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**SUSITNA
HYDROELECTRIC PROJECT**

SUSITNA RIVER ICE STUDY

1984 FREEZUP

R&M
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

UNDER CONTRACT TO
HARZA-EBASCO
SUSITNA JOINT VENTURE

DRAFT REPORT

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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT
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1.0 INTRODUCTION

The 1984 freezeup of the lower Susitna River was documented by visual observations, ground measurements and aerial photography. These methods are similar to those used during the previous 4 years of the on-going ice processes study. Emphasis during 1984 was placed on identifying dominant ice processes influencing lower river ice cover formation. Hydraulic data were collected at several locations for use in modelling analyses. Several potential fishery habitats were identified prior to the freezeup and were monitored as the ice front progressed through the lower river reach.

General conclusions regarding lower river freezeup can not be made from the data contained in this report, due to the unusual nature of ice cover progression attributed to the prevailing mild weather during the 1984 freezeup. This report describes the chronology of the ice cover development in Section 3, and presents miscellaneous data pertinent to the ice modelling study in Section 4 and in Appendix A and B. Most of the specific processes controlling freezeup, as well as those of ice cover progression, have been previously reported in a series of ice study reports (R&M 1980, 1981, 1982 and 1983). Users of the data contained herein who are not familiar with river ice processes are referred to these published reports. This report refers to river mile (RM) numbers for identification of specific sites on the river mainstem, with the river mouth at Cook Inlet corresponding to RM 0. River Mile numbers have been annotated on the blueline photomosaic maps in Appendix C.

2.0 SUMMARY

The 1984 Susitna River freezeup was characterized by:

1. Low initial discharges and stage levels
2. Multiple ice bridges
3. Rapid lower river ice front progression
4. Middle river ice bridge at River Mile 105
5. Long reaches of open water between ice bridges, after ice cover progression
6. Thick anchor ice deposits

Unusually mild weather during September and early October delayed the formation of significant volumes of frazil ice until the fourth week in October. The lack of late summer rainfall resulted in low freezeup stages compared to previous years. When the ice bridge near Cook Inlet finally formed on October 27, 1984, the river stage was so low that a series of ice bridges formed in quick succession, within 48 hours of the initial bridge, between river mile (RM) 5 and RM 52. These bridges formed primarily due to grounding of large slush ice flows in shallow water. After the last ice bridge formed at RM 52, a continuous ice cover progressed on the lower river up to RM 88 on about November 2, formation of a middle river ice bridge at RM 105 stopped ice from continuing down to the lower river. The rate of middle river ice cover progression was subsequently rapid compared to previous years due to low water levels, large volumes of slush ice entering the reach from upstream, and the early initiation of ice cover development. The middle river ice bridge cut off the upper Susitna slush ice contribution to the lower river ice front, and progression on the lower river significantly slowed. During November, the Chulitna and Talkeetna tributaries supplied some ice to the lower river ice front. Ice front progression eventually stopped completely after ice bridges developed on the tributaries in mid-November. The remaining open water between the lower river leading edge and the RM 105 ice bridge was of insufficient length for generation of substantial frazil ice volumes.

The middle river ice front progressed continuously, reaching RM 130 in early December. Unusually cold air temperatures in November, which brought the number of accumulated freezing degree days to the average total, also caused large volumes of frazil ice to be generated on the middle and upper Susitna, as well as on the Chulitna and Talkeetna Rivers. Although most of this ice contributed directly to the upstream advance of the two ice fronts, a secondary consequence was rapid and massive accumulations of anchor ice. The anchor ice was readily visible, since it accumulated sediment and acquired a light brown tint. Upstream of the Gold Creek Bridge, the anchor ice formed thick layers on the channel bed in shallow areas. By early December, many of these formations were near the water surface, effectively changing the local hydraulics of the channel by damming the flow. The resulting backwater caused local stage increases which fractured the shore ice along the flow margins as buoyant lifting forces separated the ice from the channel bed. Fragments of shore ice were often seen floating downstream during December. On about December 15 several shore ice fragments lodged on an anchor ice dam near RM 135.5. This ice jam prevented slush ice from continuing downstream and thus developed into a new ice front. The progression from this point was relatively short-lived, extending only up to RM 137 before the slush ice generated upstream was so minimal that sufficient thickening for continued upstream progression was no longer possible.

The remaining open water gradually diminished as shore ice extended towards the channel center. As of late December the following reaches remained open, some containing intermediate ice bridges:

RM 24 - 26

RM 43 - 46 (West channel)

RM 49 - 52 (East channel)

RM 92 - 105

RM 131 - 135

RM 137 - 147

3.0 CHRONOLOGY OF 1984 SUSITNA RIVER FREEZEUP

Slush ice was first observed flowing down the mainstem at Gold Creek on October 16, 1984, although it had probably started flowing during the previous night. Variable concentrations of ice were observed until the afternoon of October 22, when the air temperatures warmed to 3°C and all ice disappeared. A full 6 feet of accumulated border ice disintegrated at Gold Creek during the following two days. Slush ice concentrations began to increase on October 25. On October 26, at river mile (RM) 9, near the mouth of the Susitna River, a dense concentration of ice floes had accumulated during the high tide of 32.4 feet (Anchorage reference station) at about 7:30 a.m. (see Section 4.5). At RM 9 the tidal fluctuation was measured to range over 6 feet during this particular cycle. Tidal measurements were made using an overlapping series of staff gages installed on October 19, prior to the extreme monthly tide cycle. Slush ice floes on the Susitna River generally consisted of large pans of tightly packed but poorly bonded clusters of sintered ice crystals. Near the river mouth the top 1-2 inches of the ice pans had solidified, forming a rigid sheet on the surface. Under this sheet the slush ice had not frozen solid. This condition of a solid surface layer was observed only on the reach near RM 9. Pan size was variable with average diameters ranging from 2 feet to over 6 feet. The water velocity during the high tide was less than 1 foot/sec. and at low tide about 2.5 feet/sec at center channel. The ice floes which drifted into the flow margin along the east bank were barely moving, and became grounded when the tide receded.

The following day, October 27, the ice concentration in the area below RM 9 again increased during high tide. With substantially higher volumes of ice floes coming into this area from upstream due to the cold air temperatures, an ice bridge developed near RM 5. Although the actual development was not observed, evidence of the formation process suggested the following scenario. The high tide on October 27 was near 33.0 feet at Anchorage. At that level it would have significantly decreased the water velocity in the reach of river near RM 9. The drifting ice entering this

reach of near-zero velocity would quickly accumulate. At the high tide a continuous unconsolidated ice cover was probably present from Cook Inlet up to about RM 12. As the tide receded the ice floes started flowing out to sea. However, before the ice at RM 5 could begin moving the water level had dropped sufficiently so that most of the floes at the channel margin became grounded, resulting in a stable bottleneck which prevented movement of the ice floes near center channel. As the tide continued to recede, the backwater area diminished and water velocity increased. At RM 9 the resulting increased water velocity stressed the unconsolidated ice cover, which eventually moved. However, because of the ice bridge at RM 5 the downstream ice cover only compressed, increasing in thickness and creating a backwater area. This backwater area stabilized the remaining ice above RM 9 so that no further movement took place. Since no direct observations were made of this, there is no way of knowing the upstream extent of the initial ice cover, but assuming a continuous inflow of slush, the cover would have rapidly lengthened.

On October 29, a complex picture unfolded of ice cover development on the lower reach. From RM 5 a somewhat continuous cover extended to RM 19, adjacent to the entrance of Alexander Slough. The predominant process of advance was juxtapositioning. Large areas of open water were present throughout the cover, indicating that little pressure was acting on the ice and no compression had occurred. By 10:30 a.m. on October 29, the leading edge was located at RM 19. The leading edge was no longer advancing, however, due to insufficient ice from upstream, and this ice front was essentially stalled at RM 19. The leading edge consisted of a thin layer of fine slush that was building in diagonal layers across the channel from the area of high water velocity on the outside of the river bend to low velocity on the inside of the bend. Open water with no slush was noted from RM 19 to RM 25.9 at Susitna Station (USGS gage site). A second ice bridge had formed here. A continuous ice cover had developed upstream from RM 25.9 to RM 43 of the east channel through the Delta Islands. The ice cover had also progressed up the Yentna River about 12 miles. The west channel through the Delta Islands, from RM 42.5 to RM

46 was entirely open. At RM 46 on the west channel a third ice bridge had formed. This obstruction had prevented slush ice from drifting downstream to advance the ice cover above RM 42.5. From the ice bridge at RM 46, the ice cover had progressed up the west channel to RM 51. At this point the main channel bifurcates creating the west and east channels. Here the ice cover progression had stopped and there was open water up to RM 52. The east channel was open from RM 43 to RM 52. At RM 52 a fourth ice bridge had formed. Very little slush ice emerged from under the downstream edge of the bridge, indicating that most of the ice floes were retained by the advancing ice cover near the leading edge. This ice cover had progressed up to RM 55. Visual estimates of slush concentrations at Gold Creek, during the preceding 4 days since the ice bridge formation, were never less than 50% of the total open water surface area.

On November 3 the leading edge of the ice cover, which now originated from the ice bridge at RM 52, had progressed to RM 71.5 at an average rate of 4.1 miles/day. At the three rivers confluence, the Chulitna River and Talkeetna Rivers appeared to be contributing most of the slush ice to the lower Susitna River. The Susitna above this confluence area contained very little slush. At RM 105, slush ice had bridged the river at a shallow reach. This bridge had remained stable long enough to initiate an upstream progression of an ice cover on the middle reach of the Susitna. The consequence of this new progression was a decreased supply of slush ice to the lower river ice front, ultimately delaying ice cover formation below Talkeetna. The leading edge progression rate slowed to under 2 miles/day on the lower river, being entirely dependent on slush from the Chulitna and Talkeetna Rivers and frazil generated below the ice bridge at RM 105.

A warm weather period began on November 5 and lasted until the 10th. Ice concentrations sharply decreased during this period to less than 10% at Gold Creek on November 8. This subsequently decreased the rate of leading edge progression to 0.5 miles/day on the middle river and 0.2 miles/day on the lower river. The open water below RM 105, through the

east channel of the Delta Islands and between RM 26 and RM 20, remained open during this period, but were slowly freezing over by a combination of upstream cover progression and border ice growth. The slush ice contributing to these processes originated both from within the open water reaches and from underneath the downstream edge of existing covers upstream. At this time, an estimated 75% of the slush forming the lower river ice cover above the Yentna River confluence originated from the Chulitna and Talkeetna Rivers.

On November 10, cold air temperatures once again increased the ice concentrations, and on November 13 the surface coverage was estimated at 80% by the Gold Creek observer. The middle river ice front advanced 6 miles (up to RM 121) and the lower river front moved upstream about 2 miles (up to RM 86). The middle river ice front progressed more rapidly due to a larger volume of slush ice generated in the available open water reach from Gold Creek to Watana.

On November 14, the Chulitna and Talkeetna Rivers had formed ice bridges several miles upstream of the Susitna confluence. These ice bridges prevented slush from entering the Susitna, and the ice cover progression on the Susitna stopped at RM 88. An insufficient supply of slush prevented further upstream progression at the rates previously observed.

In Slough 8A, ponds with black ice about 4-6 inches thick began overflowing and flooding the surrounding snow cover on November 16, when the leading edge was located at RM 127. This indicated that groundwater levels were rising. The entrance berm at RM 127 had not yet been overtopped. However, the berm at RM 126.1 had been flooded. Ice floes about 1 foot thick had partially breached the entrance berm and had become stranded, indicating that a depth slightly less than this had occurred over the berm. Using a minimum overtopping depth of 8 inches and an estimated flow width of 50 feet, then about 50 cfs could have entered the slough with a velocity of 2 fps. The ponds in Slough 8A

increased in size prior to overtopping of the upper berm at RM 127, indicating a local increase in the height of the water table, probably due to the staging process in the mainstem. The upper entrance to Slough 8A began overtopping on November 19 when the leading edge was at RM 128. This event was not nearly as dramatic as the previous overtopping in 1982. From the air it was difficult to tell that overtopping had occurred. The snow cover was about 1 foot thick at the time, and the mainstem water seeped through the snow pack.

On November 21, the leading edge of the middle river ice front reached RM 129, near the entrance to Slough 9. No overtopping of the entrance berm occurred.

By this time the river upstream of Devil Canyon had become ice covered, severely limiting the volume of frazil capable of being generated. The rate of leading edge advance subsequently slowed to about 0.2 miles/day. The origin of the slush ice responsible for maintaining this rate of advance was primarily the open water reach from Devil Canyon to Sherman. This reach also developed massive anchor ice deposits. Anchor ice dams occurred at several areas throughout this reach, often forming to such thicknesses that backwater areas developed. The increased water surface elevation strained the border ice along the flow margins, in many places causing it to fracture and float downstream to become incorporated in the ice cover. Anchor ice accumulated on the bottom in massive proportions. Thick layers often broke free from the bottom and floated downstream to also become part of the downstream ice cover.

On December 15, backwater from an ice dam at RM 135 caused a fracturing of upstream border ice. A large solid fragment drifted downstream but instead of floating down to the leading edge at RM 131 it became lodged on the anchor ice dam at RM 135, creating a new ice bridge. This ice bridge accumulated slush ice at the upstream edge. The new ice front prevented slush from continuing downstream and advancing the previous leading edge. By December 20, the river under the Gold Creek bridge had frozen

over and the leading edge was approaching RM 137. The open water below the ice dam at RM 135 remained as it appeared a week earlier.

By the final observation flight on December 20, 1984, the leading edge on the Susitna River below the three rivers confluence had reached RM 92, at a rate of 0.12 miles/day. The Talkeetna River was frozen over above the railroad bridge. The Chulitna River was frozen over from about three miles above the Susitna confluence. Extensive open leads existed in the Susitna River ice cover below Talkeetna. Open water still persisted on the east channel of the Delta Islands, although the flow velocity had diminished in many places and border ice was beginning to close the open channel in several areas. The leading edge progression is summarized in Table 3.1.

The 1984 ice cover development had several interesting and different features which contrasted to those of previous years. In 1984, a large volume of anchor ice was observed from near Talkeetna to upstream beyond the Watana area. The onset of extremely cold weather early during freezeup, from November 10 through November 13, cooled the middle river below Gold Creek sufficiently to generate frazil ice, which due to the turbulent nature of this reach adhered to the bottom, forming anchor ice. When the frazil layer was covering the channel bed, the saltating sediment particles and suspended sediment became entrained in this ice, giving it a brown coloration. When the anchor ice continued gaining mass by accumulating more frazil, then a critical thickness was attained giving the ice mass sufficient bouyancy to float, taking with it any entrained sediment, and possibly also bed material of various sizes which adheres to the ice mass. Rafts of anchor ice were frequently observed floating downstream. These rafts would eventually become incorporated in the ice cover further downstream. The rafts varied considerably in size. Some were quite large, with diameters of about 4-5 feet, but the most common anchor ice rafts observed were generally 1-2 feet across. Anchor ice generally develops every year to some extent upstream of the Gold Creek Bridge, and usually in several areas between Talkeetna and Gold Creek. The cold

air temperatures of November 1984 caused early formation of this ice, which subsequently led to very thick and widespread deposits, with volumes exceeding those observed in previous years.

The frequency of ice bridge formation in 1984 is most likely a direct effect of the low river flows during freezeup. The resulting shallow water in many places provided natural lodgement points which at higher water would be negotiable by the ice floes.

Observations during the 1984 freezeup confirmed the critical importance of slush ice volumes to ice cover development. When open water contacts air colder than about -10°C , then frazil ice is generated in large volumes. A steep, turbulent river reach can generate much more ice than a reach of lesser gradient. Once the open water surface is about 70% covered by floating slush, then little new frazil will form, probably because the latent heat expelled during ice formation cannot be absorbed by water full of ice. The length of open water required to generate a 70% slush coverage is dependent on the degree of turbulence and the prevailing air temperature. When the ice bridge formed at RM 105, very little frazil ice was generated in the open water reach downstream to the leading edge at RM 73. Much of the ice supplying the lower river leading edge originated from the Chulitna and Talkeetna Rivers. This contribution was eliminated on November 14 when ice bridges formed on the tributaries. Consequently the lower river ice front received only minimal volumes of ice which did not advance the leading edge. By the last field trip the remaining open water downstream of RM 105, a length of approximately 13 miles in mid-December, was gradually freezing over by shore ice growing laterally out from the river banks.

Table 3.1

1984 Susitna River Freezeup
Leading Edge (LE) Progression Summary

Date	Location	Rate of Advance
10/27/84	Ice Bridge RM5	Discontinuous Ice Cover
10/30/84	LE RM19	Discontinuous Ice Cover
	Ice Bridge RM26	Discontinuous Ice Cover
	LE RM43	Discontinuous Ice Cover
	LE RM51	Discontinuous Ice Cover
	Ice Bridge RM52	Discontinuous Ice Cover
	LE RM55	Discontinuous Ice Cover
11/03/84	LE RM71.5	4.1 miles/day
	Ice Bridge RM105	
11/05/84	LE RM73	0.75 miles/day
	LE RM109	2.0 miles/day
11/07/84	LE RM74	0.5 miles/day
	LE RM111	1.0 miles/day
11/09/84	LE RM74.5	0.25 miles/day
	LE RM112	0.5 miles/day
11/11/84	LE RM80	2.75 miles/day
	LE RM114	1.0 miles/day
11/13/84	LE RM86	3.0 miles/day
	LE RM121	3.5 miles/day
11/14/84	LE RM88	2.0 miles/day
	LE RM123	2.0 miles/day
11/16/84	LE RM88	0 miles/day
	LE RM127	2.0 miles/day
11/19/84	LE RM90	0.67 miles/day
	LE RM128	0.33 miles/day
11/21/84	LE RM91	0.5 miles/day
	LE RM129	0.33 miles/day
11/27/84	LE RM92	0.17 miles/day
	LE RM130.5	0.25 miles/day

4.0 METEOROLOGY AND DATA COLLECTION

4.1 Meteorology

Daily measurements of ice and meteorological parameters were made by Nancy Larson at the Gold Creek Bridge. Twice per day, usually at sun-up and sun-down, she obtained data on the current air temperature at the water surface, minimum and maximum daily air temperatures, water temperature, water velocity, stage, shore ice width and thickness, and estimated slush ice concentration on the water surface. These data are listed in Appendix A. Daily flows are tabulated in Tables 4.1 to 4.3.

Weather data from the Talkeetna Flight Service Station (National Weather Service), Watana (R&M Consultants) and Denali (R&M) for the months September through December 1984 are included in Appendix A. Air temperature data from these stations were summarized and are listed in Tables 4.4 to 4.22, along with the accumulated freezing-degree days. The plots of mean daily air temperatures in Figures 4.1 to 4.4 show the relative temperature variation between the stations, as well as the temperature trend for the four months. As shown on the graphs, the air temperatures generally decreased steadily through October. In November the air temperatures began fluctuating considerably, with this trend continuing through December. November 1984 was colder than normal, while September, October and December all had above-normal temperatures. By the end of December, the total accumulated freezing-degree days were well below the historical average. Additional air temperature data from a site located in the Delta Islands (RM 47.8) are shown in Tables 4.4 to 4.6. In order to quantify the variation in air temperature between the Watana weather station, located on the high plateau adjacent to the river, and the air temperature near the water surface, a thermograph recorded air temperatures at the streamgaging site since September, 1984. The data from this recorder are listed in Tables 4.15 to 4.18, along with the mean daily deviation from the Watana station.

4.2 Lower River Cross Sections

In September, 1984, a total of 13 sections were surveyed on the lower river below Talkeetna. Six new cross-sections were located between Talkeetna and the Parks Highway Bridge at the following river miles:

84.6	90.0
86.3	91.7
87.8	93.3

Three cross-sections, originally surveyed in 1982, were re-surveyed in order to have recent data for sediment modelling. These sections were located at river miles:

95.9 (LRX - 0.7)	98.0 (LRX - 2.0)
97.1 (LRX - 1.0)	

The primary purpose of these 9 sections is for the on-going river aggradation study, which will analyze potential aggradation between the Chulitna confluence and the Parks Highway Bridge. Details pertaining to the cross-section survey and the field data collected were published by R&M Consultants (1984).

Four additional cross-sections were surveyed below the Parks Highway Bridge at river miles:

40.0	59.7
47.8	76.8

These sections will be used for estimating ice volumes and ice front progression rates under with-project conditions. These four sections are not tied in to the project datum. The elevations are based on an altimeter survey which established approximate elevations on all the east bank bench marks.

In addition to the 13 sections surveyed by R&M Consultants, two (2) cross-sections from the U.S.G.S. streamgage sites at Sunshine and Susitna Station were plotted and are included with the tabulated cross-section data in Appendix B. Cross-section locations have been delineated on the blueline photomosaic maps in Appendix C.

Measurements of stage, water velocity, and ice thicknesses were made along the four sections below the Parks Highway Bridge. Stage and ice thickness measurements were made on the 9 sections above the bridge. These data are included in Figures 4.5 to 4.19.

4.3 Porosity Measurements of Slush Ice

Numerous measurements were made during the freezeup period in 1984 to quantify the porosity of slush ice formed from frazil crystals. The value of this parameter is necessary for accurately determining the volume of ice generated within a specific open water reach. The length of open water upstream of the measurement site, as well as the air temperature, to a great extent determine the porosity.

During October 1984, a series of measurements were taken at several locations on the Susitna River between Denali and Cook Inlet. The objective was to document a change in porosity of slush ice relative to travel time since frazil formation. Recorded air temperatures at Denali and Watana were sufficiently low in October for substantial frazil generation, but at other river locations further downstream air temperatures remained generally too warm for much additional ice to form. Theoretically, this condition would lead to high porosities near Denali where the frazil is relatively new, and decreasing porosity values further downstream as the frazil crystals metamorphosed from very small flat disc shapes to coarser, rounded particles consisting of several crystals sintered together. The slush was sampled with a wire basket, allowed to drain and then weighed on a balance beam scale. The resultant weight of slush was then compared to the weight of solid ice to obtain a value for the percentage of ice in the

sample. The porosity of the slush is the difference between the percentage of ice in the sample and 100. The tabulated data are shown in Table 4.23 and plotted in Figure 4.20. As expected, the plot shows a decrease in porosity over time, and a slight increase with the slush contribution from the tributaries.

Theoretical values for porosity of frazil are generally considerably higher than those measured on the Susitna. Published ice porosity values generally range from 40-70 percent. The range of values measured on the Susitna is slightly lower, between 29 and 55 percent. This could be explained by the long residence time of the slush in the river, which early during freezeup corresponds to the travel time required to negotiate the upper and middle river reach.

As freezeup continues, more and more of the river begins generating frazil as air temperatures drop below freezing all along the river down to Cook Inlet. Frazil ice is generated along the entire river to some extent. However, the turbulent reaches above Talkeetna still probably generate the most frazil due to more mixing with cold air. The low porosity old slush, which has developed into a mass of relatively coarse-grained and rounded particles, is mixed with the new high porosity frazil, which are generally very small discs. The resultant ice mass has the interstices between the old coarse grains occupied by the newer frazil. This arrangement produces very dense slush rafts with low porosities. For this reason, the porosity values measured on the Susitna tend to decrease as the freezeup progresses.

Materials such as unconsolidated sediments (gravels and sands) show the similar tendencies towards lower porosities with increasing grain size and also for poorly-sorted (coarse particles mixed with fines) sediment compared to well-sorted (uniform size) sediments. Porosity is dependent on particle shape, packing, and size distribution (Davis and DeWiest, 1966). Highly angular particles tend to be held apart by irregular, sharp corners, producing high values of porosity for a given grain size.

Subangular particles will contact along flat faces and have maximum compaction, while rounded particles will be less compact. Tabular particles (i.e., frazil discs) tend to form box-like openings, particularly in fine grained particles, resulting in high porosities. Porosities of materials other than ice are tabulated in Table 4.24 and plotted in Figure 4.21.

4.4 Observations at Fishery Habitat Study Areas

During the summer of 1984, the Alaska Department of Fish and Game identified a series of sites between the Yentna River confluence and Talkeetna for the Resident Juvenile Habitat Study. Table 4.25 lists the study sites and river mile locations, as well as any documented effects on the sites during ice cover development.

As indicated by the table, the majority of the listed study sites were not affected by mainstem river ice processes. Only the side channels at Rustic Wilderness and Goose 2 were overtopped. Several of the sites were flooded by backwater as the mainstem became choked with ice, and as the rising water level seeped through the snow, eventually freezing. The result is similar in appearance to the mainstem ice cover, but the snow ice is resting on the channel bottom and the surface is generally smoother, lacking the hummocked texture typical of the mainstem.

Several areas other than those listed in Table 4.25 were affected somewhat by ice-induced staging. Sunshine Slough at RM 86.7 was overtopped in mid-November, 1984, but not to the degree observed in previous years. A backwater area was also seen at the confluence of Sunshine Creek/Slough and the Susitna mainstem at RM 84.0. This backwater extended up the side channel approximately 200 yards. The side channel downstream of the Goose Creek tributary was overtopped by a substantial volume of water on November 3, 1984. The overtopping continued for about 10 days. Anchor ice was seen forming on the side channel bed and an ice front progressed slowly up the side channel from about RM 69.5. Mainstem stage eventually subsided at the entrance to this side channel, and the overtopping flow

was minimal by November 14. The interconnecting channel between the mainstem and east bank side channel at RM 51 was overtopped and the water proceeded through the side channel, regaining the mainstem at RM 50 and at Willow Creek. Several of the intermediate channels through the Delta Islands contained open water. Since no slush ice entered these channels, they essentially remained open until cold air temperatures caused shore ice growth to close them in some places. Kroto Slough at RM 40.1 was slightly overtopped, but not nearly to the degree of previous years. Alexander Slough was not overtopped during the 1984 freezeup.

In general, the 1984 freezeup was marked by a minimal degree of flooding, with few sloughs or side channels overtopped. This resulted primarily from the low initial freezeup stages and slightly lower water velocities, attributed to the relatively low discharges during ice cover progression.

4.5 Ice Bridge Formation Near Cook Inlet

Downstream of RM 15 the Susitna River is influenced by the tidal fluctuations in Cook Inlet. These tides often range over 30 feet above the datum for the Anchorage tide reference station. The local Anchorage tide datum, from which the high and low tide levels are calculated, is 16.4 feet below local mean sea level. The local datum should not be confused with the National Geodetic Vertical Datum of mean sea level which is referenced for, among other things, map elevations. For instance, the highest tides of about 34 feet do not refer to 34 feet above mean sea level but rather are referenced to mean low water or (approximately) 17.6 feet above mean sea level.

During a high tide cycle, water velocities are reduced considerably on the lower 10-15 miles of the Susitna River. The high tide in Cook Inlet restricts the normal flow of the river, raising the water level and reducing the velocity. Ice floes entering the backwater tend to accumulate rapidly since they are not conveyed through this reach at the same rate as they enter. The accumulations often attain extensive proportions, resembling a

continuous ice cover but still moving at a slow rate. When the tide begins to recede the water level drops and flow velocity increases. However, as the backwater effect is removed, the surface area of the river decreases, and it can no longer transport the accumulated volume of ice floating on the surface, with a jam resulting. The ice jam gains stability as the water level drops and more ice floes become grounded. This ice jam bridges the water surface, preventing other ice floes still coming downstream from passing out to sea. It has not yet been ascertained what critical volume of ice is required for an ice bridge to form in this manner. At low concentrations of ice floes, a bridge will not develop, and the ice accumulation will be simply flushed out to sea. Ice bridges have been observed to form at RM 5 and RM 9 during the 3 years (1981-1984) of ice study on the lower river. This has usually occurred during the latter half of October, corresponding to a period of extreme tide fluctuations. Usually by this time air temperatures have dropped sufficiently throughout the watershed so that the upper and middle Susitna reaches and the major tributaries are generating substantial volumes of ice. When the high tidal cycle and low air temperatures coincide, the result is the formation of ice bridges at the observed locations.

Staff gage measurements were obtained at RM 9 prior to formation of the ice bridge at RM 5 in 1984. The RM 9 site was selected since the ice bridge formed near this area in previous years. The objective was to monitor the rise and fall of the river water surface and correlate the observations with the Anchorage tide cycle. On October 19, three gages were set with the lower staff reading 2.0 feet at 1630 hours, about $2\frac{1}{2}$ hours after the daily high-high tide of 26.1 feet. The following low tide would occur at 2011 hours at a height of 8.8 feet. The surface flow velocity at 1630 hours was about 2 feet/second in mid-channel. On October 26 the preceding high tide level was demarcated on the upper staff gage at about 8.0 feet. The Anchorage high tide at 0716 hours was 32.4 feet. For a tidal variation of about 15 feet in Cook Inlet, the river water level at RM 9 fluctuated about 6 feet. The relationship is not linear, however, and to accurately correlate the affects of tides on water

level at RM 9, a continuous recorder should be installed. However, the chances of recovering such a recorder after the start of slush ice movement during freezeup is minimal. Table 4.26 is a reproduction from the 1984 Tide Tables of the National Oceanic and Atmospheric Administration showing the times and heights of high and low waters for the Anchorage area.

Table 4.1

Gold Creek Water Levels
and Computed Discharges
October, 1984

Date	Wire Weight (ft)	Flow (cfs)
1	-	-
2	-	-
3	-	-
4	6.84	7320
5	6.80	7200
6	6.72	6960
7	6.66	6780
8	6.66	6780
9	6.64	6720
10	6.70	6900
11	6.62	6660
12	6.52	6360
13	6.49	6270
14	6.22	5550
15	5.99	5000
16	5.99	5000
17	5.77	4430
18	5.71	4280
19	5.43	3800
20	5.41	3700
21	5.63	3900
22	5.74	4300
23	5.91	4500
24	5.96	4800
25	5.65	4000
26	5.15	3080
27	4.75	2650
28	4.51	2410
29	4.29	2230
30	4.21	2170
31	4.22	2190

Table 4.2

Gold Creek Water Levels
and Computed Discharges
November, 1984

Date	Wire Weight (ft)	Flow (cfs)*	Water Surface Elevation (Surveyed)
1	3.84	1870	
2	3.88	1900	
3	4.25	2200	
4	4.43	2340	
5	4.68	2580	4.66 (2550cfs)
6	5.18	3120	
7	5.11	3030	
8	5.09	3010	
9	5.15	3080	
10	5.07	2980	
11	4.88	2780	4.92 (2800cfs)
12	4.71	2610	
13	4.92	2820	
14	4.78	2880	4.88 (2750cfs)
15	4.89	2790	
16	5.06	2970	
17	5.01	2910	
18	5.09	3010	
19	5.05	2960	5.08 (3000cfs)
20	5.65	3820	
21	5.22	3170	
22	5.29	3270	
23	5.29	3270	
24	5.21	3150	
25	5.35	3350	
26	5.12	3040	
27	4.99	2890	
28	5.19	3100	
29	5.19	3130	
30	5.27	3240	

* Stage levels are affected by anchor ice and shore ice from November 3 through December 15.

Table 4.3
Gold Creek Water Levels
and Computed Discharges

December 1984

Day	Wire Weight (ft)	Flow (cfs) *
1	5.32	3310
2	5.35	3350
3	5.39	3410
4	5.38	3390
5	5.39	3410
6	5.27	3240
7	5.33	3320
8	-	-
9	5.33	3320
10	5.36	3360
11	5.39	3410
12	5.46	3520
13	5.90	4300
14	-	-
15	8.49	-
16	Ice Covered	-
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

* Stage levels are affected by anchor ice and shore ice from November 6 through December 15.

Table 4.4

Delta Islands Air Temperature and
Freezing Degree-Days Summary
October 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)
1	-	-	-
2	-	-	-
3	6.0	13.2	9.6
4	-3.8	11.5	3.9
5	-2.5	8.5	3.0
6	1.1	9.2	5.2
7	1.0	5.0	3.0
8	1.0	2.1	1.6
9	-2.5	4.5	1.0
10	-3.1	3.9	0.4
11	-5.0	0.8	-2.1
12	-3.5	4.9	0.7
13	-4.4	6.5	1.1
14	-7.1	4.0	-1.6
15	-9.0	3.5	-2.8
16	-9.3	5.5	-1.9
17	-8.9	4.5	-2.2
18	-12.0	1.5	-5.3
19	-8.5	3.7	-2.4
20	-11.1	-1.0	-6.1
21	-3.6	-1.9	-2.8
22	-1.9	-0.8	-1.4
23	-3.8	0.4	-1.7
24	-7.9	-1.0	-4.5
25	-10.0	1.0	-4.5
26	-15.2	-1.7	-8.5
27	-17.3	-3.5	-10.4
28	-19.0	-3.7	-11.4
29	-23.0	-7.7	-15.4
30	-12.0	-6.0	-9.0
31	-13.0	-4.0	-8.5

Mean Monthly Air Temperature	-2.5°C
Total Monthly Freezing Degree-Days	102.5
Total Accumulated Freezing Degree-Days	102.5

Table 4.5

Delta Islands Air Temperature and
Freezing Degree-Days Summary
November 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)
1	-20.0	-6.5	-13.3
2	-22.0	-8.0	-15.0
3	-21.5	-8.5	-15.0
4	-20.5	-8.5	-14.5
5	-12.0	-3.5	-7.8
6	-10.5	-2.8	-6.7
7	-15.0	-5.1	-10.1
8	-20.5	-8.7	-14.6
9	-23.0	-11.5	-17.3
10	-26.0	-13.5	-19.8
11	-28.0	-17.0	-22.5
12	-30.0	-18.0	-24.0
13	-30.0	-19.0	-24.5
14	-29.0	-10.5	-19.8
15	-12.5	-7.5	-10.0
16	-19.0	-10.0	-14.5
17	-20.5	-10.5	-15.5
18	-19.0	-8.5	-13.8
19	-22.0	-10.0	-16.0
20	-10.0	0.0	-5.0
21	-10.0	-1.5	-5.8
22	-10.0	-4.5	-7.3
23	-9.5	-9.0	-9.3
24	-12.0	-9.5	-10.8
25	-19.0	-11.0	-15.0
26	-24.0	-12.5	-18.3
27	-27.0	-13.5	-20.3
28	-15.0	-10.0	-12.5
29	-16.0	-9.0	-12.5
30	-10.5	-7.5	-9.0

Mean Monthly Air Temperature	-14.0°C
Total Monthly Freezing Degree-Days	420.5
Total Accumulated Freezing Degree-Days	523.0

Table 4.6

Delta Islands Air Temperature and
Freezing Degree-Days Summary
December 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)
1	-10.0	-6.0	-8.0
2	-17.0	-3.5	-10.3
3	-5.0	-4.5	-4.8
4	-8.0	-4.2	-6.1
5	-8.0	-2.5	-5.3
6	-11.0	-7.1	-9.1
7	-10.0	-7.8	-8.9
8	-14.5	-7.5	-11.0
9	-26.0	-17.5	-21.8
10	-27.0	-16.0	-21.5
11	-24.0	-16.0	-20.0
12	-28.0	-22.0	-25.0
13	-28.0	-21.0	-24.5
14	-30.0	-25.0	-27.5
15	-25.0	-13.5	-19.3
16	-13.5	-10.5	-12.0
17	-11.5	-7.5	-9.5
18	-7.5	-4.5	-6.0
19	-20.0	-6.0	-13.0
20	-23.0	-19.0	-21.0
21	-20.0	-12.5	-16.3
22	-12.5	-9.0	-10.3
23	-12.0	-8.0	-12.0
24	-18.0	-12.0	-15.0
25	-17.0	-10.5	-13.8
26	-17.0	-10.0	-13.5
27	-23.0	-17.0	-20.0
28	-26.0	-20.0	-23.0
29	-20.0	-12.5	-16.3
30	-12.5	-7.5	-10.0
31	-7.0	-5.5	-6.3
Mean Monthly Air Temperature		-14.2°C	
Total Monthly Freezing Degree-Days		441.1	
Total Accumulated Freezing Degree-Days		964.1	

Table 4.7

Talkeetna Weather Station Air Temperature
and Freezing Degree-Days Summary

September 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	0.6	17.8	9.4
2	0.0	18.9	9.4
3	1.1	18.3	10.0
4	1.1	18.3	10.6
5	0.6	18.3	9.4
6	3.9	17.2	10.6
7	5.6	16.1	11.1
8	6.7	20.0	13.3
9	2.2	18.9	10.6
10	0.6	20.6	10.6
11	1.1	18.3	10.0
12	2.2	14.4	8.3
13	6.7	11.1	8.9
14	4.4	16.1	10.6
15	4.4	16.7	10.6
16	1.1	16.7	8.9
17	5.6	12.8	9.4
18	5.6	12.2	8.9
19	2.2	11.1	6.7
20	0.6	13.9	7.2
21	-4.4	14.4	5.0
22	-2.8	11.1	7.2
23	1.1	12.8	6.1
24	5.0	11.1	8.9
25	6.1	14.4	8.9
26	2.2	15.6	8.3
27	2.2	16.7	8.9
28	0.0	13.9	8.3
29	6.7	14.4	10.6
30	7.2	14.4	11.1
Mean Monthly Air Temperature			9.2°C
Total Monthly Freezing Degree-Days			0.0
Total Accumulated Freezing Degree-Days			0.0
Average Historical Accumulated Freezing Degree-Days			0.0

Table 4.8

Talkeetna Weather Station Air Temperature
and Freezing Degree-Days Summary

October 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	2.2	15.0	8.9
2	3.9	13.3	8.9
3	-1.1	12.2	5.6
4	-3.9	11.1	3.9
5	-2.2	11.1	4.4
6	2.2	12.2	7.2
7	0.6	8.9	5.0
8	0.6	5.0	2.8
9	-1.1	7.2	3.3
10	-4.4	7.2	1.7
11	-6.1	4.4	0.6
12	-2.2	6.1	2.2
13	-3.3	7.8	2.2
14	-7.2	5.0	-1.1
15	-7.2	2.9	-2.2
16	-6.7	10.6	2.2
17	-6.7	8.9	1.1
18	-9.4	5.0	-2.2
19	-8.3	5.0	-1.7
20	-2.8	2.2	0.0
21	0.6	2.2	1.7
22	1.1	8.3	5.0
23	-0.6	2.2	1.1
24	-5.6	1.1	-2.2
25	-4.4	3.9	0.0
26	-8.9	3.9	-2.2
27	-11.1	1.1	-5.0
28	-13.3	2.8	-5.0
29	-12.2	-2.2	-7.2
30	-8.9	-2.8	-5.6
31	-6.1	0.6	-2.8
Mean Monthly Air Temperature			1.0°C
Total Monthly Freezing Degree-Days			37.2
Total Accumulated Freezing Degree-Days			37.2
Average Historical Accumulated Freezing Degree-Days			72.0

Table 4.9

Talkeetna Weather Station Air Temperature
and Freezing Degree-Days Summary

November 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-12.2	1.1	-5.6
2	-13.9	1.1	-6.1
3	-15.6	-1.7	-8.3
4	-15.0	-2.8	-8.9
5	-5.6	1.1	-2.2
6	-6.1	1.7	-2.2
7	-8.9	-1.7	-5.0
8	-15.0	-2.8	-8.9
9	-17.2	-8.9	-12.8
10	-19.4	-7.8	-13.3
11	-21.1	-10.6	-15.6
12	-19.4	-7.2	-13.3
13	-20.5	-7.2	-13.9
14	-15.0	-6.7	-10.6
15	-6.7	-1.7	-3.9
16	-13.3	-2.2	-7.8
17	-14.4	-3.9	-8.9
18	-6.1	-2.2	-3.9
19	-13.9	-2.8	-8.3
20	-3.9	2.8	-0.6
21	-1.1	1.1	0.0
22	-13.9	-1.1	-7.2
23	-10.0	-8.3	-8.9
24	-8.9	-6.7	-7.8
25	-15.0	-8.9	-11.7
26	-22.2	-10.6	-16.1
27	-21.1	-7.8	-14.4
28	-8.3	-5.6	-6.7
29	-8.3	-4.4	-6.1
30	-6.1	-3.9	-5.0
Mean Monthly Air Temperature			-8.1°C
Total Monthly Freezing Degree-Days			244.0
Total Accumulated Freezing Degree-Days			281.2
Average Historical Accumulated Freezing Degree-Days			263.0

Table 4.10

Talkeetna Weather Station Air Temperature
and Freezing Degree-Days Summary

December 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-3.9	-0.6	-2.2
2	-3.3	0.6	-1.1
3	0.0	2.8	1.7
4	-0.6	3.9	1.7
5	-2.2	2.2	0.0
6	-7.2	-2.2	-4.4
7	-5.6	-3.3	-4.4
8	-8.9	-3.9	-6.1
9	-23.3	-7.2	-15.0
10	-23.9	-10.0	-16.7
11	-21.7	-10.0	-15.6
12	-25.0	-16.1	-20.6
13	-26.7	-11.67	-19.4
14	-26.7	-9.4	-18.3
15	-20.0	-9.4	-14.4
16	-9.4	-6.7	-7.8
17	-6.7	-4.4	-5.6
18	-4.4	-1.1	-2.8
19	-11.1	-1.1	-6.1
20	-22.8	-10.0	-16.0
21	-22.2	-8.9	-15.6
22	-11.7	-4.4	-7.8
23	-15.0	-3.9	-9.4
24	-21.7	-15.0	-18.3
25	-16.7	-7.8	-12.2
26	-22.2	-8.9	-15.6
27	-23.3	-12.2	-17.8
28	-23.3	-12.8	-18.3
29	-13.3	-8.9	-11.1
30	-8.9	-2.8	-5.0
31	-2.2	1.7	0.0
Mean Monthly Air Temperature			-9.8°C
Total Monthly Freezing Degree-Days			307.7
Total Accumulated Freezing Degree-Days			588.9
Average Historical Accumulated Freezing Degree-Days			670.0

Table 4.11

Watana Weather Station Air Temperature
and Freezing Degree-Days Summary

September 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	0.1	14.3	7.2
2	0.0	13.5	6.8
3	-1.6	12.8	5.6
4	4.4	13.1	8.8
5	4.6	14.0	9.3
6	4.5	11.9	8.2
7	3.1	11.8	7.5
8	-0.3	13.2	6.5
9	-0.1	15.5	7.7
10	0.3	15.4	7.9
11	-1.2	14.4	6.6
12	0.8	12.5	6.7
13	2.9	9.5	6.2
14	3.3	13.1	8.2
15	5.3	13.2	9.3
16	-0.1	13.9	6.9
17	0.4	11.0	5.7
18	1.9	7.7	4.8
19	0.0	6.5	3.3
20	-0.5	8.5	4.0
21	-3.0	14.4	5.7
22	-2.7	11.9	4.6
23	-0.3	10.2	5.0
24	1.8	9.2	5.5
25	2.6	10.1	6.4
26	0.3	10.4	5.4
27	-1.7	11.4	4.9
28	-0.2	10.3	5.1
29	3.2	9.4	6.3
30	4.7	10.8	7.8
Mean Monthly Air Temperature			6.4°C
Total Monthly Freezing Degree-Days			0
Total Accumulated Freezing Degree-Days			0
Average Historical Accumulated Freezing Degree-Days			13

Table 4.12

Watana Weather Station Air Temperature
and Freezing Degree-Days Summary

October 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	2.9	10.7	6.8
2	0.5	8.9	4.7
3	-2.5	8.3	2.9
4	-5.8	7.8	1.0
5	-1.1	6.1	2.5
6	0.1	6.8	3.5
7	-2.2	7.2	2.5
8	0.1	6.7	3.4
9	-2.4	3.4	0.5
10	-5.0	5.5	0.3
11	-4.5	5.2	0.4
12	-1.9	2.4	0.3
13	-3.2	4.2	0.5
14	-5.5	0.2	-2.7
15	-8.4	0.5	-4.0
16	-5.0	2.0	-1.5
17	-11.1	3.3	-3.9
18	-7.6	4.2	-1.7
19	-6.6	1.5	-2.6
20	-7.5	-2.2	-4.9
21	-2.2	3.2	0.5
22	0.3	4.5	2.4
23	-5.3	1.2	-2.1
24	-10.8	0.0	-5.4
25	-12.7	-0.7	-6.7
26	-14.0	-2.0	-8.0
27	-14.1	-1.1	-7.6
28	-14.3	-4.5	-9.4
29	-16.2	-8.3	-12.3
30	-15.8	-9.4	-12.6
31	-11.7	-4.6	-8.2
Mean Monthly Air Temperature			-2.0°C
Total Monthly Freezing Degree-Days			93.6
Total Accumulated Freezing Degree-Days			93.6
Average Historical Accumulated Freezing Degree-Days			140.0

Table 4.13

Watana Weather Station Air Temperature
and Freezing Degree-Days Summary

November 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-14.9	-1.5	-8.2
2	-14.3	-5.9	-10.1
3	-14.2	-2.6	-8.4
4	-14.6	-8.1	-11.4
5	-9.2	-3.5	-6.4
6	-4.8	-2.0	-3.4
7	-7.7	-3.3	-5.5
8	-7.9	-3.4	-5.7
9	-17.0	-6.6	-11.8
10	-21.3	-12.8	-17.1
11	-23.4	-16.8	-20.1
12	-25.0	-15.9	-20.5
13	-22.0	-13.5	-18.2
14	-20.7	-13.5	-17.1
15	-13.3	-7.4	-10.4
16	-14.3	-7.5	-10.9
17	-16.3	-10.3	-13.3
18	-14.9	-8.5	-11.7
19	-16.2	-10.5	-13.4
20	-12.0	0.4	-5.8
21	-4.9	1.3	-1.8
22	-10.7	-4.6	-7.7
23	-11.0	-7.6	-9.3
24	-12.7	-9.6	-11.2
25	-17.1	-12.6	-14.9
26	-22.1	-17.8	-20.0
27	-23.2	-12.1	-17.7
28	-14.7	-11.7	-13.2
29	-13.3	-10.4	-11.9
30	-13.3	-8.3	-10.8

Mean Monthly Air Temperature	-11.2°C
Total Monthly Freezing Degree-Days	347.5
Total Accumulated Freezing Degree-Days	441.1
Average Historical Accumulated Freezing Degree-Days	420.6

Table 4.14

Watana Weather Station Air Temperature
and Freezing Degree-Days Summary

December 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-8.5	-5.8	-7.2
2	-8.7	-4.1	-6.4
3	-4.9	-2.9	-3.9
4	-2.9	0.0	-1.5
5	-6.7	-1.0	-3.9
6	-10.1	-6.7	-8.4
7	-9.5	-6.7	-8.1
8	-9.3	-6.7	-8.0
9	-19.3	-9.4	-14.4
10	-20.6	-15.5	-18.1*
11			-17.9*
12			-22.4*
13	-21.6	-16.5	-19.1
14	-24.5	-18.7	-21.6
15			-16.8*
16			-10.9*
17	-11.3	-7.9	-9.6
18	-8.4	-4.0	-6.2
19	-12.9	-3.1	-8.0
20			-18.4*
21			-17.9*
22			-10.9*
23			-12.3*
24			-20.3*
25			-14.8*
26			-17.9*
27			-19.9*
28			-20.3*
29			-13.9*
30			-8.4*
31			-3.9*

Mean Monthly Air Temperature	-12.6°C
Total Monthly Freezing Degree-Days	391.3
Total Accumulated Freezing Degree-Days	822.4
Average Historical Accumulated Freezing Degree-Days	874.4

* Estimates based on linear regression with Talkeetna (NWS)

Table 4.15

Watana Streamgage Site
Air Temperature and
Freezing Degree-Days Summary
September 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)	Deviation From Watana Weather Station (°C)
1	-1.0	12.4	5.7	-1.5
2	-0.9	3.2	1.2	-5.6
3	-1.0	10.1	4.6	-1.0
4	3.8	12.0	7.9	-0.9
5	5.0	11.7	8.4	-0.9
6	5.0	10.5	7.8	-0.4
7	5.0	10.5	7.8	0.3
8	0.5	13.0	6.8	0.3
9	-1.5	13.0	5.8	-1.9
10	-1.0	12.0	5.5	-2.4
11	-2.1	13.2	5.6	-1.0
12	1.2	11.5	6.4	-0.3
13	3.8	7.2	5.5	-1.7
14	2.9	10.2	6.6	-1.6
15	6.1	13.2	9.7	0.4
16	0.4	14.0	7.2	0.3
17	-0.2	8.7	4.3	-1.4
18	3.0	6.6	4.8	0
19	2.8	5.5	4.2	0.9
20	0	9.0	4.5	0.5
21	-4.1	9.0	2.5	-3.2
22	-4.0	10.1	3.1	-1.5
23	-2.3	8.0	2.9	-2.1
24	-1.3	7.2	3.0	-2.5
25	3.0	8.8	5.9	-0.5
26	1.0	17.1	9.1	3.7
27	-2.0	11.0	4.5	-0.4
28	-1.0	8.0	3.5	-1.6
29	4.0	7.5	5.8	-0.5
30	3.2	10.5	6.9	-0.9

Average -0.9°C

Mean Monthly Air Temperature	5.6°C
Total Montly Freezing Degree-Days	0
Total Accumulated Freezing Degree-Days	0

Table 4.16

Watana Streamgage Site
Air Temperature and
Freezing Degree-Days Summary
October 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)	Deviation From Watana Weather Station (°C)
1	3.0	11.4	7.2	0.4
2	1.2	7.9	4.6	-0.1
3	-1.2	7.9	3.4	0.5
4	-6.2	8.0	0.9	-0.1
5	-2.0	5.0	1.5	-1.0
6	0.9	5.1	3.0	-0.5
7	-1.7	4.8	1.6	-0.9
8	1.0	5.0	3.0	-0.4
9	-0.3	3.0	1.4	0.9
10	-6.1	5.7	-0.2	-0.5
11	-4.3	3.5	-0.4	-0.8
12	-1.0	3.1	1.1	0.8
13	-3.0	4.8	0.9	0.4
14	-4.9	0.5	-2.2	0.5
15	-7.1	-2.0	-4.6	-0.6
16	-5.1	3.0	-1.1	0.4
17	-8.8	1.2	-3.8	0.1
18	-7.5	1.1	-3.2	-1.5
19	-3.5	-0.5	-2.0	0.6
20	-6.3	-2.1	-4.2	0.7
21	-2.9	3.5	0.3	-0.2
22	0.0	3.1	1.6	-0.8
23	-1.8	2.5	0.4	1.7
24	-9.5	-3.0	-6.3	-0.9
25	-13.5	-8.0	-10.8	-4.1
26	-13.0	-6.0	-9.5	-1.5
27	-14.0	-6.0	-10.0	-2.4
28	-14.9	-9.5	-12.2	-2.8
29	-15.5	-7.8	-11.7	0.6
30	-15.2	-10.5	-12.9	-0.3
31	-16.3	-9.1	-12.7	-4.5

Average -0.5°C

Mean Monthly Air Temperature	-2.5°C
Total Monthly Freezing Degree-Days	107.8
Total Accumulated Freezing Degree-Days	107.8

Table 4.17

Watana Streamgage Site
Air Temperature and
Freezing Degree-Days Summary
November 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)	Deviation From Watana Weather Station (°C)
1	-13.5	-9.0	-11.3	-3.1
2	-15.2	-11.0	-13.1	-3.0
3	-15.0	-10.0	-12.5	-4.1
4	-17.5	-13.0	-15.3	-3.9
5	-13.5	-5.7	-9.6	-3.2
6	-6.0	-4.8	-5.4	-2.0
7	-6.5	-4.5	-5.5	0
8	-9.0	-7.0	-8.0	-2.3
9	-16.0	-9.5	-12.8	-1.0
10	-22.0	-17.0	-19.5	-2.4
11	-26.0	-22.0	-24.5	-3.9
12	-27.0	-22.0	-24.0	-4.4
13	-24.0	-18.0	-21.0	-2.9
14	-20.0	-15.0	-17.5	-0.4
15	-15.0	-9.5	-12.3	-1.9
16	-17.0	-10.0	-13.5	-2.6
17	-20.0	-14.0	-17.0	-3.7
18	-15.0	-9.5	-14.0	-2.3
19	-19.0	-15.0	-17.0	-3.6
20	-14.0	-3.5	-8.8	-3.0
21	-6.0	-1.5	-3.8	-2.0
22	-12.0	-6.0	-9.0	-1.3
23	-13.0	-11.5	-12.3	-3.0
24	-12.5	-11.5	-12.0	-0.8
25	-14.0	-12.0	-13.0	1.9
26	-22.0	-14.0	-18.0	2.0
27	-27.0	-15.0	-21.0	-3.3
28	-16.0	-14.5	-15.3	-2.1
29	-15.0	-12.0	-13.5	-1.6
30	-13.5	-12.0	-12.7	-1.9

Average -2.2°C

Mean Monthly Air Temperature	-13.8°C
Total Monthly Freezing Degree-Days	413.2
Total Accumulated Freezing Degree-Days	521 0

Table 4.18

Watana Streamgage Site
Air Temperature and
Freezing Degree-Days Summary
December 1984

Date	Minimum (°C)	Maximum (°C)	Average (°C)	Deviation From Watana Weather Station (°C)
1	-11.5	-7.0	-9.3	-2.1
2	-7.0	-4.5	-5.8	0.6
3	-4.5	-2.5	-3.5	0.4
4	-9.0	-4.0	-6.5	-5.0
5	-11.7	-9.0	-10.4	-6.5
6	-11.5	-10.5	-11.0	-2.6
7	-9.5	-8.5	-9.0	-0.9
8	-25.0	-11.0	-18.0	-10.0
9	-24.0	-17.0	-20.5	-6.1
10	-24.0	-17.0	-20.5	-2.4
11	-27.0	-22.0	-24.5	-6.6
12	-25.0	-21.0	-23.0	-0.6
13	-28.0	-25.0	-26.5	-7.4
14	-28.0	-16.0	-22.0	-0.4
15	-15.5	-13.5	-14.5	2.3
16	-15.0	-10.5	-12.8	-1.9
17	-10.5	-7.0	-8.8	0.8
18	-21.0	-7.0	-14.0	-7.8
19	-23.0	-20.0	-21.5	-13.5
20	-23.0	-17.0	-20.0	-1.6
21	-17.0	-11.5	-14.3	3.6
22	-11.5	-9.0	-10.3	0.6
23	-25.0	-10.0	-17.5	-5.2
24	-25.0	-9.0	-17.0	3.3
25	-25.0	-8.5	-16.8	-2.3
26	-27.0	-23.0	-25.0	-7.1
27	-23.0	-22.0	-22.5	-2.6
28	-20.0	-15.0	-17.5	-2.8
29	-15.0	-7.0	-11.0	2.9
30	-7.5	-3.0	-5.3	3.1
31	-4.5	-3.8	-3.0	0.9

Average -2.5°C

Mean Monthly Air Temperature	-14.9°C
Total Monthly Freezing Degree-Days	463.1
Total Accumulated Freezing Degree-Days	984.1

Table 4.19

Denali Weather Station Air Temperature
and Freezing Degree-Days Summary

September 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-3.1	12.0	4.5
2	-0.1	11.9	5.9
3	-2.3	10.8	4.3
4	1.7	11.9	6.8
5	1.3	12.8	7.1
6	3.3	10.8	7.1
7	3.5	11.5	7.5
8	0.5	13.7	7.1
9	-1.2	14.7	6.8
10	-1.6	13.0	5.7
11	-0.5	13.1	6.3
12	-1.6	10.8	4.6
13	2.3	8.4	5.4
14	-0.4	13.5	6.6
15	1.5	10.6	6.1
16	-0.5	12.2	5.9
17	3.5	10.5	7.0
18	1.6	8.8	5.2
19	0.4	5.7	3.1
20	-1.1	6.0	2.5
21	-5.0	9.5	2.3
22	-3.1	11.1	4.0
23	-1.4	11.2	4.9
24	0.9	9.7	5.3
25	0.9	8.7	4.8
26	1.5	8.7	5.1
27	-2.7	10.4	3.9
28	-2.9	9.3	3.2
29	2.1	11.5	6.8
30	3.0	9.7	6.4
Mean Monthly Air Temperature			5.4°C
Total Monthly Freezing Degree-Days			0.0
Total Accumulated Freezing Degree-Days			0.0
Average Historical Accumulated Freezing Degree-Days			23.0

Table 4.20

Denali Weather Station Air Temperature
and Freezing Degree-Days Summary

October 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	2.6	9.9	6.3
2	1.2	7.7	4.5
3	-3.5	7.0	1.8
4	-6.7	6.7	0.0
5	-3.8	6.1	1.2
6	-1.5	8.4	3.5
7	-2.2	5.5	1.7
8	-1.0	7.5	3.3
9	-4.0	2.9	-0.6
10	-7.9	3.1	-2.4
11	-8.4	2.3	-3.1
12	-1.1	1.7	0.3
13	-5.1	2.1	-1.5
14	-6.7	-2.7	-4.7
15	-10.1	-1.6	-5.9
16	-9.9	0.3	-4.8
17	-15.5	-1.2	-8.4
18	-14.9	1.9	-6.5
19	-11.1	-1.9	-6.5
20	-11.3	-4.3	-7.8
21			-1.4*
22			0.8*
23			-4.4*
24			-8.2*
25			-9.7*
26			-11.2*
27			-10.7*
28			-12.8*
29			-16.1*
30			-16.5*
31			-11.4*

Mean Monthly Air Temperature	-4.2°C
Total Monthly Freezing Degree-Days	144.6
Total Accumulated Freezing Degree-Days	144.6
Average Historical Accumulated Freezing Degree-Days	208.0

* Estimate based on linear regression with Watana Weather Station

Table 4.21

Denali Weather Station Air Temperature
and Freezing Degree-Days Summary

November 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1			-8.2*
2	-15.1	-10.1	-12.6
3	-18.5	-7.6	-13.1
4	-14.3	-9.2	-11.8
5	-13.0	-3.1	-8.1
6	-7.8	-1.5	-4.7
7	-8.3	-3.6	-6.0
8	-8.7	-7.5	-8.1
9	-13.9	-8.5	-11.2
10	-21.4	-11.8	-16.6
11	-28.4	-16.8	-22.6
12	-28.7	-19.4	-24.1
13	-32.3	-17.1	-24.7
14	-29.4	-16.1	-22.8
15	-17.4	-9.8	-13.6
16	-18.6	-9.3	-14.0
17	-19.4	-14.6	-17.0
18	-21.1	-10.1	-15.6
19	-23.8	-14.4	-19.1
20	-15.9	3.3	-6.3
21	-5.8	3.1	-1.4
22	-13.3	-5.3	-9.3
23			-9.3*
24	-15.4	-8.9	-12.2
25	-21.0	-14.0	-17.5
26	-24.4	-19.4	-21.9
27	-28.7	-18.7	-23.7
28	-25.2	-20.2	-22.7
29	-21.1	-15.4	-18.3
30	-15.4	-12.0	-13.7

Mean Monthly Air Temperature	-14.3°C
Total Monthly Freezing Degree-Days	430.2
Total Accumulated Freezing Degree-Days	574.8
Average Historical Accumulated Freezing Degree-Days	579.0

* Estimate based on linear regression with Watana Weather Station

Table 4.22

Denali Weather Station Air Temperature
and Freezing Degree-Days Summary

December 1984

Day	Minimum (°C)	Maximum (°C)	Average (°C)
1	-12.9	-6.9	-9.9
2	-14.6	-7.8	-11.2
3	-10.9	-3.7	-7.3
4	-4.8	5.1	0.2
5	-7.3	0.9	-3.2
6	-12.2	-5.5	-8.9
7	-13.5	-5.6	-9.6
8	-8.5	-6.6	-7.6
9	-22.3	-7.9	-15.1
10	-30.5	-18.6	-24.6
11	-26.1	-20.1	-23.1
12	-30.7	-15.1	-22.9
13	-29.6	-16.6	-23.1
14	-31.0	-16.7	-23.9
15	-30.4	-17.8	-24.1
16	-20.7	-14.2	-17.5
17	-17.6	-8.3	-13.0
18	-8.9	-5.5	-7.2
19	-22.0	-3.7	-12.9
20	-28.3	-22.4	-25.4
21	-27.4	-18.6	-23.0
22	-21.9	-12.5	-17.2
23	-12.2	-5.0	-8.6
24	-20.5	-9.6	-15.1
25	-22.7	-13.5	-18.1
26	-19.5	-11.0	-15.1
27	-33.0	-17.9	-25.5
28	-35.7	-21.9	-28.8
29	-25.9	-13.3	-19.6
30	-12.8	-2.2	-7.5
31	-5.6	2.6	-1.5

Mean Monthly Air Temperature	-15.2°C
Total Monthly Freezing Degree-Days	470.9
Total Accumulated Freezing Degree-Days	1,045.7
Average Historical Accumulated Freezing Degree-Days	1,175.0

Table 4.23

Susitna River Freezeup 1984
Slush Ice Porosity Values

Location	Date			
	10/19/84	10/26/84	11/03/84	11/14/84
Denali	55	-	-	-
Watana	35	-	-	-
Gold Creek	29	-	-	-
RM 9	37	53	-	-
Yentna	53	50	-	-
Talkeetna	45	44	-	-
Chulitna	51	42	39	-
RM 60	-	-	34	-
RM 78	-	-	38	-
Curry	-	-	-	42
Near Slough 8	-	-	-	35
Sherman	-	-	-	39

Table 4.24

Published Porosity Values
For Various Materials

Material	Porosity (%)	Grain Size (mm)
Soils	50 - 60	
Clay	45 - 55	.004
Silt	40 - 50	.062
Medium to coarse mixed sand	35 - 40	0.5 - 1.0
Uniform sand	30 - 40	0.5
Fine to medium mixed sand	30 - 35	0.25 - 0.5
Gravel (well-sorted material)	30 - 40	4.0 - 64.0
Gravel and sand (poorly-sorted material)	20 - 35	-
Sandstone	10 - 20	-
Shale	01 - 10	-
New snow	67 - 99	0.01 - 5.0
Old snow	35 - 78	0.5 - 3.0
Firn	08 - 56	0.5 - 5
Glacier ice	0 - 8	1 - 100

* Source: Davis and DeWiest, 1966.

