31

SUSITNA HYDROELECTRIC PROJECT

RIVER MORPHOLOGY

MASTER COPY
Please Return To
DOCUMENT CONTROL

JANUARY 1982

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

ALASKA POWER AUTHORITY

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY
RIVER MORPHOLOGY

JANUARY 1982

Prepared for:

ACRES AMERICAN INCORPORATED
1000 Liberty Bank Building
Main at Court
Buffalo, New York 14202
Telephone (716) 853-7525

Prepared by:

S. Bredthauer & B. Drage
R&M CONSULTANTS, INC.
P.O. Box 6087
5024 Cordova Street
Anchorage, Alaska 99503
Telephone (907) 279-0483

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

RIVER MORPHOLOGY

TABLE OF CONTENTS — Page

LIST OF FIGURES

LIST OF FIGURES - (Continued)

LIST OF FIGURES - (Continued)

LIST OF FIGURES - (Continued)

LIST OF TABLES

LIST OF TABLE - (Continued)

1 - INTRODUCTION

1.1 Background and Purpose

Construction of dams at Watana and Devil Canyon will effect the river morphology downstream of Devil Canyon, with possible effects on fisheries, vegetation, and wildlife. The possible effects of dams on river morphology are described below. The purpose of this report is to describe the existing flow, sediment and river regimes from Devil Canyon to the mouth of the Susitna River, and to assess potential morphological changes in the river.

1.2 Downstream Effects of Dams

The construction of dams on a river system modifies both the natural flow regime and the natural sediment transport regime, thus impacting the river processes downstream of the dams. Before discussing the impacts on the river morphology of the Susitna River downstream of Devil Canyon, a summary of impacts downstream of similar projects is worthwhile.

Kellerhals and Gill (1973), Petts (1977), Taylor (1978) and Baxter and Glaude (1980) have summarized channel response to flow regulation. Operation of reservoirs significantly alters the flow regime. There is often an increase in the diurnal variation of flow due to the variation in the amount of water passing the turbines in order to follow the load demand. Annual peak discharges are reduced not only due to storage which allows no overflow over the spillway, but also due to the surcharge storage provided by the rise in water level above the spillway crest. Routing through a reservoir with no available storage may reduce some flood peaks by over 50% (Moore, 1969), depending on the characteristics of the spillway, reservoir, and flood hydrograph. The magnitude of the mean annual flood of the Colorado River below Hoover Dam has been reduced by 60% (Dolan, Howard, and Gallenson, 1974). The total volume of flow may be reduced due to the increase in time during which seepage and evaporation losses may occur. Base flow tends to be increased due to seepage and to minimum releases to the channel below the dam.

Reservoirs with a large storage capacity may trap and store over 95% of the sediment load transported by the river (Leopold, Wolman, and Miller, 1964), with the actual percentage depending primarily on the storage capacity-inflow ratio (Brune, 1953), although reservoir shape, reservoir operation, and sediment characteristics have some influence (Gottschalk, 1964).

The effect of dams on the sediment load must not be considered in isolation but in relation to changes in river sediment transport capacity, to river regime, to channel morphometry, and with regard to major tributaries. At tributaries which transport large quantities of sediment into a regulated mainstream with reduced flows and consequently less ability to flush away sediments, the effects include aggradation, an increase in bed slope of the tributary, and trenching of the deposit to form a channel that is in quasi-equilibrium with the flow regime (King, 1961; Kellerhals, Church and Davies, 1977). The increased gradient results in increased velocities, bank instability, possible major changes in the geomorphic character of the tributary stream, and increased local scour (Simons and Senturk, 1976).

All of the bedload entering a reservoir is deposited in the reservoir. This reduction in sediment supply is usually greater than that in sediment-carrying capacity, resulting in erosion downstream of the dam except where an armor layer or an outcrop of bedrock occurs (Petts, 1977). Degradation will occur where the regulated flow has sufficient tractive force to initiate sediment movement in the channel (Gottschalk, 1964). Once the channel bed has been stabilized, either by armoring or by the exposure of bedrock, then the banks, which usually consist of finer material than the bed, begin to fail and the channel will widen. Where armoring or bedrock occur across the width of the channel, a simple adjustment will occur where streamflow is accommodated in the existing channel.

The sediment load plays an important role in the process of meander migration across alluvial plains by forming point bars from bed load deposition on the inside bank. These point bars are then aggraded to floodplain levels due to the deposition of suspended sediment in the emerging vegetation. The reduction in sediment load may disrupt this process, with at least local ecological changes. Widening of channels at meander bends and lateral instability may also be expected (Kellerhals and Gill, 1973).

Maximum degradation normally occurs in the tailwater of the dam, but may extend downstream. Rates of degradation up to 15 cm per year have been observed both in the United States (Leopold, Wolman, and Miller, 1964) and Europe (Shulits, 1934). Channel adjustment to bed degradation and the associated reduction in slope was observed for nearly 250 km below Elephant Butte Dam (Stabler, 1925). When an armored condition occurs where the river is unable to recharge itself to capacity, the river may pick up additional material downstream, as was observed on the Colorado River below Hoover Dam (Stanley, 1951).

The channel properties of gravel-bed rivers such as the main stem of the Peace River in Alberta appear to be controlled by floods with a recurrence interval of 1.5 to 2 years (Bray, 1972). Regulation reduces these flows, effectively reducing the size of the gravel-bed river without immediately changing the channel, but certain channel properties will adjust to the channel regime over a longer period of time. On the Peace River, the entrenched layer of the channel, the proximity of bedrock, and the resistant bed material preclude significant changes in width and depth relationships or in the slope (except near tributary junctions), but deep scour holes at bends will fill to some degree, and gravel bars exposed above the new high water mark will have emerging vegetation (Kellerhals and Gill, 1973).

Vegetation encroachment on the higher elevations of the gravel bars downstream of a dam can be expected due to the reduced summer streamflows and the lower flood peaks, and in time could encroach on present high water channels (Tutt, 1979; Kellerhals, Church and Davies, 1977). The effect of the additional vegetation would be to increase the channel roughness, thus decreasing the channel water conveyance. The channel size and capacity could gradually decrease due to vegetation encroachment, deposition of suspended load in the newly vegetated areas, accumulation of material from the valley walls and deposition of sediment brought in by the tributaries. During periods of high flow, higher river stages could be expected.

The W.A.C. Bennett Dam on the Peace River had a dramatic unplanned impact on the Peace-Athabasca Delta (Baxter and Glaude, 1980). The delta is a series of marshes interspersed with lakes and ponds of various sizes. Before the dam was built, the delta was maintained in this state due to almost annual flooding, which prevented vegetation typical of drier ground from being able to establish itself. The hydrological situation itself was complex. The Peace River, passing to the north of the delta, contributed little to the actual flooding, but its flood waters blocked the exit of the Athabasca River, which entered from the south and caused the actual flooding. After construction of Bennett Dam, the delta started drying up, with dry-ground vegetation establishing itself. The effect of the dam was initially obscured due to lower than normal precipitation for some years previously, but it was eventually concluded that the dam was at least a contributing factor, as flood levels on the Peace River were lowered, resulting in the Peace River no longer blocking the exit of the Athabasca River.

1.3 Report Contents

A relatively significant amount of data are available for the reach of river between Devil Canyon and Talkeetna. Over 30 years of streamflow and suspended sediment data are available for the Susitna River at Gold Creek. Aerial photography was flown in 1980, and blueline copies made at a scale of 1" = 500'. Cross-sections were surveyed at 66 sites from Devil Canyon to the Chulitna confluence. Bed material data were gathered at a number of cross-sections. Using crest gage data gathered in this reach, the HEC-2 water surface profile model was calibrated, and water surface elevations estimated using results from the model. Ice conditions were observed during the 1980-81 winter and 1981 freeze-up.

The available data base is considerably smaller below Talkeetna. Streamflow, suspended sediment and water quality data have been gathered at the Susitna Station gaging site since 1975. Streamflow suspended sediment and bedload data were collected at Sunshine (Parks Highway Bridge) in 1981. Aerial photography is available at a scale of 1" = 500'. Cross-sections are available only at U.S. Geological Survey gaging sites and at miscellaneous sites or sloughs along the river. Ice conditions were observed during the 1980-81 and 1981-82 winters.

This report compiles, presents and interprets all available information pertinent to assessing changes in the river morphology. The existing river patterns and controlling features are described from Devil Canyon to Cook Inlet. A qualitative assessment is also made to predict the response of the river to post-project conditions.

2 - SUMMARY

2.1 - Basin Overview

The Susitna River drainage basin is located in the Cook Inlet subregion of the southcentral region of Alaska. The drainage basin covers 19,600 square miles. It is bordered on the west and north by the Alaska Range, on the east by the Talkeetna Mountains and the Copper River lowland, and on the south by Cook Inlet.

Climate

The upper drainage basin is in the continental climatic zone, and the lower drainage basin is in the transitional climatic zone. Due to the maritime influence and the lower elevations, temperatures are more moderate and precipitation is less in the lower basin than that in the upper basin. In the higher regions, freeze-up starts in early October, and most rivers are ice-free in late April or early May.

Topography

Tributaries in the western and northern portions of the drainage basin rise in the glaciers of the Alaska Range, which is dominated by Mount McKinley (20,320 feet) and Mount Foraker. Other peaks average 7,000 to 9,000 feet in altitude. Those in the eastern portion rise in the Copper River lowland and in the Talkeetna Mountains. The highest peak is 8,850 feet, with elevations averaging 6,000 to 7,000 feet and decreasing northward and westward. To the northwest, the mountains form a broad, rolling glacially scoured upland dissected by deep glaciated valleys. Between these ranges and the Cook Inlet is the Susitna lowlands, a broad basin increasing in elevation from sea level to 500 feet, with local relief of 50 to 250 feet.

Geology

The Susitna River basin derived its present geologic features during Quaternary glaciations. The underlying bedrock consists of granitic batholiths intruded into Paleozoic and Mesozoic volcanic and sedimentary rocks on the south side of the Alaska Range and in the Talkeetna Mountains. Copper, gold, silver, and other minerals are associated with the intrusions. The unconsolidated deposits of the lowlands, which contain thaw lakes and marshes and are poorly drained, overlay Tertiary coal-bearing rocks resting on Mesozoic rocks 30,000 feet thick.

Unconsolidated deposits are extensive and largely derived from glaciers. Glacial moraines and gravels fill glacial-carved U-shaped valleys in the upland areas. Glaciolacustrine deposits are present in the lowlands. During the periods of glaciation, convergence of glacial flow blocked drainage, and proglacial lakes formed. The deposits are laminated, rhythmically bedded sand, silt, and clay. Fluvial deposits are present in the major river valleys, and consist of gravels and sands.

The drainage basin lies in the discontinuous permafrost zone. In the mountainous areas, discontinuous permafrost is generally present. In the lowlands and upland areas below 3,000 feet, there are isolated masses of permafrost in areas of predominately fine-grained deposits. Permafrost does not exist in coarse-grained deposits or in deposits adjacent to the main stem river or large water bodies.

Soils

Gravelly till and outwash in the lowlands and on upland slopes are overlain by shallow to moderately deep silty soils. Windblown silt covers upland areas. Steeper upper slopes have shallow, gravelly and loamy deposits with many bedrock exposures. On the south flank of the Alaska Range and south-facing slopes of the Talkeetna Mountains, soils are well-drained, dark, and gravelly to loamy. Poorly drained, gravelly and stony loams with permafrost are present on northfacing slopes of foothills, moraines, and valley bottoms. Water erosion is moderate on low slopes and severe on steep slopes.

Vegetation

Vegetation above tree line in steep, rocky soils is predominately alpine tundra. Well-drained upland soils support white spruce and grasses, whereas poorly drained valley bottom soils support muskeg. Tideflats are dominated by sedge meadows where drainage is poor, and are bordered by moist tundra grading into spruce-hardwood forests in well-drained loamy soils.

Water Resources

The Susitna River drainage basin is the sixth largest system in Alaska. The Susitna River is 320 miles long, and major tributaries include the Yentna, Chulitna, and Talkeetna Rivers. Extensive glaciers in the headwaters contribute substantial suspended sediment loads during summer months. Streamflow is characterized by high flows between May and September and low flows from October to April. High summer discharges are caused by snowmelt, rainfall, and glacial melt. Tributaries are generally turbulent in the upper reaches and slower flowing in the lower reaches.

On the western side of the basin is the Yentna River, with its tributaries the Skwentna River (entering on the southwest) and the Kahiltna River (entering on the northwest). The Yentna River rises in the glaciers of the Alaska Range and flows 95 miles southeasterly, entering the Susitna River 28 miles from its mouth. The Chulitna River rises in the glaciers on the south slope of Mount McKinley and flows 90 miles south, entering the Susitna River near Talkeetna. The Talkeetna River rises in the Talkeetna Mountains, flows west, and also enters the Susitna River near Talkeetna, 97 miles from its mouth. The Susitna River and its major downstream tributaries are shown in Figure 2.1. Cross-section locations on the river between the Parks Highway and the proposed Watana Dam are illustrated in Figure 2.2.

2.2 Projected Post Project Morphological Changes on the Downstream River

The following summarizes potential changes in the current river morphology that could be expected from flow and sediment regulation.

The Susitna River main channel between Devil Canyon and the Chulitna River confluence will tend to become more defined with a narrower channel. The main channel river pattern will strive for a tighter, better defined meander pattern within the existing banks. A trend of channel width reduction by encroachment of vegetation and sediment deposition can be expected. This will tend to gradually increase flow depths at specific discharges above the immediate post-project condition.

Downstream of the Susitna-Chulitna confluence the frequency of occurrence of dramatic changes in river morphology will decrease under post-project conditions, resulting in a more stabilized floodplain, decreased number of subchannels and increased vegetative cover. However, it must be recognized that an extreme flood generated by either the Chulitna River, Talkeetna River or both in combination with other tributaries could mask this process and delay observable changes for several years.

The project morphological changes for specific river reaches are summarized below:

RM 149 to RM 144

- The channel is stable and little change in form is expected.
- Portage Creek fan will progress out into the Susitna until equilibrium with the regulated Susitna stage is established. Perching of the stream mouth is not expected.

RM 144 to RM 139

- Erosion of valley walls and terraces will decrease dramatically due to the armour layer.
- Reworking of alluvial deposits in the main channel will continue but at a reduced rate.
- Main channel form will progress slowly to a more uniform sinuous pattern.
- Subchannels may become inactive.
- Tributary at RM 144 could become perched. It may not be able to regrade its coarse bed sediments to meet the regulated Susitna water level.

RM 139 to RM 129.5

- Indian River will continue to extend its alluvial deposits into the Susitna. Indian River should easily grade its bed to meet the regulated Susitna Stage.
- Gold Creek gradient is presently very steep as it enters the Susitna. The cobble and boulder bed will resist regrading the bed to meet the regulated Susitna stage.
- Fourth of July Creek gradient is currently relatively flat and should easily adjust to the regulated Susitna stage.
- Erosion of valley walls, terrace deposits and alluvial banks will reduce dramatically due to the armour layer.
- Reworking of active gravel bed materials will continue at a reduced rate. Main channel form will slowly progress to a more uniform sinuous pattern.
- Several of the sloughs and subchannels could be blocked off from the Susitna main channel at the regulated stage. Where these channels rejoin the Susitna, gradual siltation and vegetation encroachment will occur.

RM 129.5 to RM 119

- Erosion of valley walls, terraces and alluvial deposits will reduce dramatically.
- At RM 128 and 125.5, reworking of gravel bed material will continue, but at a reduced rate. Main channel form will become more uniform.

- Cobble berms at the side channels and sloughs will control and perhaps block main channel flow from entering them.

- The river should continue its preferred and stable route along the west valley wall.

RM 119 to RM 104

- No consequential changes in the channel morphology are expected.

RM 104 to RM 95

- Chulitna River will continue to expand and extend its alluvial deposits. Decreasing the summer flow magnitude in the Susitna River will allow the Chulitna to extend alluvial deposits to the east and south. This could induce erosion of the east bankline towards the railroad.

- Increased deposition at the confluence will cause backwater up the Susitna River. Lateral instability will continue after the project.

- The Talkeetna River will maintain the ability to create its channel into the Susitna system. No consequential interactions can be foreseen at this time.

RM 95 to RM 61

- Under post-project conditions, the bankfull flood (mean annual flood under pre-project conditions) could be expected to have a recurrence interval of once every five to ten years. This will tend to decrease the frequency of occurrence of both bed material movement and consequently of changes in braided channel shape, form and network.

- Over a long period, a trend towards relative stabilization of the floodplain features should occur. The main channel and major subchannels could progress to a more uniform meandering pattern. The active gravel floodplain may develop a vegetative cover and the minor subchannels become relatively inactive. It must be recognized that an extreme flood generated by either the Chulitna River, Talkeetna River, or both, could mask this process and delay observable changes for several years.

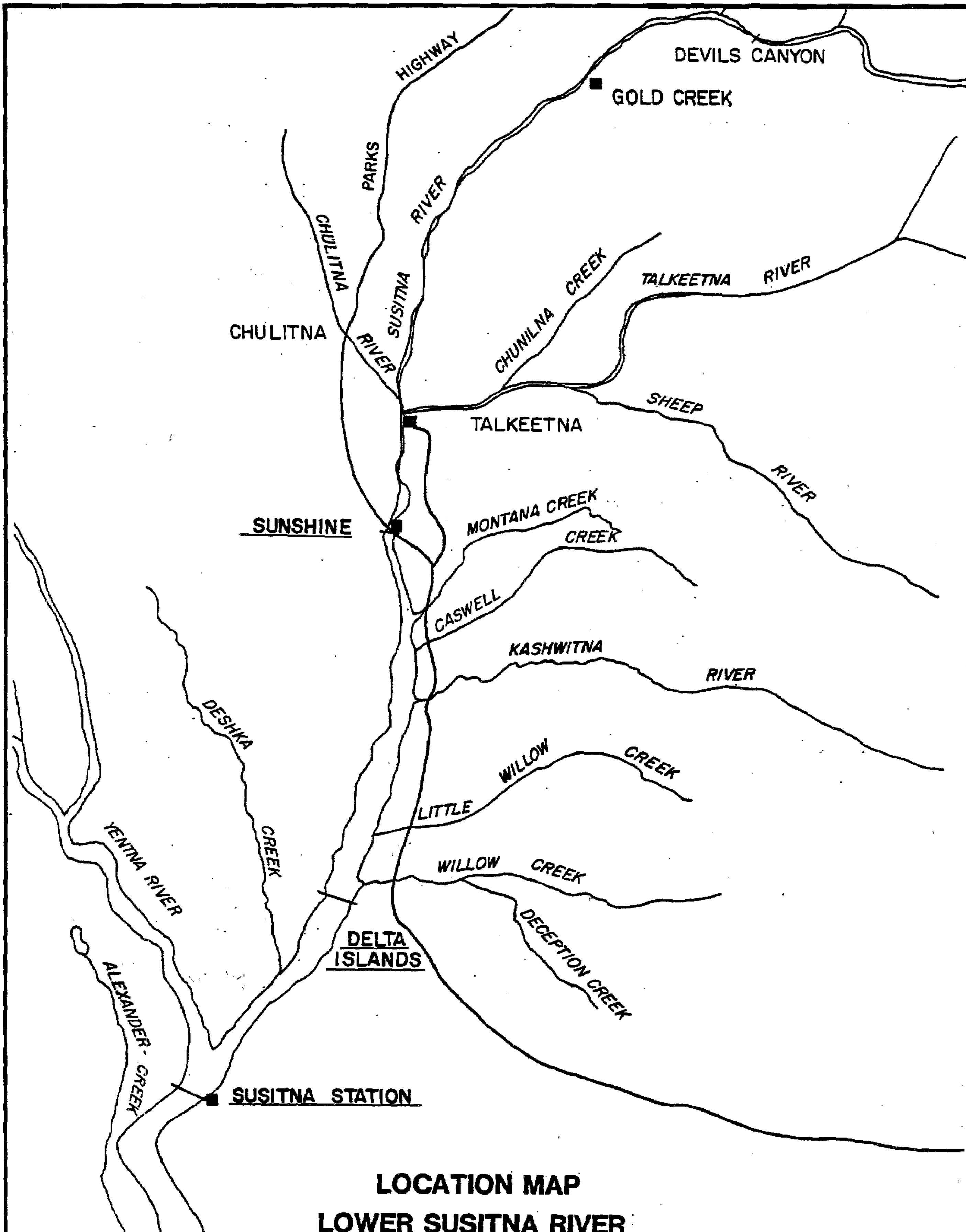
RM 61 to RM 42

- The Delta Island reach is a very complex and unstable channel network. There exists a very broad floodplain filled with varying channel types. Project induced changes in flow and sediment regime realized at this reach will be diluted by contribution from tributaries and by the Susitna satisfying its sediment load by reworking the wide floodplain alluvial deposits. Basic changes in the overall channel network are not expected.

