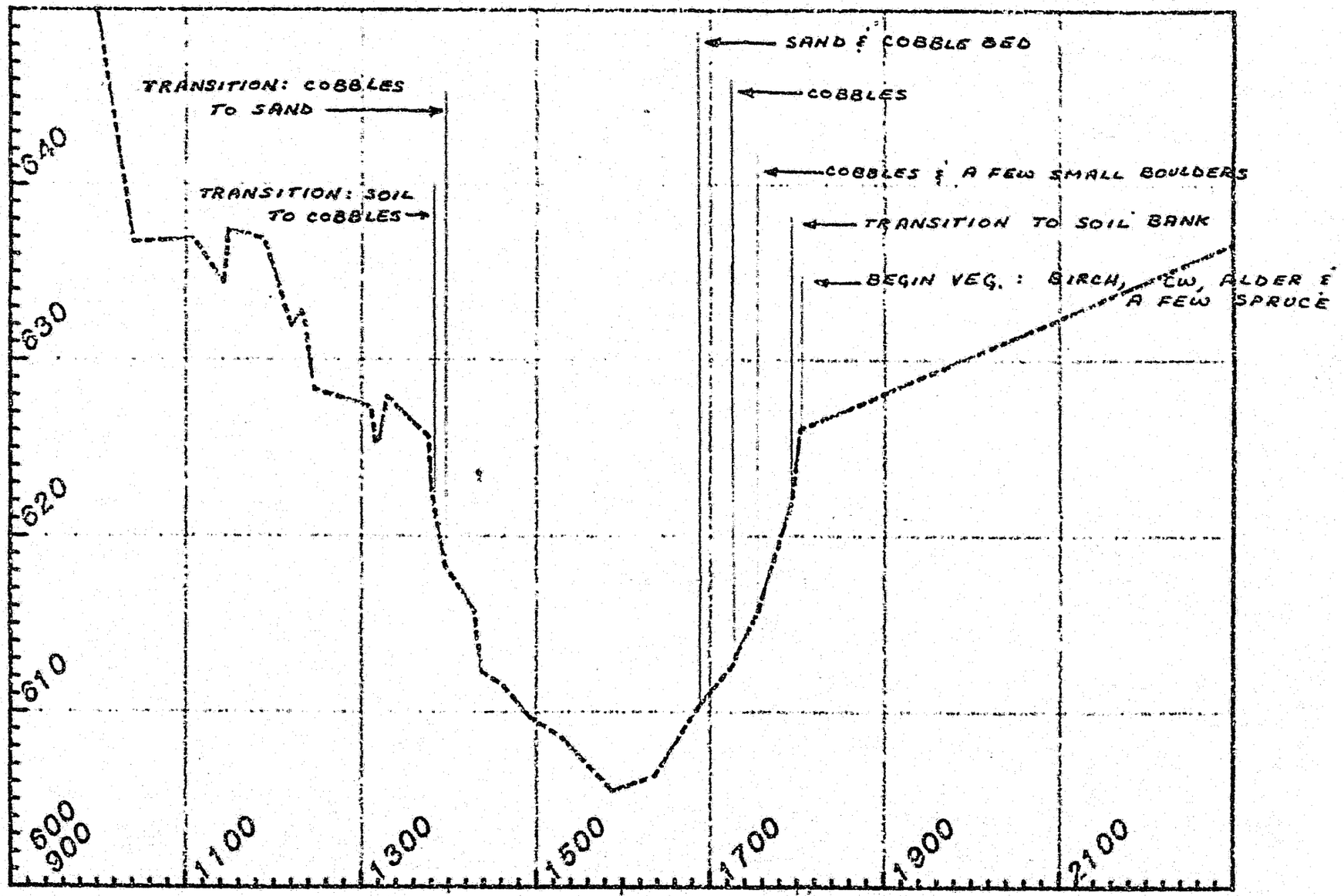
LRX - 34

DATE OF SURVEY: OCTOBER 30, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
7+20	647.3			CENTERLINE R.R.
11+95	642.0		LOB	TOP OF BANK
11+60	621.0			TRANS. VEG → COB.
12+42	611.98			MED. COB w/ GRAV. & A FEW BOULD.
13+24	616.7			COB w/ PATCHES OF SAND
14+99	619.3			TRANS. TO SAND, SCATTERED COB. & SPARSE ALDERS
16+40	621.9			MOD. DENSITY ALDER
17+06	623.6			MATURE CW & ALDERS
18+50	623.9		LOB	TRANS. TO DENSE ALD.
18+83	625.2		MC	TOP OF BANK
18+89	619.1			TRANS. TO COB. & GRAV.
19+20	611.7			COB. BED
25+04	620.5			TRANS. TO GRASSES & TOPSOIL
25+11	625.0		MC ROB	MIX OF SPR. CW & BIRCH w/ ALD. TOP OF BANK
29+87	635.0		ROB	LIMIT TO ROB

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 35



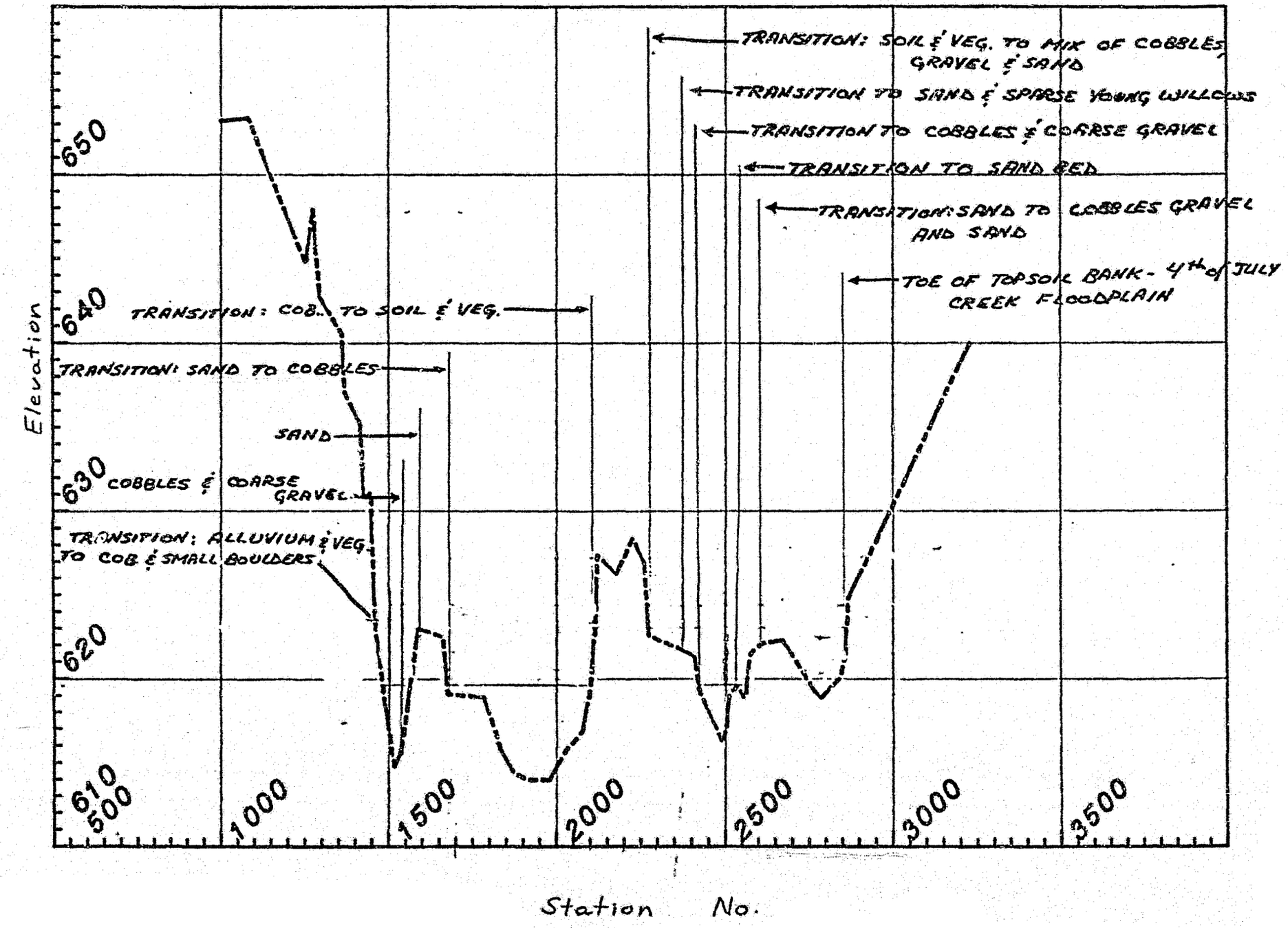
LRX - 35

DATE OF SURVEY: OCTOBER 30, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
9+86	651.0			CENTERLINE R.R.
10+92	636.7		LOB	TOE OF R.R. - DENSE ALDERS
13+67	626.5		LOB MC	TOP OF BANK
13+81	622.4			TRANS.. SOIL → COB..
13+96	618.3			TRANS. TO SAND
14+30	615.73			SILTY SAND
14+63	611.5			CLEAN SAND
14+93	609.7			SAND
16+87	610.3			SAND & COB.
17+28	612.8			COB.
17+56	615.86			COB. & A FEW SM BOULD.
17+94	622.0			TRANS. TO SOIL BANK
18+09	626.1		MC ROB	BEGIN VEG : BIRCH, CW, ALD. & A FEW SPR (TOP OF BANK)
23+16	637.0		ROB	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 36



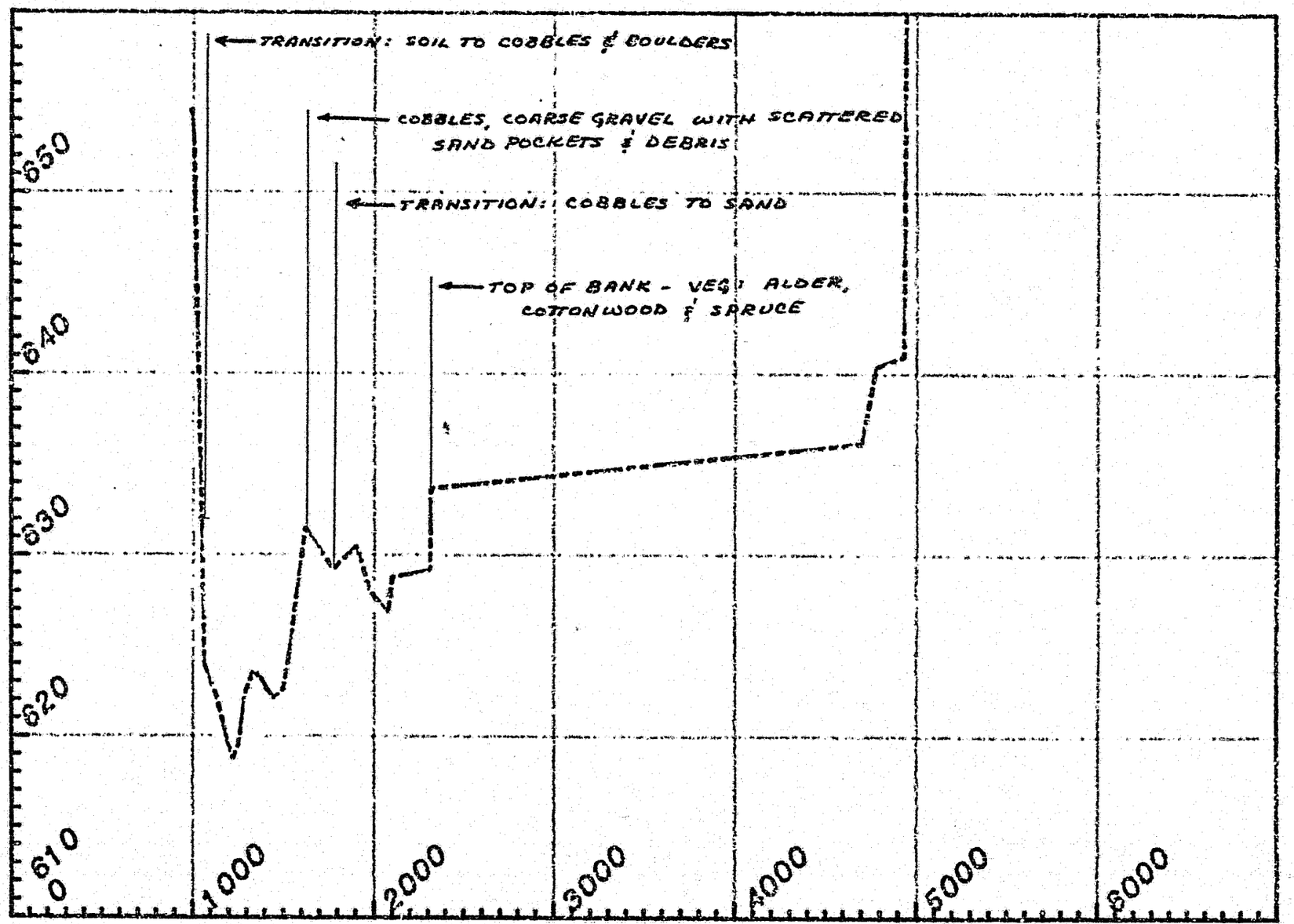
LRX - 36

DATE OF SURVEY : OCTOBER 30, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
12+75	647.9			CENTERLINE R.R.
19+48	631.1		MC	TOP OF BANK - YOUNG BIRCH
19+61	623.3			TRANS. ALLUVIUM & VEG → COBB. & SM. BOULD.
15+36	615.6			COB & COARSE GRAV.
15+88	623.0			SAND - SHOULDER OF MID-CHANNEL BAR
16+77	619.1			TRANS. SAND → COBBLES
21+16	623.3			TRANS. COB → SOIL & VEG.
21+22	627.4			TOP OF BANK
22+27	628.4		MC	HIGH PT. ON ISLAND - LIMIT MAIN CHANNEL
22+74	622.6		ROB	TRANS. SOIL & VEG. → COB, GRAV. & SAND
23+88	621.6			TRANS. TO SAND & SPARSE YOUNG WILLOWS
24+22	619.4			TRANS. TO COB. & COARSE GRAV.
25+37	619.6			TRANS. TO SAND BED
26+10	622.1			TRANS. SAND → COB, GRAV., SAND BED
28+60	621.5			TOE OF TOPSOIL BANK - 4th of JULY FLOODPLAIN
28+68	629.8			TOP OF BANK
32+30	640.0		ROB	END OF [illegible] ITEM

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 37



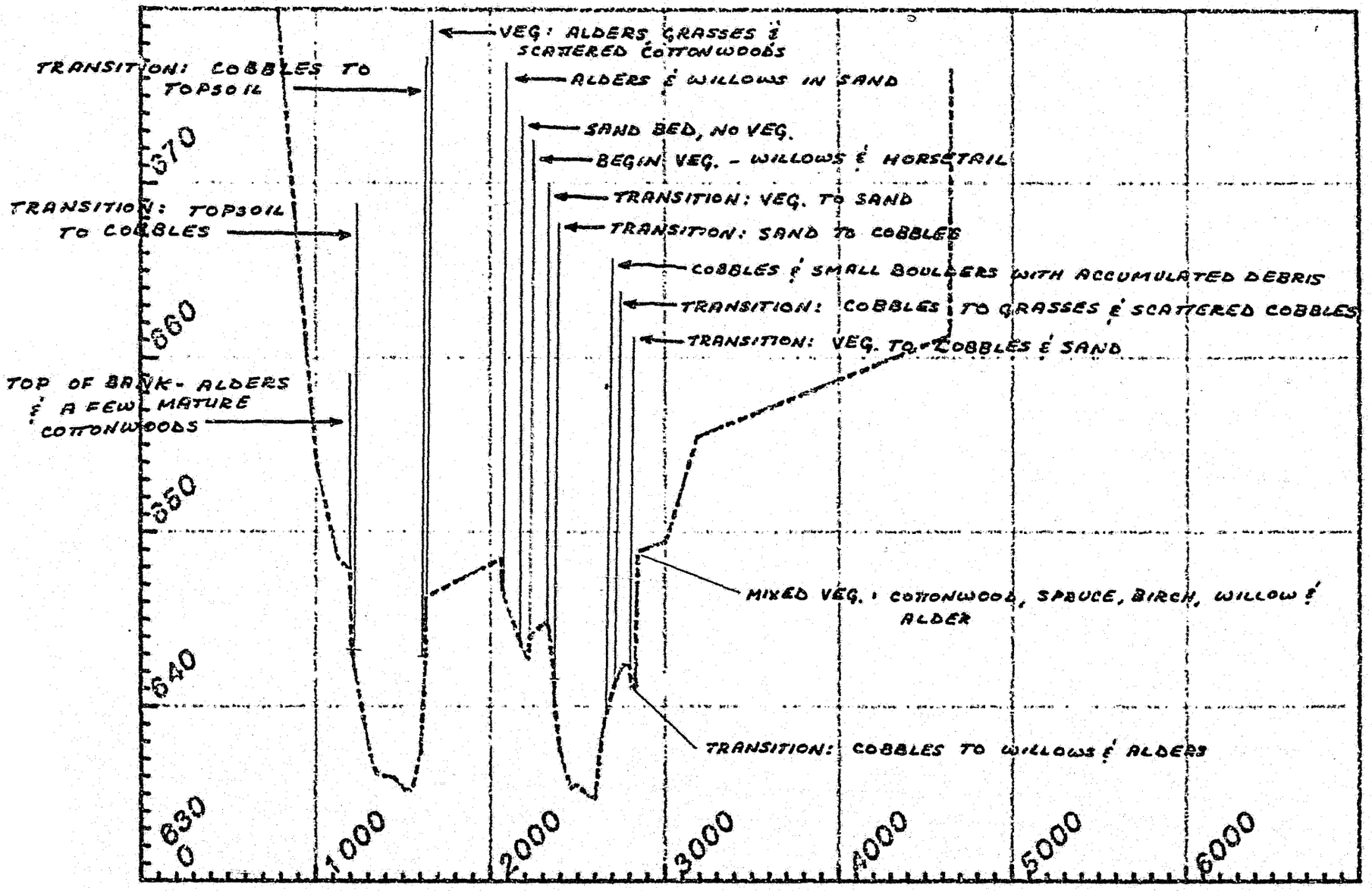
LRX - 37

DATE OF SURVEY: OCTOBER 29, 1980

STATION	ELEV	MANNINGS 'n'		DESCRIPTION
10+09	650.0		MC	SHOULDER OF BANK
10+98	631.9			TRANS. SOIL ⟶ COB & BOULD.
16+20	631.5		MC ROB	COB, LARGE GRAV. w/ SCATTERED SAND POCKET & DEBRIS (TOP OF BANK)
17+74	629.2			TRANS COB ⟶ SAND
23+16	633.7		ROB	VEG - CW, ALDER, SPR. TOP OF BANK

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 38



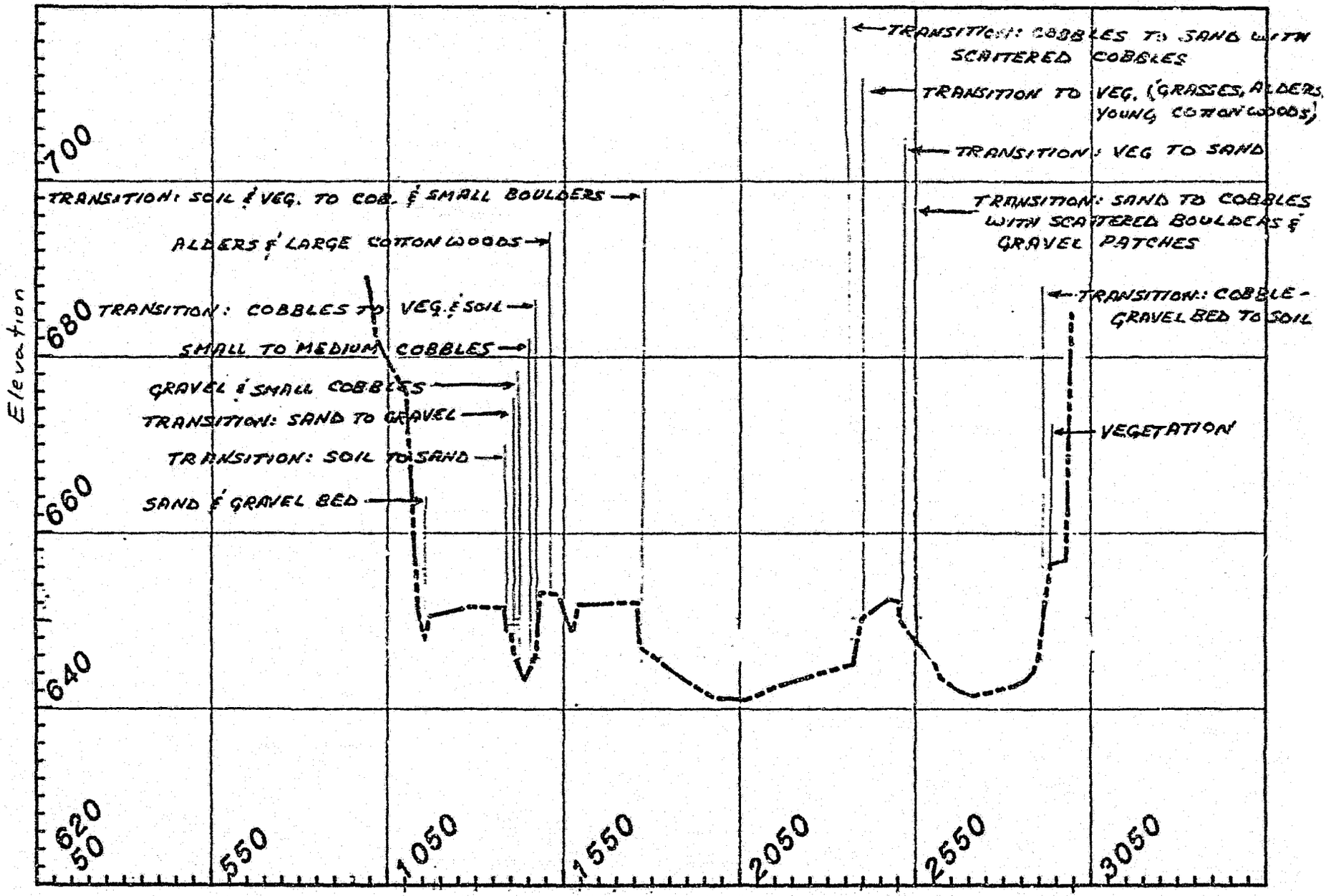
LRX - 38

DATE OF SURVEY: OCTOBER 29, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
7+70	681.5			CENTERLINE R.R.
10+00	654.3			G.S.
11+99	647.7			TOP OF BANK - ALDERS & A FEW MATURE CW.
12+05	643.1			TRANS. TOPSOIL → COB. - TOE OF BANK
16+31	642.8			TRANS. COB → TOPSOIL - TOE OF BANK
16+34	646.3			VEG: ALD., GRASS., SCATTERED CW.
20+70	646.7		LOB MC	ALD. & WIL., SAND - (TOP OF BANK)
21+78	643.6			SANDY CHAN.
22+29	644.0			BEGIN VEG - WILLOW & HORSETAIL
23+34	644.9			TRANS. VEG → SAND.
23+66	641.5			TRANS. SAND → COB.
26+57	639.31			SMALL TO LARGE COB & SM. BOULDERS. ALSO ACCUMULATED DEBRIS
27+16	641.3			LOG JAM, ALSO, TRANS. COB → GRASS & SCATTERED COB.
28+02	642.3			TRANS. VEG → OVERFLOW CHAN. W/ COB & SAND BED
28+32	641.0			TRANS. COB → WIL & ALD.
28+51	648.9		MC	VEG MIXED CW, SPR. BIR. GRAS., WIL, ALD. TOP OF TERRACE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 39



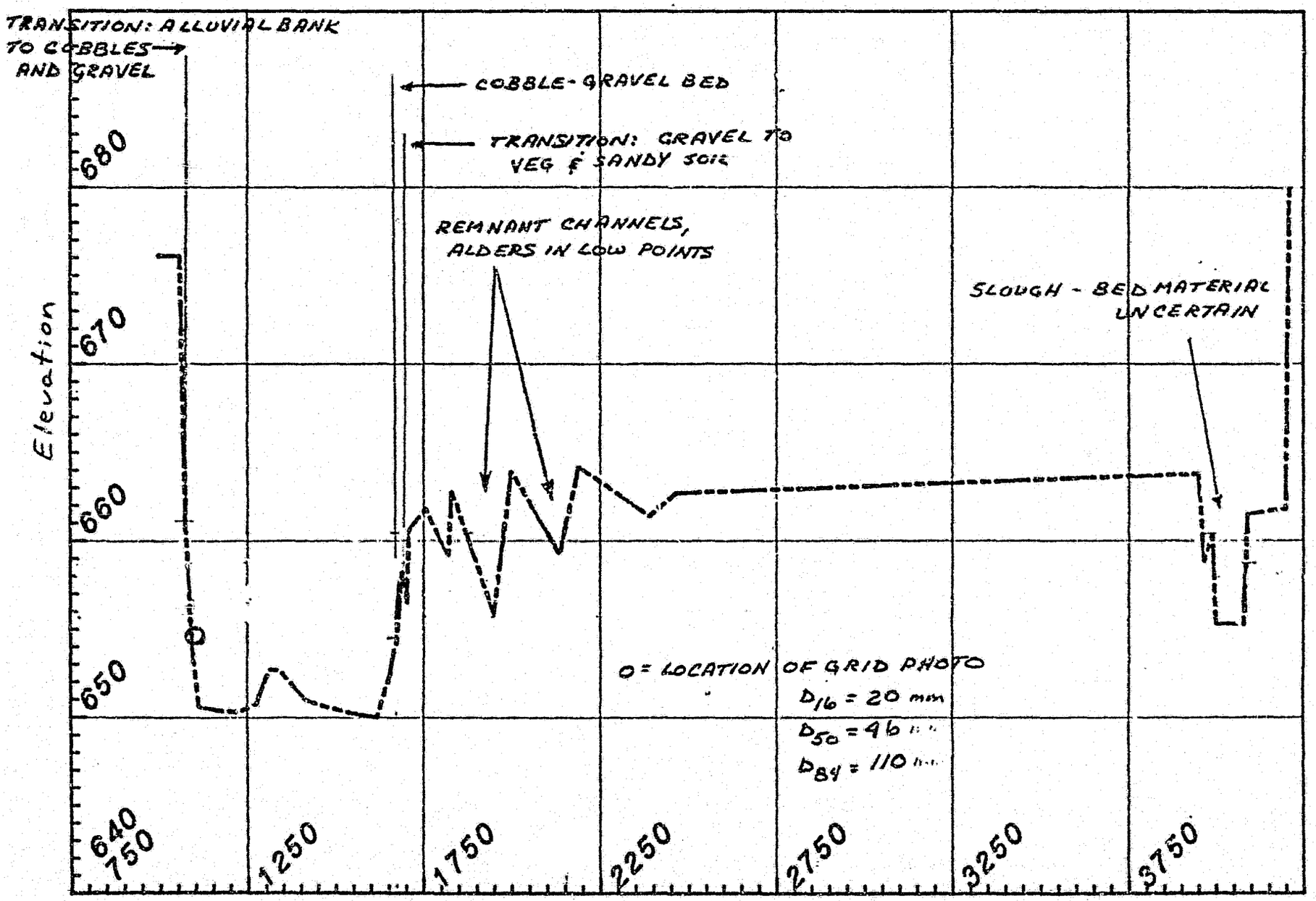
LRX - 39

DATE OF SURVEY: OCTOBER 28

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
9+90	689.0			CENTERLINE R.R.
11+02	675.9			TOP OF TERRACE - ALD & BIRCH
			LOB	
11+38	651.4			TOE OF TERRACE - ALDERS
11+56	647.9			CENTER OF FLOWING CREEK - SAND & GRAV. BED
13+89	648.6			TRANS. SOIL → SAND
14+08	646.4			TRANS. SAND → GRAVEL
14+25	644.67			GRAV & SM. COBBLES
14+56	644.67			SM - MED. COBBLES
14+72	646.4			TRANS. COB → VEG & SOIL (ALDERS)
15+35	653.0			ALD. & LARGE COTTONWOODS
			LOB	
17+60	652.1		MC	TOP OF BANK - GRASS, ALD, A FEW CWS.
17+66	647.0			TRANS. VEG & SOIL → COB. & SM. BOULDER. (LEVEL BEACH, NO BREAKS IN SLOPE)
19+78	641.2			COBBLE BED
23+73	645.1			TRANS. COB. → SAND W/ SCATTERED COBBLES
23+99	650.3			TRANS. TO VEG. (GRASS, ALD, YOUNG CW,)
25+06	650.1			TRANS. VEG. → SAND
25+55	647.6			TRANS. SAND → COB. W/ A FEW SM. BOULD & SOME GRAV PATCHES
29+27	649.0			TRANS. COB - GRAV. BEACH → SOIL
			MC	
29+35	656.4		ROB	TOP OF BANK - VEG.
29+80	657.0		ROB	TOE OF TERRACE (RK. BLUFF)
29+90	675.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 40



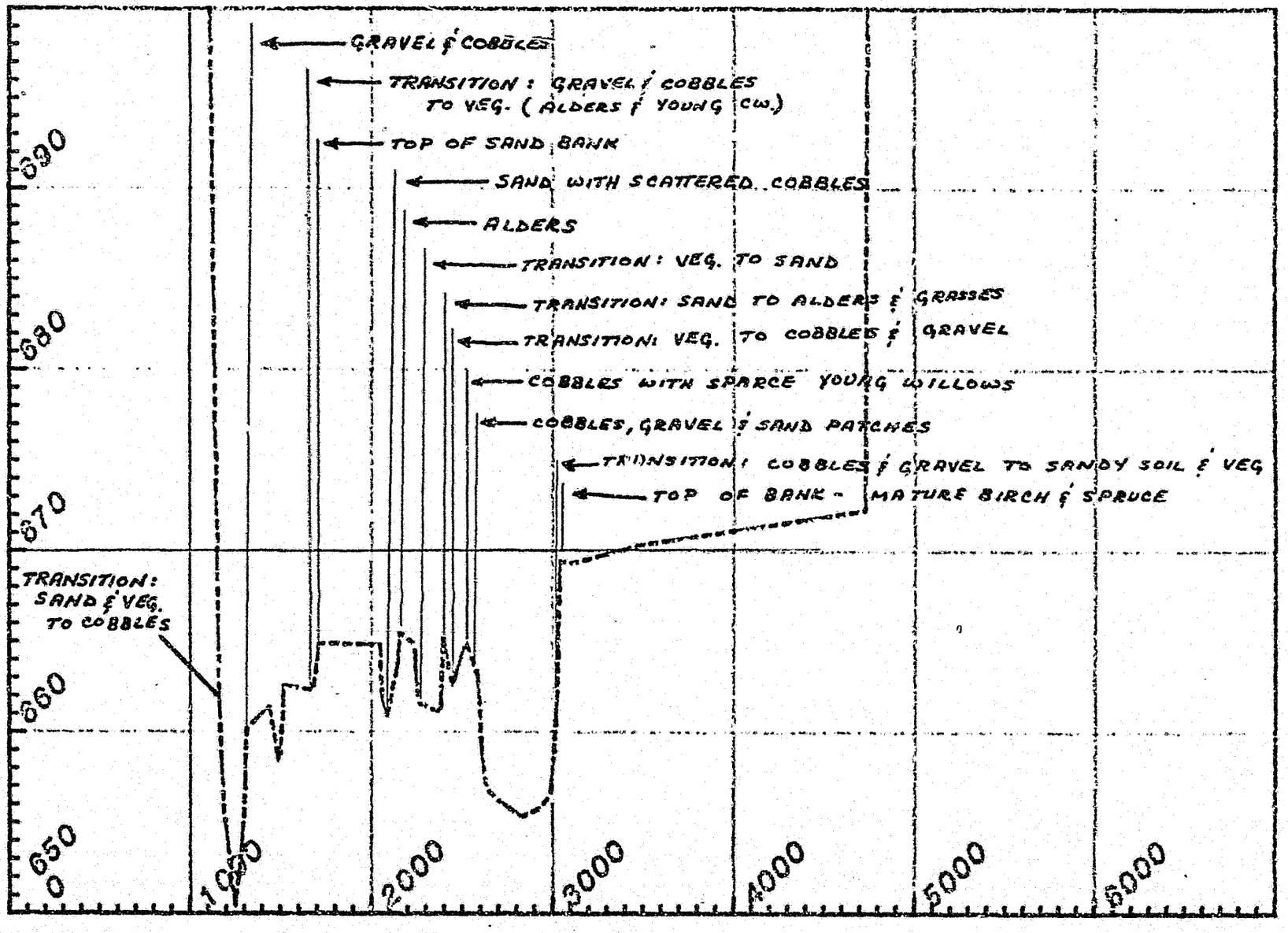
LRX - 40

DATE OF SURVEY: OCTOBER 20, 1980
MARCH 25, 1981 (RIGHT EXTENSION)

STATION	ELEV.	MANNING'S 'n'	VO LOR	DESCRIPTION
10+58	676.1		MC	TOP OF BANK - MATURE BIRCH & SPRUCE
10+74	661.2			TRANS. ALLUV. → COBBLE BEACH
10+91	653.8±			COB. GRAV. A FEW SMALL BOULDERS
16+72	654.3±			EVEN MIX: COB & GRAV
16+87	658.2			GRAVEL
17+03	656.5			TRANS. GRAV → VEG & SANDY SOIL
17+06	660.5		MC	TOP OF BANK — GVL. & CW
18+30	662.8			TOP OF BANK REMNANT CHANNEL VEG - LARGE COTTONWOOD, MEDIUM SPRUCE AND WILLOWS
19+50	655.9			LOW POINT - ALDERS
20+00	663.1			TOP OF BANK
21+00	660.2			LEFT TOP OF BANK - PERMANENT CHANNEL
21+35	657.3			LOW POINT IN CHANNEL
21+50	664.1			RIGHT TOP OF BANK - COTTONWOODS WITH SOME GVL, LOTS SPRUCE, SOME BIRCH SHOWING UP
39+50	663.8			LEFT TOP OF BANK - SLOUGH (ROUGH #10)
40+00	655.3			TOE OF BANK (WATER FROZEN IN CHANNEL NO TRUE DEPTH DEPTH)
40+80	655.3			TOE OF BANK
40+90	661.5			TOP OF BANK
42+00	661.8			TOE OF 500' VERTICAL ROCK CLIFF

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 41



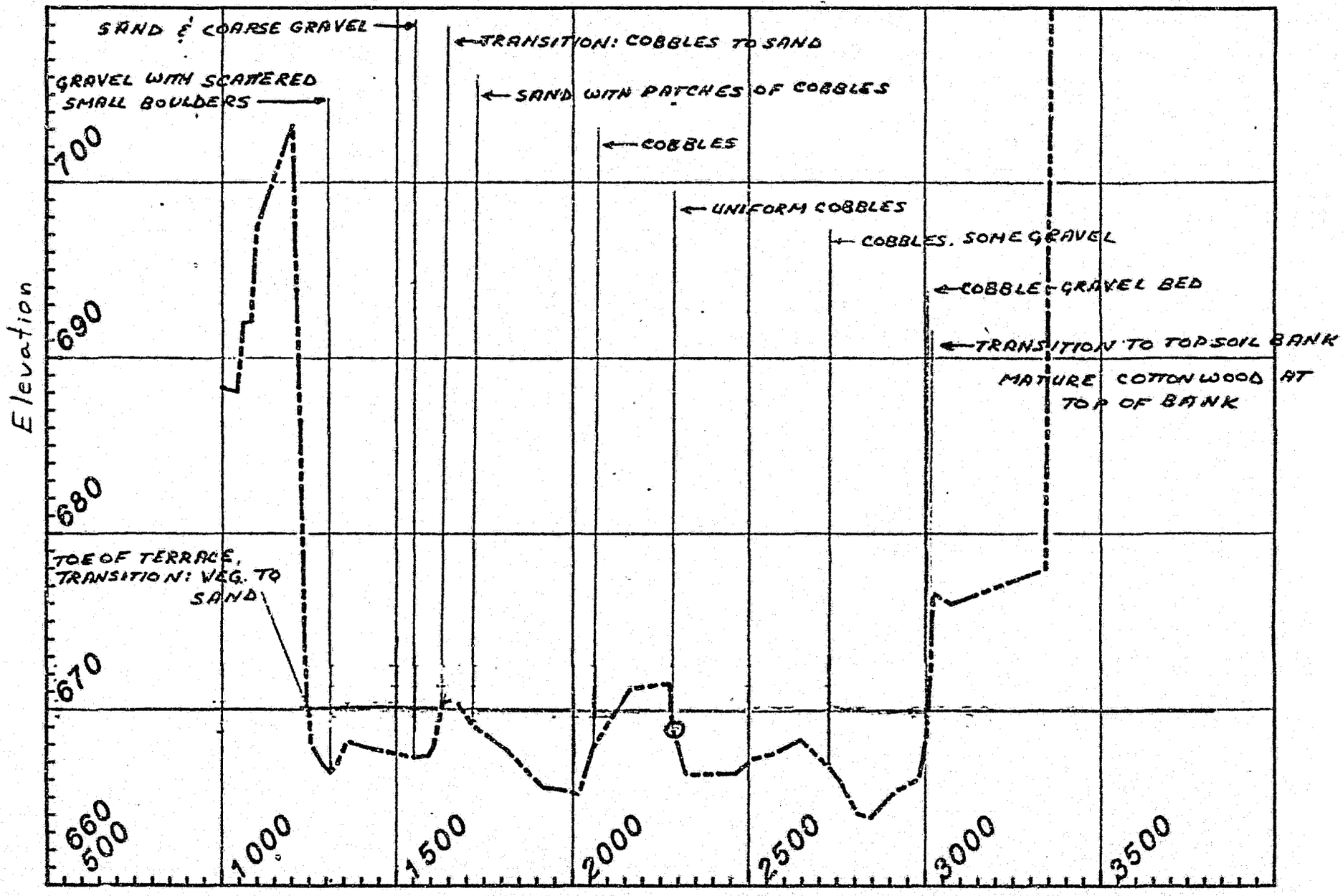
LRX-91

DATE OF SURVEY: OCTOBER 21, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
11+00	703.0		LOB	TOP OF BANK
11+57	661.8			TRANS. SAND & VEG → COB.
13+10	660.2			GRAV. & COB ON MID-CHAN. ISLAND
16+75	662.3			TRANS. GRAV & COB → VEG (GRASS, ALD., & SM. CW)
16+93	663.2			VEG & SAND
17+12	664.9			TOP OF SAND BANK
20+50	664.8			TOP OF BANK - HW. CHANNEL
20+88	660.9			SAND W/SCATTERED COB - LOW PT. IN HIGH WATER CHAN. - NO VEG.
HW CHAN				
21+58	665.5			ALDERS (TOP OF BANK)
22+38	664.8			TOP OF BANK
22+57	661.6			TRANS. VEG → SAND
FAN				
23+97	665.2			TRANS. SAND → ALD & GRASS (TOP OF BANK)
24+45	662.6			TRANS VEG → COB & GRAV.
25+20	664.9			COB. W/ SPARCE YOUNG WILLOW
25+75	663.81			COB, GRAV & SAND PATCHES - HIGH PT.
25+88	663.1			COB & SOME GRAV.
30+29	662.2			TRANS. COB & GRAV. → SANDY SOIL & VEG.
30+43	669.5		MC	MATURE BIRCH & SPRUCE
35+00	670.9			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 42