Table 4.25

Juvenile Anadromous Habitat Study Sites

Name	Location (River Mile)	Observed Ice Effects
Hooligan Side Channel	35.2	None
Eagles Nest Side Channel	36.2	Some flooded snow
Kroto Slough Head	36.3	None
Rolly Creek Mouth	39.0	None
Bear Bait Side Channel	43.0	None
Last Chance Side Channel	45.4	None
Rustic Wilderness Side Channel	59.5	Overtopped
Caswell Creek - Mouth	63.0	None
Island Side Channel	63.2	Flooded snow
Mainstem West Bank	74.4	Some flooded snow
Goose 2 Side Channel	74.8	Overtopped
Circular Side Channel	75.3	None
Sauna Side Channel	79.8	None
Sucker Side Channel	84.5	None
Beaver Dam Slough	86.3	None
Sunset Side Channel	86.9	None
Sunrise Side Channel	87.0	None
Birch Creek Slough	88.4	None
Trapper Creek Side Channel	91.6	None

Table 4.26

ANCHORAGE, ALASKA, 1984

135

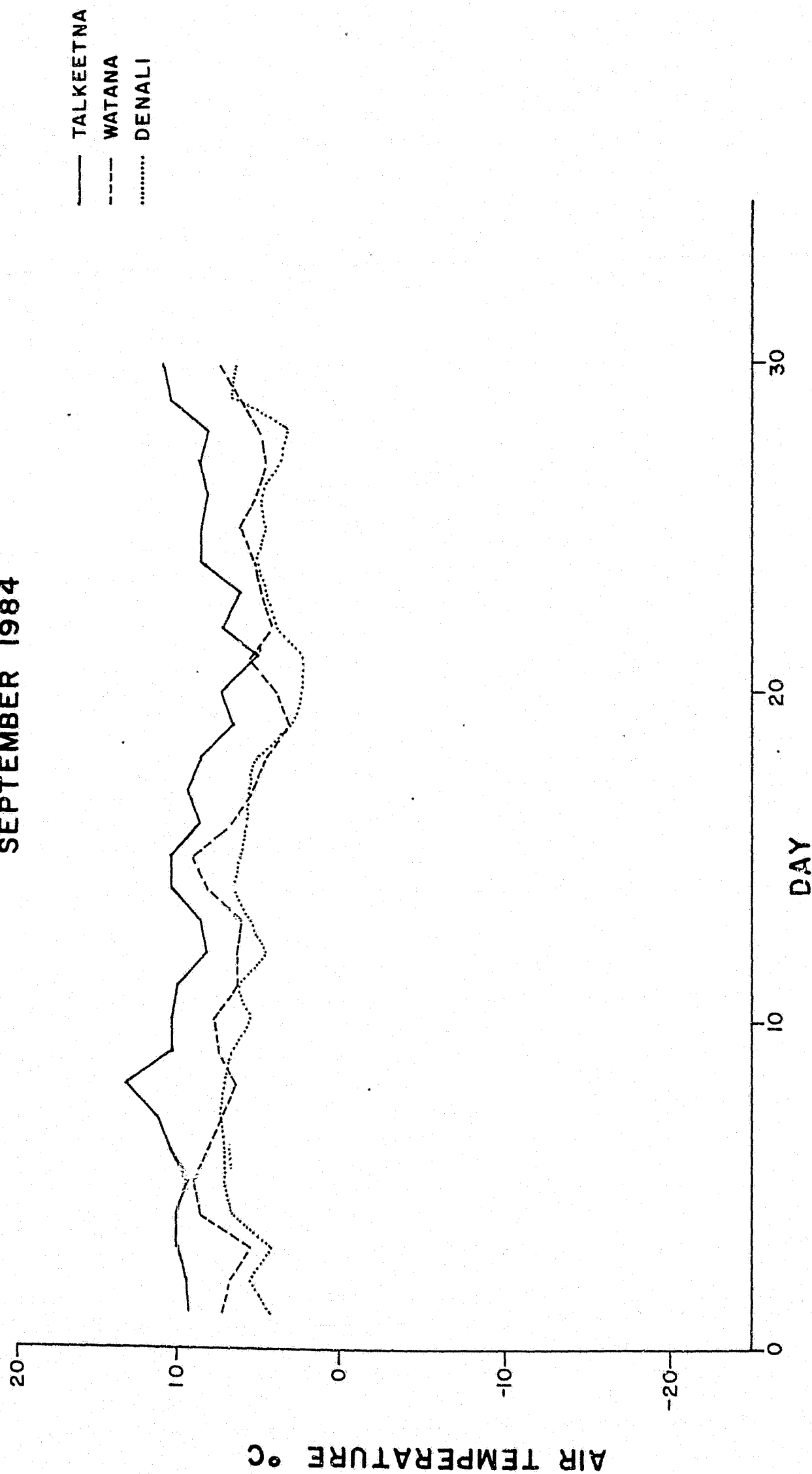
Times and Heights of High and Low Waters *

OCTOBER				NOVEMBER				DECEMBER			
Time		Height		Time		Height		Time		Height	
Day	h m	ft	m	Day	h m	ft	m	Day	h m	ft	m
1	0457	1.0	0.3	16	0422	1.9	0.6	1	0008	22.1	6.7
M	1105	26.8	8.2	Tu	1012	25.2	7.7	Sa	0634	5.7	1.7
	1704	8.9	2.7		1610	9.5	2.9		1255	25.7	7.8
	2246	26.3	8.0		2143	25.6	7.8		1951	7.2	2.2
2	0551	3.3	1.0	17	0510	3.0	0.9	2	0128	22.3	6.8
Tu	1229	25.5	7.8	W	1118	24.3	7.4	Su	0743	6.1	1.9
	1837	10.9	3.3		1713	10.8	3.3		1356	26.3	8.0
					2251	24.1	7.3		2053	4.8	1.5
3	0013	24.0	7.3	18	0608	3.8	1.2	3	0253	23.6	7.2
W	0703	4.9	1.5	Th	1247	24.6	7.5	M	0848	5.8	1.8
	1401	25.5	7.8		1830	11.0	3.4		1451	27.1	8.3
	2015	10.0	3.0						2146	2.6	0.8
4	0142	23.5	7.2	19	0016	24.0	7.3	4	0353	25.3	7.7
Th	0840	4.8	1.5	F	0723	3.7	1.1	Tu	0944	5.5	1.7
	1510	26.8	8.2		1408	26.1	8.0		1533	27.9	8.5
	2125	7.5	2.3		2011	8.8	2.7		2231	0.9	0.3
5	0256	24.5	7.5	20	0144	25.6	7.8	5	0457	26.6	8.1
F	0952	3.4	1.0	Sa	0840	2.5	0.8	W	1034	5.4	1.6
	1602	28.0	8.5		1509	28.2	8.6		1613	28.6	8.7
	2218	4.9	1.5		2125	5.4	1.6		2316	-0.2	-0.1
6	0352	26.2	8.0	21	0259	28.1	8.6	6	0514	27.6	8.4
Sa	1039	2.0	0.6	Su	0949	1.0	0.3	Th	1120	5.6	1.7
	1639	28.8	8.8		1557	30.2	9.2		1650	29.2	8.9
	2303	3.0	0.9		2228	2.2	0.7		2356	-0.9	-0.3
7	0434	27.7	8.4	22	0400	30.4	9.3	7	0551	28.2	8.6
Su	1116	1.3	0.4	M	1050	-0.2	-0.1	F	1200	5.9	1.8
	1710	29.3	8.9		1640	31.8	9.7		1724	29.7	9.1
	2341	1.8	0.5		2324	-0.6	-0.2				
8	0514	28.9	8.8	23	0453	32.0	9.8	8	0035	-1.3	-0.4
M	1152	1.1	0.3	Tu	1140	-0.7	-0.2	Sa	0626	28.6	8.7
	1735	29.8	9.1		1719	33.0	10.1		1236	6.2	1.9
9	0016	1.2	0.4	24	0014	-2.6	-0.8		1757	30.0	9.1
Tu	0548	29.6	9.0	W	0543	32.7	10.0	9	0113	-1.5	-0.5
	1226	1.4	0.4		1228	-0.6	-0.2	Su	0704	28.7	8.7
	1759	30.3	9.2		1756	33.7	10.3		1312	6.4	2.0
10	0049	0.7	0.2	25	0101	-3.9	-1.2		1832	30.0	9.1
W	0620	30.0	9.1	Th	0630	32.8	10.0	10	0151	-1.5	-0.5
	1258	2.0	0.6		1311	0.2	0.1	M	0741	28.5	8.7
	1825	30.8	9.4		1833	34.1	10.4		1349	6.5	2.0
11	0121	0.2	0.1	26	0145	-4.3	-1.3		1907	29.5	9.0
Th	0654	30.0	9.1	F	0716	32.4	9.9	11	0231	-1.3	-0.4
	1328	2.9	0.9		1352	1.4	0.4	Tu	0821	28.1	8.6
	1855	31.0	9.4		1910	34.0	10.4		1431	6.7	2.0
12	0153	-0.1	0.0	27	0227	-3.8	-1.2		1946	28.8	8.8
F	0730	29.6	9.0	Sa	0803	31.6	9.6	12	0309	-0.9	-0.3
	1357	3.9	1.2		1431	3.1	0.9	W	0900	27.8	8.5
	1922	30.8	9.4		1950	33.0	10.1		1513	6.8	2.1
13	0228	-0.2	-0.1	28	0308	-2.6	-0.8		2029	27.9	8.5
Sa	0803	28.9	8.8	Su	0850	30.4	9.3	13	0351	-0.3	-0.1
	1425	5.1	1.6		1511	5.1	1.6	Th	0942	27.6	8.4
	1949	30.0	9.1		2031	31.0	9.4		1601	6.8	2.1
14	0303	0.1	0.0	29	0348	-0.7	-0.2		2127	26.9	8.2
Su	0839	27.8	8.5	M	0940	28.8	8.8	14	0435	0.4	0.1
	1453	6.4	2.0		1551	7.3	2.2	F	1031	27.6	8.4
	2017	28.9	8.8		2116	28.2	8.6		1657	6.5	2.0
15	0340	0.8	0.2	30	0428	1.5	0.5		2225	26.1	8.0
M	0921	26.5	8.1	Tu	1038	27.1	8.3	15	0523	1.4	0.4
	1531	7.9	2.4		1638	9.5	2.9	Sa	1128	27.9	8.5
	2052	27.4	8.4		2212	25.2	7.7		1803	5.6	1.7
				31	0515	3.6	1.1		2333	25.6	7.8
				W	1145	25.8	7.9				
					1758	10.9	3.3				
					2339	23.0	7.0				

* Source: NOAA, Tide Tables (1984)

Time meridian 150° W. 0000 is midnight. 1200 is noon.
 Heights are referred to mean lower low water which is the chart datum of soundings.

UPPER SUSITNA RIVER BASIN AIR TEMPERATURE VARIATION SEPTEMBER 1984



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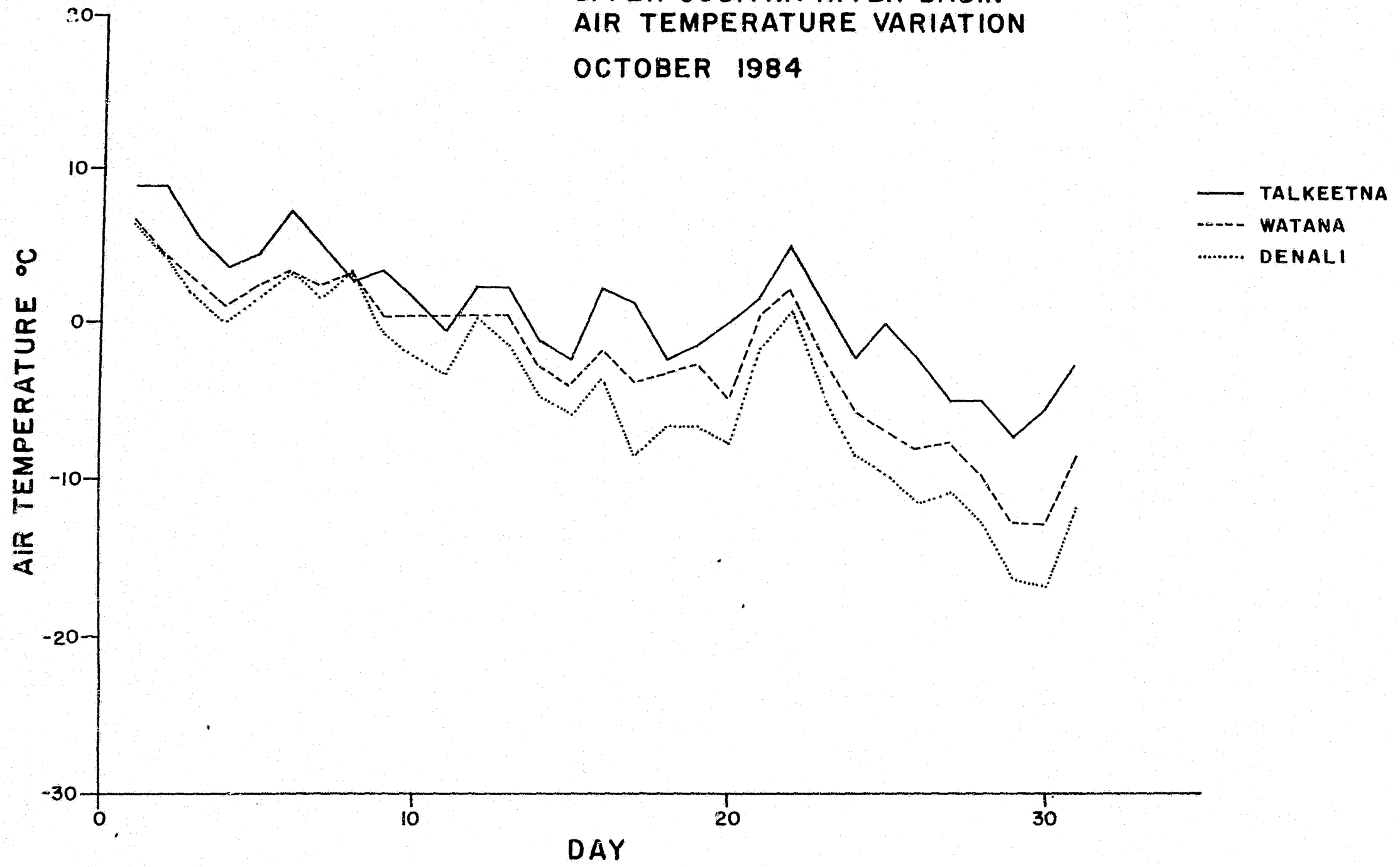
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Figure 4.1

-47-

UPPER SUSITNA RIVER BASIN
AIR TEMPERATURE VARIATION
OCTOBER 1984



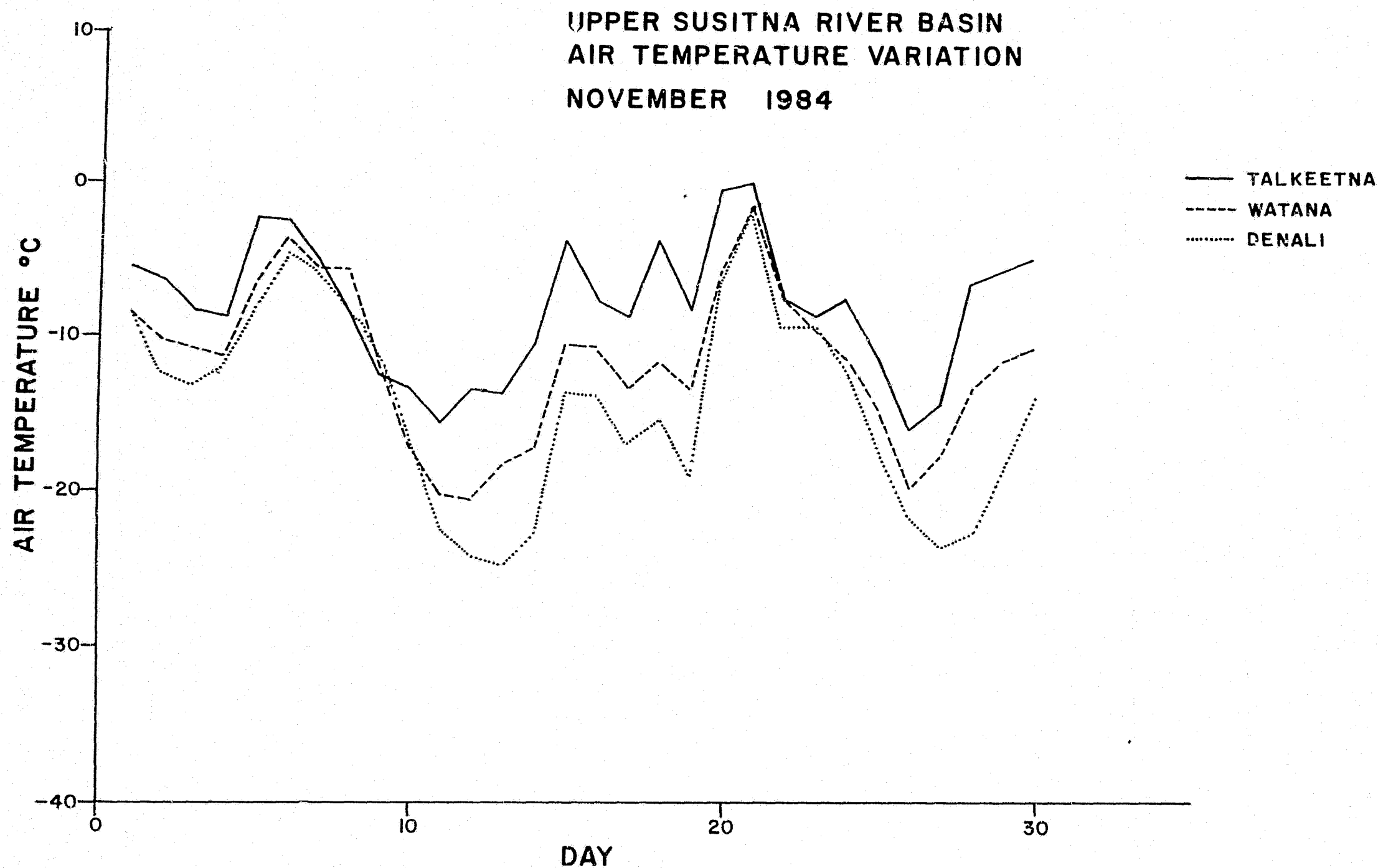
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Figure 4.2

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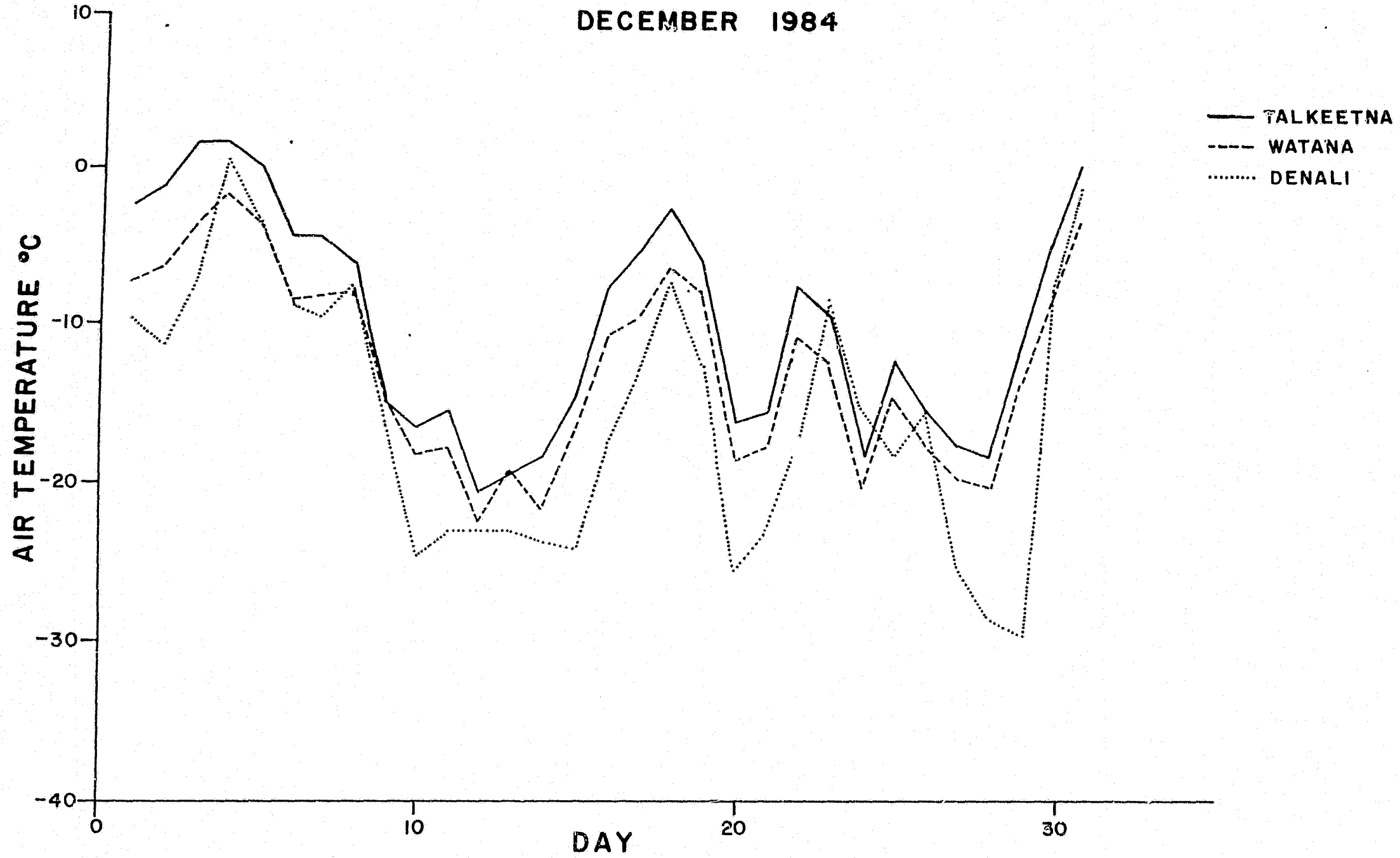
Figure 4.3

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-49-

UPPER SUSITNA RIVER BASIN
AIR TEMPERATURE VARIATION
DECEMBER 1984



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Figure 4.4

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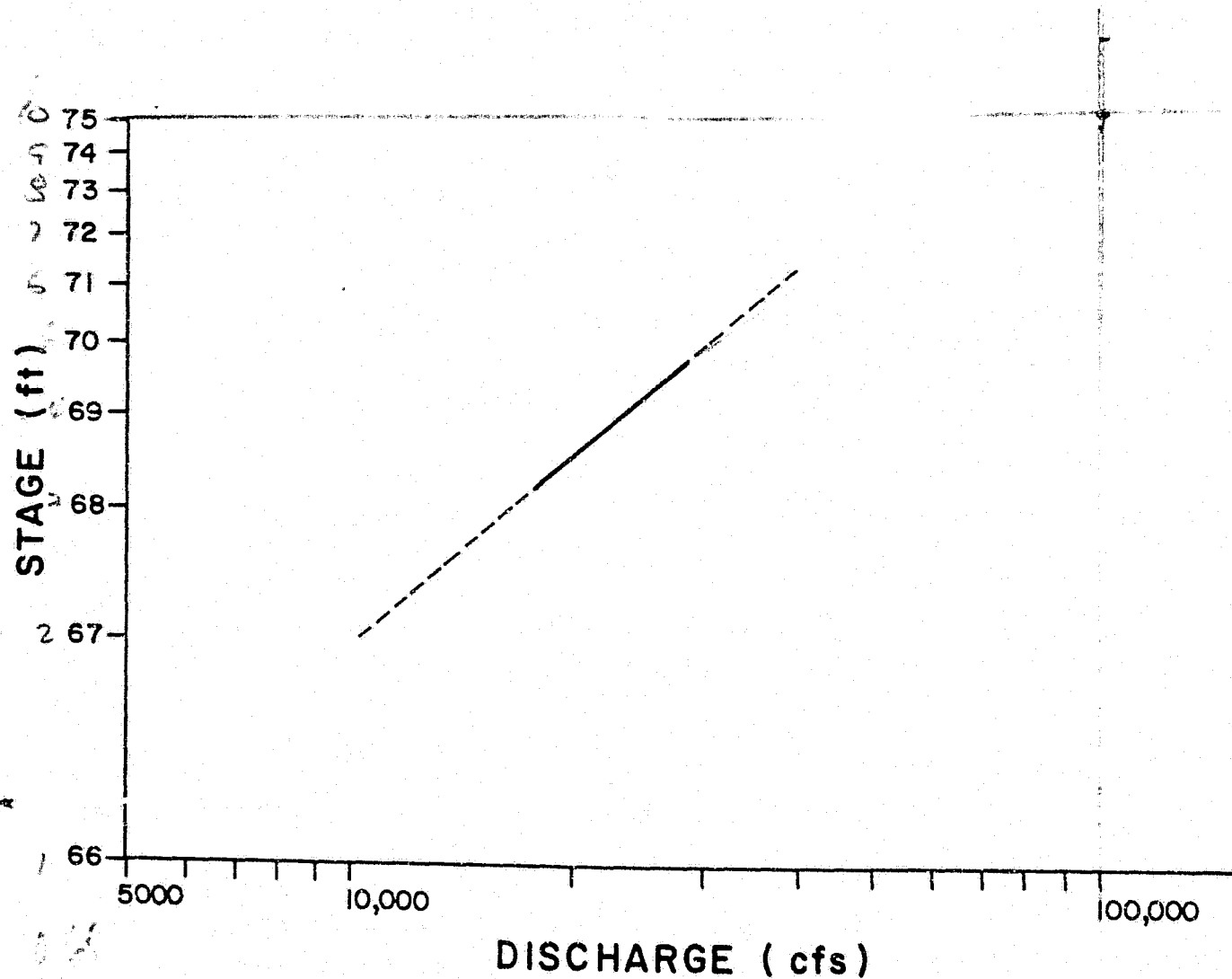
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Figure 4.5

Stage and Discharge Data
Cross Section at River Mile 40.0
(Deshka)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/05/84	69.00	25,600	-	-
09/17/84	68.45	20,100	2.9	-
09/21/84	69.82	28,700	-	-
10/03/84	68.25	18,000	3.2	6.6
10/23/84	66.58	-	-	-
10/30/84	3 69.55	Staged	Ice Covered	

1. Elevations based on altimeter established datum on rebar = 75 feet.
2. ~~20~~ USGS preliminary estimates from Sunshine gage site.
3. Surface velocity.



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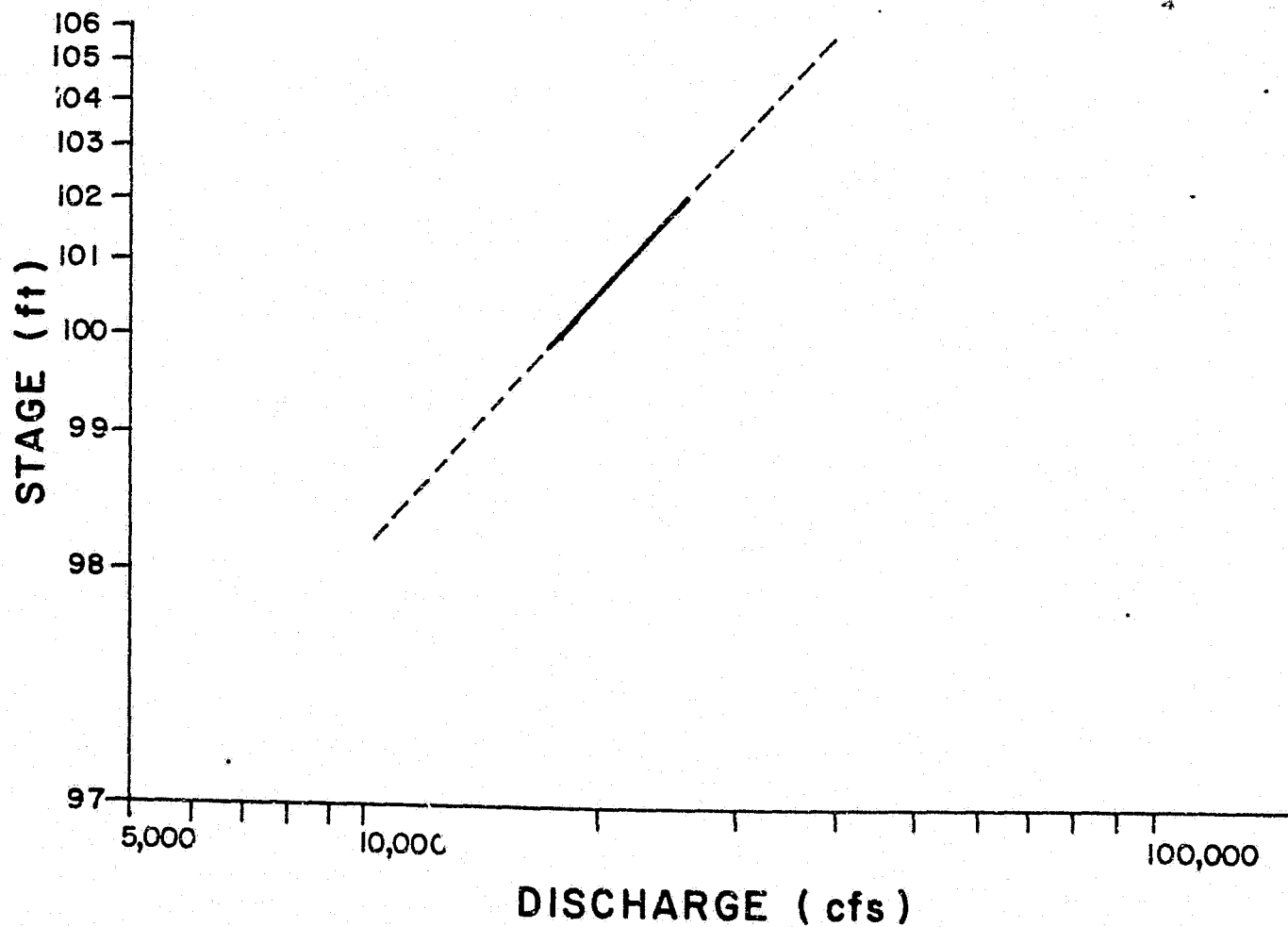
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Figure 4..6

Stage and Discharge Data
Cross Section River Mile 47.9
(Delta Islands West)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/06/84	101.9	25,600	-	-
09/17/84	100.35	20,100	5.2	-
09/24/84	100.44	20,100	-	-
10/03/84	100.08	18,000	5.2	6.2
10/23/84	98.50	-	-	0.4
10/30/84	3.5 102.05	Staged Top of Ice		
	97.0	-	-	-
11/03/84	-	-	-	-
11/11/84	99.51	-	-	-

1. Elevations based on altimeter established datum on rebar = 106 feet.
2. USGS preliminary estimates from Sunshine gage site.
3. Surface velocity.



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Figure 4.7

Stage and Discharge Data
Cross Section River Mile 47.9
(Delta Islands East)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/06/84	105.15	25,600	-	-
09/17/84	103.48	20,100	4.5	-
09/22/84	104.10	25,200	-	-
10/03/84	103.6	18,000	4.8	6.0
10/23/84	102.93	-	-	0.6
11/03/84	102.66	-	-	-
11/11/84	103.10	Staging	-	-
11/13/84	104.89	Ice Covered	-	-

1. Elevations based on altimeter datum established on spike on left bank tree = 115 feet.
Rebar on right bank elevation = 108.15 feet.
2. USGS preliminary estimates from Sunshine gage site.
3. Surface velocity estimates.

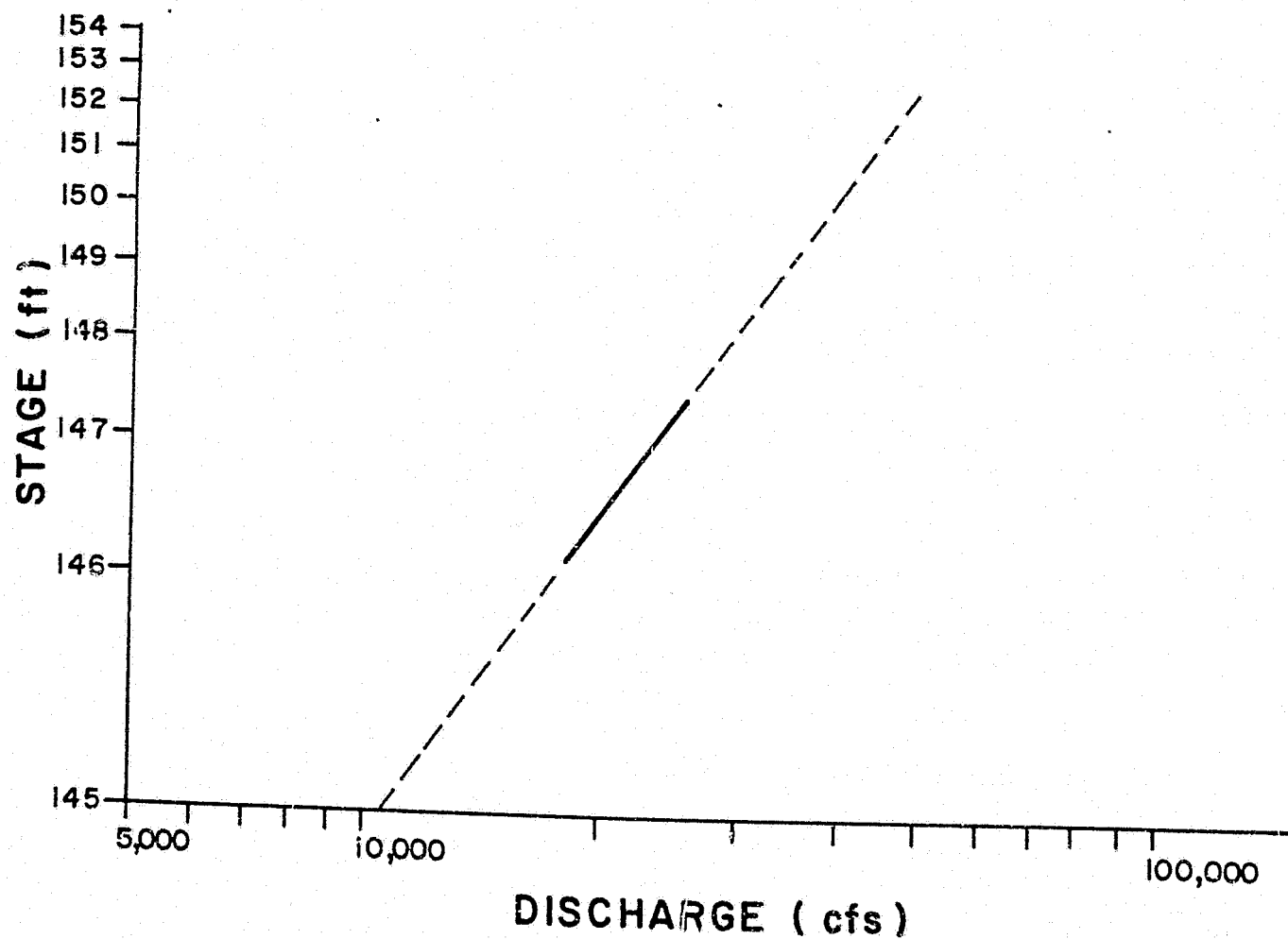
Inadequate data for stage/discharge curve

Figure 4.6

Stage and Discharge Data
Cross Section River Mile 59.7
(Kashwitna West)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/06/84	147.37	25,600	6.0	-
09/16/84	146.45	20,700	-	-
09/25/84	146.41	19,200	-	-
10/03/84	146.13	18,000	5.0	-
10/23/84	145.46	-	-	0.7
11/03/84	146.87	Ice Covered		-
11/11/84	145.88	-	-	-

1. Based on altimeter datum established on L.B. alcap elevations here were surveyed off a rebar with computed elevation 153 feet.
2. USGS preliminary estimates from Sunshine gage site.
3. Surface velocity estimates.



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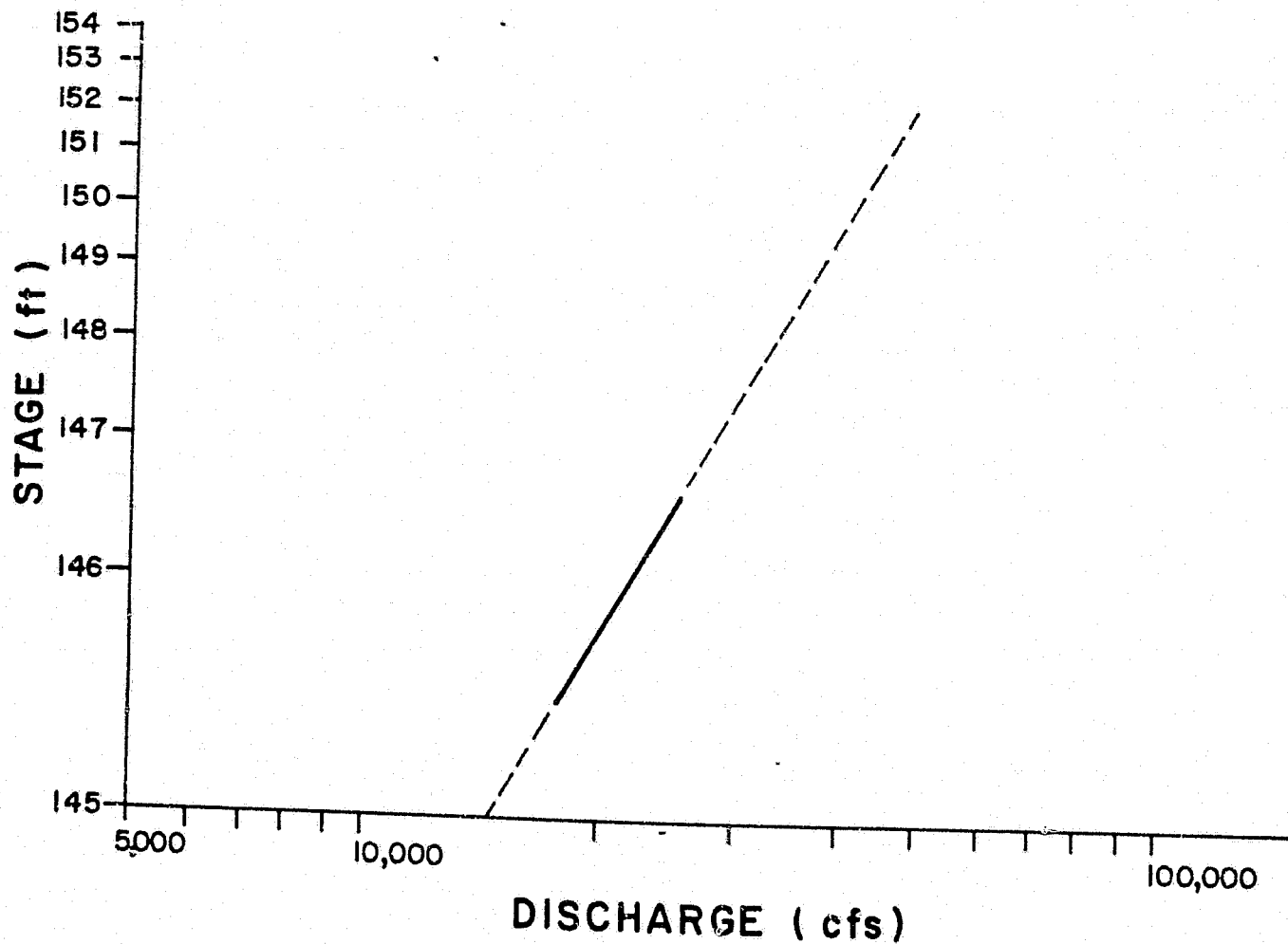
SUSITNA JOINT VENTURE

Figure 4.9

Stage and Discharge Data
Cross Section River Mile 59.7
(Kashwitna East)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/06/84	146.6	25,600	7.96	-
09/16/84	145.75	20,700	-	-
09/25/84	145.58	19,200	-	-
10/03/84	145.42	18,000	5.68	-
10/23/84	145.17	-	-	0.7
11/03/84	~ 147.30	Staged	-	-
	145.52			

1. Based on altimeter datum established on alcap = 152 feet.
2. USGS preliminary estimates from Sunshine gage site.
3. Surface velocity estimates.



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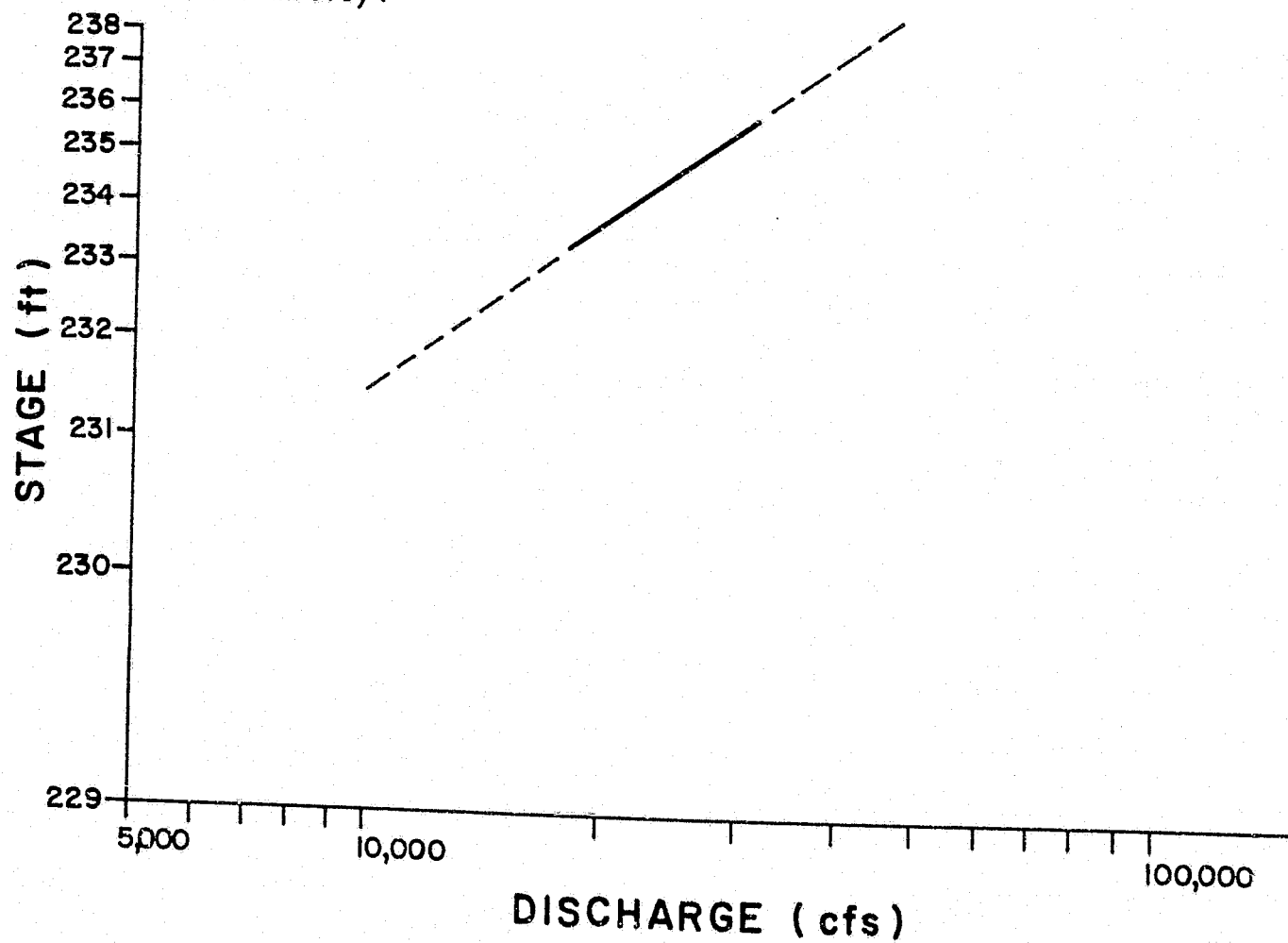
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Figure 4.10

Stage and Discharge Data
Cross Section River Mile 76.8
(Montana Creek)

Date	Stage ¹ Ft	Flow ² cfs	Velocity ³ Ft/sec	Temperature °C
09/05/84	234.70	25,600	8.3	-
09/16/84	233.37	20,700	-	-
09/20/84	235.77	31,200	-	-
10/03/84	233.42	18,000	8.2	-
10/23/84	232.69	-	-	2.0
11/03/84	7.2 229.98	-	-	-
11/11/84	238.31	Staged	-	0
11/19/84	4 237.19	Ice Covered	-	-
	236.66	-	-	-

1. Based on datum established by altimeter on the left bank alcap = 242 feet.
2. USGS preliminary estimates from Sunshine gage site.
3. Surface velocity.