- Local changes could occur in the main channel lateral position but basic channel geometry should remain relatively similar. To quantity post project morphology changes with respect to the natural system would be extremely difficult, if not impossible.

RM 42 to RM 0

- Effects of the project on river morphology through this reach of river would be extremely difficult or impossible to quantify. The dilution effect of major and minor tributaries as well as the balancing of changes by the Susitna River system should mask any measurable changes that could occur as a result of the project for several decades.



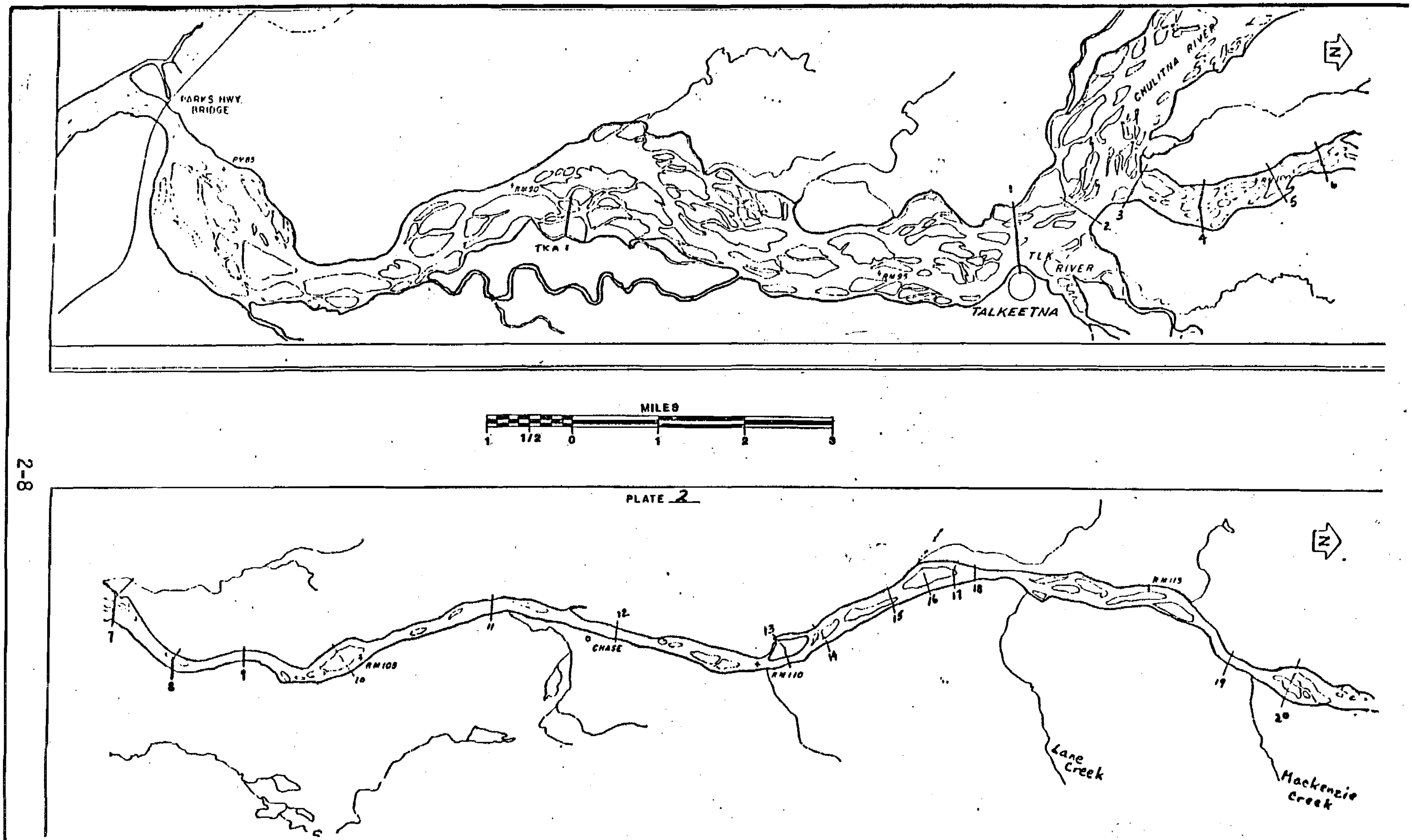
LOCATION MAP
LOWER SUSITNA RIVER

PREPARED BY: R&M CONSULTANTS, INC.

PREPARED FOR: ACRES

SUSITNA RIVER BASIN

FIGURE 2.1



2-8

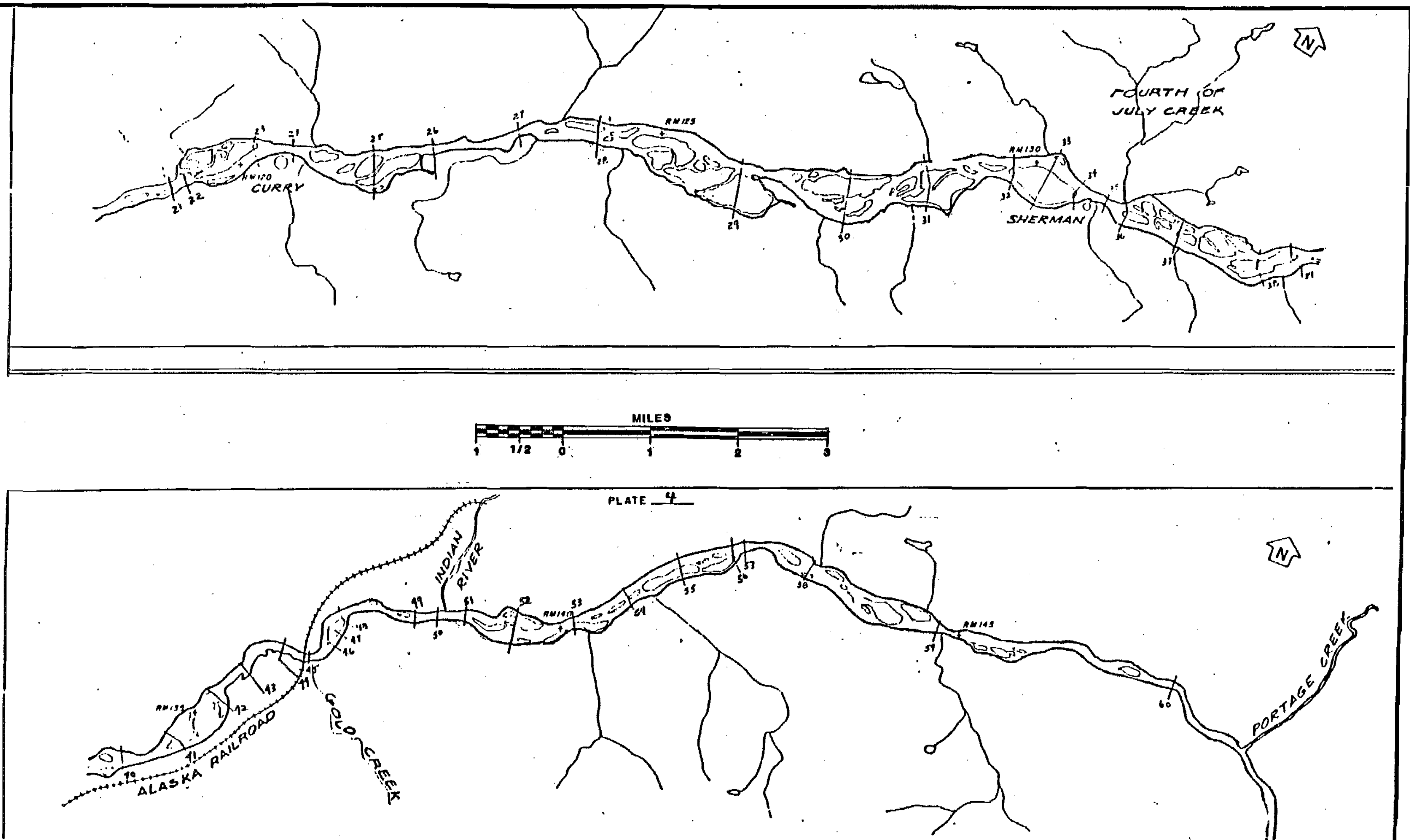
Prepared by:

R&M CONSULTANTS, INC.

FIGURE 2.2 RIVER CROSS-SECTION LOCATIONS

Prepared for

ACRES



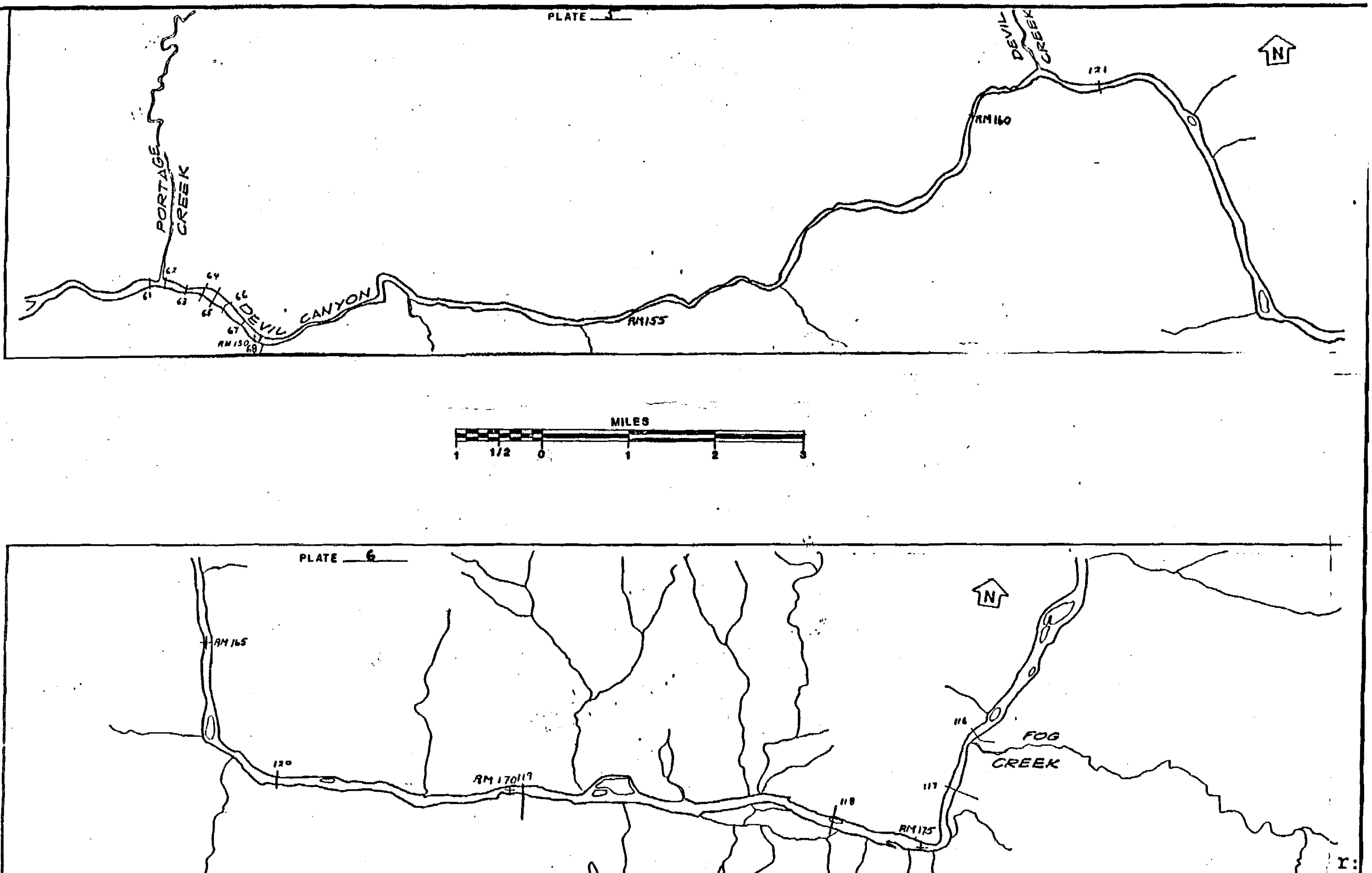
Prepared by:

R&M CONSULTANTS, INC.

FIGURE 2.2 CONTINUED

Prepared for:

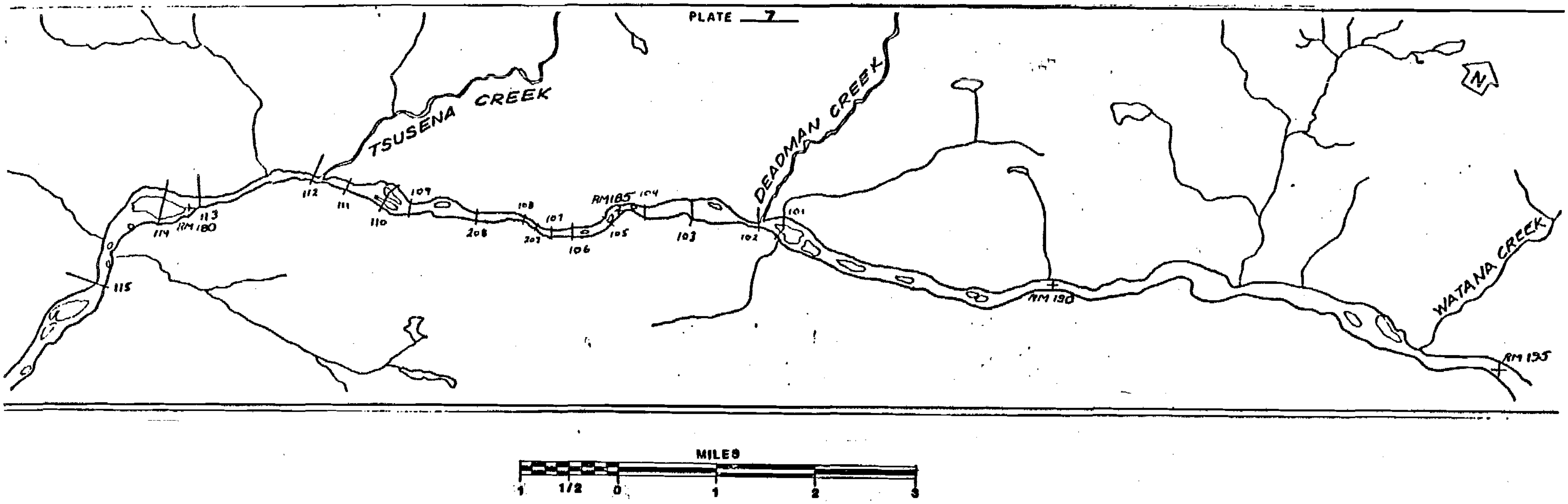
ACRES



R&M CONSULTANTS, INC.

FIGURE 2.2 CONTINUED

ACRES



Prepared by:

R&M CONSULTANTS, INC.

FIGURE 2.2 CONTINUED

Prepared for:

3 - FLOW REGIME

The flow regime defines the amount of time that certain flows, together with the corresponding hydraulic characteristics, can be expected. The information is useful in analysis of the sediment regime and the river morphology, as most of the sediment transport occurs at high flows. It is also important in evaluating the impact of flow regulation on fisheries.

3.1 Flow Duration Analysis

A flow duration curve shows the proportion of time that discharge equals or exceeds various values. Pre-project monthly and annual flow duration curves based on average daily flows were developed for the four mainstem Susitna River gaging stations (Denali, Vee Canyon, Gold Creek and Susitna Station) and three major tributaries (MacLaren, Chulitna, and Talkeetna Rivers), and are shown on Figures 3.1 through 3.4. The period of record used for each flow duration curve is shown in Table 3.1. The curves do not necessarily indicate that flows are greater than a given value for a certain number of days for every year, i.e. that 30,000 cfs is exceeded five percent of every year at the Susitna River at Gold Creek. In the above example, the flow duration curve indicates only that five percent of all days during the period of record had discharges above 30,000 cfs. The annual flow duration curve does not indicate how the sequence of flows occur - annual hydrographs should be examined to determine sequences of high or low flows.

The shape of the monthly and annual flow duration curves are similar for each of the stations. The flow duration curves are indicative of flow from glacial rivers. Streamflow is low in the winter months, with little variation in flow and no unusual peaks. Flow begins to increase slightly in April as breakup approaches. Peak flows in May are an order of magnitude greater than in April. Flow in May also shows the greatest variation for any month, as low flows may continue into May before the high snowmelt/breakup flows occur. June has the highest peaks and the highest median flow. The months of June through July have relatively flat flow duration curves, indicating that significant portions of flow are within a relatively narrow flow range. More variability of flow is evident in September and October as cooler weather becomes more prevalent.

3.2 Post Project Flows

Daily post-project flows for the Susitna River below Devil Canyon are not available. However, the change in flow durations can be estimated based on monthly flow duration curves. Due to the lack of records at Sunshine and the short period of record at Susitna Station, 30 years of pre-project monthly flows were synthesized using records from the Susitna River at Gold Creek, Talkeetna River, and Chulitna River gaging stations. The post-project project flow duration curves are based on the 30-year monthly operation of the Watana and Devil Canyon Reservoirs for Case A (optimal power operations) and Case D (minimal impact on salmon spawning areas in side channels and sloughs above Talkeetna). Tables 3.2 through 3.10 present the 30-year record of historical and synthesized monthly flows for pre- and post-project conditions at Susitna River at Gold Creek, Sunshine and Susitna Station. Annual and monthly flow duration curves for pre- and post-project conditions for these stations are shown in Figures 3.5 through 3.7. Also presented on these figures are the corresponding water surface elevations, based on USGS rating curves. For the ice cover period between November and early May, the water surface elevations shown on the graphs will not be valid. The only reason for their inclusion is that the difference in water levels under pre- and post-project conditions is likely to be of the same order as under open water conditions.

The relative contribution of average monthly flows at the confluence of the Susitna, Chulitna and Talkeetna Rivers is shown in Tables 3.11 through 3.13 for pre- and post-project conditions. The annual flow duration curves for the three rivers, including both post-project flow options for Susitna, are illustrated together on Figure 3.8.

The pre- and post-project annual flood frequency curves for the Susitna River at Gold Creek, Sunshine, Delta Islands, and Susitna Station are presented in Figures 3.9 through 3.12. Table 3.14 presents pre- and post-project flood discharges and stages for the four sites.

Rating tables and rating curves for the above three sites are presented in Attachment A.

3.3 Contribution by Tributaries

As part of Subtask 3.05 - Flood Studies, a regional equation was developed to determine mean annual flood flows based on basin characteristics. A forward stepping multiple linear regression computer program was utilized. Twelve watershed parameters were considered, including: drainage area, main channel slope, stream length, mean basin elevation, area of lakes and ponds, area of forests, area of glaciers, mean annual precipitation, precipitation intensity, mean annual snowfall, and mean minimum January temperature. The most influential parameters in predicting the mean annual instantaneous peak flow are drainage area, stream length, area of glaciers, mean annual precipitation, and mean annual snowfall.