O: LOCATION OF GRID PHOTO

D_{16} = 15 mm

D_{50} = 38 mm

D_{84} = 94 mm

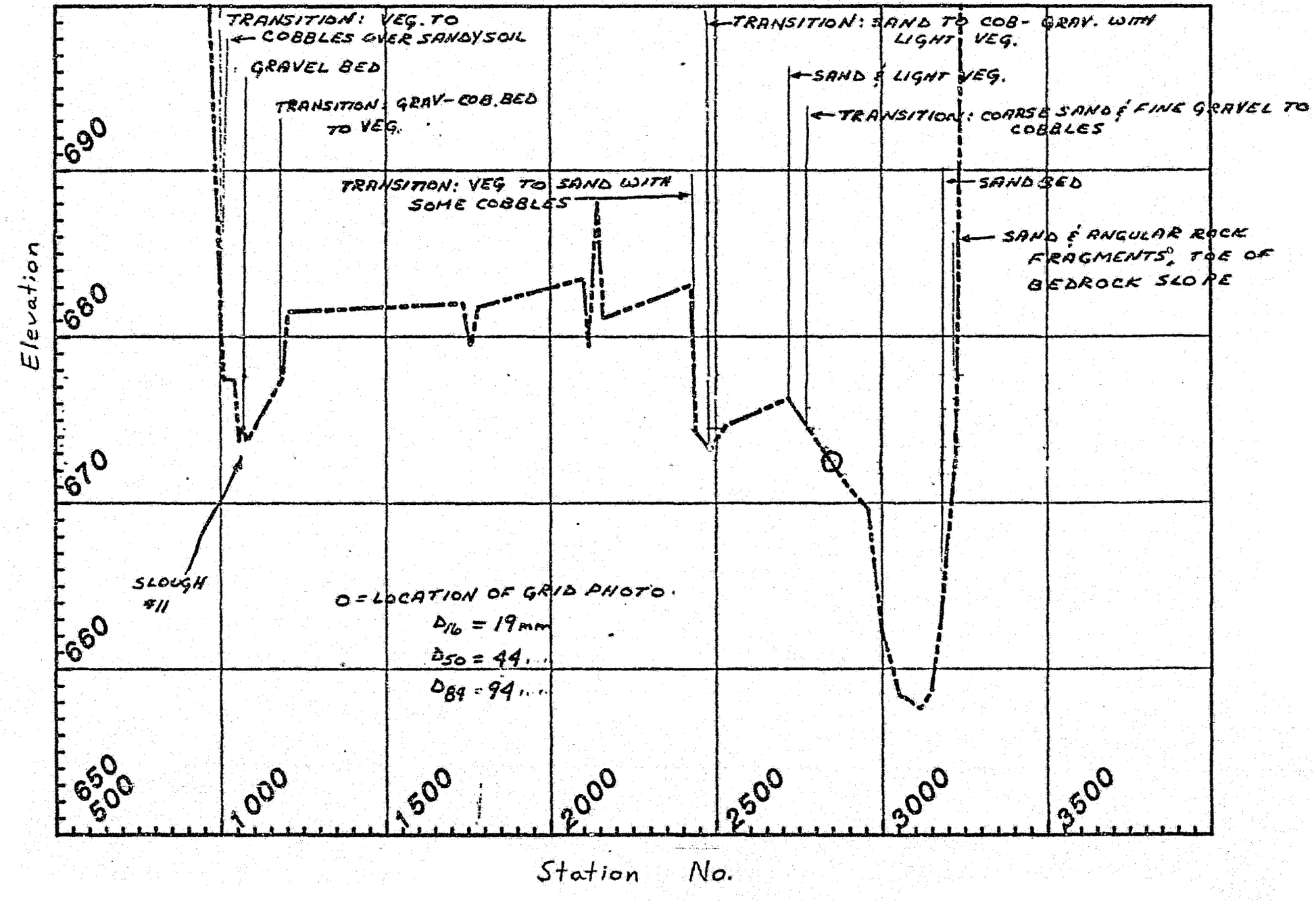
LRX - 42

DATE OF SURVEY: OCTOBER 20

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
12+01	703.3			TOP OF TERRACE
12+42	670.3			TOE OF TERRACE - TRANS. VEG (MOD DENSITY) → SAND
12+94	666.84			SAND & GRAV.
slough #11 DF&G 13+11	666.5			GRAV. W/ A FEW SCATTERED BOULDERS
13+29	666.84			SAND & GRAVEL
13+59	668.2			GRAV & COBBLES
15+46	667.3			SAND & COARSE GRAVEL - LOW PT. IN CHANNEL
16+07	667.91			MIX: COB, GRAV. & SAND
16+32	670.4			ALL SAND
17+16	669.1			SAND W/PATCHES OF COB. & LOW DENSITY HORSETAIL & YOUNG WILLOW
20+59	667.87		LOB	COBBLES
22+73	671.5		MC	HIGH PT. ON ISLAND, TOP OF BANK
22+84	668.94			MED. COBBLES
27+29	666.7			COB. & SOME GRAVEL
30+17	672.9			TRANS. TO TOPSOIL
30+23	676.6		MC	SOIL & VEG. (MATURE CW)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 43



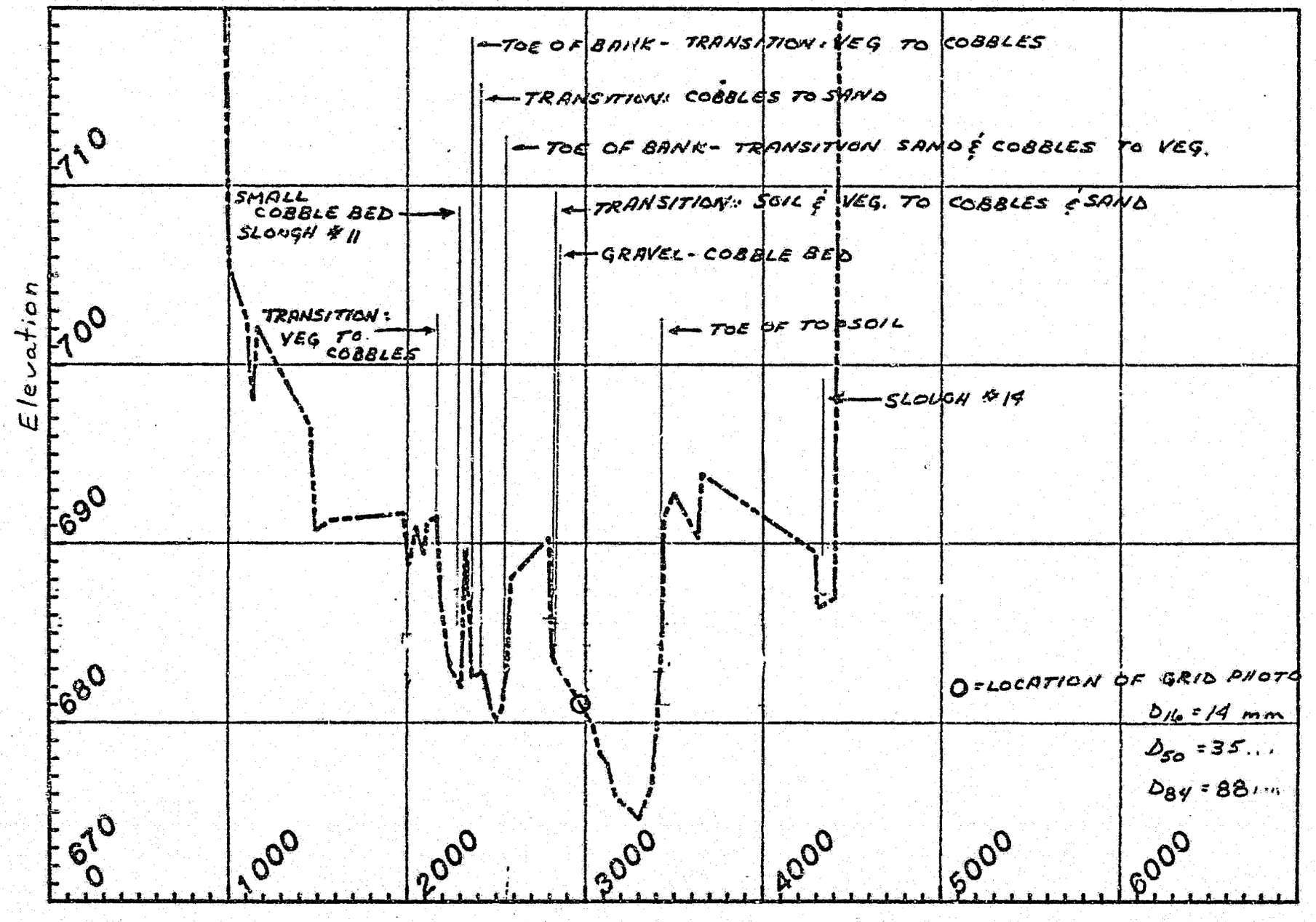
LRX - 43

DATE OF SURVEY: OCTOBER 17, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+65	701.4			TOP OF TERRACE - SPR. & BIRCH
10+00	681.9		LOB	TRANS. VEG → COB. OVER SANDY SOIL
10+54	673.69			GRAVEL BED IN SIDE CHANNEL (CHANNEL HAS SCOUR HOLES 5' DEEP W/ GRAV. BED)
slough #11 [redacted] DF&G) 10+77	673.68			GRAV. & COB.
11+86	677.5			TRANS. GRAV & COB → VEG (MIX WIL, GRAS, BIR, SPR
12+04	681.5			TOP OF BANK
24+23	682.9		MC	TOP OF BANK - GRASS, SM. WILLOWS
24+40	674.2			TRANS. VEG. → SAND W/ SOME COBBLES (SAND COVER OVER COB.)
24+81	673.2			TRANS. SAND → COB. & GRAV. W/ LIGHT VEG
27+17	676.3			SAND & LIGHT VEG.
27+74	674.6			TRANS. COARSE SAND & PEA GRAV. → COB.
29+57	669.6			D/S EDGE OF GRAV. BAR
31+79	663.4			SAND BED
32+12	670.59			SAND & ANGULAR SHALE FRAGMENTS
32+27	675.6			TOE OF VERTICAL RK. FACE
32+35	690.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 44



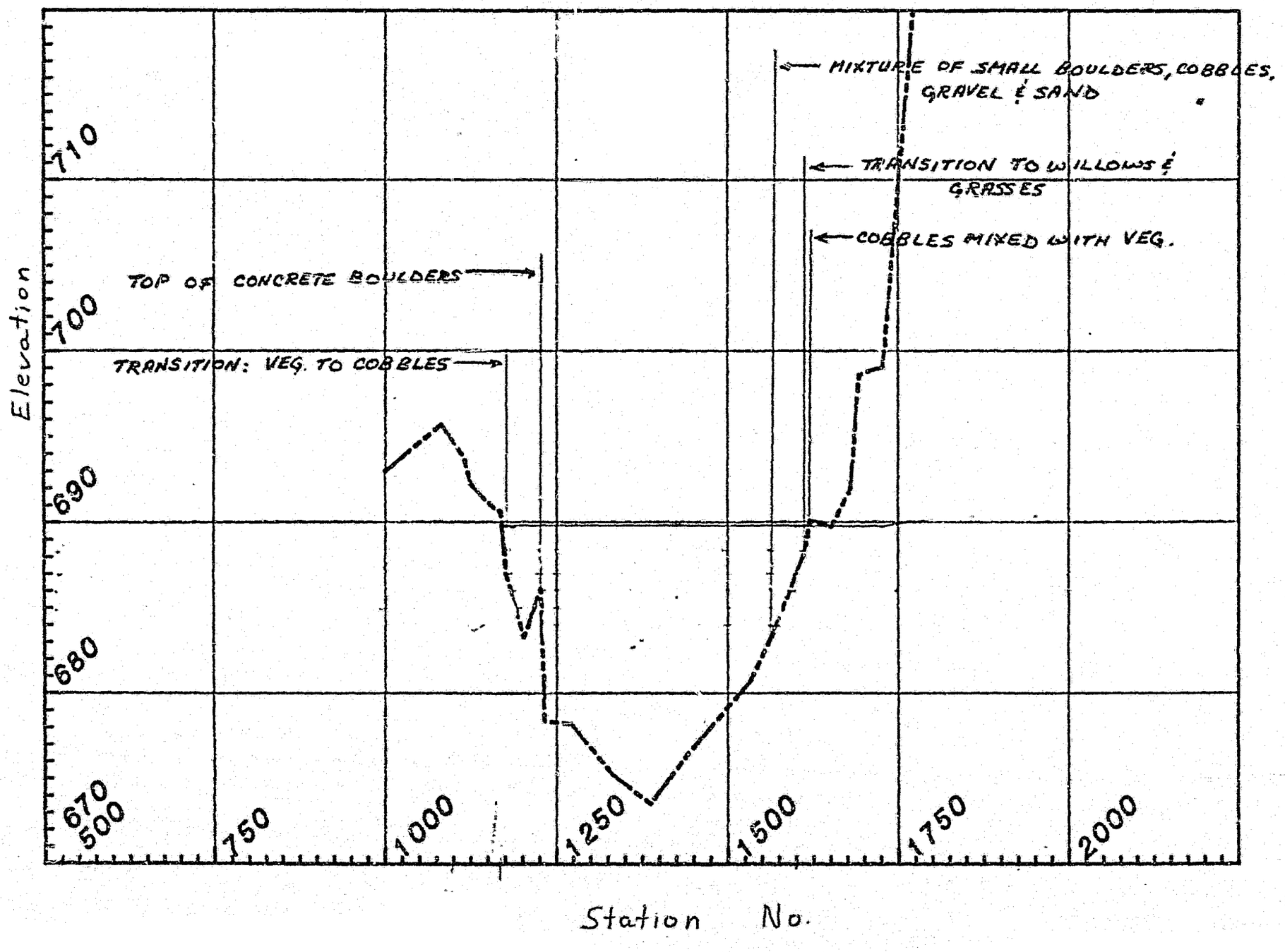
LRX - 44

DATE OF SURVEY: OCTOBER 17, 1980
OCTOBER 20, 1980 (MAIN CHANNEL)
MARCH 25, 1981 (RIGHT BANK EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
19+57	696.5			
19+74	691.7			TRANS. FROM MATURE TREES → WIL. & ALDER
entrance to slough #11 — 21+61	691.5			TRANS. WIL. & ALD → COBBLES
23+02	682.0			COB. – TOE OF BANK
23+23	689.8			TRANS. TO YOUNG VEG (ALD. & GRASS) – TOP OF BANK
side channel above slough #13 (TES) — 23+61	682.5			TRANS. VEG. → COB. (TOE OF BANK) (COBBLES IN PILES IN THIS AREA)
24+45	682.9			TRANS. COB. → SAND W/ SOME COBBLES
25+56	683.0			TRANS. SAND & COB. → VEG: (CW, ALD, GRASS)
25+79	688.1			TOP OF BANK
27+93	690.3		MC	TOP OF BANK – MAIN CHANNEL
28+03	686.1			TRANS: VEG & SOIL → LARGE COB. & SAND
28+13	683.6			TRANS. TO COB-GRAV. BED
29+14	682.0			COBBLES
34+04	680.06			COBBLES
34+35	686.0			TRANS. TO TOPSOIL BANK, SAND PATCHES AT TOE OF BANK
34+41	691.5		MC POB	VEG.
			ROB	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 45



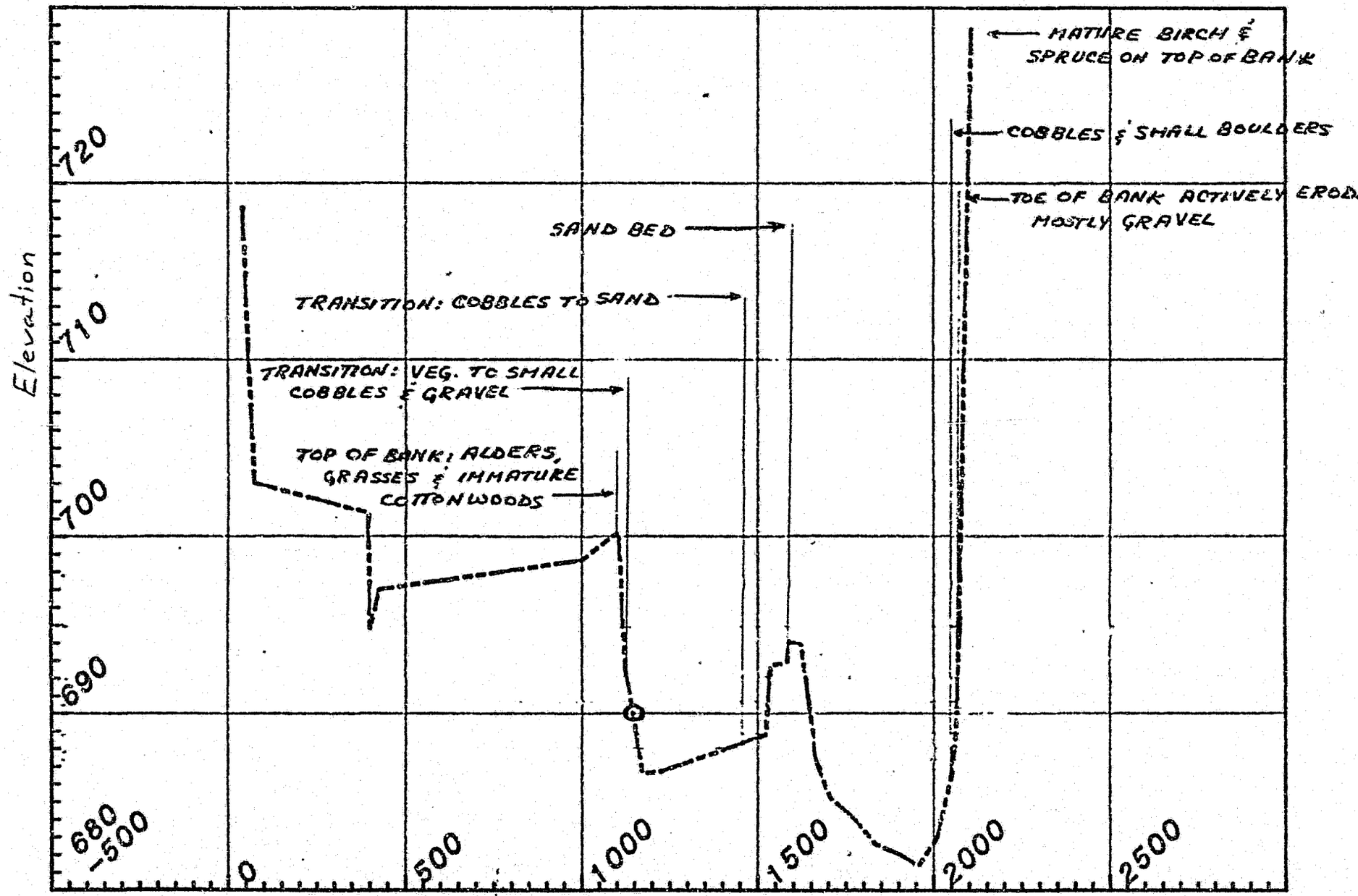
LRX - 95

DATE OF SURVEY: OCT. 15, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+81	695.7		G.S.	G.S.
11+68	690.6			TOP OF BANK
11+76	687.0			TRANS. VEG. → COB.
12+26	686.10			TOP OF MAN-MADE CONCRETE BOULDERS ~8' HIGH, EXTENDING 100' D/S
15+64	683.32			BOULDERS, SOME COB., GRAV. & SAND
16+12	688.20			TRANS. TO WIL. & GRASSES
16+20	~~695.10~~ 690.10			VEG. W/ COBBLES MIXED IN
17+28	699.1		MC	TOE OF R.R. BED

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 46



O = LOCATION OF GRID PHOTO

D_{16} = 29mm

D_{50} = 53mm

D_{84} = 100mm

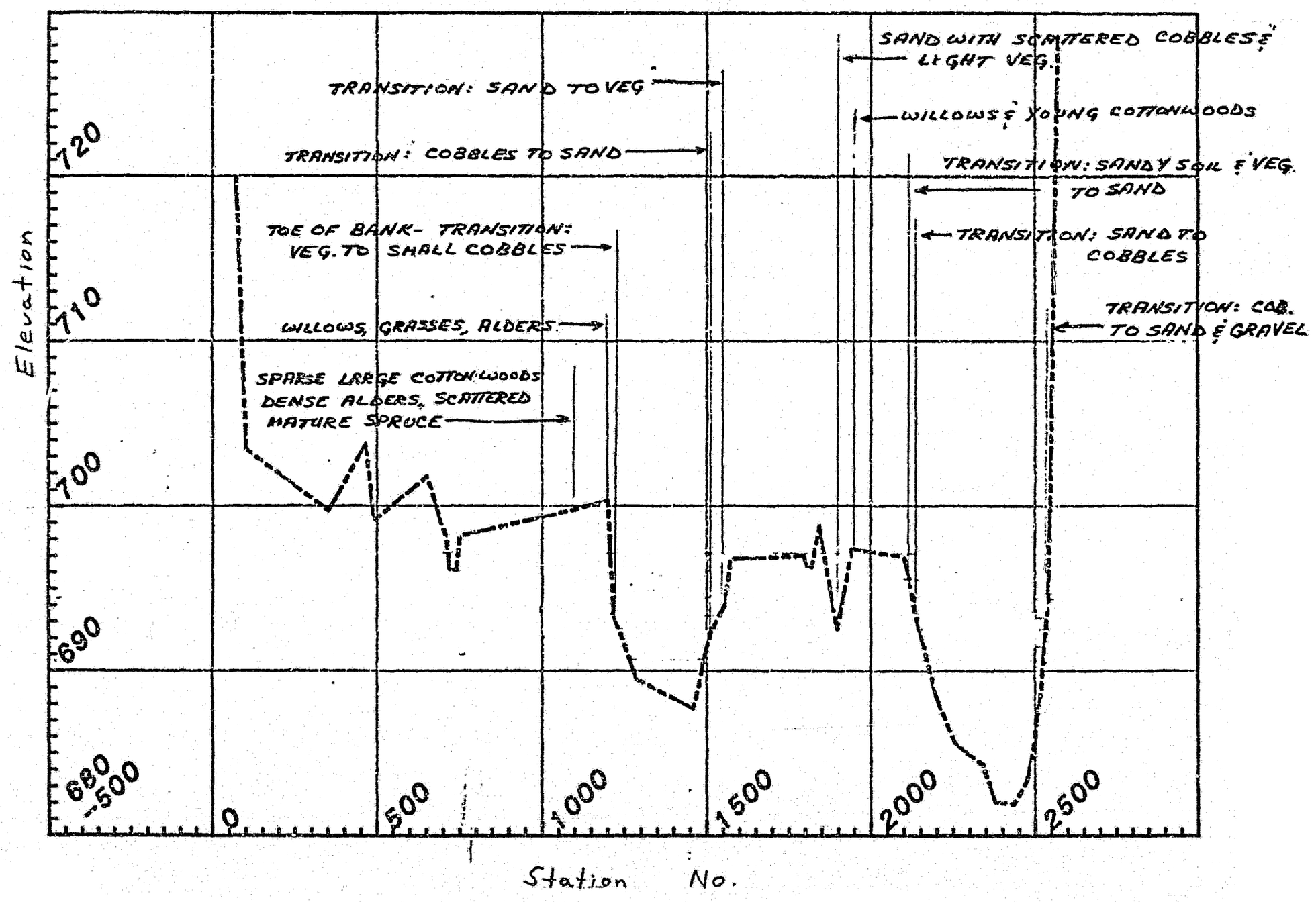
LRX - 46

DATE OF SURVEY: OCTOBER 16, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
0+50	701.0			TOE OF TERRACE (ALD., MATURE CW & SPR.)
11+06	699.8		TOB	TOP OF BANK - (GRASSES, ALD., IMMATURE CW.)
11+23	692.6			TRANS. VEG. → SMALL COB. & GRAV.
14+54	689.6			TRANS. COB. → SAND
15+87	694.1		MC	TOP OF SAND BAR
16+66	687.17			SAND W/ COB. PATCHES
20+52	686.73			BOULD. & LARGE COBBLES
20+65	690.2		MC	BANK MATERIAL: GRAVEL & SAND PARTIALLY COVERED W/ FALLEN TREES

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 47



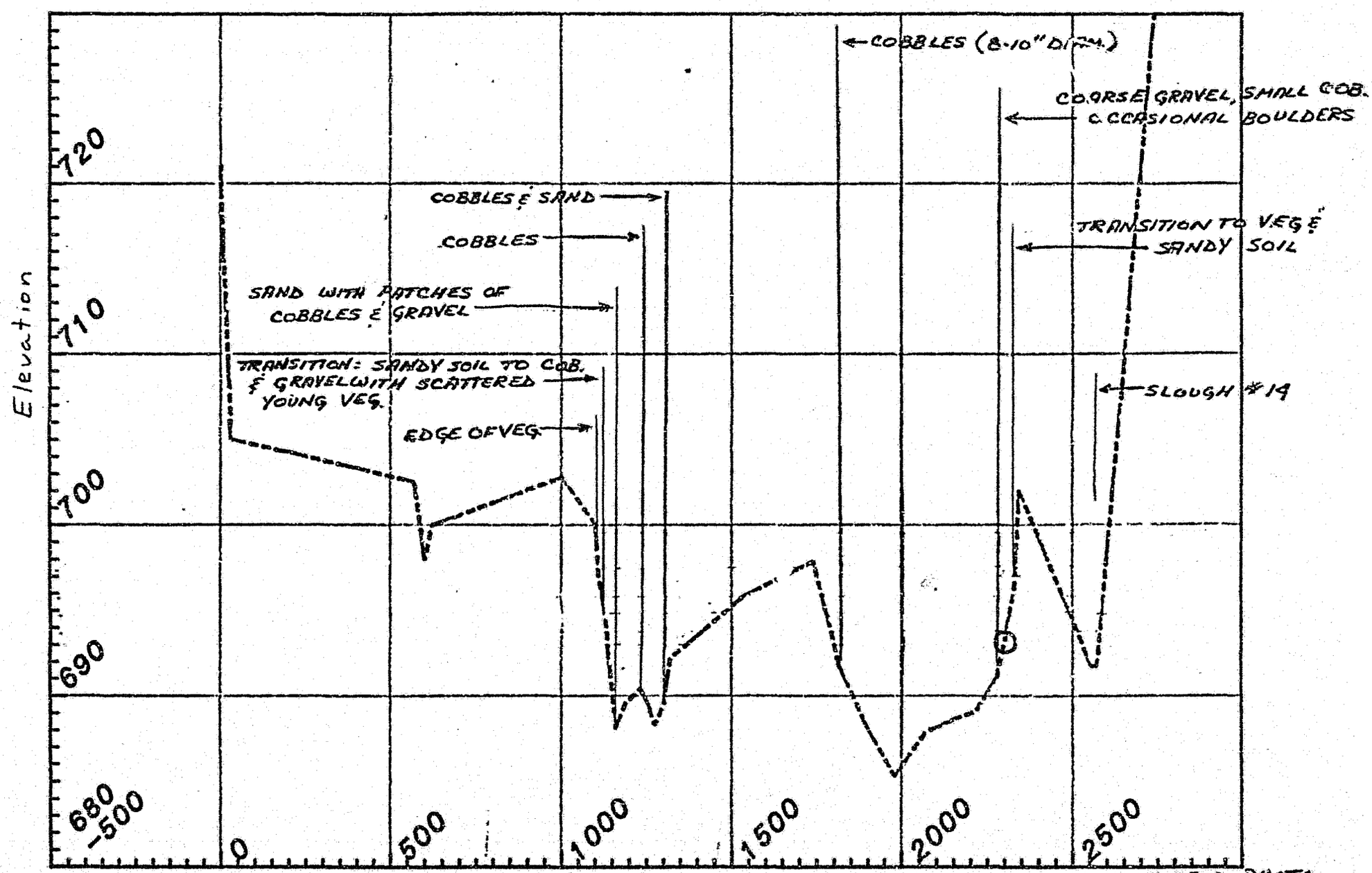
LRX - 97

DATE OF SURVEY: OCTOBER 15, 1980
MARCH 26, 1981

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
0+00	701.8			TOE OF TERRACE - ESTIMATED
12+00	700.4		LOB	TOP OF BANK - WIL, GRASS & ALDERS
12+18	693.3			TRANS. VEG. → COBBLES
15+09	692.3			TRANS. COB → SAND
15+52	693.9			TRANS. SAND → VEG. (WILLOWS)
15+72	696.8			TOPSOIL & VEG.
18+07	696.3			HIGH WATER CHANNEL W/ WILLOWS
18+20				IN THE CHAN. & ACCUMULATED DEBRIS
			LOB	INCLUDING 8" DIAM. SPRUCE LOGS
18+43	698.8		MC	HIGH PT. ON ISLAND
18+96	692.5			SAND BED CHAN. W/ SCATTERED COBBLES
				& SOME HORSETAIL
19+34	697.2			VEG. INCL. WIL. & SM. COTTONWOODS
21+16	695.6			TRANS. VEG. (YOUNG CW, DENSE ALD.) → SANDY SOIL
21+35	693.3			TRANS. SAND → COBBLES
25+41	694.5			TRANS. COB. ARMOR → SAND & GRAV. BANK
25+70	728.6			TOP OF BANK - ALLUVIAL

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 48



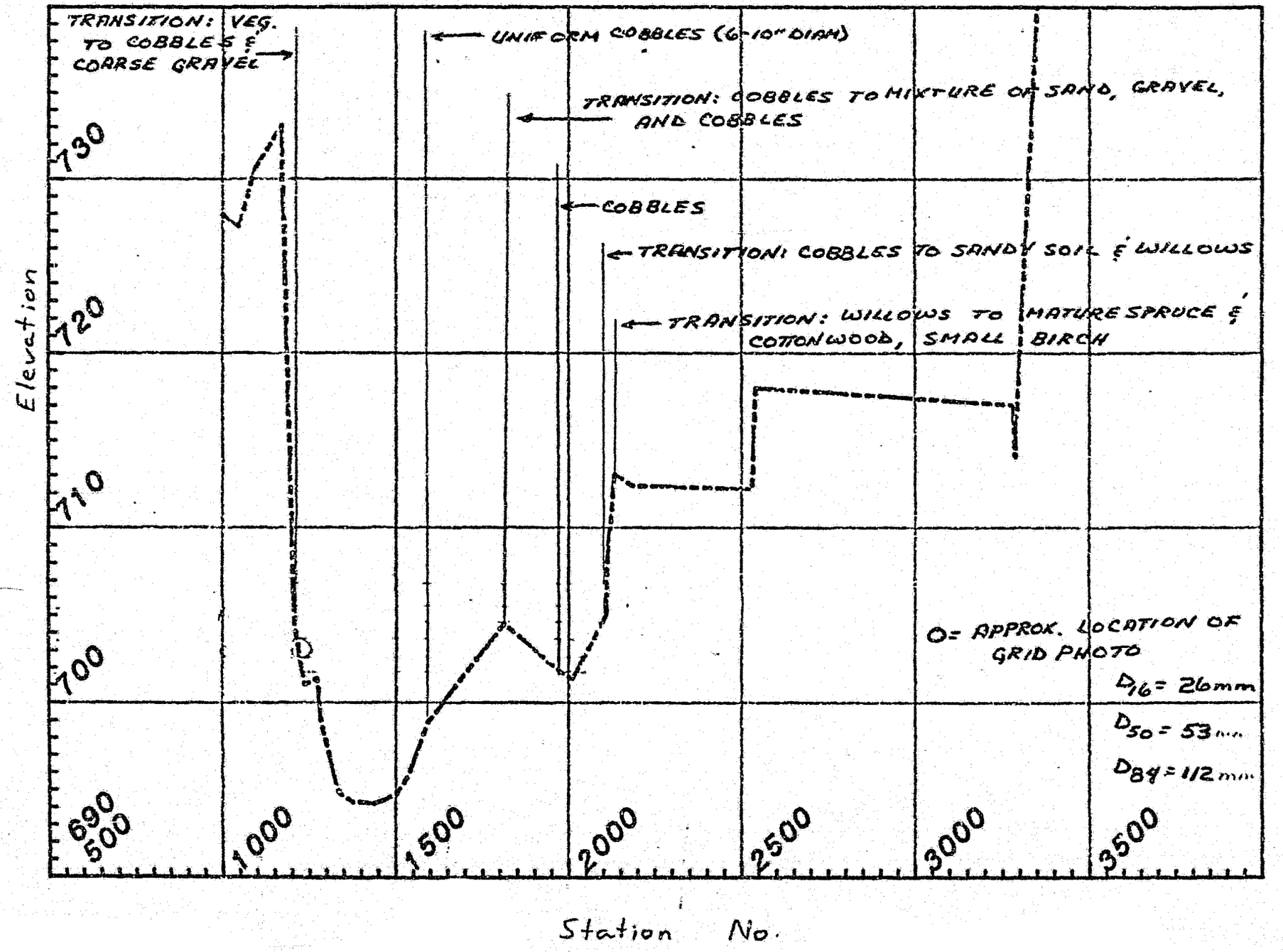
LRX-4B

DATE OF SURVEY: OCTOBER 14, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	702.82			
11+01	700.02			TOP OF BANK - WILL. & GRASSES
11+10	697.02			EDGE OF VEG.
11+27	695.12			TRANS. SANDY SOIL → COB. W/ SCATTERED YOUNG VEG.
11+53	689.68			SAND W/ SCATTERED COB. & GRAV. PATCHES
12+32	690.42			TRANS. TO COBBLES ON BANK OF X-OVER CHANNEL
13+00	689.53			COB. & SAND
13+21	692.22			UNIFORM COB. W/ SAND PATCHES (6-8")
17+90	697.92		MC	TOP OF BANK - MAIN CHANNEL
18+15	691.70			LARGER COB. (8-10" DIAM.)
22+79	691.17			COARSE GRAV., SMALL COB., OCCASIONAL BOULDE
23+30	696.62			TRANS. TO VEG. & SANDY SOIL
23+43	702.02		MC ROB	TOP OF BANK
24+00	699.8			TOP OF BANK - WILLOWS (SLOUGH #19)
slough #19 25+63	691.0			ESTIMATED LOW POINT IN CHANNEL
25+95	698.8			TOP OF BANK
27+23	699.5			TOE OF TERRACE
27+79	739.1			TOP OF TERRACE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 49