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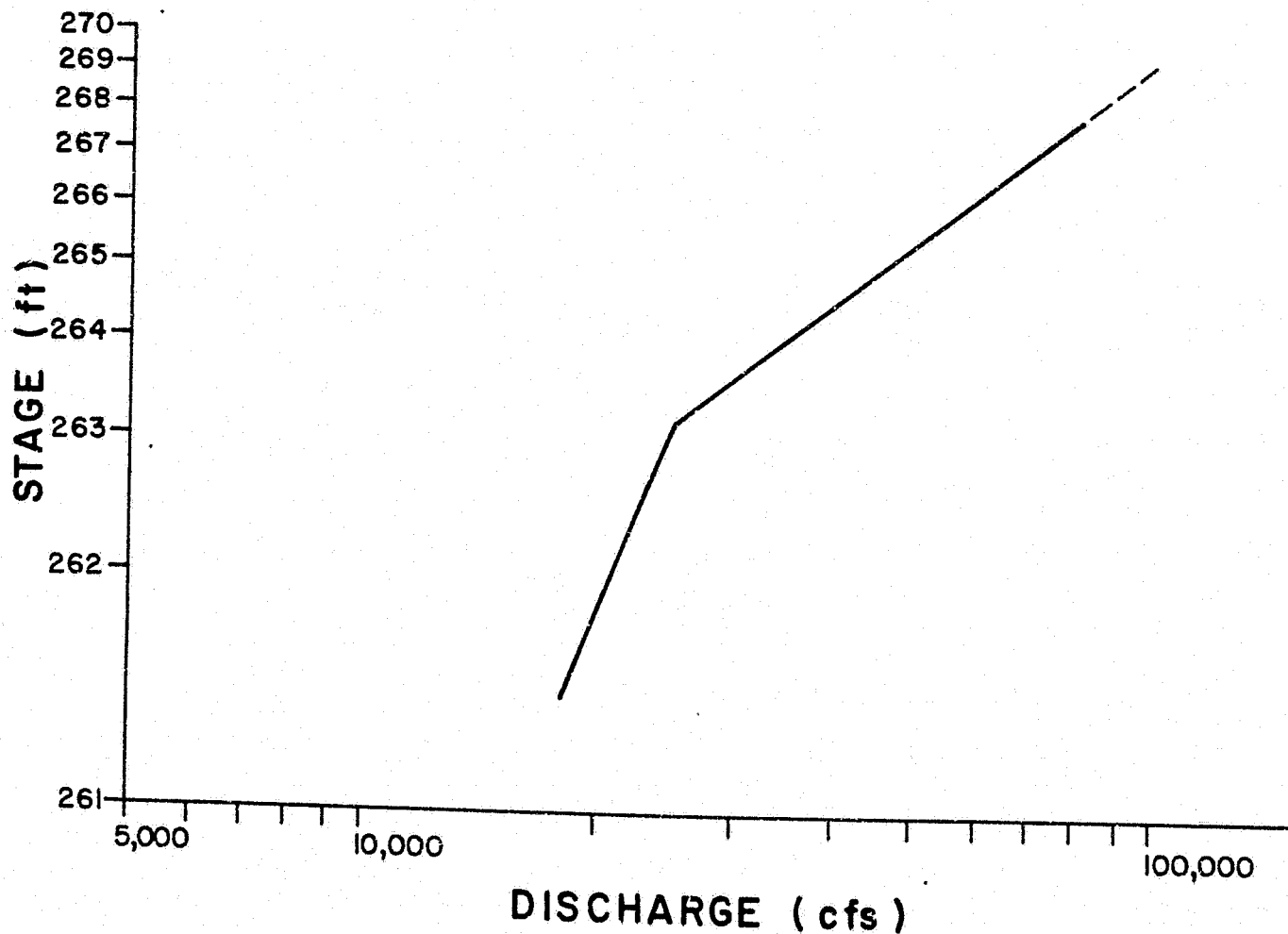
SUSITNA JOINT VENTURE

Figure 4.11

Stage and Discharge Data
Cross Section River Mile 84.6

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	266.60	69,900	-	-
07/28/84	267.40	80,300	-	-
08/15/84	264.88	46,000	-	-
08/27/84	267.80	81,600	-	-
09/05/84	263.20	25,700	-	-
09/16/84	261.70	20,700	-	-
09/20/84	263.90	31,200	-	-
10/03/84	261.58	18,000	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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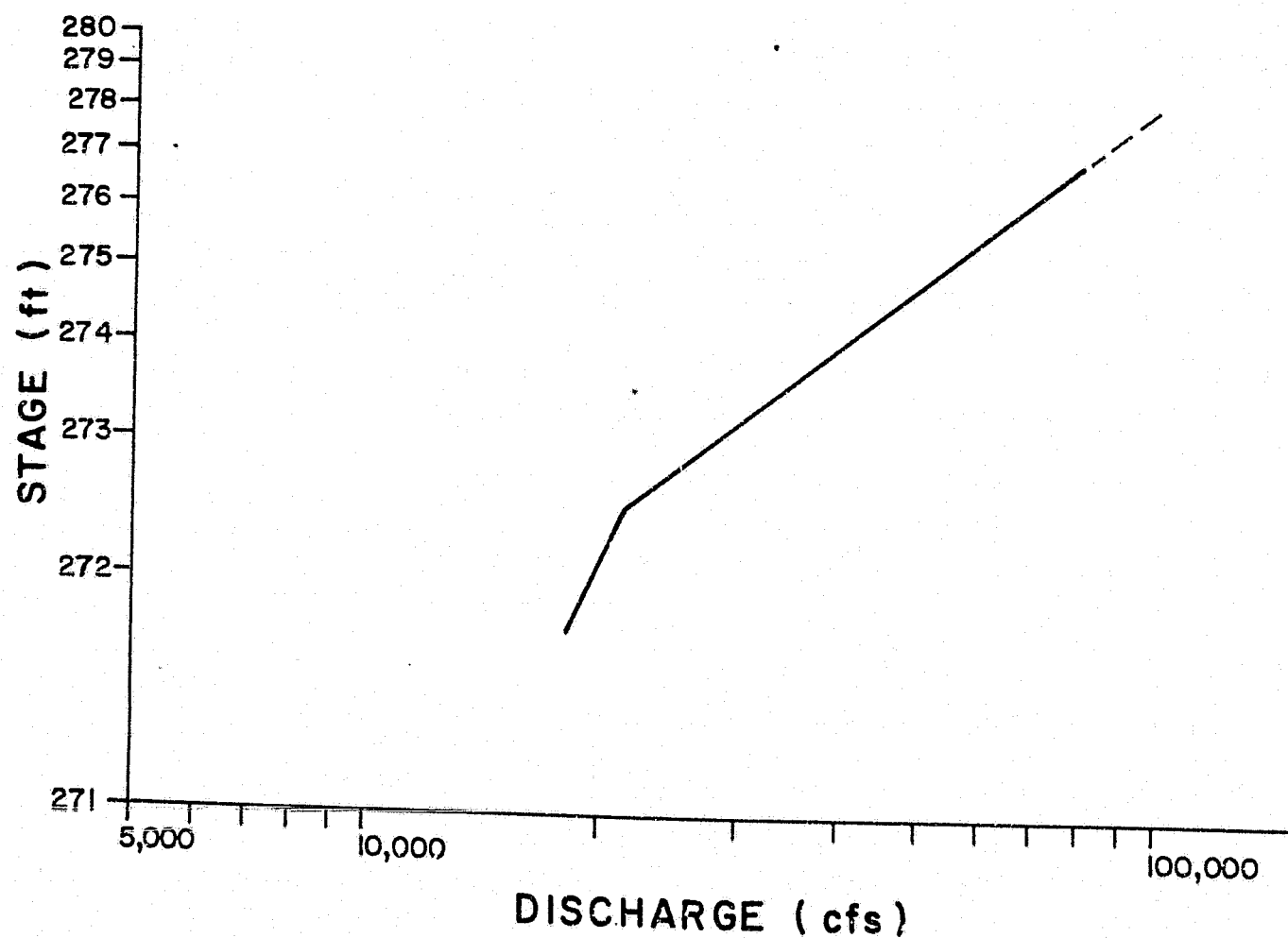
SUSITNA JOINT VENTURE

Figure 4.12

Stage and Discharge Data
Cross Section River Mile 86.3

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	275.70	69,900	-	-
07/28/84	276.87	80,300	-	-
08/15/84	274.61	46,000	-	-
08/27/84	276.08	81,600	-	-
09/05/84	272.87	25,700	-	-
09/16/84	272.23	20,700	-	-
09/18/84	271.90	20,700	-	-
10/03/84	271.69	18,000	-	-
11/19/84	2 273.66	-	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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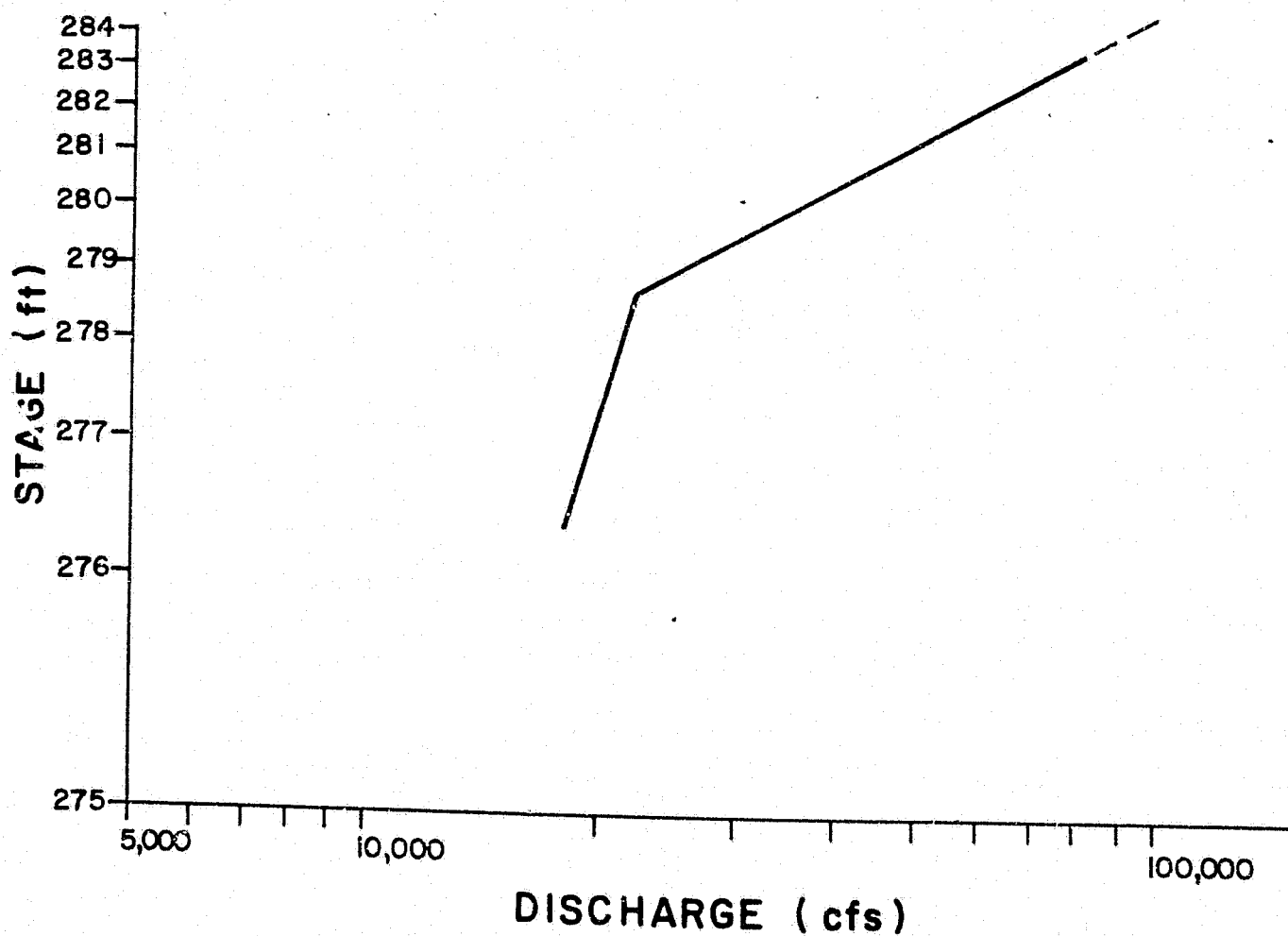
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Figure 4.13

Stage and Discharge Data
Cross Section River Mile 87.8

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	282.40	69,900	-	-
07/28/84	283.50	80,300	-	-
08/15/84	280.60	46,000	-	-
08/27/84	282.82	81,600	-	-
09/05/84	279.20	25,700	-	-
09/16/84	277.50	20,700	-	-
10/03/84	276.33	18,000	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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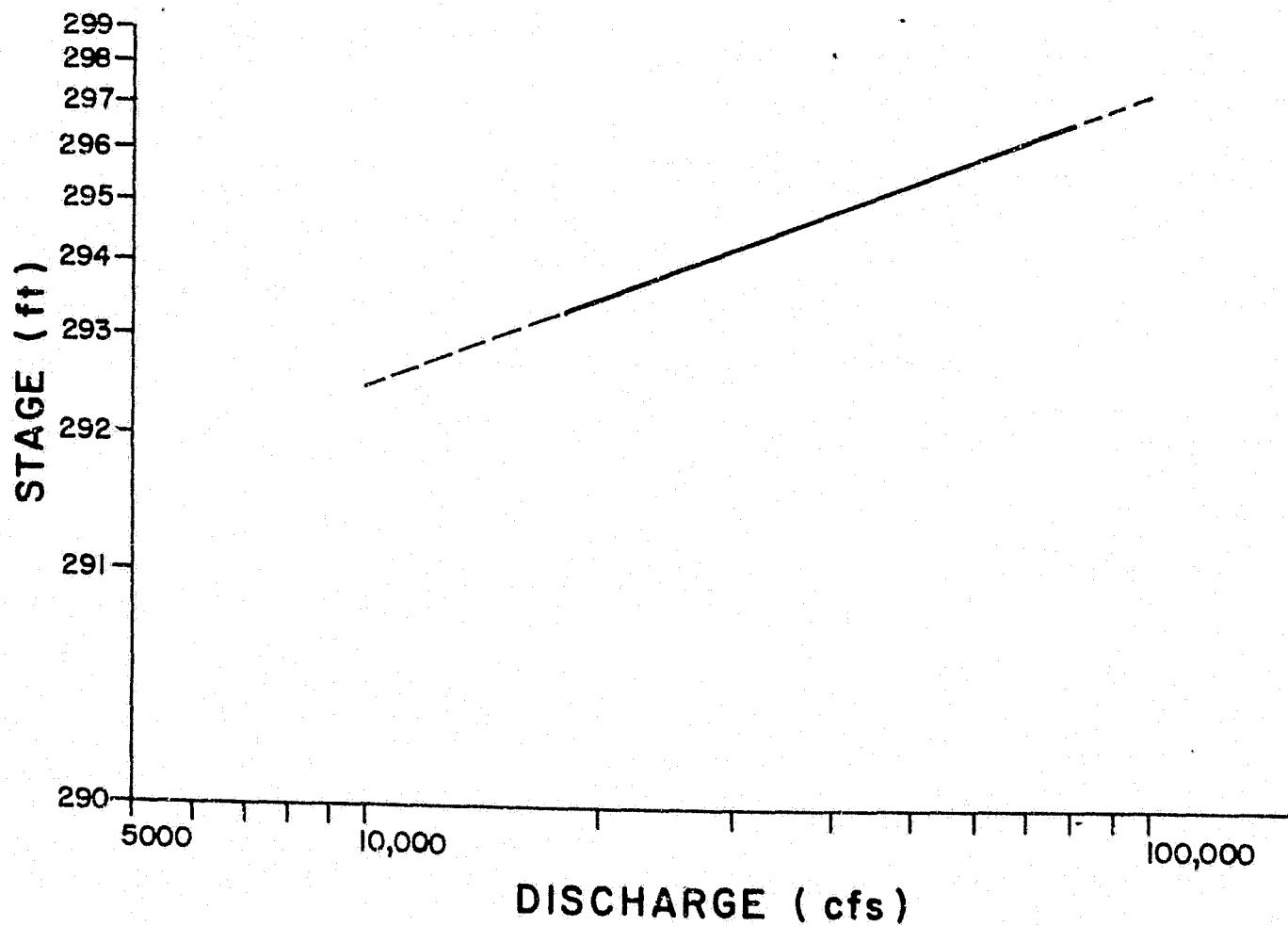
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Figure 4.14

Stage and Discharge Data
Cross Section River Mile 90.0

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	294.93	69,900	-	-
08/27/84	296.60	81,600	-	-
09/05/84	294.60	25,700	-	-
09/15/84	293.70	22,200	-	-
09/16/84	293.70	20,700	-	-
10/03/84	293.27	18,000	-	-
11/19/84	292.80	-	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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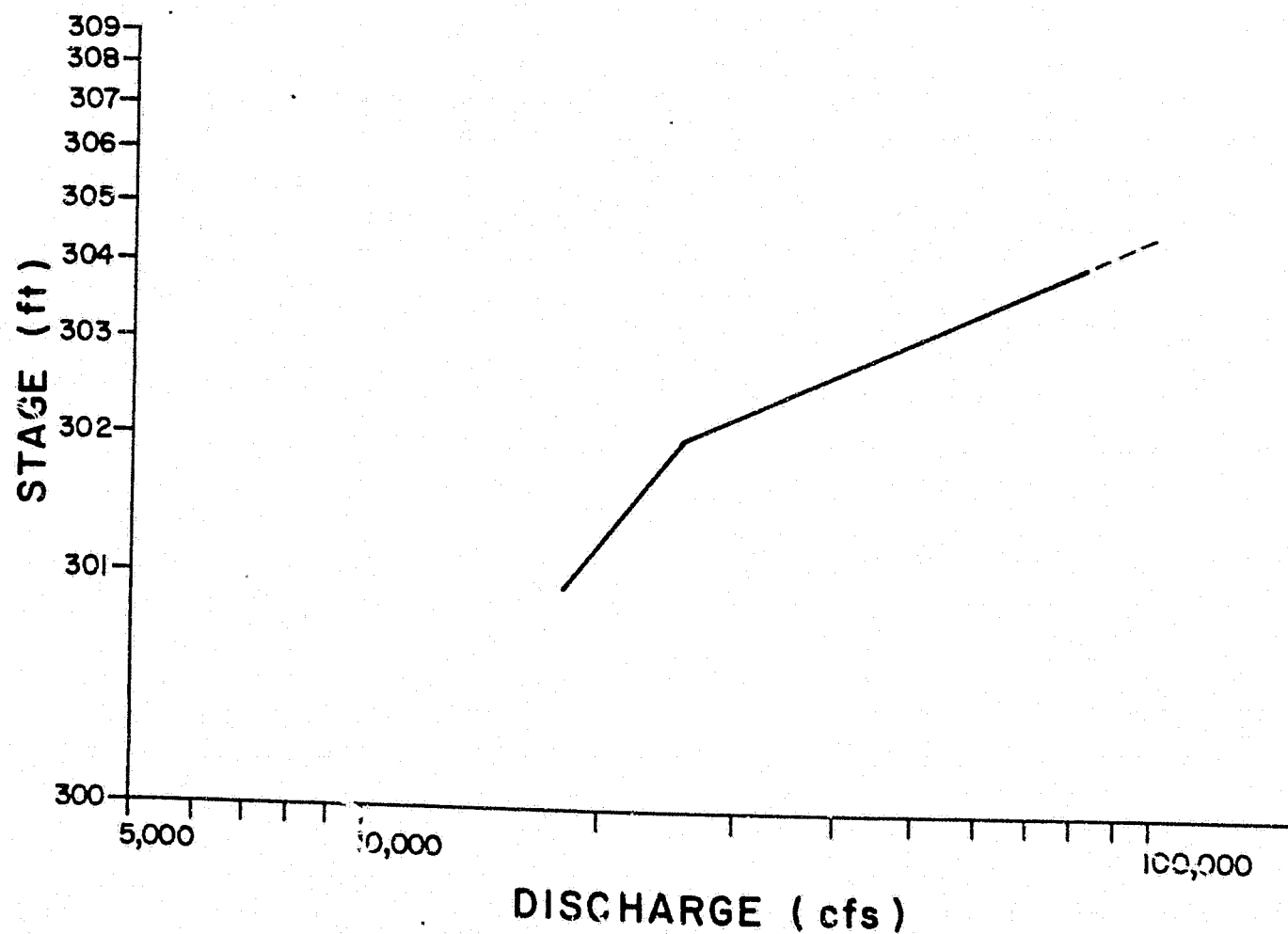
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Figure 4.15

Stage and Discharge Data
Cross Section River Mile 91.7

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	303.10	69,900	-	-
07/28/84	304.12	80,300	-	-
08/15/84	302.76	46,000	-	-
09/05/84	302.22	25,700	-	-
09/13/84	301.40	22,600	-	-
09/16/84	301.34	20,700	-	-
10/03/84	300.97	18,000	-	-
11/19/84	301.41	-	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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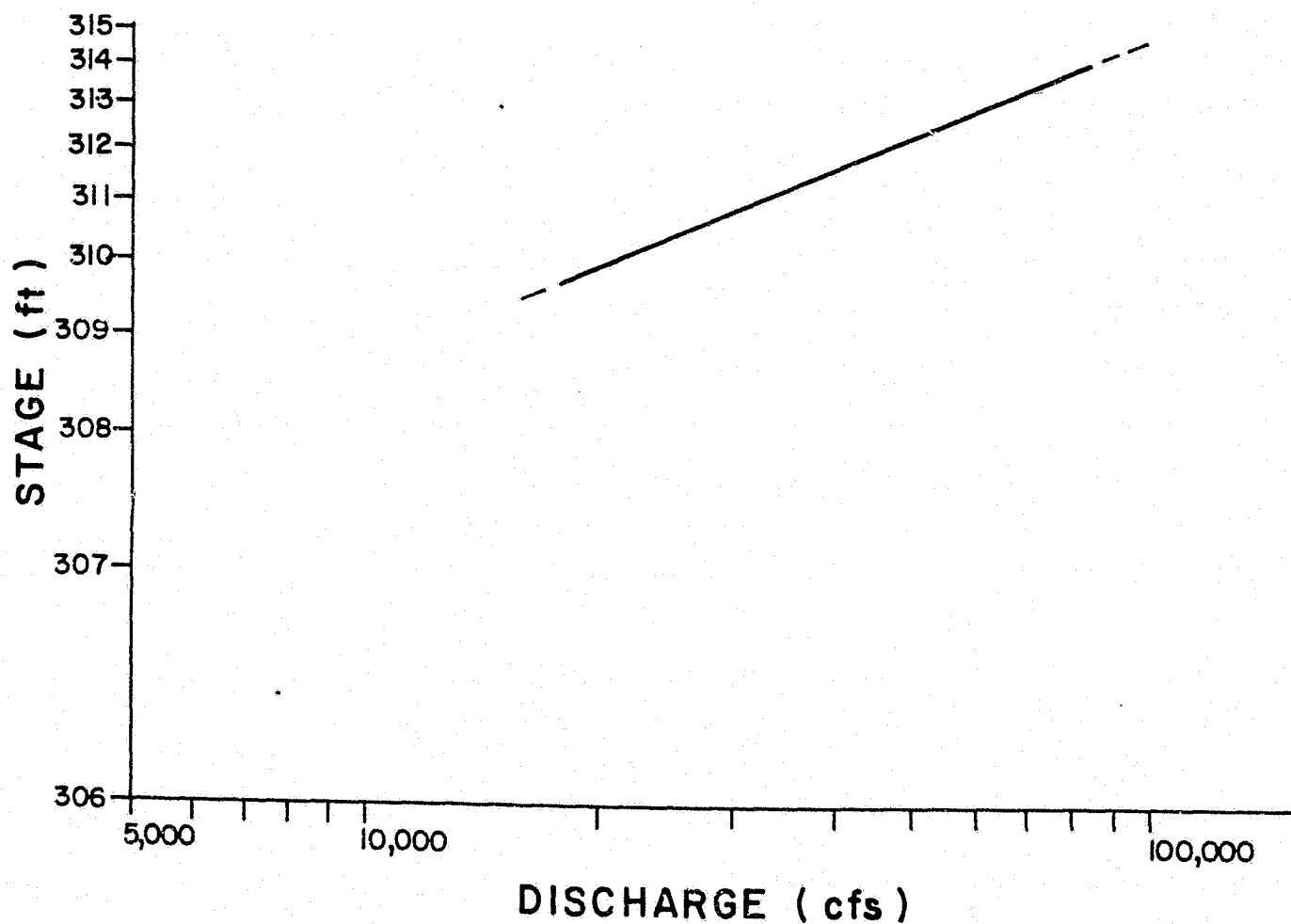
SUSITNA JOINT VENTURE

Figure 4.16

Stage and Discharge Data
Cross Section River Mile 93.3

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
06/14/84	313.00	69,900	-	-
07/28/84	313.96	80,300	-	-
08/15/84	311.67	46,000	-	-
09/05/84	310.56	25,700	-	-
09/11/84	310.20	23,600	-	-
09/16/84	309.99	20,700	-	-
10/03/84	309.41	18,000	-	-
11/19/84	308.12	-	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.



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Figure 4.17

Stage and Discharge Data
Cross Section River Mile 95.9
LRX - 0.7

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
09/16/84	323.69	20,700	-	-
09/26/84	323.18	18,500	-	-
10/03/84	322.81	18,000	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Sunshine gage site.

Inadequate data for stage/discharge curve

Figure 4.18

Stage and Discharge Data
Cross Section River Mile 97.1
LRX - 1.0

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
09/11/84	333.22	9,300	-	-
09/16/84	332.89	8,200	-	-
09/26/84	332.50	7,650	-	-
10/03/84	332.30	7,700	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Gold Creek gage site.

Inadequate data for stage/discharge curve

Figure 4.19

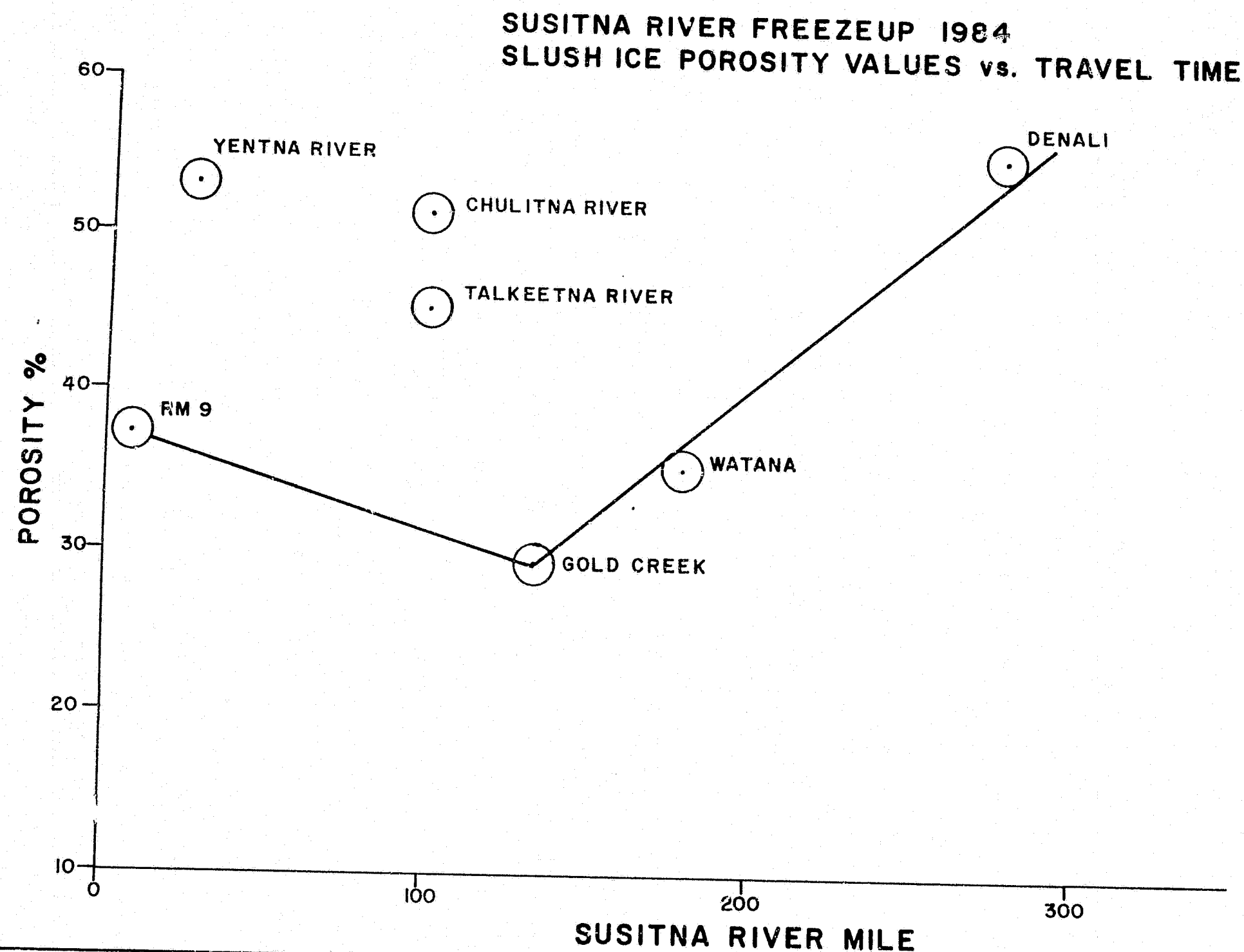
Stage and Discharge Data
Cross Section River Mile 98.0
LRX - 2.0

Date	Stage ¹ Ft	Flow ² cfs	Velocity Ft/sec	Temperature °C
09/11/84	339.00	9,300	-	-
09/16/84	338.40	8,200	-	-
09/27/84	337.00	7,400	-	-
10/03/84	337.26	7,700	-	-

1. Water surface elevation referenced to project datum.
2. USGS preliminary estimates from Gold Creek gage site.

Inadequate data for stage/discharge curve

-65-



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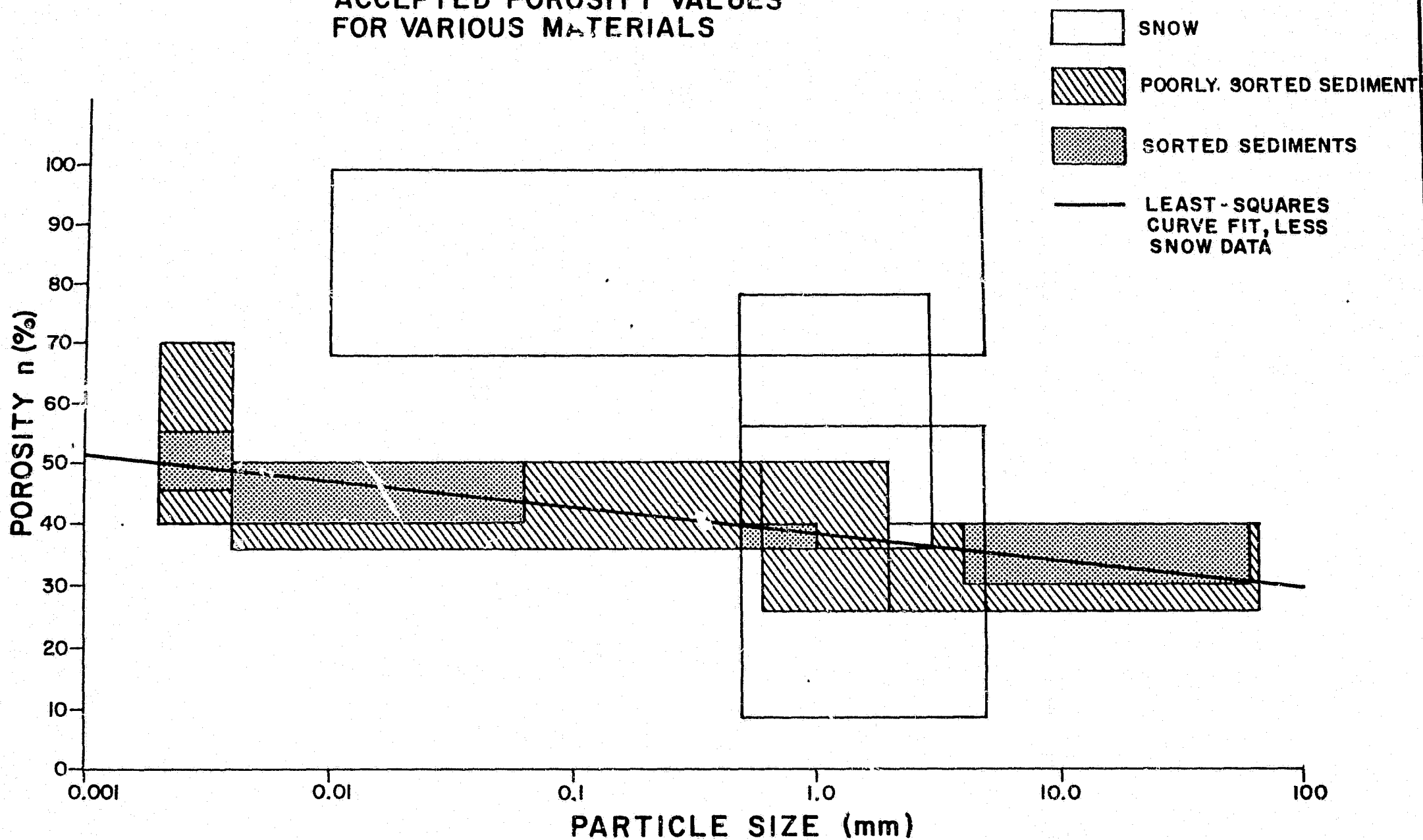
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ACCEPTED POROSITY VALUES FOR VARIOUS MATERIALS



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APPENDIX A

Monthly Meteorological Summaries From
Weather Stations at Denali, Watana, and Talkeetna
River Ice Observations and Weather Data
From Gold Creek

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR DENALI WEATHER STATION
DATA TAKEN DURING September, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SDM	DAY
1	12.0	-3.1	4.5	***	****	****	***	****	***	42	-9.0	0.0	*****	1
2	11.9	-1	5.9	***	****	****	***	****	***	45	-8.3	0.0	*****	2
3	10.8	-2.3	4.3	***	****	****	***	****	***	45	-9.0	0.0	*****	3
4	11.9	1.7	6.8	***	****	****	***	****	***	58	-4.3	0.0	*****	4
5	12.8	1.3	7.1	***	****	****	***	****	***	67	-1	0.0	*****	5
6	10.8	3.3	7.1	***	****	****	***	****	***	54	-4.6	1.4	*****	6
7	11.5	3.5	7.5	***	****	****	***	****	***	56	-4.6	.4	*****	7
8	13.7	.5	7.1	***	****	****	***	****	***	59	-3.0	0.0	*****	8
9	14.7	-1.2	6.8	***	****	****	***	****	***	56	-4.3	0.0	*****	9
10	13.0	-1.6	5.7	***	****	****	***	****	***	49	-7.0	0.0	*****	10
11	13.1	-1.5	6.3	***	****	****	***	****	***	44	-7.6	.2	*****	11
12	10.8	-1.6	4.6	***	****	****	***	****	***	50	-8.7	1.0	*****	12
13	8.4	2.3	5.4	***	****	****	***	****	***	47	-9.3	0.0	*****	13
14	13.5	-1.4	6.6	***	****	****	***	****	***	45	-6.1	0.0	*****	14
15	10.6	1.5	6.1	***	****	****	***	****	***	45	-8.9	2.4	*****	15
16	12.2	-1.5	5.9	***	****	****	***	****	***	62	-3.5	0.0	*****	16
17	10.5	3.5	7.0	167	1.1	1.2	174	7.0	5	64	-1.6	7.2	*****	17
18	8.8	1.6	5.2	158	.8	.9	112	1.9	5	67	-2.3	4.6	*****	18
19	5.7	.4	3.1	***	****	****	***	****	***	68	-5.2	14.2	*****	19
20	6.0	-1.1	2.5	***	****	****	***	****	***	56	-8.6	7.2	*****	20
21	9.5	-5.0	2.3	***	****	****	***	****	***	54	-9.7	0.0	*****	21
22	11.1	-3.1	4.0	***	****	****	***	****	***	61	-6.2	0.0	*****	22
23	11.2	-1.4	4.9	***	****	****	***	****	***	49	-8.1	0.0	*****	23
24	9.7	.9	5.3	***	****	****	***	****	***	65	-2.6	0.0	*****	24
25	8.7	.9	4.8	***	****	****	***	****	***	34	-13.1	.2	*****	25
26	8.7	1.5	5.1	***	****	****	***	****	***	40	-10.9	0.0	*****	26
27	10.4	-2.7	3.9	***	****	****	***	****	***	66	-5.0	0.0	*****	27
28	9.3	-2.9	3.2	***	****	****	***	****	***	63	-5.5	.4	*****	28
29	11.5	2.1	6.8	***	****	****	***	****	***	51	-4.8	5.2	*****	29
30	9.7	3.0	6.4	***	****	****	***	****	***	58	-3.6	0.0	*****	30
MONTH	14.7	-5.0	5.4	166	1.0	1.2	174	7.0	5	54	-6.1	44.4	*****	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 5.7
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 6.3
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 7.0
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 6.3

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR DENALI WEATHER STATION
DATA TAKEN DURING October, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SQM	DAY
1	9.9	2.6	6.3	***	****	****	***	****	***	**	*****	****	*****	1
2	7.7	1.2	4.5	***	****	****	***	****	***	**	*****	****	*****	2
3	7.0	-3.5	1.8	***	****	****	***	****	***	**	*****	****	*****	3
4	6.7	-6.7	0.0	***	****	****	***	****	***	**	*****	****	*****	4
5	6.1	-3.8	1.2	182	2.2	2.5	177	9.5	S	56	-5.3	****	*****	5
6	8.4	-1.5	3.5	178	2.5	3.3	131	12.7	S	60	-4.0	****	*****	6
7	5.5	-2.2	1.7	347	2.0	2.4	340	7.0	NNW	75	-2.4	****	*****	7
8	7.5	-1.0	3.3	134	2.0	3.6	139	14.6	SE	76	-.7	****	*****	8
9	2.9	-4.0	-.6	353	1.0	1.7	356	5.7	N	88	-1.9	****	*****	9
10	3.1	-7.9	-2.4	350	1.3	1.7	342	3.2	NNW	81	-5.9	****	*****	10
11	2.3	-8.4	-3.1	177	.9	1.7	172	10.2	S	81	-4.4	****	*****	11
12	1.7	-1.1	.3	002	.9	2.7	351	7.6	N	76	-3.7	****	*****	12
13	2.1	-5.1	-1.5	013	2.9	3.0	350	7.0	NNE	67	-6.8	****	*****	13
14	-2.7	-6.7	-4.7	353	3.6	.2	349	8.3	N	66	-10.2	****	*****	14
15	-1.6	-10.1	-5.9	359	1.7	2.0	356	7.0	N	73	-9.0	****	*****	15
16	.3	-9.9	-4.8	066	.2	2.1	357	5.7	S	67	-9.3	****	*****	16
17	-1.2	-15.5	-8.4	348	1.0	1.7	343	5.7	NNW	66	-13.2	****	*****	17
18	1.9	-14.9	-6.5	026	.4	1.7	143	6.3	NNW	61	-13.0	****	*****	18
19	-1.9	-11.1	-6.5	010	1.0	2.2	143	8.9	NNE	61	-11.5	****	*****	19
20	-4.3	-11.3	-7.8	358	1.6	1.7	010	5.1	N	76	-12.2	****	*****	20
21	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	21
22	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	22
23	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	23
24	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	24
25	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	25
26	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	26
27	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	27
28	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	28
29	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	29
30	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	30
31	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	31
MONTH	9.9	-15.5	-1.5	007	.7	2.4	139	14.6	N	71	-7.1	****	*****	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 14.0
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 11.4
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 14.0
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 12.1

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR DENALI WEATHER STATION
DATA TAKEN DURING November, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/30M	DAY
1	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	1
2	-10.1	-15.1	-12.6	127	.2	.7	196	2.5	ENE	65	-16.8	****	*****	2
3	-7.6	-18.5	-13.1	316	.4	1.4	359	3.8	NNW	65	-18.2	****	*****	3
4	-9.2	-14.3	-11.8	139	.8	1.4	152	6.3	SE	68	-16.2	****	*****	4
5	-3.1	-13.0	-8.1	190	2.1	2.6	187	9.5	S	76	-10.6	****	*****	5
6	-1.5	-7.8	-4.7	131	.3	1.1	207	5.1	SSE	81	-7.6	****	*****	6
7	-3.6	-8.3	-6.0	011	.4	1.1	183	3.2	NNW	86	-7.3	****	*****	7
8	-7.5	-8.7	-8.1	343	.5	1.8	000	6.3	N	85	-10.2	****	*****	8
9	-8.5	-13.9	-11.2	147	.3	.9	178	3.8	S	83	-12.3	****	*****	9
10	-11.8	-21.4	-16.6	009	1.3	1.4	024	4.4	NNE	78	-17.5	****	*****	10
11	-16.8	-28.4	-22.6	009	.5	.8	343	3.2	NNW	73	-27.9	****	*****	11
12	-19.4	-28.7	-24.1	345	1.9	2.1	348	5.7	NNW	71	-28.6	****	*****	12
13	-17.1	-32.3	-24.7	002	.3	1.0	000	4.4	N	69	-31.7	****	*****	13
14	-16.1	-29.4	-22.8	089	1.1	2.3	161	8.3	N	70	-25.8	****	*****	14
15	-9.8	-17.4	-13.6	174	.7	1.7	169	7.6	SSW	75	-16.9	****	*****	15
16	-9.3	-18.6	-14.0	017	.9	1.3	145	5.7	N	81	-16.0	****	*****	16
17	-14.6	-19.4	-17.0	008	.7	.9	028	3.8	N	79	-19.9	****	*****	17
18	-10.1	-21.1	-15.6	062	.4	1.2	175	7.0	NNE	81	-16.9	****	*****	18
19	-14.4	-23.8	-19.1	156	.8	1.7	164	12.7	N	78	-21.3	****	*****	19
20	3.3	-15.9	-6.3	156	5.4	7.3	141	26.7	S	71	-10.6	****	*****	20
21	3.1	-5.8	-1.4	134	6.4	6.5	129	23.5	SE	80	-3.8	****	*****	21
22	-5.3	-13.3	-9.3	357	2.2	2.2	013	4.4	N	84	-10.7	****	*****	22
23	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	23
24	-8.9	-15.4	-12.2	054	.4	1.1	162	6.3	N	81	-13.7	****	*****	24
25	-14.0	-21.0	-17.5	194	.2	.7	169	2.5	SSW	80	-18.3	****	*****	25
26	-19.4	-24.4	-21.9	040	.3	.6	017	2.5	NNE	76	-25.5	****	*****	26
27	-18.7	-28.7	-23.7	063	.2	.7	019	2.5	NNE	76	-24.9	****	*****	27
28	-20.2	-25.2	-22.7	015	.7	.8	022	2.5	NNE	82	-23.7	****	175	28
29	-15.4	-21.1	-18.3	024	1.3	1.4	022	3.8	NNE	86	-19.0	****	215	29
30	-12.0	-15.4	-13.7	032	.8	1.5	186	5.7	NNE	89	-15.8	****	140	30
MONTH	3.3	-32.3	-14.7	103	.3	1.7	141	26.7	N	78	-17.4	****	530	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 19.0
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 24.8
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 19.7
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 25.4

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR DENALI WEATHER STATION
DATA TAKEN DURING December, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SDH	DAY
1	-6.9	-12.9	-9.9	189	5.0	5.0	189	8.9	S	86	-10.8	****	245	1
2	-7.8	-14.6	-11.2	180	1.2	2.4	193	8.9	S	85	-13.0	****	135	2
3	-3.7	-10.9	-7.3	203	2.3	2.8	196	8.9	SSW	88	-8.0	****	130	3
4	5.1	-4.8	.2	176	4.8	5.6	226	25.4	S	78	-3.3	****	65	4
5	.9	-7.3	-3.2	166	4.3	5.1	152	15.9	SSE	86	-3.7	****	115	5
6	-5.5	-12.2	-8.9	354	2.5	2.6	347	7.0	N	85	-11.5	****	310	6
7	-5.6	-13.5	-9.6	090	.3	2.1	193	8.9	NNE	89	-10.2	****	135	7
8	-6.6	-8.5	-7.6	015	2.1	3.4	348	8.9	NNE	87	-9.3	****	85	8
9	-7.9	-22.3	-15.1	024	5.3	5.5	010	12.7	NNE	62	-17.6	****	105	9
10	-18.6	-30.5	-24.6	171	.8	1.9	175	8.9	N	76	-26.3	****	115	10
11	-20.1	-26.1	-23.1	003	1.2	1.5	002	3.8	N	76	-26.8	****	185	11
12	-15.1	-30.7	-22.9	032	1.7	2.2	047	6.3	NE	66	-26.4	****	145	12
13	-16.6	-29.6	-23.1	005	1.6	1.7	032	6.3	N	73	-26.5	****	110	13
14	-16.7	-31.0	-23.9	013	2.3	3.1	029	7.6	NNE	61	-29.0	****	80	14
15	-17.8	-30.4	-24.1	095	.5	1.6	152	7.0	NNE	75	-24.2	****	95	15
16	-14.2	-20.7	-17.5	075	.2	1.3	175	6.3	S	81	-19.2	****	135	16
17	-8.3	-17.6	-13.0	196	.4	1.2	161	4.4	S	87	-15.1	****	100	17
18	-5.5	-8.9	-7.2	***	****	****	***	****	***	96	-7.9	****	45	18
19	-3.7	-22.0	-12.9	017	4.9	5.1	016	11.4	NNE	53	-19.9	****	115	19
20	-22.4	-28.3	-25.4	002	.7	1.4	358	4.4	N	60	-30.7	****	55	20
21	-18.6	-27.0	-23.0	175	.2	1.2	339	5.7	S	73	-25.1	****	40	21
22	-12.5	-21.9	-17.2	183	1.2	1.7	169	8.9	SSW	80	-16.8	****	85	22
23	-5.0	-12.2	-8.6	189	2.0	5.2	008	14.0	S	88	-10.9	****	165	23
24	-9.6	-20.5	-15.1	016	3.3	3.6	011	8.3	NNE	72	-18.4	****	100	24
25	-13.5	-22.7	-18.1	153	1.4	2.3	187	10.8	S	81	-19.3	****	90	25
26	-11.0	-19.5	-15.3	023	3.4	3.6	015	8.9	NNE	76	-18.0	****	85	26
27	-17.9	-33.0	-25.5	019	.4	1.0	008	3.8	N	76	-27.0	****	230	27
28	-21.9	-35.7	-28.8	151	1.4	2.2	167	8.9	S	73	-30.6	****	235	28
29	-13.3	-25.9	-19.6	178	2.2	3.3	136	8.3	S	78	-22.4	****	45	29
30	-2.2	-12.8	-7.5	164	6.7	7.0	159	17.8	SSE	74	-10.4	****	80	30
31	2.6	-5.6	-1.5	155	6.0	6.8	151	19.7	SE	78	-4.2	****	140	31
MONTH	5.1	-35.7	-15.2	129	.6	3.1	226	25.4	NNE	77	-17.6	****	3800	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 8.3
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 22.2
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 15.2
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 8.3

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING September, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SGH	DAY
1	14.3	.1	7.2	062	1.5	2.1	096	6.3	NNE	48	-4.5	0.0	*****	1
2	13.5	0.0	6.8	056	.9	1.8	332	8.3	NNE	51	-3.6	0.0	*****	2
3	12.8	-1.6	5.6	085	2.1	2.4	139	6.3	NE	47	-4.9	0.0	*****	3
4	13.1	4.4	8.8	092	2.1	2.2	084	7.0	E	50	-1.4	0.0	*****	4
5	14.0	4.6	9.3	104	1.6	1.9	116	7.6	ESE	55	.5	0.0	*****	5
6	11.9	4.5	8.2	094	1.3	1.7	069	5.7	ESE	72	2.4	3.4	*****	6
7	11.8	3.1	7.5	072	1.6	2.1	136	6.3	E	69	1.5	.8	*****	7
8	13.2	-.3	6.5	063	2.6	3.1	091	8.9	E	60	-1.3	0.0	*****	8
9	15.5	-.1	7.7	050	.9	1.6	077	5.1	N	53	-2.7	.6	*****	9
10	15.4	.3	7.9	069	1.1	1.7	358	7.6	ENE	52	-2.9	1.0	*****	10
11	14.4	-1.2	6.6	078	1.5	2.1	103	6.3	ENE	53	-3.8	0.0	*****	11
12	12.5	.8	6.7	117	.1	1.7	184	7.6	E	65	-.2	.2	*****	12
13	9.5	2.9	6.2	054	2.1	2.3	075	5.7	NE	74	1.5	1.0	*****	13
14	13.1	3.3	8.2	071	3.8	4.0	091	11.4	ENE	48	-2.4	0.0	*****	14
15	13.2	5.3	9.3	076	3.6	4.1	070	8.9	E	59	1.3	0.0	*****	15
16	13.9	-.1	6.9	303	.8	1.7	272	5.1	W	70	.7	0.0	*****	16
17	11.0	.4	5.7	305	1.1	2.0	279	7.6	N	79	1.8	1.0	*****	17
18	7.7	1.9	4.8	093	.3	1.4	279	7.6	E	89	2.5	6.2	*****	18
19	6.5	0.0	3.3	087	1.2	1.8	118	5.1	ESE	84	.7	7.2	*****	19
20	8.5	-.5	4.0	082	2.0	2.5	015	7.0	N	71	-1.3	8.2	*****	20
21	14.4	-3.0	5.7	057	.7	1.6	013	4.4	N	64	-3.8	0.0	*****	21
22	11.9	-2.7	4.6	070	2.5	2.8	085	8.3	E	62	-2.9	0.0	*****	22
23	10.2	-.3	5.0	065	2.4	2.7	078	8.3	ENE	51	-4.4	0.0	*****	23
24	9.2	1.8	5.5	065	2.9	3.2	076	8.3	NE	46	-4.7	0.0	*****	24
25	10.1	2.6	6.4	064	2.3	2.5	066	5.7	ENE	63	-.6	4.0	*****	25
26	10.4	.3	5.4	020	.9	1.4	294	5.1	N	67	-.5	0.0	*****	26
27	11.4	-1.7	4.9	077	1.7	2.2	112	7.0	E	67	-2.7	0.0	*****	27
28	10.3	-.2	5.1	070	3.6	3.7	089	8.9	ENE	56	-2.9	0.0	*****	28
29	9.4	3.2	6.3	068	4.1	4.3	075	12.1	ENE	75	2.4	0.0	*****	29
30	10.8	4.7	7.8	082	5.6	5.7	088	12.1	E	63	.4	0.0	*****	30
MONTH	15.5	-3.0	6.4	069	1.8	2.5	075	12.1	ENE	62	-1.2	33.6	*****	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 8.3
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 10.8
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 11.4
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 8.3

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING October, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SQ	DAY
1	10.7	2.9	6.8	076	4.5	4.7	092	10.2	ENE	62	-2	****	*****	1
2	8.9	.5	4.7	058	2.0	2.5	082	6.3	NE	72	-5	****	*****	2
3	8.3	-2.5	2.9	062	1.7	2.1	084	6.3	E	74	-2.9	****	*****	3
4	7.8	-5.8	1.0	073	2.9	3.0	090	8.3	E	66	-5.3	****	*****	4
5	6.1	-1.1	2.5	069	4.4	4.5	076	11.5	ENE	63	-3.5	****	2336	5
6	6.8	.1	3.5	069	3.7	3.9	069	8.7	ENE	68	-1.7	****	1235	6
7	7.2	-2.2	2.5	067	2.3	2.4	071	9.2	ENE	83	-0	****	1035	7
8	6.7	.1	3.4	072	2.1	3.3	072	8.3	ENE	90	1.9	****	885	8
9	3.4	-2.4	.5	063	.7	1.1	097	3.7	N	92	-6	****	995	9
10	5.5	-5.0	.3	073	2.3	2.5	085	7.4	E	83	-2.8	****	1995	10
11	5.2	-4.5	.4	081	2.2	2.6	074	8.3	ENE	85	-2.2	****	1540	11
12	2.4	-1.9	.3	271	1.4	1.5	261	6.0	W	89	-1.3	****	1325	12
13	4.2	-3.2	.5	038	1.5	1.9	049	6.4	N	72	-4.5	****	1940	13
14	.2	-5.5	-2.7	051	1.9	2.0	047	6.0	NE	66	-7.9	****	1380	14
15	.5	-8.4	-4.0	291	.5	1.2	268	5.1	W	77	-6.6	****	1165	15
16	2.0	-5.0	-1.5	070	2.6	2.8	049	7.8	NE	74	-6.7	****	1860	16
17	3.3	-11.1	-3.9	064	2.4	2.7	065	8.3	NE	56	-12.4	****	1550	17
18	4.2	-7.6	-1.7	077	3.6	3.8	077	8.7	ENE	46	-11.8	****	1365	18
19	1.5	-6.6	-2.6	075	.8	1.6	082	6.0	E	59	-9.8	****	925	19
20	-2.2	-7.5	-4.9	075	4.3	4.4	082	9.7	ENE	78	-7.9	****	905	20
21	3.2	-2.2	.5	075	5.7	5.8	082	12.0	ENE	69	-4.6	****	1210	21
22	4.5	.3	2.4	076	4.8	5.0	076	12.4	ENE	75	-1.5	****	620	22
23	1.2	-5.3	-2.1	265	2.5	2.6	252	7.4	W	96	-2.6	****	535	23
24	0.0	-10.8	-5.4	072	1.2	1.6	032	5.5	NE	80	-9.6	****	1535	24
25	-.7	-12.7	-6.7	058	1.8	2.2	072	6.0	E	56	-13.2	****	1175	25
26	-2.0	-14.0	-8.0	069	1.8	1.9	086	5.5	ENE	60	-15.5	****	1125	26
27	-1.1	-14.1	-7.6	077	1.3	1.5	078	4.1	ENE	67	-15.3	****	1075	27
28	-4.5	-14.3	-9.4	074	3.2	3.3	074	9.2	ENE	65	-15.7	****	1075	28
29	-8.3	-16.2	-12.3	077	3.4	3.6	083	9.7	E	53	-20.8	****	1035	29
30	-9.4	-15.8	-12.6	077	4.6	4.7	092	10.1	ENE	52	-19.7	****	550	30
31	-4.6	-11.7	-8.2	074	5.0	5.0	070	11.0	ENE	62	-15.1	****	895	31
MONTH	10.7	-16.2	-2.0	070	2.4	3.0	076	12.4	ENE	70	-7.1	****	33266	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 9.7
 GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 10.1
 GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 10.6
 GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 9.7

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING November, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SDH	DAY
1	-1.5	-14.9	-8.2	085	2.8	2.9	080	7.4	E	65	-14.6	****	1000	1
2	-5.9	-14.3	-10.1	091	2.0	2.2	099	5.5	E	55	-18.5	****	925	2
3	-2.6	-14.2	-8.4	077	1.4	1.6	108	4.1	ENE	54	-17.0	****	730	3
4	-8.1	-14.6	-11.4	059	1.2	1.5	031	5.1	NE	70	-15.5	****	635	4
5	-3.5	-9.2	-6.4	060	4.1	4.1	066	8.3	ENE	71	-10.0	****	215	5
6	-2.0	-4.8	-3.4	059	1.3	1.7	072	6.4	ENE	78	-6.5	****	220	6
7	-3.3	-7.7	-5.5	021	.2	.8	097	3.2	W	98	-6.1	****	115	7
8	-3.4	-7.9	-5.7	094	1.2	1.4	088	4.6	E	94	-6.7	****	220	8
9	-6.6	-17.0	-11.8	042	1.5	1.8	085	4.6	ENE	83	-13.3	****	515	9
10	-12.8	-21.3	-17.1	044	1.6	2.0	107	4.6	N	83	-19.3	****	560	10
11	-16.8	-23.4	-20.1	080	1.5	1.6	089	3.7	E	80	-23.7	****	550	11
12	-15.9	-25.0	-20.5	082	2.0	2.2	105	5.5	E	71	-24.8	****	570	12
13	-13.5	-22.8	-18.2	078	3.7	3.8	072	9.7	E	66	-23.4	****	565	13
14	-13.5	-20.7	-17.1	066	5.7	5.8	064	11.0	ENE	67	-22.1	****	305	14
15	-7.4	-13.3	-10.4	071	4.2	4.3	071	9.2	ENE	72	-14.0	****	335	15
16	-7.5	-14.3	-10.9	084	2.3	2.4	076	6.4	E	89	-11.6	****	395	16
17	-10.3	-16.3	-13.3	069	4.0	4.0	076	8.7	ENE	87	-14.2	****	295	17
18	-8.5	-14.9	-11.7	062	3.1	3.2	078	7.8	ENE	88	-12.4	****	390	18
19	-10.5	-16.2	-13.4	071	3.1	3.2	062	11.0	ENE	85	-15.6	****	560	19
20	.4	-12.0	-5.8	081	7.1	7.2	102	14.3	E	83	-9.5	****	110	20
21	1.3	-4.9	-1.8	034	.6	2.8	081	10.1	WNW	93	-2.3	****	175	21
22	-4.6	-10.7	-7.7	004	1.2	1.3	001	3.7	N	89	-9.3	****	360	22
23	-7.6	-11.0	-9.3	017	.9	1.1	055	4.1	N	94	-10.6	****	160	23
24	-9.6	-12.7	-11.2	349	.7	.8	000	3.7	N	93	-12.9	****	65	24
25	-12.6	-17.1	-14.9	061	.7	.8	103	2.3	NNE	91	-15.5	****	105	25
26	-17.8	-22.1	-20.0	087	1.4	1.4	091	4.1	E	84	-21.9	****	180	26
27	-12.1	-23.2	-17.7	086	2.5	2.5	079	11.0	E	83	-18.1	****	60	27
28	-11.7	-14.7	-13.2	069	4.5	4.6	060	8.3	ENE	82	-15.6	****	120	28
29	10.4	-13.3	-1.5	074	3.3	3.5	077	7.4	ENE	81	-13.9	****	130	29
30	-8.3	-13.3	-10.8	082	2.0	2.1	065	6.9	E	83	-13.8	****	140	30
MONTH	10.4	-25.0	-11.2	070	2.3	2.6	102	14.3	ENE	79	-14.4	****	10705	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 12.0
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 13.4
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 12.4
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 11.5

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

MONTHLY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING December, 1984

DAY	MAX. TEMP. DEG C	MIN. TEMP. DEG C	MEAN TEMP. DEG C	RES. WIND DIR. DEG	RES. WIND SPD. M/S	AVG. WIND SPD. M/S	MAX. GUST DIR. DEG	MAX. GUST SPD. M/S	P'VAL DIR.	MEAN RH %	MEAN DP DEG C	PRECIP MM	DAY'S SOLAR ENERGY WH/SGH	DAY
1	-5.8	-8.5	-7.2	050	3.6	3.7	050	6.4	NE	79	-10.2	****	125	1
2	-4.1	-8.7	-6.4	057	4.4	4.5	059	7.8	NE	75	-10.3	****	135	2
3	-2.9	-4.9	-3.9	061	4.2	4.3	070	7.4	ENE	75	-7.8	****	115	3
4	0.0	-2.9	-1.5	068	4.8	4.9	089	11.0	ENE	75	-5.2	****	105	4
5	-1.0	-6.7	-3.9	065	3.7	3.8	068	9.2	ENE	85	-4.8	****	125	5
6	-6.7	-10.1	-8.4	069	1.0	1.1	072	2.8	E	87	-10.6	****	120	6
7	-6.7	-9.5	-8.1	070	1.5	1.7	076	6.4	ENE	88	-9.6	****	88	7
8	-6.7	-9.3	-8.0	278	2.3	3.6	266	10.1	W	92	-9.3	****	85	8
9	-9.4	-19.3	-14.4	332	.7	1.5	262	7.4	N	85	-16.2	****	265	9
10	-15.5	-20.6	-18.1	072	4.5	4.6	057	11.0	ENE	75	-20.9	****	117	10
11	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	11
12	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	12
13	-16.5	-21.6	-19.1	080	1.7	1.8	100	4.6	E	73	-22.7	****	48	13
14	-18.7	-24.5	-21.6	082	2.4	2.5	095	7.8	ENE	65	-26.9	****	222	14
15	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	15
16	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	16
17	-7.9	-11.3	-9.6	115	.7	.9	094	3.2	ESE	93	-10.3	****	13	17
18	-4.0	-8.4	-6.2	097	.8	.9	126	2.8	E	93	-7.1	****	50	18
19	-3.1	-12.9	-8.0	078	2.1	3.2	079	8.7	E	70	-13.8	****	305	19
20	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	20
21	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	21
22	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	22
23	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	23
24	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	24
25	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	25
26	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	26
27	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	27
28	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	28
29	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	29
30	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	30
31	*****	*****	*****	***	****	****	***	****	***	**	*****	****	*****	31
MONTH	0.0	-24.5	-9.6	063	2.3	3.0	089	11.0	ENE	80	-12.4	****	1910	

GUST VEL. AT MAX. GUST MINUS 2 INTERVALS 10.1
GUST VEL. AT MAX. GUST MINUS 1 INTERVAL 10.6
GUST VEL. AT MAX. GUST PLUS 1 INTERVAL 8.7
GUST VEL. AT MAX. GUST PLUS 2 INTERVALS 6.9

NOTE: RELATIVE HUMIDITY READINGS ARE UNRELIABLE WHEN WIND SPEEDS ARE LESS THAN ONE METER PER SECOND. SUCH READINGS HAVE NOT BEEN INCLUDED IN THE DAILY OR MONTHLY MEAN FOR RELATIVE HUMIDITY AND DEW POINT.