The resulting equation was selected as being the most representative for determining the mean annual instantaneous peak flow:

$$Q = 7.06\,(D.A.) + 46.36\,(L) + 697.14\,(G) + 200.15\,(MAP) - 49.55\,(MAS) - 2594$$

Where:

	D.A.	=	Drainage Area (mi^2)
	L	=	Stream Length (mi)
	G	=	Percent of Drainage Area Covered by Glaciers(%)
	MAP	=	Mean Annual Precipitation (in)
	MAS	=	Mean Annual Snowfall (in)

Table 3.15 lists a summary of basin characteristics at various locations along the lower Susitna River that were used in this study to determine flood flows. It is interesting to note the variance that exists within the Susitna basin. For example, the two major western tributaries, the Chulitna and Yentna Rivers, have the highest percentage of glacial area. Susitna River at Gold Creek has the lowest percentage of forested area. Table 3.15 is a good reference for general comparison of basin characteristics.

The mean annual instantaneous peak was used in conjunction with Figure 3.13, the design dimensionless regional frequency curve for the Susitna River basin. The annual instantaneous peak for selected return periods was determined by multiplying the appropriate dimensionless curve value by the mean annual instantaneous peak determined from the above equation. This procedure was used to determine pre-project flood frequencies at ungaged sites along the Susitna River.

Additional discussion of the regional flood frequency analysis can be found in the Regional Flood Studies (R&M, 1981b).

3.4 Flow Variability Index

Long-term average monthly pre- and post-project streamflows may be used to initially assess the project effects on fishery and wildlife habitat. However, Trihey (1981) notes that average monthly flows do not reflect the seasonal and annual flow extremes which may have significant impacts on habitat. High streamflows may scour eggs from streambed gravels. Low streamflows during salmon spawning periods may concentrate spawners into confined areas. Only monthly flows are available below Devil Canyon for post-project conditions. Consequently, an analysis is required to assess the value of monthly streamflow values as indicators of flow extremes.

The 1-day, 3-day, 7-day and 15-day high and low flow values were determined for each May through October (open-water period) for the periods of record at Susitna River at Gold Creek, Chulitna River near Talkeetna, Talkeetna River near Talkeetna, and Susitna River at Susitna Station. The ratios of the values to the corresponding average monthly flow were then determined in order to provide an indication of how well monthly streamflow values represent the extremes in habitat conditions (Trihey, 1981). The average 1-, 3-, 7- and 15-day ratios and standard deviations for each stations are presented in Tables 3.16 through 3.19. The ratios for each of the months of May through October for the periods of record are presented in Attachment B.

The ratio of annual 1-, 3-, 7-, 14-, 30-, 60- and 90-day low flows to the annual low monthly flow were also computed for the above four stations, together with data from the Susitna River near Cantwell. The ratios are summarized in Table 3.20, and the station values for the periods of record are presented in Appendix B. The annual low daily flows are closely approximated by monthly flows. The low monthly flows occur in mid-winter, when the rivers are ice-covered.

Flow statistics indicate that the ratios of 1-, 3-, 7- and 15-day high and low flows vary both with time and with basin characteristics. On all rivers analyzed, May showed the most variability, as it is usually the month when high breakup flows begin to occur. This large variability in May is also evident on the flow duration curves. The ratios for May also had the greatest standard deviation for high flows, indicating significant changes from year to year. June and July generally exhibited less variability than the late summer months, primarily because flows are usually dominated by snow and glacier melt. In the Susitna Regional Flood Analysis (R&M, 1981), it was demonstrated that June had the greatest frequency of annual floods (55%). Floods in June are dominated by rain and snowmelt storms, resulting in high volume floods with relatively slow changes in daily discharge. Flow variability increases in the August through October period. Heavy rainstorms often occur in August, with 28% of the annual floods occurring in that month. The increase in the ratio of high daily flow to monthly flow for September and October is partially due to rainstorm floods and partially due to the decrease in flows due to cooler weather later in each month as winter approaches.

The monthly ratios for high and low flows may be used as indicators of the monthly high and low flow values for the unregulated portions of the river, i.e., that portion of flow on the Susitna River contributed below Devil Canyon. The 2-dam reservoir system will have almost complete regulation of flows up to floods with about a 50-year recurrence interval. Table 3.21 indicates the average monthly spill from Devil Canyon.

The spills are completely regulated, i.e., reservoir outlets are controlled so that average monthly flows are nearly constant for those months. The 1-day, 3-day, 7-day, and 15-day high flow ratios may be used as indices of the increase in flow contributed below Devil Canyon, so that maximum flows expected between Devil Canyon and the Susitna-Chulitna-Talkeetna confluence may be estimated. Overall, the daily/monthly flow ratio for the Susitna River at Gold Creek will be decreased significantly under post-project conditions. Once the Susitna-Chulitna confluence is reached, there will be also be some decrease in the daily/monthly flow ratios due to the storage effects of the reservoirs, but it will not be as significant as that above the confluence.

TABLE 3.1
STREAMGAGING STATIONS
PERIOD OF RECORD

Susitna River near Denali - US.G.S. Station 15291000
Mean Daily Discharge Records: May 1957 - September, 1966
July 1968 - Present

MaClaren River near Paxson - U.S.G.S. Station 15291200
Mean Daily Discharge Record: June 1958 - Present

Susitna River near Cantwell - U.S.G.S. Station 15291500
Mean Daily Discharge Records: May 1961 - September 1972
May 1980 - Present

Susitna River near Gold Creek - U.S.G.S. Station 15292000
Mean Daily Discharge Records: August 1949 - Present

Chulitna River near Talkeetna - U.S.G.S. Station 15292400
Mean Daily Discharge Record: February 1958 - September 1972
May 1980 - Present

Talkeetna River near Talkeetna - U.S.G.S. Station 15292700
Mean Daily Discharge Record: October 1974 - Present

GOLD CREEK UPDATED PRE-PROJECT FLOWS

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
6335.	2583.	1439.	1027.	788.	726.	870.	11510.	19600.	22600.	19880.	8301.	7972.
3848.	1300.	1100.	960.	820.	740.	1617.	14090.	20790.	22570.	19670.	21240.	9062.
5571.	2744.	1900.	1600.	1000.	880.	920.	5419.	32370.	26390.	20920.	14480.	9516.
8202.	3497.	1700.	1100.	820.	820.	1615.	19270.	27320.	20200.	20610.	15270.	10035.
5604.	2100.	1500.	1300.	1000.	780.	1235.	17280.	25250.	20360.	26100.	12920.	9619.
5370.	2760.	2045.	1794.	1400.	1100.	1200.	9319.	29860.	27560.	25750.	14290.	10204.
4951.	1900.	1300.	980.	970.	940.	950.	17660.	33340.	31090.	24530.	18330.	11412.
5806.	3050.	2142.	1700.	1500.	1200.	1200.	13750.	30160.	23310.	20540.	19800.	10347.
8212.	3954.	3264.	1965.	1307.	1148.	1533.	12900.	25700.	22880.	22540.	7550.	9413.
4811.	2150.	1513.	1448.	1307.	980.	1250.	15990.	23320.	25000.	31180.	16920.	10489.
6558.	2850.	2200.	1845.	1452.	1197.	1300.	15780.	15530.	22980.	23590.	20510.	9649.
7794.	3000.	2694.	2452.	1754.	1810.	2650.	17360.	29450.	24570.	22100.	13370.	10750.
5916.	2700.	2100.	1900.	1500.	1400.	1700.	12590.	43270.	25850.	23550.	15890.	11531.
6723.	2800.	2000.	1600.	1500.	1000.	830.	19030.	26000.	34400.	23670.	12320.	10989.
6449.	2250.	1494.	1048.	966.	713.	745.	4307.	50580.	22950.	16440.	9571.	9793.
6291.	2799.	1211.	960.	860.	900.	1360.	12990.	25720.	27840.	21120.	19350.	10117.
7205.	2098.	1631.	1400.	1300.	1300.	1775.	9645.	32950.	19860.	21830.	11750.	9395.
4163.	1600.	1500.	1500.	1400.	1200.	1167.	15480.	29510.	26800.	32620.	16870.	11151.
4900.	2353.	2055.	1981.	1900.	1900.	1910.	16180.	31550.	26420.	17170.	8816.	9761.
3822.	1630.	882.	724.	723.	816.	1510.	11050.	15500.	16100.	8879.	5093.	5561.
3124.	1215.	866.	824.	768.	776.	1080.	11380.	18630.	22660.	19980.	9121.	7535.
5288.	3407.	2290.	1442.	1036.	950.	1082.	3745.	32930.	23950.	31910.	14440.	10206.
5847.	3093.	2510.	2239.	2028.	1823.	1710.	21890.	34430.	22770.	19290.	12400.	10836.
4826.	2253.	1465.	1200.	1200.	1000.	1027.	8235.	27800.	18250.	20290.	9074.	8052.
3733.	1523.	1034.	874.	777.	724.	992.	16180.	17870.	18800.	16220.	12250.	7581.
3739.	1700.	1603.	1516.	1471.	1400.	1593.	15350.	32310.	27720.	18090.	16310.	10234.
7739.	1993.	1081.	974.	950.	900.	1373.	12620.	24380.	18940.	19800.	6881.	8136.
3874.	2650.	2403.	1829.	1618.	1500.	1680.	12680.	37970.	22870.	19240.	12640.	10080.
7571.	3525.	2589.	2029.	1668.	1605.	1702.	11950.	19050.	21020.	16390.	8607.	8142.
4907.	2535.	1681.	1397.	1286.	1200.	1450.	13870.	24690.	28880.	20460.	10770.	9427.
5639.	2467.	1773.	1454.	1236.	1114.	1368.	13317.	27928.	23853.	21479.	13171.	

TABLE 3.2 Susitna River at Gold Creek
Pre-Project Monthly Flows

SUNSHINE STATION UPDATED PRE-PROJECT FLOWS

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
14003.	5639.	3611.	2748.	2276.	2033.	2311.	22418.	45613.	59179.	54849.	27734.	20201.
12226.	4712.	3804.	2930.	2435.	2144.	3563.	42196.	58872.	69474.	58356.	51069.	25982.
13713.	5702.	3782.	3470.	2511.	2282.	2357.	11258.	68738.	64937.	53363.	32057.	22014.
17394.	7199.	4080.	2818.	2343.	2317.	4292.	50302.	64075.	54231.	49954.	33737.	24395.
13227.	5092.	3977.	3667.	2889.	2423.	3204.	32595.	54805.	53386.	57701.	28376.	21779.
12188.	6340.	4313.	3927.	3189.	2577.	2658.	21758.	69686.	70894.	77692.	35385.	25884.
11011.	4367.	3161.	2612.	2286.	2209.	2244.	33157.	73941.	80569.	69034.	44495.	27424.
15252.	7029.	4907.	4006.	3471.	2844.	2907.	34140.	79153.	62302.	53243.	48121.	26448.
18399.	9032.	6139.	4067.	2996.	2643.	3399.	27759.	60752.	59850.	56902.	20098.	22670.
11578.	5331.	3592.	3387.	3059.	2280.	2895.	29460.	64286.	67521.	71948.	36915.	25188.
15131.	6415.	4823.	4059.	3201.	2675.	2928.	34802.	39311.	58224.	55315.	43086.	22498.
16996.	6109.	5504.	4739.	3478.	3480.	5109.	32438.	60886.	63640.	60616.	36071.	24922.
14579.	6657.	4820.	4222.	3342.	2975.	3581.	24520.	87537.	67756.	61181.	38711.	26657.
13956.	6052.	4690.	4074.	3621.	2399.	2025.	35245.	56629.	78219.	52938.	29182.	24086.
18555.	5907.	3533.	2797.	2447.	2013.	2381.	8645.	111073.	58836.	46374.	23267.	23819.
15473.	7472.	4536.	3373.	2962.	2818.	3435.	24597.	58488.	65042.	56375.	53703.	24856.
18208.	5321.	3965.	3404.	3009.	2875.	3598.	16479.	69569.	55243.	62007.	30156.	22820.
11551.	4295.	3856.	3698.	3294.	2793.	2639.	32912.	66162.	77125.	82747.	37379.	27371.
10706.	5413.	4563.	4181.	3986.	3898.	4359.	36961.	76770.	69735.	46730.	20885.	24016.
8593.	4048.	2650.	2218.	2082.	2077.	3458.	21509.	40404.	45267.	24656.	14268.	14269.
9416.	3978.	2848.	2600.	2448.	2382.	3150.	25687.	47602.	60771.	54926.	27191.	20250.
12264.	7467.	4930.	3325.	2514.	2351.	2640.	10652.	76208.	64787.	74519.	32402.	24505.
14313.	6745.	4922.	4257.	3801.	3335.	3210.	36180.	66856.	62292.	51254.	34156.	24277.
13588.	6018.	4030.	3312.	2984.	2646.	2821.	18215.	59933.	51711.	51085.	25238.	20132.
11284.	4699.	3524.	2882.	2519.	2220.	2916.	31486.	43713.	51267.	43222.	29114.	19071.
12302.	4938.	3777.	3546.	2990.	2810.	3160.	29380.	72836.	75692.	51678.	35567.	24890.
15565.	4238.	2734.	2507.	2355.	2281.	3294.	22875.	56366.	55506.	52155.	18502.	19865.
10620.	5888.	5285.	4231.	3640.	3171.	3537.	27292.	87773.	62194.	55157.	32719.	25126.
17399.	7130.	5313.	4213.	3227.	3002.	3542.	22707.	48044.	57930.	42118.	22742.	19781.
11223.	5648.	4308.	3674.	3206.	2963.	3704.	33876.	59849.	71774.	48897.	26790.	22993.
13690.	5829.	4199.	3498.	2952.	2631.	3177.	27717.	64198.	63178.	55900.	32304.	

TABLE 3.3 Susitna River at Sunshine
Pre-Project Monthly Flows

SUSITNA STATION UPDATED PRE PROJECT FLOWS

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
26869.	11367.	6197.	6072.	5256.	5377.	5657.	66294.	101616.	124890.	106432.	39331.	42113.
18026.	6933.	5981.	7074.	7295.	6382.	7354.	59273.	82255.	123164.	100947.	73471.	41513.
31053.	16364.	6989.	8274.	7036.	5853.	5985.	45294.	132547.	137322.	116186.	82076.	49582.
44952.	16289.	9746.	8069.	6775.	6350.	7993.	88840.	130561.	125949.	97610.	44168.	48942.
20169.	11829.	5272.	7202.	4993.	4980.	6306.	58516.	108881.	116732.	128587.	66275.	44978.
23896.	9168.	6183.	7255.	5845.	5316.	6412.	58164.	169045.	148877.	120120.	53504.	51149.
19923.	10522.	7295.	6179.	6831.	6324.	7182.	82486.	161346.	168815.	131620.	104218.	59395.
41822.	21548.	14146.	10600.	8356.	7353.	7705.	63204.	176219.	140318.	124813.	87825.	58659.
52636.	19887.	10635.	7553.	6387.	6679.	8099.	70321.	112897.	122280.	99609.	53053.	47503.
30543.	9528.	4763.	7795.	6564.	5666.	6468.	56601.	110602.	146217.	138334.	67904.	49249.
25754.	10165.	7005.	6716.	6310.	5651.	5830.	50062.	84134.	129403.	113972.	81565.	43881.
33782.	12914.	13768.	12669.	10034.	9193.	9803.	85457.	151715.	138969.	116697.	62504.	54792.
29029.	13043.	8977.	9050.	6183.	5951.	6635.	54554.	163049.	143441.	121221.	74806.	52995.
27716.	10755.	8865.	8671.	7854.	6058.	5565.	53903.	85648.	146420.	106707.	70782.	44912.
37846.	11702.	5626.	6351.	5762.	4910.	5531.	35536.	153126.	124806.	92280.	46110.	44132.
28747.	10458.	6127.	6952.	6196.	6170.	7120.	49485.	110075.	138407.	111846.	89944.	47627.
36553.	12313.	9159.	8031.	7489.	7091.	8048.	52311.	125183.	117607.	118729.	63887.	47200.
26396.	12963.	8322.	8029.	7726.	6683.	7281.	58107.	134881.	136306.	137318.	89527.	52795.
37725.	15873.	15081.	11604.	11532.	8772.	8763.	94143.	137867.	130514.	86875.	42385.	50094.
15940.	6606.	4279.	5033.	5137.	5172.	6452.	44317.	83226.	102121.	62368.	34085.	31228.
22683.	6799.	5016.	6074.	5581.	5732.	5769.	53036.	94612.	132985.	117728.	80585.	44717.
32817.	16607.	8633.	6509.	6254.	5883.	5788.	29809.	122258.	139183.	133310.	69021.	48006.
32763.	14922.	8791.	9380.	8458.	6646.	6895.	74062.	176024.	142787.	107597.	60220.	54045.
26782.	14853.	8147.	7609.	7477.	6313.	7688.	64534.	122797.	123362.	107261.	45227.	45171.
20976.	10113.	6081.	7402.	6747.	6294.	6963.	61458.	67838.	102184.	80252.	56124.	36036.
19520.	10400.	9419.	8597.	7804.	7048.	6867.	47540.	128800.	135700.	91360.	77740.	45900.
31550.	9933.	6000.	6529.	5614.	5368.	7253.	70460.	107000.	115200.	99650.	48910.	42789.
30140.	18270.	13100.	10100.	8911.	6774.	6233.	56180.	165900.	143900.	125500.	83810.	55735.
38230.	12630.	7529.	6974.	6771.	6590.	7033.	48670.	90930.	117600.	102100.	55500.	41713.
36810.	15000.	9306.	8823.	7946.	7032.	8683.	81260.	119900.	142500.	128200.	74340.	53317.
30055.	12658.	8215.	7906.	7037.	6320.	6979.	60463.	123698.	131932.	110841.	65963.	