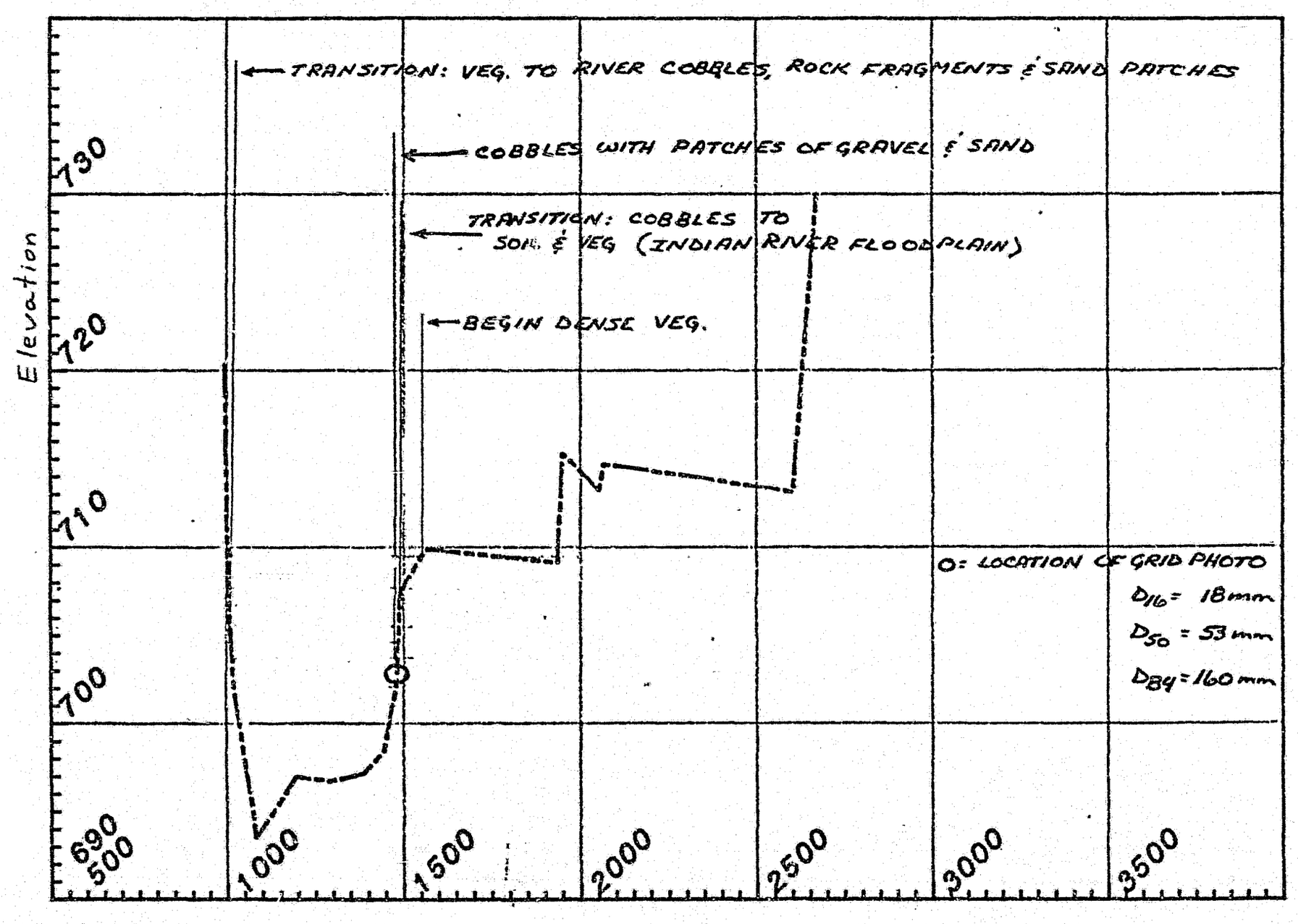
LRX - 49

DATE OF SURVEY: OCTOBER 19, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
11+68	733.1			TOP OF BANK
			MC	
12+06	709.3			TRANS. VEG → COB. & COARSE GRAV.
15+92	698.88			UNIFORM COB. (6-10" DIAM.)
18+11	709.5			TRANS. COB. → MIX SAND, GRAV, COB. TOP OF BEACH
19+71	701.8			COBBLES ON SHOULDER OF SIDE CHANNEL
21+09	705.1		MC	TRANS. COB → TOPSOIL & WILLOWS
			ROB	
21+32	713.1			TRANS. WIL → MATURE SPR. & CW, SMALL BIRCH
32+00	714.6		ROB	TOE OF BLUFF
32+05	720.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 50



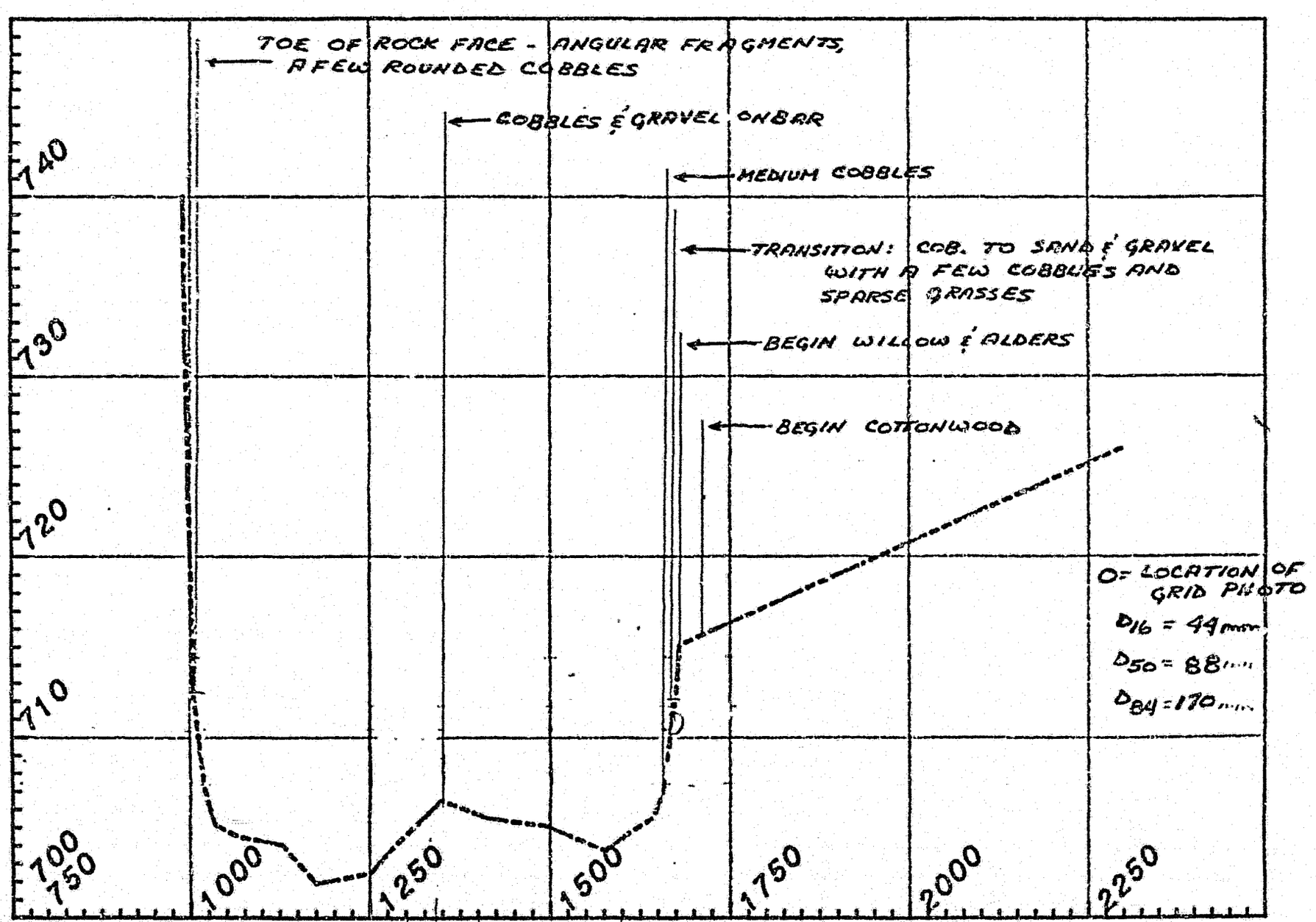
LRX - 50

DATE OF SURVEY: OCTOBER 13, 1980
MARCH 26, 1981 (RIGHT BANK EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+90	720.0			
10+00	709.34		T/C	TOE OF STEEP FACE
10+08	705.9			TRANS. VEG. → RIVER COB. BEDRX FRAG., SAND PATCHES
14+78	701.98			COB. PATCHES OF GRAV. & SAND (DEP. FROM INDIAN RIVER)
14+90	707.5		T/C R.O.B.	TRANS. COB → TOPSOIL & VEG. - INDIAN RIVER FLOODPLAIN
15+61	709.9			DENSE VEG

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 51



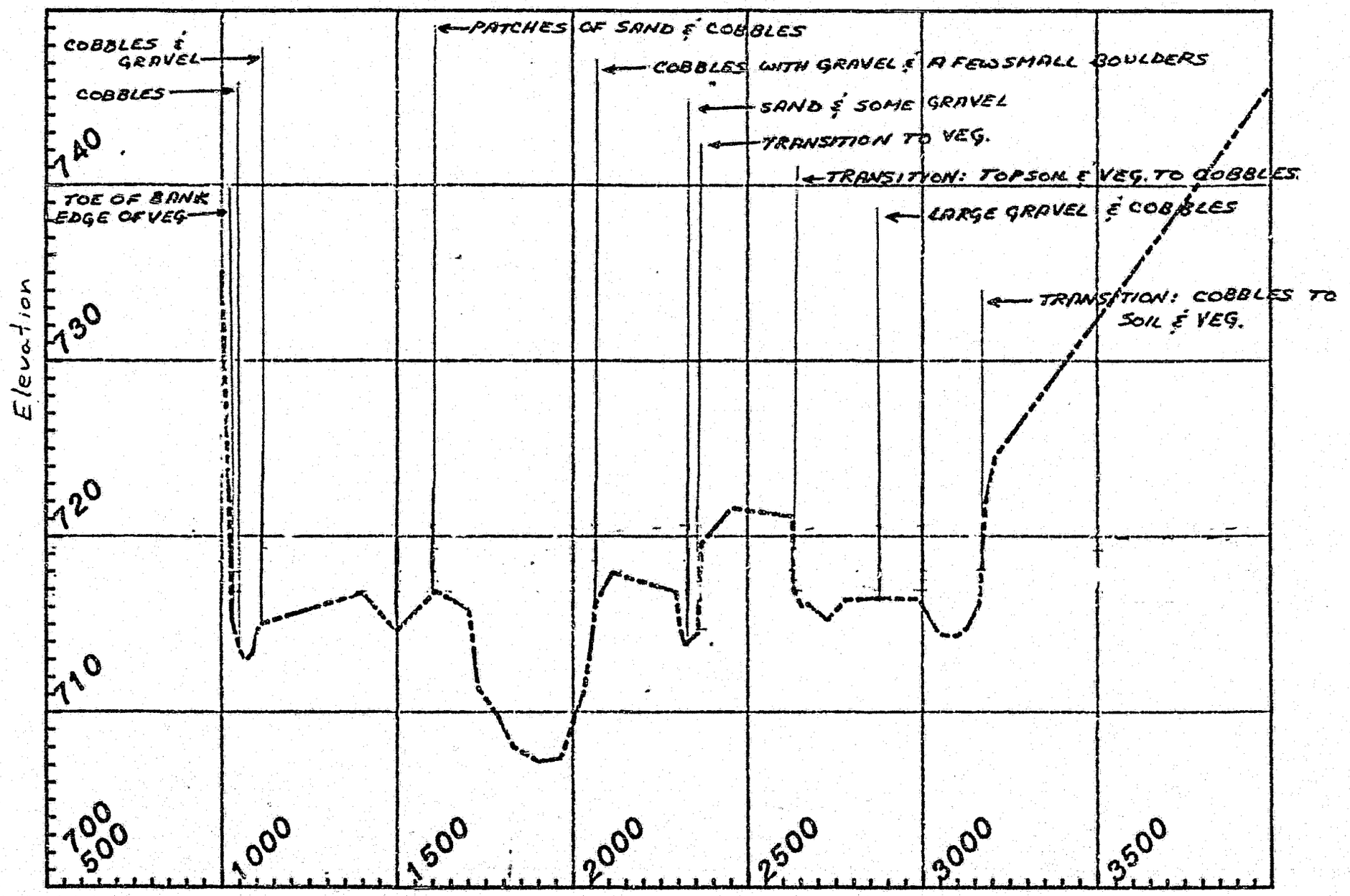
LRX - 51

DATE OF SURVEY: OCTOBER 13, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+95	780.0			
10+05	712.3		MC	TOE OF ROCK FACE - ANGULAR FRAGMENTS & A FEW ROUNDED COBBLES
13+98	706.5			COB. & GRAV. ON MID-CHAN. BAR
14+93	705.1			SHOULDER OF BAR - COB & GRAVEL
16+57	707.04			MED. COBBLES
16+70	710.83			COBB. ⟶ SAND & GRAV. w/A FEW COBB., SPARSE GRASSES
16+80	715.1		MC FOE	BEGIN WILLOW & ALDER
17+12	715.7			BEGIN COTTONWOOD - FLAT FLOODPLAIN
22+95	726.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 52



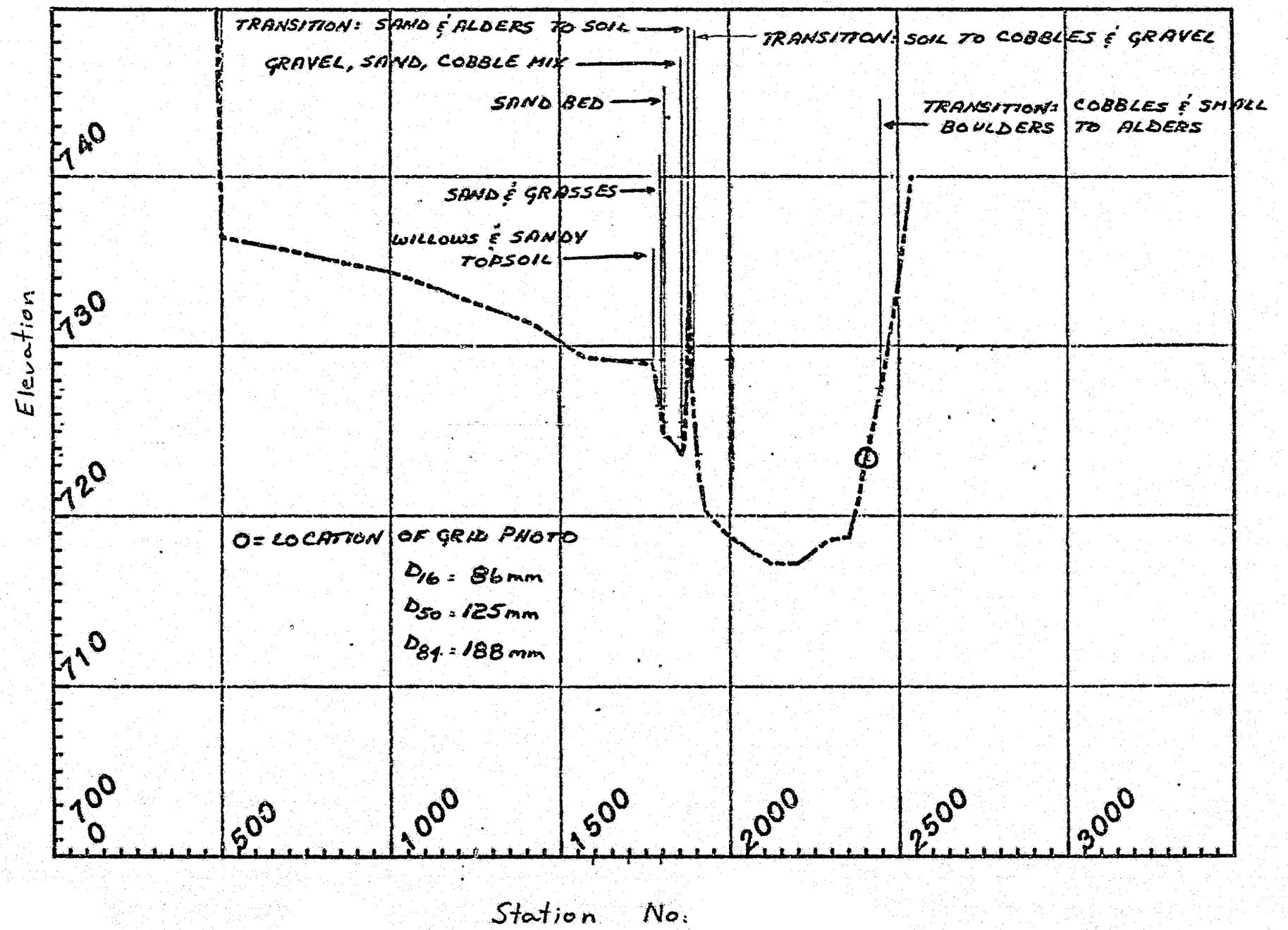
LRX - 52

DATE OF SURVEY: OCTOBER

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	735.67	-	MC	VEG - ON BANK
10+29	715.3			TOE OF BANK
10+51	713.46			COBBLES - SIDE CHANNEL
11+08	715.0			COB. & GRAV.
16+09	716.9			SAND & COBBLES - PATCHES
20+64	716.2			MOSTLY COB. w/ GRAV & A FEW SMALL BOULDERS
23+19	713.8			LOW PT. - SAND & SOME GRAVEL
23+57	719.5			TRANS. TO VEG.
24+53	721.6		MC ROB	HIGH PT. ON ISLAND
26+30	716.9			TRANS. TOPSOIL & VEG → COBBLES
28+70	716.5			LARGE GRAV & COB. ON U/S END OF ISLAND
31+30	714.8			COB-GRAV. BED w/ SOME BOULDERS
31+65	716.14			GRAV-COB.
31+71	718.1			TRANS. COB. → TOPSOIL & VEG.
32+09	724.6		ROB	TOE OF TERRACE
32+20	730.0			(estimated)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 53



LRX - 53

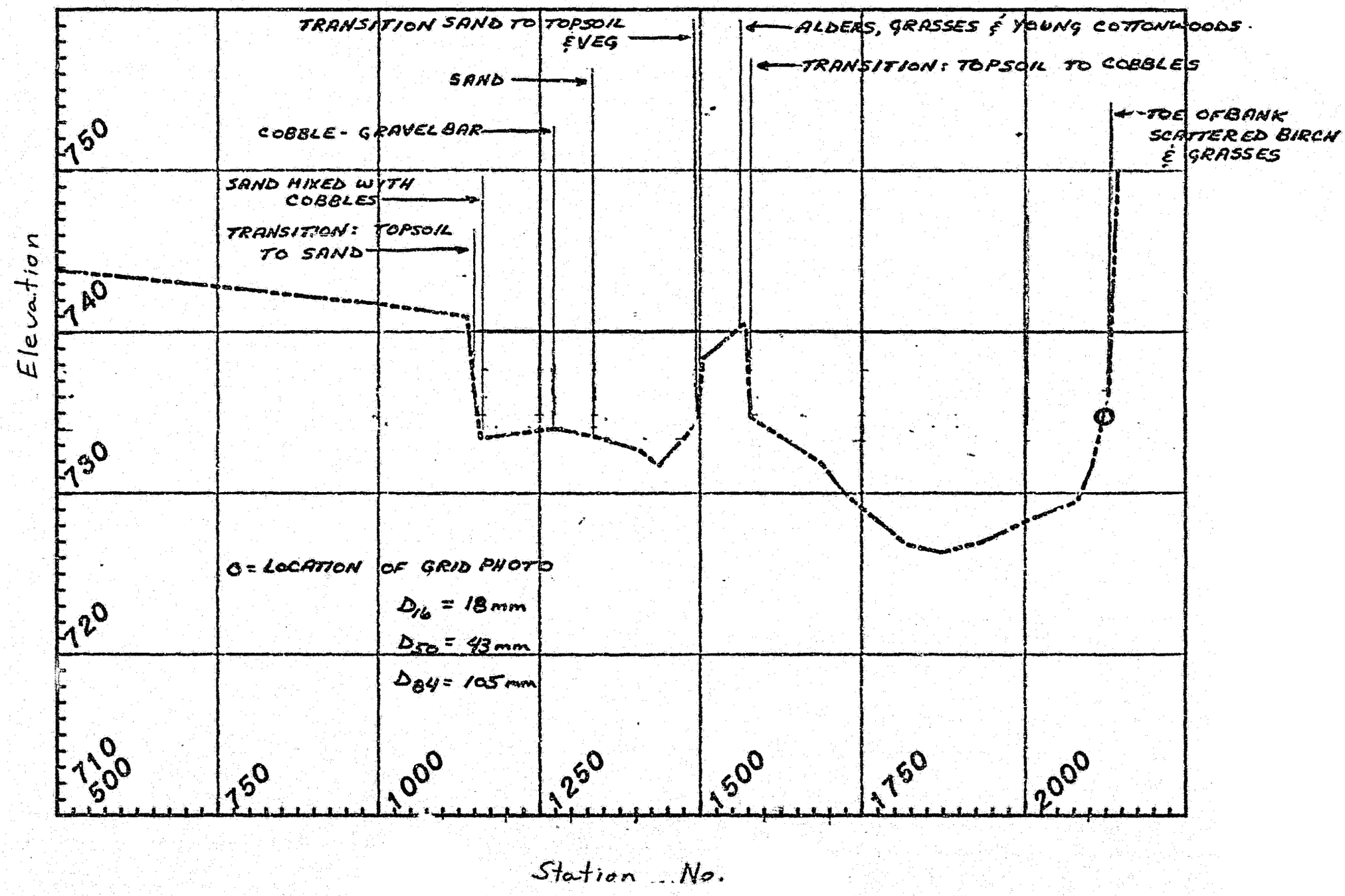
DATE OF SURVEY: OCTOBER 29, 1980

STATION	ELEV	MANNINGS 'n'		DESCRIPTION
9+90	743.0		LOE	
10+00	734.3			TOE OF TERRACE - ALDERS
17+75	728.9			WILLOWS & SANDY TOPSOIL - TOP OF BANK
17+96	726.4			SHOULDER - GRASSES & SAND
18+01	724.9			SAND
18+56	723.6			GRAY., SAND. & COB. MIX IN SMALL SIDE CHANNEL
18+72	727.3			SAND & ALDERS
18+73	727.9			TRANS. TO TOPSOIL BANK
18+80	733.2		LOB MC	TOP OF BANK - MAIN CHANNEL
18+85	728.4			TRANS. TOPSOIL → COB. & GRAVEL
24+47	727.5			TRANS. COB. & BOULDER → ALDERS
24+88	732.3			TOE OF TERRACE
25+90	740.0		ROB	(estimated)

Slough #20 (DEG)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 54



LRX - 59

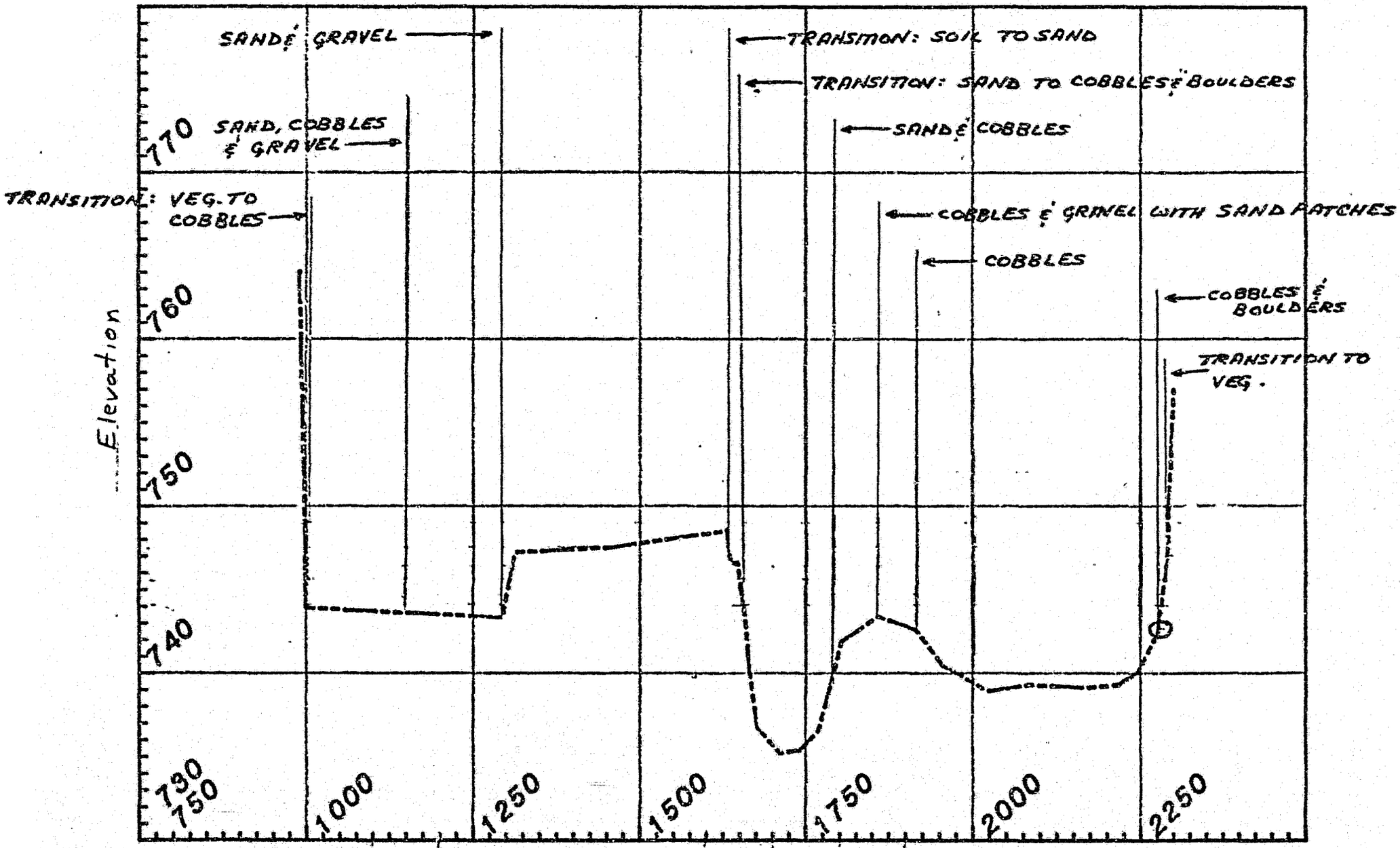
DATE OF SURVEY: OCTOBER 24, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	741.7			
11+38	740.9		L03	VEG. & TOPSOIL - TOP OF BANK
11+99	736.4			SAND (TRANS., TOPSOIL TO SAND)
11+59	733.4			SAND MIXED W/COBBLES
12+70	734.0			COB - GRAV. BED
13+34	733.50			SAND
14+96	734.8			TRANS. SAND → SANDY TOPSOIL & VEG.
15+05	738.4			TOP OF BANK
15+67	740.5		~~M.C~~	HIGH PT
15+78	734.7		M2	TOPSOIL → COBBLE BED & A FEW SMALL BOULDERS
21+31	736.4		M2	COB → SCATTERED YOUNG VEG.
21+53	744.0			

Side channel below Slough #20

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 55



O = LOCATION OF GRID PHOTO

D_{16} = 178mm

D_{50} = 220mm

D_{84} = 265mm

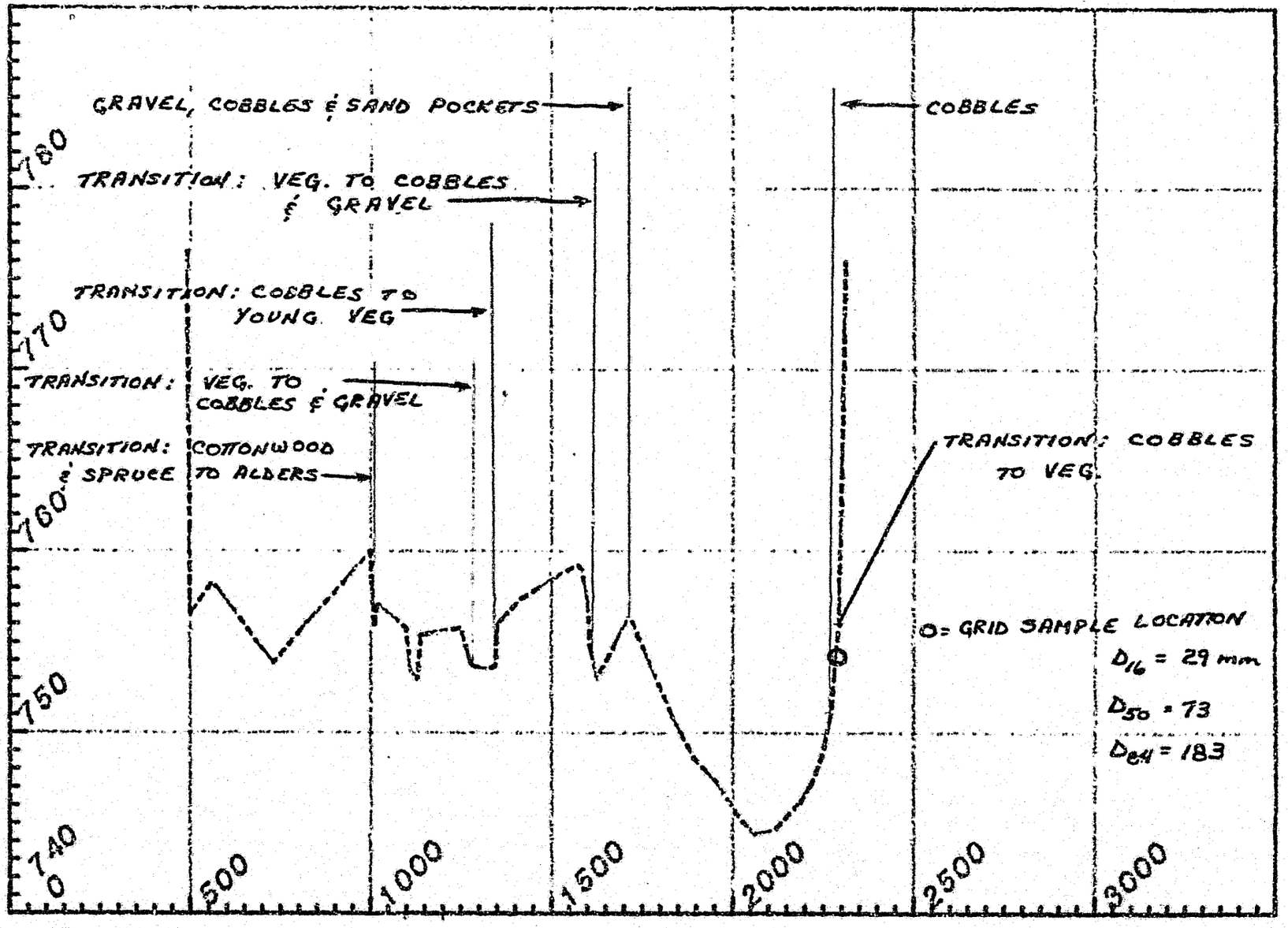
LRX - 55

DATE OF SURVEY: OCTOBER 23, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
9+95	750.0			
10+00	743.9		LOB	TOE OF TERRACE
				TRANS. VEG TO COBBLES
11+50	743.6			SAND & COBBLES w/ SCATTERED GRAV. IN SIDE CHANNEL
12+93	743.3			SAND & GRAVEL
13+13	747.2			TRANS. SAND & GRAV. → YOUNG CW. & ALDERS
16+30	748.6		LOB MC	TOP OF BANK
16+37	746.2			TRANS. VEG. → SAND
16+56	744.0			TRANS. SAND → COBB. & BOULDERS
17+90	739.90			SAND & COB. - SHLD. OF MID-CHAN. BAR
18+59	743.4			COB. & GRAV. W/ SAND PATCHES - HIGH PT.
19+15	742.57			COBBLES
22+77	742.53			BOULD. MAINLY, W/ COBBLES
22+91	746.6		MC	TRANS TO VEG. - TOE OF TERRACE
23+00	751.0			

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 56



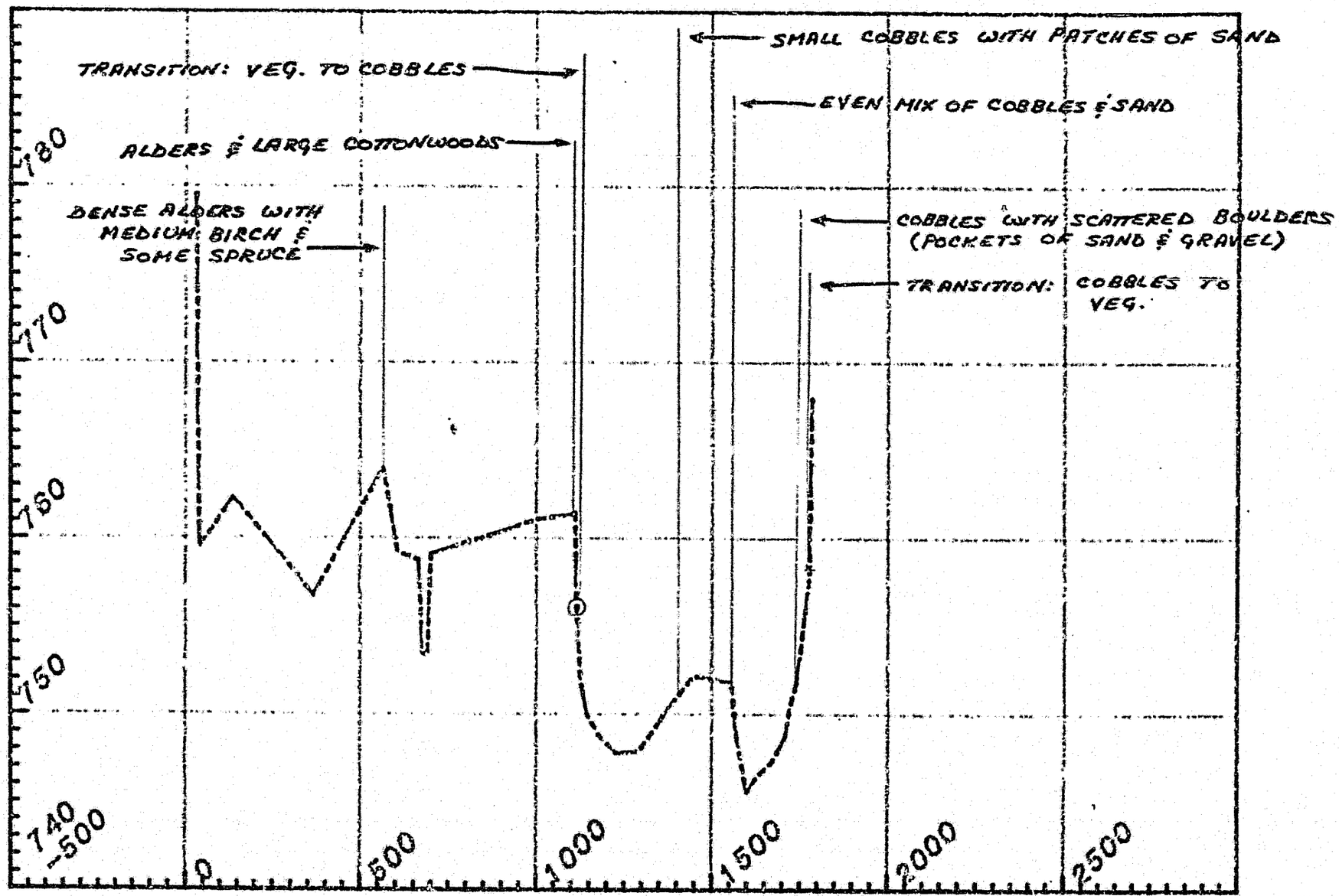
LRX - 56

DATE OF SURVEY: OCTOBER 23, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+00	760.0		LOB	TOP OF TERRACE (CW. SPR, ALD.)
10+09	755.8			TRANS. CW & SPR → ALDERS
11+11	753.4			TRANS. ALDER → HORSETAIL
11+90	755.4			ALDER & YOUNG CW.
12+77	753.7			TRANS. VEG → COBB. & GRAV.
13+95	753.7			TRANS. COBB → YOUNG VEG. (CW)
15+87	758.9		LOB MC	TOP OF BANK - ALDERS & GRASSES
16+07	754.8			TRANS. VEG. → COB. & GRAV.
16+27	753.0			LOW PT. - COBBLES
17+15	756.4			GRAV., COB. & SAND POCKETS NEAR FALLEN CW
22+71	750.94			BOULDERS & COBBLES
22+93	755.9			TRANS. COBBLE → VEG. (CW & ALD.)
				TOE OF BLUFF

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 57



O = GRID SAMPLE LOCATION

D_{16} = 20 mm

D_{50} = 47

D_{84} = 110

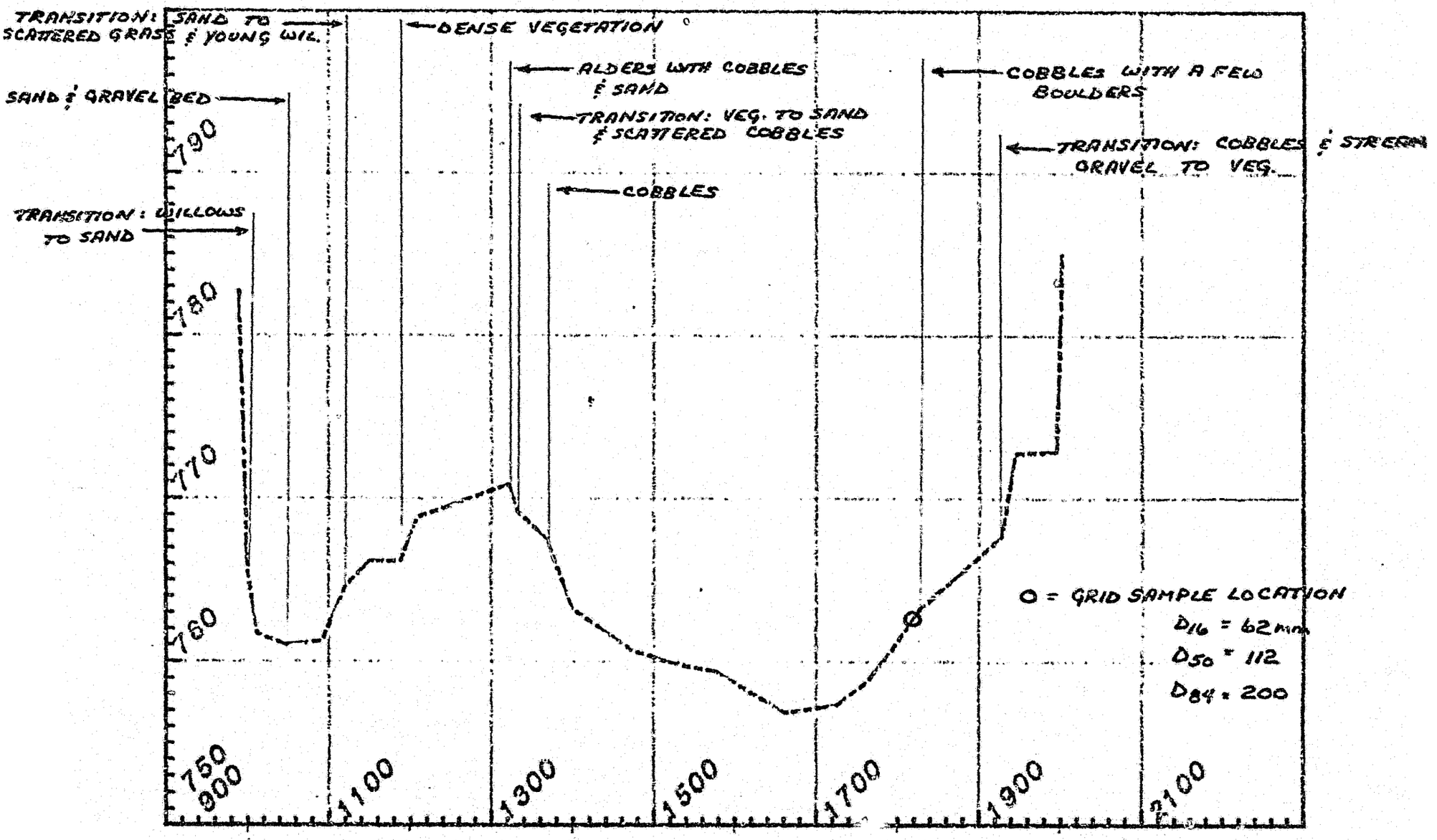
LRX - 57

DATE OF SURVEY: OCTOBER 23, 1980
MARCH 26, 1981 (LEFT BANK EXTENSION)