WS FORM F-4 (1-79)										U. S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE										STATION WSCMO, TALKEETNA, ALASKA																																																			
PRELIMINARY LOCAL CLIMATOLOGICAL DATA															MONTH SEPTEMBER					YEAR 1984																																																			
LATITUDE 62° 18' N					LONGITUDE 150° 06' W					GROUND ELEVATION (ft) 345					STANDARD TIME ALASKAN																																																								
DAY	TEMPERATURE °F			DEPARTURE FROM NORMAL	DEGREE DAYS (Base 65°)		PRECIPITATION (in.)		SNOWFALL, ICE PELLETS	+ SNOW, ICE PELLETS OR ICE ON GROUND AT 0900G	WIND			SUNSHINE		WEATHER OCCURRENCES	2/ 0300G	2/ 0900G																																																					
	MAXIMUM	MINIMUM	AVERAGE		HEATING	COOLING	TOTAL (Water equivalent)	AVERAGE SPEED (m.p.h.)			FASTEST MILE	TOTAL (Min.)	PERCENT OF POSSIBLE																																																										
1	64	33	49	-2	16	0	0	0	0	3.0	8	20			1																																																								
2	66	32	49	-2	16	0	0	0	0	2.7	6	18			1																																																								
3	65	34	50	-1	15	0	0	0	0	7.8	17	02			23	0																																																							
4	65	34	50	0	15	0	0	0	0	5.2	9	15			19	6	0 9																																																						
5	65	33	49	-1	16	0	0	0	0	4.1	10	20			23	4																																																							
6	63	39	51	+1	14	0	.06	0	0	4.8	15	18			23	6																																																							
7	61	42	52	+3	13	0	.02	0	0	3.7	7	36			9																																																								
8	68	44	56	+7	9	0	0	0	0	5.6	10	14			9																																																								
9	66	36	51	+3	14	0	0	0	0	3.4	7	15			6																																																								
10	69	33	51	+3	14	0	0	0	0	3.1	8	18			23	1																																																							
11	63	34	50	+2	15	0	0	0	0	3.4	8	20			14	1	0 9																																																						
12	58	36	47	-1	18	0	.08	0	0	3.0	9	31			23	10	1																																																						
13	52	44	48	+1	17	0	.06	0	0	5.5	8	35			23	10	1																																																						
14	61	40	51	+4	14	0	0	0	0	4.2	12	34			10																																																								
15	62	40	51	+3	14	0	0	0	0	3.2	9	17			9																																																								
16	62	34	48	+2	17	0	.02	0	0	4.7	12	17			4																																																								
17	53	42	49	+3	16	0	.12	0	0	3.5	8	14			23	10	2																																																						
18	54	42	48	+3	17	0	.05	0	0	7.5	13	18			19	10	1 0 9																																																						
19	52	36	44	-1	21	0	.76	0	0	7.5	15	15			23	10	1																																																						
20	57	33	45	+1	20	0	.11	0	0	4.5	10	02			23	4	1																																																						
21	58	24	41	-3	24	0	0	0	0	2.0	6	26			0	1																																																							
22	62	27	45	+2	20	0	0	0	0	3.1	9	24			8																																																								
23	52	34	43	0	22	0	0	0	0	2.4	7	18			10																																																								
24	55	41	48	+6	17	0	T	0	0	3.5	7	34			23	10																																																							
25	52	43	48	+6	17	0	.17	0	0	2.8	8	02			14	10	1 0 9																																																						
26	58	36	47	+5	18	0	0	0	0	2.1	6	21			23	7	2																																																						
27	60	36	48	+7	17	0	0	0	0	4.1	8	26			23	3																																																							
28	62	32	47	+6	18	0	.02	0	0	5.1	4	02			8																																																								
29	57	44	51	+11	14	0	.16	0	0	4.8	9	17			10	1																																																							
30	58	45	52	+13	13	0	.10	0	0	5.0	4	33			8	1																																																							
31																																																																							
SUM	1804	1163			491	0	1.73	0		125.5					142																																																								
AVG	60.1	36.8								4.2	17	02			6.7																																																								
TEMPERATURE DATA																		PRECIPITATION DATA																		WEATHER																		SYMBOLS USED IN COLUMN 16																	
AVERAGE MONTHLY <u>48.5</u>																		TOTAL FOR THE MONTH <u>1.73</u> IN.																		NUMBER OF DAYS -																																			
DEPARTURE FROM NORMAL <u>+2.6</u>																		DEPARTURE FROM NORMAL <u>-2.24</u> IN.																		CLEAR (Scale 0-3) <u>7</u>																		1 = FOG																	
HIGHEST <u>69</u> ON <u>10</u>																		GREATEST IN 24 HRS. <u>.87</u> ON <u>14-20</u>																		PARTLY CLOUDY (Scale 4-7) <u>7</u>																		2 = FOG REDUCING VISIBILITY TO 1 MILE OR LESS																	
LOWEST <u>24</u> ON <u>21</u>																		SNOWFALL, ICE PELLETS																		CLOUDY (Scale 8-10) <u>16</u>																		3 = THUNDER																	
NUMBER OF DAYS WITH -																		TOTAL FOR THE MONTH <u>0</u> IN.																		WITH 0.01 INCH OR MORE PRECIP. <u>13</u>																		4 = ICE PELLETS																	
MAX. 32° OR BELOW <u>0</u>																		GREATEST IN 24 HRS <u>0</u> ON <u>-</u>																		WITH 0.10 INCH OR MORE PRECIP. <u>6</u>																		5 = HAIL																	
MAX. 90° OR ABOVE <u>0</u>																		GREATEST DEPTH ON GROUND <u>0</u> ON <u>-</u>																		WITH 0.50 INCH OR MORE PRECIP. <u>1</u>																		6 = GLAZE OR RIME																	
MIN. 32° OR BELOW <u>4</u>																		PRESSURE DATA																		WITH 1.00 INCH OR MORE PRECIP. <u>0</u>																		7 = BLOWING DUST OR BLOWING SAND REDUCING VISIB TO 1 MILE OR LESS																	
MIN. 0° OR BELOW <u>0</u>																		HIGHEST SEA-LEVEL <u>30.38</u> IN. ON <u>22</u>																																				8 = SMOKE OR HAZE																	
HEATING DEGREE DAYS (Base 65°) <u>491</u>																		LOWEST SEA-LEVEL <u>27.6</u> IN. ON <u>30</u>																																				9 = BLOWING SNOW																	
TOTAL THIS MONTH <u>-82</u>																																																						10 = TORNADO																	
DEPARTURE FROM NORMAL <u>-82</u>																																																																							
SEASONAL TOTAL <u>1028</u>																																																																							
DEPARTURE FROM NORMAL <u>-69</u>																																																																							
COOLING DEGREE DAYS (Base 65°) <u>0</u>																																																																							
TOTAL THIS MONTH <u>0</u>																																																																							
DEPARTURE FROM NORMAL <u>0</u>																																																																							
SEASONAL TOTAL <u>3</u>																																																																							
DEPARTURE FROM NORMAL <u>+3</u>																																																																							
																		MAXIMUM PRECIPITATION																																																					
																		Δt (Minutes)																		5 10 15 20 30 45 60 80 100 120 150 180																																			
																		PRECIPITATION (inches)																																																					
																		ENDED: DATE																																																					
																		TIME																																																					
																		* Average wind speed is based on 24 hours unless otherwise indicated.																																																					
																		# Fastest one minute wind speed and its direction.																																																					
																		+ Snow data is obtained at 0900A where indicated.																																																					
																		1/ Indicates only the last of several occurrences.																																																					
																		2/ Synoptic data is based on 6 hours unless otherwise indicated.																																																					

★ U.S. G.P.O. 1981-564-008 1034 REG. #6

WS FORM F-6 (11-79)															U. S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE										STATION WSCMO, TALKEETNA, ALASKA	
PRELIMINARY LOCAL CLIMATOLOGICAL DATA															MONTH NOVEMBER		YEAR 1984									
LATITUDE 62° 18' N					LONGITUDE 150° 06' W					GROUND ELEVATION (ft) 345					STANDARD TIME ALASKAN											
DAY	TEMPERATURE °F					PRECIPITATION (in.)					WIND			SUNSHINE		WEATHER OCCURRENCES	2/	2/								
	MAXI-MUM	MINI-MUM	AVER-AGE	DE-PARTURE FROM NORMAL	DEGREE DAYS (Base 65°)	TOTAL (Water equiv-alent)	SNOW-FALL, ICE PELLETS	SNOW, ICE PELLETS OR ICE ON GROUND AT 0300H	AVERAGE SPEED (m.p.h.)	FASTEST MILE SPEED (m.p.h.)	DIREC-TION	TOTAL (Min.)	PER-CENT OF POS-SIBLE													
1	34	10	22	-2	43	0	0	0	5.6	9	034	23	0													
2	34	7	21	-2	44	0	0	0	2.8	9	01		0													
3	29	4	17	-6	48	0	0	0	2.0	6	042		3													
4	27	5	16	-6	49	0	0	0	2.5	8	07		5													
5	34	22	22	+6	37	0	T	T	7.0	12	35	23	10	1												
6	35	21	28	+7	37	0	0	T	(1.8)	6	29	18	9		0	9										
7	29	16	23	+2	42	0	0	T	(1.9)	5	012	23	10													
8	27	5	16	-5	49	0	0	T	(2.6)	5	024	23	8													
9	16	1	9	-11	56	0	0	T	1.2	5	074		3													
10	18	-3	8	-12	57	0	0	T	3.8	6	034		0													
11	13	-6	4	-15	61	0	0	T	3.9	6	044		0													
12	19	-3	8	-11	57	0	0	T	(5.9)	12	34	23	0													
13	19	-5	7	-12	58	0	0	T	5.1	12	024	18	9		0	9										
14	20	5	13	-5	52	0	0	T	13.0	21	01	23	10													
15	24	20	25	+7	40	0	0.06	1.8	9.8	21	01	23	7	1												
16	28	8	18	+1	47	0	0	0	7.3	16	03		8													
17	25	6	16	-1	49	0	0	0	8.3	14	36		10													
18	28	21	25	+8	40	0	0	0	10.7	15	03		8													
19	27	7	17	+1	48	0	0	0	8.2	20	03	23	6													
20	37	25	31	+5	34	0	0.06	1.4	10.8	20	03	18	10	1		0	9									
21	34	30	32	+17	33	0	0.17	(0.7)	3	(2.3)	8	16	23	10	2											
22	30	7	17	+4	46	0	0	0	1.9	6	034	23	2	1												
23	17	14	16	+1	49	0	0.03	0.7	1.5	5	342		10	16												
24	20	16	18	+4	47	0	0.07	1.4	0.9	6	17		10	16												
25	16	5	11	-3	54	0	0.3	0.6	0.1	4	07		10	1												
26	13	-8	3	-11	62	0	T	T	4	(3.6)	9	36	23	8	1											
27	18	-6	6	-7	59	0	0	0	4	(5.0)	7	312	18	10		0	9									
28	22	17	20	+7	45	0	T	T	4	10.2	17	36	23	10	1											
29	24	17	21	+8	44	0	0.02	0.6	7.7	14	35	23	10	1												
30	25	21	23	+11	42	0	T	T	5	6.8	9	354		9	1											
31																										
SUM	747	279			1429	0	0.44	7.2	154.2				205													
AVG	24.1	9.3							5.1	21	01		6.8													

TEMPERATURE DATA				PRECIPITATION DATA				WEATHER				SYMBOLS USED IN COLUMN 16				
AVERAGE MONTHLY	17.1			TOTAL FOR THE MONTH	0.44 IN.			NUMBER OF DAYS -								
DEPARTURE FROM NORMAL	- 0.6			DEPARTURE FROM NORMAL	- 1.43 IN.			CLEAR (Scale 0-3)	8			1 = FOG				
HIGHEST	37	ON	20	GREATEST IN 24 HRS.	0.22	ON	20-21	PARTLY CLOUDY (Scale 4-7)	3			2 = FOG REDUCING VISIBILITY TO 1/2 MILE OR LESS				
LOWEST	-8	ON	26	SNOWFALL, ICE PELLETS				CLOUDY (Scale 8-10)	19			3 = THUNDER				
NUMBER OF DAYS WITH -				TOTAL FOR THE MONTH	7.2 IN.			WITH 0.01 INCH OR MORE PRECIP.	7			4 = ICE PELLETS				
MAX. 22° OR BELOW	24			GREATEST IN 24 HRS.	1.8	ON	20-21	WITH 0.10 INCH OR MORE PRECIP.	1			5 = HAIL				
MAX. 90° OR ABOVE	0			GREATEST DEPTH ON GROUND	5	ON	30	WITH 0.50 INCH OR MORE PRECIP.	0			6 = GLAZE OR RIME				
MIN. 32° OR BELOW	30			PRESSURE DATA				WITH 1.00 INCH OR MORE PRECIP.	0			7 = SAND REDUCING VSBY TO 1 MILE OR LESS				
MIN. 0° OR BELOW	6			HIGHEST SEA-LEVEL	30.12	IN. ON	11								8 = SMOKE OR HAZE	
HEATING DEGREE DAYS (Base 65°)				LOWEST SEA-LEVEL	28.74	IN. ON	22								9 = BLOWING SNOW	
TOTAL THIS MONTH	1429															10 = TORNADO
DEPARTURE FROM NORMAL	+10															
SEASONAL TOTAL	3427															
DEPARTURE FROM NORMAL	-131															
COOLING DEGREE DAYS (Base 65°)																
TOTAL THIS MONTH	0															
DEPARTURE FROM NORMAL	0															
SEASONAL TOTAL	3															
DEPARTURE FROM NORMAL	+3															

MAXIMUM PRECIPITATION											
Δt (Minutes)	5	10	15	20	30	45	60	80	100	120	180
PRECIPITATION (Inches)											
ENDED DATE											
TIME											

* Average wind speed is based on 24 hours unless otherwise indicated.
 # Fastest one minute wind speed and its direction.
 + Snow data is obtained at 0900A where indicated.
 1/ Indicates only the best of several occurrences.
 2/ Synoptic data is based on 6 hours unless otherwise indicated.

WS FORM F-6 (11-79)										U. S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE										STATION WSCMO, TALKEETNA, ALASKA									
PRELIMINARY LOCAL CLIMATOLOGICAL DATA										MONTH DECEMBER										YEAR 1984									
LATITUDE 62° 18' N					LONGITUDE 150° 06' W					GROUND ELEVATION (ft) 345					STANDARD TIME ALASKAN														
DAY	TEMPERATURE °F				DEGREE DAYS (Base 65°)		PRECIPITATION (in.)		SNOW, ICE PELLETS ON GROUND AT 0900H	WIND			SUNSHINE		SKY COVER PERCENT TO SUNSET (P.M.)	WEATHER OCCURRENCES	2/ 0700H	2/ 0900H											
	MAXI- MUM	MINI- MUM	AVER- AGE	DE- PARTURE FROM NOM- MAL	HEAT- ING	COOL- ING	TOTAL (Water equiv- alent)	SNOW- FALL ICE PELLETS		AVERAGE SPEED (m.p.h.)	FASTEST MILE SPEED (m.p.h.)	DIREC- TION	TOTAL (%)	PER- CENT CLEAR (%)															
1	31	25	28	+16	37	0	0	0	5	9.8	16	03			10														
2	33	26	30	+18	35	0	0	0	5	10.6	15	36			10														
3	37	32	35	+24	30	0	T	T	5	10.8	21	02	X	23	10	1													
4	39	31	35	+24	30	0	T	T	5*	7.4	13	35	X	18	10		0	9											
5	36	28	32	+21	33	0	.01	T	3	7.1	13	04	X	23	10														
6	28	19	24	+13	41	0	T	T	3	5.1	5	05	X	23	10														
7	26	22	24	+14	41	0	.07	2.4	3	5.2	10	04			10	16													
8	25	16	21	+11	44	0	.05	0.6	6	2.8	7	36			10	1													
9	19	-10	5	-5	60	0	0	0	6	(2.3)	6	05			2														
10	14	-11	2	-8	63	0	0	0	6	8.1	15	01	X	23	10														
11	14	-7	4	-5	61	0	0	0	6*	(4.9)	13	02	X	18	4		0	9											
12	3	-13	-5	-14	70	0	0	0	5	4.6	14	03	X	23	7														
13	11	-16	-3	-12	68	0	0	0	5	(6.5)	18	04	X	23	7														
14	15	-16	-1	-10	66	0	0	0	5	7.7	17	02			0														
15	15	-9	6	-2	59	0	.07	0.1	5	1.8	8	03			10	1													
16	25	15	18	+10	47	0	.04	0.2	6	5.4	12	02			10	1													
17	24	20	22	+14	43	0	.04	0.8	6	3.3	10	01	X	23	10	16													
18	30	24	27	+19	38	0	.54	5.4	9*	3.3	7	21	X	18	10	16	0	9											
19	30	12	21	+13	44	0	0	0	11	4.3	8	33	X	23	0	1													
20	14	-9	3	-5	62	0	0	0	11	(4.2)	8	35	X	23	2														
21	16	-8	4	-4	61	0	0	0	11	2.3	7	34			10														
22	24	11	18	+11	47	0	.06	1.9	11	2.9	8	36			10	1													
23	25	5	15	+8	50	0	.67	6.5	14	4.3	10	17			10	1													
24	5	-7	-1	-8	66	0	0	0	19	(2.1)	6	03	X	23	7														
25	18	2	10	+3	55	0	.12	2.0	20*	3.3	8	33	X	18	10	1	0	9											
26	16	-8	4	-3	61	0	T	T	21	(1.7)	6	04	X	23	4	1													
27	10	-10	0	-7	65	0	0	0	21	5.4	9	35	X	23	0														
28	9	-10	-1	-8	66	0	0	0	20	10.9	18	36			0														
29	16	8	12	+5	53	0	.61	20.0	20	7.9	17	02			10	1													
30	29	16	23	+16	42	0	.30	(6.1)	40	10.4	16	01			10	1													
31	35	28	32	+25	33	0	.06	0.1	43	(7.5)	12	36	X	23	10	1													
SUM	66.7	211			1571	0	2.69	47.5		169.9					238														
AVG	21.5	6.8								5.5	FASTEST 21	DIREC- TION 02	POS- SIBLE	5	7.7														

TEMPERATURE DATA				PRECIPITATION DATA				WEATHER				SYMBOLS USED IN COLUMN 16			
AVERAGE MONTHLY <u>14.2</u>				TOTAL FOR THE MONTH <u>2.69</u> IN.				NUMBER OF DAYS -				1 = FOG			
DEPARTURE FROM NORMAL <u>-12.5</u>				DEPARTURE FROM NORMAL <u>-11.38</u> IN.				CLEAR (Scale 0-3) <u>6</u>				2 = FOG REDUCING VISIBILITY TO 3 MILE OR LESS			
HIGHEST <u>39</u> ON <u>4</u>				GREATEST IN 24 HRS. <u>.74</u> ON <u>24-30</u>				PARTLY CLOUDY (Scale 4-7) <u>4</u>				3 = THUNDER			
LOWEST <u>-16</u> ON <u>14</u>				SNOWFALL, ICE PELLETS				CLOUDY (Scale 8-10) <u>21</u>				4 = ICE PELLETS			
NUMBER OF DAYS WITH -				TOTAL FOR THE MONTH <u>47.5</u> IN.				WITH 0.01 INCH OR MORE PRECIP. <u>13</u>				5 = HAIL			
MAX. 32° OR BELOW <u>26</u>				GREATEST IN 24 HRS. <u>21.9</u> ON <u>29-30</u>				WITH 0.10 INCH OR MORE PRECIP. <u>5</u>				6 = GLAZE OR RIME			
MAX. 50° OR ABOVE <u>0</u>				GREATEST DEPTH ON GROUND <u>44</u> ON <u>30</u>				WITH 0.50 INCH OR MORE PRECIP. <u>3</u>				7 = SAND REDUCING VISIB TO 1 MILE OR LESS			
MIN. 32° OR BELOW <u>31</u>				PRESSURE DATA				WITH 1.00 INCH OR MORE PRECIP. <u>0</u>				8 = SMOKE OR HAZE			
MIN. 0° OR BELOW <u>13</u>				HIGHEST SEA-LEVEL <u>30.32</u> IN. ON <u>16</u>								9 = BLOWING SNOW			
HEATING DEGREE DAYS (Base 65°) <u>1571</u>				LOWEST SEA-LEVEL <u>28.98</u> IN. ON <u>6</u>								X = TORNADO			
TOTAL THIS MONTH <u>-174</u>															
DEPARTURE FROM NORMAL <u>-49.98</u>															
SEASONAL TOTAL <u>-305</u>															
DEPARTURE FROM NORMAL <u>-305</u>															
COOLING DEGREE DAYS (Base 65°) <u>0</u>															
TOTAL THIS MONTH <u>0</u>															
DEPARTURE FROM NORMAL <u>0</u>															
SEASONAL TOTAL <u>3</u>															
DEPARTURE FROM NORMAL <u>-3</u>															

MAXIMUM PRECIPITATION											
Δt (Minutes)	5	10	15	20	30	45	60	80	100	120	180
PRECIPITATION (Inches)											
ENDED: DATE											
TIME											

X Wind data is based on 24 HOUR observations unless otherwise indicated.
Fastest one minute wind speed and its direction.
* Snow data is obtained at 0900H where indicated.
1/ Indicates only the last of several occurrences.
2/ Synoptic data is based on 6 hours unless otherwise indicated.

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp. °F	Ice Conc.	Water Level ft	Water Velocity ft/sec	Shore Ice		Snowfall	Weather
	Current °F	Min °F	Max °F					Width	Thickness		
10/4/84	40	35	57	39.2	0	55.22		0	0	0	clear & warm
10/5/84	35	28	55	39.2	0	55.10		0	0	0	high overcast/calm
10/6/84	40	37	54	40.5	0	55.10		0	0	0	partly cloudy/calm
10/7/84	43	33	52	40.5	0	55.04		0	0	0	overcast/calm
10/8/84	43	32	51	40.1	0	55.04		0	0	0	light rain/calm
10/9/84	40	33	49	39.2	0	55.02		0	0	0	partly cloudy/calm
10/10/84	30	24	50	37.8	0	55.08	4.2	0	0	0	clear/calm
10/11/84	32	24	50	37.4	0	55.00		0	0	0	partly cloudy w/fog
10/12/84	30	22	48	38.1	0	54.90	4.2	0	0	1/4" (melting)	partly cloudy
10/13/84	34	19	48	38.3	0	54.82		0	0	0	partly cloudy/calm

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp.	Ice Conc. %	Water Level Ft	Water Velocity Ft/sec	Shore Ice		Snowfall inches	Weather
	Current °F	Min °F	Max °F					Width	Thickness		
10/14/84	35	20	41	36.5	0	54.60	3.8				clear
10/15/84	—	—	—	—	0						clear
10/16/84	19.0	19		35.2	40	54.37					high clouds
	39.2		48	35.1	30	—		6"	very thin	0	clear w/wind
10/17/84	32.9	27		34.7	50	51.63					clear / windy
	36.9		48	34.7	30	51.62		47"	1/8" - 1/2"	0	clear / N. wind
10/18/84	35.6	24		33.6	50	51.57	3.3	70"			
	37.4		49	34.0	30	51.42		66"	1/8" - 2"	0	clear / S. wind
10/19/84	21.2	18		34.1	50	51.29		18"	—	0	clear / calm
	34.7		38	33.8	40	51.29		(water: 12 ft from shelf)			clear / calm
10/20/84	29.8	22		32.1	45	51.27					high overcast
	34.7		36	33.8	50	51.34		(water: near shore)			overcast / N. wind
10/21/84	34.7	31		34.2	40	51.47		shore ice cracked and			light snow
	34.3		45	34.5	30	51.53		melted 2' out from bank			high overcast
10/22/84	41.2	32		35.1	5	51.60		no shore ice			high overcast
	41.4		50	35.2	0	51.60		no shore ice			overcast / light rain

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp. °F	Ice Conc. %	Water Level Fe	Water Velocity ft/sec	Shore Ice		Snowfall	Weather
	Current °F	Min °F	Max °F					Width	Thickness		
10/21/84	33.8	32		34.2	-	51.70	2.9	20'	ice	0	clearing
	32.9		37	34.5	10	51.83				2"	clearing
10/24/84	30.2	20			10	51.92		12'	ice	0	clear
	35.1		37	34.2	20	51.70		10'	ice	0	clear / light wind
10/25/84	33.3	20		33.8	60	51.51		21'	1/8' - 1/2"	0	clear / w. wind
	35.6		40	34.2	60	51.56		15'	1/8' - 2"	0	clear
10/26/84	-4	14		34.2	50	51.01	3.6			0	clear / 10% ice
	-		38	34.2	50	50.80		15'	2 1/2"	0	clear / calm
10/27/84	14	8		34.0	60	50.61		15'	3"	0	clear / calm
	23		32	33.4	50	51.18		16'	4"	0	clear / calm
10/28/84	15	4		33.2	60	50.77	2.7	17'	4"	0	clear / windy
	22		34	33.8	55	49.98		17.5'	4"	0	clear / wind
10/29/84	14	14		33.4	55	50.15		21'	4 1/2"	0	clear / light wind
	22		27	33.4	55	49.85		21'	4 1/2"	0	clear / calm
10/30/84	23	10		33.4	40	50.07	2.6	21'	4 1/2"	0	clear / strong wind
	24		26	33.4	40	50.15					
10/31/84	22	20		33.8	10	50.08		21'	5"	0	clear / w. wind
	25		35	34.2	40	49.75				0	clear / calm

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp. °F	Ice Conc. %	Water Level ft	Water Velocity ft/sec	Shore Ice		Snowfall	Weather
	Current °F	Min °F	Max °F					Width	Thickness at edge		
11/1/84	18	8		34.2	50	49.70	3.2	21'	4"	0	clear / calm
	33		38	33.8	40	49.70	3.1			0	clear / calm
11/2/84	23	16		33.6	40	49.72	2.9	21'	4"	0	clear / light wind
	24		34	33.3	40	49.75					cloudy
11/3/84	10	4		33.3	50	50.13	3.1	21'	7"	0	clear / calm
	24		30	32.9	35	50.09				0	clear / calm
11/4/84	0	0		33.1	60	50.20		22'	7"	0	clear / calm
	14		24	33.4	55	50.38				0	high overcast
11/5/84	30	8		33.2	55	50.48	2.9	20'		0	light snow
	30		36	33.2	10	50.60		breaking up		1/2	snowing
11/6/84	24	22		33.4	20	51.04		20'		0	cloudy / calm
			34	33.4	30						cloudy / calm
11/7/84	22	16		33.1	20	50.98		20'		0	clearing
	25		28	33.1	15	50.96				0	partly cloudy
11/8/84	19	3		33.2	10	50.92	2.9	18'		0	partly cloudy
	25		27	33.3	10	50.97					
11/9/84	18	16		33.1	15	51.02	3.0	18'		0	partly cloudy
	20		27	33.3	30	51.00				0	clear / calm

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp.	Ice Conc.	Water Level	Water Velocity	Shore Ice		Snowfall	Weather
	Current	Min	Max					Width	Thickness		
11/10/84	2	-4		33.3	70	50.75	2.1	24'	6"	0	clear / calm
			24	32.0	70	50.70				0	clear
11/11/84	-2	-10		32.4	70	50.78		30'		0	clear / light wind
	-4		3	32.4	70	50.78				0	clear
11/12/84	-4	-10		32.4	80	50.53	2.7	31'	6"	0	clear / calm
	8		12	32.4	70	50.60				0	clear / calm
11/13/84	-2	-8		32.3	65	50.71	2.9	31'		0	clear / calm
	10		16	33.1	60	50.78				0	Partly cloudy
11/14/84	8	2		32.1	75	50.60	2.7	31'		0	Cloudy / N. wind
	20		22	32.0	75	50.67		34'		0	Very Windy
11/15/84	28	14			65	50.70	2.7	36'		0	high overcast
	28		32		50	50.80		36'		0	high overcast
11/16/84	21	21			50	50.92	2.5	36'	8"	1 1/4"	Cloudy / calm
	22		28		40	50.72				0	
11/17/84	7	1			50	50.83				0	Cloudy / calm
	20		27		50	50.90				0	
11/18/84	25	6			40	50.95		31'		0	clear / windy
	20		28		40		2.4			0	

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp.	Ice Conc.	Water Level	Water Velocity	Shore Ice		Snowfall	Weather
	Current	Min	Max					Width	Thickness		
11/19/84	6	3			55	50.85		30'	4"	0	Clear / calm
	20		32		50	50.72	2.6			0	
11/20/84	30	3			50	51.10					light snow
	30		43		40	51.09				1'	rain
11/21/84	34	26			25	51.07	2.9	35'	8"	0	Cloudy / calm
	30		37		20	51.10				0	
11/22/84	15	12			10	51.15				0	Cloudy / calm
	20		22		10	51.15				0	Cloudy / calm
11/23/84	15	10			20	51.11		35'	4"	0	Cloudy / calm
	18		18		20	51.11	2.9			-	Snowing
11/24/84	10	-3			10	51.07				3"	Snowing
	20		22		30	51.07	3.1			-	Snowing
11/25/84	10	8			30	51.22				2"	Snowing
	10		16		25	51.10				-	light snow
11/26/84	10	-5			40	51.15	2.9			1/2'	high overcast
	10		12		50	51.15				0	high overcast
11/27/84	10	-4			25	50.80				0	overcast / fog
	18		24		40	51.10	2.6		5"	0	high overcast

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

[illegible]

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp.	Ice Conc.	Water Level	Water Velocity	Shore Ice		Snowfall	Weather
	Current	Min	Max					Width	Thickness		
12/1/84	17	17				51.17		40		0	clear
	25		30			51.20	2.5			1/2"	snowing / calm
12/2/84	20	16				51.21		10	20		high overcast
	30		36			51.22	2.6			1/2"	high snow
12/3/84	34	24				51.25		water near shore			overcast
	42		43			51.24	2.7				overcast
12/4/84	24	24				51.24		water near shore			overcast
	30		42			51.25	2.8	ice near shore			overcast / fog
12/5/84	30	24				51.25				0	
	36		36			51.25	2.9				light rain
12/6/84	20	20				51.17					
	22		26			51.15	3.0			0	overcast / calm
12/7/84	22	18				51.17		3' ice near shore			snowing
	20		24			-	2.6	8' open water 15' ice near shore		1/2'	overcast / fog
12/8/84											
12/9/84	14	-1				51.17				2 3/4"	overcast
	10		12			51.20	2.6	ice along		0	overcast

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp. °F	Ice Conc. %	Water Level ft	Water Velocity ft/sec	Shore Ice		Snowfall	Weather
	Current °F	Min °F	Max °F					Width	Thickness		
12/10/84	5	13		32.0		51.22	2.5			0	
	10		14							0	clear / calm
12/11/84	-4	12		32.0	25	51.22	2.4			0	clear / calm
			14	32.0						0	fog
12/12/84	-10	-16		32.0	50	51.32				0	
	2		2	32.1	50	51.40	1.5			0	clear / windy
12/13/84	-1	-16			50	51.76				0	
			12	32.0	50		1.0			0	
12/14/84		-18								0	clear / calm
			6							0	
12/15/84	9	-4		32.1		54.35		Shore ice lifted		1/2"	high overcast
	10		16			ice jam		11-20 ft	1.5 feet		Snowing
12/16/84	10	6	18		ICE	COVER				7 3/4"	overcast
12/17/84	20	18	20							1"	Snowing
12/18/84	20	14	25							11 3/4"	Snowing hard
				↓	↓	↓	↓				

1984
FREEZE-UP OBSERVATION

Location: Susitna River
At Gold Creek

Date	Air Temperature			Water Temp.	Ice Conc.	Water Level ft	Water Velocity ft/sec	Shore Ice		Snowfall	Weather
	Current °F	Min °F	Max °F					Width	Thickness		
12/19/84					ICE	COVER					
12/20/84											
12/21/84	0	-16	8							0	clear / windy
12/22/84	25	16	28							10 1/2"	snowing / calm
12/23/84	25	18	28							3"	snowing / calm
12/24/84	20	14	27							0	clear / calm
12/25/84	20	20	32							0	clear / calm
12/26/84	-4	-10	20							0	clear / calm
12/27/84	-16	-20	-14							0	Cloudy / calm
12/28/84				✓	↓	✓	✓			7"	Snowing

APPENDIX B

1984 Lower River Cross Section Plots

GLOSSARY OF ABBREVIATED TERMS

ALCAP - 2" Aluminum Cap set on a 5/8" rebar with cross-section identification marking.

ANGL PT - Angle point in horizontal alignment marked by an alcap.

BRK - Break in slope

E VEG - Edge of vegetation

GS - Ground shot on even slope

POL - Point on line of horizontal alignment

LB - Left Bank

RB - Right Bank

L EOW,

R EOW - Left or right edge of water surface

RIV BOT - Elevation in submerged channel

TOE - Base of a slope

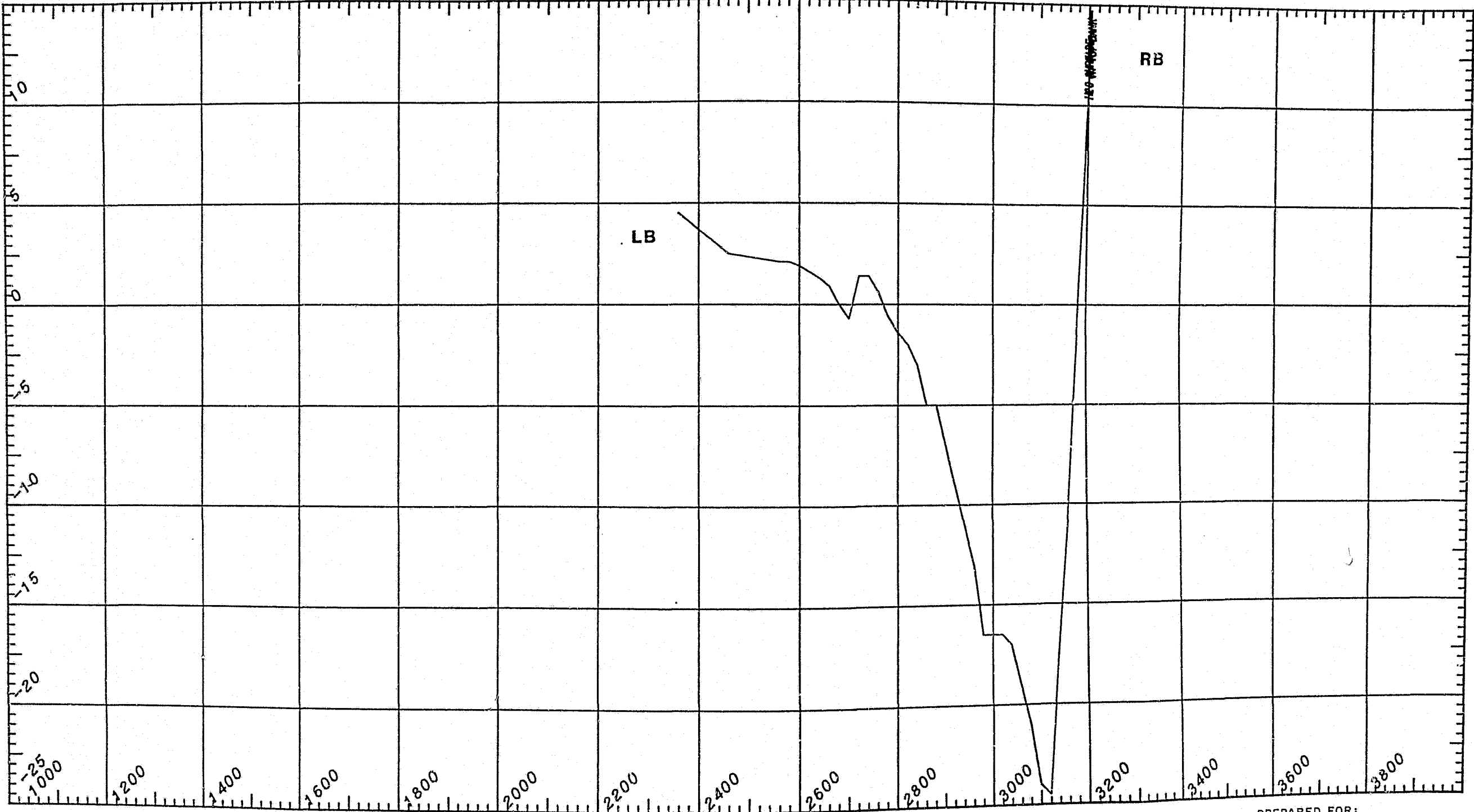
TOP - Top of a slope

NOTE: All tabulated cross section data begin at the left bank when viewed looking downstream, with the exception of CRX RM 9.0 which begin on the right bank.

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 9.0

REFERENCE ELEVATION ESTIMATED FROM USGS TOPOGRAPHIC MAP



PREPARED BY:

R&M
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
SUSITNA JOINT VENTURE

TITLE: SUSITNA HYDROGRAPHIC SURVEYS
 IDENT: 1984 cross section LRX 25.9
 DATE: AUGUST 15, 1984

	*** X ***	*** Y ***	***** DESCRIPTION *****
	=====	=====	=====
SECTION:	100	35.0	LEOW
	140	20.5	RIV BOT
	190	11.5	RIV BOT
	215	5.5	RIV BOT
	240	6.5	RIV BOT
	265	-0.8	RIV BOT
	290	0.2	RIV BOT
	315	0.2	RIV BOT
	340	4.0	RIV BOT
	365	8.3	RIV BOT
	390	10.6	RIV BOT
	440	14.2	RIV BOT
	490	14.8	RIV BOT
	540	19.3	RIV BOT
	590	21.7	RIV BOT
	640	24.6	RIV BOT
	740	27.6	RIV BOT
	840	29.2	RIV BOT
	940	28.7	RIV BOT
	1040	30.1	RIV BOT
	1140	31.9	RIV BOT
	1240	32.8	RIV BOT
	1540	34.0	RIV BOT
	1970	35.0	REOW
WATER:	100	35.0	H2O SURFACE
	1970	35.0	

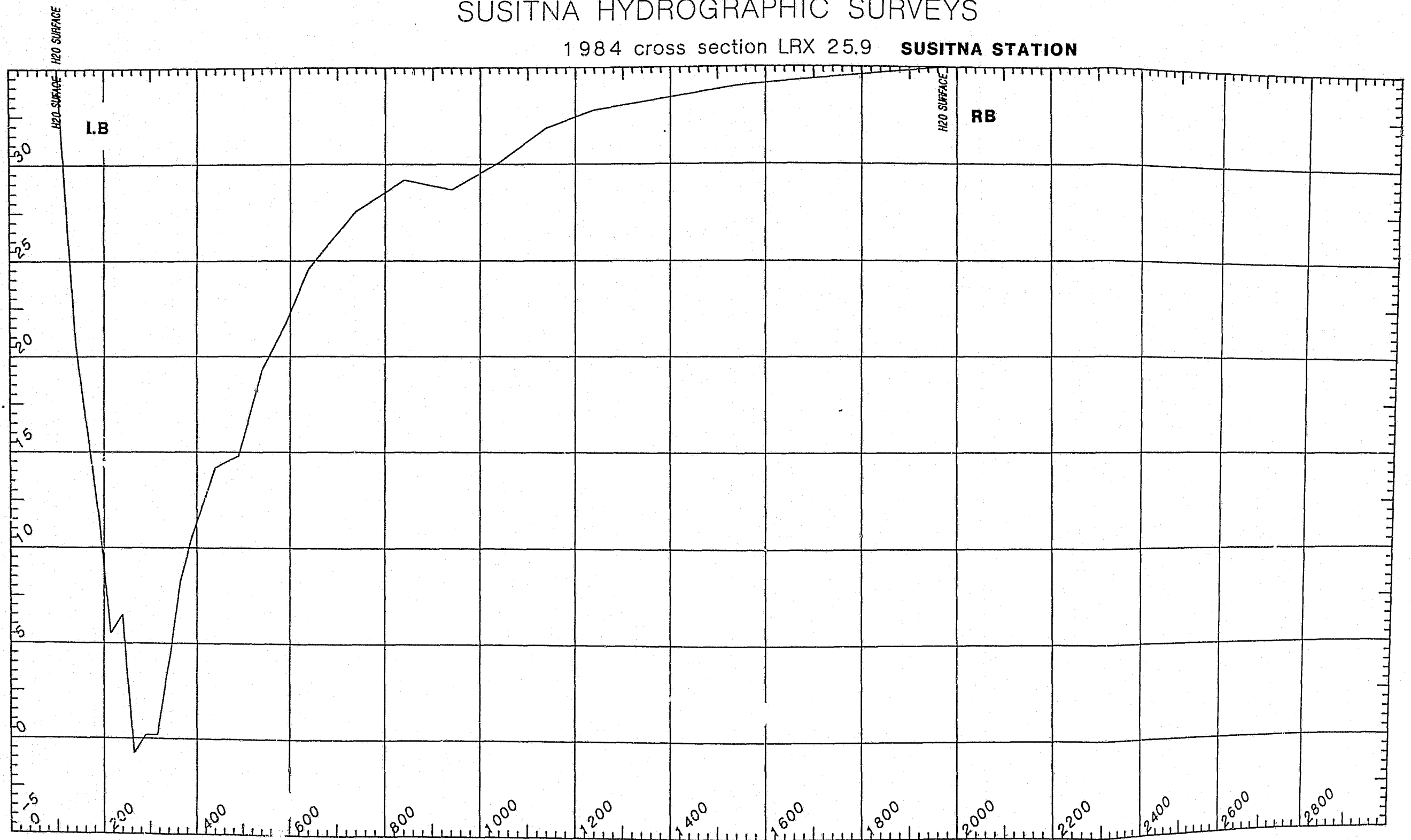
DISCHARGE 82.200
 END OF DATA

Note: This data was compiled from U.S.G.S. streamgaging measurement field notes. All "y" values are soundings, "x" values are estimated distances. This cross section uses a datum estimated from a U.S.G.S. topographic map.

REFERENCE ELEVATION ESTIMATED FROM USGS TOPOGRAPHIC MAP

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 25.9 SUSITNA STATION



PREPARED BY:

R&M
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

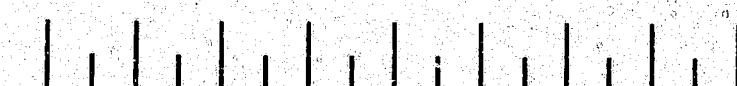
HARZA-EBASCO
SUSITNA JOINT VENTURE

***** CROSS-SECTION PLOT *****

SUSITNA HYDROGRAPHIC SURVEYS
1984 cross section LRX 40.0

Date of Survey: SEPTEMBER 21, 1984

POINT	'X'	'Y'	DESCRIPTION
Cross section data:			
1	0.000	80.900	ALCAP LRX RM 40 LB
2	19.000	71.200	TOE
3	40.000	70.500	BRK
4	75.000	71.100	BRK
5	151.000	69.300	L EDW
6	176.000	68.800	RIV BOT
7	195.000	68.500	RIV BOT
8	216.000	68.000	RIV BOT
9	250.000	66.200	RIV BOT
10	274.000	66.400	RIV BOT
11	284.000	67.800	RIV BOT
12	296.000	69.300	R EDW
13	304.000	71.800	TOE
14	314.000	80.900	TOP
15	317.040	81.500	ANGL PT 1
16	398.040	80.300	GS
17	841.040	81.400	TOP
18	861.000	76.700	TOE
19	904.000	75.000	GS
20	969.000	75.600	TOE
21	990.000	78.700	TOP
22	999.000	79.200	BRK
23	1021.000	77.000	TOP
24	1044.000	73.000	TOE
25	1131.000	72.200	BRK
26	1162.000	70.600	TOE
27	1189.000	77.800	TOP
28	1201.040	77.700	ANGL PT 2
29	1208.000	76.700	TOP
30	1227.000	72.200	TOE
31	1240.000	72.000	TOE
32	1248.000	74.700	TOP
33	1323.000	74.600	BRK
34	1434.000	73.000	GS
35	1511.380	72.600	TOP
36	1536.000	69.900	L EDW
37	1548.000	67.900	RIV BOT
38	1564.000	64.000	RIV BOT
39	1610.000	58.800	RIV BOT
40	1680.000	53.900	RIV BOT
41	1770.000	54.500	RIV BOT
42	1812.000	55.000	RIV BOT
43	1870.000	60.000	RIV BOT
44	1923.000	60.000	RIV BOT
45	1958.000	61.000	RIV BOT



FOLD LENGTH
12
11
8.5
8
AUTO
MANUAL
FEED

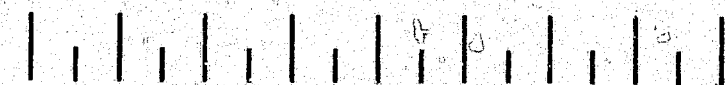
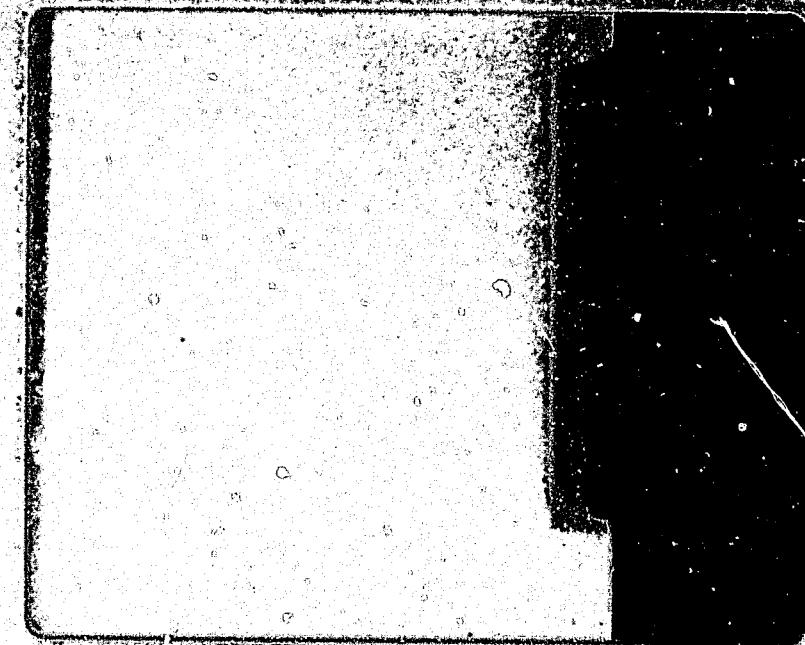
46	2010.000	62.900	RIV BOT
47	2060.000	63.900	RIV BOT
48	2106.000	64.800	RIV BOT
49	2156.000	66.800	RIV BOT
50	2208.000	68.400	RIV BOT
51	2253.000	69.900	R EOW
52	2337.000	72.300	GS
53	2430.000	74.300	GS
54	2506.000	74.900	GS
55	2593.980	75.000	ANGL. PT 3
56	2673.000	73.600	GS
57	2764.000	71.500	TOP
58	2790.000	69.000	L EOW
59	2806.000	67.100	RIV BOT
60	2839.000	61.000	RIV BOT
61	2849.000	60.900	RIV BOT
62	2863.000	62.600	RIV BOT
63	2882.000	67.000	RIV BOT
64	2891.000	69.000	R EOW
65	2903.000	72.200	TOE
66	2917.000	84.300	TOP
67	2922.450	85.800	ALCAP LRx Rm 40 RD

Water surface data:

1	151.000	69.300	L EOW
2	296.000	69.300	R EOW
3	1536.000	0.000	
4	1536.000	69.900	L EOW
5	2253.000	69.900	R EOW
6	2790.000	0.000	
7	2790.000	69.000	L EOW
8	2891.000	69.000	R EOW

MIN	0.000	53.900
MAX	2922.450	85.800

Maximum 'X' scale : 1" = 417 (for 8.5 by 11 format)
Maximum 'Y' scale : 1" = 6 (for 8.5 by 11 format)



FOLD LENGTH

12
11
8.5
8

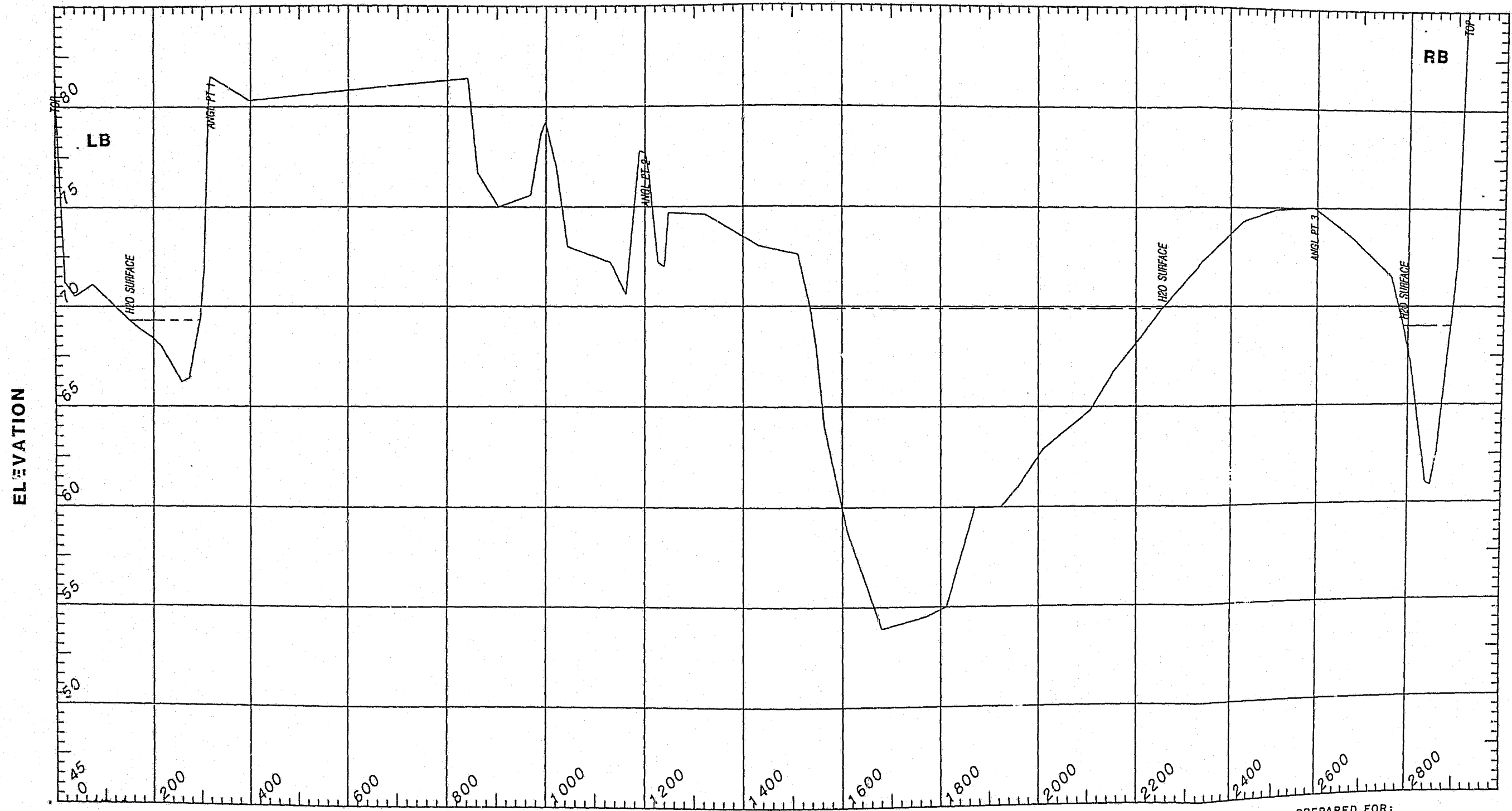
AUTO

MANUAL

FEED

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 40.0



PREPARED BY:

RSM
RSM CONSULTANTS, INC.
 ENGINEERS GEOLOGIST PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

TITLE: SUSITNA HYDROGRAPHIC SURVEYS
 IDENT: 1984 cross section LRX 47.9
 DATE: SEPTEMBER 19, 1984

*** X ***	*** Y ***	***** DESCRIPTION *****
SECTION:		
00	113.9	ALCAP LRX RM 47.9 L8.
03	113.3	TOP
06.7	108.2	TOE
12	104.3	L EOW
17	102.2	RIV BOT
49	98.9	RIV BOT
101	96.6	RIV BOT
161	97.5	RIV BOT
214	101.9	RIV BOT
269	102.7	RIV BOT
321	100.7	RIV BOT
367	101.3	RIV BOT
416	100.5	RIV BOT
458	100.4	RIV BOT
482	100.6	RIV BOT
500	104.1	R EOW
513	106.7	TOP
555	108.2	POL
578	108.8	BRK
595	108.5	BRK
601	107.9	BRK
641	107.0	TOE
660	109.6	TOP
693	110.5	TOP
712	108.7	TOE
745	108.8	BRK
805	106.8	BRK
866	108.3	GS
892	109.2	TOE
914	109.6	TOP
992	108.7	TOP
1007	106.4	TOE
1042	105.7	GS
1080	106.0	TOE
1101	108.2	TOP
1131	108.2	POL
1145	108.0	BRK
1192	107.0	BRK
1218	106.0	TOP
1237	104.2	BRK
1256	103.6	BRK
1273	103.9	BRK
1268	104.4	TOE
1302	108.9	TOP
1321	109.0	TOP
1357	106.9	BRK
1376	106.3	TOE
1399	107.0	BRK
1431	105.1	BRK
1483	104.8	POL&GS
1531	104.9	L EOW
1560	104.2	RIV BOT