TABLE 3.4 Susitna River at Susitna Station
Pre-Project Monthly Flows

GOLD CREEK POST-PROJECT FLOWS (CASE A) DEC.23,1981

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
7736.	9073.	12669.	10814.	8961.	7877.	7931.	10434.	10176.	8338.	5773.	4906.	8724.
6967.	7875.	9414.	8340.	6614.	6604.	6355.	10016.	9362.	7650.	6111.	12518.	8152.
7464.	10635.	13130.	11386.	9173.	8031.	7856.	8838.	13752.	9211.	8027.	6692.	9516.
10094.	11388.	12930.	10886.	8992.	7971.	8195.	11809.	12915.	7642.	9453.	8148.	10035.
7496.	9991.	12729.	11087.	9173.	7932.	8031.	13161.	12866.	8060.	9628.	6109.	7689.
7006.	10074.	13274.	11581.	9573.	8251.	7998.	10179.	12109.	8858.	14554.	8159.	10135.
6843.	9791.	12529.	10766.	9143.	8092.	7972.	12287.	13255.	15641.	16005.	14617.	11412.
7698.	10941.	13371.	11487.	9673.	8352.	7993.	11151.	11989.	8472.	10243.	12789.	10347.
10104.	11845.	14487.	11759.	9480.	8299.	8114.	10518.	10704.	7992.	9257.	4995.	9796.
6972.	7686.	10229.	11234.	9480.	8131.	8103.	13428.	12095.	9401.	14602.	9909.	10106.
8451.	10741.	13430.	11632.	9625.	8348.	7967.	10312.	9259.	8359.	6411.	11258.	9649.
9686.	10891.	13923.	12239.	9926.	8961.	9231.	11297.	13741.	10718.	12031.	6466.	10759.
7700.	10591.	13329.	11687.	9673.	8552.	8281.	8832.	16353.	14623.	14462.	12177.	11522.
8616.	10691.	13229.	11387.	9673.	8152.	7793.	11310.	12406.	15775.	14713.	8131.	10990.
8341.	10141.	12723.	10835.	9139.	7864.	7878.	8373.	16524.	4787.	8482.	5156.	10020.
7082.	9062.	12440.	10747.	9033.	8051.	7941.	9600.	11602.	9908.	10868.	12339.	9889.
9097.	9989.	12861.	11186.	9473.	8452.	8356.	10127.	14134.	8370.	7412.	5355.	9568.
6876.	7599.	11735.	11286.	9573.	8351.	8056.	10504.	11886.	12937.	17240.	14905.	10912.
7589.	10244.	13284.	11768.	10073.	9051.	8491.	10929.	12927.	13800.	8329.	5032.	10126.
6793.	7664.	9304.	10510.	8896.	7947.	8091.	9312.	8547.	6053.	5164.	4957.	7772.
7172.	8004.	9519.	8420.	6801.	6948.	5875.	6737.	11552.	9506.	6034.	5151.	7645.
7144.	7780.	8987.	8222.	7128.	7462.	8403.	8918.	12834.	8086.	6732.	5270.	8081.
6900.	7758.	11879.	12036.	10201.	8974.	8291.	13492.	14059.	14508.	10628.	5634.	10363.
6630.	9987.	12694.	10986.	9372.	8151.	7851.	8526.	11066.	6587.	5581.	4932.	8530.
7060.	7922.	9300.	7844.	8798.	7876.	7859.	10869.	10046.	7560.	5682.	5413.	8019.
6916.	7775.	9304.	8227.	6515.	7573.	8173.	11254.	12710.	14690.	9124.	9298.	9297.
9631.	9884.	12310.	10760.	9123.	8051.	8050.	11258.	11496.	6634.	5271.	5070.	8962.
7194.	8175.	9717.	8191.	8160.	8651.	8260.	11686.	13729.	11817.	9834.	5861.	9273.
9231.	11416.	13819.	11815.	9841.	8756.	8283.	8295.	8865.	7516.	5777.	5071.	9057.
7141.	7951.	9349.	8126.	6998.	8351.	8030.	9074.	8870.	13091.	11171.	5024.	8598.
7788.	9452.	11930.	10574.	8943.	8137.	7990.	10418.	12061.	10220.	9553.	7711.	

TABLE 3.5 Susitna River at Gold Creek Post-Project Monthly Flows (Case A)

SUNSHINE STA. POST PROJECT FLOWS (CASE A) DEC.23,1981

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
13404.	12129.	14841.	12535.	10449.	9184.	9372.	21342.	36189.	44917.	40742.	24339.	20954.
15345.	11287.	12118.	10310.	8229.	8008.	8301.	38122.	47444.	54534.	44797.	42347.	25072.
15606.	13593.	15012.	13236.	10684.	9433.	9293.	14677.	50120.	47758.	40470.	24269.	22014.
19286.	15090.	15310.	12604.	10515.	9468.	10872.	42841.	49670.	41673.	38797.	26615.	21395.
15119.	12983.	15206.	13454.	11062.	9575.	10000.	28476.	42421.	41086.	41229.	21565.	21848.
13824.	13654.	15542.	13714.	11362.	9728.	9456.	22618.	51935.	52192.	66496.	29254.	25815.
12903.	12258.	14390.	12398.	10459.	9361.	9266.	27784.	53856.	65120.	60509.	40782.	27424.
17144.	14920.	16136.	13793.	11644.	9996.	9700.	31541.	60982.	47464.	42946.	41110.	26448.
20291.	16923.	17362.	13861.	11169.	9794.	9980.	25377.	45756.	44962.	43619.	17543.	23053.
13739.	10867.	12308.	13173.	11232.	9431.	9748.	26898.	53061.	81922.	55370.	29904.	24804.
17024.	14306.	16053.	13846.	11374.	9826.	9595.	29334.	33040.	43603.	38136.	33834.	22498.
18888.	14000.	16733.	14526.	11650.	10631.	11690.	26375.	45177.	49788.	50547.	29167.	24931.
16363.	14548.	16049.	14009.	11515.	10127.	10162.	20762.	60620.	56529.	54093.	34998.	26648.
15849.	13943.	15919.	13861.	11794.	9551.	8988.	27525.	43035.	59594.	43981.	24993.	24086.
20447.	13798.	14762.	12584.	10620.	9164.	9514.	12711.	77017.	50673.	38416.	10852.	24047.
16264.	13735.	15765.	13160.	11135.	9969.	10016.	21207.	44370.	47110.	46123.	46692.	24629.
20100.	13212.	15195.	13190.	11182.	10027.	10179.	16961.	50753.	43753.	47589.	33761.	22992.
14264.	10294.	14091.	13484.	11467.	9944.	9528.	27936.	48538.	63262.	67367.	35414.	27132.
13395.	13304.	15792.	13968.	12159.	11049.	10940.	31710.	58147.	57115.	37889.	17101.	24381.
11564.	10002.	11072.	12004.	10255.	9228.	10039.	19771.	33451.	35220.	20941.	14132.	16480.
13464.	10767.	11501.	10196.	8481.	8574.	7945.	21044.	40524.	47617.	40980.	23221.	20360.
14120.	11840.	11627.	10105.	8606.	8863.	9961.	15825.	56112.	48923.	49341.	23232.	22380.
15366.	11410.	14291.	14044.	11974.	10486.	9791.	27782.	46483.	54030.	42592.	27390.	23803.
15392.	13752.	15259.	13098.	11156.	9797.	9645.	18506.	43199.	40048.	36376.	21096.	20610.
14611.	11098.	11790.	9852.	10540.	9372.	9783.	26175.	35889.	40027.	32684.	22277.	19508.
15479.	11013.	11478.	10257.	8034.	8983.	9740.	25284.	53236.	62662.	42712.	28555.	23953.
17457.	12129.	13963.	12293.	10528.	9432.	9971.	21513.	43482.	43200.	37626.	16691.	20690.
13940.	11413.	12599.	10593.	10182.	10322.	10117.	26298.	63532.	51141.	45751.	25940.	24319.
19059.	15021.	16543.	13999.	11400.	10153.	10123.	19052.	37859.	44426.	31503.	19206.	20696.
13457.	11064.	11976.	10403.	8918.	10114.	10284.	29082.	44029.	55985.	39608.	21044.	22164.
15839.	12814.	14356.	12419.	10659.	9453.	9800.	24818.	48331.	49545.	43974.	26844.	

TABLE 3.6 Susitna River at Sunshine
Post-Project Monthly Flows (Case A)

SUSITNA STATION POST PROJECT FLOWS (CASE A) DEC.23,1981

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
28270.	17857.	17427.	15859.	13429.	12528.	12718.	65218.	92192.	110628.	92325.	35936.	42845.
21145.	13508.	14295.	14454.	13089.	12246.	12092.	55199.	70827.	108244.	87388.	64749.	40603.
32946.	24255.	18219.	18060.	15209.	13004.	12921.	48713.	113929.	120143.	103293.	74288.	49582.
45844.	24180.	20976.	17855.	14947.	13501.	14573.	81379.	116156.	113391.	86453.	37046.	48942.
22061.	19720.	16501.	16989.	13166.	12132.	13102.	54397.	96497.	104432.	112115.	59464.	45048.
25532.	16482.	17412.	17042.	14018.	12467.	13210.	59024.	151294.	130175.	108924.	47373.	51079.
21815.	18413.	18524.	15965.	15004.	13476.	14204.	77113.	141261.	153366.	123095.	100505.	59395.
43714.	29439.	25375.	20387.	16529.	14505.	14498.	60605.	158048.	125480.	114516.	80814.	58659.
54528.	27778.	21858.	17347.	14560.	13830.	14680.	67939.	97901.	107392.	86326.	50498.	47886.
32704.	15064.	13479.	17581.	14737.	12817.	13321.	54039.	99377.	130618.	121756.	60893.	48866.
27647.	18056.	18235.	16503.	14483.	12802.	12497.	44394.	77863.	114782.	96793.	72313.	43881.
35674.	20805.	24997.	22456.	18206.	16344.	16384.	79394.	136006.	125117.	106628.	55600.	54801.
30813.	20934.	20206.	18837.	14356.	13103.	13216.	50796.	136132.	132214.	114133.	71093.	52986.
29609.	18646.	20094.	18458.	16027.	13210.	12528.	46183.	72054.	127795.	97750.	66593.	44912.
39738.	19593.	16855.	16138.	13935.	12061.	12664.	39602.	119070.	116643.	84322.	41695.	44360.
29538.	16721.	17356.	16739.	14369.	13321.	13701.	46095.	95957.	120475.	101594.	82933.	47400.
38445.	20204.	20389.	17817.	15662.	14243.	14629.	52793.	106367.	106117.	104311.	57492.	47373.
29109.	18942.	18557.	17815.	15899.	13834.	14170.	53131.	117257.	122443.	121938.	87562.	52556.
40414.	23764.	26310.	21391.	19705.	15923.	15344.	88892.	119244.	117894.	78034.	38601.	50460.
18911.	12640.	12701.	14819.	13310.	12323.	13033.	42579.	76273.	92074.	58653.	33949.	33439.
26731.	13588.	13669.	13670.	11614.	11924.	10564.	48393.	87534.	119831.	103782.	74615.	44826.
34673.	20980.	15330.	13289.	12346.	12395.	13109.	34982.	102162.	123319.	108132.	59851.	45881.
33816.	19587.	18160.	19167.	16631.	13797.	13476.	65664.	159653.	134525.	98935.	53454.	53572.
28584.	22587.	19376.	17395.	15649.	13464.	14512.	64825.	106063.	111699.	92552.	41085.	45649.
24303.	16512.	14347.	14372.	14768.	13446.	13830.	56147.	60014.	90944.	69714.	49287.	36474.
22697.	16475.	17120.	15308.	12848.	13221.	13447.	43444.	109200.	122670.	82394.	70728.	44963.
33442.	17824.	17229.	16315.	13787.	13519.	13930.	69098.	94116.	102894.	85121.	47099.	43615.
33460.	23795.	20414.	16462.	15453.	13925.	12813.	55186.	141659.	132847.	116094.	77031.	54928.
39890.	20521.	18759.	16760.	14944.	13741.	13614.	45015.	80745.	104096.	91487.	51964.	42638.
39044.	20416.	14974.	15552.	13658.	14183.	15263.	76466.	104080.	126711.	118911.	68594.	52488.
32203.	19643.	18371.	17027.	14745.	13343.	13601.	57564.	107831.	118299.	98915.	60504.	

TABLE 3.7 Susitna River at Susitna Station
Post-Project Monthly Flows (Case A)

GOLD CREEK POST-PROJECT FLOWS (CASE D) DEC.23,1981

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
7853.	7870.	9053.	8086.	6789.	6907.	5821.	8016.	7497.	12967.	18819.	8301.	8998.
6055.	6785.	7703.	6610.	5360.	5221.	5715.	7702.	6756.	12744.	10900.	12531.	8507.
5827.	6522.	7309.	7205.	6787.	6876.	5729.	6348.	11028.	13278.	19033.	12582.	9044.
8202.	8097.	9151.	8106.	6809.	6854.	5830.	9355.	10193.	12766.	19801.	15270.	10035.
7630.	7876.	9120.	8103.	6851.	6902.	5929.	10751.	10179.	12956.	19708.	12431.	9876.
5701.	6975.	9293.	8284.	6988.	6953.	5877.	7751.	9398.	13097.	24674.	14290.	9947.
7094.	7688.	9069.	8042.	6880.	7017.	5880.	9884.	10576.	21932.	24530.	18330.	11412.
7843.	8149.	9218.	8191.	6935.	6988.	5858.	8710.	9272.	12950.	20245.	19800.	10347.
8423.	8377.	9727.	8284.	6835.	6840.	5819.	8031.	7947.	12867.	22254.	7550.	9413.
7388.	7876.	9214.	8270.	7022.	7054.	6008.	11024.	9410.	13360.	22324.	16920.	10489.
7637.	8003.	9292.	8290.	6922.	6942.	5817.	7858.	6559.	12991.	19284.	16197.	9649.
7990.	8031.	9458.	8487.	7026.	7148.	6231.	8806.	10983.	19375.	22100.	13370.	10750.
7524.	7808.	9112.	8142.	6854.	6929.	5826.	6375.	14507.	25850.	23550.	15890.	11531.
7408.	7654.	9039.	8122.	6912.	6811.	5633.	8846.	9677.	25782.	23671.	12320.	10990.
7507.	7828.	9077.	8065.	6822.	6880.	5742.	5885.	12185.	21493.	16440.	9571.	9793.
7777.	7801.	8916.	7965.	6724.	6833.	5745.	7173.	8899.	13394.	20825.	19350.	10117.
8229.	7899.	9209.	8210.	6951.	7051.	6047.	7694.	11419.	13074.	19345.	11750.	9740.
5664.	6299.	8123.	8320.	7049.	7093.	5972.	8108.	9214.	14346.	32620.	16870.	10807.
7126.	7796.	9146.	8236.	6966.	7055.	5921.	8476.	10202.	20226.	17171.	8816.	9761.
6932.	7744.	8969.	8039.	6814.	6937.	5924.	6939.	5905.	12199.	8879.	5093.	7531.
5494.	6963.	9539.	8634.	7344.	7524.	6304.	7538.	8979.	13268.	19087.	9121.	9150.
6155.	6688.	7565.	9163.	7793.	7990.	6824.	7019.	10558.	12758.	19354.	11894.	9480.
6087.	6783.	7629.	6506.	7050.	7753.	6535.	11474.	11749.	12003.	18396.	11523.	9524.
6347.	7219.	8212.	7045.	5711.	5547.	4460.	5299.	6677.	12428.	18572.	9074.	8049.
6344.	7080.	8033.	6879.	5567.	5441.	4378.	6934.	7526.	12760.	16220.	11970.	8261.
5834.	6521.	7390.	6914.	7445.	7604.	6472.	9261.	10380.	13282.	18690.	12245.	9287.
6324.	6536.	7327.	6460.	7004.	7120.	6079.	8967.	8909.	12437.	18262.	6881.	8526.
6394.	7252.	8143.	6883.	5560.	5402.	4910.	9428.	11169.	12879.	18629.	11814.	9039.
6281.	6781.	7549.	6438.	6288.	7020.	5848.	5810.	6112.	12691.	16390.	8607.	7985.
5874.	6512.	7276.	7381.	6881.	6848.	5754.	6655.	6173.	16914.	20460.	10770.	8958.
6901.	7380.	8595.	7779.	6765.	6851.	5830.	8071.	9335.	14996.	19924.	12371.	

TABLE 3.8 Susitna River at Gold Creek
Post-Project Monthly Flows (Case D)

SUNSHINE STA. POST PROJECT FLOWS (CASE D) DEC.23,1981

OCT	NOV.	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
15521.	10926.	11225.	9807.	8277.	8214.	7262.	18924.	33510.	49546.	53788.	27734.	21228.
14433.	10197.	10407.	8580.	6975.	6625.	7641.	35808.	44838.	59648.	57586.	42360.	25427.
13969.	9480.	9191.	9075.	8298.	8278.	7166.	12187.	47396.	51825.	51476.	30159.	21542.
17394.	11799.	11531.	9824.	8332.	8351.	8497.	40387.	46948.	46797.	49145.	33737.	24395.
15253.	10868.	11597.	10470.	8740.	8545.	7898.	26066.	39734.	45982.	51389.	27887.	22036.
12599.	10555.	11561.	10417.	8777.	8430.	7335.	20190.	49224.	56431.	76616.	35385.	25627.
13154.	10155.	10930.	9694.	8196.	8286.	7174.	25381.	51177.	71411.	69034.	44495.	27424.
17289.	12128.	11983.	10497.	8906.	8632.	7565.	29100.	50265.	51942.	52948.	48121.	26448.
18610.	13455.	12602.	10386.	8524.	8335.	7685.	22890.	42999.	49837.	56616.	20098.	22670.
14155.	11057.	11293.	10209.	8774.	8354.	7653.	24494.	50376.	55881.	63092.	36915.	25188.
16210.	11568.	11915.	10504.	8671.	8420.	7445.	26880.	30340.	48235.	51009.	38773.	22498.
17192.	11140.	12268.	10774.	8750.	8818.	8690.	23884.	42419.	58445.	60614.	36071.	24922.
16187.	11765.	11832.	10464.	8696.	8504.	7707.	18305.	50774.	67756.	61181.	38711.	26657.
14641.	10906.	11729.	10596.	9033.	8210.	6828.	25061.	40306.	69601.	52939.	29182.	24086.
19613.	11485.	11116.	9814.	8303.	8180.	7398.	10223.	72678.	57379.	46374.	23267.	23819.
16959.	12474.	12241.	10378.	8826.	8751.	7820.	18780.	41667.	50596.	56080.	53703.	24856.
19232.	11122.	11543.	10214.	8660.	8626.	7870.	14528.	48038.	48457.	59522.	30156.	23164.
13052.	8994.	10479.	10518.	8943.	8686.	7444.	25540.	45866.	64671.	82747.	37379.	27027.
12932.	10856.	11654.	10436.	9052.	9053.	8370.	29257.	55422.	63541.	46731.	20885.	24016.
11703.	10162.	10737.	9533.	8173.	8198.	7872.	17398.	30809.	41366.	24656.	14268.	16240.
11786.	9726.	11521.	10410.	9024.	9130.	8374.	21845.	37951.	51379.	54033.	27191.	21864.
13131.	10748.	10205.	11046.	9271.	9391.	8382.	13926.	53836.	53595.	61963.	29856.	23779.
14553.	10435.	10041.	8524.	8823.	9265.	8035.	25764.	44175.	52325.	50360.	33279.	22965.
15109.	10984.	10777.	9157.	7495.	7193.	6254.	15279.	38810.	45889.	49367.	25238.	20129.
13895.	10256.	10523.	8887.	7309.	6937.	6302.	22242.	33369.	45227.	43222.	28834.	19750.
14397.	9759.	9564.	8944.	8964.	9014.	8039.	23291.	50906.	61254.	51678.	31502.	23943.
14150.	8781.	8980.	7993.	8409.	8501.	8000.	19222.	40895.	49003.	50617.	18502.	20254.
13140.	10490.	11025.	9285.	7582.	7073.	6767.	24040.	60972.	52203.	54546.	31893.	24085.
16109.	10386.	10273.	8622.	7847.	8417.	7688.	16567.	35106.	49601.	42118.	22742.	19623.
12190.	9625.	9903.	9658.	8801.	8611.	8008.	26661.	41332.	59808.	48897.	26790.	22524.
14952.	10743.	11022.	9824.	8481.	8368.	7640.	22471.	45605.	54321.	54345.	31504.	