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
11+10	761.5		MC	TOP OF BANK - VEG (ALDERS & LARGE COTTONWOOD
11+14	756.0			TRANS. VEG → COBBLE
14+05	751.1			SM. COB. w/ SAND PATCHES ON SHOULDER OF MID-CHAN. BAR
15+55	751.8			EVEN MIX SAND & COBBLES ON SHOULDER OF BAR
17+91	751.83			COBBLES w/ SCATTERED BOULDERS (POCKETS OF SAND & GRAV.)
17+78	757.9		MC	TRANS. COB → VEG. TOE OF HIGH TERRACE
17+81	763.0			(T.T. STD. SURVEY)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 58



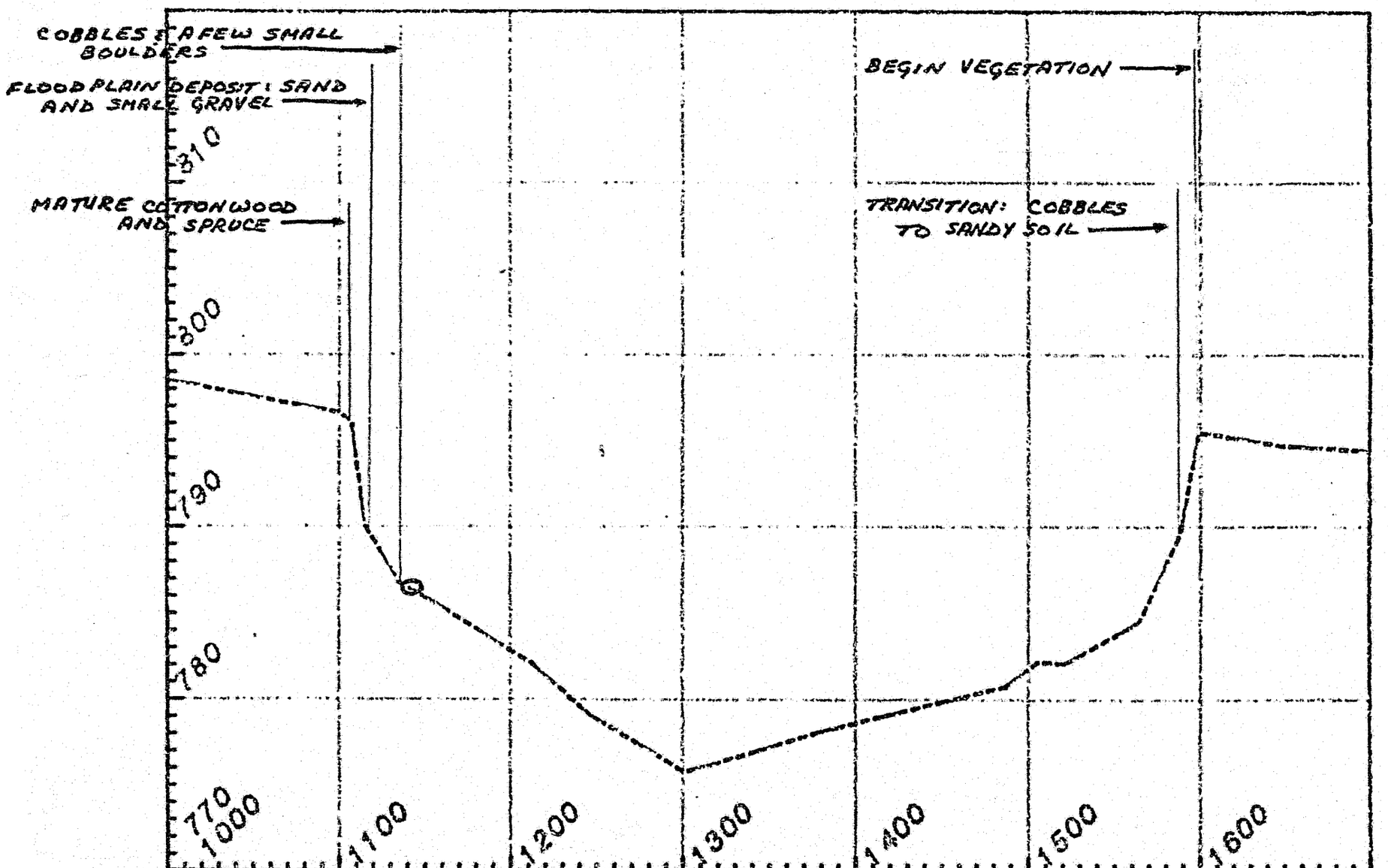
LRX - 58

DATE OF SURVEY: OCTOBER 23

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
9+90	776.0			EST. STA & ELEV. ON SLOPE
10+00	765.7		LOB	TOE OF ALLUV. BANK ~ 70' HIGH TRANS. WIL. & GRASSES → SAND
10+98	761.00			MIDDLE SIDE CHANNEL, PONDED WATER SAND & GRAV. BED
10+92	761.29			SAND & A FEW COBBLES
11+21	764.7			TRANS.. SAND → SCATTERED GRASS & YOUNG WIL.
11+88	766.2			DENSE VEG.
13+22	770.9		LOB MC	ALDERS w/ COBBLES & SAND
13+32	769.2			TRANS VEG TO SAND & SCATTERED COBBLES
13+69	767.5			COBBLES - SHOULDER OF BEACH
18+27	763.23			COBBLES w/ A FEW BOULDERS
19+28	767.7			TRANS. COBBLES & STREAM GRAV. → VEG.
19+45	772.8		MC	TOP OF BANK - VEG

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 59



o = APPROXIMATE LOCATION OF BED MATERIAL GRID SAMPLE

D_{16} = 26 mm
D_{50} = 66
D_{84} = 170

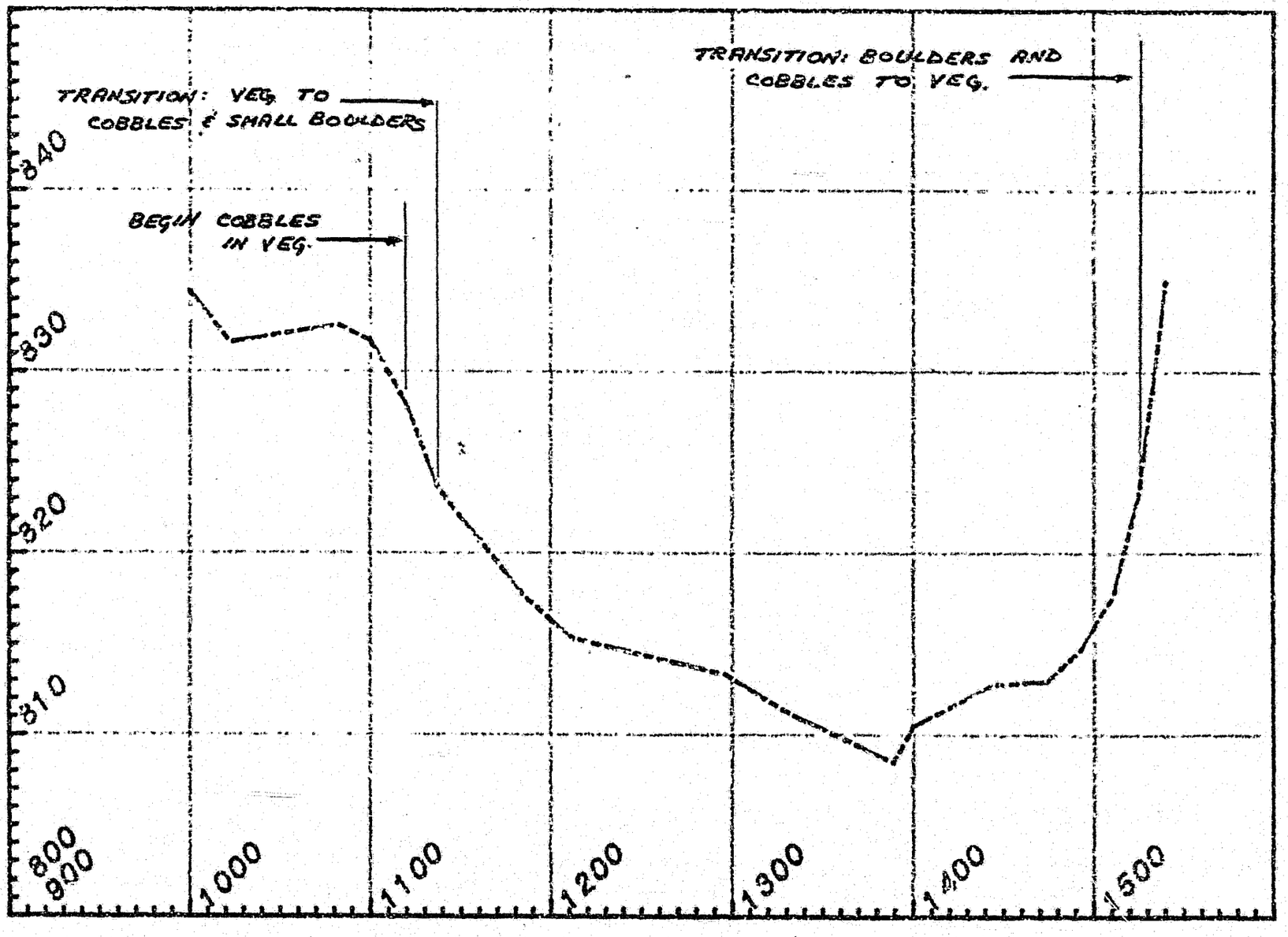
LRX - 59

DATE OF SURVEY: . OCTOBER 23, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
11+07	796.1		MC	TOP OF BANK - MATURE CW & SPR.
11+15	790.1			FLOODPLAIN DEPOSIT FROM STREAM ENTERING W/S, SAND & SM. GRAV.
11+35	786.8			MAIN CHANNEL - COBBLES A FEW SM. BOULD
15+88	789.6			TRANS. - COB. → SANDY SOIL
15+99	795.5		MC	BEGIN VEG - TOP OF BANK (CW, ALD., SPR. & BIR)

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 60



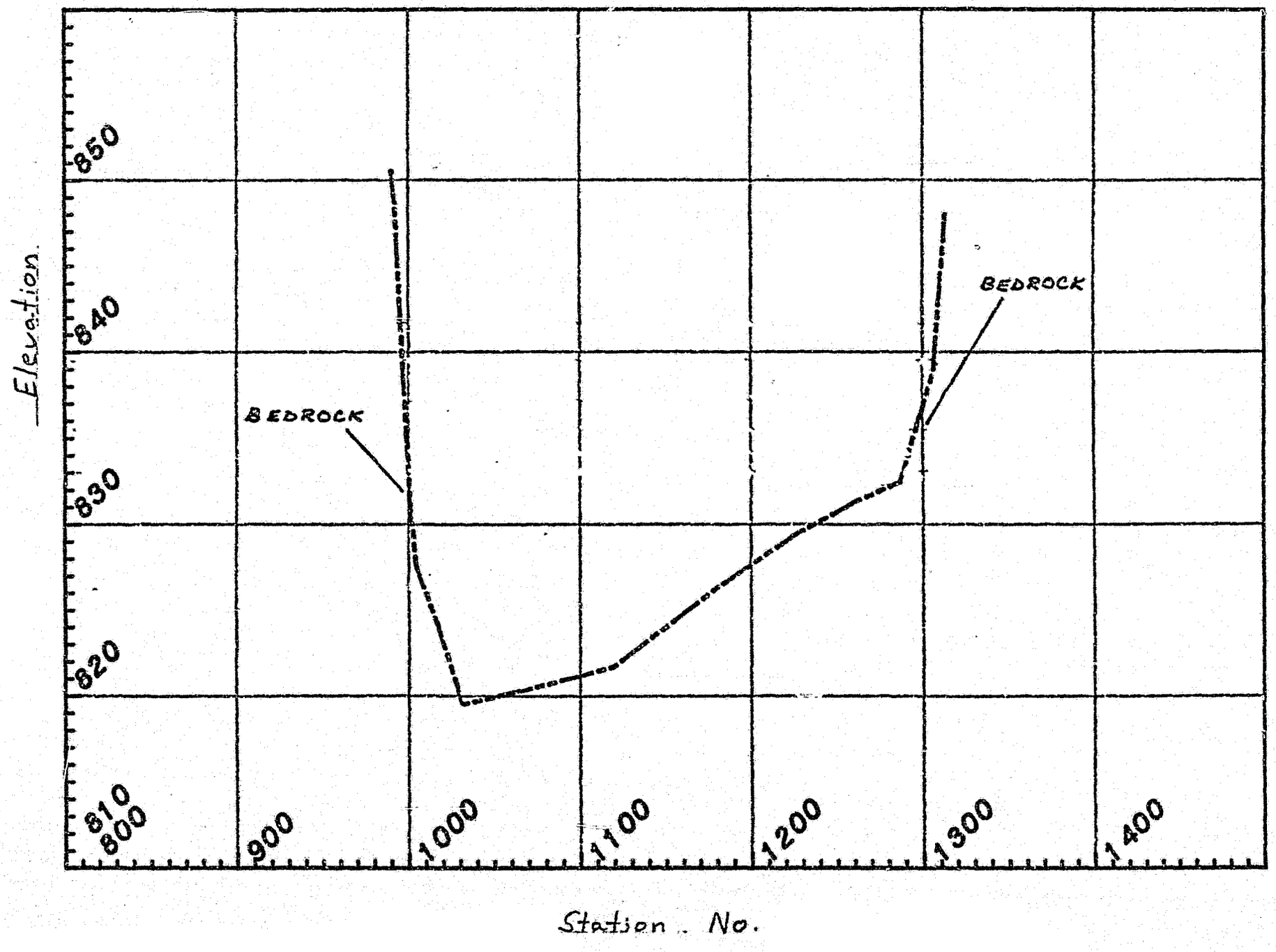
LRX - 60

DATE OF SURVEY: OCTOBER 22, 1980

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
11+19	828.3		MC	TOP OF BANK - BEGIN COBBLES IN VEG.
11+38	823.5			TRANSITION: VEG. TO COBBLES & SMALL BOULDERS
15+25	823.5		MC	TOE OF BLUFF - TRANSITION: BOULDERS AND COBBLES TO VEG (SPRUCE & BIRCH)
15+30	835.0			
				NO WELL DEVELOPED ROD

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 61



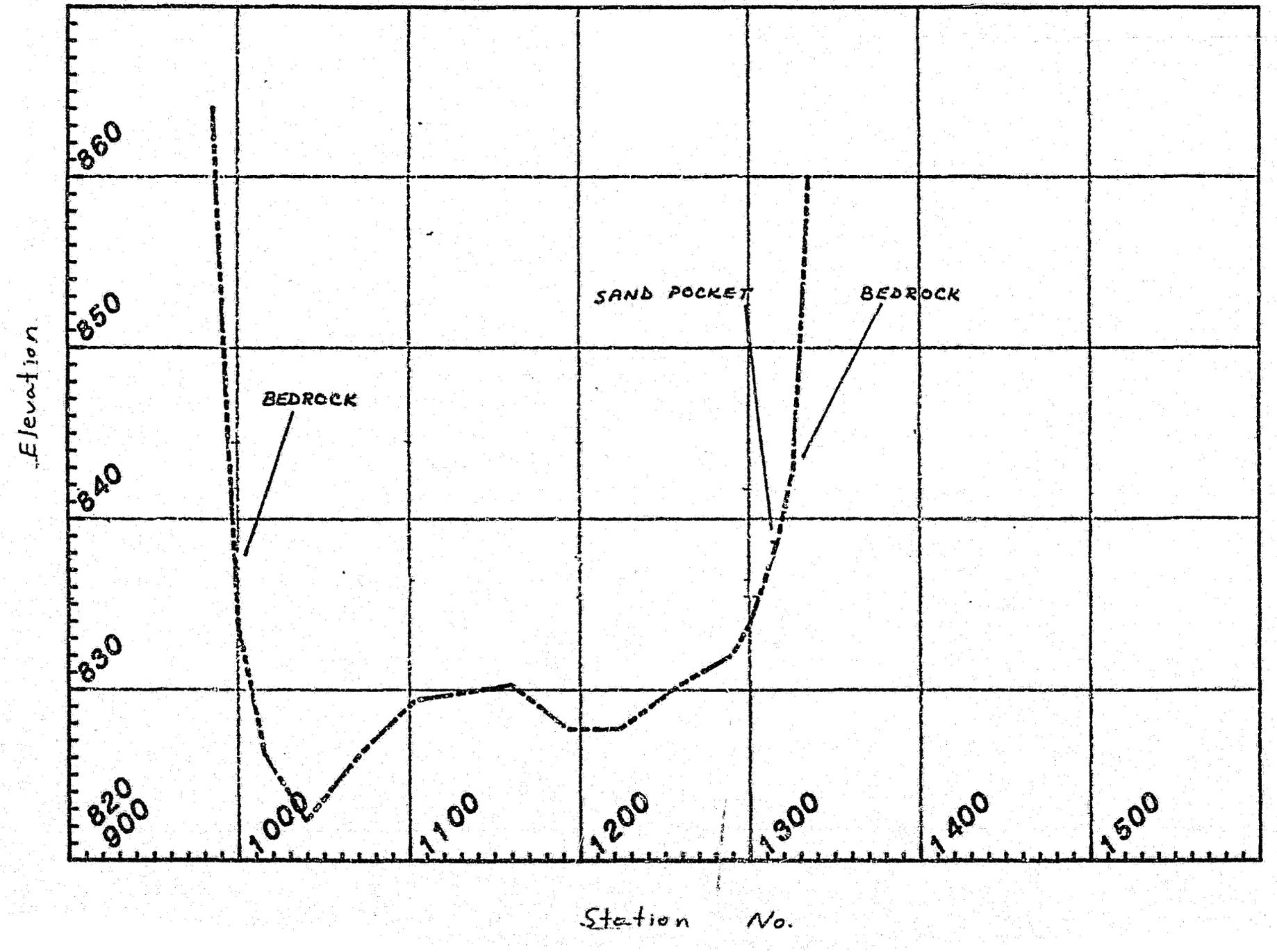
LRX - 61

DATE OF SURVEY : OCTOBER 22, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
9+95	840.0		MC	BEDROCK
10+00	832.48			E.O.W, L/B BEDROCK FACE
12+87	832.49			EOW R/B BEDROCK FACE
13+06	838.9			TOE OF BEDROCK FACE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 62



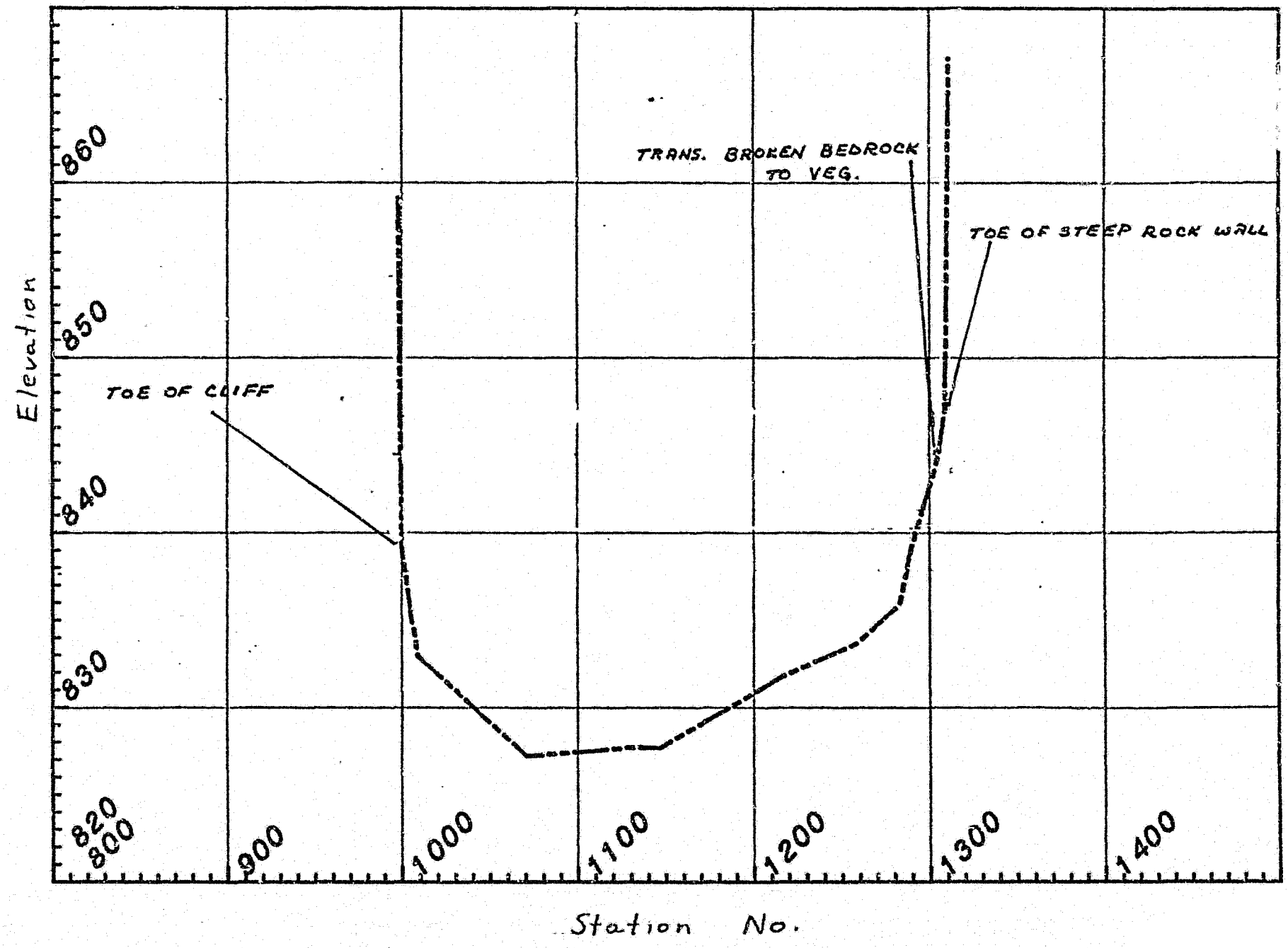
LRX - 62

DATE OF SURVEY: OCTOBER 22, 1980

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
9+95	846.0			BEDROCK
10+00	833.89			E.O.W., NEARLY VERTICAL RX. FACE
13+00	833.90			E.O.W, R/B
13+16	838.5			SAND POCKET
13+26	843.0			BEDROCK
				- steep valley walls, main channel confined

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 63



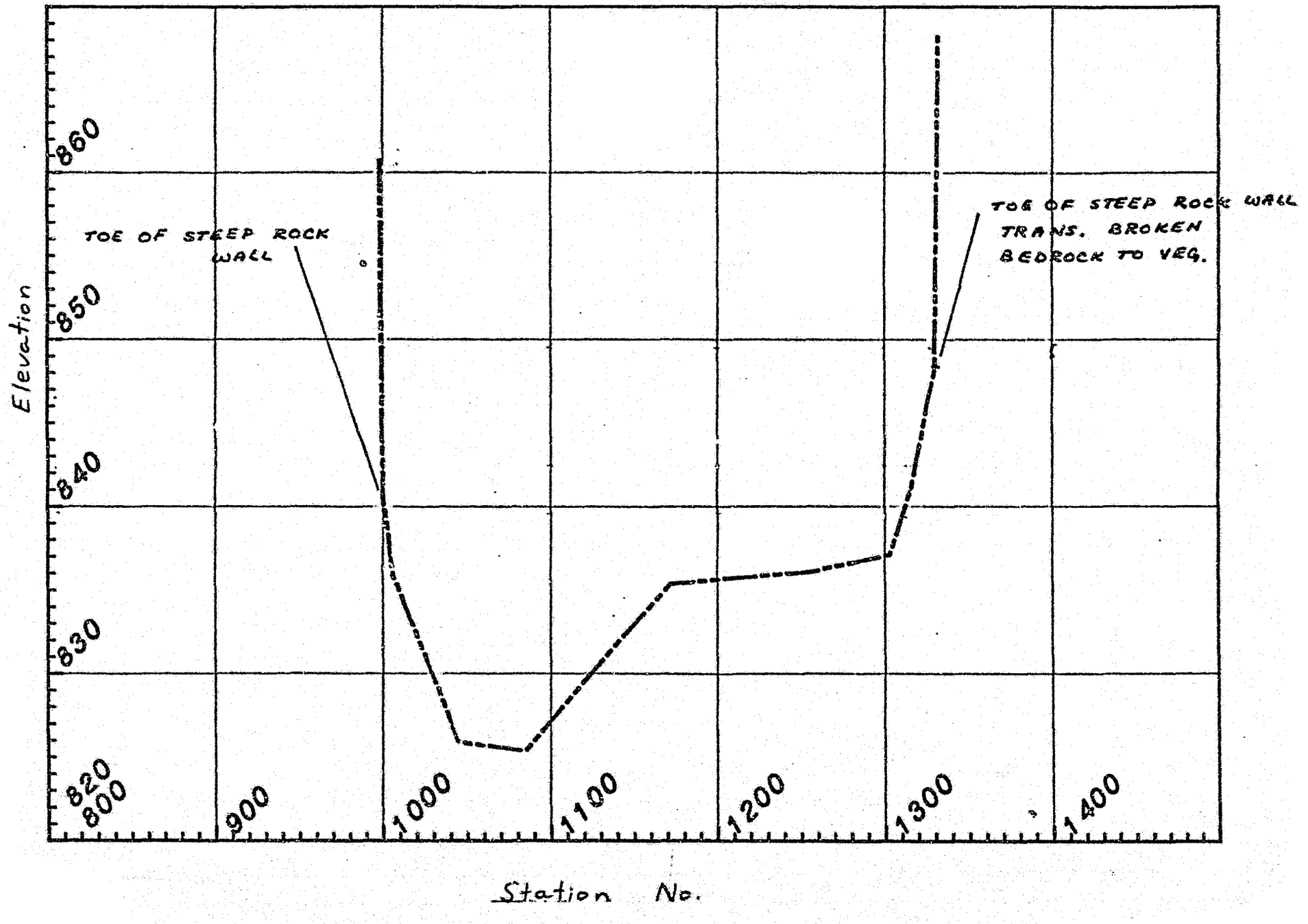
LRX - 63

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+00	839.12			TOE OF CLIFF
13+05	844.3			TRANS. BROKEN BEDROCK TO VEG.
13+09	847.1			TOE OF STEEP ROCK WALL

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 64



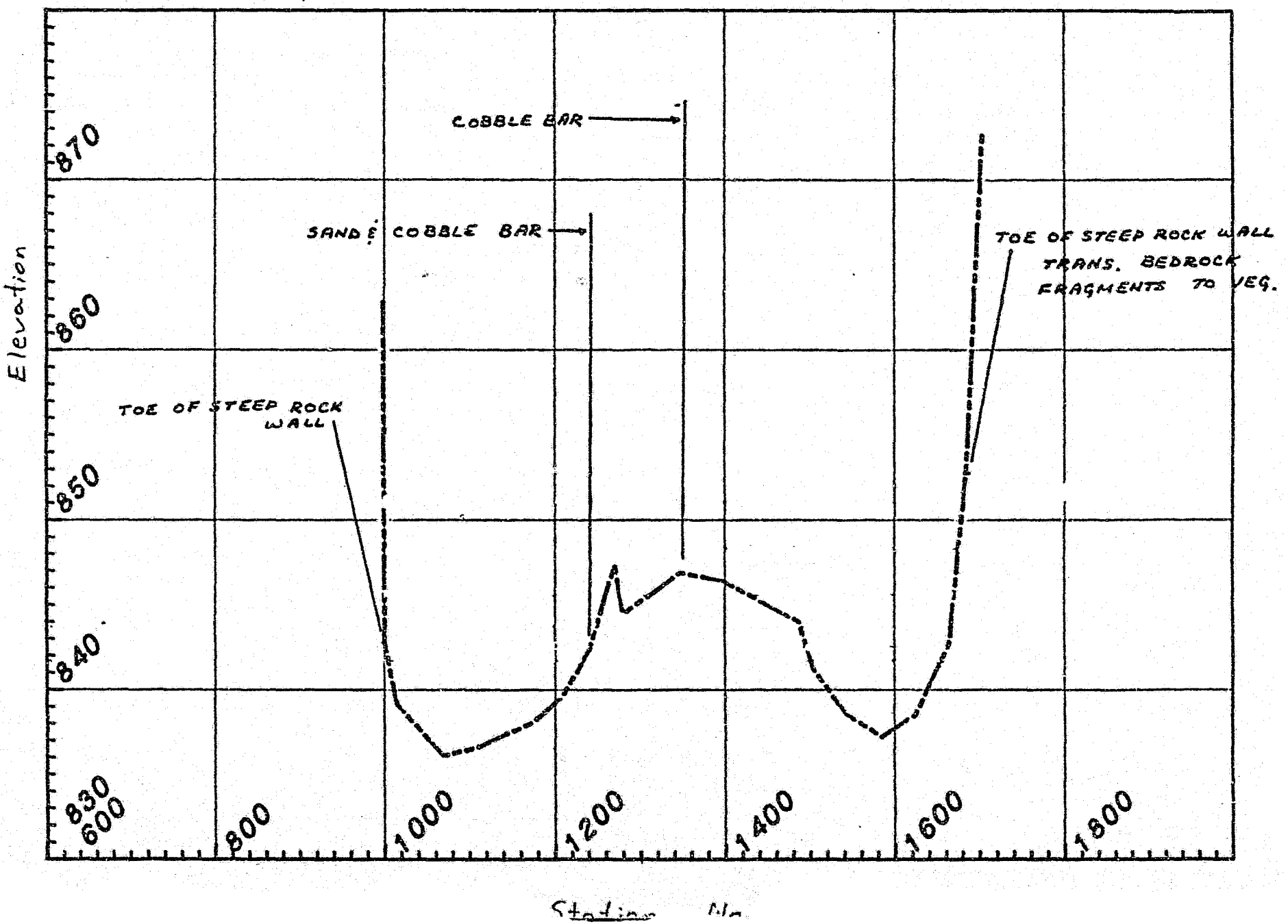
LRX - 64

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	840.7			TOE OF STEEP ROCK WALL
13+30	848.23			TOE OF STEEP ROCK WALL, TRANS. BROKEN BEDROCK TO VEG.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 65



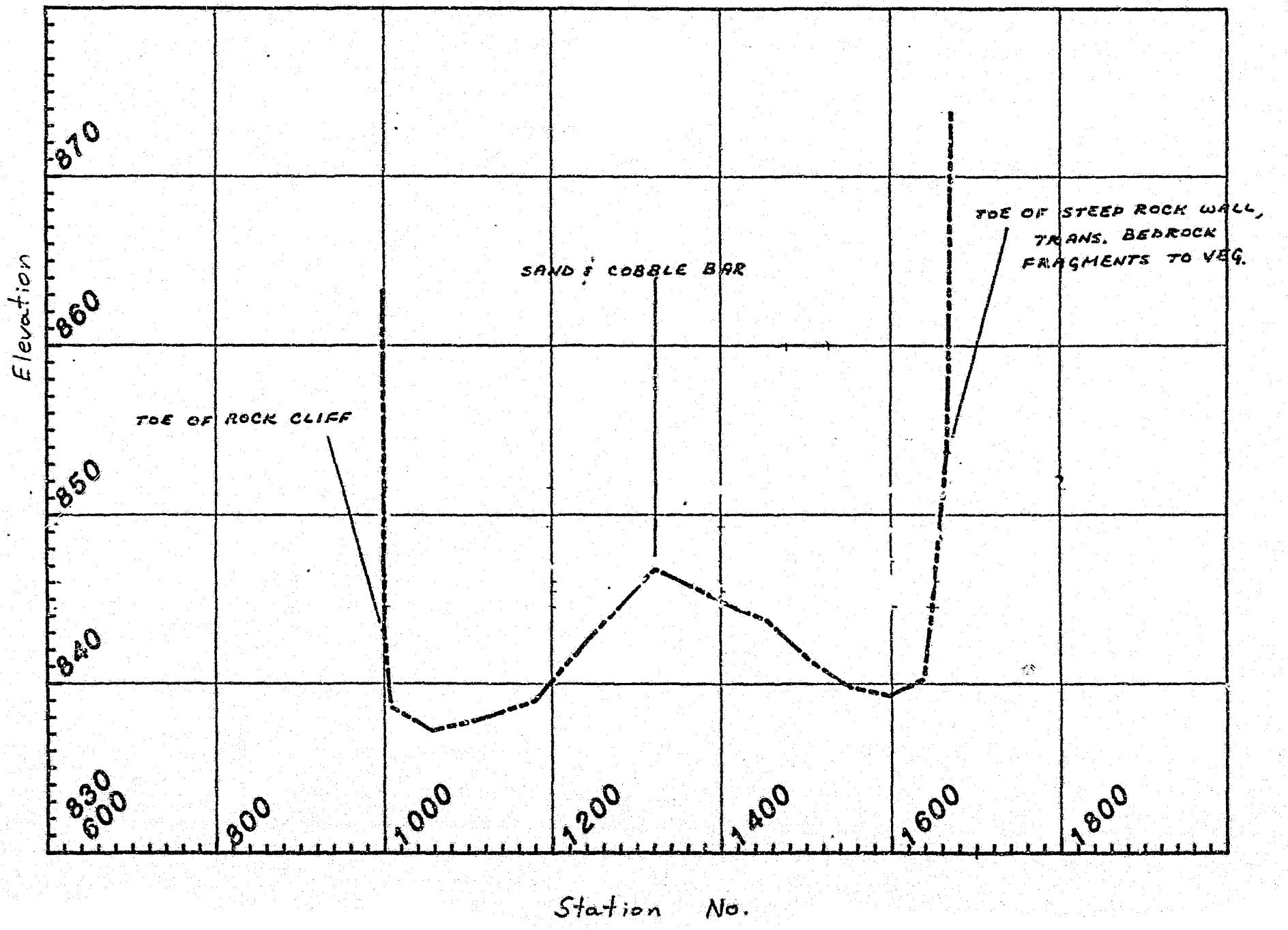
LRX - 65

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	842.85			TOE OF STEEP ROCK WALL
12+41	842.43			SAND & COBBLE BAR - 50/50 MIX. COBBLES 12-14" DIAM.
13+47	846.9			HIGH PT ON BAR - COBBLE BED
16+84	852.72			TOE OF STEEP ROCK WALL, TRANSITION FROM BEDROCK FRAGMENTS TO VEG.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 66