1585	104.2	RIV BOT
1604	104.7	RIV BOT
1621	103.9	RIV BOT
1644	103.6	RIV BOT
1668	102.8	RIV BOT
1720	102.8	RIV BOT
1739	103.7	RIV BOT
1760	104.7	R EOW
1791	106.0	GS
1836	107.4	BRK
1876	106.9	BRK
1908	107.3	BRK
1974	106.3	TOE
1989	108.2	TOP
2033	108.5	POL & E VEG
2103	109.8	TOE
2116	112.6	BRK
2122	113.5	TOP&E VEG
4321.7	111.7	REBAR
4328	111.3	TOP
4333	107.2	TOE
4363	108.3	BRK
4366	109.3	BRK
4375	108.7	BRK
4379	108.0	BRK
4394	108.4	TOE
4403	109.8	TOP
4428	110.3	BRK
4455	109.2	TOP
4467	108.1	TOE
4488	107.3	TOE
4504	109.3	TOP
4534	109.1	TOP
4550	106.5	L EOW
4559	104.5	RIV BOT
4563	103.8	RIV BOT
4581	103.7	RIV BOT
4586	106.5	R EOW
4591	111.8	TOP
4597	111.6	POL GS
4624	112.1	GS
4709	111.8	ANG PT 1
4723	111.5	TOP
4726	108.8	L EOW
4731	106.5	RIV BOT
4748	104.0	RIV BOT
4759	108.6	R EOW
4791	109.1	GS
4804	109.0	L EOW
4833	106.1	RIV BOT
4853	105.0	RIV BOT
4886	101.4	RIV BOT
4905	99.1	RIV BOT
4940	107.9	RIV BOT
4980	108.3	RIV BOT
5014	107.8	RIV BOT
5028	106.7	RIV BOT
5069	101.6	RIV BOT
5088	103.8	RIV BOT
5105	107.3	RIV BOT

5110	109.3	R EOW
5114	111.4	TOP
5119.3	111.8	REBAR
8169.3	112.4	REBAR
8176	111.2	TOP
8185	105.7	L EOW
8190	103.7	RIV BOT
8215	102.1	RIV BOT
8235	102.2	RIV BOT
8257	101.0	RIV BOT
8273	100.5	RIV BOT
8291	102.3	RIV BOT
8304	103.6	RIV BOT
8309	105.3	RIV BOT
8327	105.6	R EOW
8350	106.8	BRK
8415	109.2	BRK
8475	108.8	TOP
8482	107.3	TOE
8521	105.7	TOE
8535	111.5	TOP
8542.8	111.4	REBAR
8842.8	111.9	REBAR
9845	111.4	TOP
9852	108.7	TOE
9871	109.9	BRK
9897	106.2	BRK
9920	106.7	TOP
9938	104.0	L EOW
9945	101.3	RIV BOT
9978	101.5	RIV BOT
10013	102.4	RIV BOT
10045	102.2	RIV BOT
10087	102.1	RIV BOT
10146	107.8	RIV BOT
10174	103.3	RIV BOT
10199	103.3	RIV BOT
10209	103.9	R EOW
10225	105.2	TOP
10297	105.5	GS
10370	106.1	BRK
10431	105.3	GS
10473	104.8	TOP
10481	103.3	L EOW
10509	102.7	RIV BOT
10537	102.8	RIV BOT
10554	101.9	RIV BOT
10573	102.8	RIV BOT
10637	103.1	RIV BOT
10693	101.8	RIV BOT
10725	100.9	RIV BOT
10763	100.1	RIV BOT
10809	99.5	RIV BOT
10866	99.6	RIV BOT
10928	99.4	RIV BOT
11007	100.1	RIV BOT
11065	99.7	RIV BOT
11108	98.8	RIV BOT
11159	96.8	RIV BOT
11188	98.4	RIV BOT

11197	101.1
11210	102.5
11227	105.0
11283.6	108.0
11342	107.8
11411	108.5
11447	107.2
11509	108.2
11555	106.8
11604	105.8
11622	107.2
11662	106.7
11748	107.4
11826	108.8
11840	105.2
11900	105.4
11953	105.4
11962	107.7
12039	107.6
12112	106.5
12138	104.5
12172	105.6
12178	103.4
12199	103.1
12208	110.8
12220.2	110.3

WATER:

12	104.3
500	104.1
1531	0
1531	104.9
1760	104.7
4550	0
4550	106.5
4586	106.5
4726	0
4726	108.8
4759	108.6
4804	0
4804	109.0
5110	109.3
8185	0
8185	105.7
8327	105.6
9938	0
9938	104.0
10209	103.9
10481	0
10481	103.4
11210	102.5

END OF DATA

RIV BOT
R EOW
TOP
ANGL PT2
GS
BRK
BRK
BRK
BRK
BRK
BRK
BRK
TOP
TOE
GS
TOE
TOP
GS
BRK
BRK
BRK
BRK
TOE
TOP
ALCAP LRY RM 47.9 RB

L EOW
R EOW

L EOW
R EOW

L EOW
R EOW

L EOW
R EOW

L EOW
R EOW

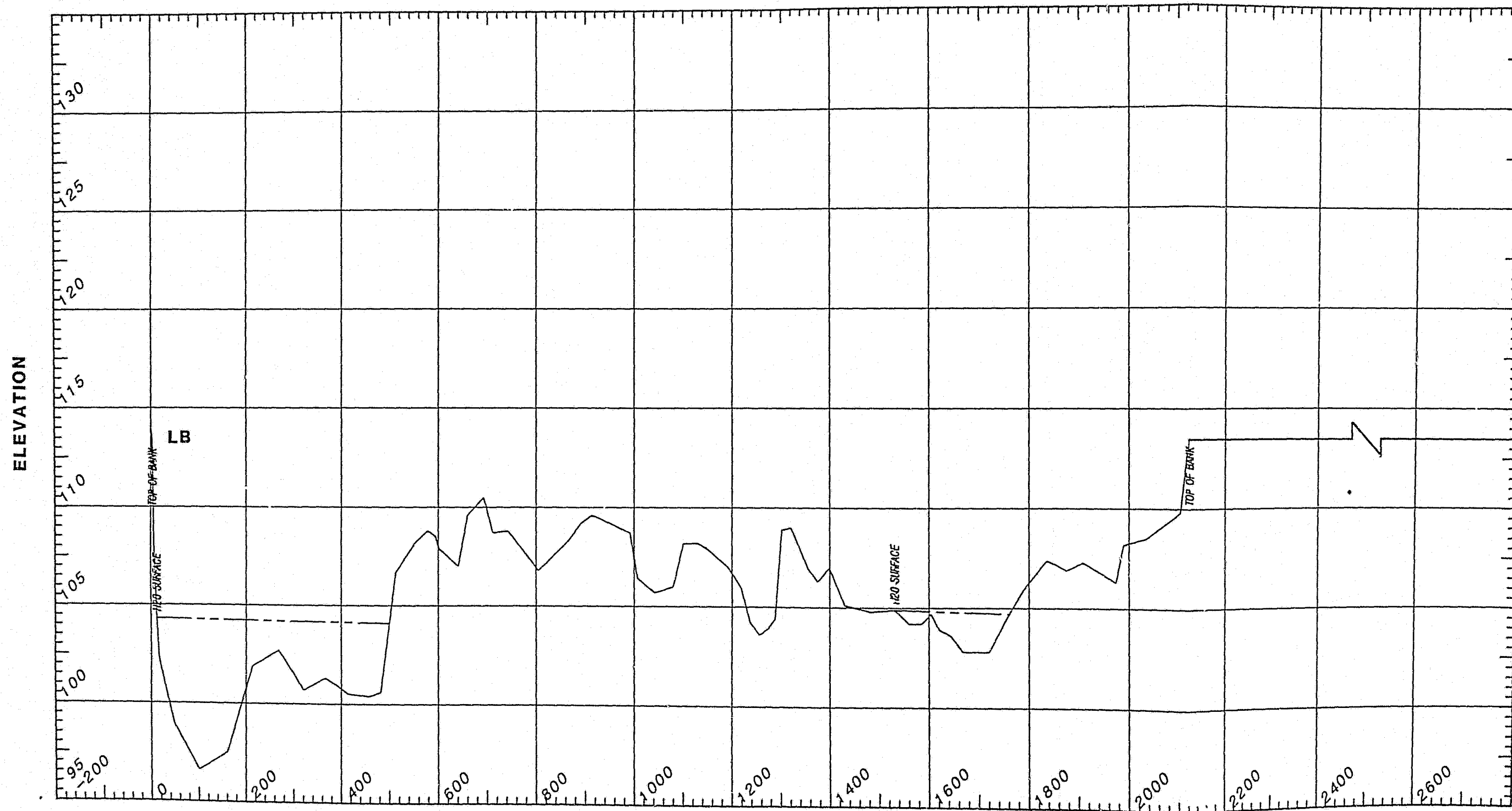
L EOW
R EOW

L EOW
R EOW

L EOW
R EOW

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 47.9



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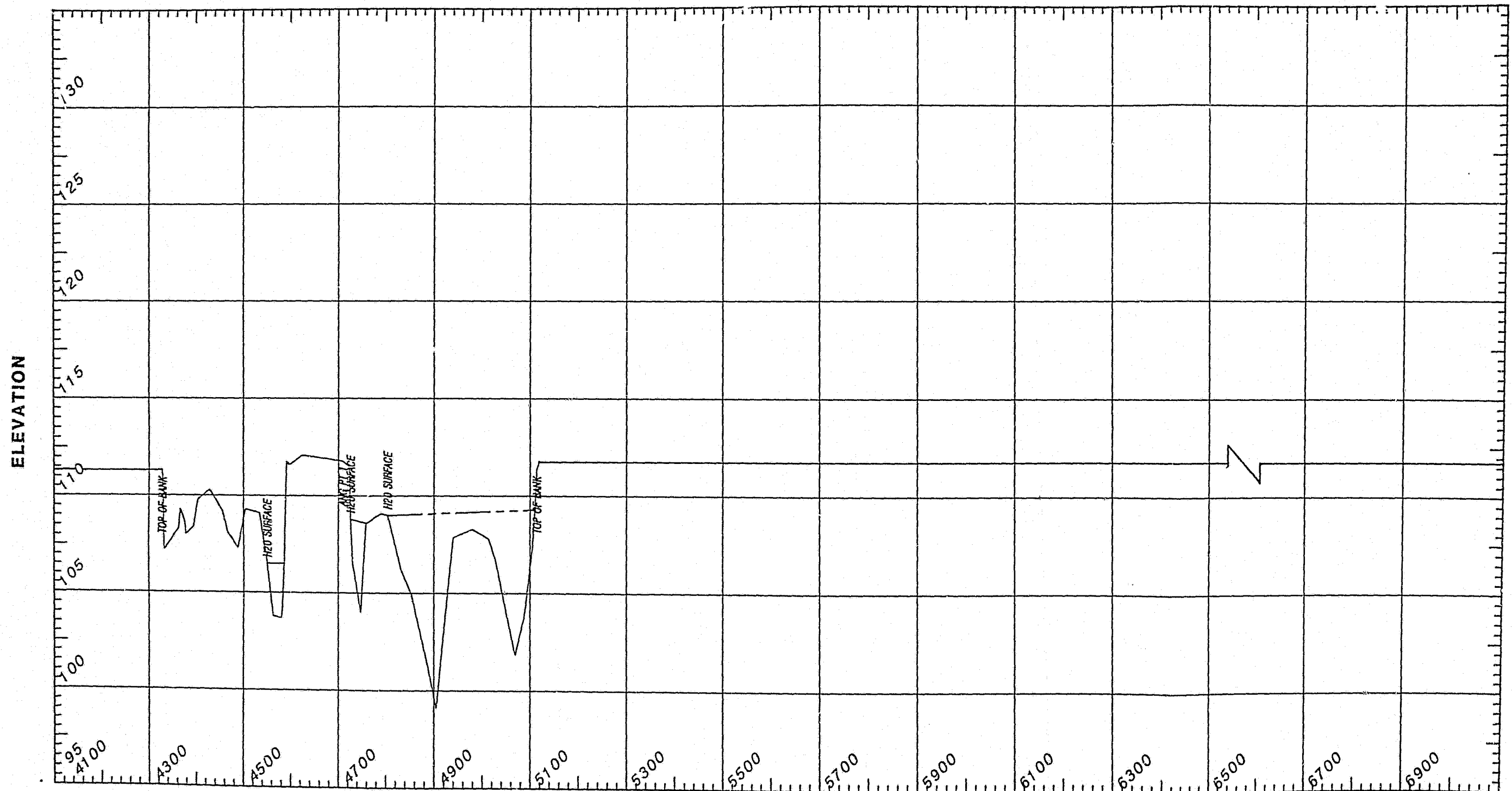
DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 47.9 **CONTINUED**



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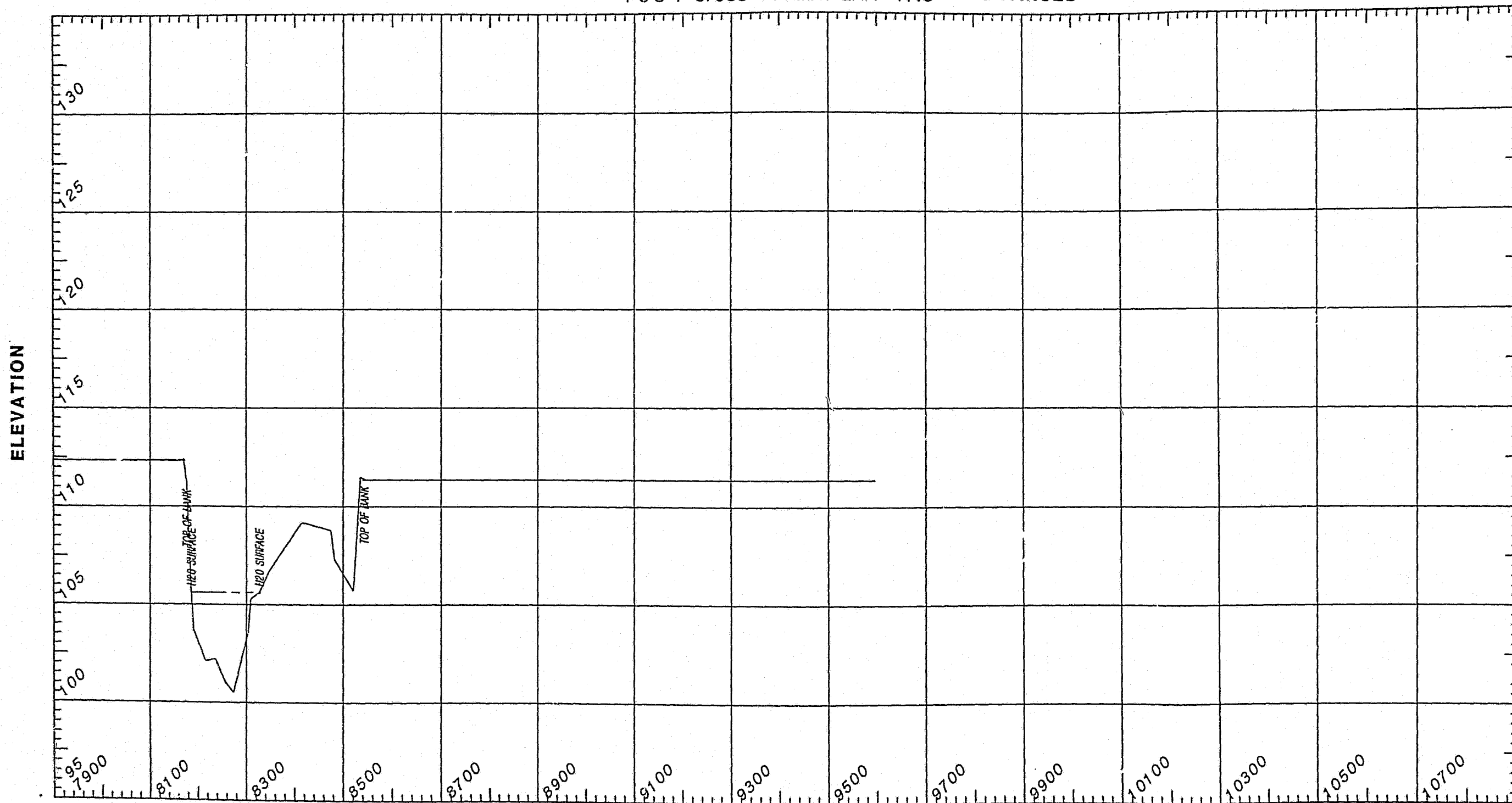
DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 47.9 **CONTINUED**



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DISTANCE FT

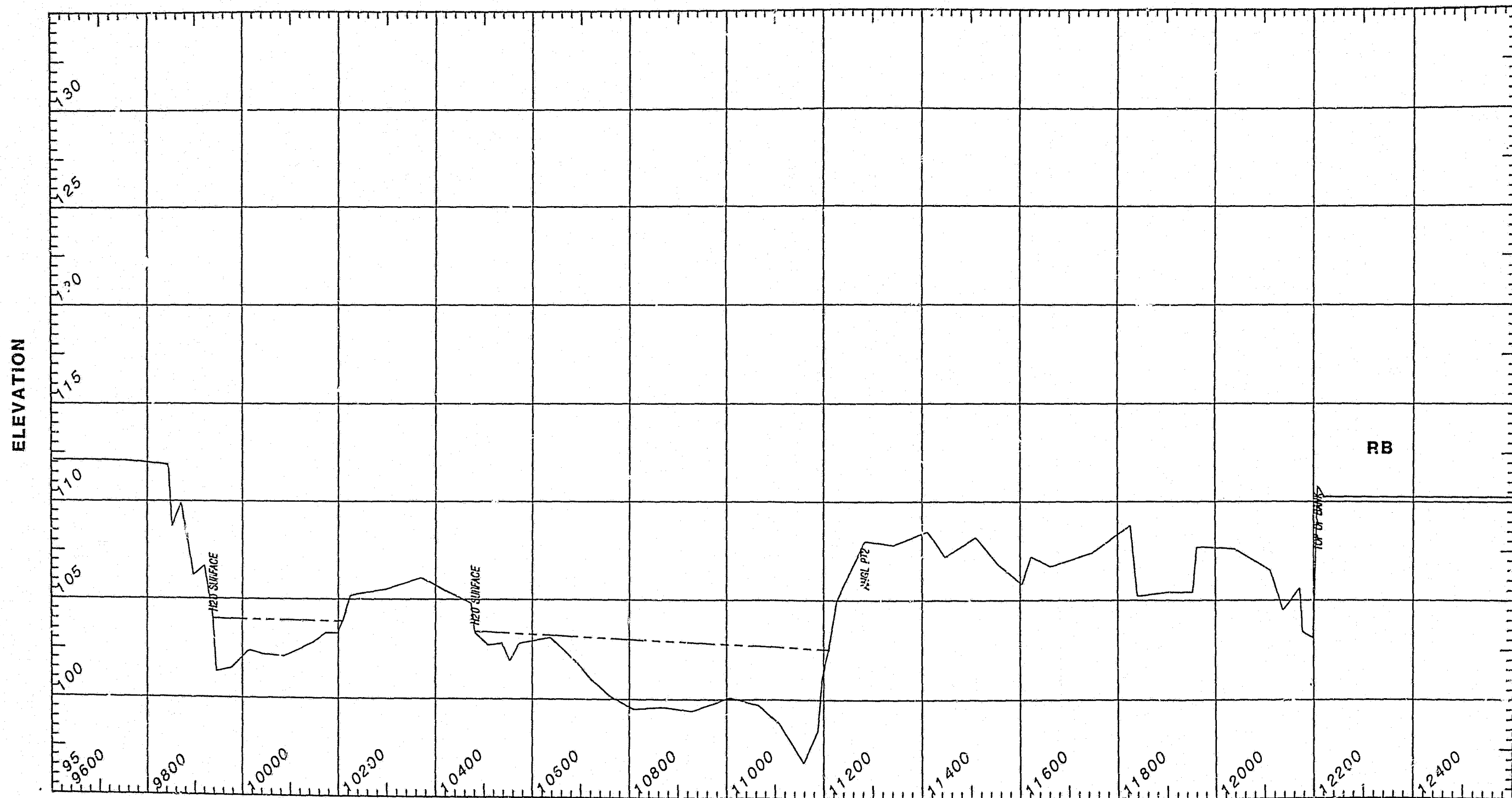
PREPARED FOR:

HARZA-EBASCO

SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 47. CONTINUED



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DISTANCE FT

PREPARED FOR:

HARZA-EBASCO

SUSITNA JOINT VENTURE

***** CROSS-SECTION PLOT *****

SUSTINA HYDROGRAPHIC SURVEYS
1984 cross section LRX 59.7

Date of Survey: SEPTEMBER 25, 1984

POINT	X	Y	DESCRIPTION
Cross section data:			
1	0.000	152.000	ALCAP LRX RM 59.7 LB
2	12.000	150.500	TOP
3	17.000	146.300	TOE
4	28.000	144.800	BRK
5	45.000	146.500	BRK
6	59.000	145.600	L EOW
7	71.000	144.000	RIV BOT
8	94.000	138.600	RIV BOT
9	126.000	137.200	RIV BOT
10	167.000	137.000	RIV BOT
11	215.000	137.000	RIV BOT
12	261.000	138.300	RIV BOT
13	312.000	141.700	RIV BOT
14	350.000	139.700	RIV BOT
15	378.000	139.300	RIV BOT
16	422.000	138.400	RIV BOT
17	472.000	137.300	RIV BOT
18	512.000	139.200	RIV BOT
19	545.000	143.400	RIV BOT
20	557.000	145.100	RIV BOT
21	565.000	145.600	R EOW
22	597.000	147.800	BRK
23	649.000	149.600	BRK
24	684.000	148.800	BRK
25	696.000	147.500	BRK
26	721.000	148.200	TOE
27	731.000	149.400	BRK
28	736.000	150.100	TOP
29	736.990	150.500	ANGL PT 1
30	741.000	150.400	TOP
31	744.000	147.300	TOE
32	750.000	148.800	TOP
33	808.000	148.100	GS
34	847.000	146.800	BRK
35	882.000	147.700	BRK
36	934.000	148.000	BRK
37	1004.000	148.100	BRK
38	1058.000	149.900	BRK
39	1098.000	149.600	TOP
40	1117.000	147.400	L EOW
41	1127.000	145.800	RIV BOT
42	1138.000	144.900	RIV BOT
43	1154.000	145.400	RIV BOT
44	1182.000	146.700	RIV BOT
45	1231.000	146.900	RIV BOT

46	1274.000	147.400	R EOW
47	1304.000	147.700	BRK
48	1308.000	145.700	BRK
49	1323.000	143.700	TOE
50	1334.000	146.100	TOP
51	1344.000	149.400	BRK
52	1449.000	148.800	GS
53	1544.000	147.800	BRK
54	1575.000	146.000	BRK
55	1626.000	147.900	BRK
56	1689.000	146.900	GS
57	1748.000	146.100	TOE
58	1756.000	150.400	TOP
59	1764.960	150.500	POL
60	1789.000	150.300	TOP
61	1800.000	149.400	BRK
62	1804.000	148.000	TOE
63	1835.000	147.300	TOP
64	1842.000	145.200	TOE
65	1876.000	148.100	TOP
66	1944.000	147.700	GS
67	2049.000	148.300	TOP
68	2072.000	145.100	L EOW
69	2085.000	144.100	RIV BOT
70	2093.000	144.300	RIV BOT
71	2097.000	145.100	R EOW
72	2110.000	145.400	GS
73	2123.000	145.600	L EOW
74	2135.000	145.000	RIV BOT
75	2150.000	145.600	R EOW
76	2177.000	146.700	GS
77	2198.000	146.300	BRK
78	2261.000	147.300	GS
79	2354.000	149.100	GS
80	2443.000	148.300	BRK
81	2480.000	149.300	BRK
82	2541.000	148.700	GS
83	2586.600	148.700	ANGL PT 2
84	2614.000	145.000	TOE
85	2661.000	144.200	BRK
86	2698.000	145.300	BRK
87	2739.000	144.800	L EOW
88	2762.000	143.500	RIV BOT
89	2796.000	143.300	RIV BOT
90	2842.000	143.000	RIV BOT
91	2895.000	142.800	RIV BOT
92	2920.000	142.500	RIV BOT
93	2931.000	144.800	R EOW
94	2944.000	150.400	TOP
95	2993.000	150.200	BRK
96	3023.000	151.300	BRK
97	3078.000	151.100	GS
98	3126.000	151.000	GS
99	3169.000	150.800	TOP
100	3182.000	148.400	TOE
101	3195.000	148.700	TOE
102	3201.000	151.500	TOP
103	3219.790	151.300	POL
104	3276.000	151.100	GS
105	3326.000	150.800	BRK

106	3398.000	149.700	TOP
107	3407.000	147.400	TOE
108	3431.000	146.000	GS
109	3470.000	146.600	TOE
110	3477.000	149.800	TOP
111	3536.000	150.700	GS
112	3568.000	150.800	BRK
113	3588.000	149.900	BRK
114	3599.340	150.900	POL
115	3610.000	149.900	TOP
116	3619.000	146.700	TOE
117	3640.000	147.800	BRK
118	3662.000	146.100	L EOW
119	3681.000	143.700	RIV BOT
120	3691.000	142.300	RIV BOT
121	3743.000	143.500	RIV BOT
122	3789.000	143.000	RIV BOT
123	3839.000	142.900	RIV BOT
124	3889.000	140.000	RIV BOT
125	3937.000	138.600	RIV BOT
126	3983.000	136.700	RIV BOT
127	4031.000	137.100	RIV BOT
128	4064.000	139.800	RIV BOT
129	4092.000	143.600	RIV BOT
130	4095.000	146.100	R EOW
131	4104.000	152.500	TOP
132	4114.950	153.100	ANGL PT 3
133	4172.000	151.900	TOP
134	4191.000	149.700	TOE
135	4203.250	149.900	POL
136	4218.000	149.000	TOP
137	4224.000	147.200	TOE
138	4240.000	148.900	TOP
139	4266.000	148.300	TOP
140	4276.000	145.700	TOP
141	4291.000	144.500	BRK
142	4311.000	146.400	TOE
143	4321.000	149.000	TOP
144	4373.000	149.800	BRK
145	4384.000	148.000	BRK
146	4405.000	150.000	BRK
147	4455.000	149.600	GS
148	4527.000	148.800	BRK
149	4577.000	148.600	BRK
150	4614.000	146.900	BRK
151	4631.000	148.500	BRK
152	4673.000	148.200	BRK
153	4690.000	150.500	TOP
154	4749.000	145.600	TOE
155	4779.000	144.600	BRK
156	4827.000	147.100	BRK
157	4871.000	147.300	TOP
158	4887.000	143.700	TOE
159	4927.000	144.000	TOE
160	4942.000	147.000	TOP
161	5038.000	147.200	GS
162	5103.000	147.400	TOP
163	5121.000	146.100	L FOW
164	5135.000	144.400	RIV BOT
165	5156.000	144.400	RIV BOT

166	5190.000	143.600	RIV BOT
167	5221.000	142.400	RIV BOT
168	5248.000	143.100	RIV BOT
169	5261.000	143.800	RIV BOT
170	5269.000	146.100	R EOW
171	5278.720	151.300	POL E VEG TOP
172	5377.170	151.400	POL E VEG TOP
173	5393.000	149.500	BRK
174	5398.000	146.900	TOE
175	5423.000	145.500	BRK
176	5488.000	146.300	GS
177	5574.000	147.200	TOE
178	5578.000	149.000	TOP
179	5591.650	150.000	TOP E VEG
180	5663.000	150.200	TOP
181	5675.000	147.200	TOE
182	5714.000	150.700	TOP
183	5744.020	150.500	ANGL PT 4
184	5752.000	149.100	BRK
185	5755.000	146.100	TOE
186	5824.000	144.300	BRK
187	5851.000	144.000	BRK
188	5877.000	144.500	L EOW
189	5898.000	143.500	RIV BOT
190	5929.000	143.000	RIV BOT
191	5961.000	142.700	RIV BOT
192	5978.000	143.800	RIV BOT
193	5995.000	143.200	RIV BOT
194	6007.000	144.500	R EOW
195	6011.000	146.500	BRK
196	6020.000	147.300	BRK
197	6030.000	151.600	TOP
198	6048.290	152.300	ALCAP LRY RM 59.7 RE

Water surface data:

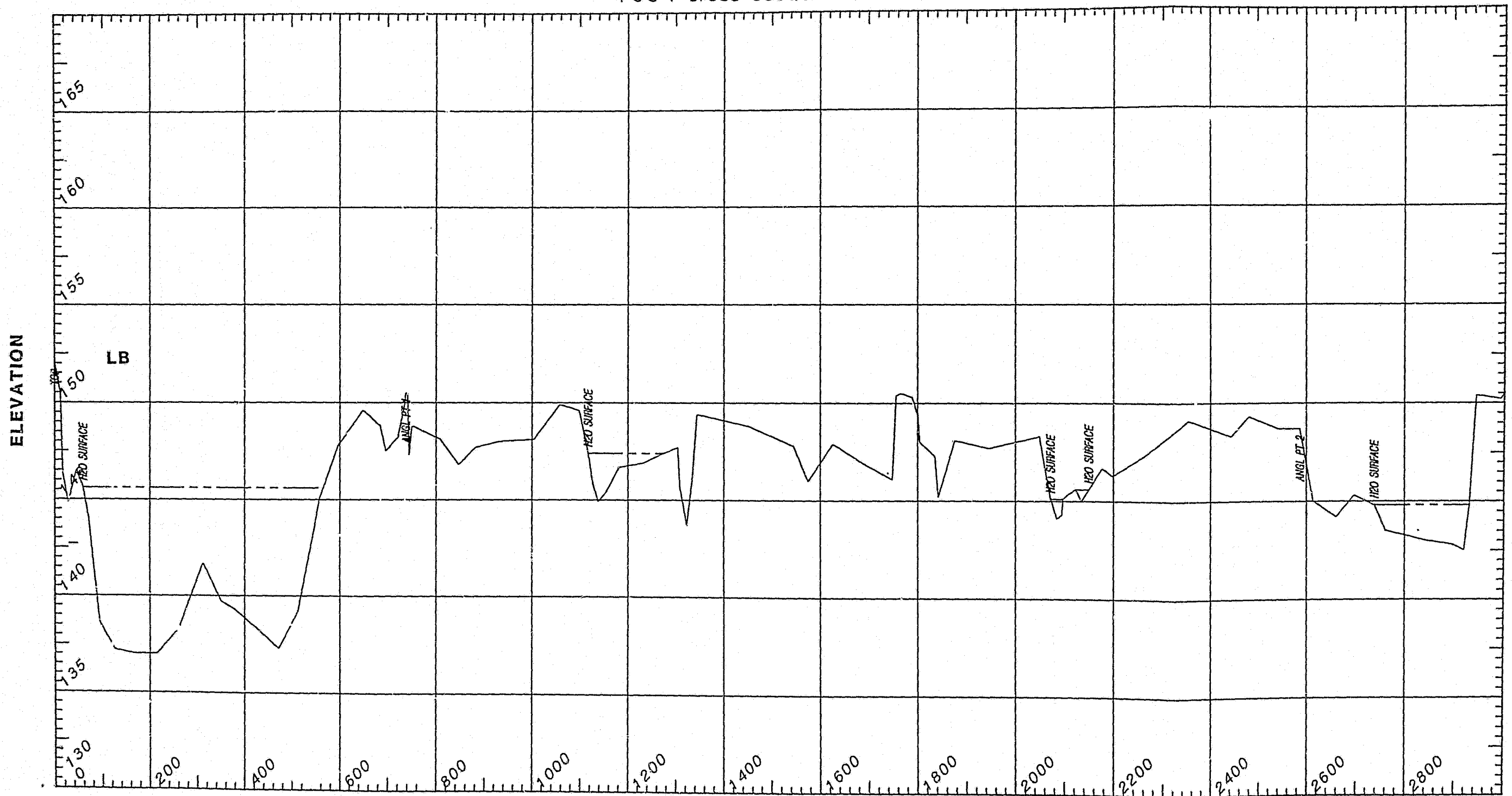
1	59.000	145.600	L FOW
2	565.000	145.600	R EOW
3	1117.000	0.000	
4	1117.000	147.400	L EOW
5	1274.000	147.400	R EOW
6	2072.000	0.000	
7	2072.000	145.100	L EOW
8	2097.000	145.100	R EOW
9	2123.000	0.000	
10	2123.000	145.600	L EOW
11	2150.000	145.600	R EOW
12	2739.000	0.000	
13	2739.000	144.800	L EOW
14	2931.000	144.800	R EOW
15	3662.000	0.000	
16	3662.000	146.100	L EOW
17	4095.000	146.100	R EOW
18	5121.000	0.000	
19	5121.000	146.100	L EOW
20	5269.000	146.100	R EOW
21	5877.000	0.000	
22	5877.000	144.500	L EOW
23	6007.000	144.500	R EOW

MIN	0.0	136.700
MAX	6048	153.100

Maximum 'X' scale : 1" = 864 (for 8.5 by 11 format)
Maximum 'Y' scale : 1" = 3 (for 8.5 by 11 format)

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 59.7



PREPARED BY:

R&M

R&M CONSULTANTS, INC.

ENGINEERS GEOLOGISTS HYDROLOGISTS SURVEYORS

DISTANCE FT

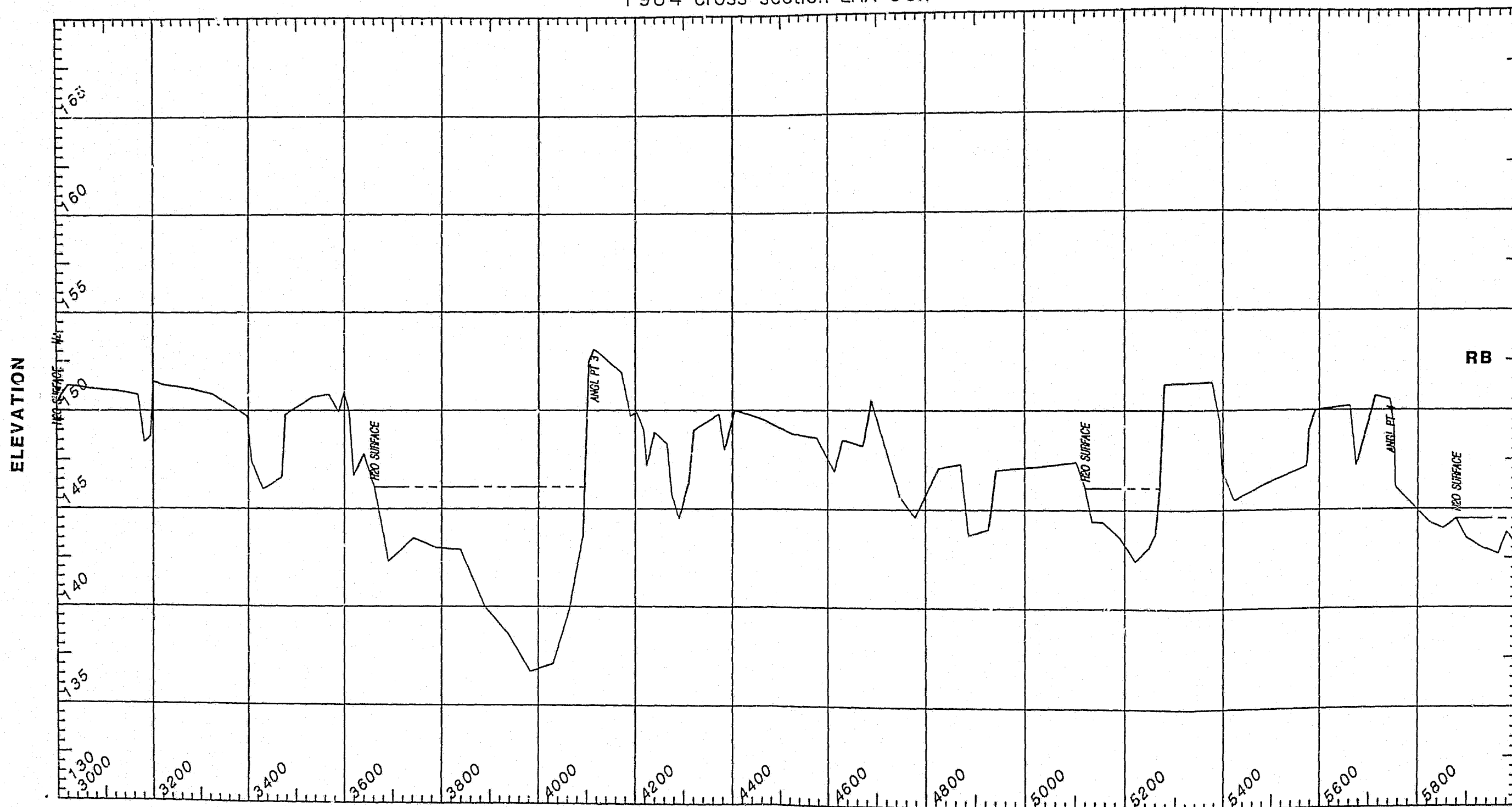
PREPARED FOR:

HARZA-EBASCO

SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 59.7 **CONTINUED**



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DISTANCE FT

PREPARED FOR:

HARZA-EBASCO

SUSITNA JOINT VENTURE

***** CROSS-SECTION PLOT *****

SUSITNA HYDROGRAPHIC SURVEYS
1984 cross section LRX 76.8

Date of Survey: SEPTEMBER 20, 1984

POINT	'X'	'Y'	DESCRIPTION
Cross section data:			
1	0.000	242.000	ALCAP LRX RM 76.8 LB
2	5.000	240.700	BRK
3	7.000	238.600	TOE
4	43.000	237.700	GS
5	62.000	236.900	BRK
6	67.000	235.700	L EOW
7	76.000	233.000	RIV BOT
8	94.000	230.000	RIV BOT
9	141.000	226.400	RIV BOT
10	185.000	226.700	RIV BOT
11	231.000	227.900	RIV BOT
12	250.000	228.400	RIV BOT
13	294.000	228.000	RIV BOT
14	346.000	227.700	RIV BOT
15	398.000	228.000	RIV BOT
16	451.000	228.500	RIV BOT
17	495.000	226.100	RIV BOT
18	548.000	229.000	RIV BOT
19	598.000	231.200	RIV BOT
20	651.000	232.700	RIV BOT
21	688.000	234.100	RIV BOT
22	713.000	234.600	RIV BOT
23	746.000	235.700	R EOW
24	812.000	237.500	GS
25	862.000	238.400	BRK
26	879.000	237.500	BRK
27	940.000	237.500	BRK
28	990.100	240.200	POL
29	1049.000	241.000	GS
30	1123.000	241.000	GS
31	1209.000	240.500	GS
32	1312.000	240.000	GS
33	1396.000	238.900	TOP
34	1421.000	237.600	TOE
35	1442.000	237.600	BRK
36	1461.000	237.700	BRK
37	1473.000	236.700	BRK
38	1508.000	237.500	TOE
39	1519.000	239.400	TOP
40	1553.000	239.300	BRK
41	1579.000	237.700	BRK
42	1632.000	238.200	BRK
43	1685.000	238.900	BRK
44	1716.000	238.100	BRK
45	1798.000	239.500	BRK

46	1870.000	238.800	GS
47	1892.000	237.900	BRK
48	1937.000	237.500	GS
49	2003.000	238.500	TOE
50	2019.000	241.400	TOP
51	2056.200	241.900	POL
52	2101.000	241.900	BRK
53	2111.000	240.800	TOP
54	2125.000	236.300	L EOW
55	2142.000	235.000	RIV BOT
56	2152.000	235.900	RIV BOT
57	2175.000	235.100	RIV BOT
58	2197.000	233.900	RIV BOT
59	2232.000	233.600	RIV BOT
60	2264.000	235.700	RIV BOT
61	2304.000	235.000	RIV BOT
62	2330.000	234.500	RIV BOT
63	2369.000	234.800	RIV BOT
64	2389.000	235.700	RIV BOT
65	2392.000	236.300	R EOW
66	2424.000	237.800	GS
67	2501.000	237.600	GS
68	2596.000	238.800	BRK
69	2689.000	239.000	GS
70	2754.000	239.500	TOP
71	2769.000	237.000	L EOW
72	2784.000	235.900	RIV BOT
73	2804.000	236.500	RIV BOT
74	2822.000	235.800	RIV BOT
75	2837.000	236.600	RIV BOT
76	2860.000	236.500	RIV BOT
77	2869.000	237.000	R EOW
78	2911.000	238.400	TOP
79	2948.000	237.200	TOP
80	2987.000	235.700	L EOW
81	2987.000	235.000	RIV BOT
82	3013.000	233.320	RIV BOT
83	3027.000	234.000	RIV BOT
84	3033.000	235.700	R EOW
85	3040.000	238.800	BRK
86	3047.000	244.300	TOP
87	3048.300	244.600	ANGL PT 1
88	3213.300	242.500	GS
89	3248.000	242.600	TOE
90	3258.000	245.800	TOP
91	3371.300	241.800	TOP
92	3376.000	240.300	TOE
93	3382.000	241.700	TOP
94	3536.300	242.500	GS
95	3701.300	241.700	GS
96	3836.300	243.500	GS
97	3941.300	243.900	TOP
98	3946.000	239.100	BRK
99	3949.000	237.300	L EOW
100	3958.000	235.000	RIV BOT
101	3977.000	234.900	RIV BOT
102	3999.000	236.700	RIV BOT
103	4008.000	237.300	R EOW
104	4014.000	237.400	GS
105	4025.000	237.000	L EOW

106	4037.000	238.400	RIV BOT
107	4054.000	237.000	R EOW
108	4083.000	239.300	BRK
109	4106.300	239.900	GS
110	4174.000	240.300	BRK
111	4271.300	238.800	GS
112	4279.000	238.700	L EOW
113	4295.000	238.300	RIV BOT
114	4309.000	234.800	RIV BOT
115	4326.000	234.900	RIV BOT
116	4344.000	238.700	R EOW
117	4376.000	240.100	GS
118	4417.300	241.200	E VEG
119	4582.300	242.600	GS
120	4747.300	242.700	GS
121	4912.300	242.300	GS
122	5077.300	241.700	GS
123	5215.000	242.600	TOP
124	5229.000	240.200	BRK
125	5241.300	238.000	TOE
126	5252.000	238.700	TOE
127	5255.000	242.100	TOP
128	5339.300	241.500	ANGL PT 2
129	5353.000	237.800	L EOW
130	5359.000	235.800	RIV BOT
131	5375.000	235.500	RIV BOT
132	5392.000	235.000	RIV BOT
133	5411.000	235.100	RIV BOT
134	5435.000	234.800	RIV BOT
135	5445.000	234.600	RIV BOT
136	5452.000	237.800	R EOW
137	5462.850	244.300	ALCAP LRX RM 76.8 RB

Water surface data:

1	67.000	235.700	L EOW
2	746.000	235.700	R EOW
3	2125.000	0.000	
4	2125.000	236.300	L EOW
5	2392.000	236.300	R EOW
6	2769.000	0.000	
7	2769.000	237.000	L EOW
8	2869.000	237.000	R EOW
9	2987.000	0.000	
10	2987.000	235.700	L EOW
11	3033.000	235.700	R EOW
12	3949.000	0.000	
13	3949.000	237.300	L EOW
14	4008.000	237.300	R EOW
15	4025.000	0.000	
16	4035.000	237.000	L EOW
17	4054.000	237.000	R EOW
18	4279.000	0.000	
19	4279.000	238.700	L EOW
20	4344.000	238.700	R EOW
21	5353.000	0.000	
22	5353.000	237.800	L EOW
23	5452.000	237.800	R EOW

MIN

0.000

226.100

MAX

5462.850

245.800

Maximum 'X' scale : 1" = 780

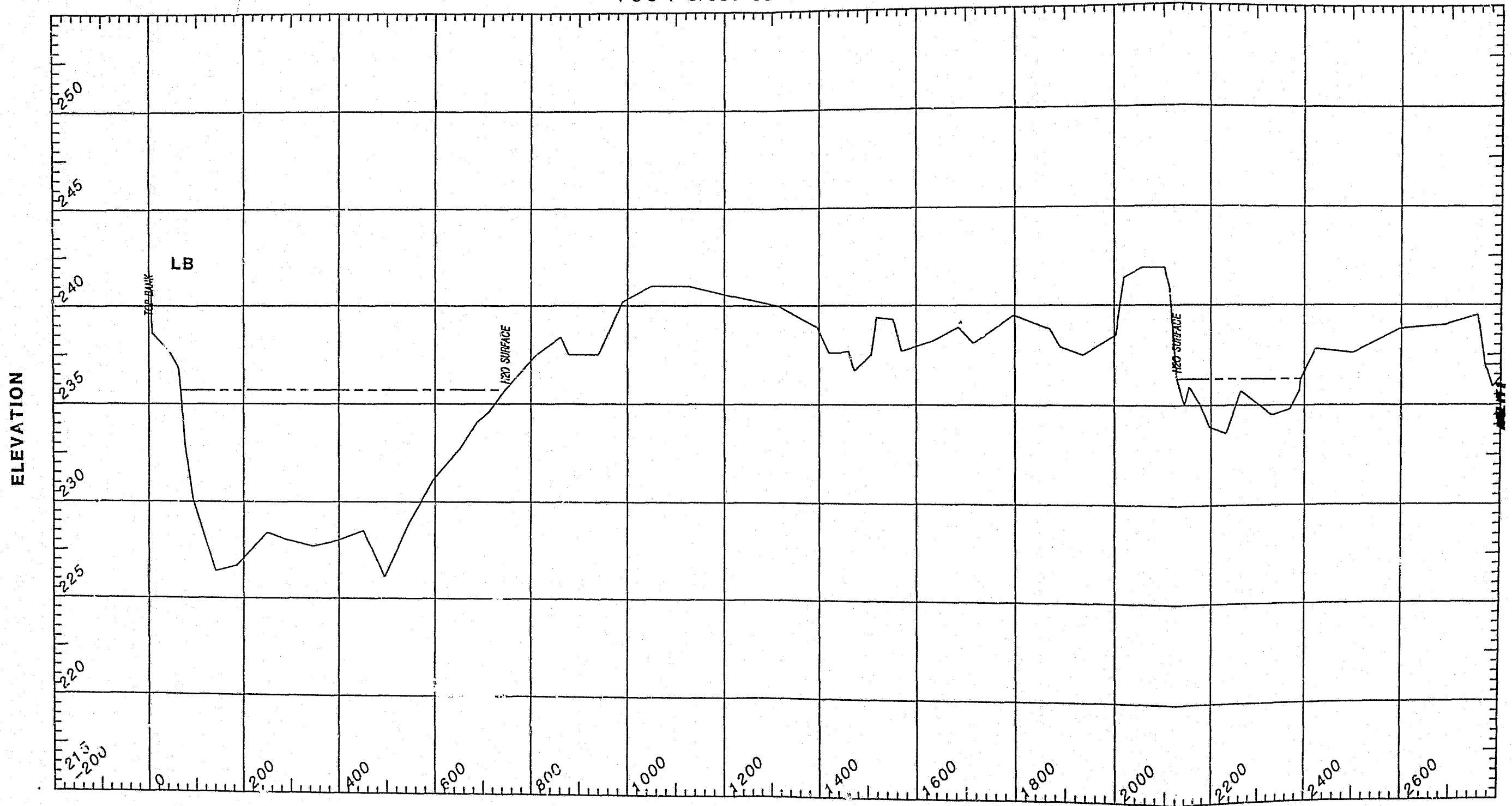
(for 8.5 by 11 format)

Maximum 'Y' scale : 1" = 4

(for 8.5 by 11 format)

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 76.8



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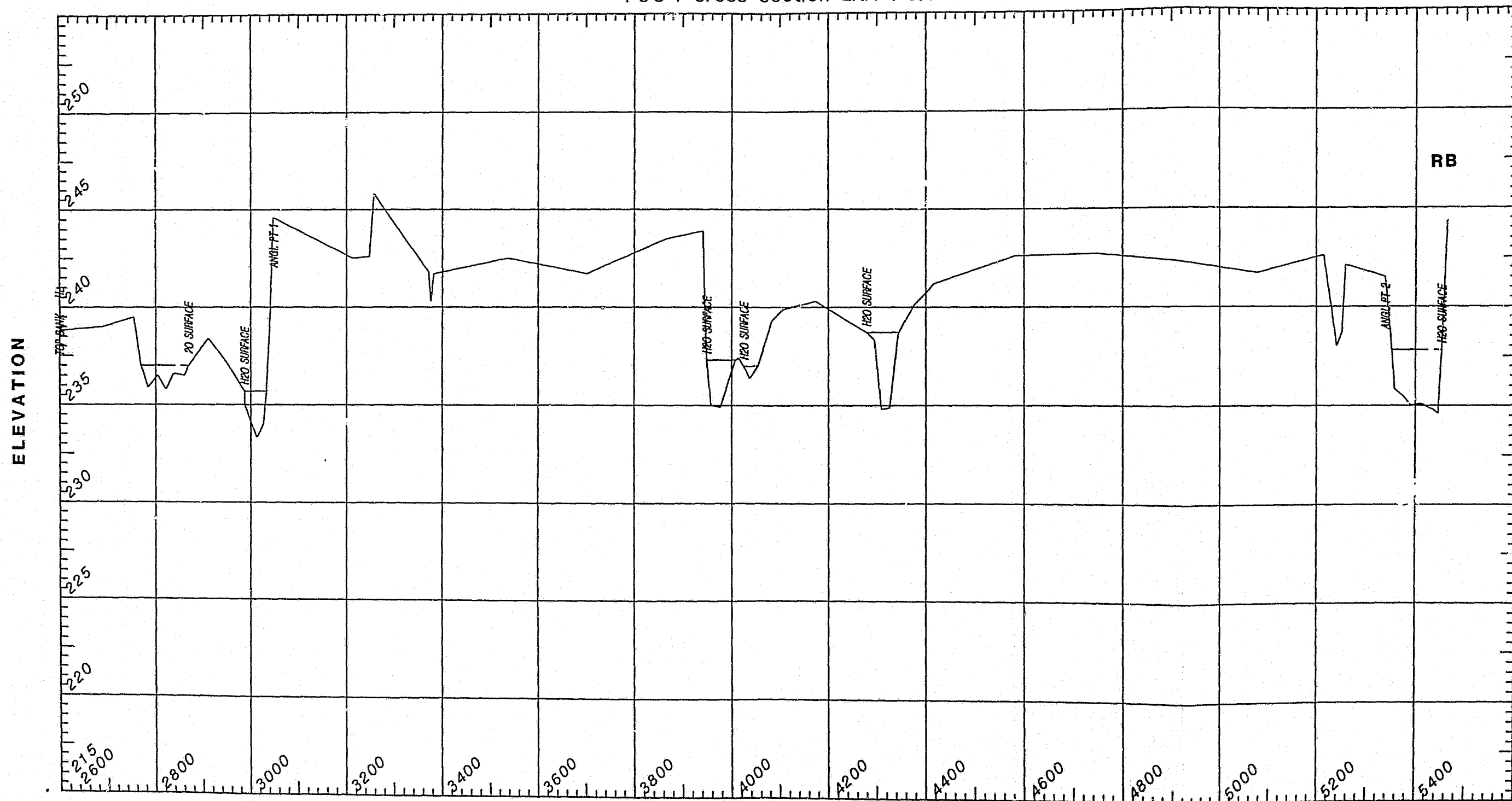
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R&M CONSULTANTS, INC.

PREPARED FOR:

HARZA-EBASCO

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 76.8 **CONTINUED**



PREPARED BY:

R&M CONSULTANTS, INC.
ENGINEERS GEODETISTS HYDROLOGISTS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
SUSITNA JOINT VENTURE

TITLE: SUSITNA HYDROGRAPHIC SURVEYS
 IDENT: 1984 cross section LRX 83.8
 DATE: AUGUST 16, 1984

*** X ***
 =====

*** Y ***
 =====

***** DESCRIPTION *****
 =====

SECTION:

100	265.0	LEOW
117	255.7	RIV BOT
142	254.7	RIV BOT
167	251.6	RIV BOT
192	251.6	RIV BOT
217	250.4	RIV BOT
242	251.5	RIV BOT
267	252.0	RIV BOT
292	251.7	RIV BOT
317	252.0	RIV BOT
342	252.5	RIV BOT
367	252.3	RIV BOT
392	252.0	RIV BOT
417	252.2	RIV BOT
442	253.0	RIV BOT
467	253.5	RIV BOT
492	254.2	RIV BOT
517	256.1	RIV BOT
542	258.5	RIV BOT
567	260.8	RIV BOT
592	262.7	RIV BOT
617	265.0	REOW
642	265.0	LEOW
667	258.2	RIV BOT
692	253.8	RIV BOT
717	254.6	RIV BOT
742	265.0	REOW

WATER:

100	265.0	H2O SURFACE
1042	265.0	H2O SURFACE

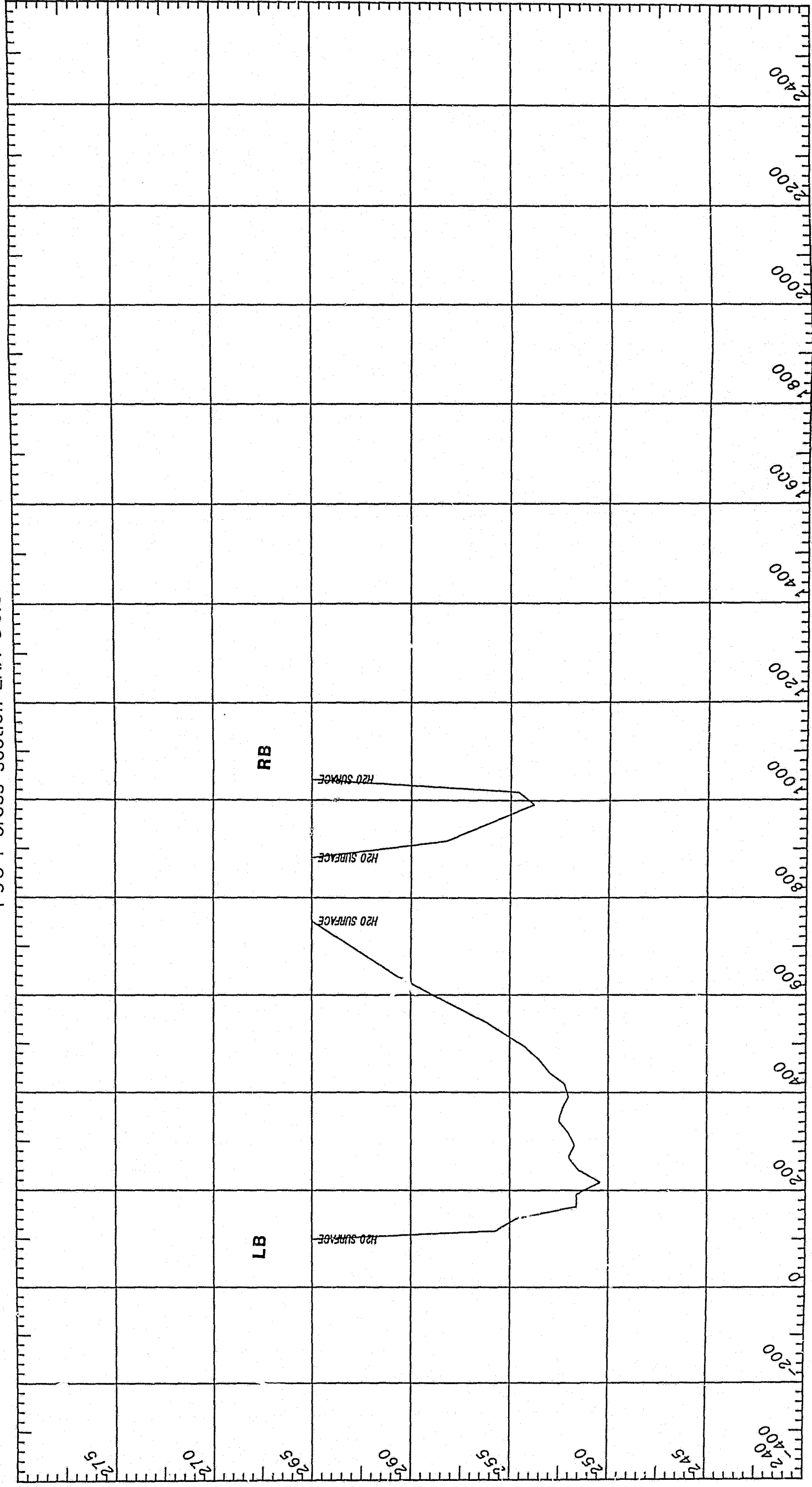
DISCHARGE

45.400

END OF DATA

Note: This data was compiled from U.S.G.S. streamgaging measurement field notes. All "y" values are soundings, "x" values are estimated distances. This cross section uses a datum estimated from a U.S.G.S. topographic map.