TABLE 3.9 Susitna River at Sunshine
Post-Project Monthly Flows (Case D)

SUSITNA STATION POST PROJECT FLOWS (CASE D) DEC.23,1981

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR AVG
28387.	16654.	13811.	13131.	11257.	11558.	10608.	62800.	89513.	115257.	103371.	39331.	43140.
20233.	12418.	12584.	12724.	11835.	10863.	11452.	52885.	68221.	113338.	100177.	64762.	40958.
31309.	20142.	12390.	13079.	12823.	11849.	10794.	46223.	111205.	124210.	114299.	80178.	49109.
44952.	20889.	17197.	15075.	12764.	12384.	12198.	78925.	113434.	118515.	96801.	44168.	48942.
22195.	17605.	12892.	14005.	10844.	11102.	11000.	51987.	93810.	109328.	122275.	65786.	45236.
24307.	13383.	13431.	13745.	11433.	11169.	11089.	54596.	148583.	134414.	119044.	53504.	50891.
22066.	16310.	15064.	13261.	12741.	12401.	12112.	74710.	138582.	159657.	131670.	104218.	59395.
43859.	26647.	21222.	17091.	13791.	13141.	12363.	58164.	155331.	129958.	124518.	87825.	58659.
52847.	24310.	17098.	13872.	11915.	12371.	12385.	65452.	95144.	112267.	99323.	53053.	47503.
33120.	15254.	12464.	14617.	12279.	11740.	11226.	51635.	96692.	134577.	129478.	67904.	49249.
26833.	15318.	14097.	13161.	11780.	11396.	10347.	47140.	75163.	119414.	109666.	77252.	43881.
33978.	17945.	20532.	18704.	15306.	14531.	13384.	76903.	133248.	133774.	116697.	62504.	54792.
30637.	18151.	15989.	15292.	11537.	11480.	10761.	48339.	134286.	143441.	121221.	74806.	52995.
28401.	15609.	15904.	15193.	13266.	11869.	10368.	43719.	69325.	137802.	106708.	70782.	44912.
38904.	17280.	13209.	13368.	11618.	11077.	10548.	37114.	114731.	123349.	92280.	46110.	44132.
30233.	15460.	13832.	13957.	12060.	12103.	11505.	43668.	93254.	123961.	111551.	89944.	47627.
37577.	18114.	16737.	14841.	13140.	12842.	12320.	50360.	103652.	110821.	114244.	63887.	47545.
27897.	17662.	14945.	14849.	13375.	12576.	12086.	50735.	114585.	123852.	137318.	89527.	52450.
39951.	21316.	22172.	17859.	16598.	13927.	12774.	86439.	116519.	124320.	86876.	42385.	50095.
19050.	12720.	12366.	12348.	11228.	11293.	10866.	40206.	73631.	98220.	62368.	34085.	33198.
25053.	12547.	13689.	13884.	12157.	12480.	10993.	49194.	84961.	123593.	116835.	80585.	46331.
33684.	19880.	13908.	14230.	13011.	12923.	11530.	33083.	99886.	127991.	120754.	66475.	47280.
33003.	18612.	13910.	13647.	13480.	12576.	11720.	63646.	153343.	132820.	106703.	59343.	52734.
28303.	19819.	14894.	13454.	11988.	10860.	11121.	61598.	101674.	117540.	105543.	45227.	45168.
23587.	15670.	13080.	13407.	11537.	11011.	10349.	52214.	57494.	96144.	80252.	55844.	36716.
21615.	15221.	15206.	13795.	13778.	13252.	11746.	41451.	106870.	121262.	91360.	73675.	44953.
30135.	14476.	12246.	12015.	11668.	11588.	11759.	66807.	91529.	108697.	98112.	48910.	43179.
32660.	22872.	18840.	15154.	12853.	10676.	9463.	52928.	139099.	133909.	124889.	82984.	54694.
36940.	15886.	12489.	11383.	11391.	12005.	11179.	42530.	77992.	109271.	102100.	55500.	41556.
37777.	18977.	14901.	14807.	13541.	12680.	12987.	74045.	101383.	130534.	128200.	74340.	52848.
31316.	17572.	15037.	14232.	12566.	12057.	11441.	55217.	105105.	123075.	109286.	65163.	

TABLE 3.10 Susitna River at Susitna Station
Post-Project Monthly Flows (Case D)

TABLE 3.11

RELATIVE CONTRIBUTION OF FLOWS
AT SUSITNA-CHULITNA-TALKEETNA CONFLUENCE
(PRE-PROJECT)

	Flow Contribution by			Total Flow D/S	Percent Flow by		
	Chulitna[1]	Talkeetna[1]	Susitna[1]	Talkeetna	Chulitna	Talkeetna	Susitna
October	4859	2537	5639	13035	37%	20%	43%
November	1994	1187	2467	5648	35%	21%	44%
December	1457	838	1773	4068	36%	21%	43%
January	1276	671	1454	3401	37%	20%	43%
February	1095	565	1236	2896	38%	19%	43%
March	976	492	1114	2582	38%	19%	43%
April	1158	557	1368	3083	38%	18%	44%
May	8511	4176	13317	26004	33%	16%	51%
June	22540	11910	27928	62378	36%	19%	45%
July	26330	10390	23853	60573	44%	17%	39%
August	22190	9749	21479	53418	42%	18%	40%
September	11740	5853	13171	30764	38%	19%	43%
Annual	8748	4086	9567	22401	39%	18%	43%

1 Discharge data from U.S.G.S. records.

TABLE 3.12

RELATIVE CONTRIBUTION OF FLOWS
AT SUSITNA-CHULITNA-TALKEETNA CONFLUENCE
(POST-PROJECT, CASE A)

	Flow Contribution by			Total Flow D/S	Percent Flow by		
	Chulitna[1]	Talkeetna[1]	Susitna[2]	Talkeetna	Chulitna	Talkeetna	Susitr
October	4859	2537	7788	15184	32%	17%	51%
November	1994	1187	9452	12633	16%	9%	75%
December	1457	838	11930	14225	10%	6%	84%
January	1276	671	10574	12521	10%	5%	85%
February	1095	565	8943	10603	10%	5%	85%
March	976	492	8137	9605	10%	5%	85%
April	1158	557	7990	9705	12%	6%	82%
May	8511	4176	10418	23105	37%	18%	45%
June	22540	11910	12061	46511	48%	26%	26%
July	26330	10390	10220	46940	56%	22%	22%
August	22190	9749	9553	41492	53%	24%	23%
September	11740	5853	7711	25304	46%	23%	31%
Annual	8748	4086	9573	22407	39%	18%	43%

1 Discharge data from U.S.G.S. records.
2 Based on 30 years of simulated power operations.

TABLE 3.13

RELATIVE CONTRIBUTION OF FLOWS
AT SUSITNA-CHULITNA-TALKEETNA CONFLUENCE
(POST-PROJECT, CASE D)

	Flow Contribution by			Total Flow D/S	Percent Flow by		
	Chulitna[1]	Talkeetna[1]	Susitna[2]	Talkeetna	Chulitna	Talkeetna	Susitna
October	4859	2537	6901	14297	34%	18%	48%
November	1994	1187	7380	10561	19%	11%	70%
December	1457	838	8595	10890	13%	8%	79%
January	1276	671	7779	9726	13%	7%	80%
February	1095	565	6765	8425	13%	7%	80%
March	976	492	6851	8319	12%	6%	82%
April	1158	557	5830	7545	15%	8%	77%
May	8511	4176	8071	20758	41%	20%	39%
June	22540	11910	9335	43785	52%	27%	21%
July	26330	10390	14996	51716	51%	20%	29%
August	22190	9749	19924	51863	43%	19%	38%
September	11740	5853	12371	29964	39%	20%	41%
Annual	8748	4086	9567	22401	39%	18%	43%

1 Discharge data from U.S.G.S. records.
2 Based on 30 years of simulated power operations.

TABLE 3.14
ESTIMATES OF PRE AND POST PROJECT DISCHARGE AND STAGE FREQUENCY ANALYSIS

Devil Canyon Damsite

Recurrence Interval	Preproject Q (cfs)	Postproject Revised Q (cfs)
2	47,000	11,000
5	61,000	12,000
10	71,000	13,000
25	84,000	28,000

Susitna River at Gold Creek

Recurrence Interval	Preproject Q (cfs)	Preproject Stage (ft)	Postproject Q (cfs)	Postproject Stage (ft)	Change In Stage (feet)
2	49,500	13.4	13,500	8.7	-4.7
5	66,000	14.9	17,000	9.6	-5.3
10	78,000	15.8	20,000	10.1	-5.7
25	94,000	16.7	38,000	12.3	-4.4

Susitna River at Sunshine Station

Recurrence Interval	Preproject Q (cfs)	Preproject Stage (ft)	Postproject Q (cfs)	Postproject Stage (ft)	Change In Stage (feet)
2	95,000	12.5	59,000	9.3	-3.2
5	124,000	14.8	75,000	10.8	-4.0
10	144,000	16.3	85,000	11.7	-4.6
25	174,000	18.4	118,000	14.3	-4.1

Susitna River at Delta Islands

Recurrence Interval	Preproject Q (cfs)	Preproject Stage (ft)	Postproject Q (cfs)	Postproject Stage (ft)	Change In Stage (feet)
2	105,000	94.6	69,000	92.7	-1.9
5	138,000	95.6	89,000	94.0	-1.6
10	159,000	96.3	101,000	95.0	-1.3
25	193,000	97.3	137,000	96.0	-1.3

Susitna River at Susitna Station

Recurrence Interval	Preproject Q (cfs)	Preproject Stage (ft)	Postproject Q (cfs)	Postproject Stage (ft)	Change In Stage (feet)
2	157,000	16.7	121,000	14.8	-1.9
5	206,000	19.3	157,000	16.7	-2.6
10	239,000	20.9	181,000	18.0	-2.9
25	289,000	23.0	233,000	20.5	-2.5

TABLE 3.15
LOWER SUSITNA RIVER BASIN CHARACTERISTICS
FOR MEAN ANNUAL FLOOD CALCULATIONS

	Drainage Area D.A. (mi.^{2})	Glacial Area G (%)	Forested Area F (%)	Lake Area LP (%)	Mean Annual Precipitation M.A.P. (in.)	Mean Annual Snowfall M.A.S. (in.)	Mean Minimum January Temp. J (°F.)	Stream Length L (mi.)
Susitna River at Susitna Station	19,400	12	23	2	43	167	-4	301
Local Area: Susitna Station to Delta Islands x-section	640	1	60	5	30	70	0	-
Skwentna River nr. Skwentna	2,250	16	34	5	43	140	-5	98
Yentna River nr. Susitna Station	3,930	20	12	4	50	150	-5	-
Delta Islands x-section	12,580	9	23	1	41	182	-3	281
Local Area: Delta Islands x-section to Sunshine	1,080	1	60	5	30	70	0	-
Susitna River at Sunshine	11,500	10	19	1	42	193	-4	224
Local Area: Sunshine to Talkeetna	764	0	90	2	30	50	0	-
Chulitna River Talkeetna	2,570	27	22	1	55	250	-5	87
Talkeetna River nr. Talkeetna	2,006	7	25	0	70	150	-2	90
Susitna River at Gold Creek	6,160	5	7	1	29	200	-4	189
Local Area: Gold Creek to Devils Canyon	350	0	-	0	20	-	0	-
Devils Canyon	5,810	5	7	1	29	200	-4	-

TABLE 3.16
MONTHLY AVERAGE RATIOS
(1-DAY HIGH AND 1-DAY LOW FLOW)/(MONTHLY FLOW)

1-Day High Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Creek	2.45 (1.33)	1.49 (0.27)	1.36 (0.18)	1.57 (0.33)	1.61 (0.32)	1.66 (0.39)
Chulitna River near Talkeetna	2.05 (0.38)	1.52 (0.29)	1.36 (0.22)	1.56 (0.28)	1.72 (0.39)	1.81 (0.38)
Talkeetna River near Talkeetna	2.51 (0.76)	1.69 (0.27)	1.64 (0.49)	1.89 (0.62)	1.91 (0.51)	1.64 (0.26)
Susitna River at Susitna Station	1.89 (0.44)	1.25 (0.05)	1.21 (0.07)	1.27 (0.06)	1.58 (0.18)	1.69 (0.27)

1-Day Low Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Greek	0.26 (0.14)	0.68 (0.13)	0.78 (0.08)	0.65 (0.13)	0.66 (0.11)	0.59 (0.13)
Chulitna River near Talkeetna	0.31 (0.15)	0.63 (0.14)	0.78 (0.07)	0.66 (0.10)	0.62 (0.13)	0.58 (0.10)
Talkeetna River near Talkeetna	0.24 (0.08)	0.61 (0.11)	0.72 (0.07)	0.59 (0.08)	0.63 (0.12)	0.62 (0.11)
Susitna River at Susitna Station	0.25 (0.10)	0.74 (0.09)	0.82 (0.05)	0.64 (0.05)	0.70 (0.12)	0.60 (0.11)

TABLE 3.17
MONTHLY AVERAGE RATIOS
(3-DAY HIGH AND 3-DAY LOW FLOW)/(MONTHLY FLOW)

3-Day High Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Creek	2.24 (0.96)	1.42 (0.23)	1.29 (0.16)	1.49 (0.30)	1.52 (0.27)	1.56 (0.31)
Chulitna River near Talkeetna	1.91 (0.31)	1.40 (0.19)	1.28 (0.15)	1.47 (0.26)	1.60 (0.29)	1.66 (0.28)
Talkeetna River near Talkeetna	2.33 (0.60)	1.51 (0.22)	1.44 (0.30)	1.69 (0.45)	1.69 (0.37)	1.53 (0.19)
Susitna River at Susitna Station	1.89 (0.39)	1.20 (0.05)	1.16 (0.05)	1.23 (0.07)	1.45 (0.15)	1.52 (0.23)

3-Day Low Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Greek	0.28 (0.14)	0.71 (0.13)	0.80 (0.08)	0.67 (0.12)	0.68 (0.11)	0.61 (0.12)
Chulitna River near Talkeetna	0.33 (0.13)	0.66 (0.13)	0.80 (0.06)	0.68 (0.09)	0.64 (0.13)	0.59 (0.10)
Talkeetna River near Talkeetna	0.24 (0.09)	0.65 (0.11)	0.75 (0.07)	0.61 (0.09)	0.64 (0.12)	0.64 (0.11)
Susitna River at Susitna Station	0.30 (0.16)	0.78 (0.08)	0.85 (0.05)	0.68 (0.05)	0.71 (0.12)	0.63 (0.11)

TABLE 3.18
MONTHLY AVERAGE RATIOS
(7-DAY HIGH AND 7-DAY LOW FLOW)/(MONTHLY FLOW)

7-Day High Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Creek	1.87 (0.46)	1.28 (0.15)	1.17 (0.10)	1.33 (0.20)	1.37 (0.18)	1.43 (0.23)
Chulitna River near Talkeetna	1.75 (0.23)	1.29 (0.14)	1.19 (0.08)	1.34 (0.17)	1.41 (0.17)	1.54 (0.20)
Talkeetna River near Talkeetna	2.00 (0.39)	1.32 (0.15)	1.25(0.15)	1.43 (0.27)	1.45 (0.22)	1.38 (0.14)
Susitna River at Susitna Station	1.62 (0.33)	1.14 (0.07)	1.09 (0.04)	1.17 (0.06)	1.31 (0.12)	1.34 (0.16)

7-Day Low Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Greek	0.34 (0.15)	0.77 (0.11)	0.86 (0.07)	0.74 (0.11)	0.72 (0.10)	0.65 (0.11)
Chulitna River near Talkeetna	0.38 (0.12)	0.73 (0.12)	0.82 (0.05)	0.73 (0.09)	0.69 (0.12)	0.61 (0.10)
Talkeetna River near Talkeetna	0.30 (0.12)	0.72 (0.10)	0.81 (0.07)	0.68 (0.09)	0.69 (0.11)	0.68 (0.11)
Susitna River at Susitna Station	0.42 (0.26)	0.84 (0.07)	0.90 (0.05)	0.76 (0.04)	0.76 (0.11)	0.68 (0.13)

TABLE 3.19
MONTHLY AVERAGE RATIOS
(15-DAY HIGH AND 14-DAY LOW FLOW)/(MONTHLY FLOW)

15-Day High Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Creek	1.51 (0.20)	1.13 (0.07)	1.08 (0.04)	1.16 (0.10)	1.19 (0.08)	1.26 (0.10)
Chulitna River near Talkeetna	1.48 (0.14)	1.15 (0.09)	1.11 (0.04)	1.17 (0.09)	1.22 (0.10)	1.32 (0.11)
Talkeetna River near Talkeetna	1.53 (0.16)	1.15 (0.07)	1.11 (0.06)	1.19 (0.12)	1.22 (0.10)	1.23 (0.08)
Susitna River at Susitna Station	1.38 (0.22)	1.06 (0.04)	1.05 (0.03)	1.12 (0.04)	1.17 (0.07)	1.23 (0.11)

14-Day Low Flow Ratios

Monthly Average (Standard Deviation)

	May	June	July	Aug.	Sept.	Oct.
Susitna River at Gold Greek	0.48 (0.21)	0.77 (0.11)	0.92 (0.05)	0.83 (0.09)	0.82 (0.10)	0.73 (0.11)
Chulitna River near Talkeetna	0.50 (0.16)	0.84 (0.10)	0.89 (0.05)	0.83 (0.08)	0.78 (0.10)	0.68 (0.10)
Talkeetna River near Talkeetna	0.45 (0.15)	0.85 (0.06)	0.90 (0.06)	0.81 (0.10)	0.79 (0.11)	0.76 (0.09)
Susitna River at Susitna Station	0.61 (0.24)	0.92 (0.04)	0.95 (0.04)	0.87 (0.04)	0.86 (0.10)	0.78 (0.14)

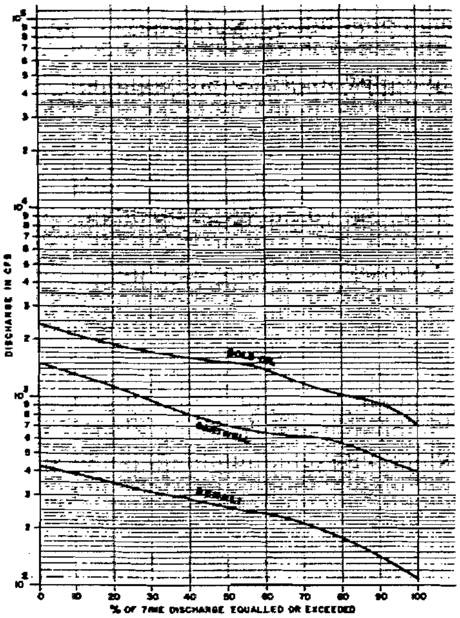
TABLE 3.20

AVERAGE RATIOS OF ANNUAL
DAILY LOW FLOWS TO ANNUAL MONTHLY LOW FLOWS

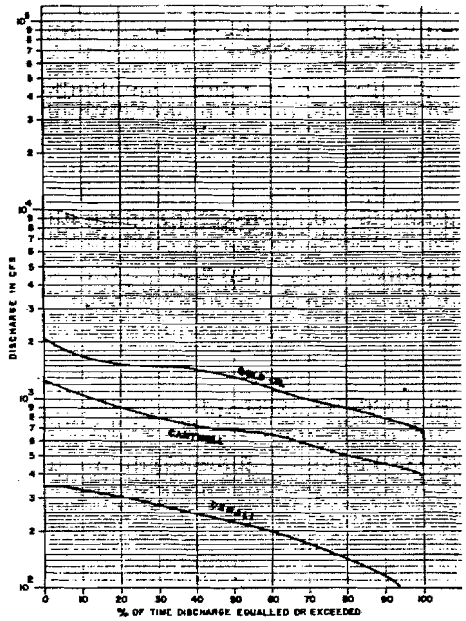
	1-Day	3-Day	7-Day	14-Day	30-Day	60-Day	90-Day
Susitna River near Cantwell	0.98	0.98	0.98	0.98	0.99	1.02	1.06
Susitna River at Gold Creek	0.97	0.97	0.97	0.98	0.99	1.02	1.08
Chulitna River near Talkeetna	0.96	0.96	0.96	0.96	0.99	1.03	1.10
Talkeetna River near Talkeetna	0.96	0.96	0.96	0.96	0.98	1.02	1.07
Susitna River at Susitna Station	0.92	0.92	0.92	0.92	0.99	1.10	1.06

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	321.6	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	364.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1390.5	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1149.8	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3138.8	0.0

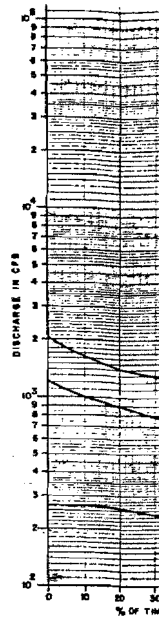
TABLE 3.21 Average Monthly Spill Below Devil Canyon Dam