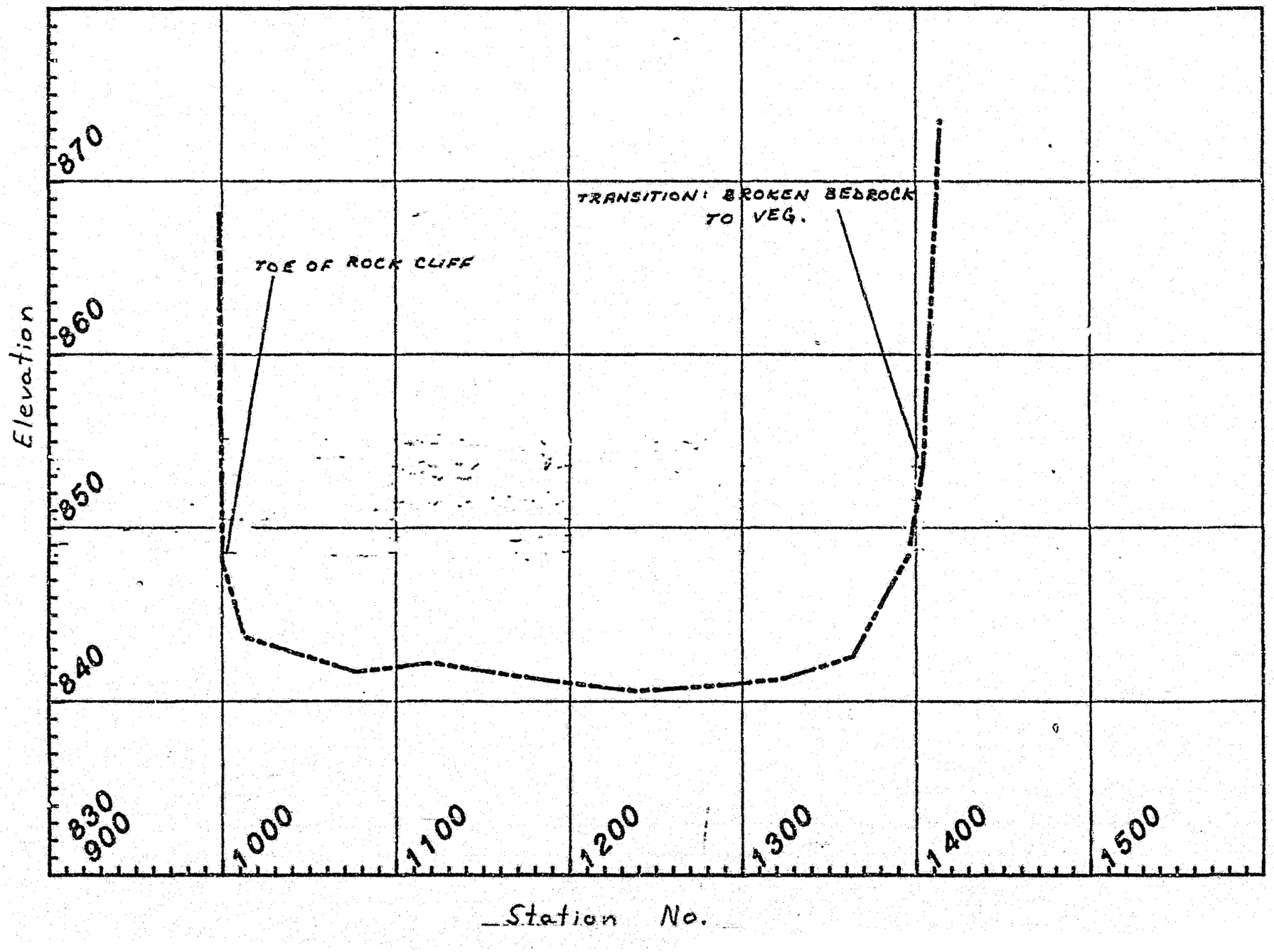
LRX - 66

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	843.17			TOE OF ROCK CLIFF
13+22	846.8			HIGH PT ON SAND & COBBLE BAR
16+67	853.75			TOE OF STEEP ROCK WALL, ALSO TRANSITION FROM BEDROCK FRAGMENTS TO VEG.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 67



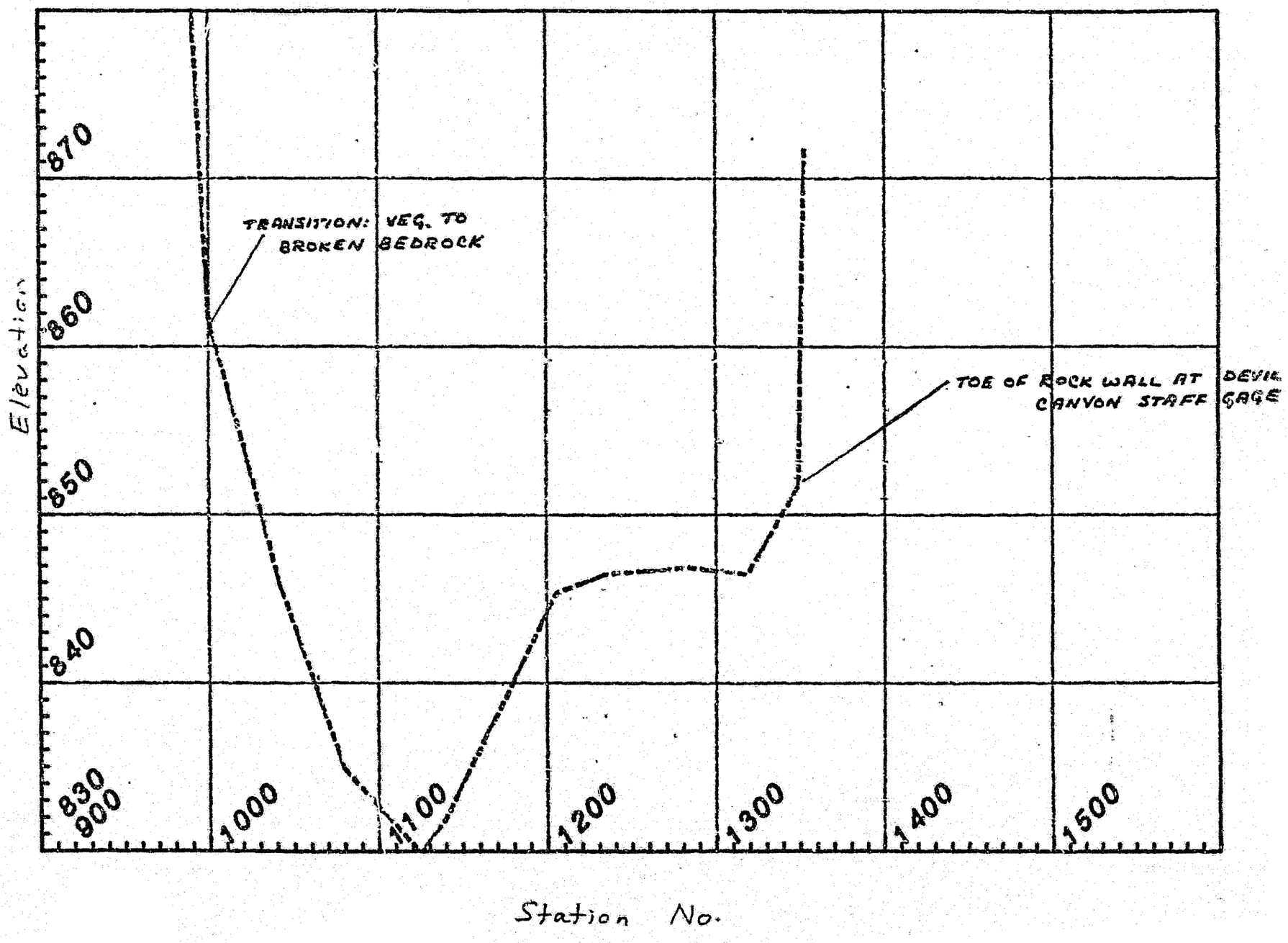
LRX - 67

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV.	MANNING'S 'n'		DESCRIPTION
10+00	848.10			TOE OF ROCK CLIFF
14+04	853.47			TRANS. BROKEN BEDROCK TO VEG.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 68



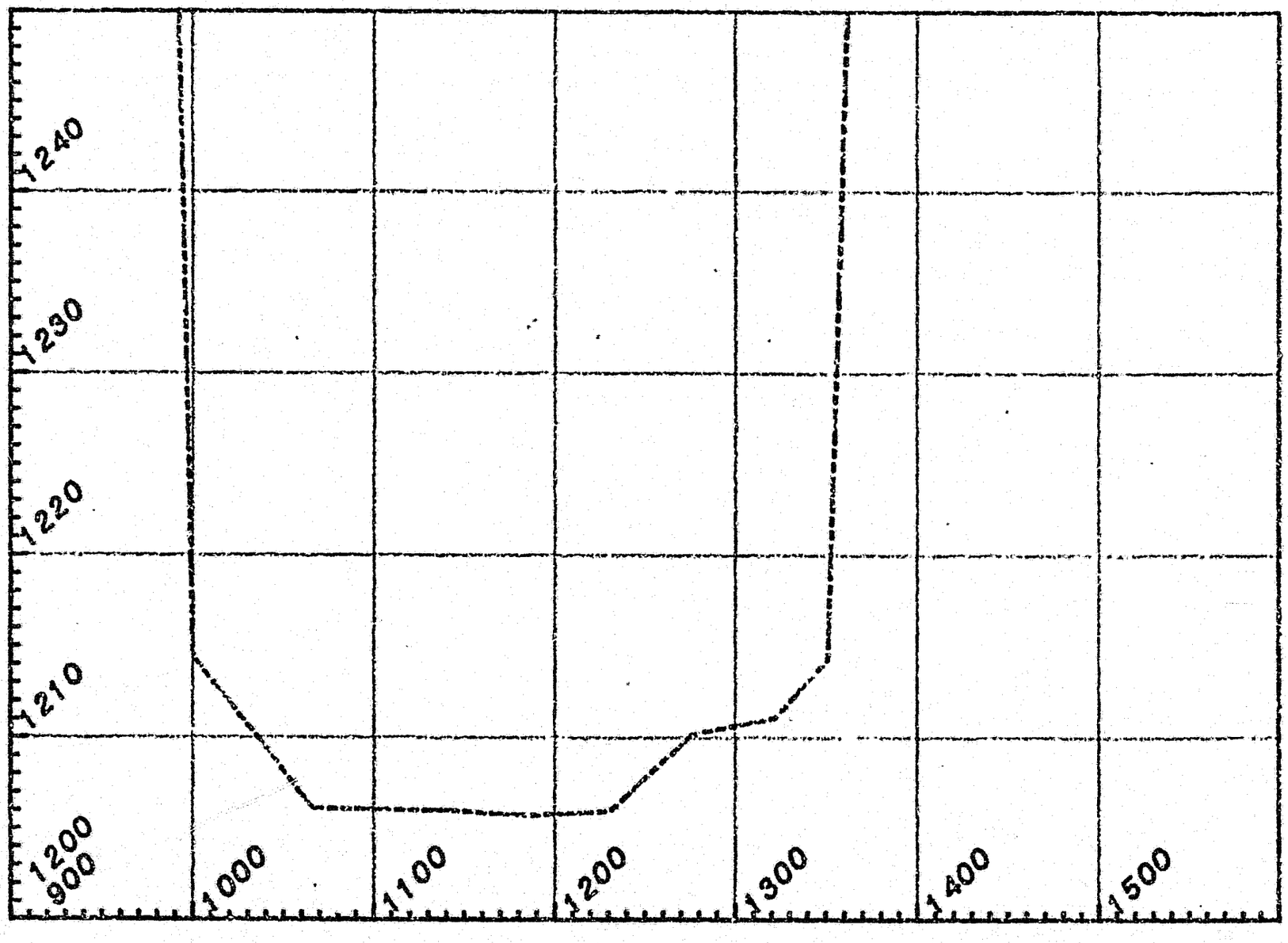
LRX - 68

DATE OF SURVEY: MAY 21, 1981

STATION	ELEV	MANNING'S 'n'		DESCRIPTION
10+00	861.70			TOE OF STEEP ROCK WALL, TRANSITION: VEG TO BROKEN BEDROCK
13+49	851.69			TOE OF ROCK WALL AT DEVIL CANYON STAFF GAGE.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 121



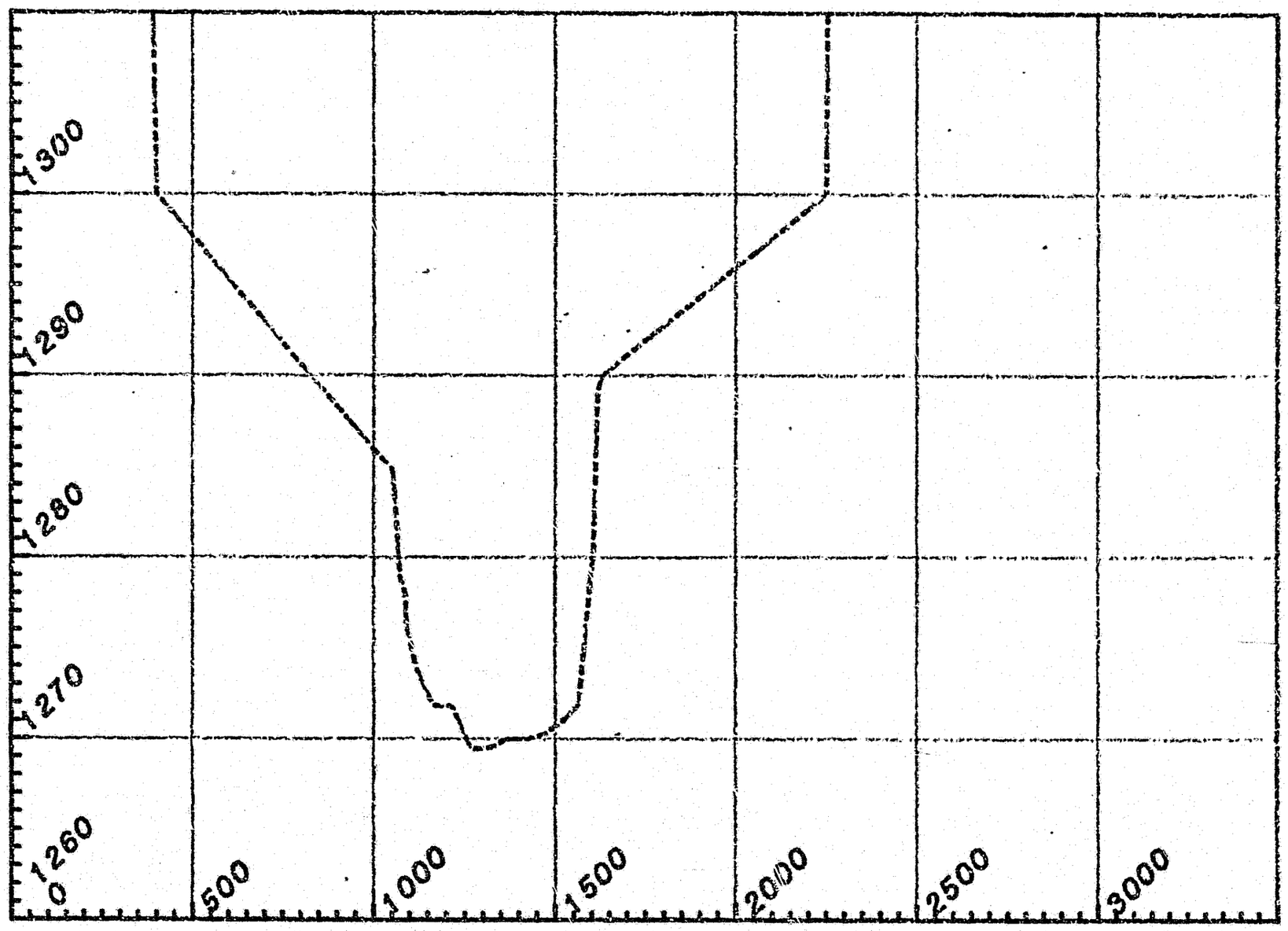
URX - 121

DATE OF SURVEY : MARCH 13, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1214.4	TOE OF CLIFF, TOP OF ICE, L.B.
10+66	1206.1	CHANNEL BOTTOM
12+31	1206.0	CHANNEL BOTTOM
12+76	1210.2	CHANNEL BOTTOM
13+22	1211.1	CHANNEL BOTTOM
13+51	1214.3	R. TOE OF RIDGE
13+54	1229.75	5/8" REBAR w/ AL CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 120



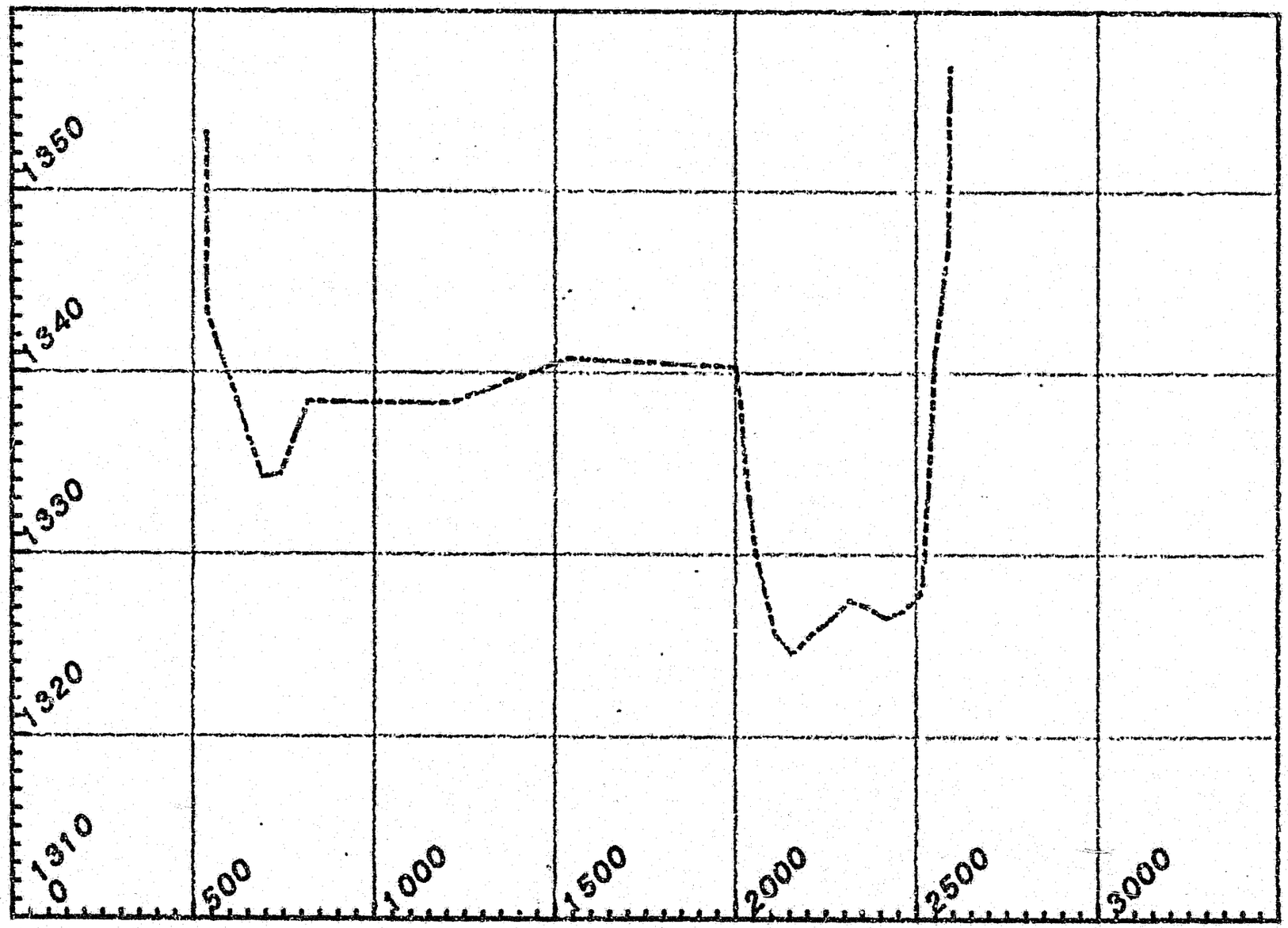
URX - 129

DATE OF SURVEY : MARCH 12, 1981

STATION	ELEVATION	DESCRIPTION
3+90	1310.0	
10+50	1284.82	5/8" REBAR W/ AL. CAP, L.B.
11+65	1271.8	CHANNEL BOTTOM
12+15	1271.8	CHANNEL BOTTOM
12+66	1269.4	CHANNEL BOTTOM
13+18	1269.5	CHANNEL BOTTOM
14+22	1270.0	CHANNEL BOTTOM
15+62	1271.9	CHANNEL BOTTOM
16+05	1280.6	TOE OF R. BANK
16+16	1289.2	SHLD. OF R. BANK
16+30	1290.03	5/8" REBAR W/ AL. CAP, R.B.
22+50	1300.00	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 119



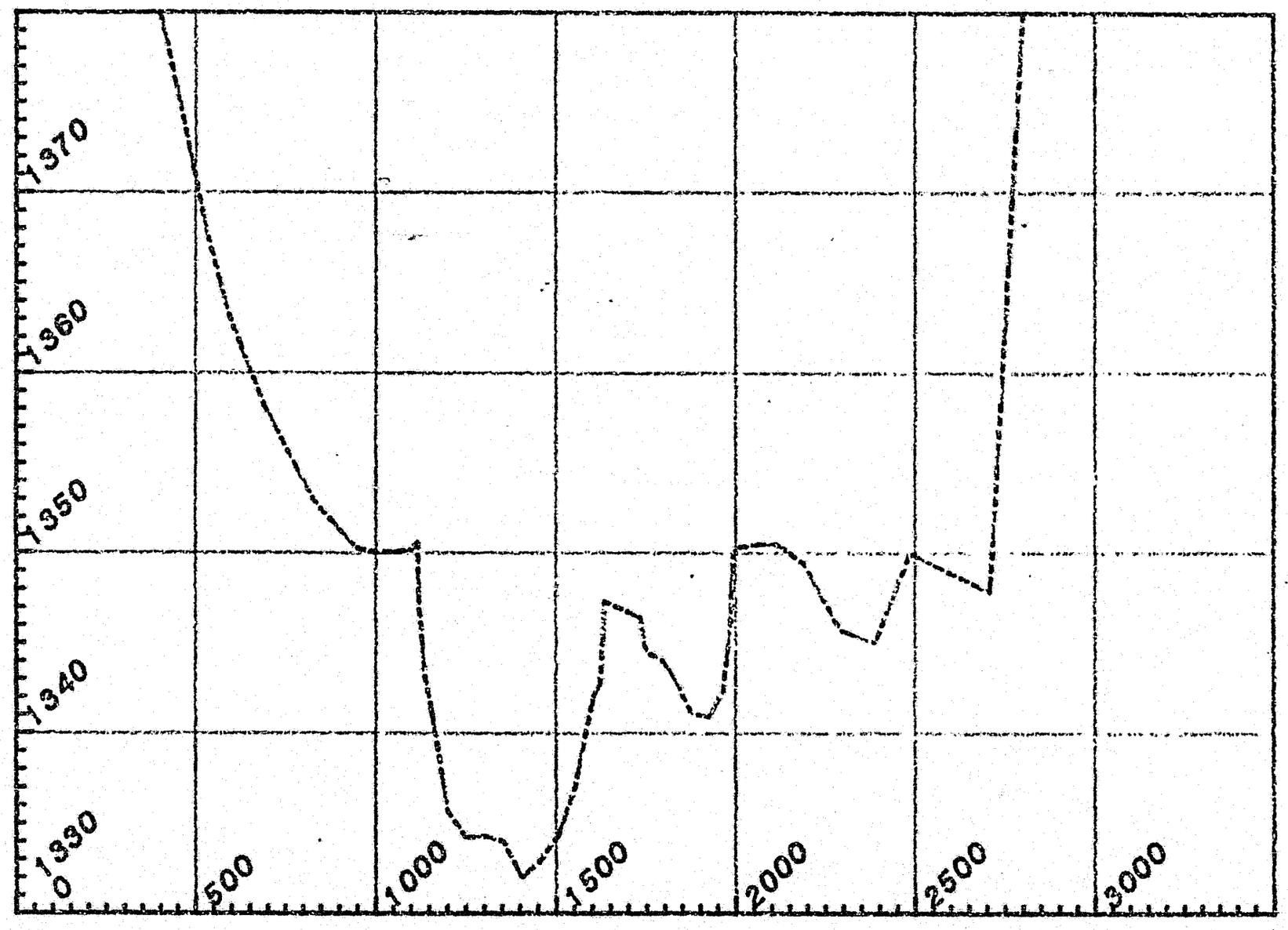
URX - 119

DATE OF SURVEY : MARCH 12, 1981

STATION	ELEVATION	DESCRIPTION
5+39	1343.2	TOE OF SLOPE, DENSE BRUSH
6+89	1334.2	MEADOW BEGINS
7+41	1334.4	G.S., MEADOW ENDS
8+16	1338.42	G.S.
12+05	1338.35	G.S.
15+35	1340.82	G.S., DENSE SPRUCE
20+00	1340.35	5/8" REBAR W/ AL. CAP, L.B.
20+11	1338.6	SHLD.
20+29	1334.4	TOE
21+11	1325.6	CHANNEL BOTTOM
21+58	1324.5	CHANNEL BOTTOM
23+14	1327.5	CHANNEL BOTTOM
24+18	1326.5	CHANNEL BOTTOM
25+15	1327.9	CHANNEL BOTTOM
25+36	1334.9	R. TOE
25+50	1341.0	R. SUB - SHLD.
25+87	1347.14	5/8" REBAR W/ AL. CAP

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 118



URX - 118

DATE OF SURVEY : MARCH 11, 1981

STATION	ELEVATION	DESCRIPTION
5+37	1367.45	TOE OF RIDGE, L.B.
9+43	1350.35	GROUND SHOT
11+00	1350.30	5/8" REBAR W/AL. CAP, L.B.
11+16	1350.7	L. SHLD.
11+38	1343.1	L. TOE ON ICE
12+02	1335.6	CHANNEL BOTTOM
12+51	1334.2	CHANNEL BOTTOM
13+54	1334.0	CHANNEL BOTTOM
14+05	1332.0	CHANNEL BOTTOM
15+54	1337.2	CHANNEL BOTTOM
16+22	1342.8	R. TOE OF MAIN CHANNEL, L. TOE ISLAND
16+35	1347.3	L. SHLD. OF ISLAND
17+35	1346.4	R. SHLD. OF ISLAND
17+48	1344.5	R. TOE OF ISLAND, L. TOE OF SIDE CHANNEL
17+91	1344.1	G.S. IN SIDE CHANNEL
19+23	1340.9	CHANNEL BOTTOM
19+64	1342.3	TOP OF ICE

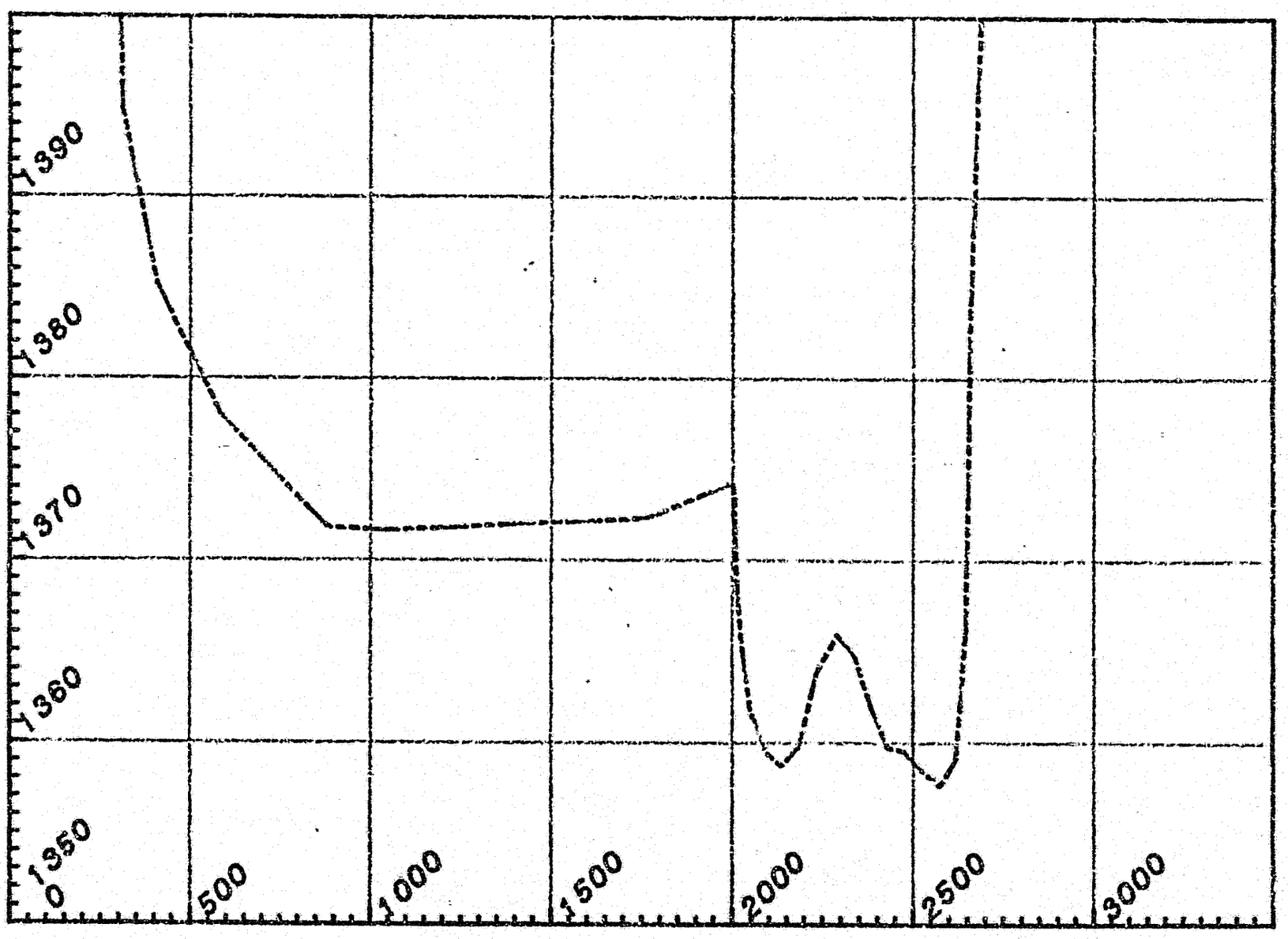
URX - 118 (cont.)

DATE OF SURVEY : MARCH 31, 1981

STATION	ELEVATION	DESCRIPTION
19+86	1346.3	R. TOE
19+90	1349.6	R. SHLD.
20+00	1350.31	5/8" REBAR W/AL. CAP, R.B.
21+12	1350.47	G.S.
22+93	1345.67	G.S.
23+87	1344.97	G.S.
24+85	1349.97	G.S.
27+07	1347.77	TOE OF RIDGE, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 117



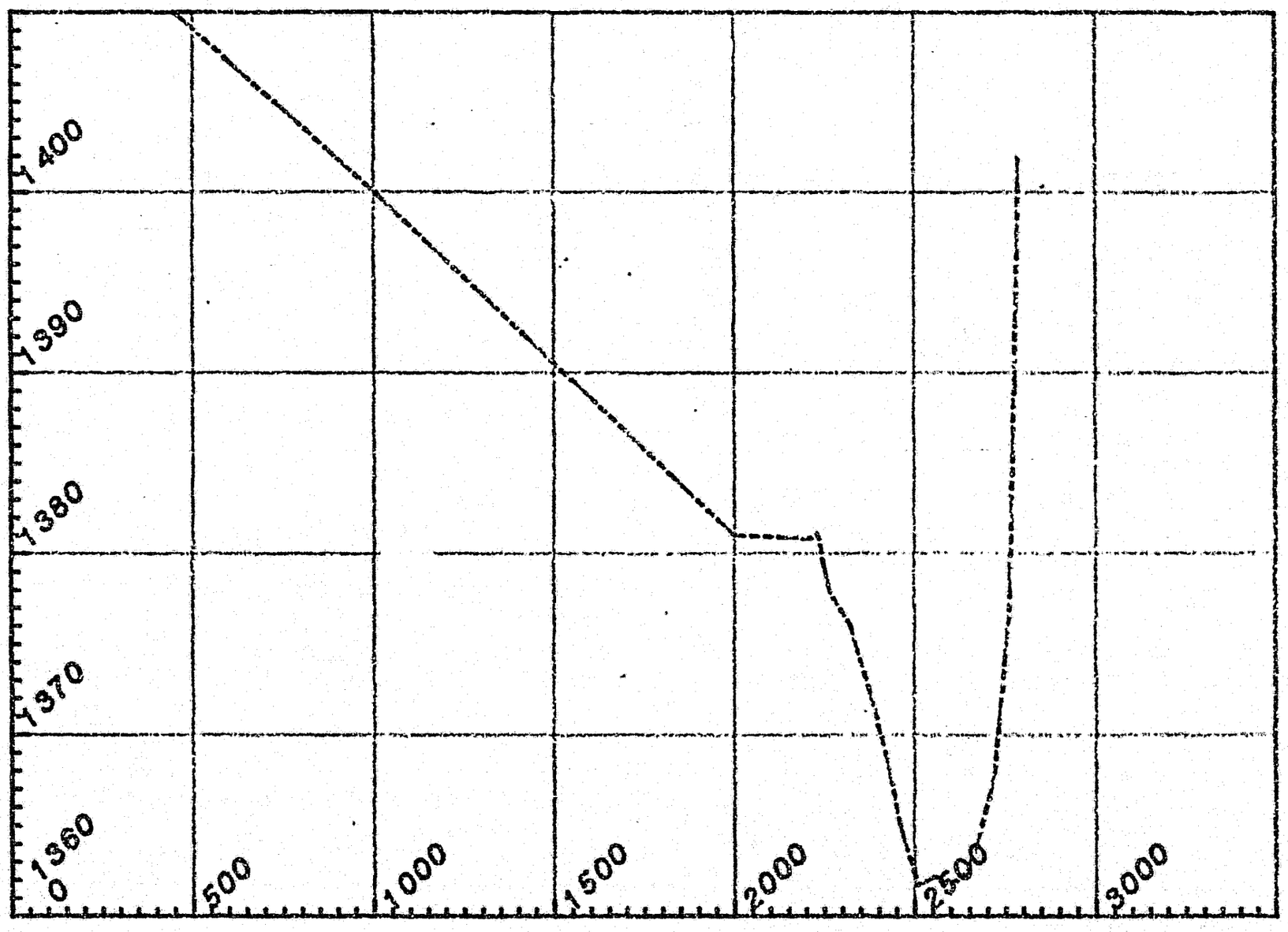
URX- 117

DATE OF SURVEY : MARCH 11, 1981

STATION	ELEVATION	DESCRIPTION
3+10	1394.85	TOE OF STEEP SLOPE
4+08	1385.20	GROUND SHOT, SMALL BLACK SPRUCE
5+82	1378.00	G.S.
8+79	1371.81	G.S.
17+60	1372.29	G.S., SCATTERED SPR.
20+00	1374.33	5/8" REBAR W/AL. CAP, L.B.
20+04	1373.4	SHOULDER L.B.
20+07	1370.0	TOE L.B.
20+46	1361.8	CHANNEL BOTTOM
21+34	1358.7	CHANNEL BOTTOM
22+89	1365.9	CHANNEL BOTTOM
23+80	1361.9	CHANNEL BOTTOM
25+74	1357.6	CHANNEL BOTTOM
26+45	1366.3	TOE OF R. HILLSIDE, TOP OF ICE
26+58	1383.81	5/8" REBAR W/AL. CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 116



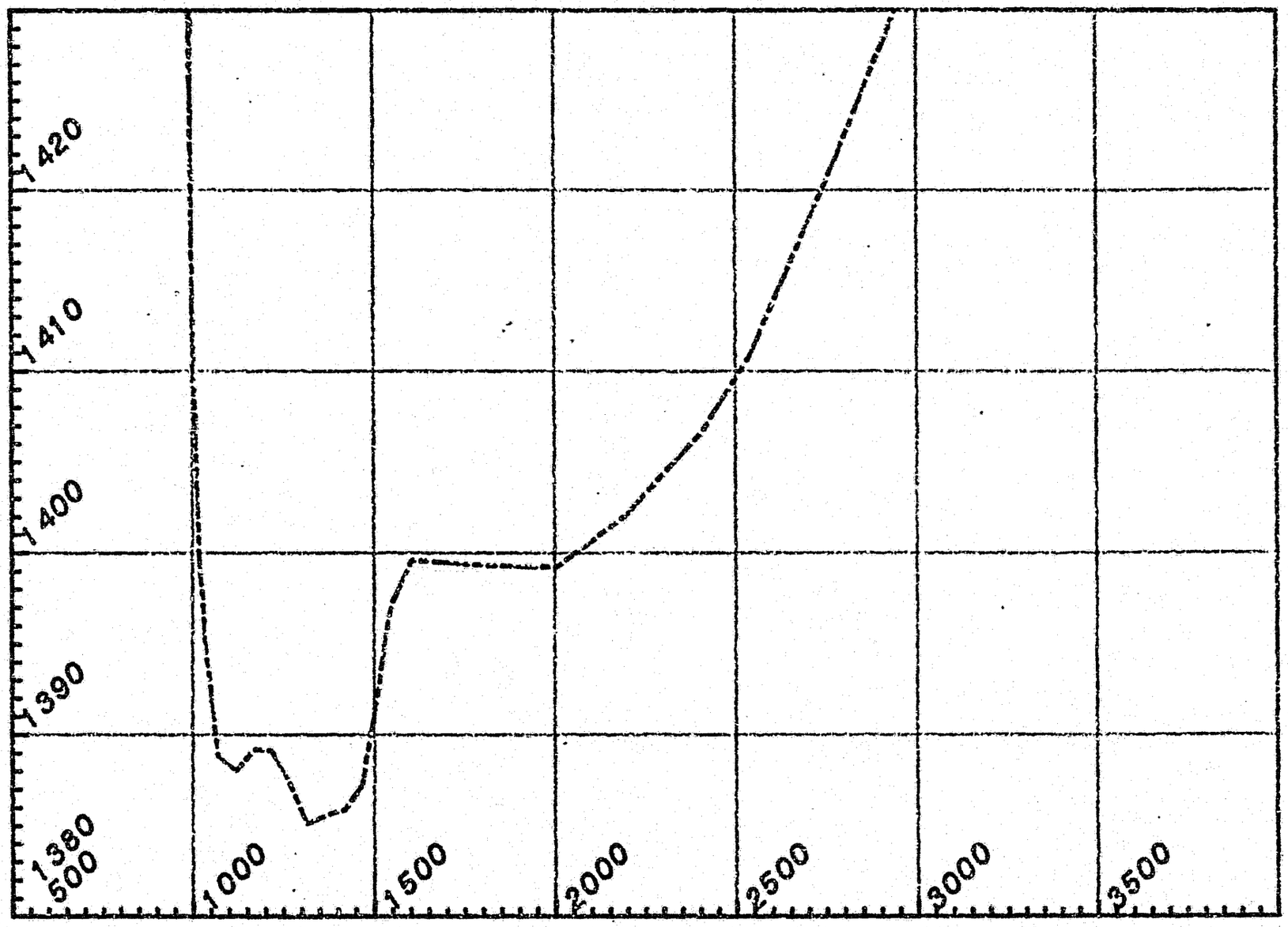
URX - 116

DATE OF SURVEY : MARCH 11, 1981

STATION	ELEVATION	DESCRIPTION
4+50	1410.0	
10+00	1400.0	
20+00	1381.0	GROUND SHOT
22+12	1380.81	5/8" REBAR W/ AL. CAP, L.B.
22+30	1381.1	SHLD. OF L.B.
22+66	1377.8	L. TOE
23+22	1376.0	EDGE OF SPARCE VEGATATION
25+09	1361.7	CHANNEL BOTTOM
25+56	1362.2	CHANNEL BOTTOM
26+00	1361.7	CHANNEL BOTTOM
26+45	1362.5	CHANNEL BOTTOM
27+61	1376.8	R. TOE OF HILLSIDE
27+75	1389.24	5/8" REBAR W/ AL. CAP, R. HILLSIDE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 115