SUSITNA HYDROGRAPHIC SURVEYS 1984 cross section LRX 83.8 SUNSHINE



REFERENCE ELEVATION ESTIMATED FROM USGS TOPOGRAPHIC MAP

PREPARED BY:

RSM CONSULTANTS, INC.
ENGINEERS GEOLOGISTS HYDROLOGISTS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
SUSITNA JOINT VENTURE

***** CROSS-SECTION PLOT *****

SUSITNA HYDROGRAPHIC SURVEYS
1984 cross section LRX 84.6

Date of Survey: SEPTEMBER 19, 1984

POINT	X'	Y'	DESCRIPTION
Cross section data:			
1	0.000	270.600	ALCAP LRX RM 84.6 L3
2	3.000	265.800	TOE
3	16.000	261.700	L EOW
4	26.000	259.100	RIV BOT
5	40.000	256.400	RIV BOT
6	72.000	257.700	RIV BOT
7	100.000	260.100	RIV BOT
8	107.000	260.500	RIV BOT
9	122.000	261.700	R EOW
10	163.000	262.700	GS
11	205.000	263.600	BRK
12	275.000	262.900	GS
13	311.000	262.500	TOP
14	322.000	261.300	L EOW
15	334.000	258.900	RIV BOT
16	345.000	257.400	RIV BOT
17	365.000	256.800	RIV BOT
18	396.000	258.600	RIV BOT
19	393.000	261.300	R EOW
20	394.000	262.000	BRK
21	403.000	263.900	TOE
22	407.000	267.500	TOP
23	414.000	269.100	ANG PT 1
24	572.000	271.300	GS
25	637.000	270.600	TOP
26	643.000	268.700	TOE
27	664.000	270.200	TOP
28	674.000	267.500	TOE
29	744.000	269.900	GS
30	764.000	267.000	BRK
31	787.000	267.500	TOP
32	792.000	265.200	BRK
33	799.000	264.600	BRK
34	804.000	262.000	TOE
35	847.000	263.300	GS
36	889.000	265.000	GS
37	904.000	265.200	TOE
38	911.000	268.000	TOP
39	914.000	268.000	BRK
40	917.400	269.000	ANG PT 2
41	958.000	271.400	GS
42	1042.000	272.100	BRK
43	1082.000	269.900	GS
44	1157.000	272.300	GS
45	1247.000	270.800	GS

46	1412.000	270.600	GS
47	1419.000	269.100	TOE
48	1453.000	268.900	TOE
49	1464.000	270.400	TOP
50	1577.000	270.700	GS
51	1742.000	272.600	GS
52	1810.000	270.100	TOP
53	1816.000	265.700	TOE
54	1828.000	265.600	TOE
55	1836.000	268.800	TOP
56	1871.000	269.900	GS
57	1907.000	271.400	GS
58	1956.000	270.400	BRK
59	2013.000	274.100	BRK
60	2068.000	269.600	BRK
61	2103.000	270.800	TOP
62	2110.000	268.900	TOE
63	2147.000	269.000	TOE
64	2170.000	271.400	TOP
65	2233.000	271.400	GS
66	2398.000	270.800	GS
67	2563.000	271.900	GS
68	2728.000	273.800	GS
69	2769.000	274.300	TOP
70	2780.000	264.900	L EOW
71	2788.000	262.600	RIV BOT
72	2816.000	261.500	RIV BOT
73	2851.000	262.300	RIV BOT
74	2878.000	264.900	R EOW
75	2934.000	265.400	GS
76	2951.000	265.600	BRK
77	2994.000	264.900	TOE
78	3000.000	269.800	TOP
79	3003.800	270.000	ANG PT 3
80	3169.000	271.700	GS
81	3225.000	272.700	TOP
82	3241.000	268.800	TOE
83	3265.000	268.400	TOE
84	3286.000	270.400	TOP
85	3334.000	272.100	GS
86	3422.000	271.100	TOP
87	3430.000	266.700	TOE
88	3457.000	266.000	TOE
89	3475.000	271.200	TOP
90	3484.000	272.300	GS
91	3612.000	272.900	TOP
92	3629.000	267.300	TOE
93	3649.000	267.200	GS
94	3665.000	268.500	TOE
95	3681.000	271.900	TOP
96	3814.000	272.600	GS
97	3987.900	271.900	ANG PT 4
98	3998.000	271.700	TOP
99	4004.000	265.200	TOE
100	4009.000	264.600	BRK
101	4014.000	266.900	TOP
102	4052.000	267.800	GS
103	4097.000	268.100	BRK
104	4157.000	265.900	BRK
105	4224.000	266.900	TOP

106	4277.000	263.900	L EOW
107	4311.000	262.700	RIV BOT
108	4346.000	264.000	R EOW
109	4381.000	264.700	TOP
110	4395.000	266.600	TOP
111	4398.000	265.400	TOP
112	4433.000	255.200	TOE
113	4437.000	266.800	TOP
114	4503.000	266.300	RRK
115	4572.000	267.400	RRK
116	4627.000	266.700	POL
117	4650.000	265.700	RRK
118	4681.000	264.500	TOP
119	4684.000	263.400	L EOW
120	4700.000	261.500	RIV BOT
121	4737.000	258.700	RIV BOT
122	4779.000	254.500	RIV BOT
123	4829.000	252.800	RIV BOT
124	4882.000	252.300	RIV BOT
125	4944.000	252.300	RIV BOT
126	5003.000	251.000	RIV BOT
127	5053.000	249.700	RIV BOT
128	5098.000	255.900	RIV BOT
129	5137.000	256.400	RIV BOT
130	5177.000	260.200	RIV BOT
131	5189.000	263.300	R EOW
132	5201.400	267.600	ALCAP LXX RM P4.6 RB

Water surface data:

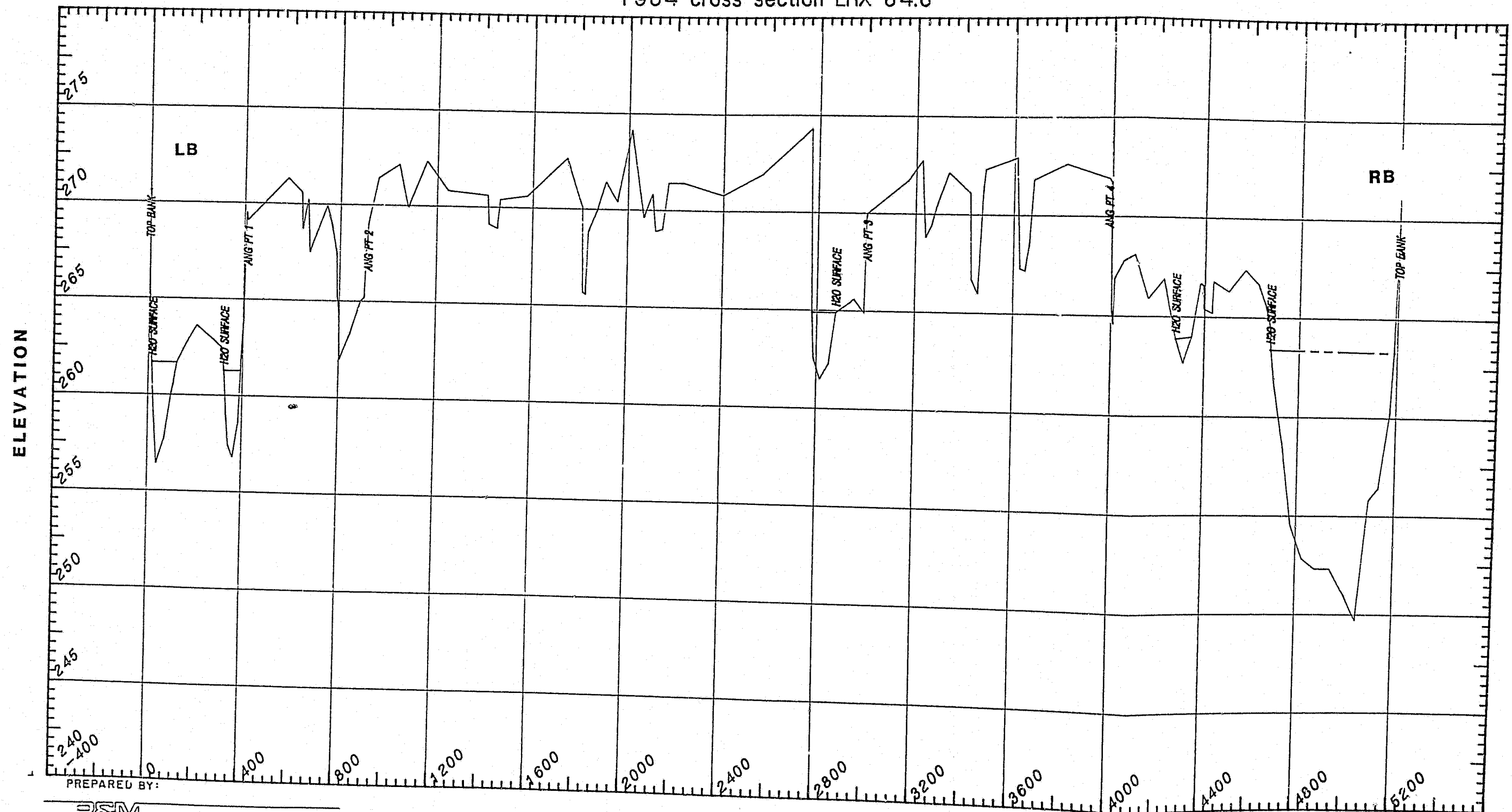
1	16.000	261.700	L EOW
2	122.000	261.700	R EOW
3	322.000	0.000	
4	322.000	261.300	L EOW
5	393.000	261.300	R EOW
6	2780.000	0.000	
7	2780.000	264.900	L EOW
8	2878.000	264.900	R EOW
9	4277.000	0.000	
10	4277.000	263.900	L EOW
11	4346.000	264.000	R EOW
12	4681.000	0.000	
13	4681.000	263.400	L EOW
14	5189.000	263.300	R EOW

MIN	0.000	249.700
MAX	5201.400	274.300

Maximum 'X' scale : 1" = 743 (for 8.5 by 11 format)
Maximum 'Y' scale : 1" = 5 (for 8.5 by 11 format)

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 84.6



PREPARED BY:

R&M
R&M CONSULTANTS, INC.
 ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT.

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

CUS:INA HYDROGRAPHIC SURVEYS
cross section LRX 86.3

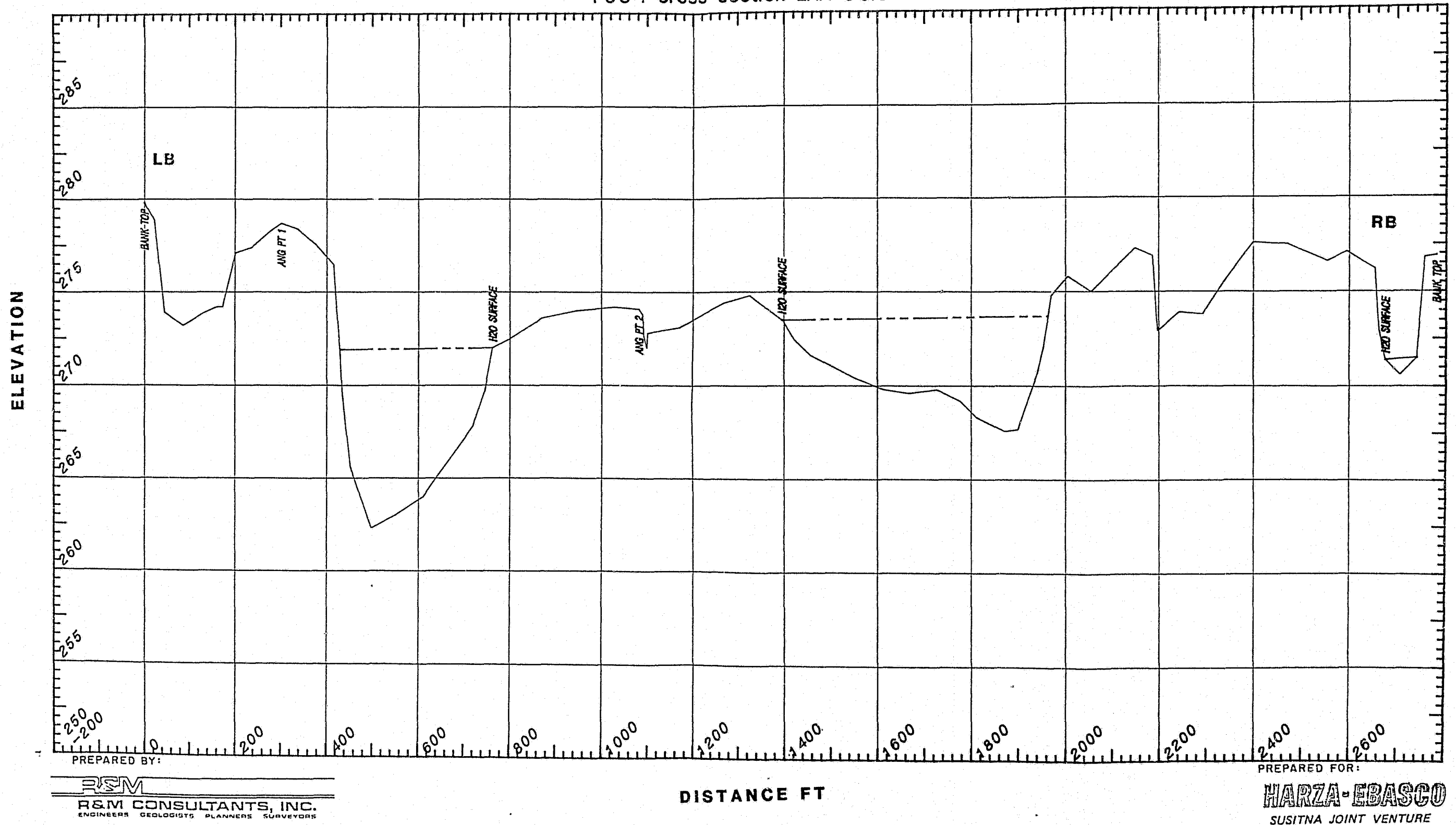
Date of Survey: SEPTEMBER 18, 1984

POINT	X'	Y'	DESCRIPTION
Cross section data:			
1	0.000	279.900	ALCAP LRX RM 86.3 LB
2	22.000	279.900	TOP
3	45.000	273.900	TOE
4	86.000	273.200	BRK
5	134.000	273.900	GS
6	161.000	274.200	BRK
7	174.000	274.200	TOE
8	202.000	277.100	TOP
9	237.000	277.400	GS
10	278.000	278.300	BRK
11	300.000	279.700	ANG PT 1
12	336.000	278.400	BRK
13	375.000	277.600	BRK
14	415.000	276.500	BRK
15	429.000	271.900	L EOW
16	434.000	269.600	RIV BOT
17	452.000	265.600	RIV BOT
18	498.000	262.300	RIV BOT
19	550.000	263.000	RIV BOT
20	611.000	264.000	RIV BOT
21	720.000	267.800	RIV BOT
22	746.000	269.700	RIV BOT
23	763.000	272.000	R EOW
24	795.000	272.400	GS
25	871.000	273.600	GS
26	946.000	274.000	GS
27	1028.000	274.200	GS
28	1081.500	274.100	ANG PT 2
29	1090.000	273.800	TOP
30	1092.000	272.600	TOE
31	1099.000	272.000	TOE
32	1101.000	272.800	TOP
33	1169.000	273.100	GS
34	1269.000	274.400	GS
35	1326.000	274.800	BRK
36	1396.000	273.500	L EOW
37	1425.000	272.400	RIV BOT
38	1458.000	271.600	RIV BOT
39	1498.000	271.100	RIV BOT
40	1555.000	270.400	RIV BOT
41	1613.000	269.800	RIV BOT
42	1666.000	269.600	RIV BOT
43	1726.000	269.800	RIV BOT
44	1776.000	269.200	RIV BOT
45	1813.000	268.300	RIV BOT
46	1872.000	267.600	RIV BOT
47	1900.000	267.700	RIV BOT
48	1941.000	270.700	RIV BOT
49	1953.000	272.000	RIV BOT
50	1964.000	273.700	R EOW

51	1970.000	274.800	TOP
52	2005.000	275.800	BRK
53	2055.000	275.000	BRK
54	2149.900	277.300	POL 1
55	2187.000	276.900	TOP
56	2198.000	272.900	TOE
57	2244.000	273.900	GS
58	2294.000	273.800	TOE
59	2335.000	275.400	BRK
60	2400.000	277.600	TOP
61	2471.000	277.500	GS
62	2555.000	276.600	GS
63	2595.000	277.100	GS
64	2653.000	276.200	TOP
65	2662.000	272.900	TOE
66	2675.000	271.400	L EOW
67	2706.000	270.600	RIV BOT
68	2740.000	271.500	R EOW
69	2756.000	276.800	TOP
70	2780.100	276.900	ALCAP LRX RM 86.3 RB
Water surface data:			
1	429.000	271.900	L EOW
2	763.000	272.000	R EOW
3	1396.000	0.000	
4	1396.000	273.500	L EOW
5	1964.000	273.700	R EOW
6	2675.000	0.000	
7	2675.000	271.400	L EOW
8	2740.000	271.500	R EOW
MIN	0.000	262.300	
MAX	2780.100	279.800	

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 86.3



***** CROSS-SECTION PLOT *****

SUSITNA HYDROGRAPHIC SURVEYS
1984 cross section LRX 87.7

Date of Survey: SEPTEMBER 16, 1984

POINT	X'	Y'	DESCRIPTION
Cross section data:			
1	0.000	290.600	ALCAP LRX RM 87.7 LB
2	2.000	290.700	TOP
3	16.000	287.100	BRK
4	21.000	281.700	BRK
5	28.000	278.000	TOE
6	29.000	277.600	L EOW
7	36.000	275.600	ROT
8	46.000	277.600	R EOW
9	63.000	279.200	GS
10	113.000	280.000	BRK
11	141.000	278.000	BRK
12	158.000	277.000	LW PT
13	188.000	277.900	BRK
14	207.000	280.200	TOE
15	222.000	285.500	TOP
16	228.000	286.100	BRK
17	248.000	285.900	TOP
18	252.000	284.600	TOE
19	264.000	283.200	TOE
20	281.000	286.200	TOP
21	308.000	286.000	BRK
22	360.000	282.600	BRK
23	386.000	286.400	ANG PT 1
24	389.000	286.400	TOP
25	398.000	283.600	BRK
26	402.000	281.400	TOE
27	419.000	278.400	LW PT
28	435.000	281.200	BRK
29	466.000	282.600	BRK
30	482.000	283.000	TOE
31	488.000	284.200	TOP
32	495.500	284.500	ANG PT 2
33	533.000	284.900	GS
34	574.000	284.600	GS
35	609.000	285.000	GS
36	638.600	285.400	POL 1
37	673.000	285.700	GS
38	733.500	285.000	POL 2
39	742.000	284.800	TOP
40	748.000	281.600	BRK
41	761.000	277.500	L EOW
42	771.000	275.000	RIV BOT
43	803.000	272.700	RIV BOT
44	846.000	273.100	RIV BOT
45	889.000	274.800	RIV BOT

46	924.000	275.200	RIV BOT
47	950.000	277.000	RIV BOT
48	979.000	277.500	R EOW
49	1021.000	278.300	GS
50	1085.000	278.700	GS
51	1169.000	278.800	TOE
52	1181.000	282.300	TOP
53	1232.900	282.800	ANG PT 3
54	1286.000	282.900	GS
55	1364.000	281.500	GS
56	1417.000	280.700	TOP
57	1431.000	279.200	TOE
58	1474.000	278.100	GS
59	1515.000	277.600	TOE
60	1549.000	279.000	GS
61	1659.000	279.900	GS
62	1742.000	281.400	TOP
63	1804.000	281.400	GS
64	1853.000	281.400	BRK
65	1949.000	280.100	GS
66	2005.300	279.500	POL 3
67	2044.000	278.500	GS
68	2072.000	278.600	TOP
69	2082.000	278.000	L EOW
70	2097.000	277.700	RIV BOT
71	2114.000	278.000	R EOW
72	2120.000	277.600	L EOW
73	2140.000	277.000	RIV BOT
74	2156.000	277.600	R EOW
75	2178.000	278.800	TOP
76	2185.000	277.400	L EOW
77	2200.000	272.800	RIV BOT
78	2238.000	268.700	RIV BOT
79	2287.000	266.800	RIV BOT
80	2331.000	268.600	RIV BOT
81	2379.000	269.500	RIV BOT
82	2434.000	270.100	RIV BOT
83	2484.000	270.300	RIV BOT
84	2538.000	269.300	RIV BOT
85	2594.000	271.800	RIV BOT
86	2640.000	274.600	RIV BOT
87	2688.000	273.800	RIV BOT
88	2721.000	272.900	RIV BOT
89	2726.000	274.300	RIV BOT
90	2733.000	277.200	R EOW
91	2744.000	280.400	TOE
92	2750.900	283.600	ALCAP LRX RM 87.7 RB

Water surface data:

1	29.000	277.600	L EOW
2	46.000	277.600	R EOW
3	761.000	0.000	
4	761.000	277.500	L EOW
5	979.000	277.500	R EOW
6	2120.000	0.000	
7	2120.000	277.600	L EOW
8	2156.000	277.600	R EOW
9	2185.000	0.000	
10	2185.000	277.400	L EOW
11	2733.000	277.400	R EOW

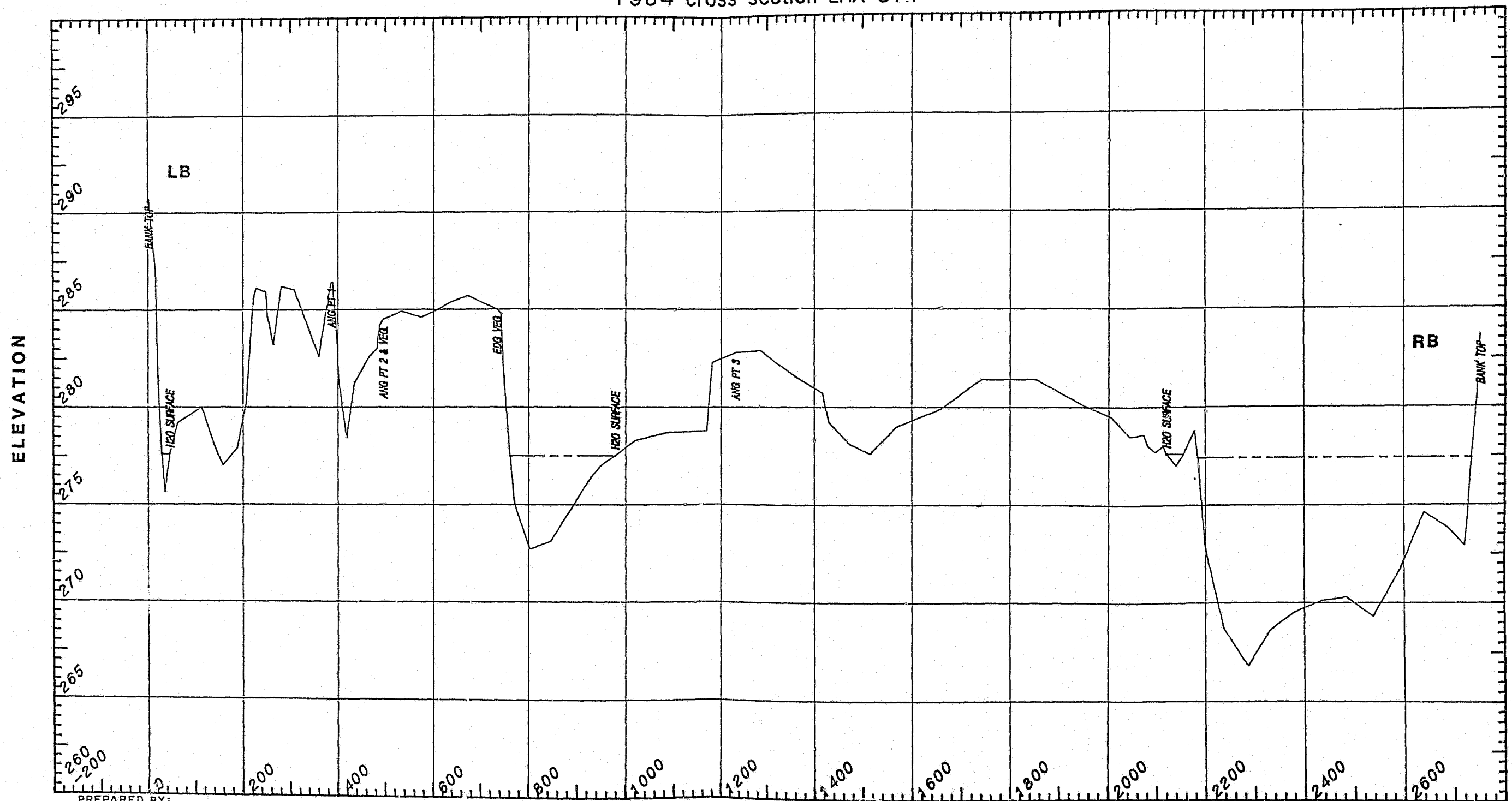
MIN	0.000	266.600
MAX	2750.900	290.700

Maximum 'X' scale : 1" = 393 (for 8.5 by 11 format)
Maximum 'Y' scale : 1" = 5 (for 8.5 by 11 format)

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SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 87.7



PREPARED BY:

RSM
R&M CONSULTANTS, INC.
 ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT.

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

***** CROSS-SECTION PLOT *****

SUSITNA HYDROGRAPHIC SURVEYS
1984 cross section LRX 90.6

Date of Survey: SEPTEMBER 15, 1984

POINT	X'	Y'	DESCRIPTION
Cross section data:			
1	0.000	296.900	ALCAP LRX RM 90.6 48
2	23.000	296.600	TOP
3	31.000	294.200	TOE
4	39.000	295.300	BRK
5	65.000	293.700	L EOW
6	79.000	291.500	RIV BOT
7	96.000	284.500	RIV BOT
8	126.000	284.500	RIV BOT
9	176.000	287.600	RIV BOT
10	226.000	287.600	RIV BOT
11	275.000	290.500	RIV BOT
12	329.000	291.500	RIV BOT
13	379.000	291.700	RIV BOT
14	423.000	292.400	RIV BOT
15	474.000	292.700	RIV BOT
16	503.000	293.600	R EOW
17	540.000	294.500	GS
18	561.000	295.600	BRK
19	599.000	296.300	GS
20	626.000	295.100	TOP
21	631.000	293.300	L EOW
22	637.000	290.600	RIV BOT
23	675.000	290.400	RIV BOT
24	721.000	291.500	RIV BOT
25	738.000	291.200	RIV BOT
26	776.000	290.200	RIV BOT
27	812.000	291.200	RIV BOT
28	823.000	292.600	RIV BOT
29	849.000	293.200	RIV BOT
30	872.000	293.300	R EOW
31	903.000	293.800	GS & L EOW
32	940.000	292.600	RIV BOT
33	980.000	290.100	RIV BOT
34	1035.000	289.100	RIV BOT
35	1080.000	286.700	RIV BOT
36	1110.000	290.800	RIV BOT
37	1114.000	293.600	R EOW
38	1117.000	297.200	TOP
39	1123.900	296.900	ANG PT 1
40	1132.000	296.600	TOP
41	1135.000	295.700	TOE
42	1169.000	295.800	GS
43	1208.000	294.900	TOE
44	1213.000	296.600	TOP
45	1260.000	297.200	GS

46	1298.000	296.400	GS
47	1329.000	296.900	GS
48	1362.100	297.100	POL 1
49	1371.000	297.000	TOP
50	1375.000	293.600	L EOW
51	1383.000	291.500	RIV BOT
52	1392.000	291.200	RIV BOT
53	1412.000	291.000	RIV BOT
54	1430.000	292.300	RIV BOT
55	1443.000	293.600	R EOW
56	1469.000	294.400	BRK
57	1546.000	295.000	GS
58	1599.000	295.600	BRK
59	1631.000	295.100	TOP
60	1659.000	293.500	L EOW
61	1670.000	293.000	LW PT
62	1679.000	293.500	R EOW
63	1726.000	294.700	BRK
64	1764.000	293.500	L EOW
65	1800.000	292.700	LW PT
66	1835.000	293.500	R EOW
67	1845.000	294.500	TOP
68	1861.000	293.500	BRK
69	1899.000	294.700	GS
70	1933.000	294.100	BRK
71	1958.000	294.700	BRK
72	1986.000	292.700	BRK
73	2010.000	294.300	BRK
74	2021.000	293.900	GS
75	2031.000	292.700	BRK
76	2081.000	295.200	GS
77	2119.000	295.600	TOP
78	2138.000	293.700	TOE
79	2162.000	293.900	GS
80	2188.000	293.600	TOE
81	2202.000	294.600	TOP
82	2243.600	294.800	POL 2
83	2285.000	293.900	TOP
84	2297.000	292.700	TOE
85	2323.000	292.400	BRK
86	2343.000	291.600	TOE
87	2350.000	294.000	TOP
88	2409.000	295.000	BRK
89	2479.000	294.000	GS
90	2590.000	294.200	TOP
91	2602.000	292.200	TOE
92	2636.000	291.200	GS
93	2680.000	292.100	BRK
94	2717.000	291.400	TOE
95	2751.000	292.400	TOP
96	2815.000	292.100	GS
97	2912.000	290.700	GS
98	2968.400	290.700	POL 3
99	2995.000	289.500	L EOW
100	3013.000	288.800	RIV BOT
101	3042.000	289.400	RIV BOT
102	3078.000	288.800	RIV BOT
103	3112.000	288.100	RIV BOT
104	3161.000	287.200	RIV BOT
105	3215.000	287.800	RIV BOT

106	3271.000	285.700	RIV BOT
107	3319.000	284.800	RIV BOT
108	3367.000	284.000	RIV BOT
109	3406.000	279.600	RIV BOT
110	3442.000	278.200	RIV BOT
111	3483.000	284.500	RIV BOT
112	3500.000	287.700	RIV BOT
113	3507.000	289.700	R EOW
114	3516.400	294.000	ALCAP LRY PH 90.6 RB

Water surface data:

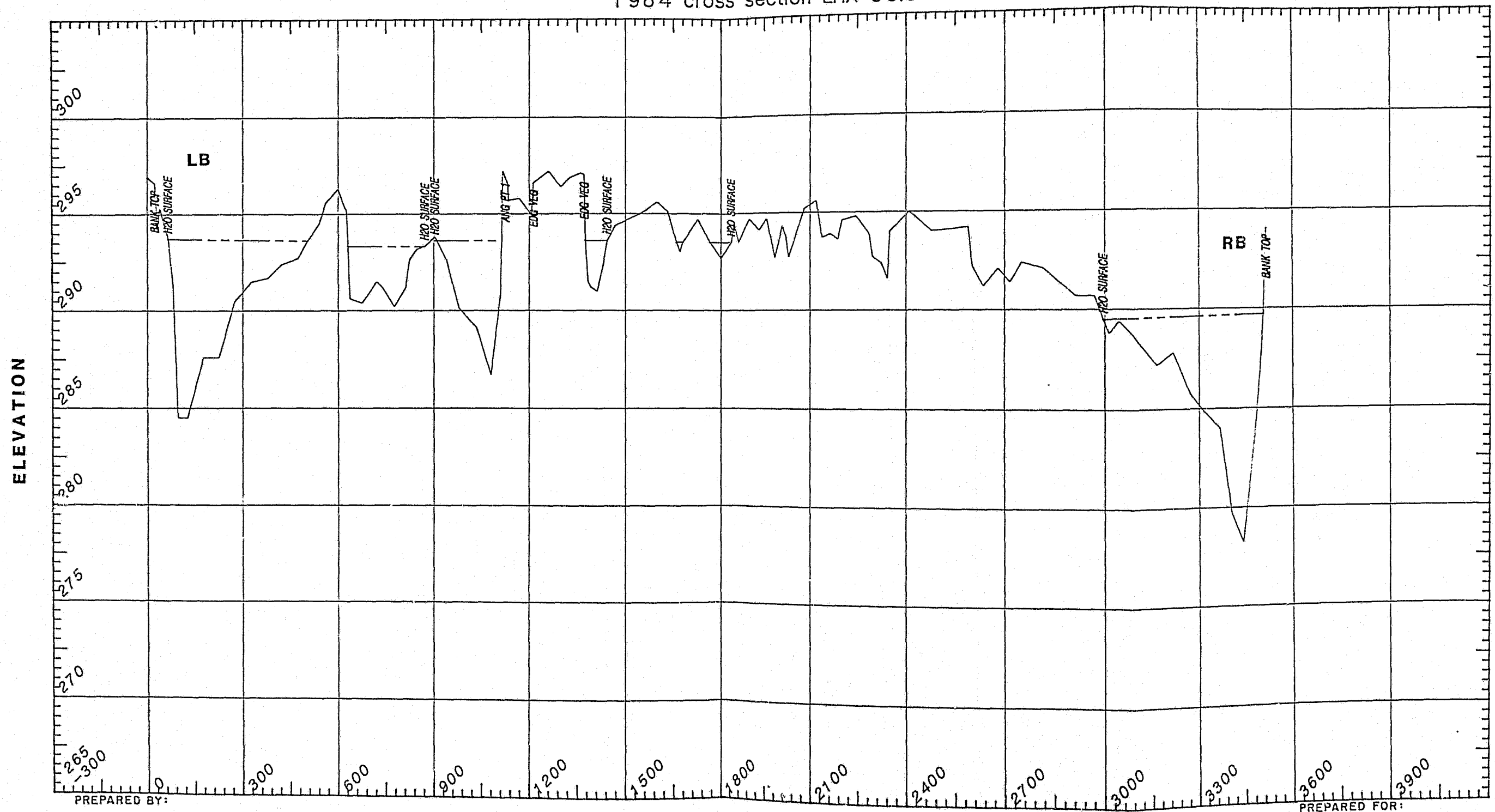
1	65.000	293.700	L EOW
2	503.000	293.600	R EOW
3	631.000	0.000	
4	631.000	293.300	L EOW
5	872.000	293.300	R EOW
6	903.000	0.000	
7	903.000	293.600	L EOW
8	1114.000	293.600	R EOW
9	1375.000	0.000	
10	1375.000	293.600	L EOW
11	1443.000	293.600	R EOW
12	1659.000	0.000	
13	1659.000	293.500	L EOW
14	1679.000	293.500	P EOW
15	1764.000	0.000	
16	1764.000	293.500	L EOW
17	1835.000	293.500	R EOW
18	2995.000	0.000	
19	2995.000	289.500	L EOW
20	3507.000	289.700	

MIN	0.000	278.200
MAX	3516.400	297.200

Maximum 'X' scale : 1" = 502 (for 8.5 by 11 format)
 Maximum 'Y' scale : 1" = 4 (for 8.5 by 11 format)

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 90.6



PREPARED BY:

R&M
R&M CONSULTANTS, INC.
 ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

SOUTHERN HYDROGRAPHIC SURVEYS
1994 cross section LPV 91.8

Date of Survey: SEPTEMBER 13 1984

POINT	Y	DESCRIPTION
cross section data:		
1	0.000	ALCAP LPV PM 91.8 LB
2	15.000	TOP
3	19.000	L EOW
4	34.000	RIV BOT
5	67.000	RIV BOT
6	90.000	PIV BOT
7	119.000	PIV BOT
8	148.000	RIV BOT
9	180.000	RIV BOT
10	216.000	PIV BOT
11	247.000	RIV BOT
12	271.500	R EOW
13	276.000	TOP
14	327.000	GS
15	418.000	BRK
16	481.000	GS
17	525.000	BRK
18	625.000	BRK
19	667.000	GS
20	688.000	BRK
21	727.000	TOP
22	775.000	TOE
23	817.000	GS
24	857.000	TOE
25	884.000	TOP
26	927.000	GS
27	950.000	BRK
28	971.000	L EOW
29	1009.000	RIV BOT
30	1055.000	RIV BOT
31	1087.000	PIV BOT
32	1102.000	RIV BOT
33	1150.000	RIV BOT
34	1187.000	PIV BOT
35	1237.000	PIV BOT
36	1290.000	PIV BOT
37	1345.000	PIV BOT
38	1390.000	RIV BOT
39	1442.000	RIV BOT
40	1493.000	RIV BOT
41	1534.000	RIV BOT
42	1554.000	RIV BOT
43	1575.000	R EOW
44	1721.000	GS
45	1792.000	TOP
46	1800.000	TOE
47	1839.000	TOE
48	1870.000	TOP
49	1949.000	GS
50	2007.000	BRK

51	2072.000	301.900	GS
52	2113.000	300.000	BRK
53	2152.000	302.200	BRK
54	2186.000	300.200	BRK
55	2253.000	302.300	GS
56	2353.000	302.900	BRK
57	2393.000	300.000	BRK
58	2475.000	301.000	GS
59	2554.000	302.400	GS
60	2618.000	301.600	TOP
61	2640.000	298.700	TOE
62	2660.000	297.700	GS
63	2685.000	298.200	TOE
64	2707.000	300.200	TOP
65	280.000	301.200	GS
66	297.000	301.300	BRK
67	3010.000	303.500	GS
68	3105.900	304.100	POL 1
69	3166.000	303.700	TOP
70	3183.000	302.700	TOE
71	3223.000	301.900	GS
72	3300.000	302.600	GS
73	3372.000	302.300	BRK
74	3428.000	299.700	GS
75	3474.000	297.700	GS
76	3490.000	295.500	GS
77	3511.000	297.700	TOE
78	3528.000	302.400	TOP
79	3571.000	302.400	TOE
80	3573.000	304.900	TOP
81	3576.900	305.100	ANG PT 1
82	3590.000	304.500	TOP
83	3592.000	301.900	TOE
84	3630.000	301.600	BRK
85	3682.000	303.600	GS
86	3753.000	303.500	GS
87	3804.000	303.400	BRK
88	3842.000	299.500	BRK
89	3891.000	301.500	GS
90	3990.000	303.300	GS
91	4086.000	300.500	GS
92	4210.000	297.700	BRK
93	4309.000	298.700	GS
94	4399.000	299.600	BRK
95	4446.000	302.400	BRK
96	4532.000	302.300	GS
97	4594.000	302.100	BRK
98	4657.000	301.200	BRK
99	4715.000	303.200	BRK
100	4753.400	303.100	POL 2
101	4802.000	302.900	GS
102	4835.000	303.100	TOP
103	4865.000	300.200	TOE
104	4892.000	301.600	BRK
105	4953.000	301.500	GS
106	5026.000	302.400	BRK
107	5091.000	302.600	GS
108	5131.000	302.800	BRK
109	5169.000	301.700	GS
110	5204.000	302.400	TOP

111	5212.000	301.100	TOE
112	5261.000	300.000	GS
113	5295.000	299.100	TOE
114	5305.000	300.700	TOP
115	5345.000	301.800	BRK
116	5399.000	301.000	GS
117	5402.000	300.900	TOP
118	5494.000	299.600	TOE
119	5516.000	299.100	TOE
120	5527.000	300.900	TOP
121	5567.000	301.200	BRK
122	5593.000	302.300	BRK
123	5642.000	302.100	GS
124	5689.000	301.200	BRK
125	5730.000	300.000	GS
126	5785.000	300.200	GS
127	5850.000	299.100	BRK
128	5903.000	300.300	TOP
129	5957.000	298.700	BRK
130	6006.000	297.400	L EOW
131	6031.000	296.000	RIV BOT
132	6063.000	294.600	RIV BOT
133	6074.000	297.400	R EOW
134	6102.000	304.200	TOP
135	6138.400	304.200	POL 3
136	6173.000	303.700	TOP
137	6182.000	301.900	TOE
138	6194.000	301.700	TOE
139	6201.000	303.500	TOP
140	6233.000	303.000	GS
141	6281.000	303.100	GS
142	6316.000	303.100	BRK
143	6334.000	302.600	BRK
144	6354.000	302.300	TOE
145	6361.000	303.800	TOP
146	6392.000	303.500	GS
147	6421.000	303.200	BRK
148	6443.000	303.200	BRK
149	6452.600	303.600	POL 4
150	6472.000	302.500	BRK
151	6519.000	301.000	BRK
152	6556.000	301.700	GS
153	6610.000	301.100	BRK
154	6651.000	299.500	GS
155	6698.000	298.400	GS
156	6732.000	297.800	L EOW
157	6773.000	297.300	RIV BOT
158	6813.000	297.000	RIV BOT
159	6847.000	296.400	RIV BOT
160	6870.000	295.900	RIV BOT
161	6887.000	295.400	RIV BOT
162	6902.000	297.900	R EOW
163	6915.000	302.300	TOP
164	6963.000	301.600	GS
165	7011.000	300.700	TOP
166	7044.000	299.400	L EOW
167	7061.000	298.900	RIV BOT
168	7093.000	299.400	R EOW
169	7107.000	300.600	TOE
170	7112.000	303.600	TOP

171	7134.000	303.700	BRK
172	7155.000	303.000	GS
173	7182.000	303.100	GS
174	7279.500	304.300	ALCAP LRX RM 91.8 R6

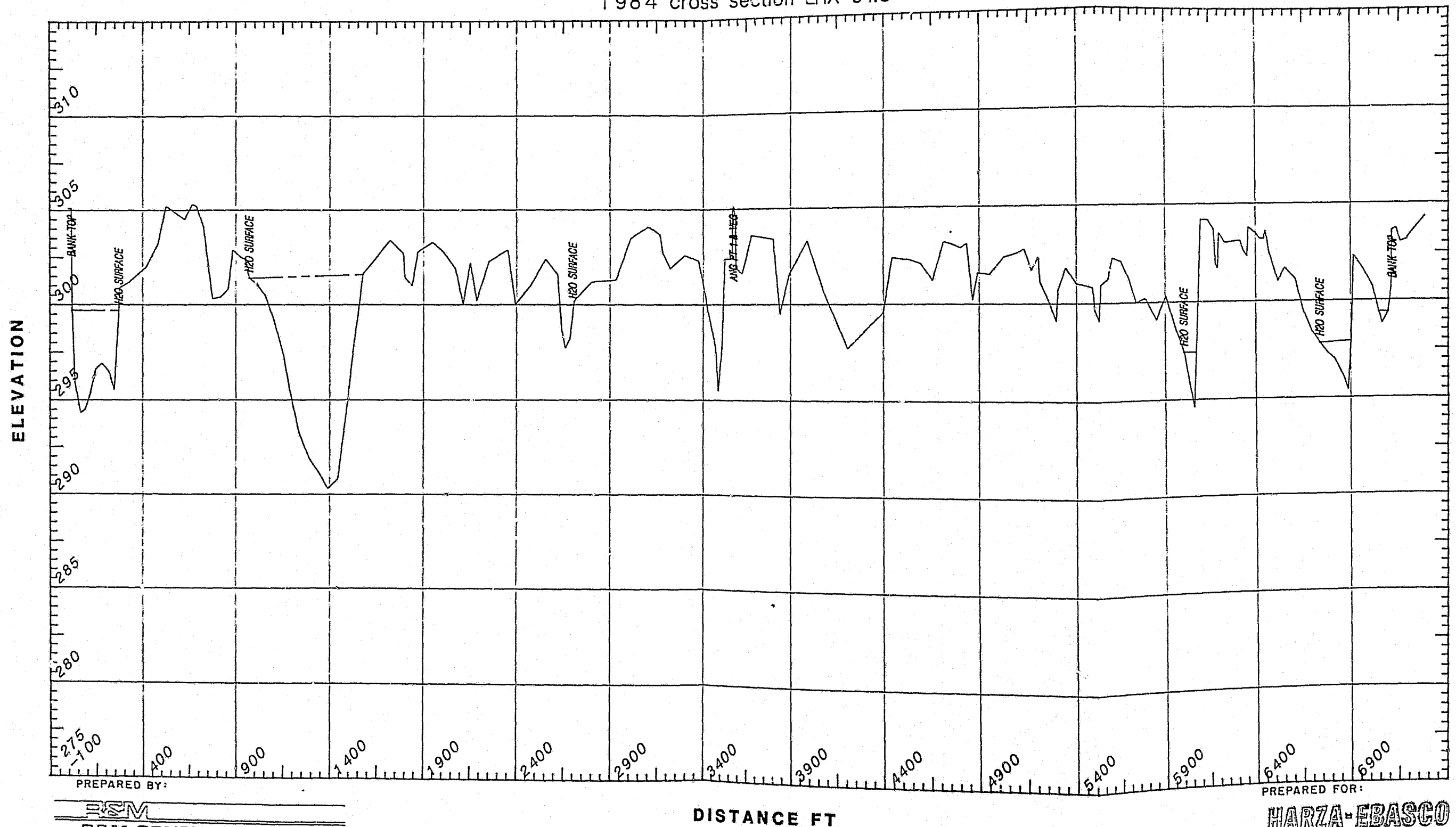
Water surface data:

1	19.000	299.700	L EOW
2	271.500	299.700	R EOW
3	971.000	0.000	
4	971.000	301.400	L EOW
5	1575.000	301.600	R EOW
6	2618.000	0.000	
7	2618.000	300.000	APPROX L EOW
8	2700.000	300.000	APPROX R EOW
9	6006.000	0.000	
10	6006.000	297.400	L EOW
11	6074.000	297.400	R EOW
12	6739.000	0.000	
13	6739.000	297.800	L EOW
14	6902.000	297.900	R EOW
15	7044.000	0.000	
16	7044.000	299.400	L EOW
17	7093.000	299.400	R EOW

MIN	0.000	290.300
MAX	7279.500	305.300

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 91.8



PREPARED BY:

R&M
R&M CONSULTANTS, INC.
 ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

CHARTNA HYDROGRAPHIC SURVEYS
Cross section LXX 23.1

Date of Survey: SEPTEMBER 11 1904

STATION	WATER	DESCRIPTION
1	0.000	
2	8.000	
3	14.000	
4	24.000	
5	34.000	
6	72.000	
7	77.000	
8	103.000	
9	112.000	
10	122.000	
11	149.000	
12	170.000	
13	244.000	
14	329.000	
15	468.000	
16	514.000	
17	543.000	
18	565.000	
19	607.000	
20	626.000	
21	644.000	
22	715.000	
23	787.000	
24	887.000	
25	962.000	
26	990.000	
27	1002.000	
28	1051.000	
29	1092.000	
30	1142.000	
31	1188.000	
32	1242.000	
33	1291.000	
34	1345.000	
35	1425.000	
36	1481.000	
37	1504.000	
38	1551.000	
39	1598.000	
40	1628.000	
41	1673.000	
42	1735.000	
43	1820.000	
44	1830.000	
45	1957.000	
46	1912.000	
47	1946.000	
48	1984.000	
49	2004.000	
50	2038.000	

51	2058.100	314.300	ANG PT 1
52	2097.000	313.900	GS
53	2182.000	314.200	GS
54	2266.000	314.300	GS
55	2396.000	313.700	GS
56	2534.600	314.500	ANG PT 2
57	2542.000	314.600	TOP
58	2587.000	311.000	TOE
59	2610.000	310.500	GS
60	2636.000	311.100	TOE
61	2644.000	314.100	TOP
62	2667.000	315.800	BRK
63	2687.000	314.900	TOP
64	2692.000	311.400	TOE
65	2721.000	311.500	GS
66	2769.000	312.000	GS
67	2799.000	311.100	BRK
68	2842.000	311.800	GS
69	2885.000	311.000	GS
70	2904.000	311.600	TOE
71	2912.000	313.800	TOP
72	2937.200	313.900	POL 1
73	2958.000	313.500	TOP
74	2969.000	310.200	L EDW
75	2987.000	308.800	RIV BOT
76	3009.000	308.000	RIV BOT
77	3045.000	307.000	RIV BOT
78	3090.000	307.900	RIV BOT
79	3145.000	309.700	RIV BOT
80	3177.000	306.900	RIV BOT
81	3217.000	306.500	RIV BOT
82	3261.000	305.700	RIV BOT
83	3308.000	305.800	RIV BOT
84	3347.000	308.000	RIV BOT
85	3356.000	310.400	R EDW
86	3376.000	316.100	TOP
87	3387.200	316.100	ANG PT 3
88	3437.000	315.500	BRK
89	3454.000	315.400	TOP
90	3478.000	314.000	TOE
91	3495.000	312.500	GS
92	3517.000	313.300	TOE
93	3552.000	316.200	TOP
94	3578.000	315.900	GS
95	3589.000	317.000	GS
96	3635.000	316.900	BRK
97	3670.000	316.500	GS
98	3691.000	315.700	TOP
99	3695.000	314.800	TOE
100	3707.000	314.500	TOE
101	3731.000	315.600	TOP
102	3752.000	315.800	TOP
103	3766.000	314.800	TOE
104	3790.000	314.800	TOE
105	3808.000	315.200	TOP
106	3827.000	316.600	BRK
107	3835.000	316.500	GS
108	3842.000	315.400	GS
109	3867.000	314.700	BRK
110	3901.000	315.000	TOE

111	3931.000	315.600	TOP
112	3943.000	315.700	TOE
113	3969.000	315.000	GS
114	3992.000	314.800	TOE
115	4000.000	316.100	TOP
116	4044.000	316.600	BRK
117	4104.000	315.700	TOP
118	4111.000	314.500	TOE
119	4144.000	313.600	GS
120	4165.000	313.600	GS
121	4213.000	313.100	TOE
122	4219.000	315.300	TOP
123	4261.000	314.800	GS
124	4295.000	314.000	TOP
125	4306.000	311.900	TOE
126	4330.000	311.300	GS
127	4368.000	310.400	TOE
128	4414.000	316.300	TOP
129	4449.000	316.700	TOP
130	4500.000	316.100	GS
131	4527.000	315.500	TOP
132	4543.000	314.100	TOE
133	4574.000	314.200	TOE
134	4582.000	315.400	TOP
135	4610.000	315.800	BRK
136	4655.000	315.500	TOP
137	4662.000	313.900	TOE
138	4689.000	313.600	GS
139	4713.000	312.800	TOE
140	4732.000	314.100	TOP
141	4737.000	314.100	TOP
142	4739.000	313.200	TOE
143	4765.000	311.700	GS
144	4793.000	312.800	TOE
145	4822.000	315.500	TOP
146	4853.000	315.500	GS
147	4897.000	315.300	GS
148	4920.000	316.000	GS
149	4961.000	316.400	BRK
150	4977.000	314.500	GS
151	5052.000	314.400	GS
152	5063.000	315.900	BRK
153	5075.000	314.900	BRK
154	5126.000	315.600	BRK
155	5171.000	314.200	GS
156	5207.000	314.400	BRK
157	5231.000	315.700	BRK
158	5250.000	315.500	GS
159	5274.000	314.200	BRK
160	5310.000	314.500	GS
161	5339.000	314.500	GS
162	5350.000	313.000	GS
163	5442.000	314.000	GS
164	5476.000	314.700	GS
165	5502.000	313.700	GS
166	5540.000	313.100	GS
167	5585.000	312.700	BRK
168	5611.000	315.300	BRK
169	5652.000	315.000	GS
170	5697.000	315.500	BRK

171	5742.000	313.200	BRK
172	5790.000	313.200	GS
173	5817.000	315.300	BRK
174	5842.000	315.100	BRK
175	5883.000	313.900	GS
176	5894.000	308.700	L EOW
177	5917.000	307.100	RIV BOT
178	5937.000	307.200	RIV BOT
179	5956.000	307.000	RIV BOT
180	5974.000	308.400	R EOW
181	5982.000	309.100	GS
182	6027.000	311.000	TOE
183	6074.000	314.100	GS
184	6100.000	312.300	BRK
185	6111.000	313.900	BRK
186	6150.000	312.200	GS
187	6172.000	313.100	TOE
188	6182.000	314.300	TOP
189	6211.000	314.000	BRK
190	6233.000	312.800	TOE
191	6244.000	316.200	TOP
192	6250.300	316.600	ALCAP LRX RM 93.1 RB