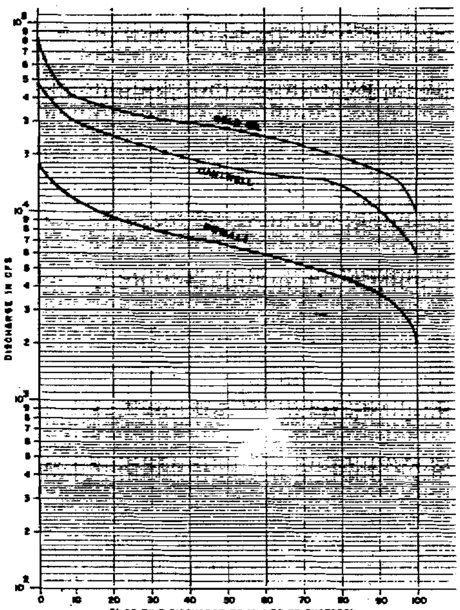


JANUARY

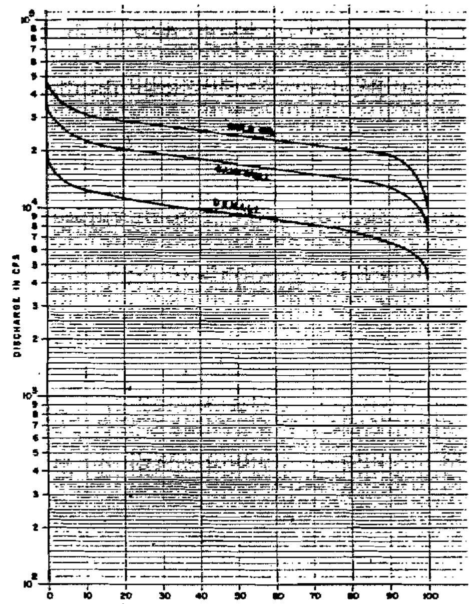


FEBRUARY

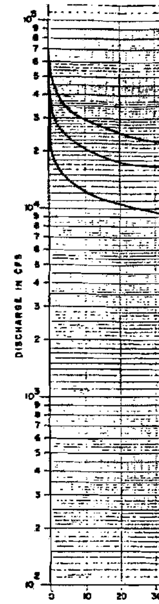


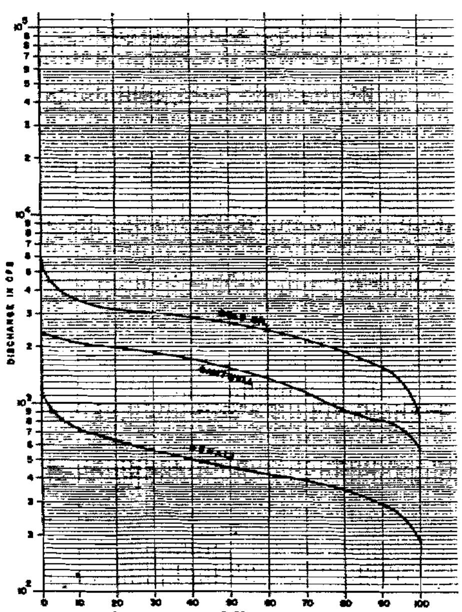


JUNE

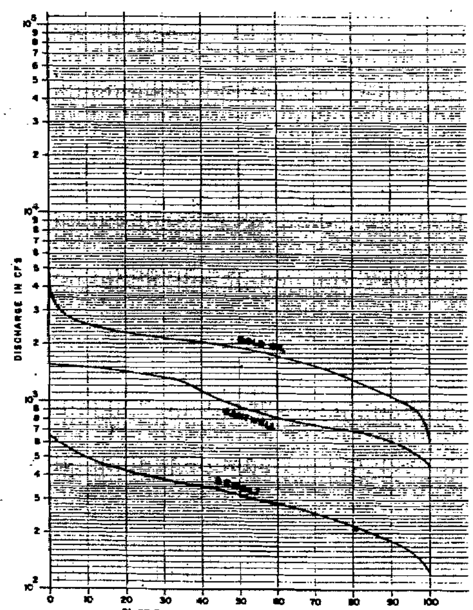


JULY

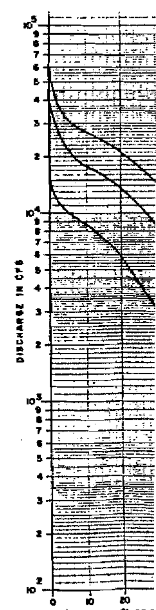




NOVEMBER



DECEMBER



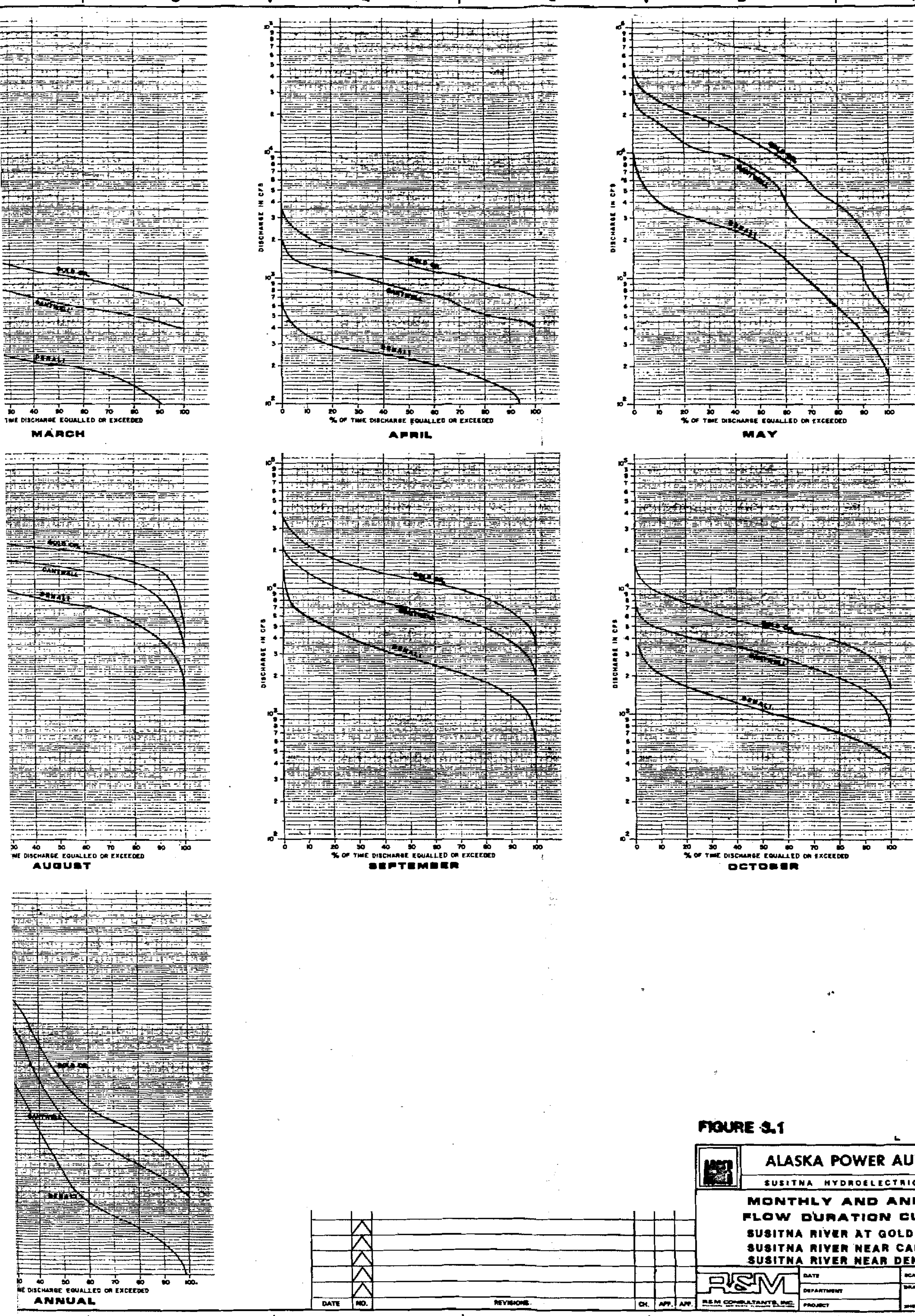


FIGURE 3.1

ALASKA POWER AUTHORITY

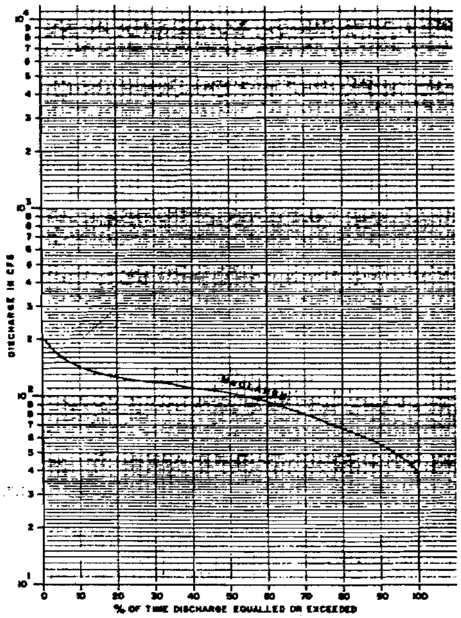
SUSITNA HYDROELECTRIC PROJECT

MONTHLY AND ANNUAL FLOW DURATION CURVES
SUSITNA RIVER AT GOLD CREEK
SUSITNA RIVER NEAR CANTWELL
SUSITNA RIVER NEAR DENALI

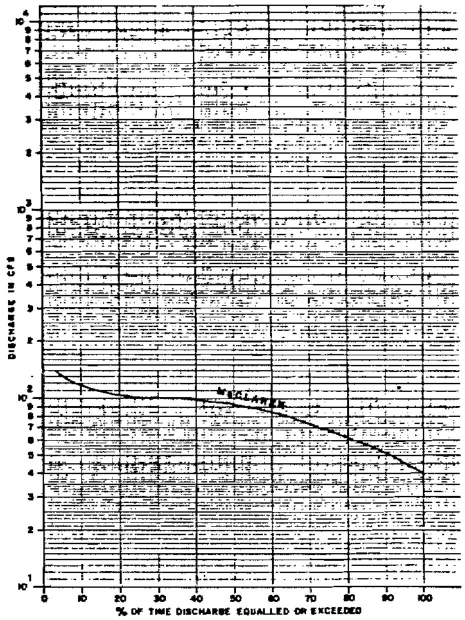
R&M CONSULTANTS, INC.

DATE	NO.	REVISIONS	CH.	APP.	APP.

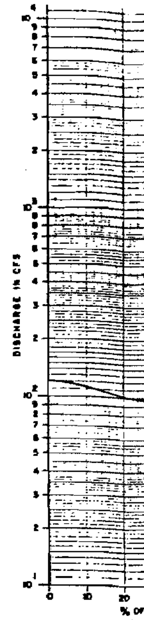
DATE | DEPARTMENT | PROJECT | SCALE | DRAWING NO. | SHEET OF | REV.

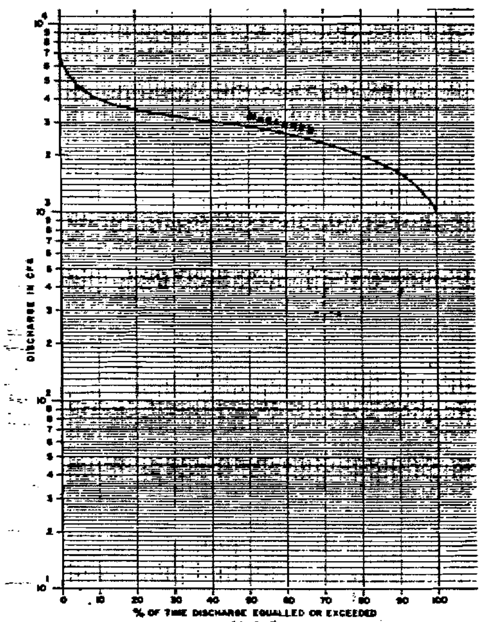


JANUARY

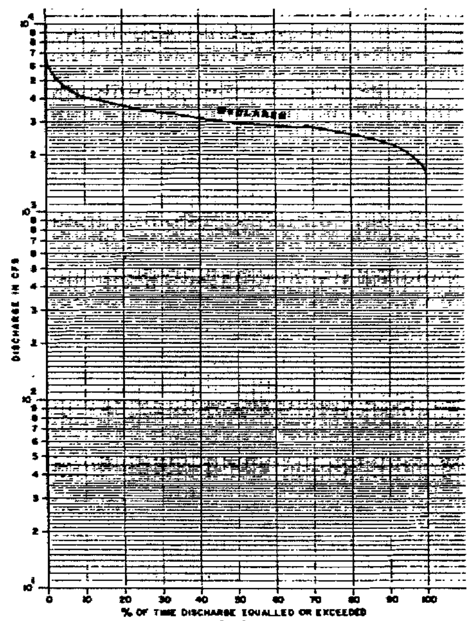


FEBRUARY

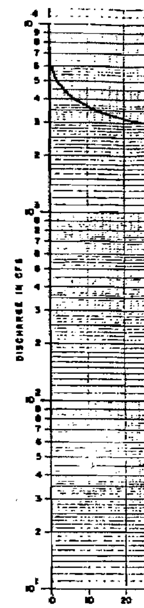


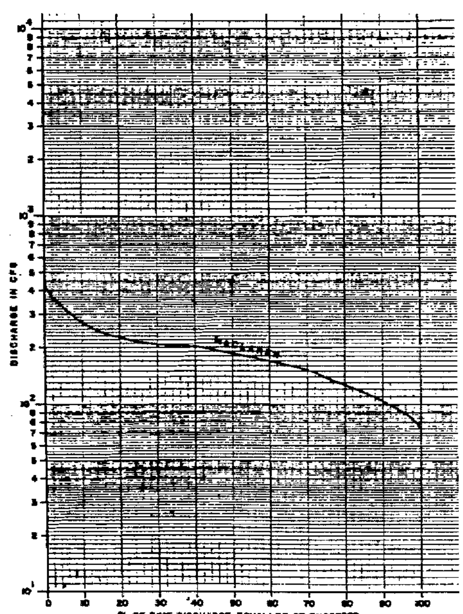


JUNE

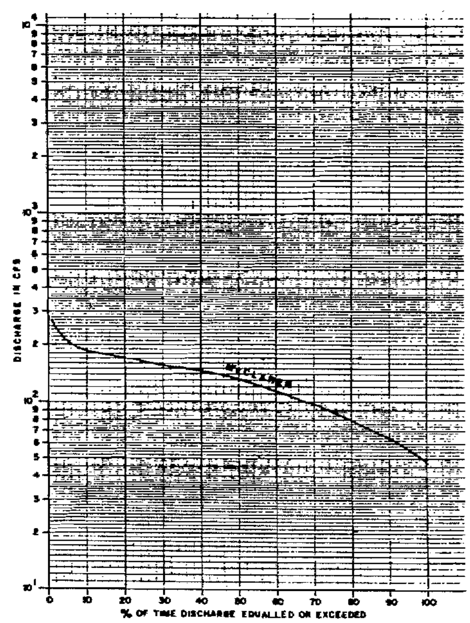


JULY

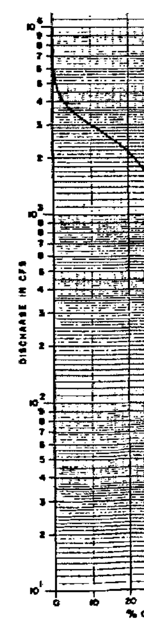


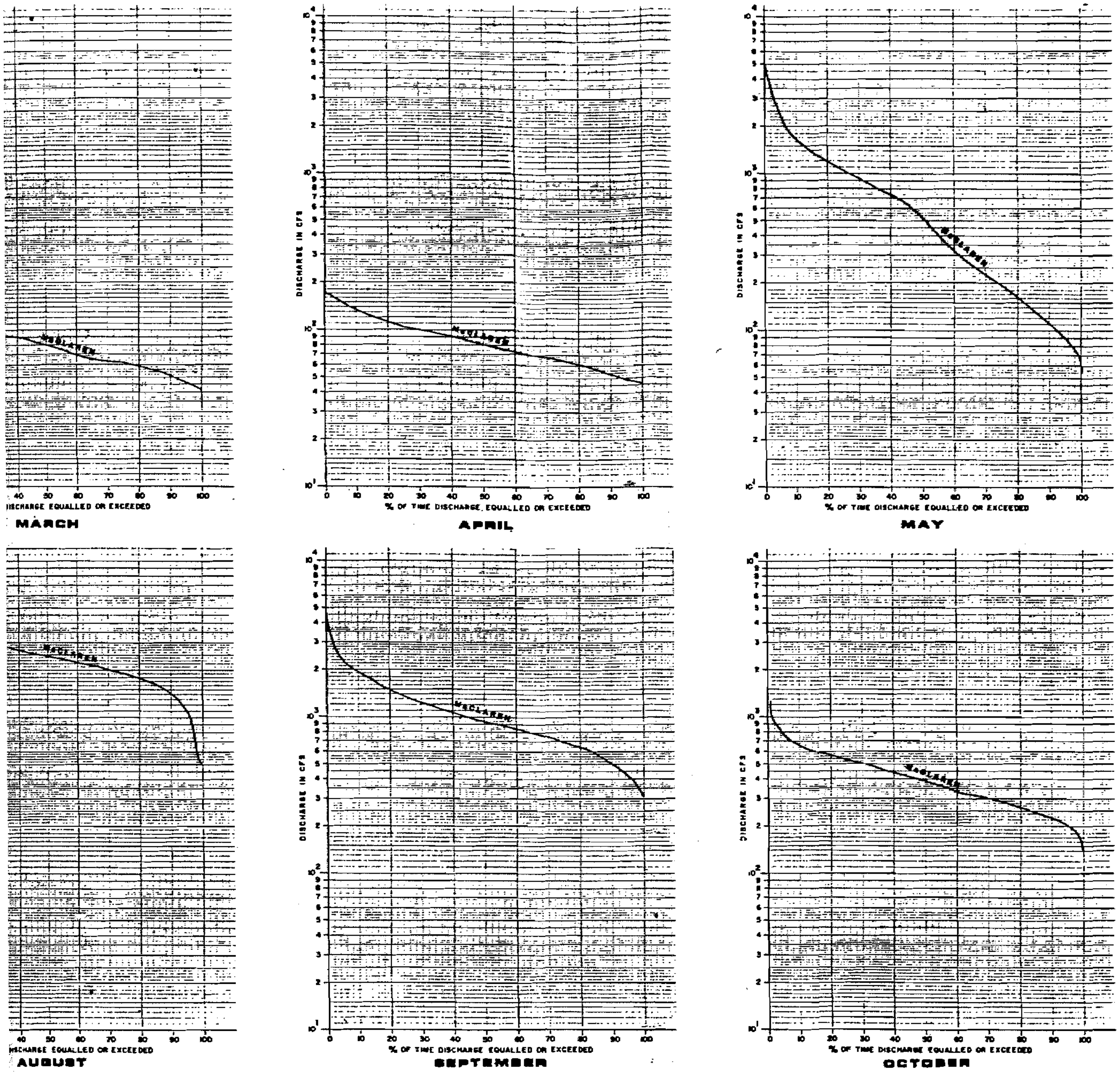


NOVEMBER



DECEMBER





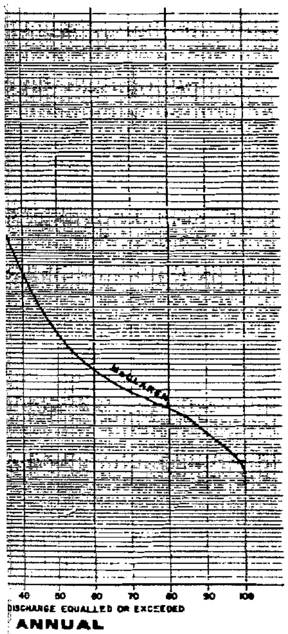


FIGURE 3.2

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

MONTHLY AND ANNUAL FLOW DURATION CURVES

MacLAREN RIVER AT PAXSON

R&M CONSULTANTS, INC.