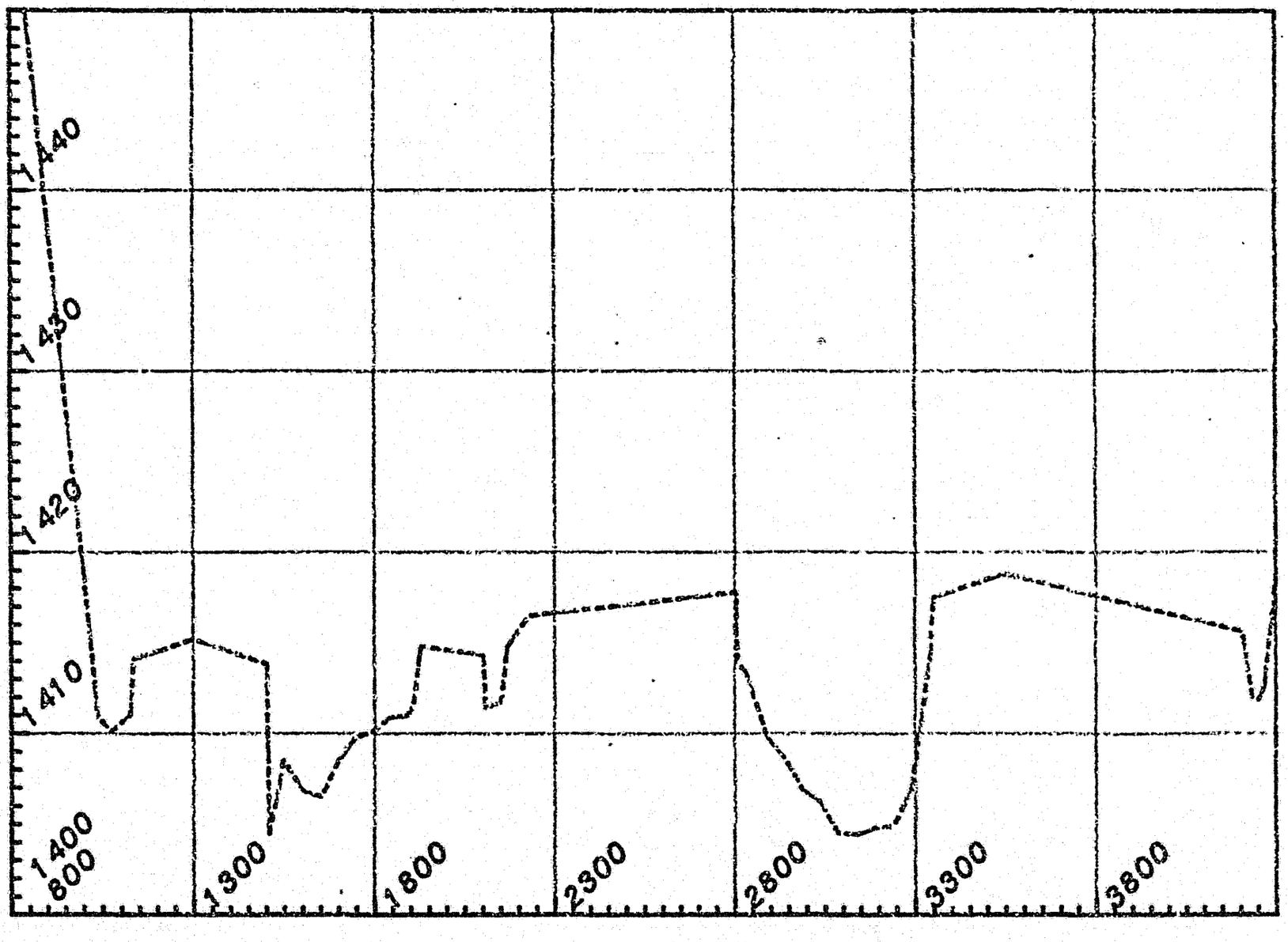
URX - 115

DATE OF SURVEY : MARCH 10, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1413.59	5/8" REBAR w/ ALUM. CAP, L.B.
10+34	1395.3	L. TOE ON ICE
10+70	1388.8	CHANNEL BOTTOM
11+20	1388.0	CHANNEL BOTTOM
11+68	1389.2	CHANNEL BOTTOM
12+17	1389.1	CHANNEL BOTTOM
13+16	1385.1	CHANNEL BOTTOM
14+65	1387.2	CHANNEL BOTTOM
16+03	1399.67	5/8" REBAR w/ ALUM. CAP, R.B.
20+03	1399.2	G.S.
25+40	1416.87	G.S.
27+87	1432.31	GROUND SHOT

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 1 1 4



URX- 114

DATE OF SURVEY : MARCH 9, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1419.06	5/8" REBAR W/ ALUM. CAP, L.B.
10+22	1414.7	LEFT SHOULDER OF SMALL SIDE CHANNEL
10+38	1410.9	L. TOE OF SIDE CHANNEL
10+74	1410.1	CTR. OF SIDE CHANNEL, TOP OF ICE
11+26	1411.1	RIGHT TOE OF SIDE CHANNEL
11+33	1414.1	L. SHLD. OF 1RST ISLAND
12+98	1415.28	CTR. G.S. OF ISLAND
15+02	1413.8	R. SHLD. OF 1RST ISLAND, L.B OF 2ND CHANNEL
15+07	1404.4	L. TOE - 2ND CHANNEL
15+47	1408.5	CHANNEL BOTTOM
16+52	1406.5	CHANNEL BOTTOM
17+48	1409.8	CHANNEL BOTTOM
19+07	1411.5	R. TOE - 2ND CHANNEL, L. TOE - 2ND ISLAND
19+23	1414.1	L. SHLD. - 2ND ISLAND
19+28	1414.83	5/8" REBAR W/ ALUM. CAP, URX -114 M.I.
21+02	1414.3	L. SHLD. OF SMALL CHANNEL ON 2ND ISLAND
21+07	1411.4	TOE OF CHANNEL

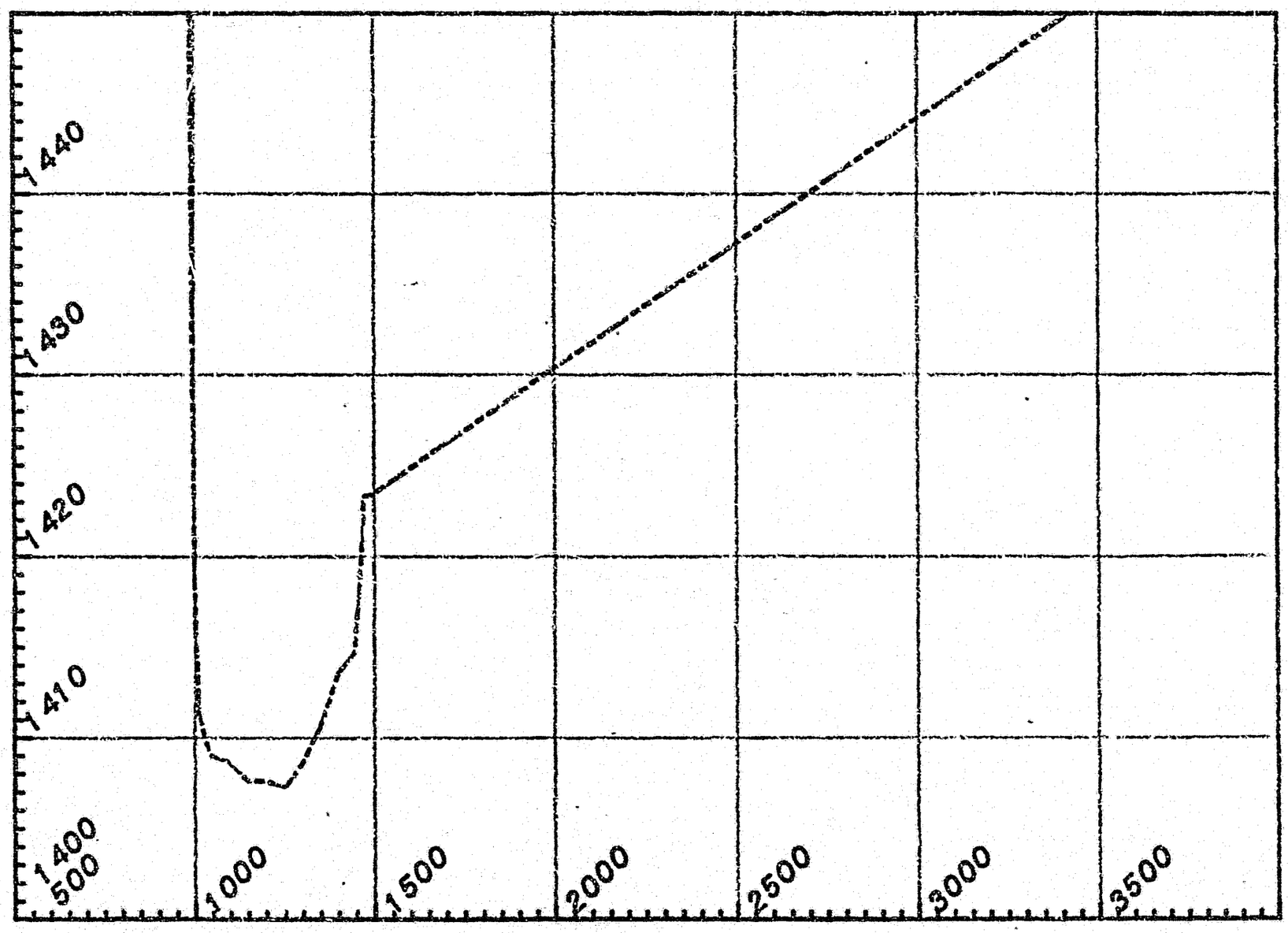
URX- 114 (cont.)

DATE OF SURVEY : MARCH 9, 1981

STATION	ELEVATION	DESCRIPTION
21+51	1411.7	R. TOE OF CHANNEL
21+68	1414.8	R. SHLD. OF SMALL CHANNEL ON 2ND ISLAND
28+04	1417.8	R. SHLD OF 2ND ISLAND, L. SHLD OF MAIN CHANNEL
28+08	1413.8	L. TOE OF MAIN CHANNEL
28+31	1413.4	EDGE OF SPARCE VEGATATION
30+86	1404.5	CHANNEL BOTTOM
32+40	1404.9	CHANNEL BOTTOM
33+43	1414.7	R. TOE OF MAIN CHANNEL, L. TOE OF 3RD ISLAND
33+49	1417.5	L. SHLD. - 3RD ISLAND
35+44	1418.8	CTR. G.S. - 3RD ISLAND
42+07	1415.6	R. SHLD. - 3RD ISLAND, L. SHLD. - 4TH CHANNEL
42+33	1412.0	L. TOE OF SIDE CHANNEL
42+67	1412.6	R. TOE OF SIDE CHANNEL
42+78	1414.4	R. SHLD. OF CHANNEL
43+35	1431.47	5/8" REBAR W/ ALUM. CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 113



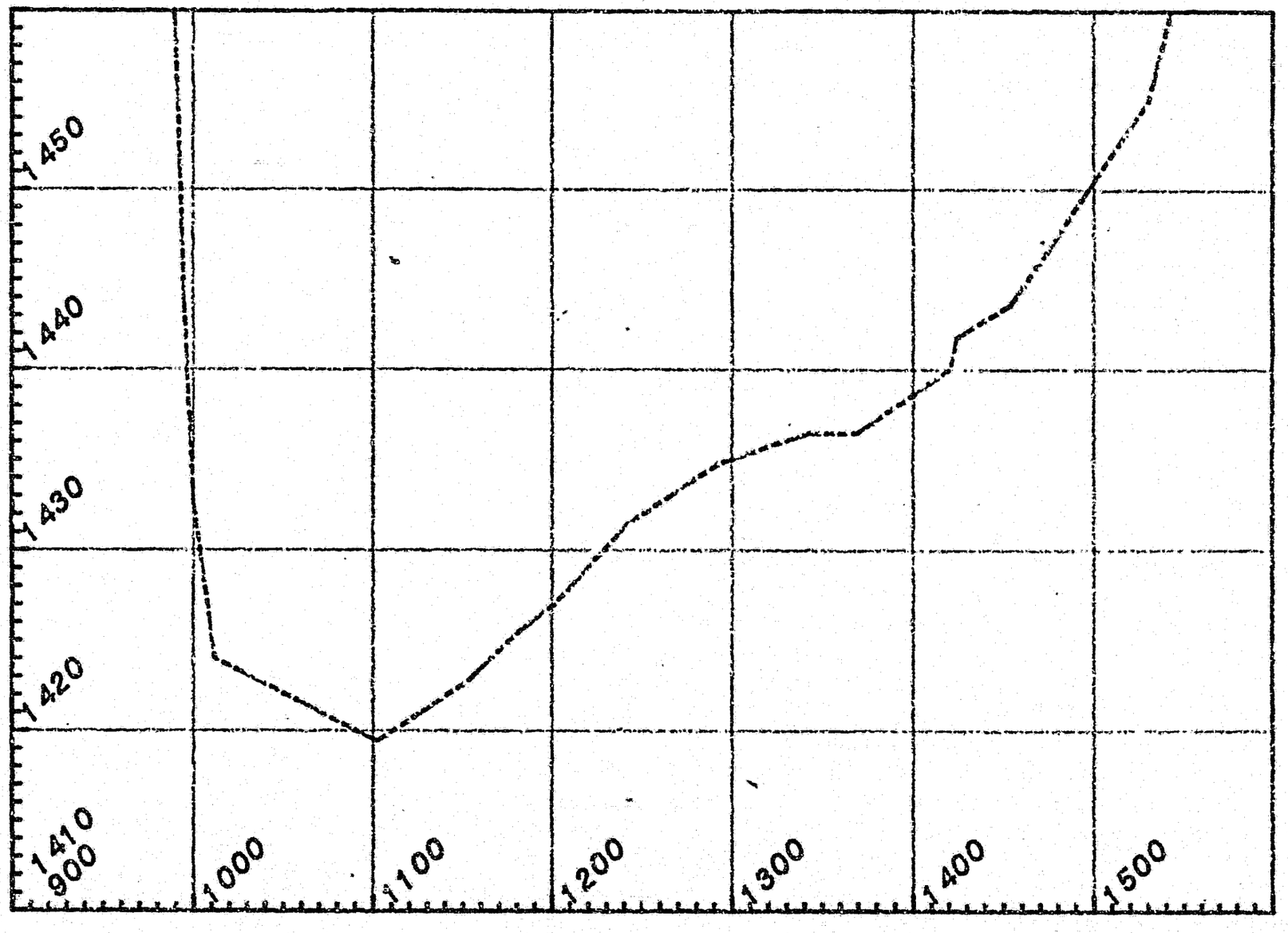
URX - 113

DATE OF SURVEY : MARCH 9, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1418.0	TOE OF VERTICAL CLIFF, L.B., TOP OF ICE
10+11	1411.3	CHANNEL BOTTOM
10+42	1409.0	CHANNEL BOTTOM
12+49	1407.3	CHANNEL BOTTOM
14+46	1414.8	CHANNEL BOTTOM
14+64	1419.9	TOE OF R.B.
14+71	1423.3	SHLD. OF R.B.
14+92	1423.46	5/8" REBAR W/ ALUM. CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 112



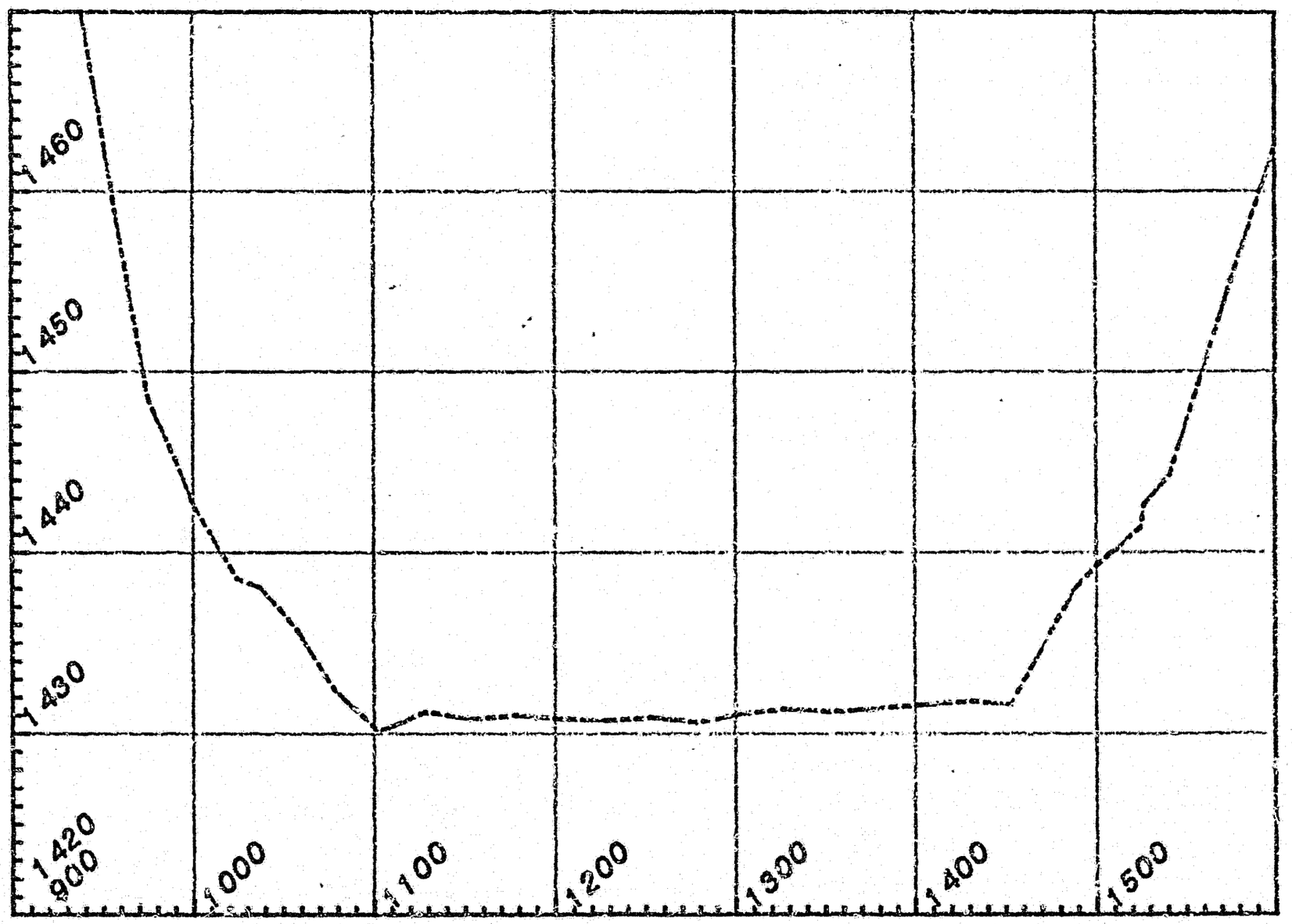
URX - 112

DATE OF SURVEY : MARCH 8, 1981

STATION	ELEVATION	DESCRIPTION
9+95	1447.00	
10+00	1432.6	TOE OF CLIFF, L.B., TOP OF ICE
10+12	1424.0	CHANNEL BOTTOM
11+02	1419.4	CHANNEL BOTTOM
12+41	1431.4	CHANNEL BOTTOM
12+92	1434.8	G.S. ON COBBLES
13+42	1436.5	CTR. - SMALL ISLAND
13+69	1436.5	CTR. - SIDE CHANNEL
14+21	1440.1	TOE OF R.B.
14+23.5	1441.8	SHLD OF R.B., SMALL TO MED. SPRUCE
14+53.5	1443.63	5/8" REBAR W/ ALUM. CAP

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 111



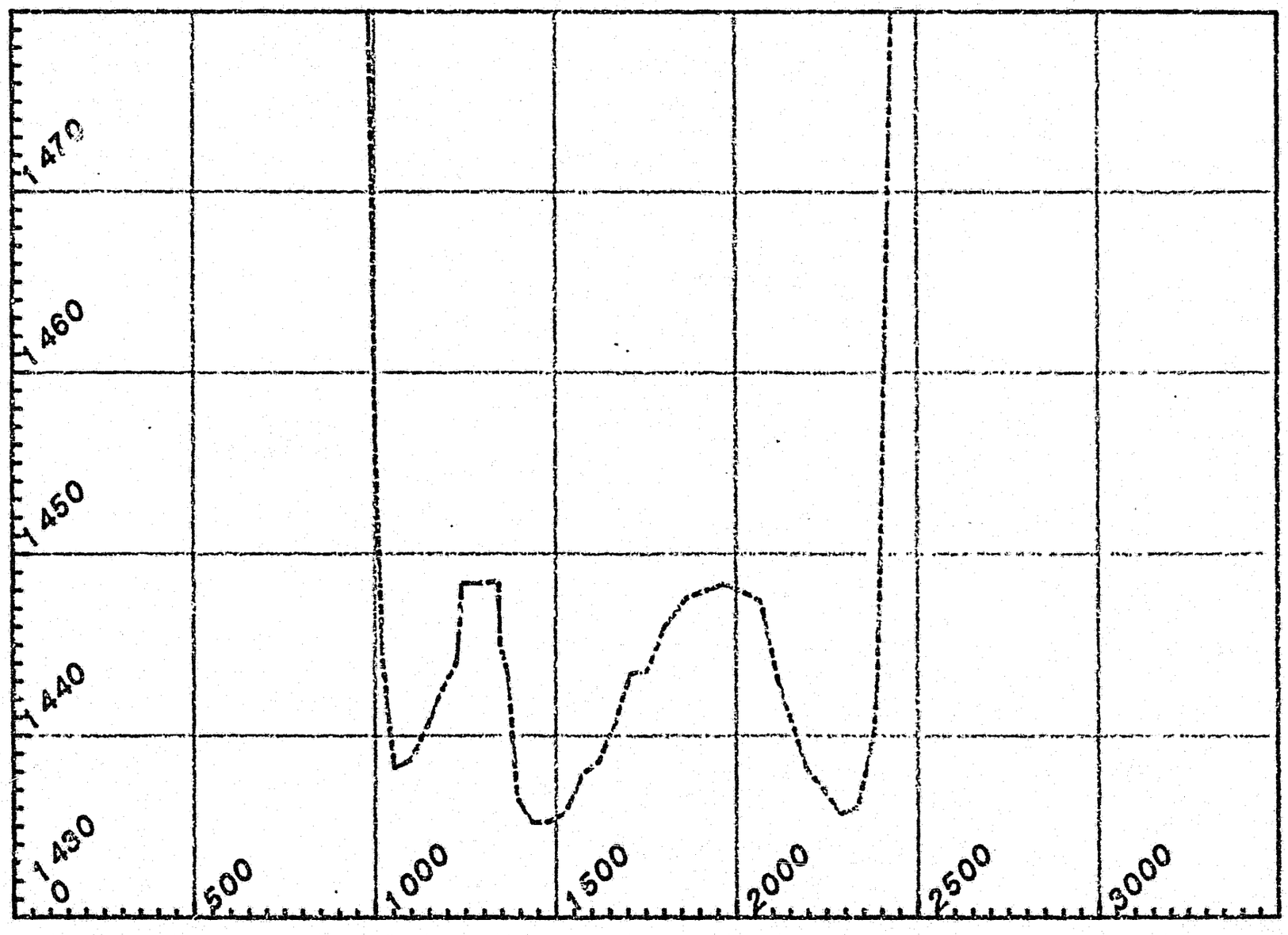
URX - 111

DATE OF SURVEY : AUGUST 21, 1980

STATION	ELEVATION	DESCRIPTION
8+75	1481.74	
9+95	1444.06	TOP OF BANK
	1443.56	EDGE OF VEGATATION
11+03	1430.14	CHANNEL BOTTOM
11+53	1430.84	CHANNEL BOTTOM
14+53	1431.64	CHANNEL BOTTOM
14+88	1438.04	RIGHT BANK
15+27	1442.70	EDGE OF VEGATATION
15+41	1444.30	TOP OF BANK
16+66	1481.36	

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 110



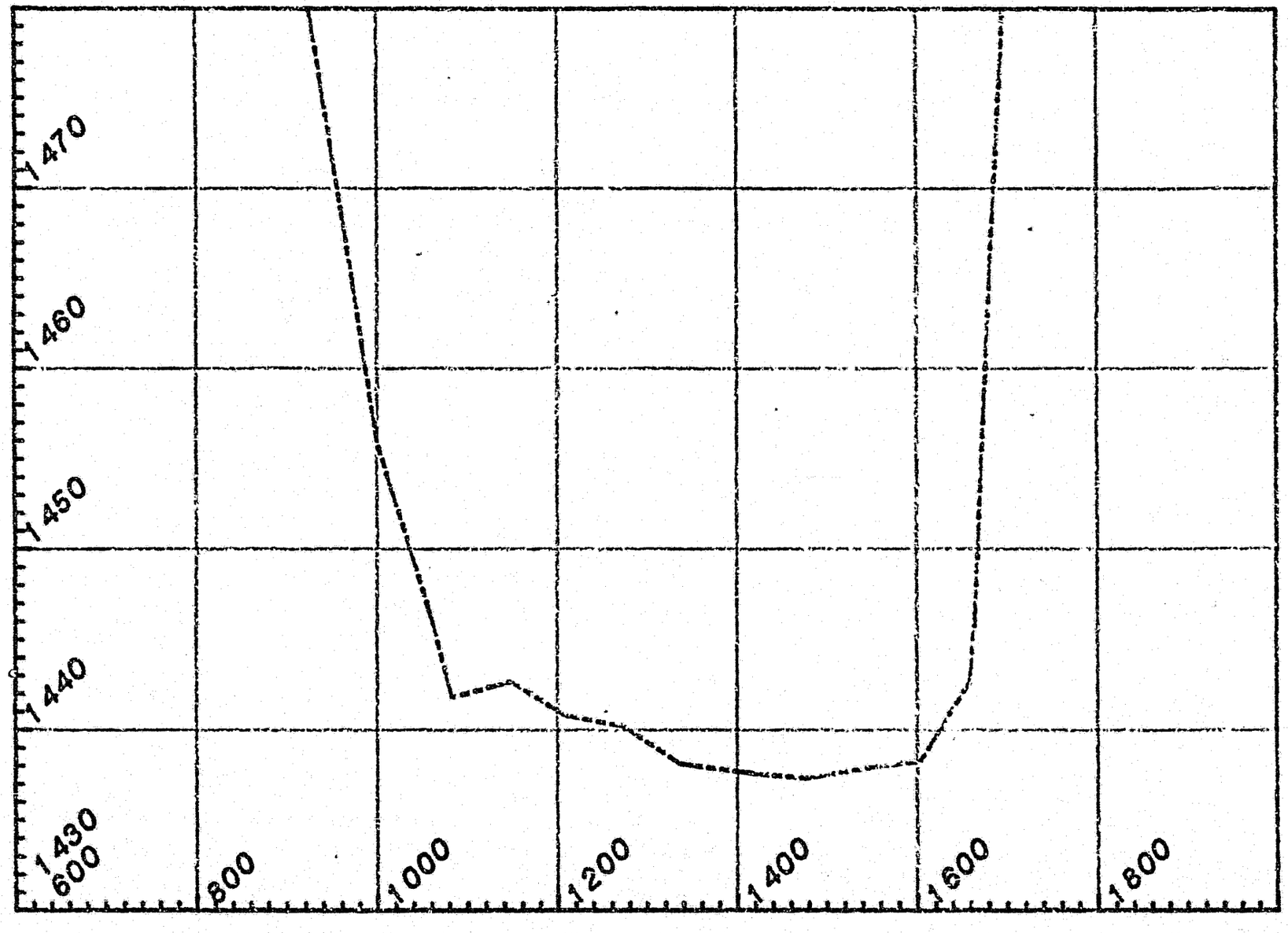
URX - 110

DATE OF SURVEY : MARCH 8, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1457.18	5/8" REBAR W/ ALUM CAP, L.B.
10+20	1444.2	TOE OF HILL
10+52	1438.2	CHANNEL BOTTOM
11+00	1438.7	CHANNEL BOTTOM
12+24	1444.0	TOE. OF 1RST ISLAND
12+38	1448.4	SHLD., L.B., 1RST ISLAND
13+40	1448.5	SHLD., R.B., 1RST ISLAND
13+46	1444.9	TOE ON RIGHT SIDE
13+91	1436.6	CHANNEL BOTTOM
15+26	1435.8	CHANNEL BOTTOM
17+75	1444.6	TOE OF 2ND ISLAND, L.B.
18+64	1447.6	L. SHLD OF 2ND ISLAND
19+64	1448.43	CENTER OF 2ND ISLAND, 5/8" REBAR W/ ALUM. CAP
20+68	1447.4	SHLD., R.B., 2ND ISLAND
21+95	1438.2	CHANNEL BOTTOM
22+88	1435.7	CHANNEL BOTTOM
23+88	1442.8	TOE, R.B.
24+04	1456.02	5/8" REBAR W/ ALUM CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 1 09



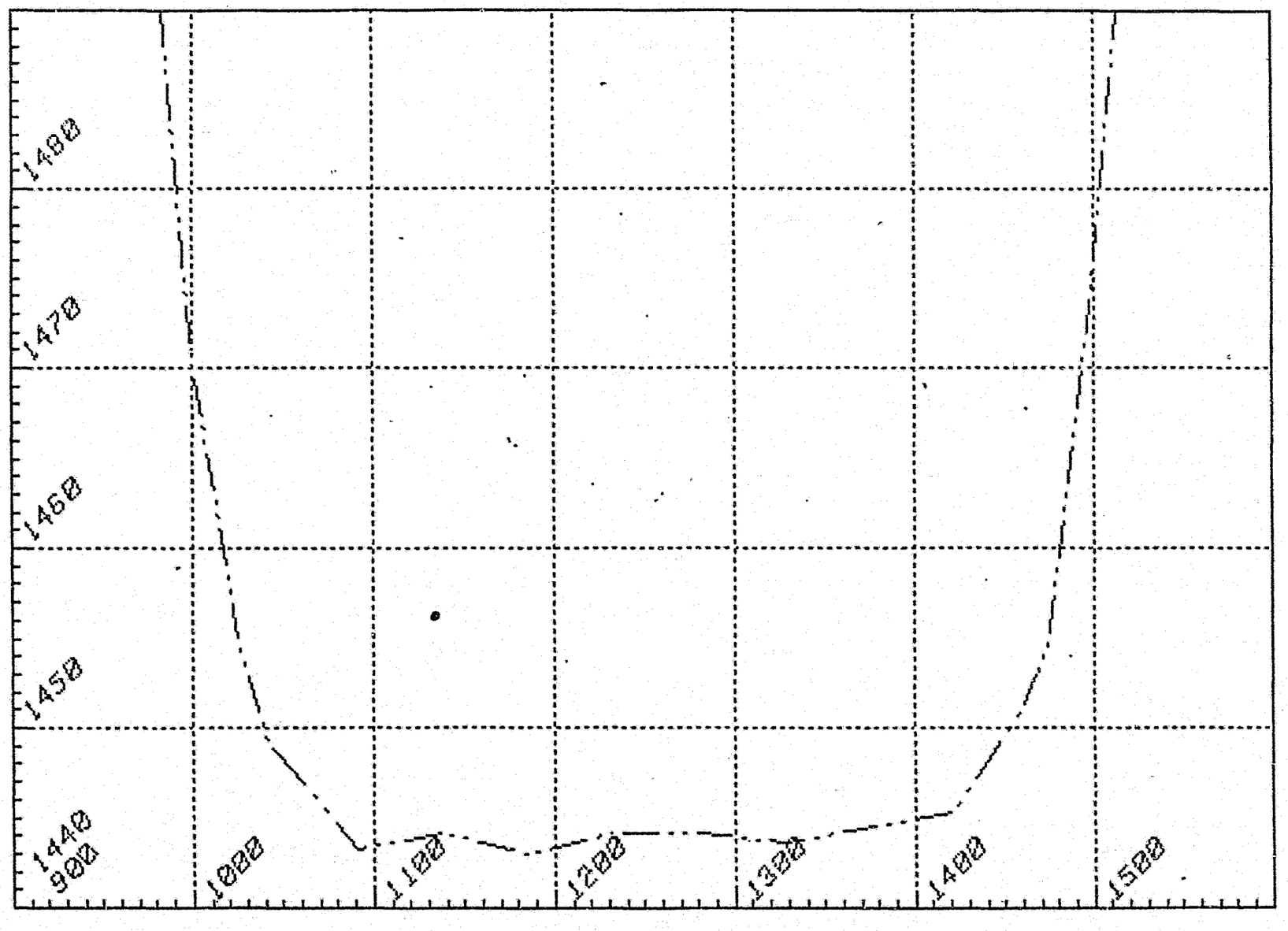
URX - 109

DATE OF SURVEY : MARCH 7, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1455.96	5/8" REBAR W/ ALUM. CAP, L.B.
10+83	1441.8	CHANNEL BOTTOM
13+37	1438.1	CHANNEL BOTTOM
14+76	1437.3	CHANNEL BOTTOM
16+03	1438.3	CHANNEL BOTTOM
16+59	1442.7	CHANNEL BOTTOM
16+82.5	1466.63	5/8" REBAR W/ ALUM CAP, TOP OF CLIFF, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 208



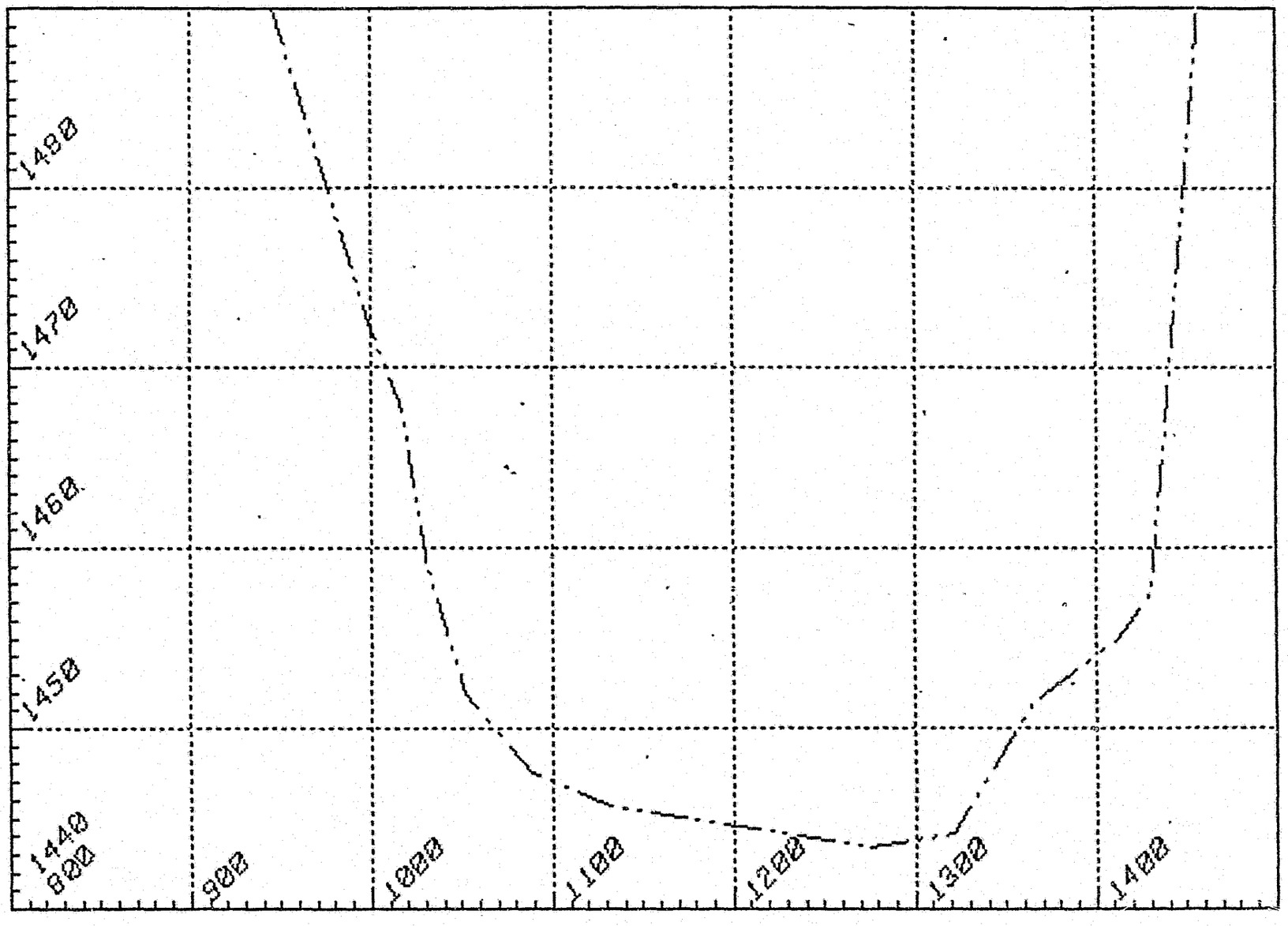
URX - 208 (108 A)