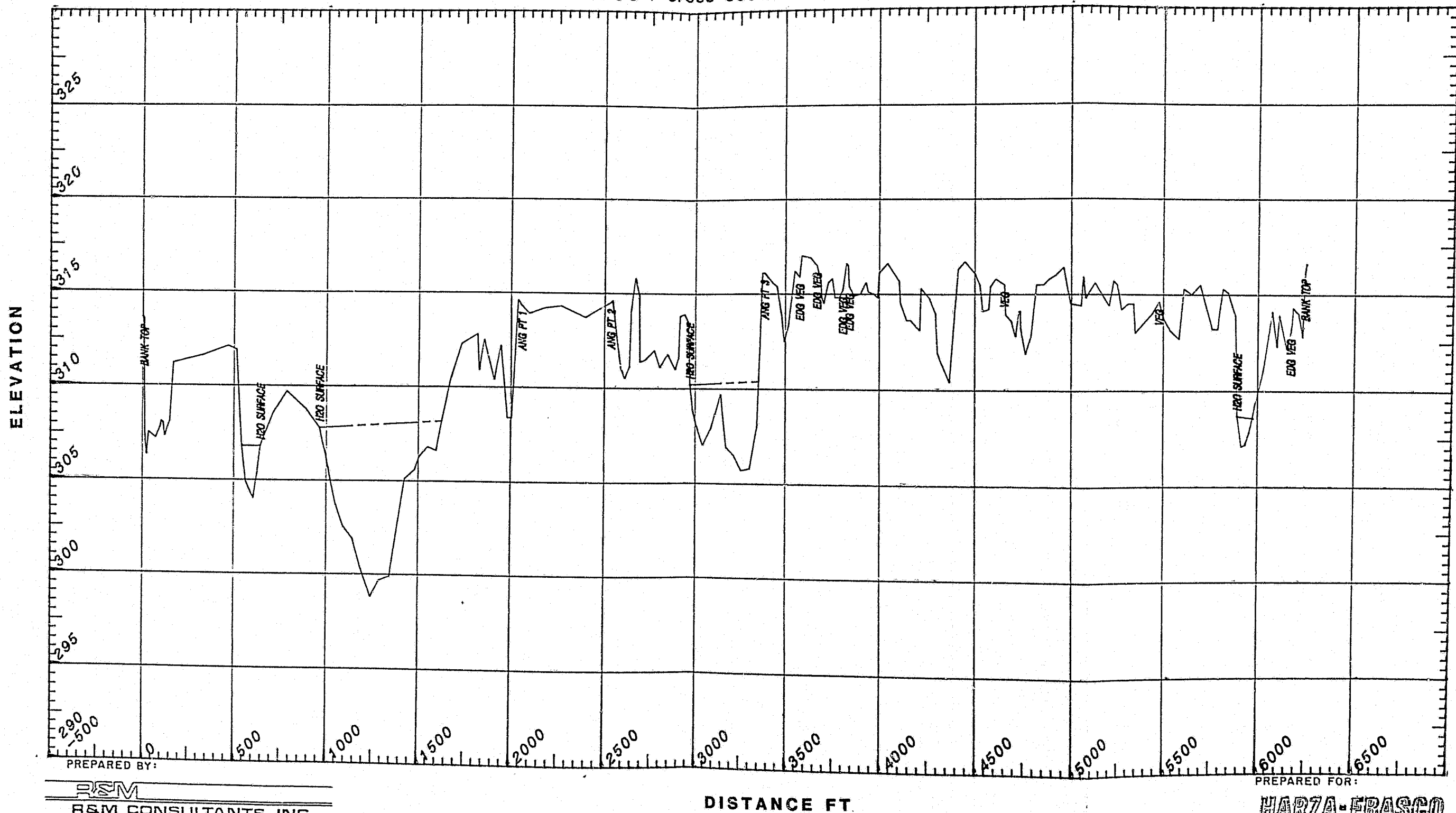
Water surface data:

1	543.000	306.000	L EOW
2	644.000	306.200	R EOW
3	762.000	0.000	
4	762.000	307.800	L EOW
5	1628.000	308.200	R EOW
6	2969.000	0.000	
7	2969.000	310.200	L EOW
8	3356.000	310.400	R EOW
9	5894.000	0.000	
10	5894.000	308.700	L EOW
11	5974.000	308.600	R EOW

MIN	0.000	298.000
MAX	6250.300	317.000

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 93.1



R&M
R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

HARZA-EBASCO
SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS
cross section LRX 95.9

Date of Survey: SEPTEMBER 26, 1984

POINT	'X'	'Y'	DESCRIPTION
Cross section data:			
1	0.000	330.540	AL CAP LRX J3 LB
2	16.000	329.200	TOP
3	18.000	322.700	TOE
4	31.000	322.300	BRK
5	52.000	322.900	BRK
6	89.000	322.700	TOE
7	97.000	326.500	TOP
8	108.000	326.500	TOP
9	117.000	324.100	TOE
10	155.000	323.200	L EDW
11	173.000	321.700	RIV BOT
12	171.000	321.200	RIV BOT
13	225.000	320.200	RIV BOT
14	261.000	319.300	RIV BOT
15	299.000	318.500	RIV BOT
16	356.000	320.100	RIV BOT
17	409.000	319.300	RIV BOT
18	466.000	318.100	RIV BOT
19	504.000	315.700	RIV BOT
20	526.000	319.600	RIV BOT
21	532.000	321.200	RIV BOT
22	547.000	322.900	R EDW
23	561.000	329.200	TOP
24	570.000	328.000	BRK
25	582.000	329.100	BRK
26	629.000	328.800	BRK
27	655.000	328.300	BRK
28	667.000	325.500	BRK
29	693.500	328.000	POL & BRK
30	713.000	327.400	TOP
31	737.000	325.400	TOE
32	780.000	325.700	BRK
33	851.000	324.500	BRK
34	928.000	324.700	GS
35	970.000	325.400	TOE ED VEG
36	986.000	328.100	TOP
37	1045.000	329.400	BRK
38	1090.000	330.500	BRK
39	1115.000	328.700	TOE
40	1122.000	330.200	TOP
41	1143.000	330.800	TOP
42	1171.000	329.000	TOE
43	1235.000	329.100	GS
44	1313.000	330.400	GS
45	1415.500	330.400	POL & TOP
46	1459.000	327.700	TOE
47	1477.000	328.300	BRK
48	1512.000	324.400	L EDW
49	1525.000	323.400	RIV BOT
50	1541.000	323.700	RIV BOT

51	1556.000	324.400	R EDW
52	1610.000	326.400	BRK
53	1662.000	325.900	BRK
54	1685.000	323.600	BRK
55	1699.000	325.800	BRK
56	1735.000	327.100	TOE
57	1763.000	327.500	BRK
58	1785.000	329.200	TOP
59	1846.000	328.900	GS
60	1906.000	328.800	TOE
61	1933.000	326.200	TOE
62	1993.000	325.400	TOE
63	2002.000	327.400	BRK
64	2031.000	328.900	BRK
65	2036.000	328.100	TOE
66	2041.000	330.100	TOP
67	2044.900	330.400	ANG PT 1
68	2054.000	330.700	TOP
69	2058.000	326.700	TOE
70	2063.000	324.800	L EDW
71	2067.000	323.100	RIV BOT
72	2071.000	321.500	RIV BOT
73	2087.000	320.600	RIV BOT
74	2102.000	321.700	RIV BOT
75	2121.000	322.000	RIV BOT
76	2139.000	323.100	RIV BOT
77	2150.000	324.800	R EDW
78	2162.000	326.400	TOP
79	2197.000	326.200	BRK
80	2280.000	328.700	GS
81	2337.000	326.800	L EDW
82	2371.000	325.800	RIV BOT
83	2389.000	325.100	RIV BOT
84	2405.000	324.000	RIV BOT
85	2438.000	323.700	RIV BOT
86	2464.000	323.700	RIV BOT
87	2496.000	323.100	RIV BOT
88	2520.000	322.700	RIV BOT
89	2540.000	324.000	RIV BOT
90	2550.000	325.200	RIV BOT
91	2556.000	326.700	R EDW
92	2569.000	329.700	TOP
93	2622.000	329.600	BRK
94	2671.000	328.800	TOP
95	2679.000	327.000	TOE
96	2698.000	326.900	BRK
97	2713.000	328.500	BRK
98	2734.000	329.900	TOP
99	2776.000	329.100	TOP
100	2783.000	326.900	TOE
101	2812.000	325.900	GS
102	2860.000	327.200	BRK
103	2905.000	328.100	BRK
104	2953.000	328.800	BRK
105	2970.000	328.000	TOE
106	2980.000	329.800	TOP
107	3028.900	330.300	POL 2
108	3089.000	327.800	GS
109	3101.000	329.500	BRK
110	3111.000	328.300	TOE

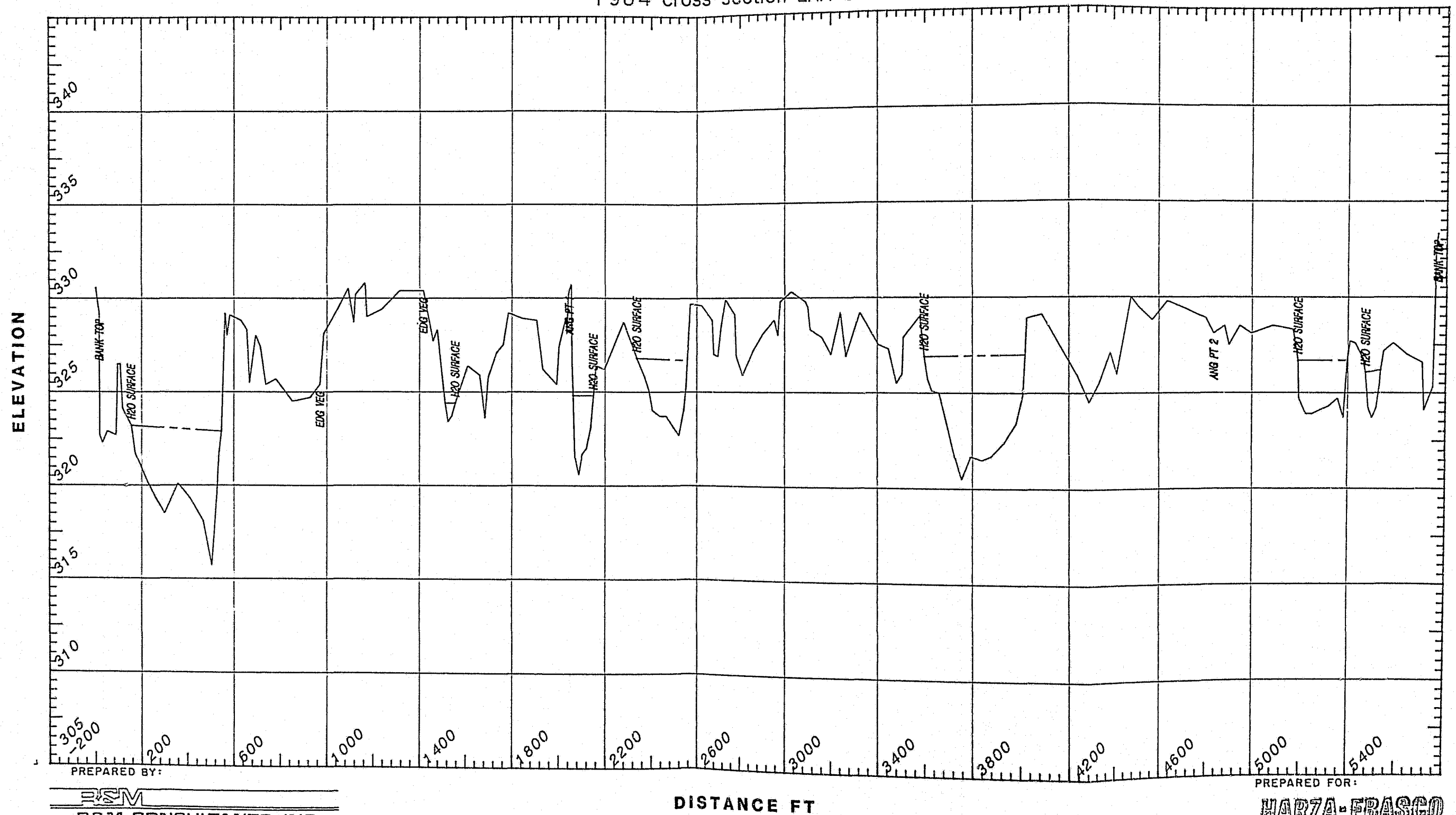
111	3162.000	327.900	GS
112	3202.000	327.000	TOE
113	3242.000	329.200	TOP
114	3266.000	326.900	BRK
115	3325.000	329.200	BRK
116	3405.000	327.500	GS
117	3447.000	327.300	GS
118	3481.000	325.500	BRK
119	3505.000	326.000	BRK
120	3510.000	327.900	BRK
121	3579.700	329.000	POI 3 & TOP
122	3598.000	326.900	L EOW
123	3613.000	325.700	RIV BOT
124	3630.000	325.100	RIV BOT
125	3660.000	325.000	RIV BOT
126	3727.000	321.600	RIV BOT
127	3755.000	320.500	RIV BOT
128	3793.000	321.700	RIV BOT
129	3838.000	321.500	RIV BOT
130	3878.000	321.700	RIV BOT
131	3931.000	322.400	RIV BOT
132	3982.000	323.400	RIV BOT
133	4010.000	324.200	RIV BOT
134	4019.000	327.000	R EOW
135	4025.000	328.900	TOP
136	4087.000	329.100	GS
137	4165.000	327.400	GS
138	4235.000	325.900	BRK
139	4283.000	324.500	BRK
140	4329.000	325.500	BRK
141	4381.000	327.100	BRK
142	4411.000	326.000	BRK
143	4475.000	330.000	BRK
144	4507.700	329.500	POL 4 & GS
145	4570.000	328.000	BRK
146	4637.000	329.800	BRK
147	4716.000	329.400	GS
148	4803.000	328.900	GS
149	4837.500	328.100	ANG PT 2
150	4884.000	328.500	BRK
151	4903.000	327.500	BRK
152	4942.000	328.500	BRK
153	4997.000	328.100	BRK
154	5087.000	328.500	GS
155	5172.000	328.300	TOP
156	5193.000	326.700	L EOW
157	5177.000	324.700	RIV BOT
158	5225.000	323.900	RIV BOT
159	5251.000	323.200	RIV BOT
160	5284.000	324.100	RIV BOT
161	5320.000	324.300	RIV BOT
162	5357.000	324.700	RIV BOT
163	5382.000	323.700	RIV BOT
164	5397.000	326.700	R EOW
165	5409.200	327.700	POL 5 & GS
166	5430.000	327.600	BRK
167	5462.000	326.800	BRK
168	5472.000	326.100	L EOW
169	5484.000	324.200	RIV BOT
170	5499.000	323.700	RIV BOT

171	5516.000	324.200	RIV BOT
172	5529.000	325.400	RIV BOT
173	5534.000	326.200	R EOW
174	5546.000	327.200	TOP
175	5585.000	327.600	BRK
176	5642.000	327.000	GS
177	5704.000	326.400	BRK
178	5712.000	324.000	BRK
179	5748.000	325.000	TOE
180	5757.000	332.500	TOP
181	5764.600	333.300	ALCAP LKX RM 95.0 RB

Water surface data:			
1	155.000	323.200	L EOW
2	547.000	322.900	R EOW
3	1512.000	0.000	
4	1512.000	324.400	L EOW
5	1556.000	324.400	R EOW
6	2063.000	0.000	
7	2063.000	324.800	L EOW
8	2150.000	324.800	R EOW
9	2337.000	0.000	
10	2337.000	326.800	L EOW
11	2556.000	326.700	R EOW
12	3598.000	0.000	
13	3598.000	326.900	L EOW
14	4019.000	327.000	R EOW
15	5193.000	0.000	
16	5193.000	326.700	L EOW
17	5397.000	326.700	R EOW
18	5472.000	0.000	
19	5472.000	326.100	L EOW
20	5534.000	326.200	R EOW
MIN	0.000	315.700	
MAX	5764.600	333.300	

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 95.9



PREPARED BY:

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R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
SUSITNA JOINT VENTURE

GUSTINA HYDROGRAPHIC SURVEYS
cross section LRX 97.1

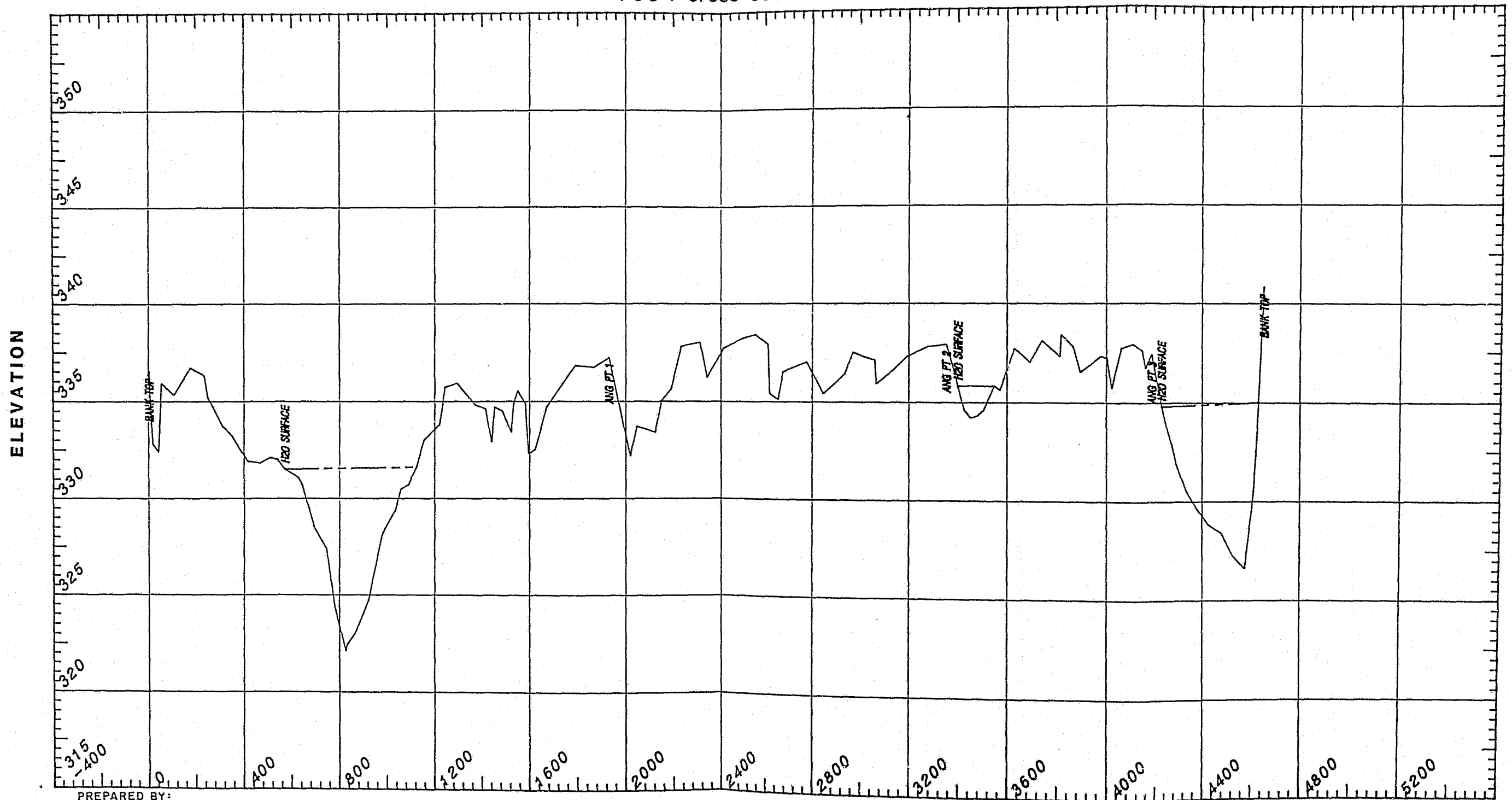
Date of Survey: SEPTEMBER 27, 1984

POINT	X'	Y'	DESCRIPTION
Cross section data:			
1	0.000	336.300	ALCAP LRX 1 LB
2	3.000	336.500	TOP
3	19.000	332.800	TOE
4	43.000	332.400	TOE
5	55.000	335.900	TOP
6	108.000	335.300	TOP
7	177.000	336.700	BRK
8	234.000	336.300	BRK
9	250.000	335.200	BRK
10	313.000	333.700	GS
11	350.200	333.200	POL 1 & GS
12	385.000	332.500	L EOW
13	417.000	331.900	RIV BOT
14	466.000	331.800	RIV BOT
15	509.000	332.100	RIV BOT
16	532.000	332.000	R EOW
17	570.000	331.500	L EOW
18	626.000	331.100	RIV BOT
19	643.000	330.700	RIV BOT
20	666.000	329.700	RIV BOT
21	697.000	328.400	RIV BOT
22	746.000	327.400	RIV BOT
23	784.000	324.200	RIV BOT
24	828.000	322.100	RIV BOT
25	832.000	322.400	RIV BOT
26	870.000	323.100	RIV BOT
27	923.000	324.700	RIV BOT
28	979.000	328.100	RIV BOT
29	1035.000	329.400	RIV BOT
30	1059.000	330.500	RIV BOT
31	1090.000	330.700	RIV BOT
32	1124.000	331.600	R EOW
33	1155.000	333.000	BRK
34	1221.000	333.800	TOE
35	1243.000	335.700	TOP
36	1293.600	335.900	POL 2
37	1372.000	334.900	BRK
38	1415.000	334.600	BRK
39	1441.000	332.900	TOE
40	1454.000	334.700	TOP
41	1486.000	334.500	BRK
42	1524.000	333.400	TOE
43	1532.000	334.800	TOP
44	1551.000	335.500	BRK
45	1582.000	334.900	TOP
46	1596.000	332.300	TOE
47	1624.000	332.500	BRK
48	1670.000	334.700	BRK
49	1791.000	336.800	BRK
50	1866.000	336.700	GS

51	1929.800	337.200	ANG PT 1
52	2019.000	332.200	TOE
53	2046.000	333.700	BRK
54	2122.000	333.400	TOE
55	2148.000	335.000	BRK
56	2189.000	335.600	TOP
57	2231.000	337.800	BRK
58	2310.000	338.000	BRK
59	2341.000	336.200	BRK
60	2412.000	337.700	BRK
61	2496.000	338.200	GS
62	2555.000	338.400	GS
63	2611.000	337.900	TOP
64	2618.000	335.400	TOE
65	2655.000	335.100	BRK
66	2677.000	336.500	BRK
67	2776.000	337.000	GS
68	2847.000	335.400	GS
69	2937.000	336.400	BRK
70	2971.000	337.500	BRK
71	3029.200	337.200	POL 3
72	3060.000	337.100	TOP
73	3068.000	335.900	TOE
74	3137.000	336.600	TOE
75	3173.000	337.300	BRK
76	3279.000	337.800	BRK
77	3351.900	337.700	ANG PT 2
78	3382.000	336.700	BRK
79	3400.000	335.000	L EOW
80	3426.000	334.600	RIV BOT
81	3452.000	334.200	RIV BOT
82	3478.000	334.300	RIV BOT
83	3505.000	334.600	RIV BOT
84	3548.000	335.800	R EOW
85	3572.000	335.600	BRK
86	3630.000	337.700	BRK
87	3692.000	337.000	BRK
88	3741.000	338.100	BRK
89	3813.000	337.300	BRK
90	3819.000	338.400	BRK
91	3866.000	337.800	BRK
92	3896.000	336.500	BRK
93	3978.000	337.300	BRK
94	4002.000	337.200	BRK
95	4022.000	335.700	BRK
96	4061.000	337.700	BRK
97	4108.000	337.900	BRK
98	4145.000	337.600	BRK
99	4161.000	336.700	BRK
100	4187.200	337.400	ANG PT 3
101	4229.000	334.800	L EOW
102	4256.000	333.500	RIV BOT
103	4272.000	332.900	RIV BOT
104	4291.000	331.900	RIV BOT
105	4336.000	330.500	RIV BOT
106	4379.000	329.600	RIV BOT
107	4428.000	328.800	RIV BOT
108	4477.000	328.400	RIV BOT
109	4530.000	327.200	RIV BOT
110	4577.000	326.600	RIV BOT

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 97.1



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 ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

DISTANCE FT.

PREPARED FOR:

HARZA-EBASCO
 SUSITNA JOINT VENTURE

SUSITNA HYDROGRAPHIC SURVEYS
cross section LRX 98.0

Date of Survey: SEPTEMBER 28, 1984

POINT	'X'	'Y'	DESCRIPTION
Cross section data:			
1	0.000	344.070	ALCAP 98.0 LB LB
2	58.500	342.900	GS
3	64.000	343.700	TOP OF BANK
4	74.000	337.000	L EOW
5	78.000	334.100	RIV BOT
6	92.000	330.300	RIV BOT
7	113.000	331.200	RIV BOT
8	142.000	331.700	RIV BOT
9	160.000	331.800	RIV BOT
10	174.000	333.500	RIV BOT
11	180.000	334.900	RIV BOT
12	183.000	336.200	RIV BOT
13	188.000	337.000	R EOW
14	227.000	337.200	BRK
15	303.000	339.900	BRK
16	387.000	339.300	BRK
17	407.000	339.600	BRK
18	471.000	339.300	GS
19	529.000	338.100	L EOW
20	552.000	337.300	RIV BOT
21	576.000	336.700	RIV BOT
22	600.000	336.500	RIV BOT
23	620.000	336.800	RIV BOT
24	635.000	337.300	RIV BOT
25	642.000	338.200	R EOW
26	677.000	340.700	BRK
27	729.000	342.500	TOP
28	761.000	342.300	BRK
29	791.000	340.600	BRK
30	859.000	340.800	GS
31	908.000	340.700	BRK
32	912.000	339.600	BRK
33	1008.000	341.900	BRK
34	1016.000	338.500	BRK
35	1045.000	339.400	BRK
36	1076.000	338.900	BRK
37	1123.000	341.100	BRK
38	1160.000	341.000	POL
39	1192.000	340.700	GS
40	1222.000	341.300	TOP E VEG
41	1227.000	337.700	TOE
42	1241.000	336.600	TOE
43	1246.000	338.800	TOP
44	1265.000	339.500	BRK
45	1271.000	340.600	BRK
46	1320.000	342.200	BRK
47	1366.000	342.100	GS
48	1416.000	342.000	GS
49	1470.000	341.500	GS
50	1538.800	341.600	ANGL PT 1

51	1598.000	339.700	BRK
52	1668.000	338.700	GS
53	1744.000	338.700	GS
54	1807.000	338.200	TOP
55	1832.000	336.000	L EOW
56	1845.000	334.700	RIV BOT
57	1860.000	334.100	RIV BOT
58	1883.000	333.900	RIV BOT
59	1899.000	334.800	RIV BOT
60	1919.000	336.100	R EOW
61	1971.000	336.600	GS
62	2027.000	336.700	GS
63	2051.000	337.300	TOE
64	2059.000	338.000	TOP
65	2069.000	337.100	BRK
66	2125.000	336.900	TOE
67	2142.000	341.100	TOP
68	2207.000	340.700	BRK
69	2274.000	341.300	GS
70	2297.000	341.300	BRK
71	2302.000	340.500	BRK
72	2348.000	340.200	BRK
73	2369.000	341.400	BRK
74	2429.000	340.600	BRK
75	2466.000	338.700	BRK
76	2481.000	340.000	BRK
77	2542.600	340.200	POL 2
78	2579.000	338.900	BRK
79	2610.000	340.300	BRK
80	2623.000	339.800	BRK
81	2630.000	340.700	BRK
82	2665.000	340.700	BRK
83	2712.000	340.600	ANGL PT 2
84	2734.000	336.800	L EOW
85	2740.000	334.800	RIV BOT
86	2758.000	331.800	RIV BOT
87	2802.000	332.500	RIV BOT
88	2859.000	331.200	RIV BOT
89	2909.000	330.500	RIV BOT
90	2952.000	328.800	RIV BOT
91	3014.000	329.600	RIV BOT
92	3060.000	330.200	RIV BOT
93	3089.000	334.000	RIV BOT
94	3103.000	336.700	R EOW
95	3108.000	337.600	TOP
96	3120.000	337.600	TOP
97	3127.000	336.700	L EOW
98	3136.000	334.700	RIV BOT
99	3151.000	334.500	RIV BOT
100	3168.000	336.000	RIV BOT
101	3180.000	336.700	R EOW
102	3207.000	337.600	BRK
103	3228.000	337.800	BRK
104	3247.000	336.500	L EOW
105	3263.000	334.800	RIV BOT
106	3269.000	334.100	RIV BOT
107	3283.000	334.800	RIV BOT
108	3288.000	336.500	R EOW
109	3296.000	342.800	TOP
110	3332.900	343.200	ALCAP 98.0 RB

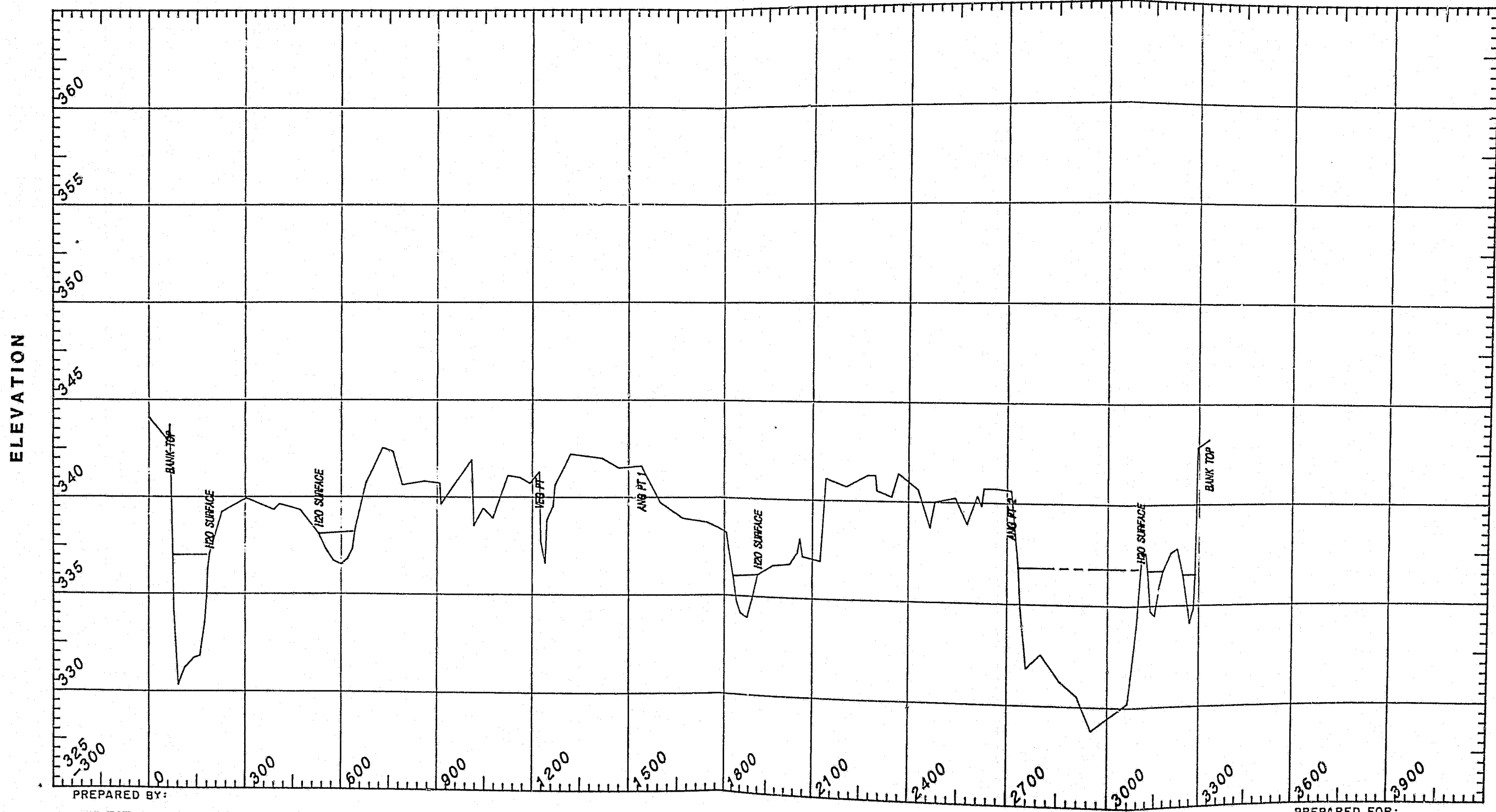
Water surface data:

1	74.000	337.000	L EQW
2	188.000	337.000	R EQW
3	529.000	0.000	
4	527.000	338.100	L EQW
5	642.000	338.200	R EQW
6	1832.000	0.000	
7	1832.000	336.000	L EQW
8	1919.000	336.100	R EQW
9	2734.000	0.000	
10	2734.000	336.800	L EQW
11	3103.000	336.800	R EQW
12	3127.000	0.000	
13	3127.000	336.700	L EQW
14	3180.000	336.700	R EQW
15	3247.000	0.000	
16	3247.000	336.500	L EQW
17	3288.000	336.500	R EQW

MIN	0.000	328.800
MAX	3332.900	344.070

SUSITNA HYDROGRAPHIC SURVEYS

1984 cross section LRX 98.0



PREPARED BY:

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ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

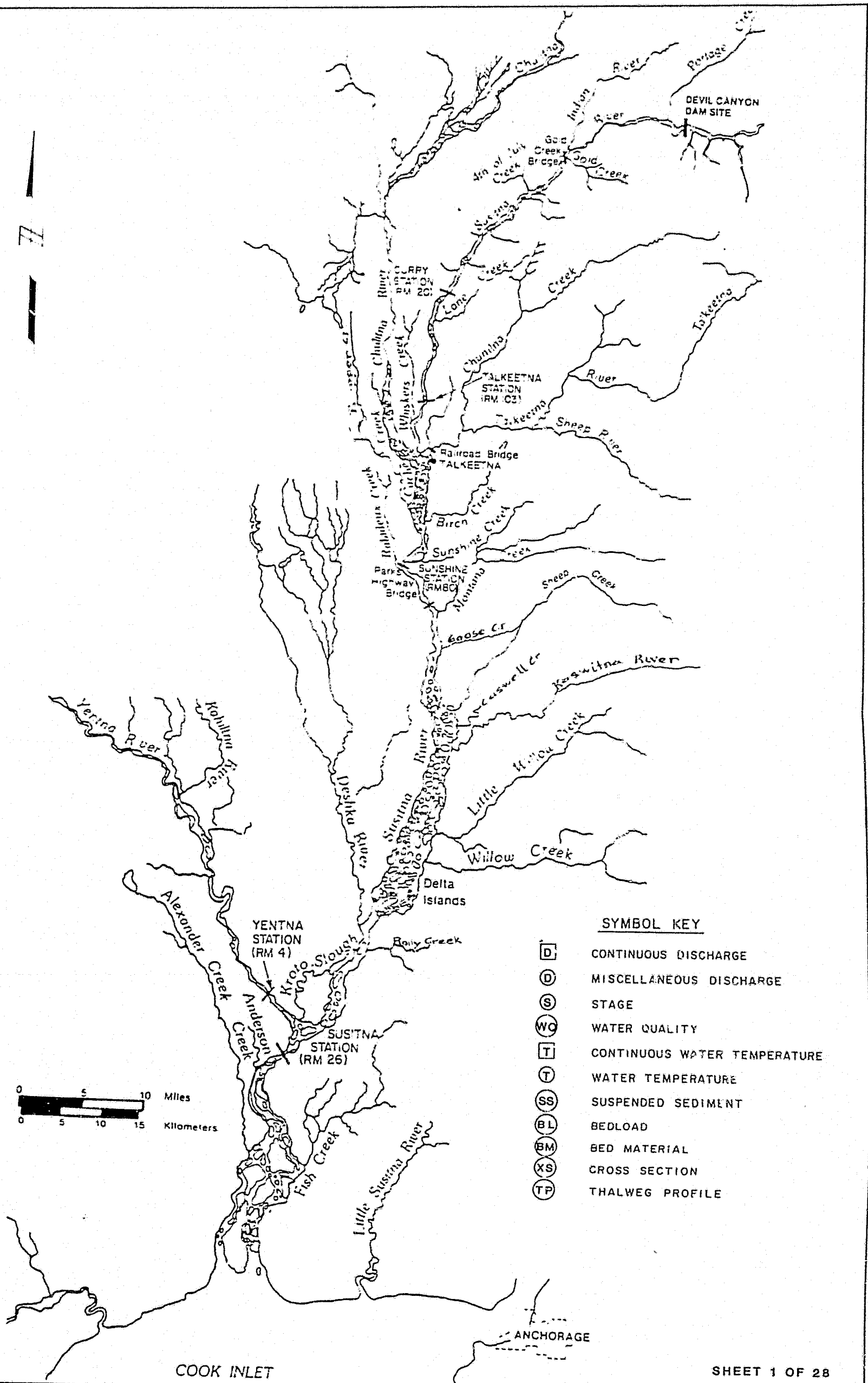
DISTANCE FT

PREPARED FOR:

HARZA-EBASCO
SUSITNA JOINT VENTURE

APPENDIX C

Blueline Photomosaic Maps of the Lower Susitna River
Showing Locations of Cross Sections and
Fisheries Habitat Study Areas





SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WC) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

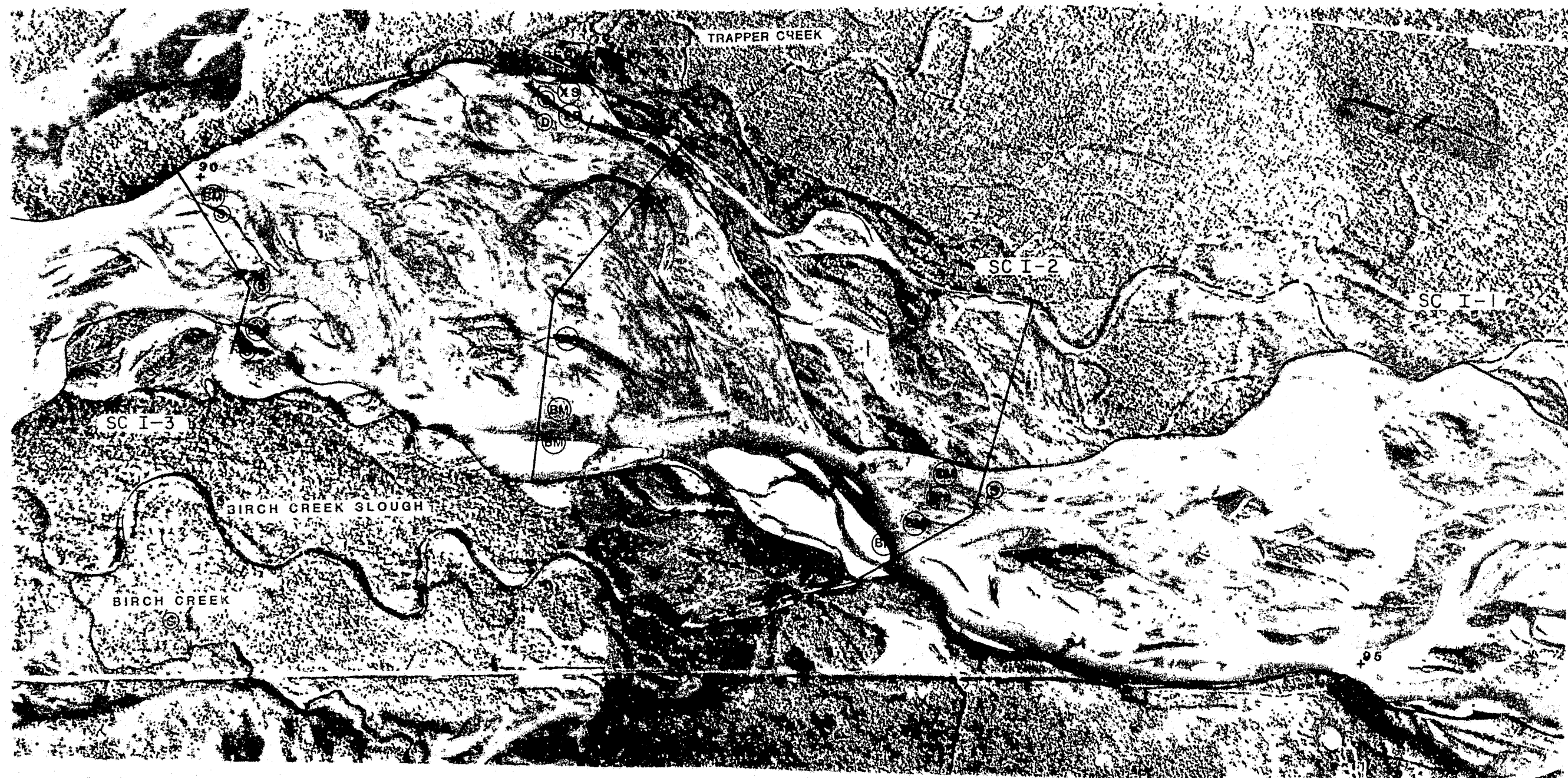
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000' SHEET 2 OF 28
DATE 2-7-84

RSM
RIVERSIDE SURVEYING METHOD

HARIA-EBASCO
SUSITNA JOINT VENTURE



SYMBOL KEY

(S)	CONTINUOUS DISCHARGE	(T)	WATER TEMPERATURE
(D)	MISCELLANEOUS DISCHARGE	(SS)	SUSPENDED SEDIMENT
(S)	STAGE	(BL)	BED LOAD
(WQ)	WATER QUALITY	(BM)	BED MATERIAL
(T)	CONTINUOUS WATER TEMPERATURE	(XS)	CROSS SECTION
		(TP)	THALWEG PROFILE

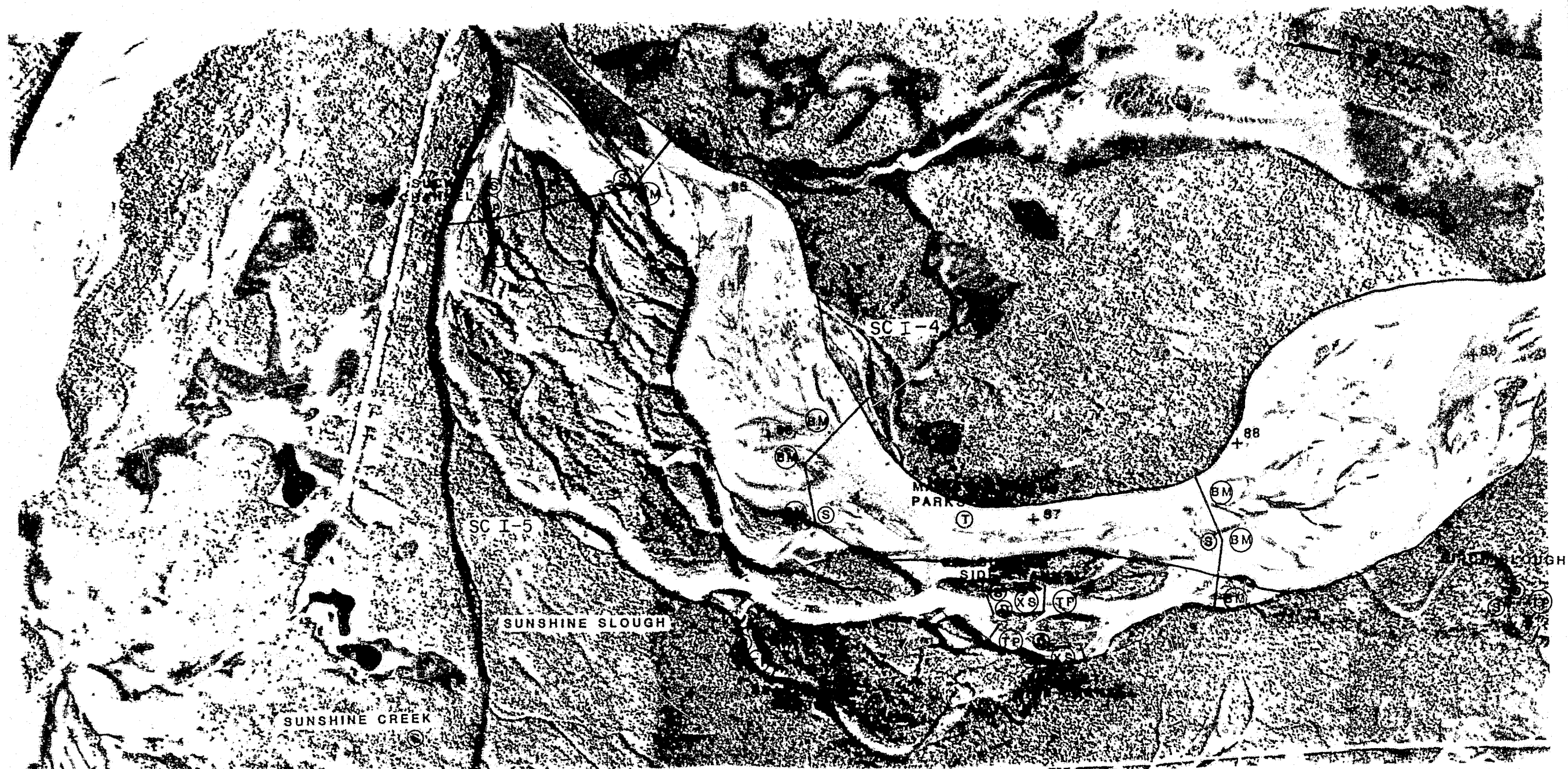
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT 6, 1983
SCALE: 1:20,000
SHEET: 4 OF 24
DATE: 2-7-84

APR 1984

MAKKA-TRABED



SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WG) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

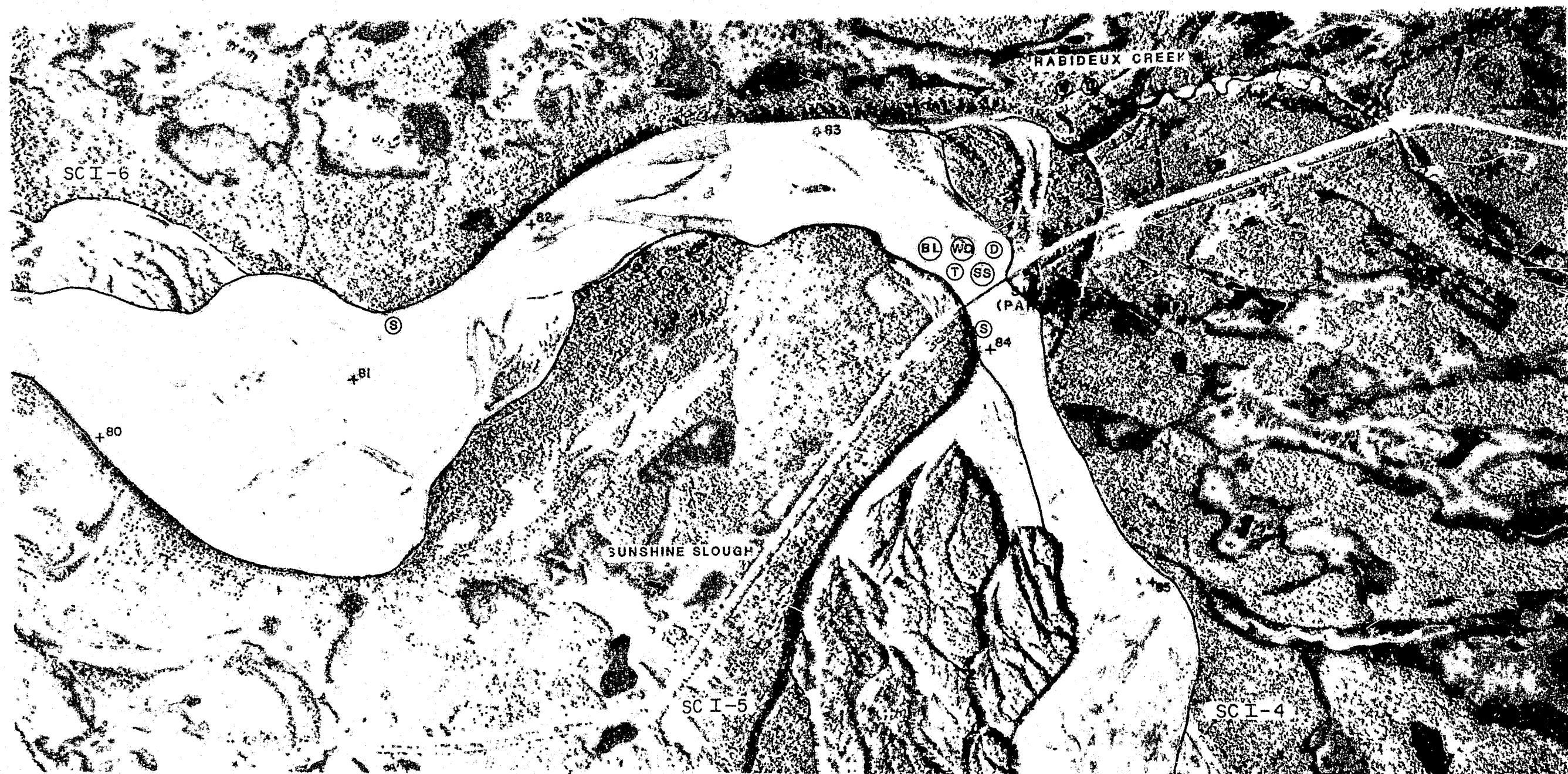
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT 16, 1983
SCALE: 1:25,000
SHEET 4 OF 28
DATE 2-7-84

PSM

MARIA BRASCO



SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WO) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

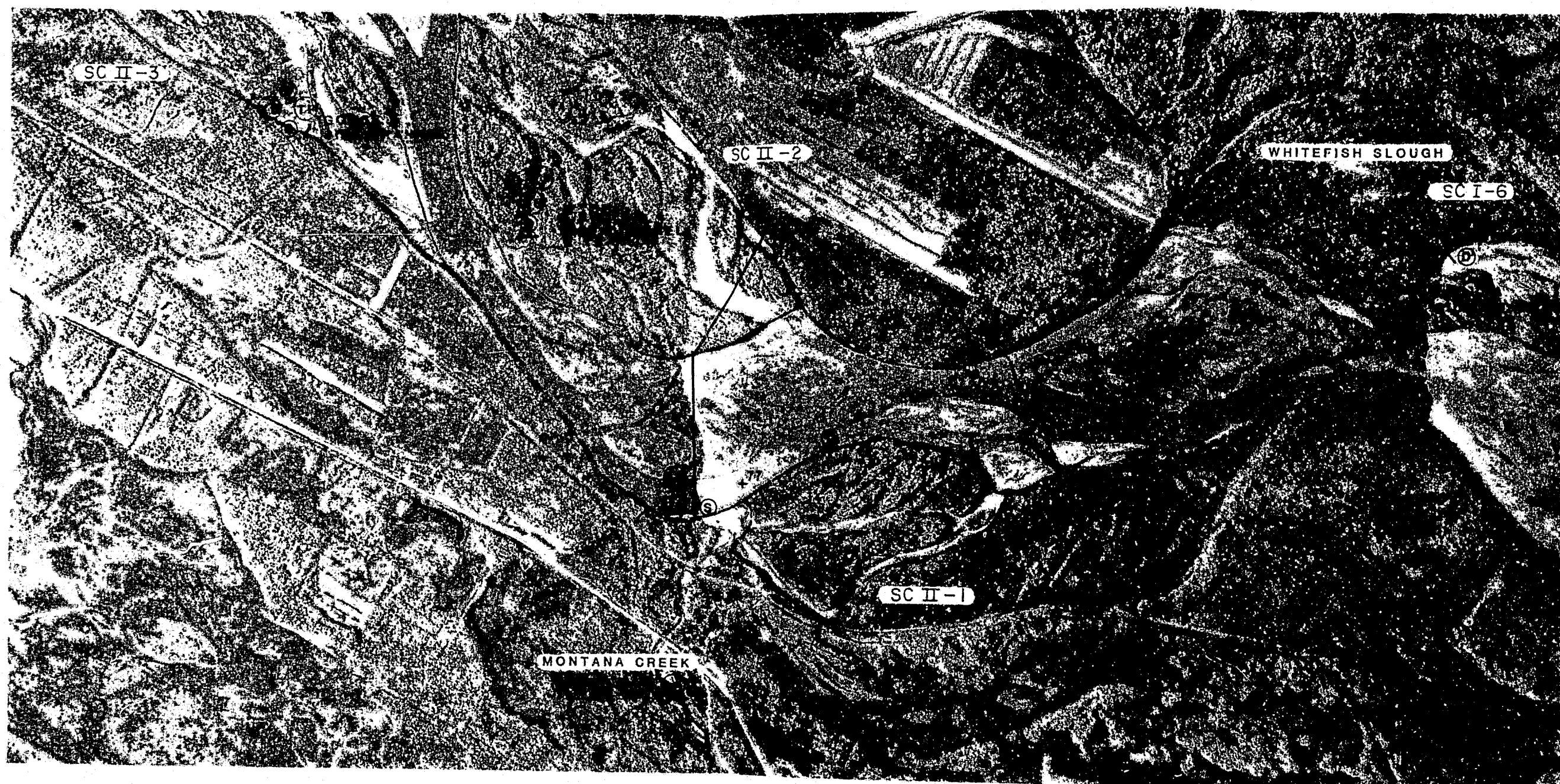
LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1" = 2000'

SHEET 5 OF 28
DATE 2-7-84

F&M
FISHER & MANN ENGINEERS, INC.

WARZA-EDASCO
WARZA ENGINEERS, INC.



SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WQ) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983

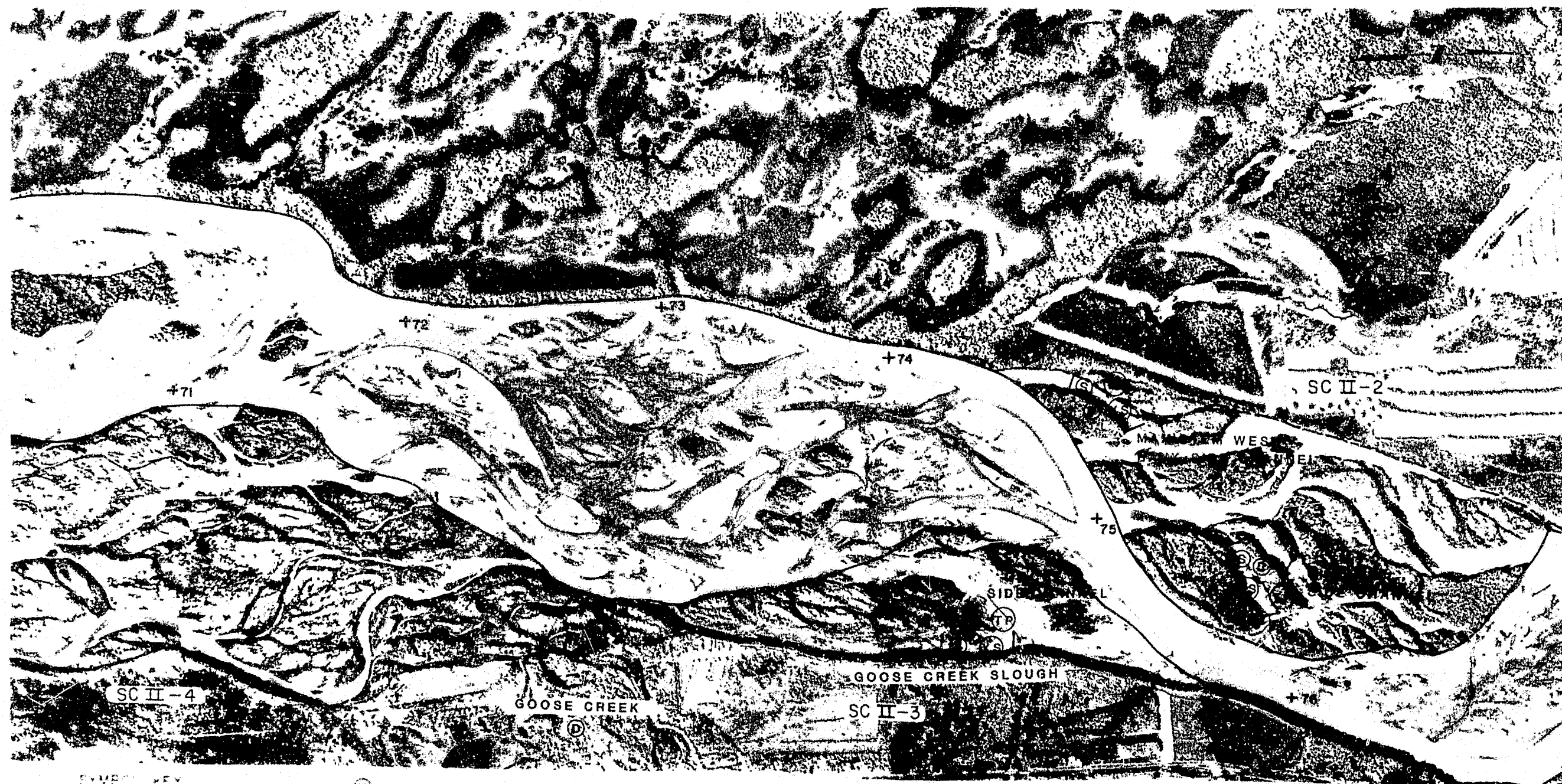
SCALE 1"=2000'

SHEET 6 OF 28

DATE 2-7-84

FSM
FISHER, STANLEY & MANN
ENGINEERS, INC.