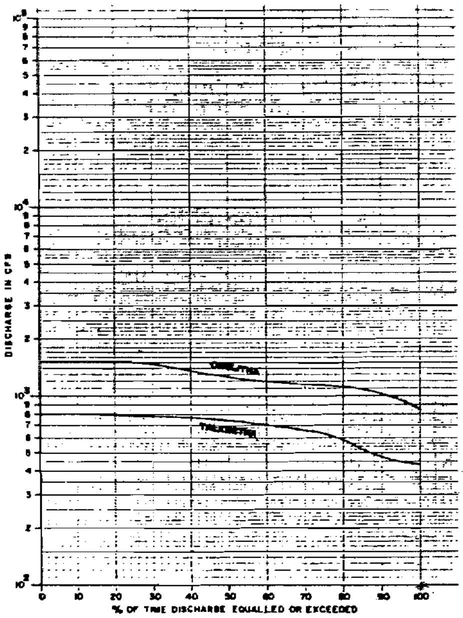
DATE	NO.	REVISIONS	CH.	APP.	APP.

DATE | DEPARTMENT | PROJECT | SCALE | DRAWING NO. | SHEET OF | REV.

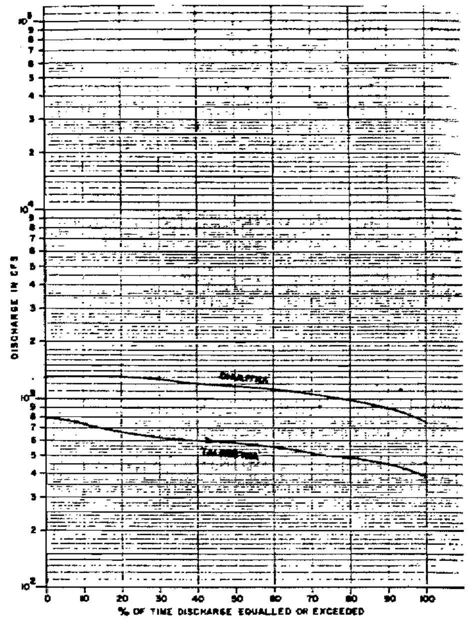
10 | 9 | 8 | 7 | 6

G

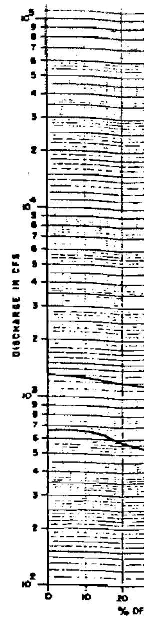
F



JANUARY



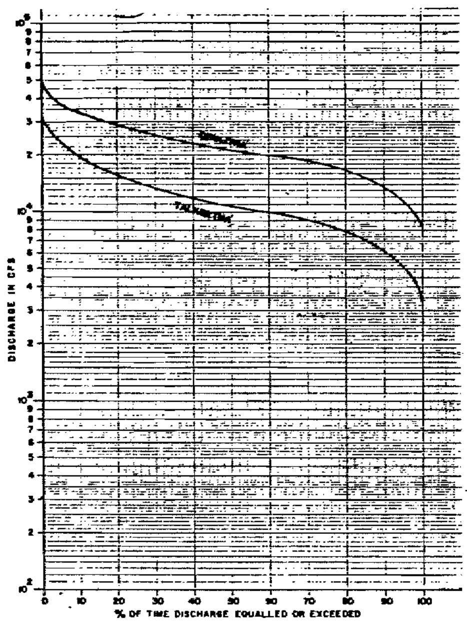
FEBRUARY



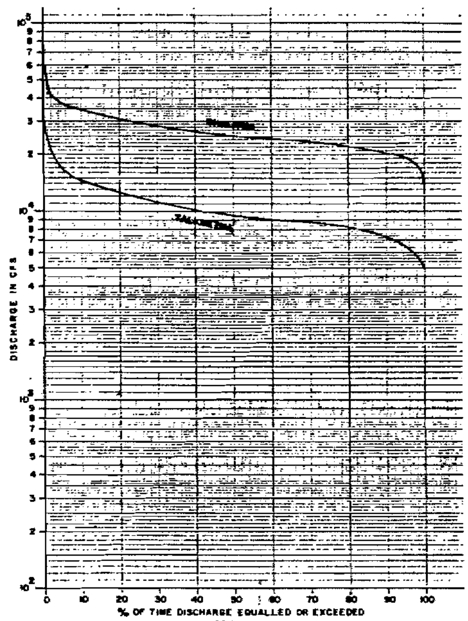
E

D

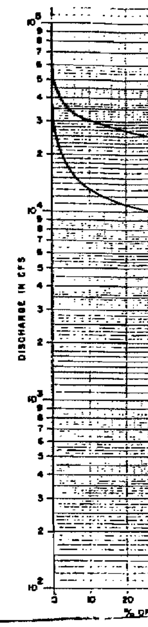
C



JUNE

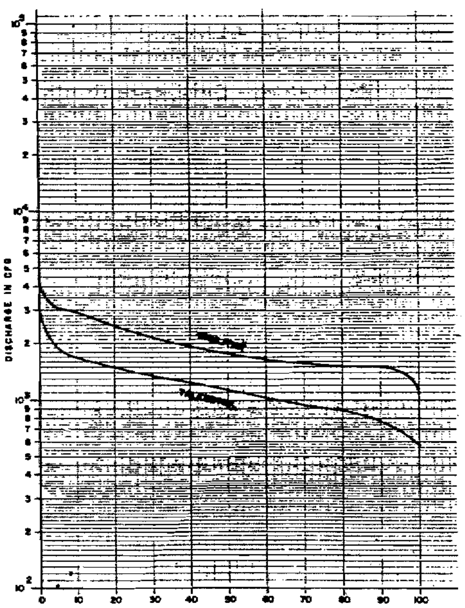


JULY

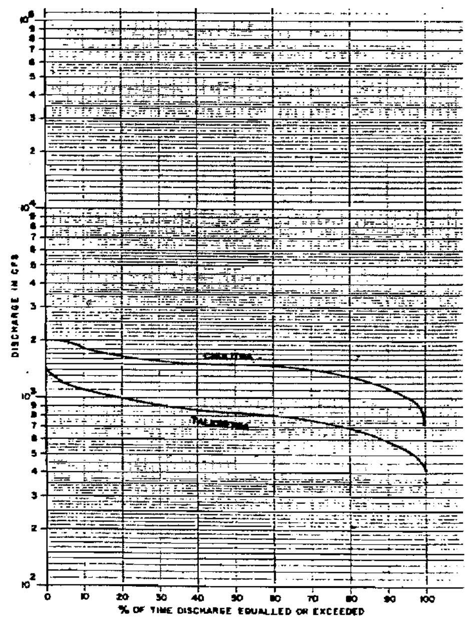


B

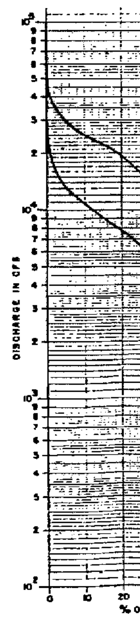
A



NOVEMBER

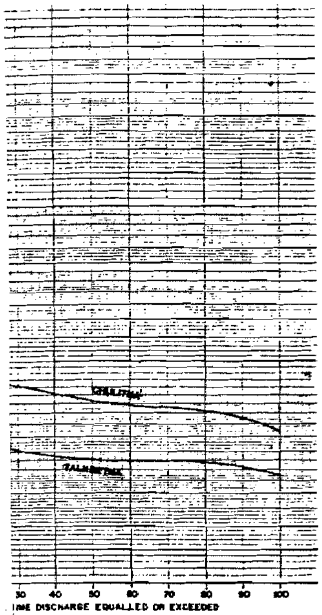


DECEMBER

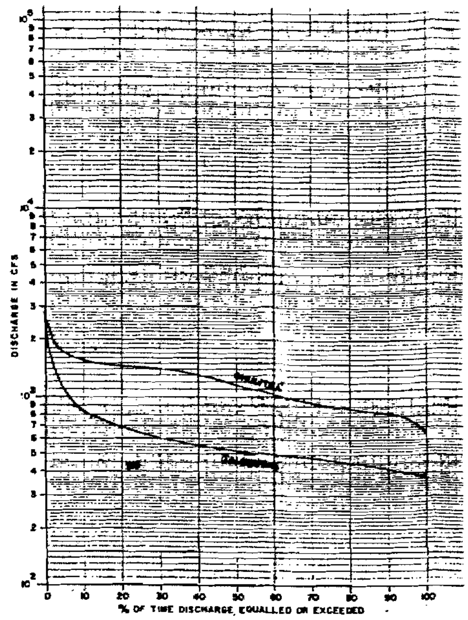


DRAWING No. ____ SHEET OF ____ REV

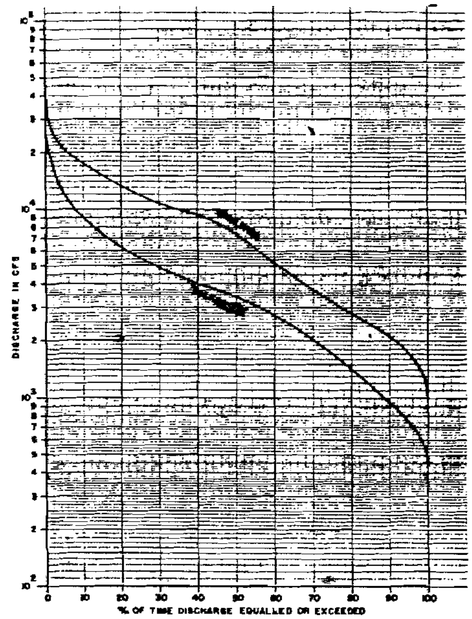
10 | 9 | 8 | 7 | 6



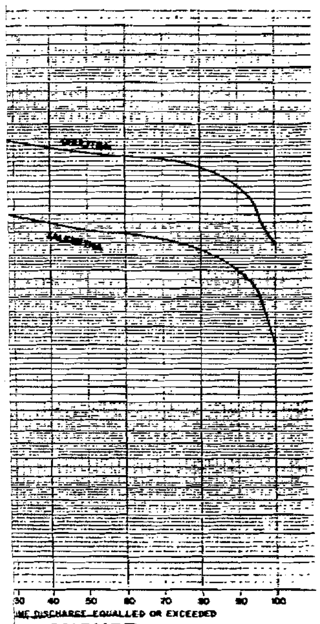
MARCH



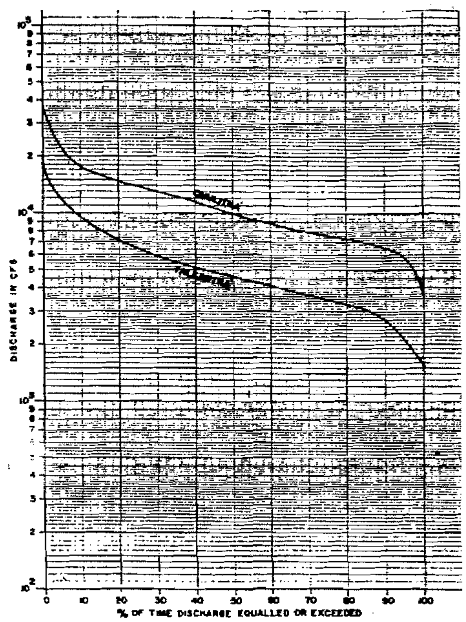
APRIL



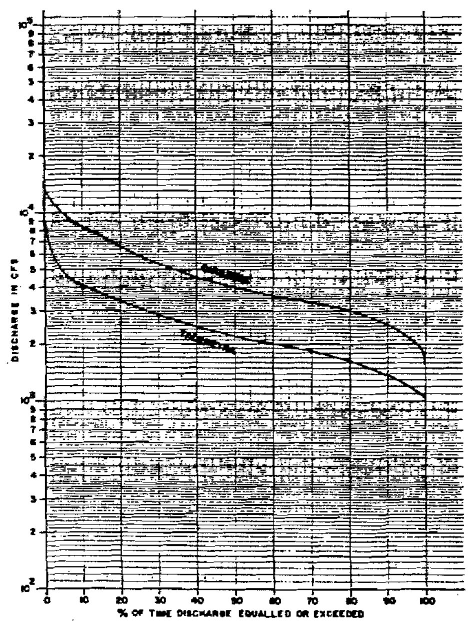
MAY



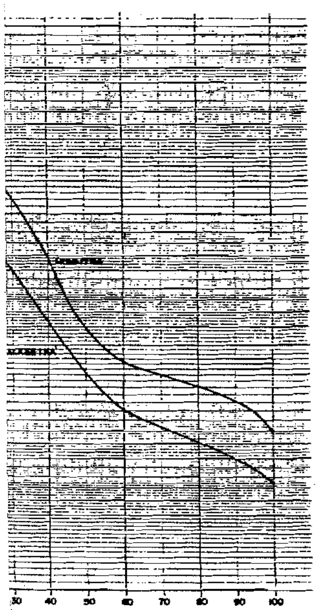
AUGUST



SEPTEMBER



OCTOBER



ANNUAL

FIGURE 3.3

ALASKA POWER AUTHORITY

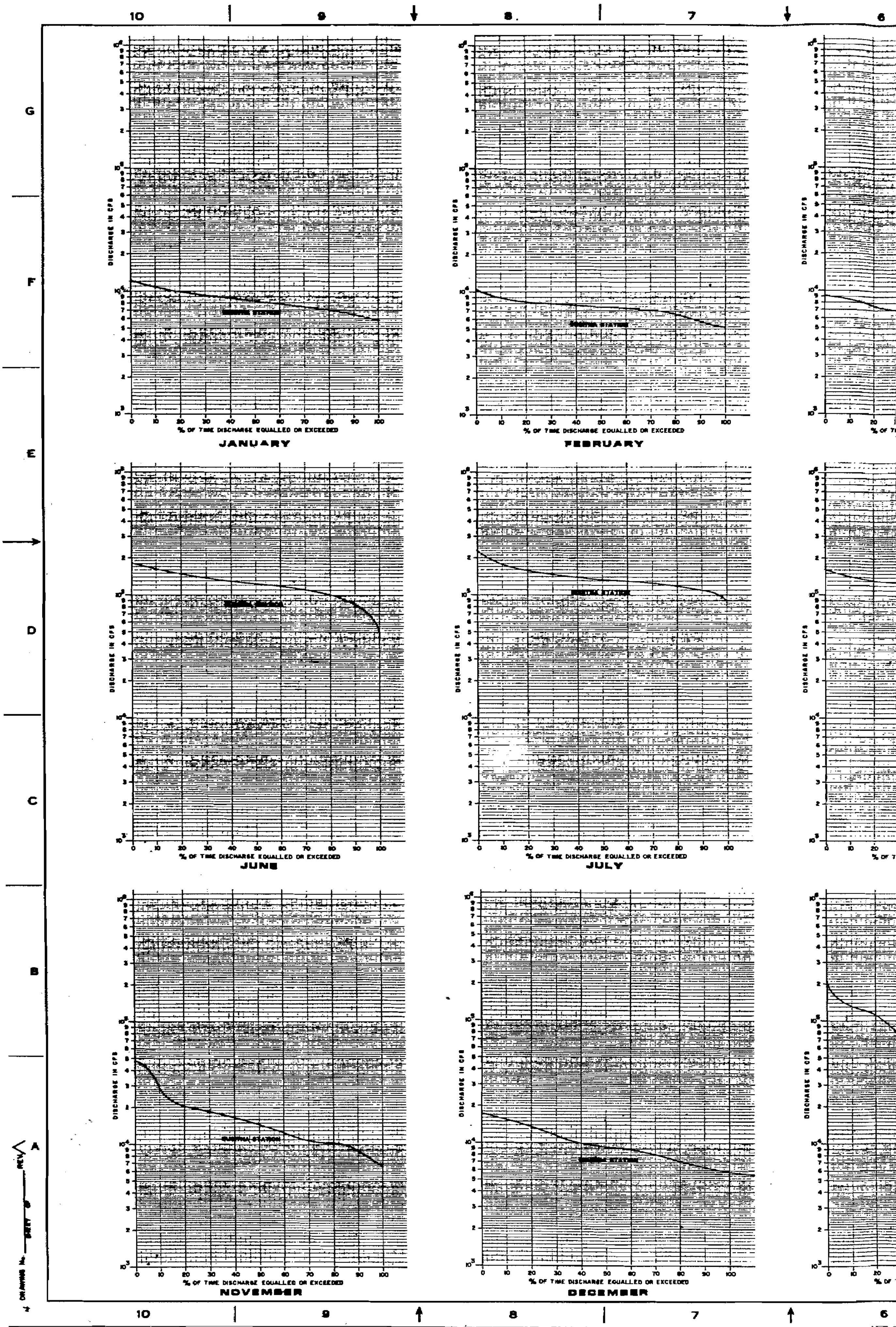
SUSITNA HYDROELECTRIC PROJECT

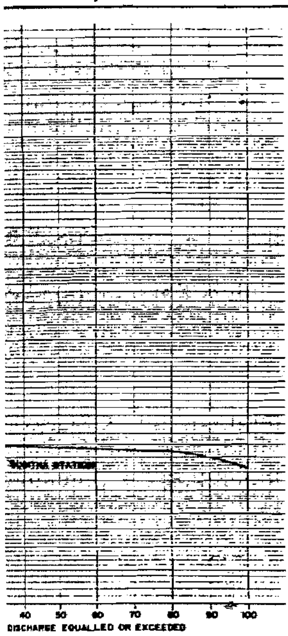
MONTHLY AND ANNUAL FLOW DURATION CURVES

TALKEETNA RIVER NEAR TALKEETNA
CHULITNA RIVER NEAR TALKEETNA

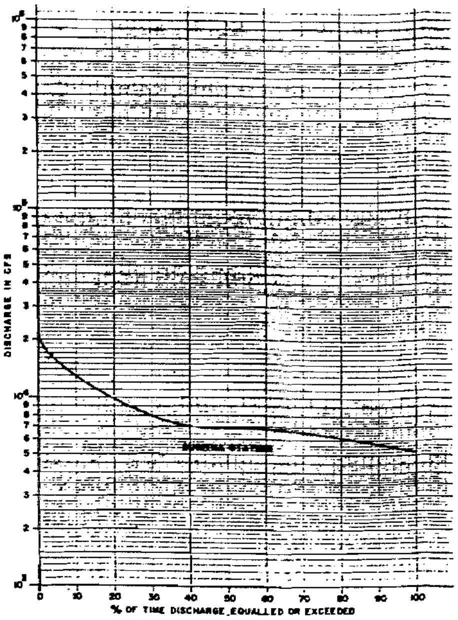
R&M CONSULTANTS, INC.

DATE	NO.	REVISIONS	CH.	APP.	APP.