DATE OF SURVEY : MARCH 7, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1470.26	5/8" REBAR W/ AL. CAP, L.B.
10+25	1454.9	TOE OF HILL, ON ICE
10+42	1449.2	CHANNEL BOTTOM
10+91	1443.2	CHANNEL BOTTOM
14+21	1445.3	CHANNEL BOTTOM
14+74	1454.6	TOP OF SIDE HILL, R.B.
14+96	1472.21	5/8" REBAR W/ AL. CAP, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 108



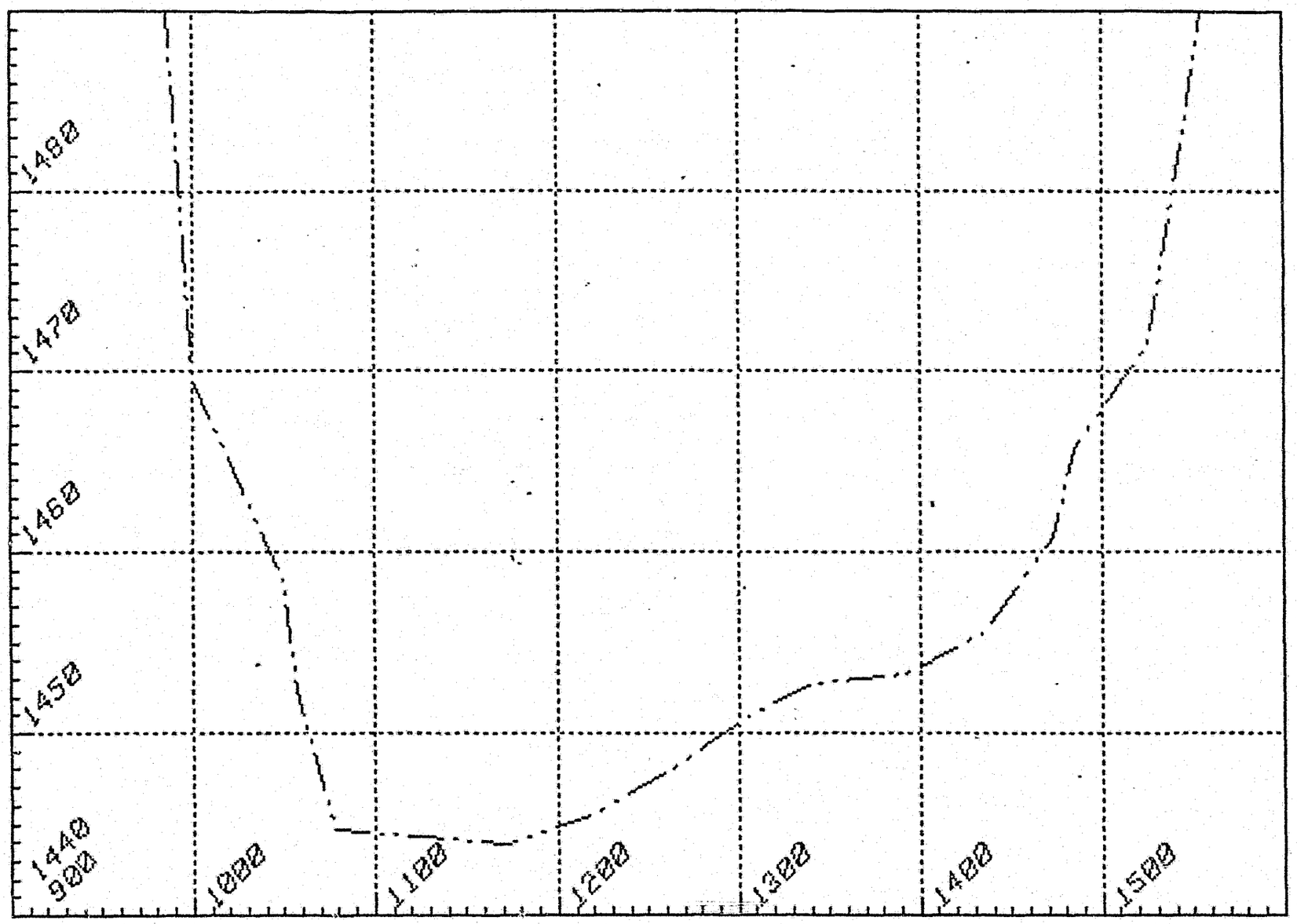
URX- 108

DATE OF SURVEY : MARCH 7, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1472.06	5/8" REBAR w/ ALUM CAP, L.B. SHLD.
10+16	1468.0	SUB. SHLD. ON L. B.
10+52	1451.9	CHANNEL BOTTOM
10+89	1447.5	CHANNEL BOTTOM
11+33	1445.7	CHANNEL BOTTOM
12+75	1443.4	CHANNEL BOTTOM
13+21	1444.2	CHANNEL BOTTOM
13+65	1451.4	CHANNEL BOTTOM
14+30	1457.5	TOE OF CLIFF
14+56	1488.93	5/8" REBAR W/ ALUM. CAP, R.B. TOP OF CLIFF

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 207



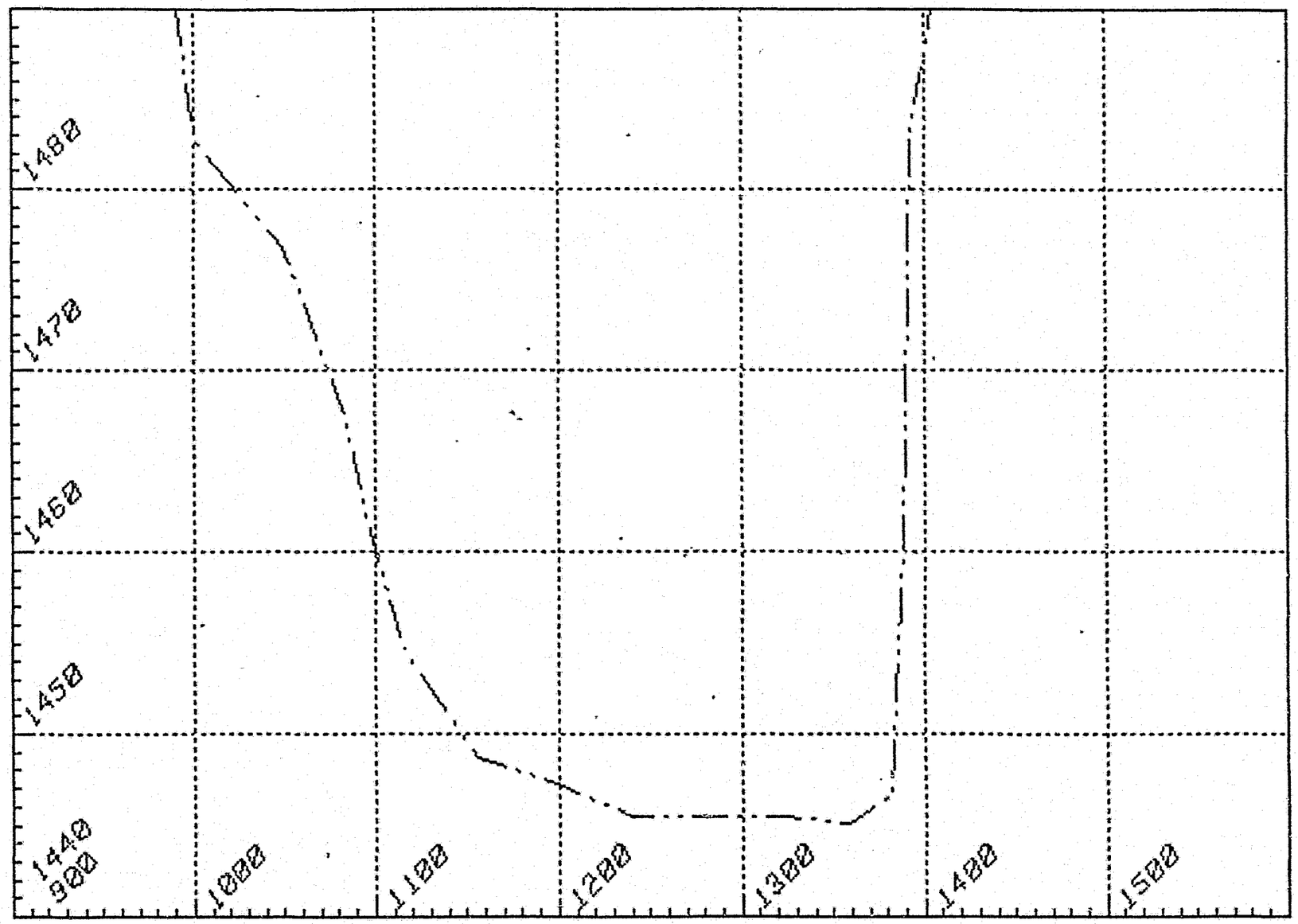
URX- 207 (107 A)

DATE OF SURVEY : MARCH 6, 1981

STATION	ELEVATION	DESCRIPTION
10+00	1469.53	5/8" REBAR W/AL. CAP, L.B.
10+50	1458.4	TOE OF CLIFF, TOE ON ICE
10+78	1444.7	CHANNEL BOTTOM
11+73	1443.9	CHANNEL BOTTOM
13+42	1452.7	CHANNEL BOTTOM
13+92	1453.3	CHANNEL BOTTOM
14+35	1455.6	CHANNEL BOTTOM
14+73	1460.8	TOE OF LEDGE, EDGE OF ICE
14+85	1465.7	SHLD. OF LEDGE
15+25	1471.51	5/8" REBAR W/AL. CAP @ ELBOW, R.B.

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 107



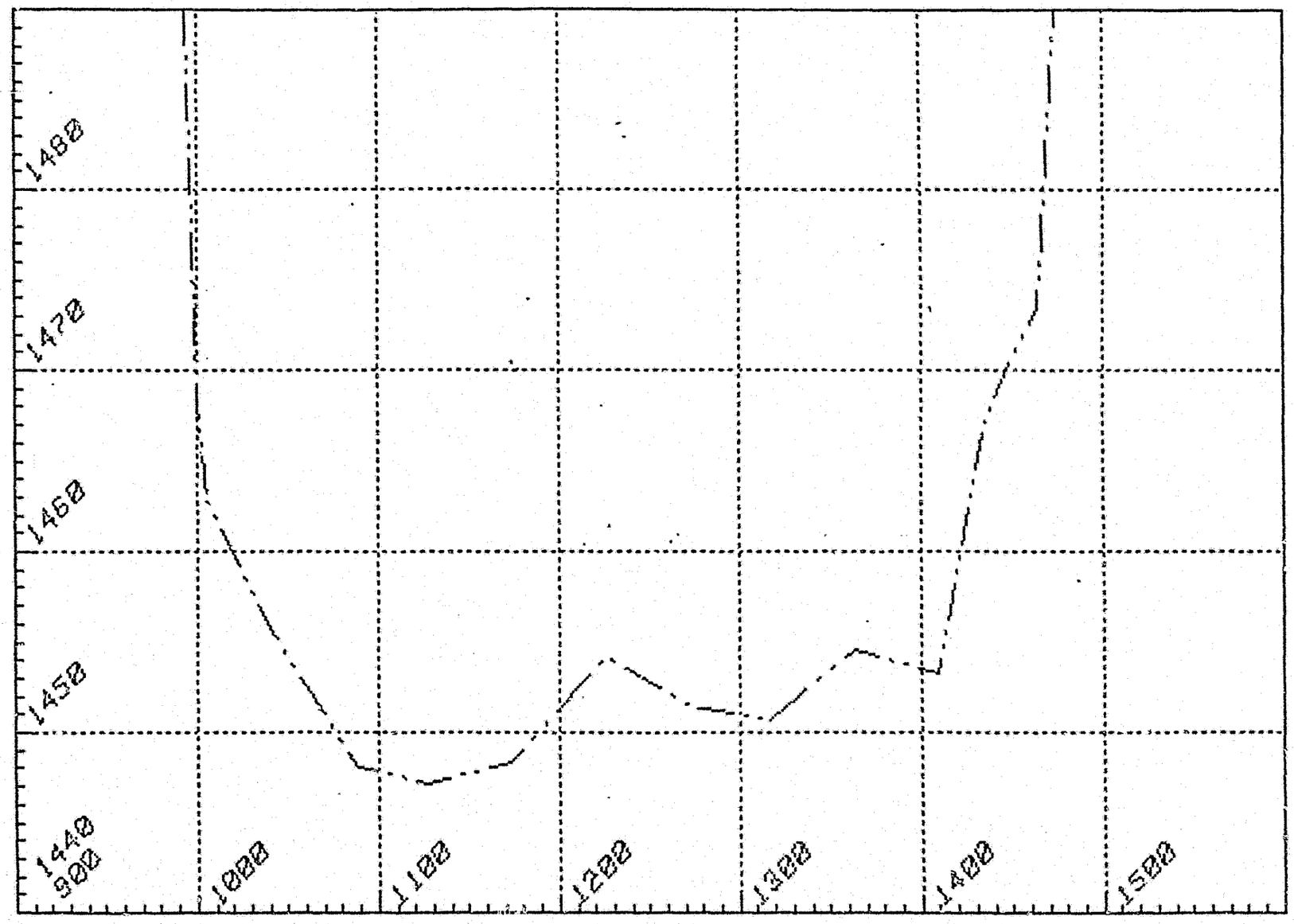
URX- 107

DATE OF SURVEY : MARCH 6, 1981

STATION	ELEVATION	DESCRIPTION
9+50	1525.0	ALUM. CAP
10+00	1482.7	TOE OF HILL
10+50	1476.8	LEFT BANK
10+83	1467.5	SHLD.
11+16	1454.5	CHANNEL BOTTOM
11+56	1448.7	CHANNEL BOTTOM
12+41	1445.5	CHANNEL BOTTOM
13+82	1446.6	CHANNEL BOTTOM
13+88	1460.1	TOE OF CLIFF
13+93	1483.2	SHLD. OF CLIFF, R.B.
14+06	1491.15	5/8" REBAR w/ ALUM. CAP

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 106



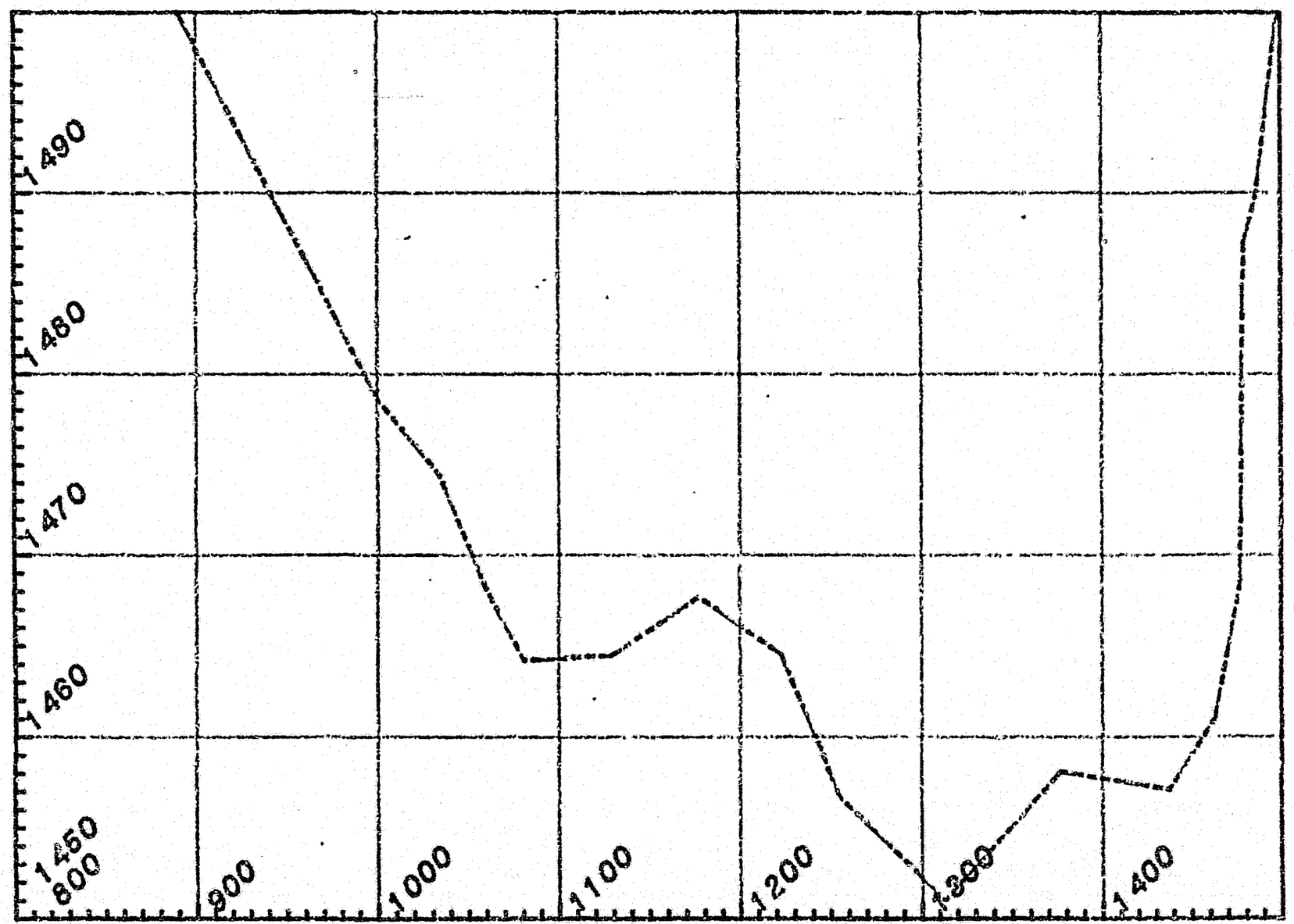
URX - 106

DATE OF SURVEY : MARCH 26, 1981

STATION	ELEVATION	DESCRIPTION
10 + 05	1462.7	TOE AT LEFT BANK
10 + 41	1455.7	CHAN. BOTTOM
11 + 73	1448.3	CHAN. BOTTOM
13 + 64	1454.6	CHAN. BOTTOM
14 + 09	1453.2	CHAN. BOTTOM
14 + 36	1467.3	TOE OF RIGHT BANK
14 + 64	1473.5	SHLD, START OF STEEP GRADE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 1 05



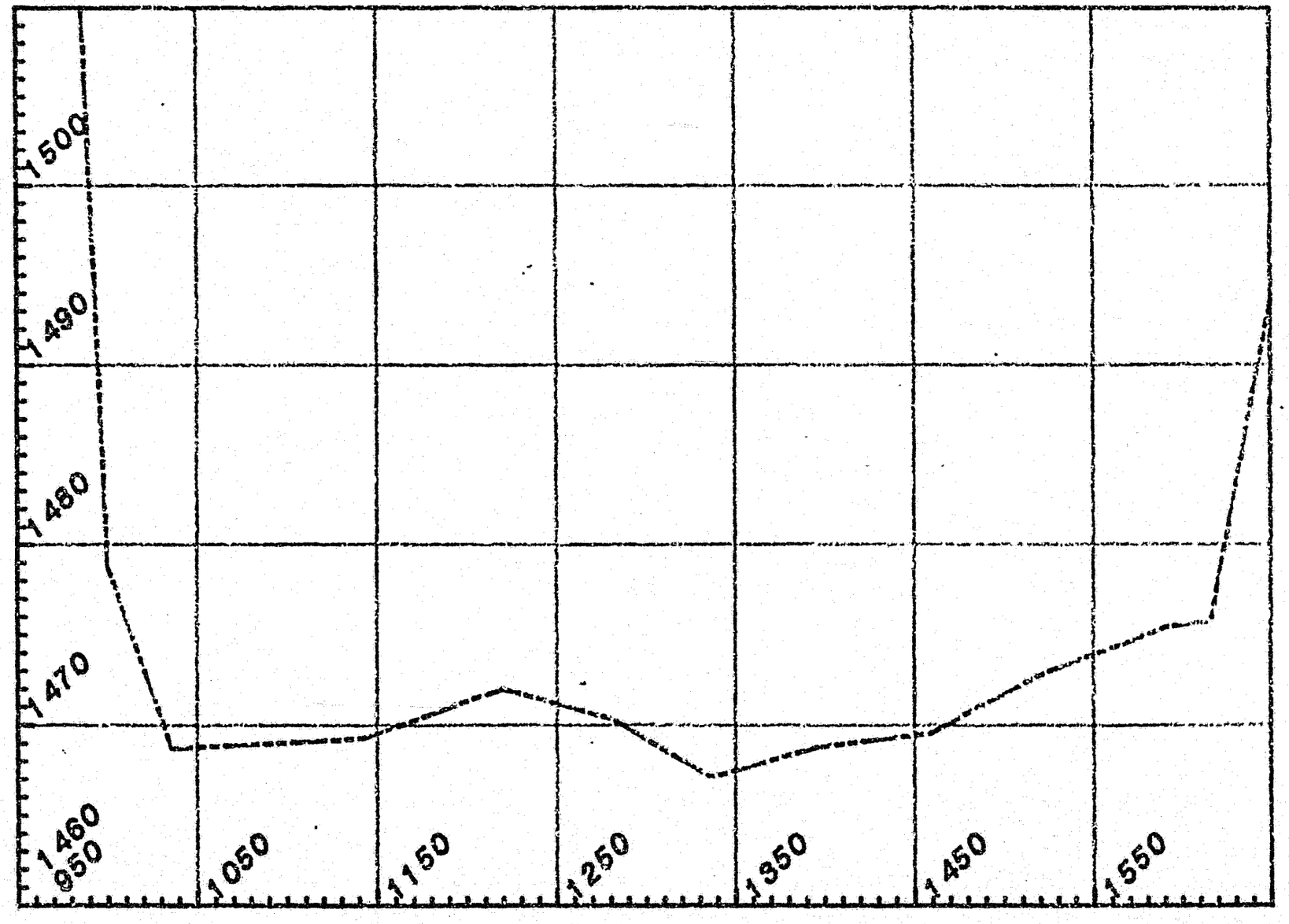
URX - 105

DATE OF SURVEY : MARCH 5, 1981

STATION	ELEVATION	DESCRIPTION
10 + 00	1478.60	ALUM. CAP, LEFT BANK
10 + 34	1474.4	SHLD. OF BANK
10 + 60	1468.1	TOE OF BANK, EDGE OF ICE
10 + 81	1464.2	CHAN. BOTTOM
11 + 77	1467.7	CHAN. BOTTOM
12 + 55	1456.7	CHAN. BOTTOM
14 + 63	1461.1	CHAN. BOTTOM
14 + 79	1487.3	TOP OF SMALL CLIFF
14 + 86	1489.84	5/8" ALUM. CAP / REBAR

SUSITNA HYDROELECTRIC PROJECT

CROSS--SECTION Number 1 0 4



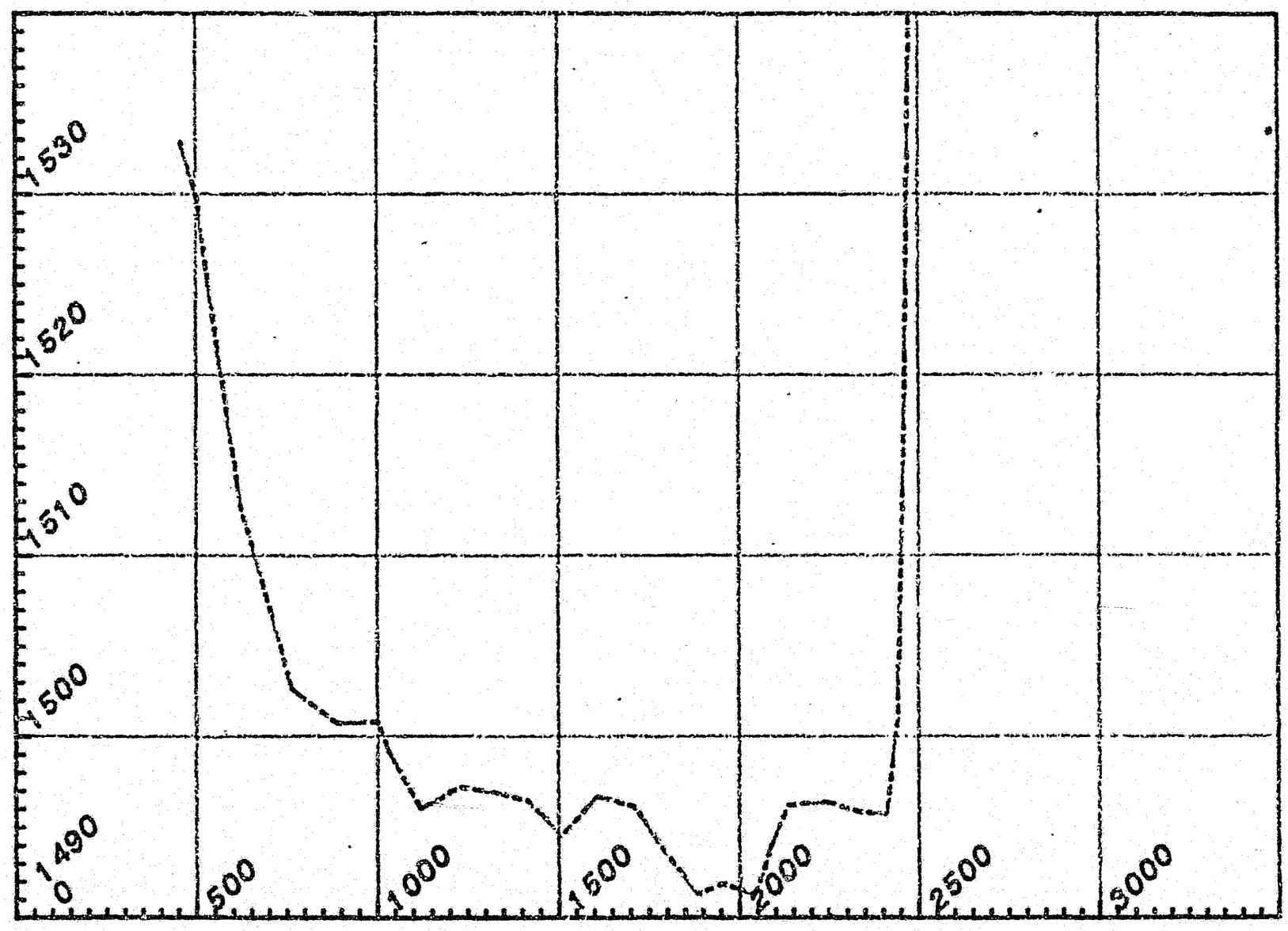
URX - 104

DATE OF SURVEY : MARCH 5, 1981

STATION	ELEVATION	DESCRIPTION
10 + 00	1478.8	TOE OF CLIFF, LEFT BANK
10 + 36	1468.7	CHAN. BOTTOM
13 + 36	1467.1	CHAN. BOTTOM
15 + 90	1475.4	CHAN. BOTTOM
16 +16	1475.8	TOE ON ICE
	1492.18	ALUM. CAP / 5/8" REBAR

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 103



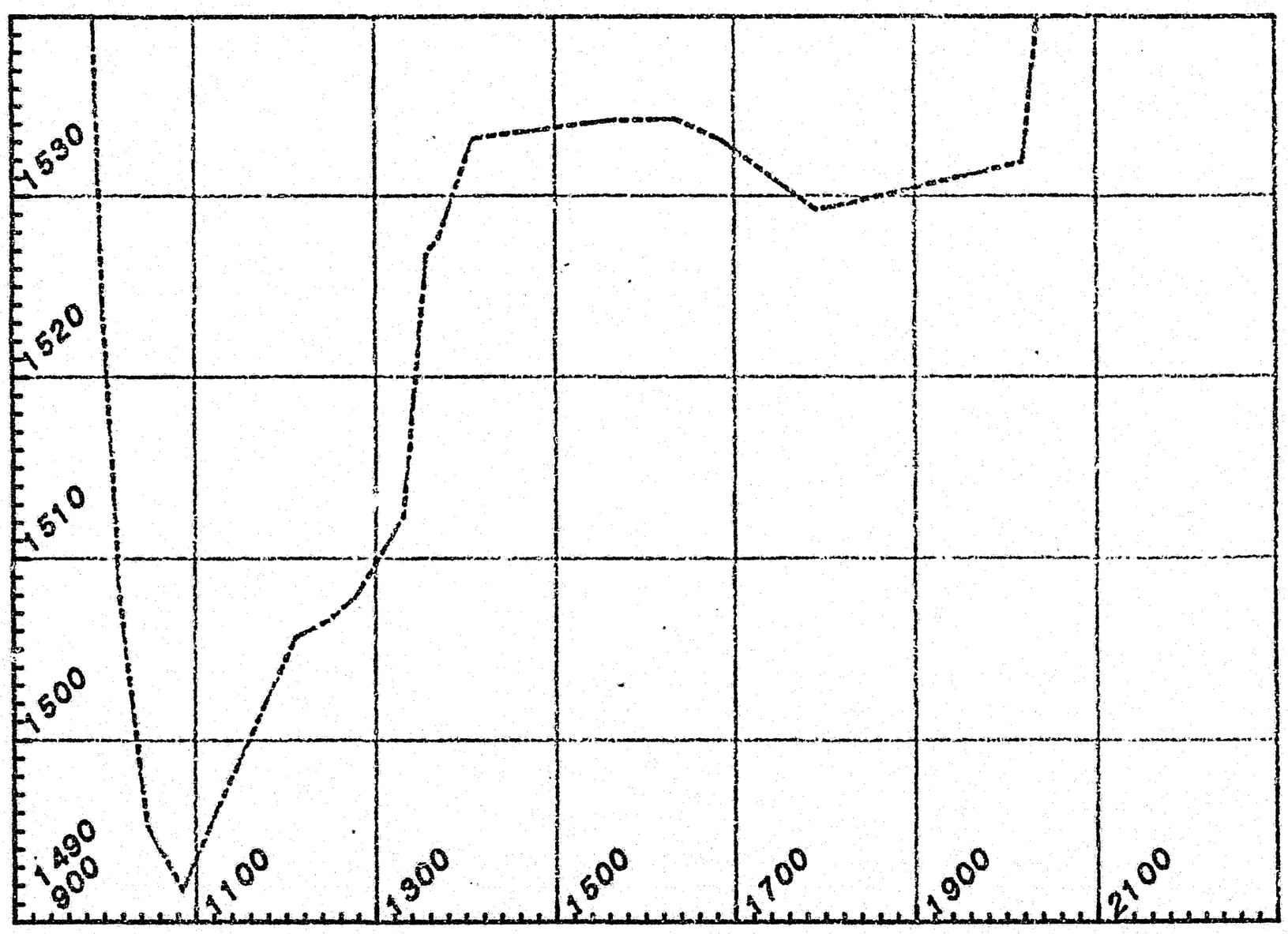
URX - 103

DATE OF SURVEY : MARCH 4, 1981

STATION	ELEVATION	DESCRIPTION
04 + 58	1532.8	TOE OF HILLSIDE & EDGE OF OVERFLOW
05 + 07	1529.6	CTR. CHANNEL
05 + 28	1525.9	SHLD.
06 + 21	1512.8	TOE OF SLOPE, BEGIN CTTNWD. VEG.
07 + 66	1502.6	SLOPE
08 + 87	1500.7	G.S.
10 + 00	1500.83	ALUM CAP.
10 + 33	1499.1	TOP OF BANK
11 + 20	1497.5	CHAN. BTM.
13 + 27	1496.9	CHAN. BOTTOM
15 + 08	1494.5	CHAN. BOTTOM.
17 + 98	1493.5	CHAN. BOTTOM
20 + 88	1494.0	CHAN. BOTTOM
24 + 10	1495.7	CHAN. BOTTOM
24 + 42	1501.2	TOE OF STEEP RIDGE

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 102



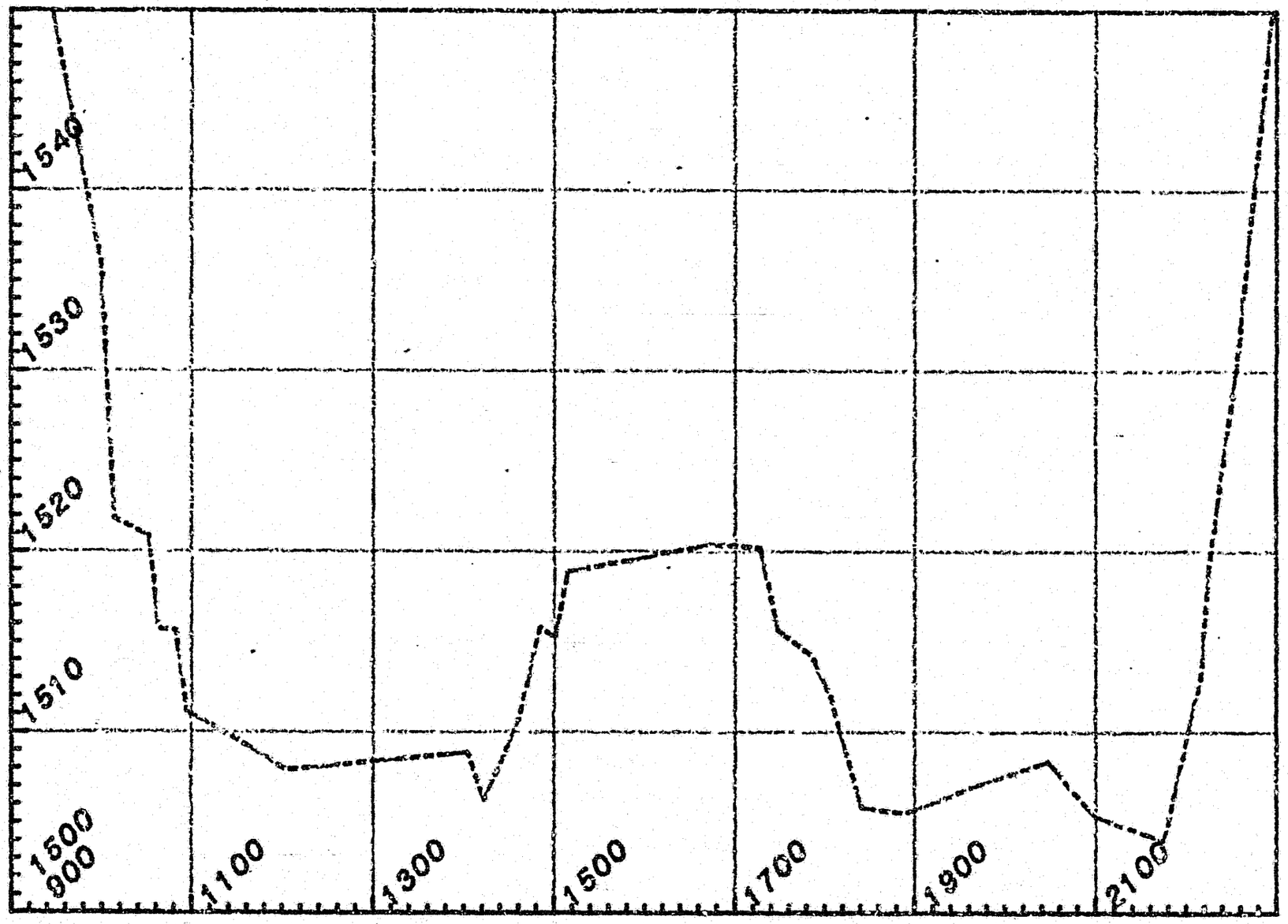
URX - 102

DATE OF SURVEY : MARCH 4, 1981

STATION	ELEVATION	DESCRIPTION
10 + 00	1524.38	ALUM. CAP ON SIDE HILL
10 + 47	1495.3	CHANNEL BOTTOM
10 + 85	1491.7	CHANNEL BOTTOM
12 + 47	1506.6	CHANNEL BOTTOM
13 + 31	1512.3	TOE OF TERRACE
13 + 57	1526.9	TOP OF TERRACE
14 + 09	1533.2	BREAK - SP. & BIR. VEG.
16 + 32	1534.3	SHLD.
20 + 20	1531.9	TOE OF BANK
20 + 41	1542.5	SHLD. OF BANK
21 + 07	1546.4	TOE
21 + 34	1550.8	SHLD.
24 + 19	1550.0	TOE TO HILLSIDE.