HARZA-EDASCO
SUSITNA JOINT VENTURE



SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WQ) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 6, 1983
SCALE 1"=2000

SHEET 7 OF 28
DATE 2-7-84

REM

MARJA-133800



SYMBOL KEY

(U)
(D)
(S)
(WC)
(T)

CONTINUOUS DISCHARGE
MISCELLANEOUS DISCHARGE
STAGE
WATER QUALITY
CONTINUOUS WATER TEMPERATURE

(T)
(SS)
(BL)
(BM)
(XS)
(TP)

WATER TEMPERATURE
SUSPENDED SEDIMENT
BEDLOAD
BED MATERIAL
CROSS SECTION
THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT. 16, 1983
SCALE: 1"=2000' SHEET 8 OF 28
DATE: 2-7-84

PSM
PACIFIC SOUTHERN MANAGEMENT

MANA-13A80
SUSITNA COUNTY, ALASKA



SYMBOL KEY

[D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WQ] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

[T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BEDLOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

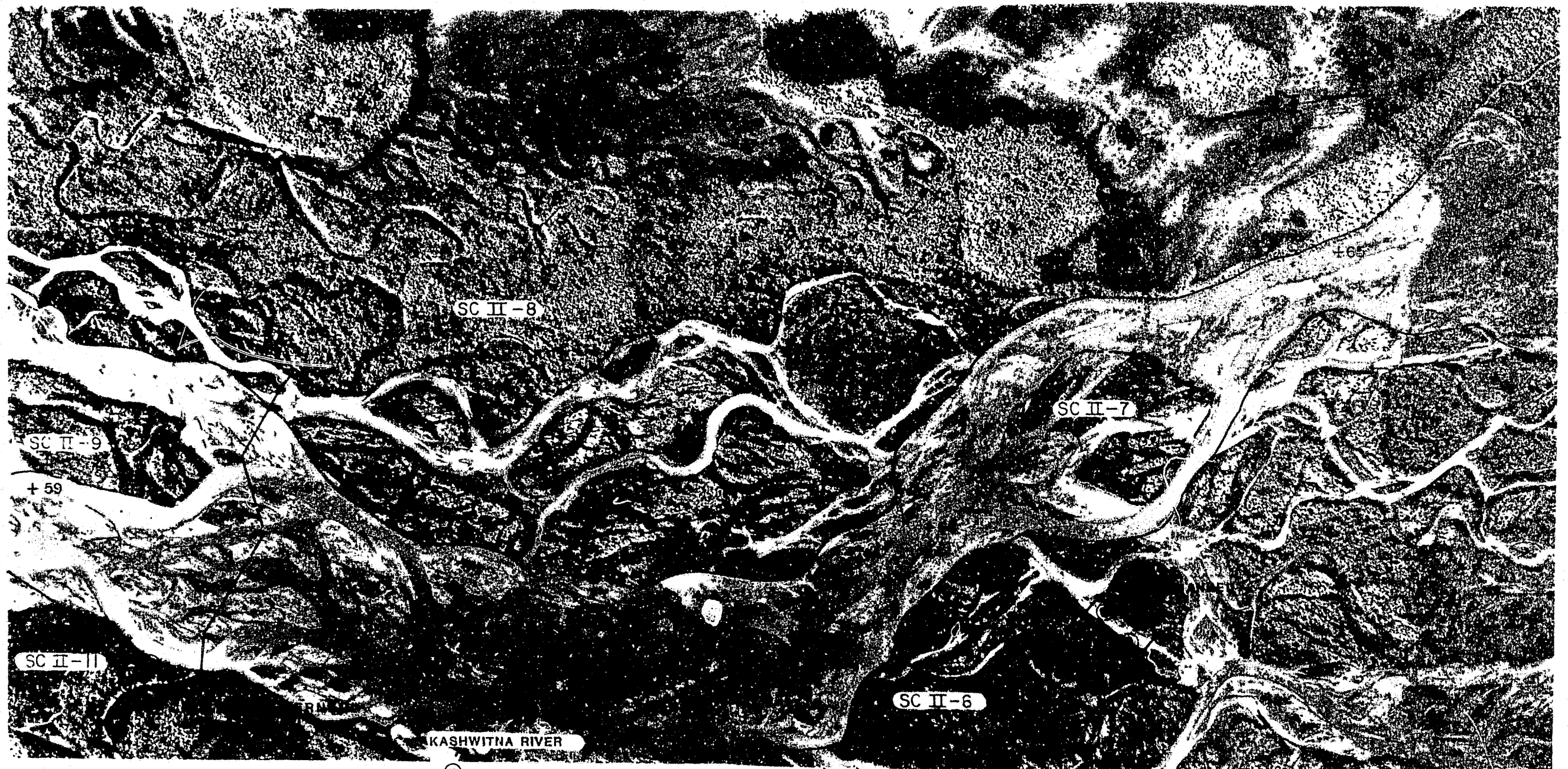
LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1"=2000'

SHEET 9 OF 28
DATE 2-7-84

PSM
HYDROCONSULTANTS, INC.

MARZA-EBASCO
SUSITNA JOINT VENTURE



SYMBOL KEY	
(D)	CONTINUOUS DISCHARGE
(D)	MISCELLANEOUS DISCHARGE
(S)	STAGE
(WC)	WATER QUALITY
(T)	CONTINUOUS WATER TEMPERATURE
(T)	WATER TEMPERATURE
(SS)	SUSPENDED SEDIMENT
(BL)	BEDLOAD
(BM)	BED MATERIAL
(XS)	CROSS SECTION
(TP)	THALWEG PROFILE

CASWELL CREEK

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT. 16, 1983

SCALE: 1" = 2000'

SHEET 10 OF 28

DATE: 2-7-84

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ALASKA POWER AUTHORITY

WATZ-EDASS
ALASKA POWER AUTHORITY



SYMBOL KEY

[D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WC] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

[T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BEDLOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

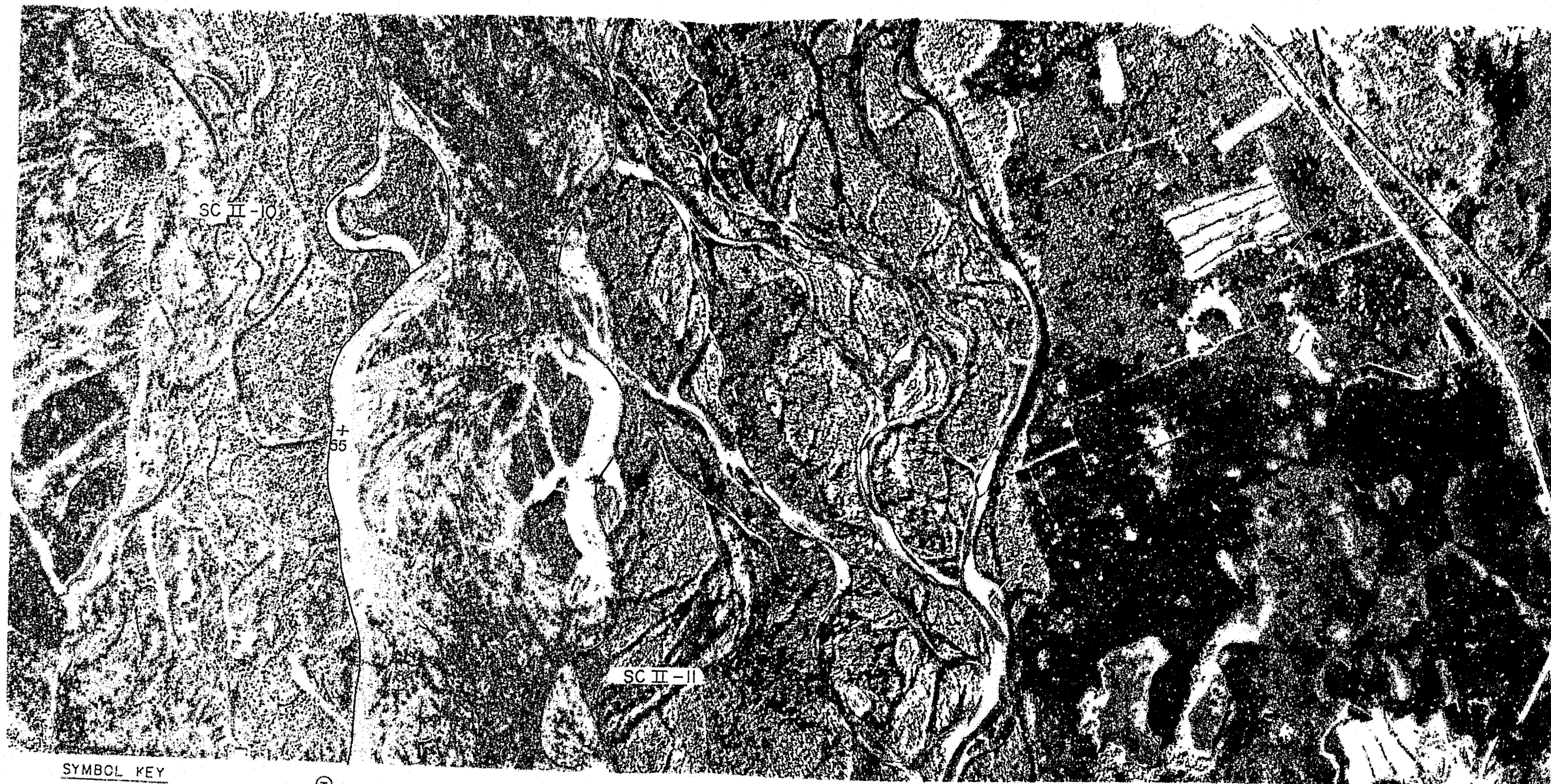
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
 SCALE 1" = 2000' SHEET 11 OF 28
 DATE 2-7-84

FSM
 FISH SCIENCE
 CONSULTANTS INC.

HARZA-EDASCO
 SUSITNA JOINT VENTURE



SYMBOL KEY

- | | | | |
|------|------------------------------|------|--------------------|
| (D) | CONTINUOUS DISCHARGE | (T) | WATER TEMPERATURE |
| (D) | MISCELLANEOUS DISCHARGE | (SS) | SUSPENDED SEDIMENT |
| (S) | STAGE | (BL) | BEDLOAD |
| (WQ) | WATER QUALITY | (BM) | BED MATERIAL |
| (T) | CONTINUOUS WATER TEMPERATURE | (XS) | CROSS SECTION |
| | | (TP) | THALWEG PROFILE |

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

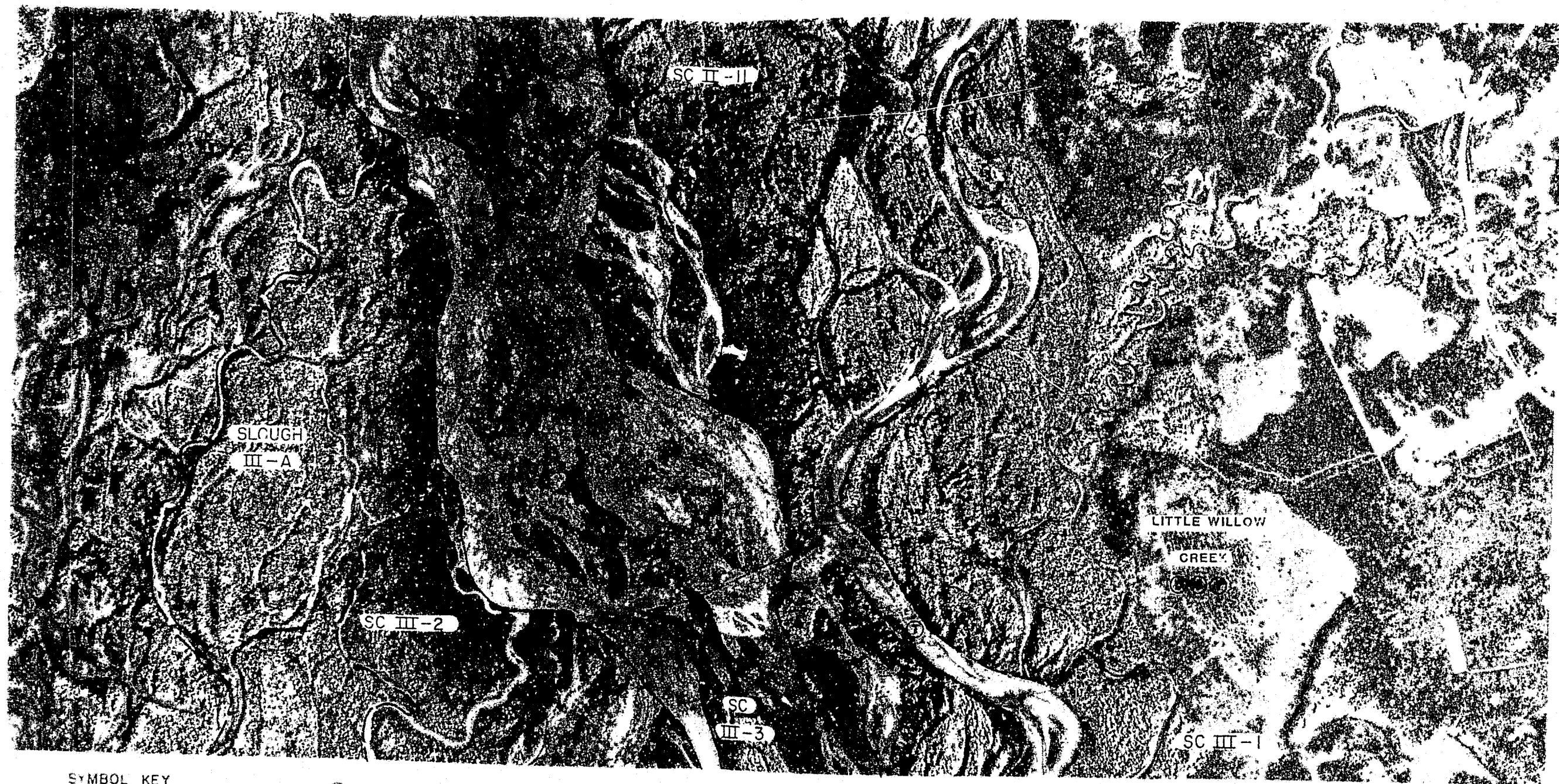
LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT '6, 1983
SCALE 1"=2000'

SHEET 12 OF 28
DATE 2-7-84

PSM
PACIFIC SOUTHERN MOUNTAIN

HAZARDA-EDASCO
SUSITNA JOINT VENTURE



SYMBOL KEY

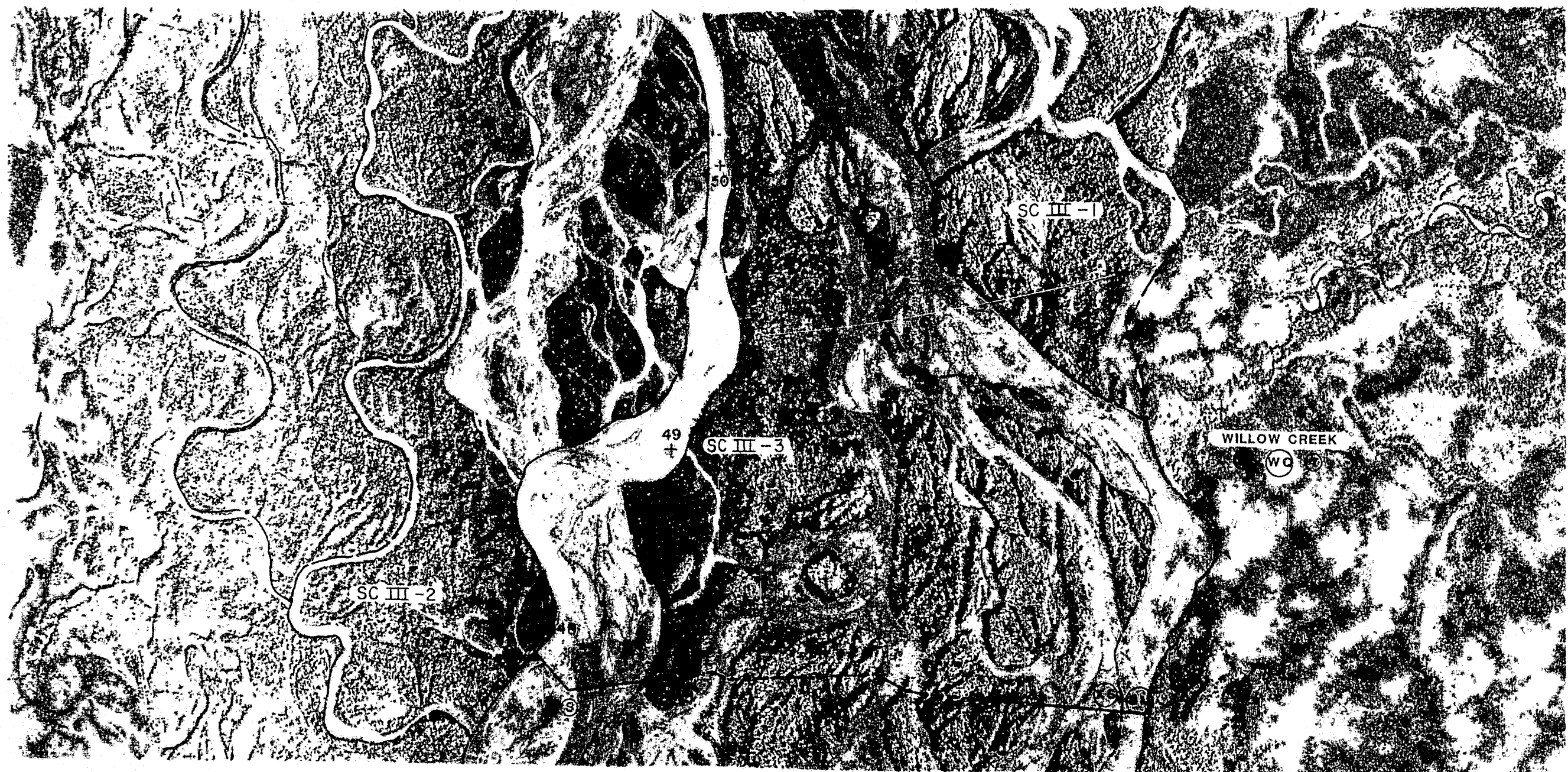
- | | | | |
|------|------------------------------|------|--------------------|
| (D) | CONTINUOUS DISCHARGE | (T) | WATER TEMPERATURE |
| (D) | MISCELLANEOUS DISCHARGE | (SS) | SUSPENDED SEDIMENT |
| (S) | STAGE | (BL) | BEDLOAD |
| (WQ) | WATER QUALITY | (BM) | BED MATERIAL |
| (T) | CONTINUOUS WATER TEMPERATURE | (XS) | CROSS SECTION |
| | | (TP) | THALWEG PROFILE |

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT. 16, 1963
SCALE: 1:50,000
SHEET 13 OF 28
DATE: 2-7-84

ALASKA-REASCO
ALASKA-REASCO



SYMBOL KEY

(C)	CONTINUOUS DISCHARGE	(T)	WATER TEMPERATURE
(D)	MISCELLANEOUS DISCHARGE	(SS)	SUSPENDED SEDIMENT
(S)	STAGE	(BL)	BEDLOAD
(WQ)	WATER QUALITY	(BM)	BED MATERIAL
(T)	CONTINUOUS WATER TEMPERATURE	(XS)	CROSS SECTION
		(TP)	THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPH: SEPT 16, 1983
SCALE: 1" = 2000'
SHEET: 14 OF 28
DATE: 2-7-84

REM
RIVER ENGINEERING METHOD

MANA-ENASCO
CONSULTANTS



SYMBOL KEY

- D CONTINUOUS DISCHARGE
- T W. S. LINE OF DISCHARGE
- S STAGE
- WG WATER QUALITY
- T CONTINUOUS WATER TEMPERATURE

- T WATER TEMPERATURE
- SS SUSPENDED SEDIMENT
- BL BEDLOAD
- BM BED MATERIAL
- XS CROSS SECTION
- TP THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT. 16, 1983
SCALE 1" = 2,000' SHEET 15 OF 28
DATE 2-7-84

ACM
ALASKA CONSULTING ENGINEERS

HARZA-EDASCO
A HARZA COMPANY



SYMBOL KEY

- [D] CONTINUOUS DISCHARGE
- [M] MISCELLANEOUS DISCHARGE
- [S] STAGE
- [WQ] WATER QUALITY
- [T] CONTINUOUS WATER TEMPERATURE

- [T] WATER TEMPERATURE
- [SS] SUSPENDED SEDIMENT
- [BL] BEDLOAD
- [BM] BED MATERIAL
- [XS] CROSS SECTION
- [TP] THALWEG PROFILE

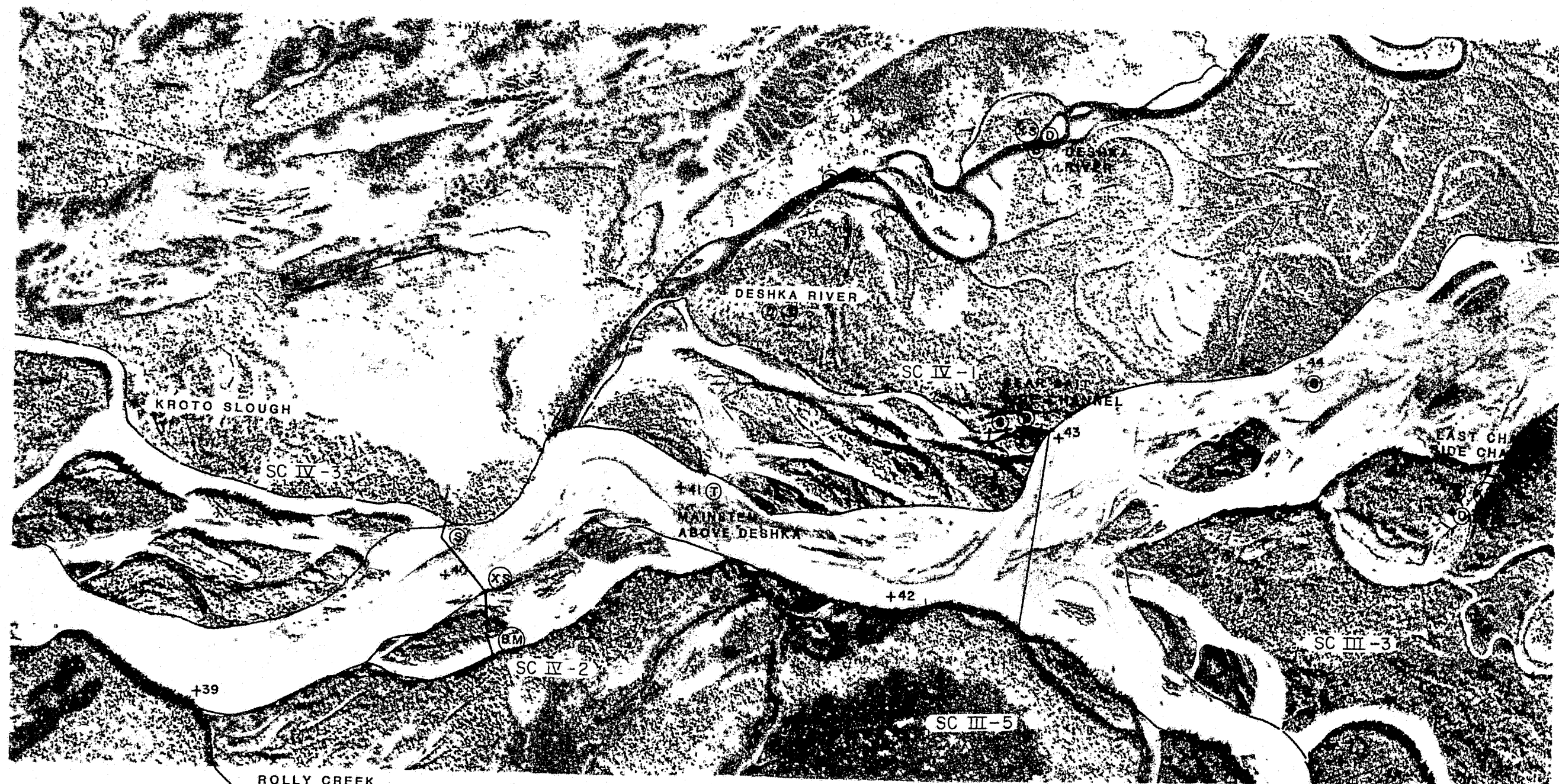
ALASKA POWER AUTHORITY SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT 16, 1983
SCALE: 200X
SHEET 16 OF 18
DATE 2-7-84

REM
RECONSTRUCTION ENGINEERING METHOD

HARZA-EDASCO
A JOINT VENTURE



SYMBOL KEY

- [D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WQ] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

- [T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BEDLOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

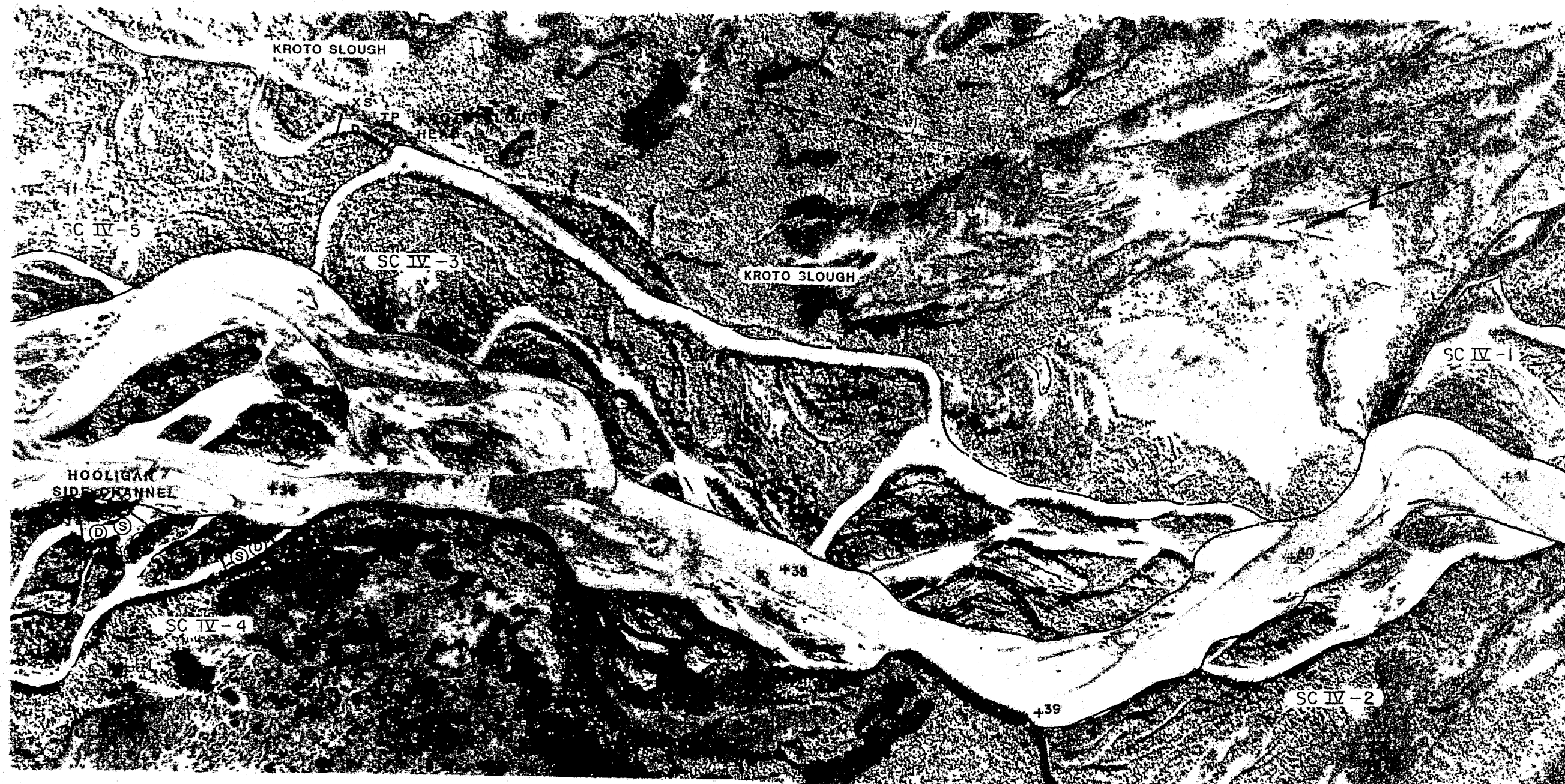
LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
 SCALE 1:25,000 SHEET 17 OF 28
 DATE 2-7-84

APR 1984

HARZA-ERASED

ILLUSTRATION UNIT, AK



SYMBOL KEY

D
S
G
WQ
I

CONTAINING DISCHARGE
W. SHELL ANNEAL DISCHARGE
TIDE
WATER QUALITY
CONTAINING WATER TEMPERATURE

T
SS
BL
BM
XS
TP

WATER TEMPERATURE
EROSIONED SEDIMENT
BED DAP
BED MATERIAL
CROSS SECTION
THALWEG PROFILE

ROLLY CREEK

D S
XS TP

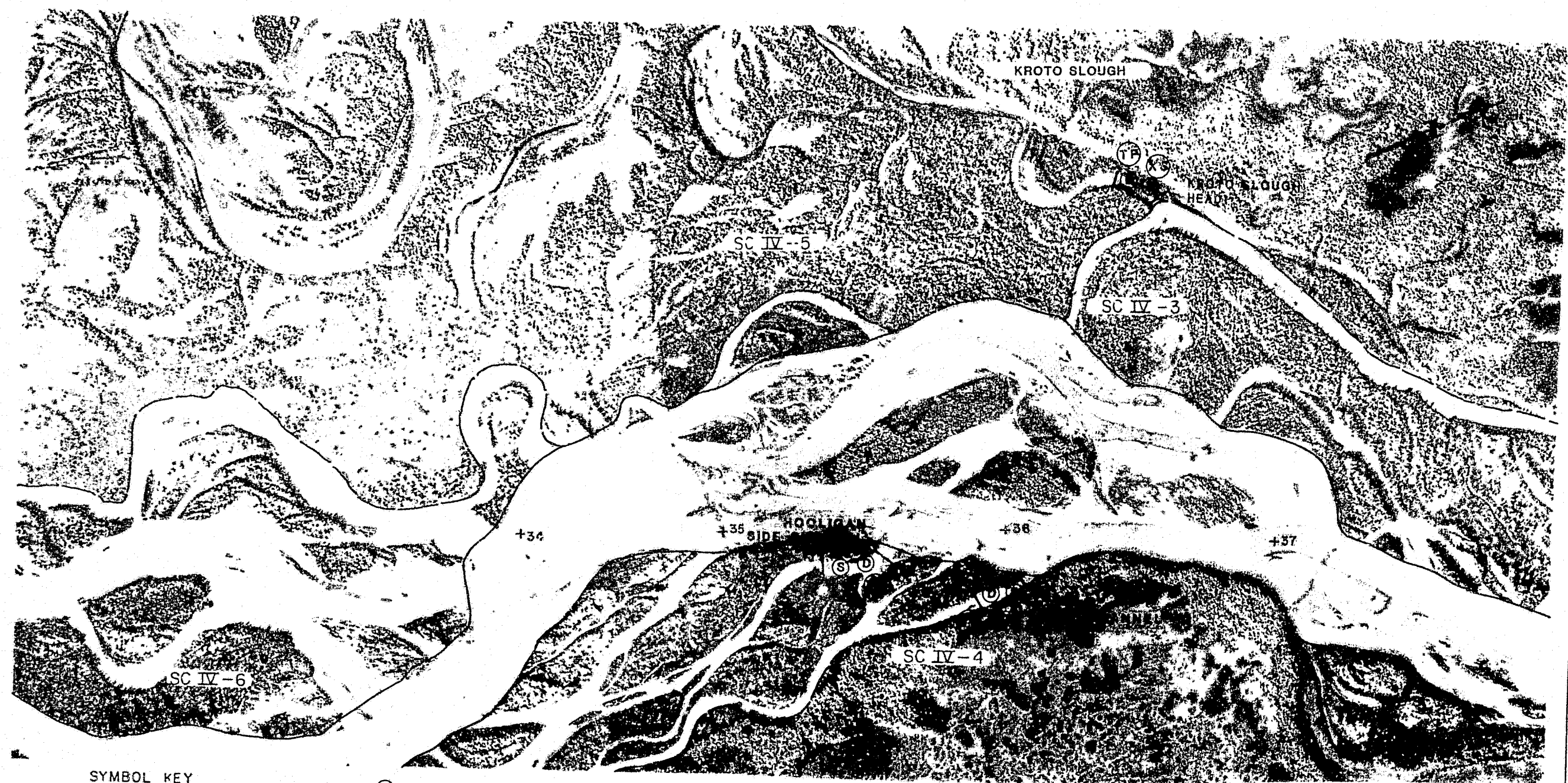
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF FIRST SURVEY: JAN 6, 1983
DATE OF THIS SURVEY: JAN 27, 1984
SHEET 18 OF 28

ALASKA POWER AUTHORITY

BARZA-EDASCO



SYMBOL KEY

- [D] CONTINUOUS DISCHARGE
- [D] MISCELLANEOUS DISCHARGE
- [S] STAGE
- [WQ] WATER QUALITY
- [T] CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT. 6, 1983
SCALE 1:2000 SHEET 19 OF 28
DATE 2-7-84

RSM

NAHA-ENASCO

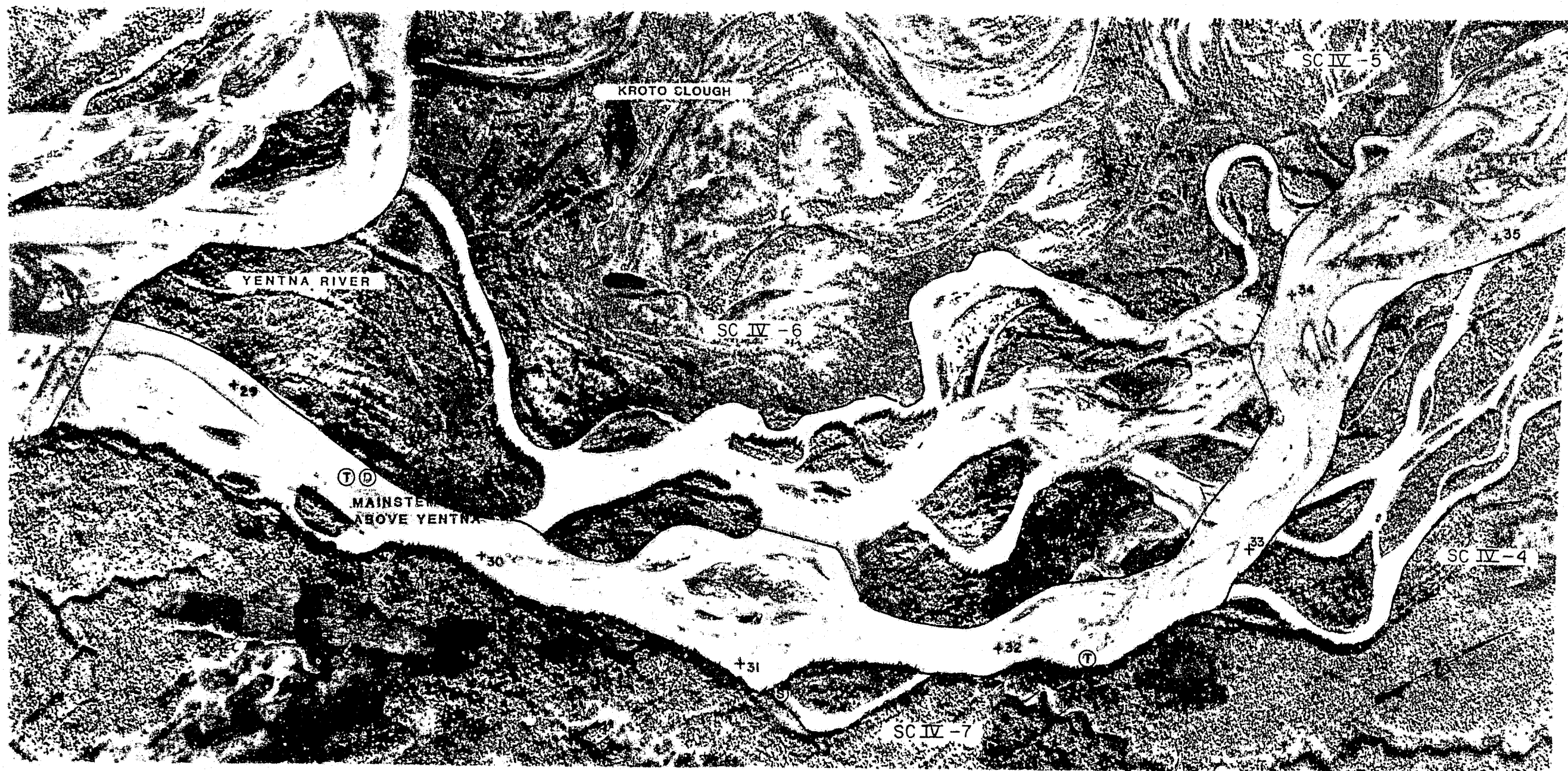
FOLD
LENGTH

12
11
8.5
8

AUTO

MANUAL

FEED



SYMBOL KEY

- (D) CONTINUOUS DISCHARGE
- (D) MISCELLANEOUS DISCHARGE
- (S) STAGE
- (WD) WATER QUALITY
- (T) CONTINUOUS WATER TEMPERATURE

- (T) WATER TEMPERATURE
- (SS) SUSPENDED SEDIMENT
- (BL) BEDLOAD
- (BM) BED MATERIAL
- (XS) CROSS SECTION
- (TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPH: SEPT 16, 1983
SCALE: 1:50,000
SHEET: 20 OF 28
DATE: 2-7-84

APR 1984

MANA-REASD

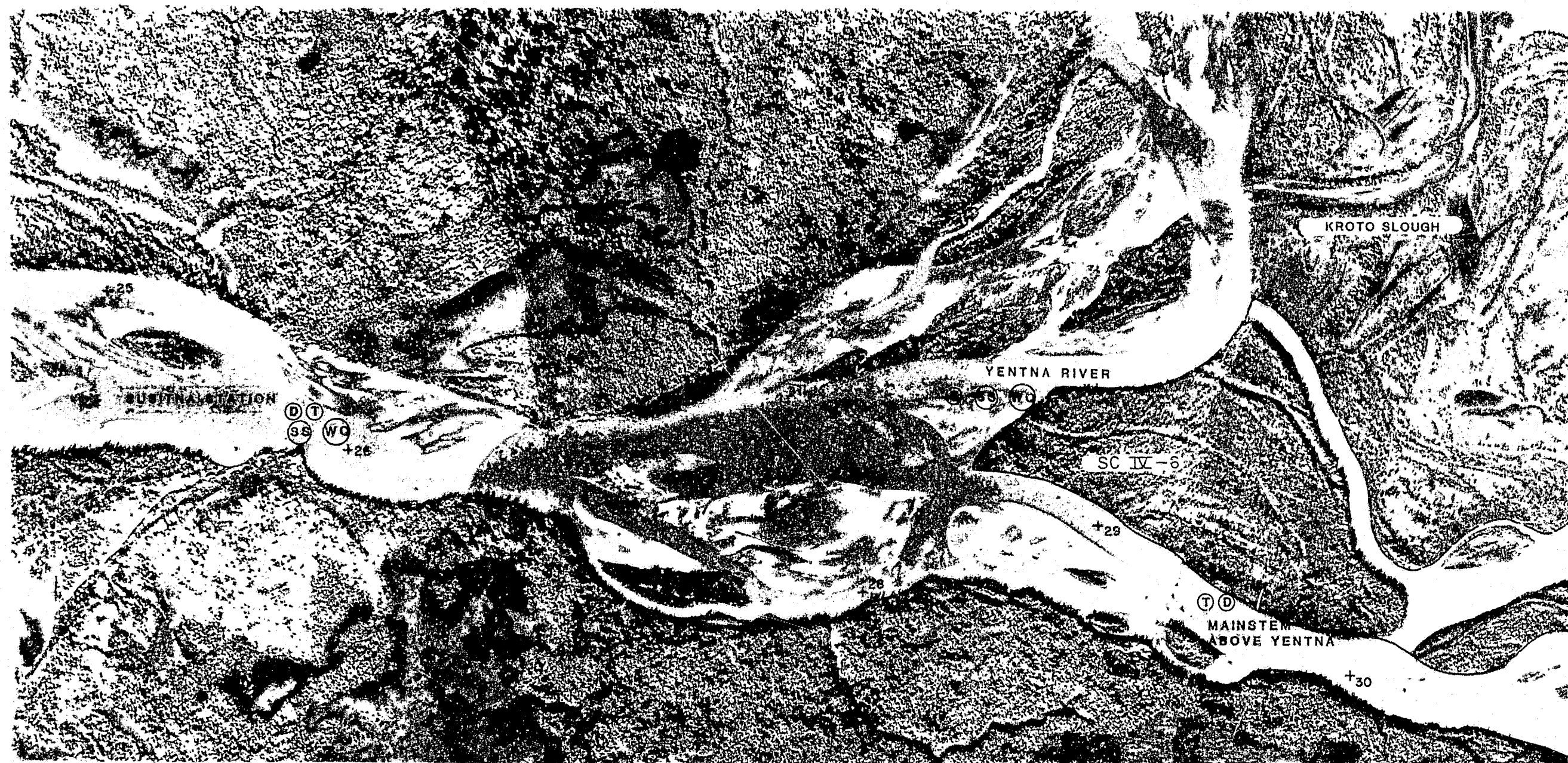
FOLD LENGTH

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- 8.5
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AUTO

MANUAL

FEED



SYMBOL KEY			
(D)	CONTINUOUS DISCHARGE	(T)	WATER TEMPERATURE
(D)	MISCELLANEOUS DISCHARGE	(SS)	SUSPENDED SEDIMENT
(S)	STAGE	(BL)	BEDLOAD
(WC)	WATER QUALITY	(BM)	BED MATERIAL
(T)	CONTINUOUS WATER TEMPERATURE	(XS)	CROSS SECTION
		(TP)	THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: 1983
DATE: 2-7-84

HAZARD-REASON

FOLD
LENGTH

12
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8.5
8

AUTO

MANUAL

FEED



SYMBOL KEY

(D) CONTINUOUS DISCHARGE
(S) MISCELLANEOUS DISCHARGE
(S) STAGE
(WQ) WATER QUALITY
(T) CONTINUOUS WATER TEMPERATURE

(D) CONTINUOUS DISCHARGE
(S) MISCELLANEOUS DISCHARGE
(S) STAGE
(WQ) WATER QUALITY
(T) CONTINUOUS WATER TEMPERATURE

(T) WATER TEMPERATURE
(SS) SUSPENDED SEDIMENT
(BL) BELLOAD
(BM) BED MATERIAL
(XS) CROSS SECTION
(TP) THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEP 6, 1983
SCALE 1"=2000' SHEET 22 OF 28
DATE 2-7-84

REM
RIVER ENGINEERING MANAGEMENT
INCORPORATED

MANA-124860
U.S. NATIONAL CENTER FOR
HYDROLOGIC INFORMATION

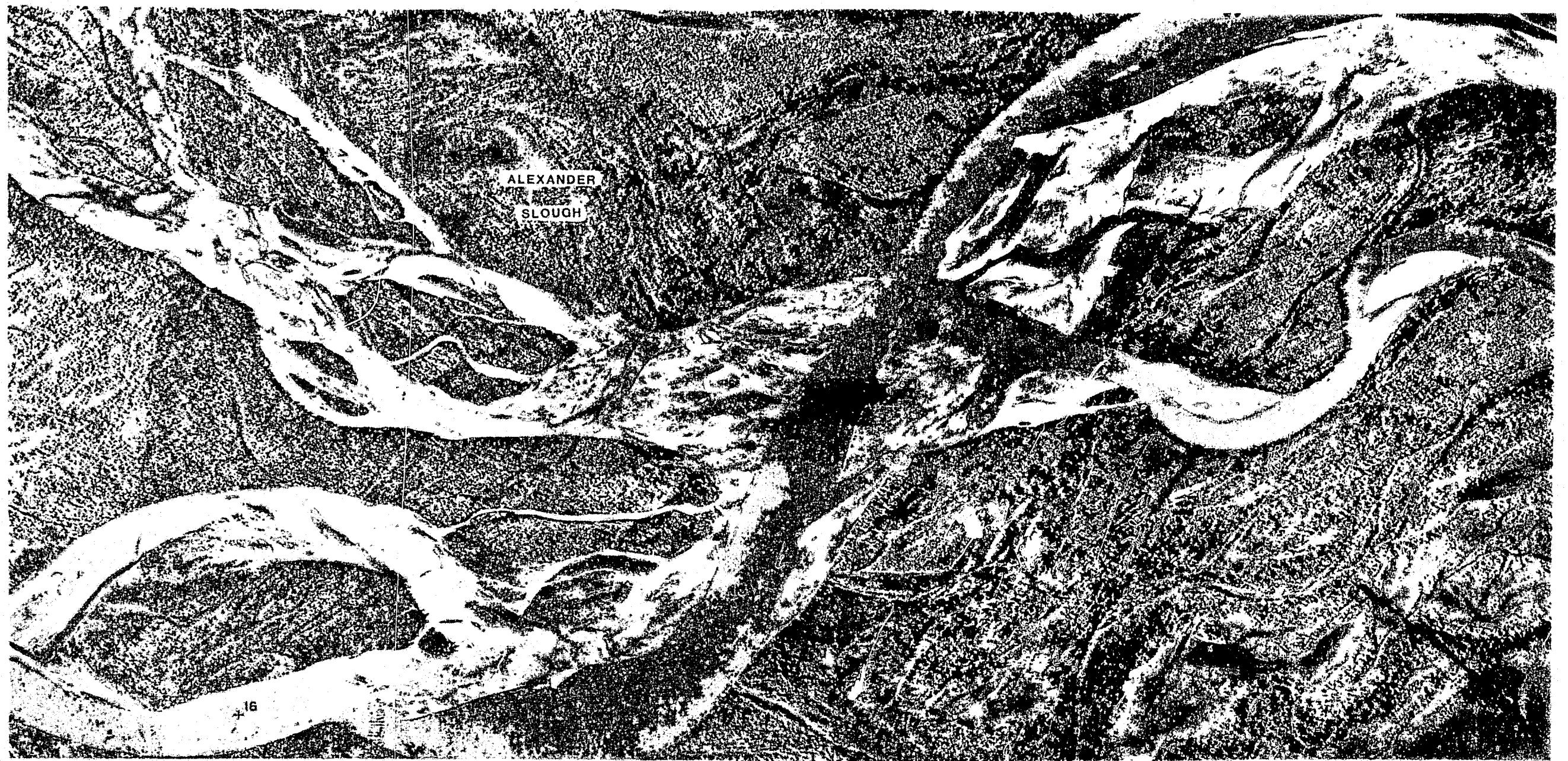
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— 8 —

AUTO

MANUAL

FEED



SYMBOL KEY

- | | | | |
|------|------------------------------|------|--------------------|
| (D) | CONTINUOUS DISCHARGE | (T) | WATER TEMPERATURE |
| (D) | MISCELLANEOUS DISCHARGE | (SS) | SUSPENDED SEDIMENT |
| (S) | STAGE | (BL) | BEDLOAD |
| (WC) | WATER QUALITY | (BM) | BED MATERIAL |
| (T) | CONTINUOUS WATER TEMPERATURE | (XS) | CROSS SECTION |
| | | (TP) | THALWEG PROFILE |

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
SCALE 1:2000
SHEET 23 OF 28
DATE 2-7-84

PSM
PACIFIC SOUTHERN MANAGEMENT, INC.

HAZRA-EBASCO
SUSITNA JOINT VENTURE

FOLD
LENGTH
— 12
— 11
— 8.5
— 8

AUTO
MANUAL
FEED



SYMBOL KEY

[D] CONTINUOUS DISCHARGE
 [C] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WQ] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

[T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BEDLOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT 16, 1983
 SCALE 1" = 2000' SHEET 24 OF 28
 DATE 2-7-84

FGM
 FISH CREEK MAPS

HARZA-EDASCO
 SUSITNA JOINT VENTURE



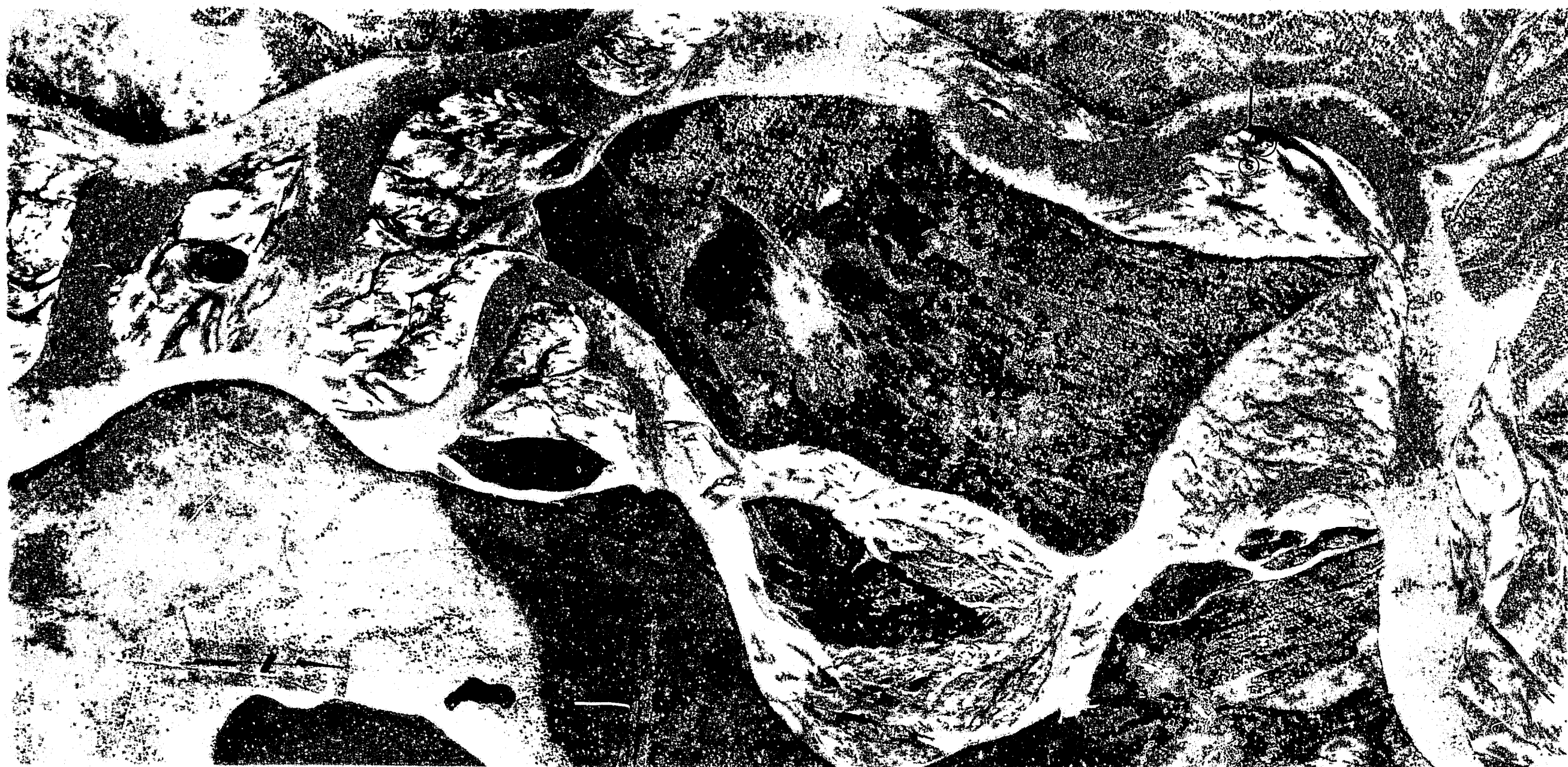
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AUTO

MANUAL

FEED



SYMBOL KEY

[D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WG] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

[T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BEDLOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY
 SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT. 6, 1983
 DATE OF SURVEY: SHEET 25 OF 28
 DATE: 2-7-84

APV

NANA-ESBGO
 SUSITNA JOINT VENTURE



FOLD LENGTH

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AUTO

MANUAL

FEED



SYMBOL KEY

(D)	CONTINUOUS DISCHARGE	(T)	WATER TEMPERATURE
(D)	MISCELLANEOUS DISCHARGE	(SS)	SUSPENDED SEDIMENT
(S)	STAGE	(BL)	BED LOAD
(WO)	WATER QUALITY	(BM)	BED MATERIAL
(T)	CONTINUOUS WATER TEMPERATURE	(XS)	CROSS SECTION
		(TP)	THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY SEPT. 6, 1983
SCALE 1:2500
SHEET 26 OF 28
DATE 2-7-84

PSM
PACIFIC SOUTHERN MANAGEMENT, INC.

HAZARD-ERASCO
SUSITNA JOINT VENTURE

FOLD
LENGTH

— 12
— 11
— 8.5
— 8

AUTO

MANUAL

FEED



SYMBOL KEY

- [D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WQ] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

- [T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BED LOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEP 16, 1983
 SCALE: 1:50,000
 SHEET: 27 OF 28
 DATE: 2-7-84

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MANA-EB360

FOLD
LENGTH

— 12
 — 11
 — 8.5
 — 8

AUTO

MANUA

FEED



SYMBOL KEY

[D] CONTINUOUS DISCHARGE
 [D] MISCELLANEOUS DISCHARGE
 [S] STAGE
 [WQ] WATER QUALITY
 [T] CONTINUOUS WATER TEMPERATURE

[T] WATER TEMPERATURE
 [SS] SUSPENDED SEDIMENT
 [BL] BED LOAD
 [BM] BED MATERIAL
 [XS] CROSS SECTION
 [TP] THALWEG PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

LOWER SUSITNA RIVER

DATE OF PHOTOGRAPHY: SEPT 16, 1983
 SCALE: 20X
 SHEET 28 OF 28
 DATE 2-7-84

APV

HARZA-EBASCO
 SUSITNA JOINT VENTURE

FOLD
LENGTH

— 12
 — 11
 — 8.5
 — 8

AUTO

MANUAL

FEED