SUSITNA HYDROELECTRIC PROJECT

CROSS--SECTION Number 1 01



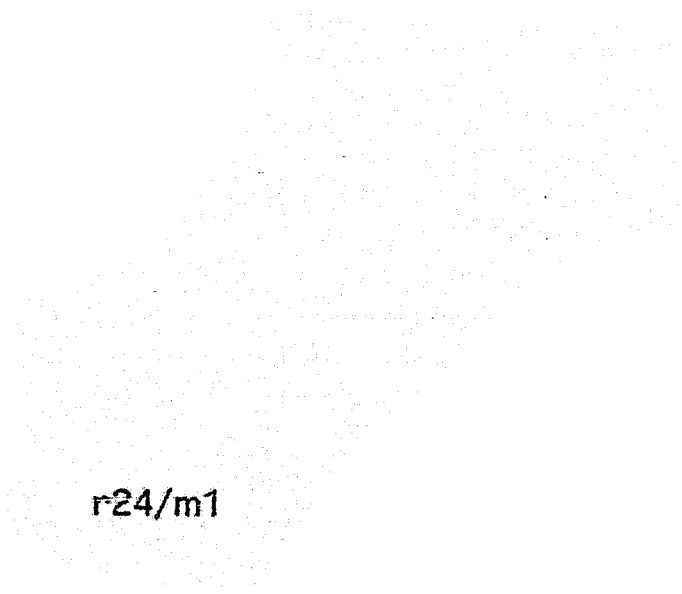
URX-101

DATE OF SURVEY : MARCH 4, 1981

STATION	ELEVATION	DESCRIPTION
10 + 00	1535.97	URX-101 L.B., ALUM. CAP / 5/8" REBAR
10 + 14	1521.8	TOE OF HILL, SCATTERED SP. & ALDER.
10 + 53	1520.8	SHLD. BANK - EDGE OF BRUSH
10 + 63	1515.7	TOE, EDGE OF ALDER
10 + 95	1511.1	TOE, EDGE OF WATER
12 + 04	1507.9	CHANNEL BOTTOM
14 + 04	1508.9	CHANNEL BOTTOM
14 + 61	1510.7	TOE, EDGE OF ICE
14 + 84	1515.8	TOP
15 + 01	1515.2	TOE OF TERRACE
15 + 15	1518.9	TOP OF TERRACE
17 + 86	1514.2	SHOULDER
18 + 07	1511.9	TOE OF ICE
18 + 41	1505.8	CHANNEL BOTTOM
20 + 46	1508.4	CHANNEL BOTTOM
21 + 75	1511 2	CHANNEL BOTTOM
22 + 55	1529.89	ALUM. CAP, R.B.

APPENDIX C

PLOTS AND SUMMARIZED FIELD NOTES FOR PARTIAL CROSS-SECTIONS BELOW TALKEETNA



Appendix C

Purpose

Under Subtask 2.16, this cross-section data will be incorporated in a study assessing the effects of controlled river discharges on commercial and recreational navigation on the Susitna River.

Site Selection

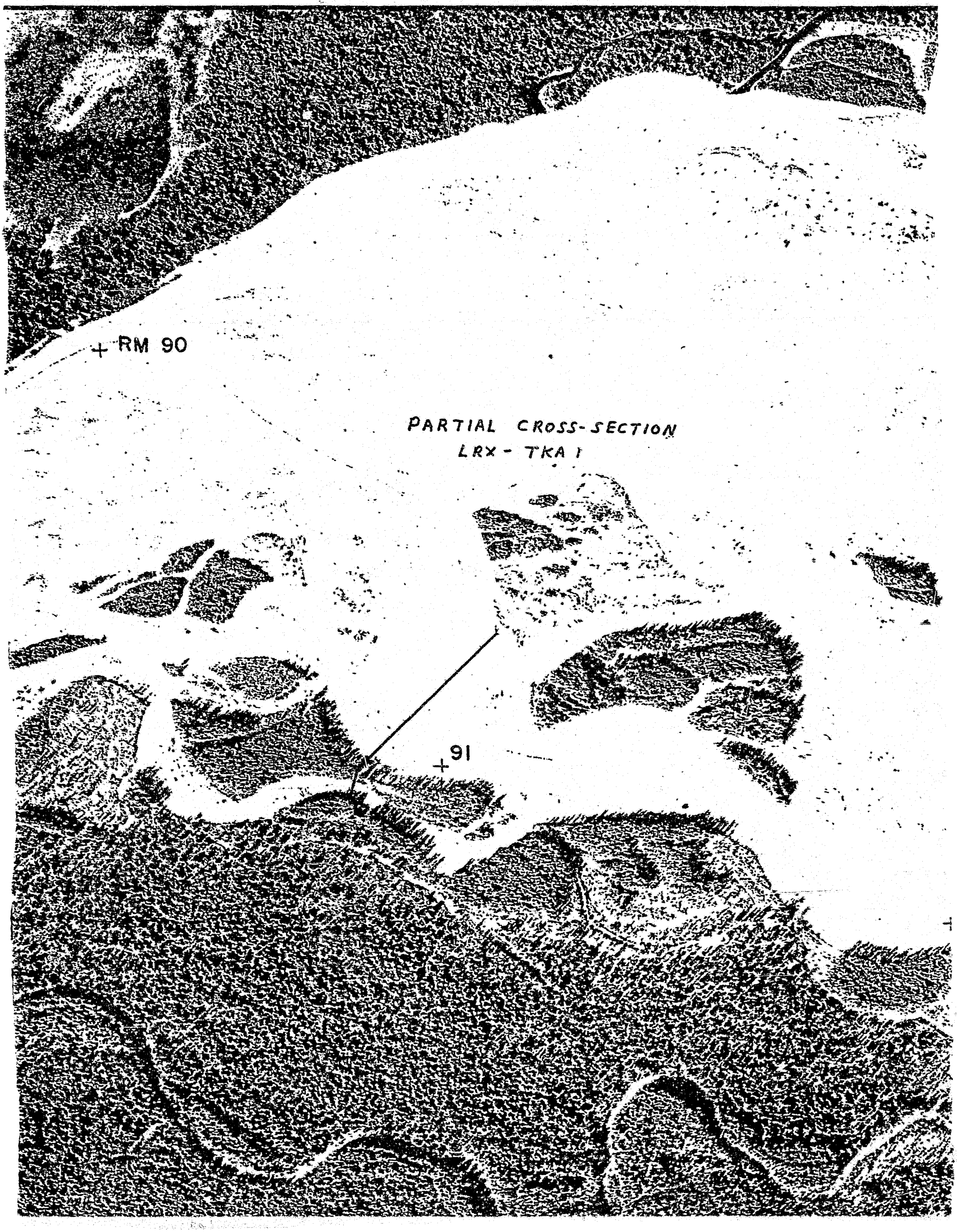
General locations were determined through consultation between Woody Trihey (Consultant to Acres), Paul Janke (ADNR) and Steve Bredthauer (R&M). The study required cross-sections and water surface elevations of heavily used access channels leading to the main channel of the Susitna. The principal areas that afford direct access are Talkeetna via the Talkeetna River, Kashwitna Creek via Susitna Landing and at Willow via Willow Creek. Indirect access to the Susitna River is available at Alexander Creek where hunting and fishing lodges have boats available for charter.

Specific locations were determined by field inspection of sites that could become critical to navigation at low discharges.

Procedure

The survey procedures for these cross-sections are the same as outlined in Section 3.2.2 of this report with several exceptions. No provisions were made to use this data for the HEC-2 model since these cross-sections are not tied to any vertical datum. Approximate elevations for comparison were estimated from U.S.G.S. topographic contours, and referenced to T.B.M.'s. These are all spikes set in mature trees and should be recoverable for correlation with future studies.

Staff gauges were installed in the navigable channels on the cross-section and arrangments were made through local residents and ADF&G personnel to monitor and report readings on a weekly basis. With this information a critical discharge for channels leading to access areas can be determined.


+ RM 90
PARTIAL CROSS-SECTION
LRX - TKA 1
+ 91

CROSS-SECTION LRX-TKA 1

— WATER SURFACE

STAFF GAUGE

THALWEG

STAFF GAUGE

ELEVATION IN FEET
BASED ON AN ASSUMED ELEVATION OF 345.00 FT. AT TBM LRX-TKA R.B.

DISTANCE IN FEET

LRX - TKA

DATE OF SURVEY : SEPT. 22, 1981

STATION	ELEVATION	DESCRIPTION
	342.87	TBM LRX 1, NAIL IN LOG
00 +00	342.50	TOP OF LEFT BANK
00+09	339.25	TOE OF BANK
00+50	340.91	TOP OF CHANNEL BANK
00+55	339.00	WATER SURFACE AT LEW, SIDE CHANNEL
01+05	334.85	BOTTOM OF SIDE CHANNEL
02+70	339.05	WATER SURFACE AT REW, SIDE CHANNEL
02+80	342.62	TOP OF BANK
04+20	342.60	Top of left bank, small slough
04+98	341.51	BOTTOM OF SLOUGH
05+81	342.98	TOP OF RIGHT BANK, SMALL SLOUGH
09+88	342.95	TOP OF LEFT BANK, SMALL CHANNEL
10+22	338.10	BOTTOM OF SMALL CHANNEL
11+70	341.93	TOP OF RIGHT BANK, SMALL CHANNEL
15+98	341.20	TOE OF SLOPE
18+20	342.51	TOP OF SLOPE
18+81	341.15	TOE OF SLOPE
19+40	342.73	TOP OF SLOPE
20+05	341.32	BOTTOM OF DRY SLOUGH
20+95	343.81	TOP OF BANK, TOP OF SLOPE
22+60	340.80	BOTTOM OF CHANNEL, PONDED WATER
23+50	342.67	TOP OF SLOPE, LEFT BANK MAIN CHANNEL
26+80	325.90	BOTTOM OF MAIN CHANNEL, THALWEG
27+81	345.20	TOP OF RIGHT BANK, MAIN CHANNEL

+59

+RM 60

PARTIAL CROSS-SECTIONS
AT KASHWITNA CR.

191+ 512+

LRX-KTA 3

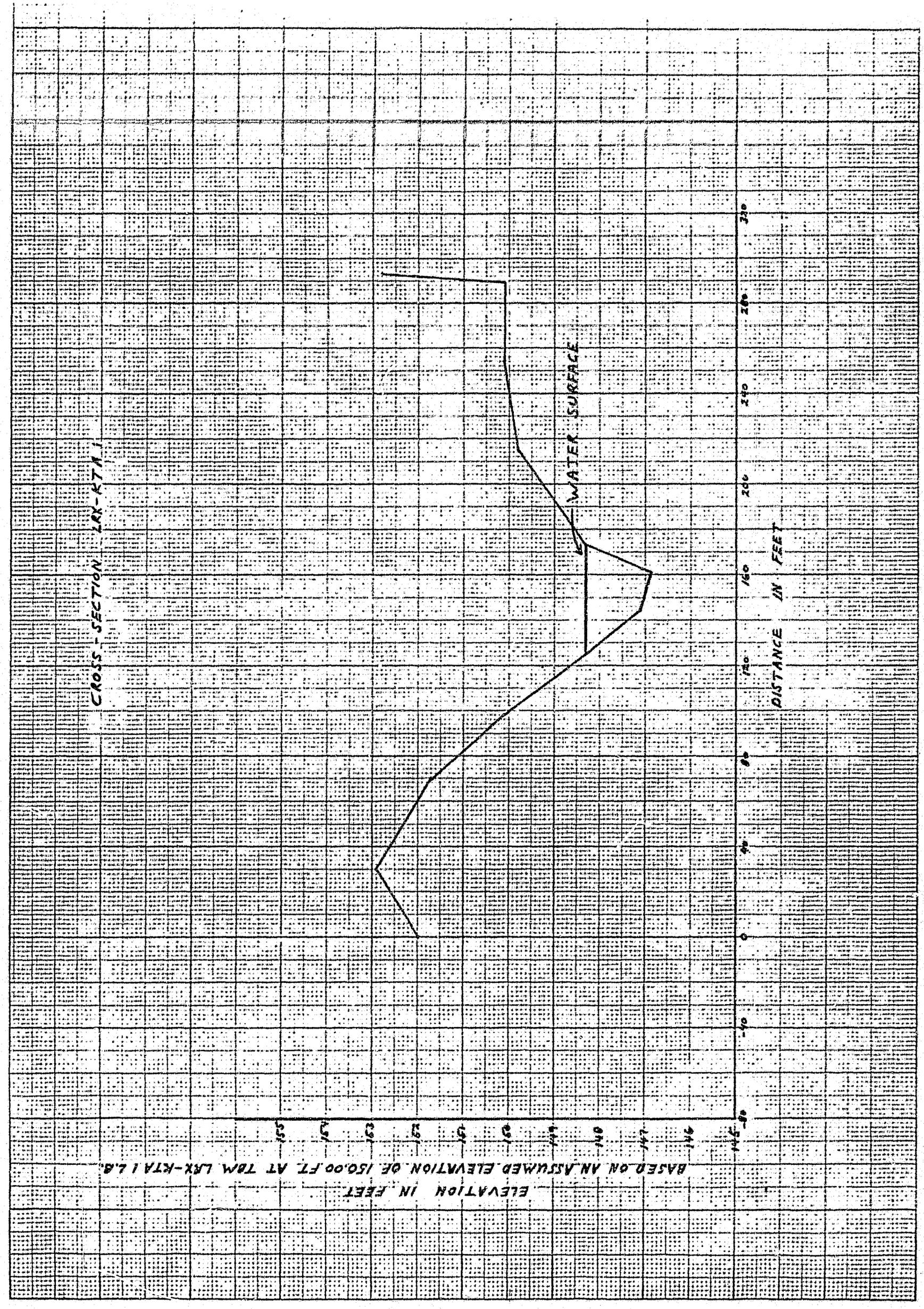
LRX-KTA 2

+61

LRX-KTA 1

SUSITNA LANDING

CROSS-SECTION LRX-RTA 1



LRX - KTA 1

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION FT. (ASSUMED)	DESCRIPTION
TBM LRX-KTA 1 LB	150.00	SPIKE IN 20" BIRCH, LEFT BANK
10+00	151.96	VEG. LINE AT LEFT BANK
10+30	152.92	TOP OF RISE
11+25	148.26	WATER SURFACE AT LEW
11+61	146.83	DEEPEST POINT OF CHANNEL
11+73	148.34	WATER SURFACE AT REW
12+89	150.12	TOE OF R.B.
12+93	152.80	TOP OF R.B., ALSO VEG. LINE
	154.29	LRX - KTA 1 R.B., SMALL NAIL IN ALDER

CROSS-SECTION LRX-KTA 2

BASED ON AN ASSUMED ELEVATION OF 150.00 FT AT TBM LRX-KTA 1 LB

STAFF GAUGE

THALWEG

WATER SURFACE

153
152
151
150
149
148
147
146
145
144
143
142
141
140

0 40 80 120 160 200 240 280 320 360 400 440 480

DISTANCE IN FEET

LRX - KTA 2

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION	DESCRIPTION
	152.07	TBM LRX-KTA2 L.B., NAIL IN ALDER ELEV. ASSUMED FROM INITIAL ELEV AT LRX-KTA 1 LB
10+15	150.31	TOP OF LEFT BANK
10+19	146.85	WATER SURFACE AT LEW, MAIN CHANNEL
10+27	144.63	CHANNEL BOTTOM
11+93	148.24	WATER SURFACE AT REW, MAIN CHANNEL
12+30	148.06	WATER SURFACE AT LEW, SIDE CHANNEL
14+94	147.70	WATER SURFACE AT REW, SIDE CHANNEL
15+04	149.81	TOP OF RIGHT BANK
	151.70	TBM LRX-KTA2 R.B., NAIL IN SMALL TREE

THE MAJORITY OF THE WATER AT THIS CROSS-SECTION IS FLOWING AGAINST THE LEFT BANK OF THE LEFT CHANNEL. THE DIFFERENCE IN WATER SURFACE ELEVATIONS IS CAUSED BY WATER FROM THE SUSITNA MAIN CHANNEL ENCOUNTERING THE GRAVEL BAR AT THE MIDDLE OF THE CROSS-SECTION AND BEING DEFLECTED INTO THE TWO SIDE CHANNELS

CROSS-SECTION LRX-KTA 3

ELEVATION IN FEET
BASED ON AN ASSUMED ELEVATION OF 150.00 FT. AT TBM LRX-KTA 1 L.B.

150
149
148
147
146
145
144
143
142
141
140
139
138

STAFF GAUGE

WATER SURFACE

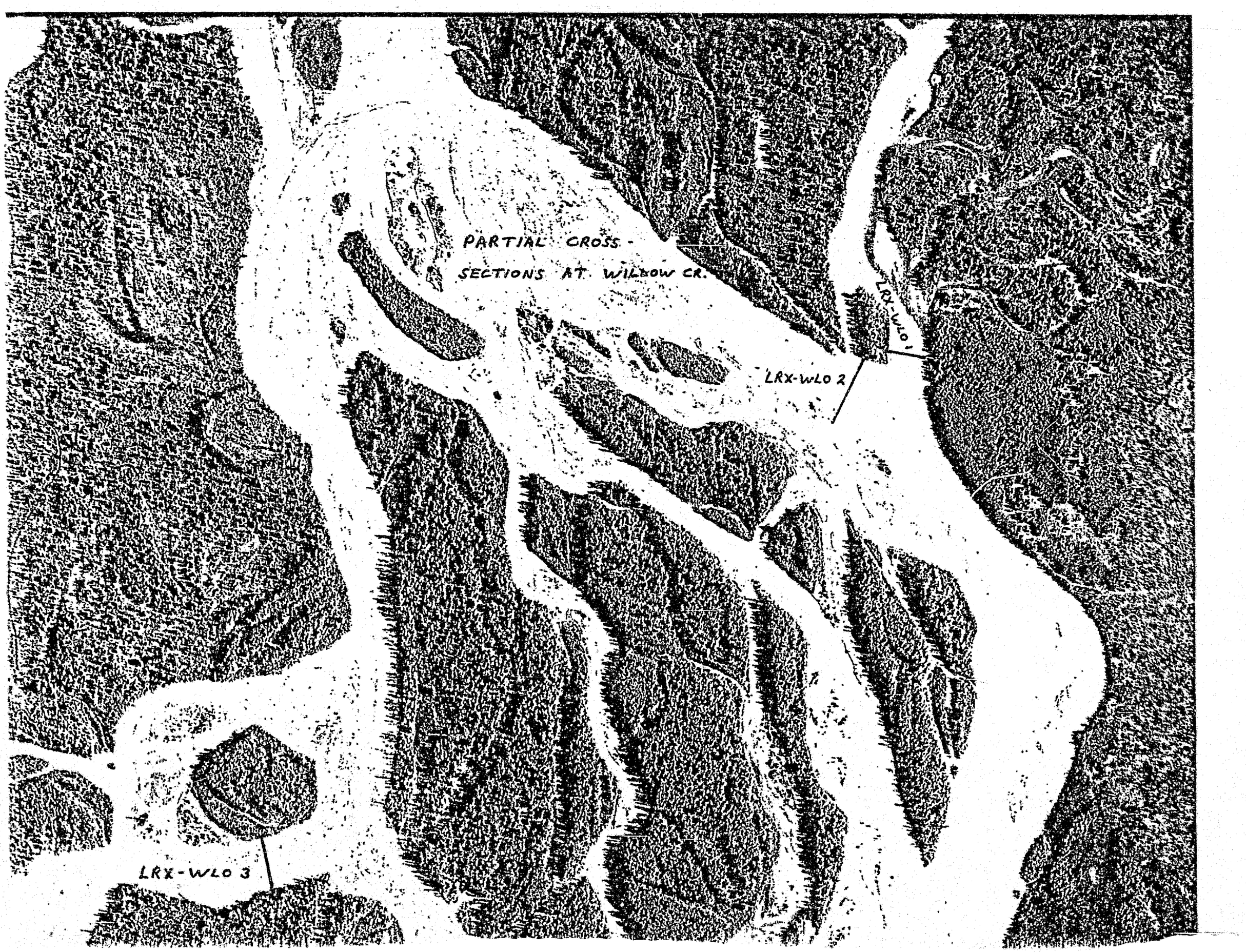
0 20 40 60 80 100 120 140 160 180 200 220 240

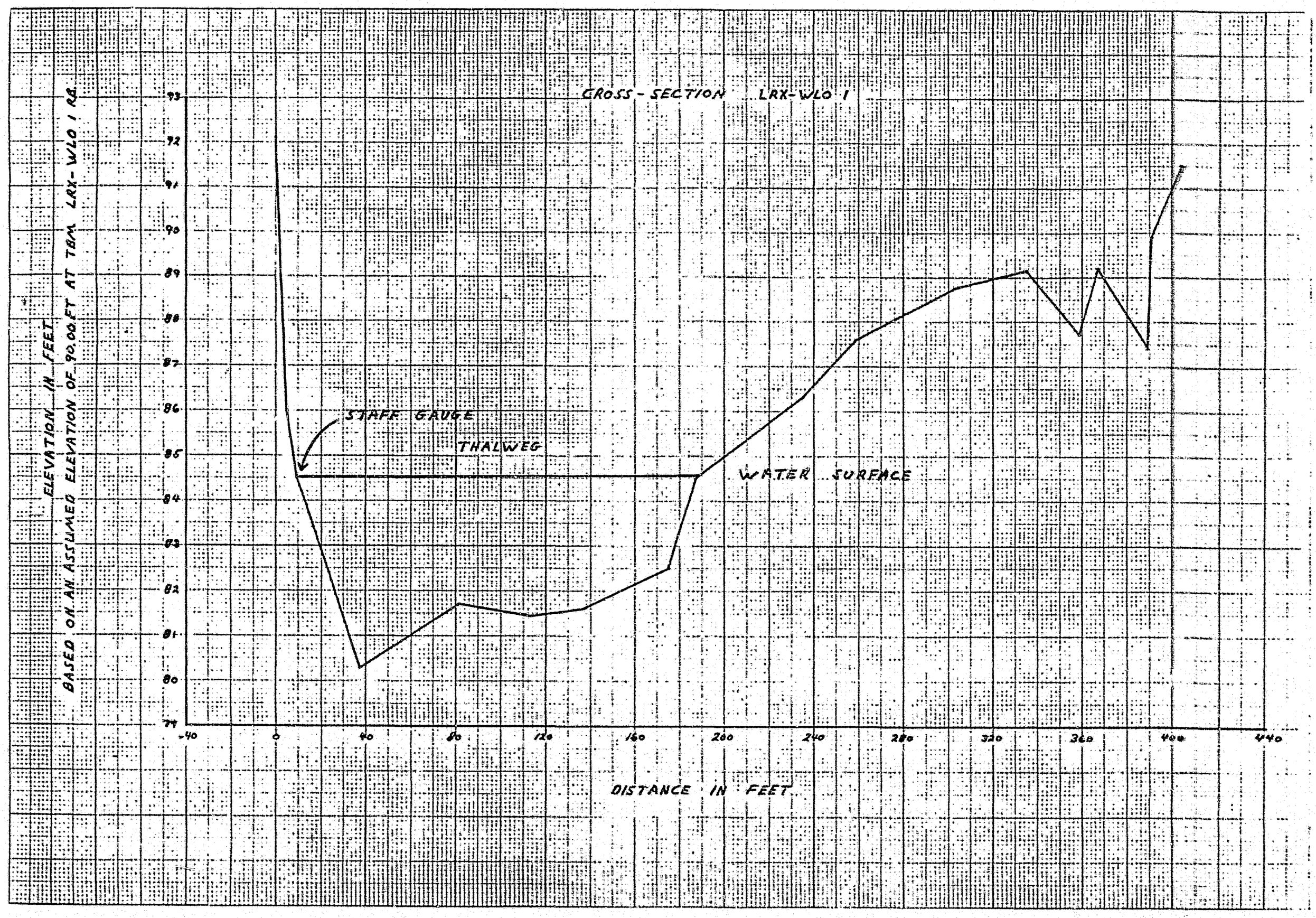
DISTANCE IN FEET

LRX - KTA 3

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION	DESCRIPTION
	156.98	TBM LRX - KTA 3 L.B., SPIKE IN 20" BIRCH BASED ON AN ASSUMED ELEVATION AT LRX - KTA 1 LB
10 + 00	156.57	TOP OF LEFT BANK
10 + 12	143.47	WATER SURFACE AT LEW
11 + 14	138.44	BOTTOM OF CHANNEL
12 + 41	143.44	WATER SURFACE AT REW
12 + 45	148.77	TOP OF RIGHT BANK
	150.57	TBM LRX - KTA 3, NAIL IN ALDER, R.B.


PARTIAL CROSS -
SECTIONS AT WILLOW CR.
LRX-WLO 1
LRX-WLO 2
LRX-WLO 3


CROSS - SECTION LRX-WLO 1
STAFF GAUGE
THALWEG
WATER SURFACE
ELEVATION IN FEET
BASED ON AN ASSUMED ELEVATION OF 90.00 FT AT TBM LRX-WLO 1 RB.
93
92
91
90
89
88
87
86
85
84
83
82
81
80
79
-40
0
40
80
120
160
200
240
280
320
360
400
440
DISTANCE IN FEET

LRX - WLO 1

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION	DESCRIPTION
	92.10	TBM LRX - WLO 1 L.B., SPIKE IN TREE
10 + 05	86.00	TOE OF LEFT BANK
10 + 09	84.53	WATER SURFACE AT LEW
10 + 38	80.30	BOTTOM OF CHANNEL
11 + 75	82.98	BOTTOM OF CHANNEL
11 + 87	84.48	WATER SURFACE AT REW
13 + 88	87.35	TOE OF BANK
14 + 04	91.47	TOP OF BANK
	(ASSUMED) 90.00	TBM LRX - WLO1 R.B., NAIL IN COTTONWOOD

CROSS-SECTION LRX-WL02

WATER SURFACE

THALWEG

DISTANCE IN FEET

960 320 240 160 80 0

90 89 88 87 86 85 84 83 82 81 80 79 78 77

ELEVATION IN FEET

BASED ON AN ASSUMED ELEVATION OF 90.00 FT AT TBM LRX-WL01 RA

LRX - WLO 2

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION (ASSUMED)	DESCRIPTION
	90.00	TBM LRX-WLO 1 R.B., LRX-WLO 2 L.B. NAIL IN CTTN WD
10 + 72	88.92	TOP OF BANK
10 + 79	85.27	TOE OF BANK
10 + 80	84.80	WATER SURFACE AT LEW
12 + 75	79.30	BOTTOM OF CHANNEL
13 + 83	84.65	WATER SURFACE AT REW
15 + 22	84.95	BOTTOM OF DRY WASH
15 + 92	86.95	TOP OF RISE
16 + 53	84.85	BOTTOM OF DRY WASH
	90.35	TBM LRX - WLO 2 R.B., SPIKE IN LOG

CROSS-SECTION

LRX-WLO 3

STAFF GAGE

THALWEG

WATER SURFACE

DISTANCE IN FEET

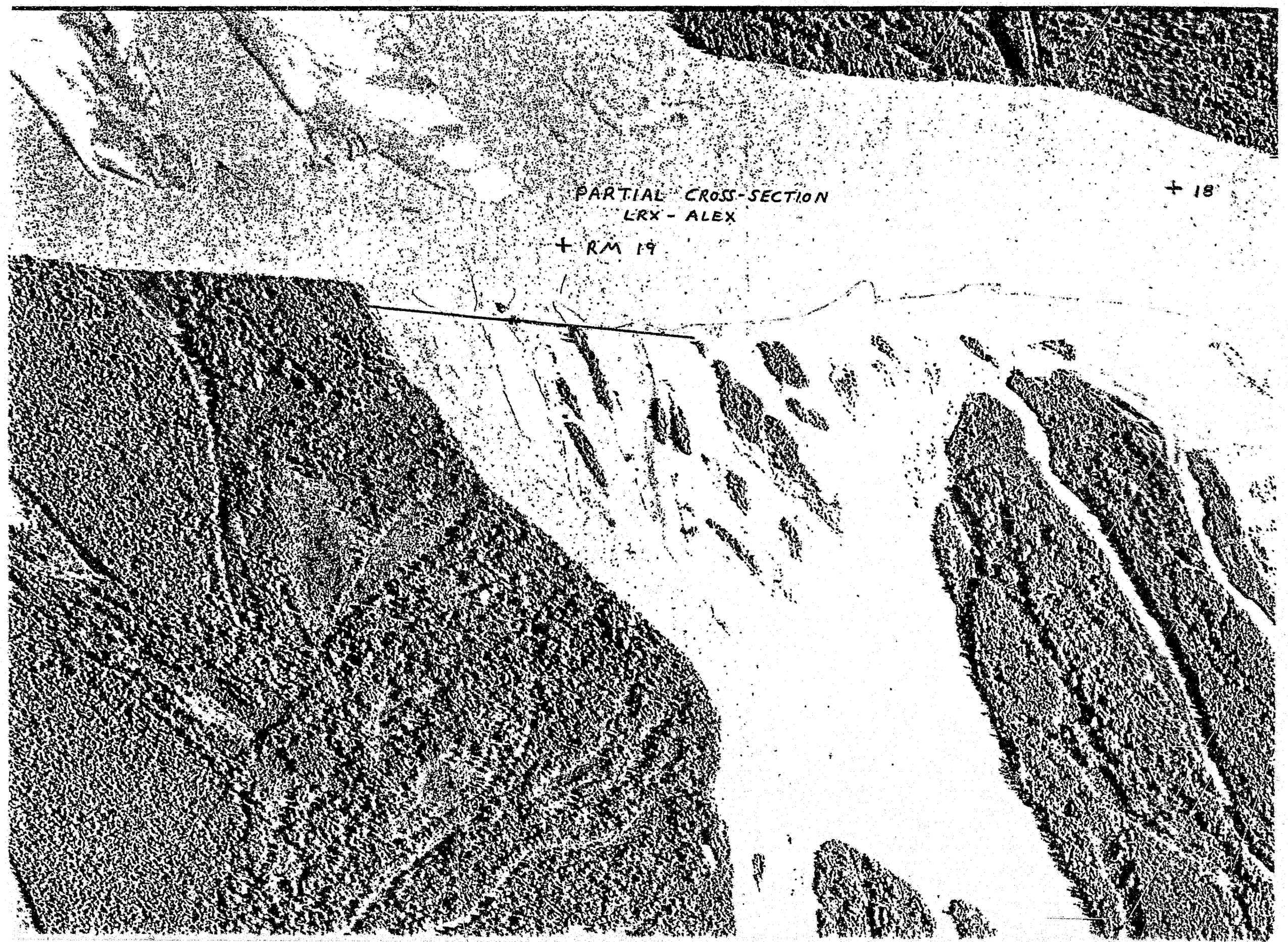
ELEVATION IN FEET

BASED ON AN ASSUMED ELEVATION OF 90.00 FT. AT TAM LRX-WLO 3 A.A.

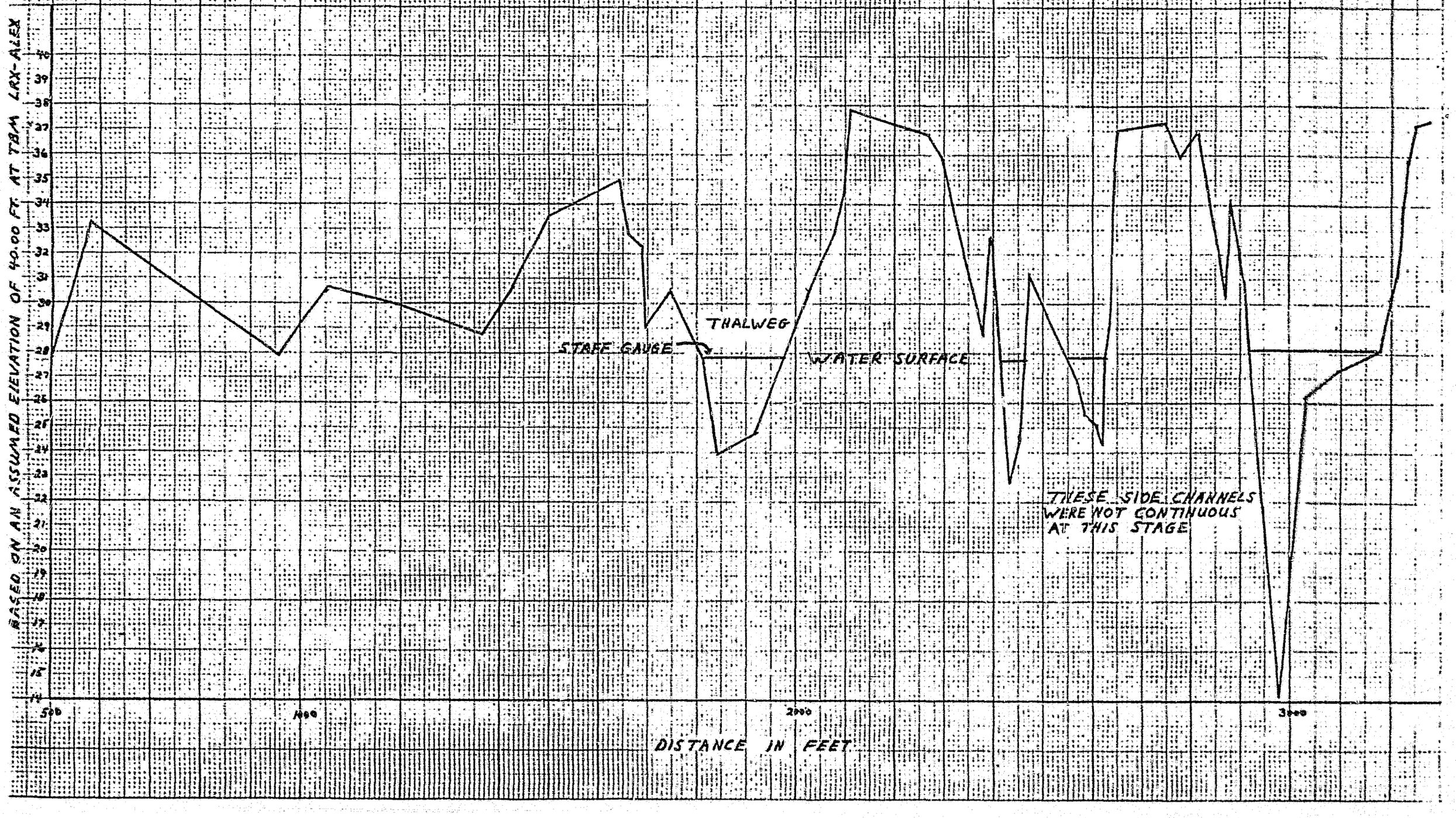
LRX - WLO 3

DATE OF SURVEY : SEPT. 23, 1981

STATION	ELEVATION	DESCRIPTION
	91.05	TBM LRX-WLO3 L.B. SPIKE IN TREE
10 + 06	90.55	TOP OF BANK
10 + 07	87.18	WATER SURFACE AT LEW, MAIN CHANNEL
10 + 43	81.18	BOTTOM OF CHANNEL
11 + 42	86.88	WATER SURFACE AT REW, MAIN CHANNEL
11 + 70	86.85	WATER SURFACE AT LEW, SIDE CHANNEL
11 + 73	85.94	BOTTOM OF CHANNEL
11 + 76	86.90	WATER SURFACE AT REW, SIDE CHANNEL
11 + 82	87.51	TOP OF RISE
12 + 07	86.99	WATER SURFACE AT LEW, SIDE SLOUGH
12 + 52	85.53	BOTTOM OF SLOUGH
12 + 58	86.96	WATER SURFACE AT REW, SIDE SLOUGH
12 + 62	90.15	TOP OF RIGHT BANK OF SLOUGH
13 + 87	88.36	TOP OF LEFT BANK OF SIDE SLOUGH
13 + 94	86.25	WATER SURFACE AT LEW SIDE SLOUGH
14 + 15	85.07	BOTTOM OF SLOUGH
14 + 49	86.28	WATER SURFACE AT REW, SIDE SLOUGH
15 + 00	90.10	TOP OF RIGHT BANK
	90.00	TBM LRX-WLO3 R.B. SPIKE IN LOG


PARTIAL CROSS-SECTION
LRX - ALEX
+ RM 19
+ 18

PARTIAL CROSS-SECTION LRX-ALEX
AT ENTRANCE TO SUSITNA WEST CHANNEL



LRX - ALEX

DATE OF SURVEY : SEPT. 25, 1981

STATION	ELEVATION	DESCRIPTION
	39.49	TBm LRX-ALEX L.B., SPIKE IN TREE
05 + 80	33.20	TOP OF RISE
09 +20	27.90	BOTTOM OF DRY CHANNEL
11 +10	30.71	TOP OF RISE
13 +65	28.75	BOTTOM OF DRY CHANNEL
16 + 40	34.98	TOP OF RISE
16 + 95	29.05	BOTTOM OF DRY CHANNEL
17 +45	30.51	TOP OF LEFT BANK FOR MAIN CHANNEL
	27.76	LEW
18 + 40	23.90	BOTTOM OF MAIN CHANNEL
	27.82	REW
21 + 10	37.85	TOP OF RIGHT BANK FOR MAIN CHANNEL
22 +70	36.80	BREAK IN GRADIENT
23 +80	28.70	CHANNEL BOTTOM
23 +95	32.75	TOP OF RISE
	27.61	LEW
24 +30	22.78	CHANNEL BOTTOM
	27.80	REW
24 +70	31.19	TOP OF RISE
	27.86	LEW
26 +20	24.33	CHANNEL BOTTOM
	27.81	REW
26 +50	37.05	TOP OF RIGHT BANK
28 + 70	30.23	BOTTOM OF SIDE SLOUGH
	28.10	LEW
29 + 75	14.20	BOTTOM OF SIDE CHANNEL, NOT CONTINUOUS
30 + 06	26.23	BREAK IN GRADIENT

LRX - ALEX CONTINUED

DATE OF SURVEY : SEPT. 25, 1981

STATION	ELEVATION	DESCRIPTION
	28.07	REW
31 + 80	28.10	BREAK IN GRADIENT
32 + 45	37.31	TOP OF RIGHT BANK
	(ASSUMED) 40.00	TBM LRX-ALEX R.B., SPIKE IN 40" COTTONWOOD