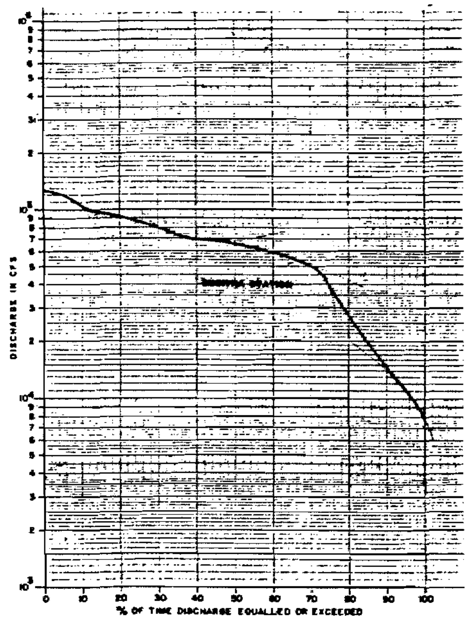

DISCHARGE IN CFS
% OF TIME DISCHARGE EQUALLED OR EXCEEDED
JANUARY
FEBRUARY
JUNE
JULY
NOVEMBER
DECEMBER
SUSITNA STATION



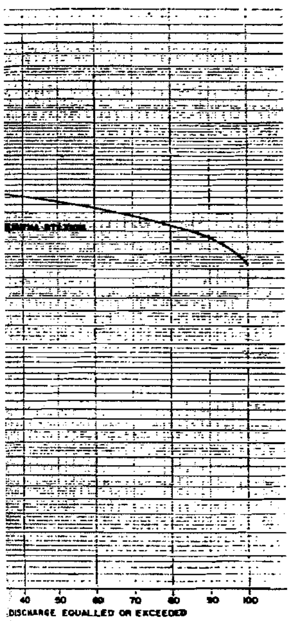
MARCH



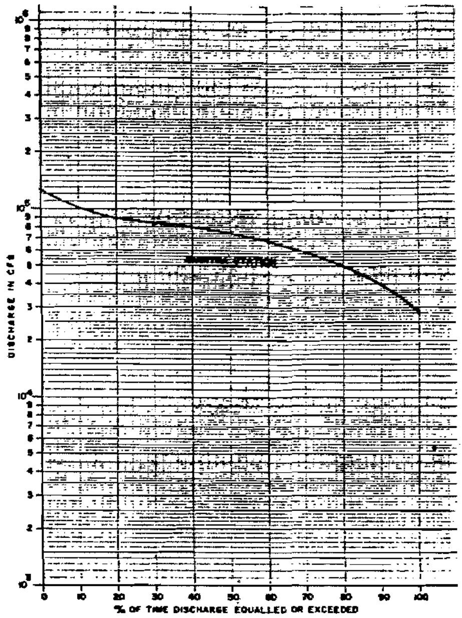
APRIL



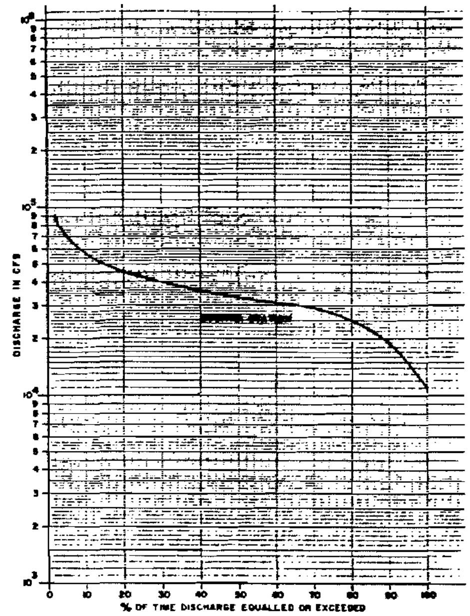
MAY



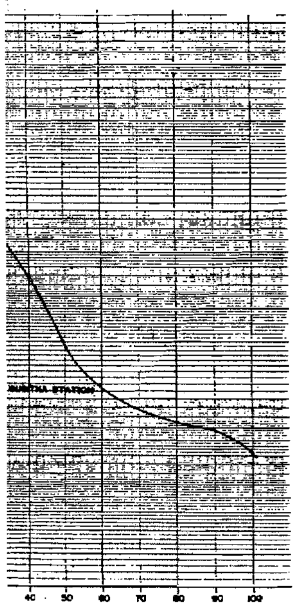
AUGUST



SEPTEMBER



OCTOBER



ANNUAL

FIGURE 3.4

ALASKA POWER AUTHORITY

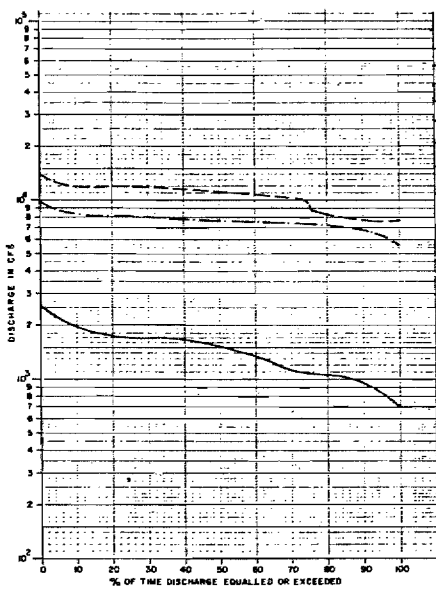
SUSITNA HYDROELECTRIC PROJECT

MONTHLY AND ANNUAL FLOW DURATION CURVES

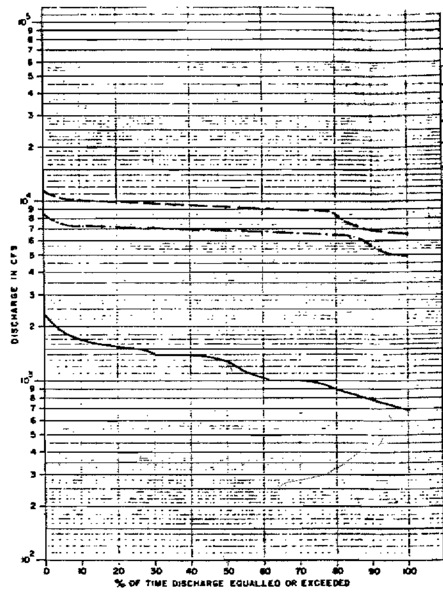
SUSITNA RIVER AT SUSITNA STATION

R&M CONSULTANTS, INC.

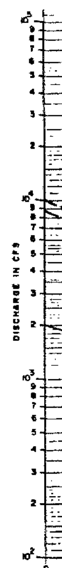
DATE	NO.	REVISIONS	CH.	APP.	APP.

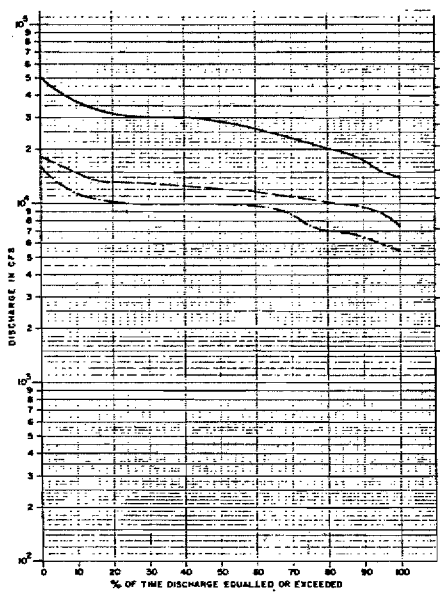


JANUARY

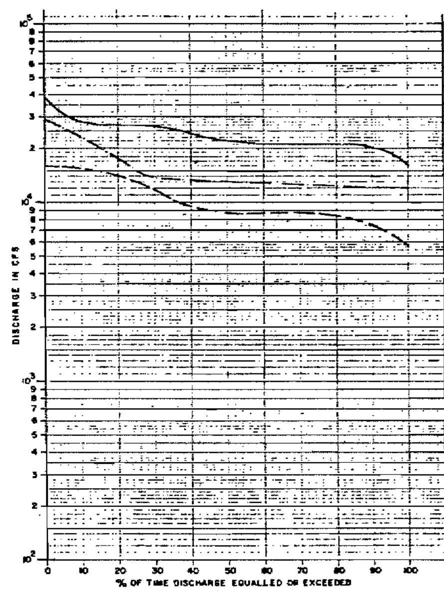


FEBRUARY

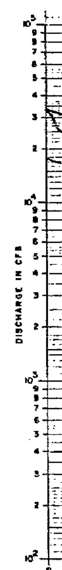


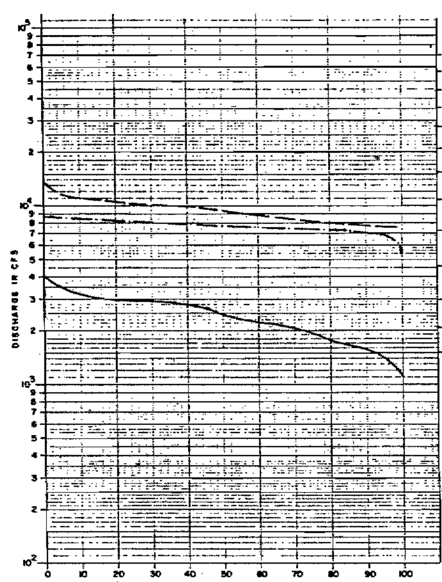


JUNE

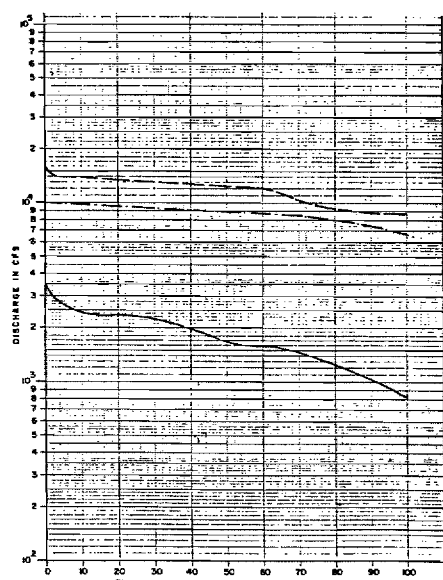


JULY

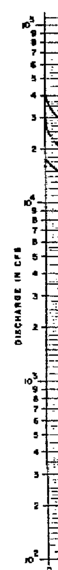


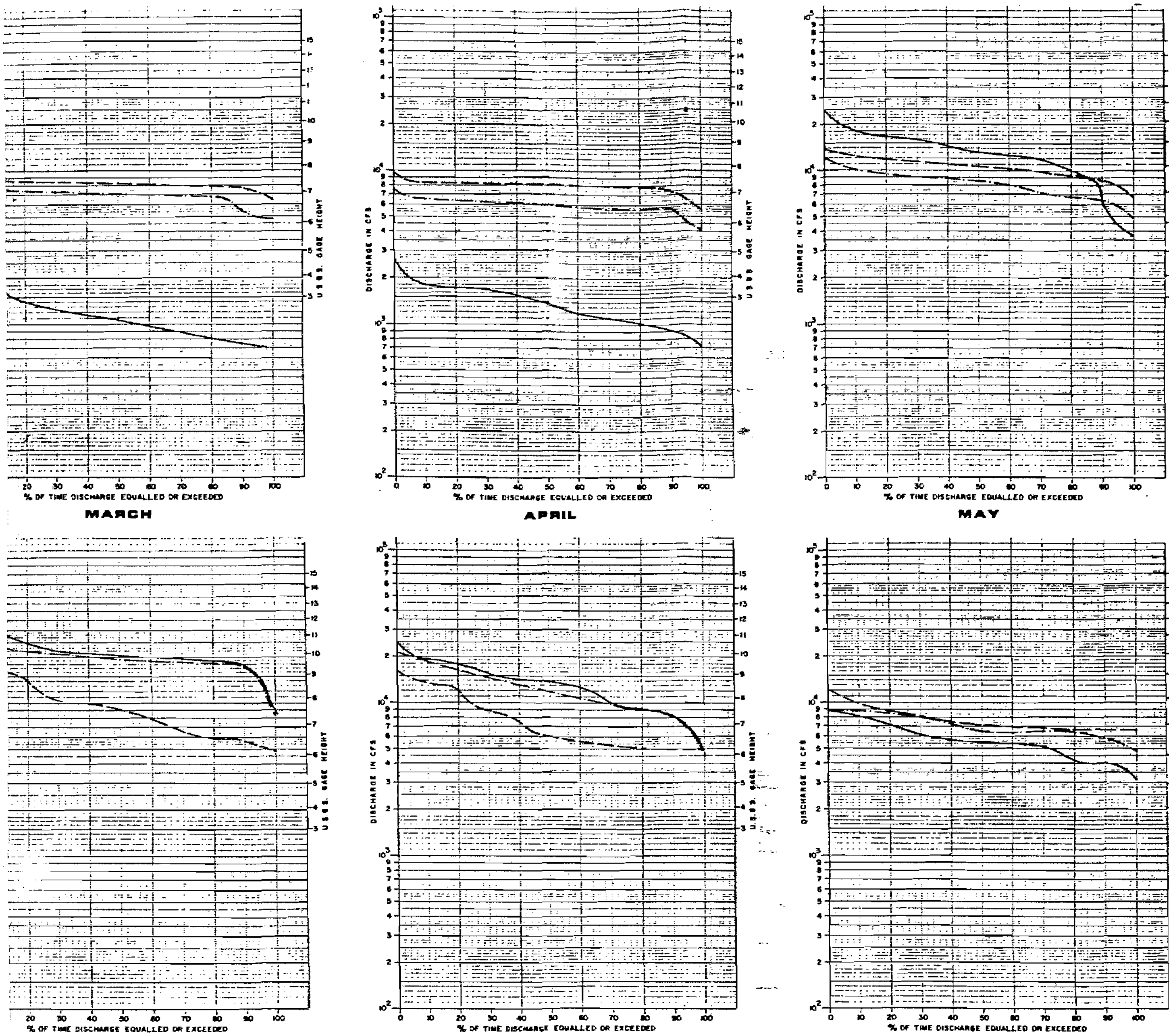


NOVEMBER



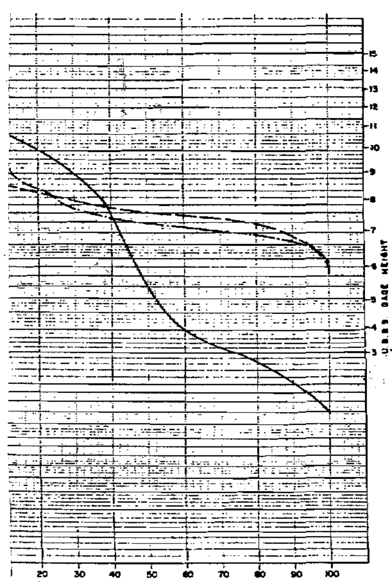
DECEMBER





MARCH APRIL MAY

AUGUST SEPTEMBER OCTOBER



ANNUAL

NOTES:

1. ———— PRE-PROJECT FLOW
   — — — CASE A (OPTIMAL POWER FLOW)
   —·—·— CASE D (MINIMAL FISHERIES IMPACT)
2. CURVES WERE GENERATED FROM 30 YEARS RECORD OF HISTORICAL AND SIMULATED AVERAGE MONTHLY FLOWS.

FIGURE 3.5

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

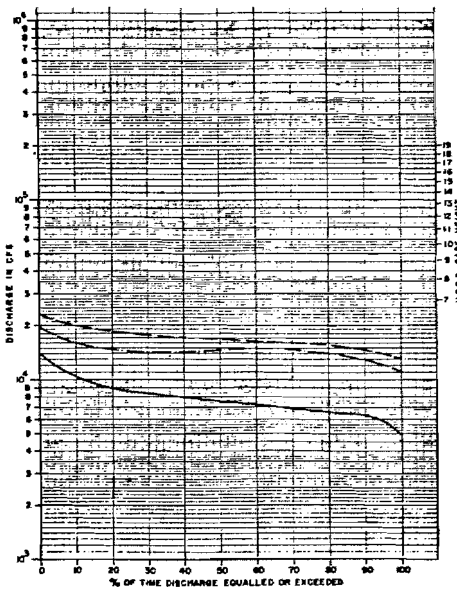
MONTHLY AND ANNUAL FLOW DURATION CURVES

SUSITNA RIVER AT GOLD CREEK

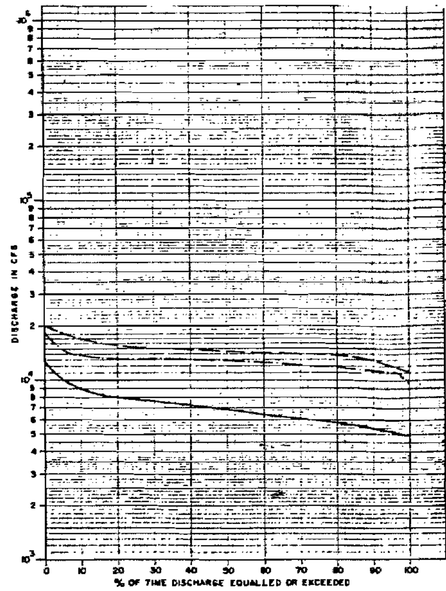
R&M CONSULTANTS, INC.

DATE	JANUARY 1982
SCALE	NONE
PROJECT	052310

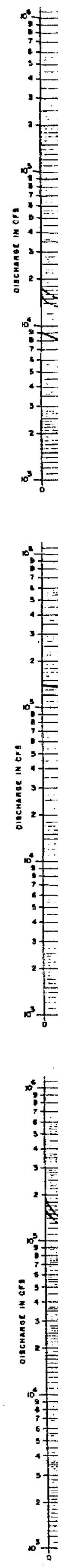
DATE	NO.	REVISIONS	CH.	APP.	APP.

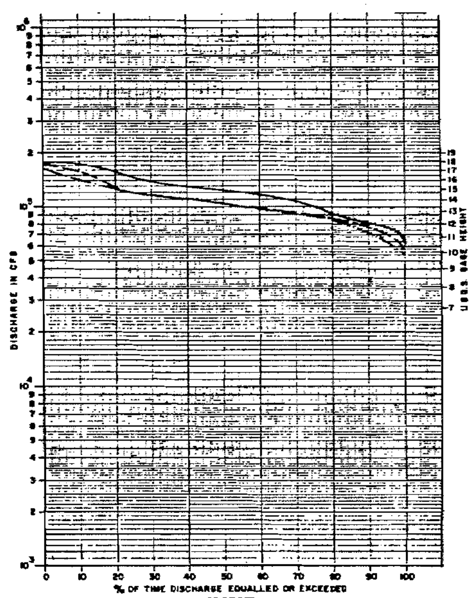


JANUARY

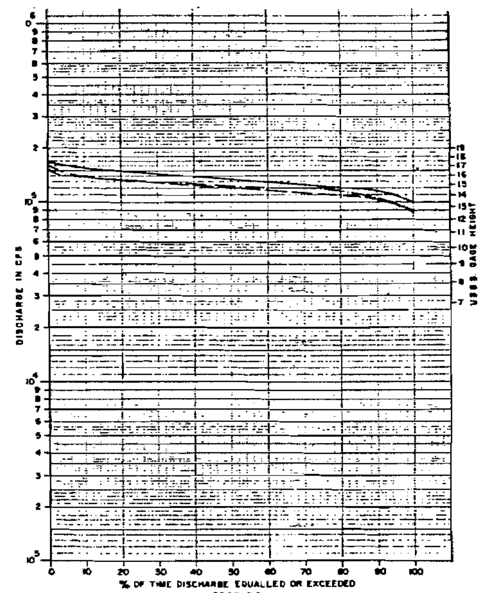


FEBRUARY

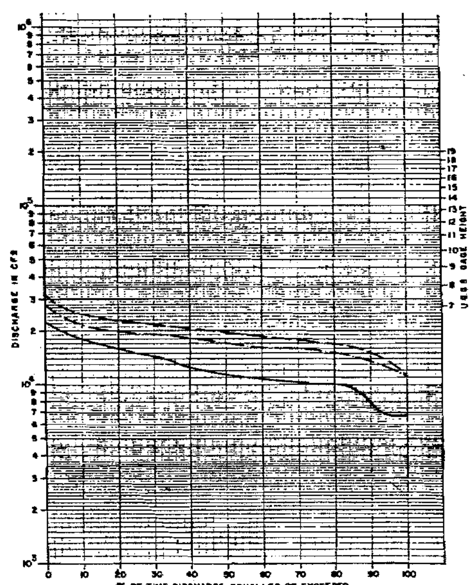




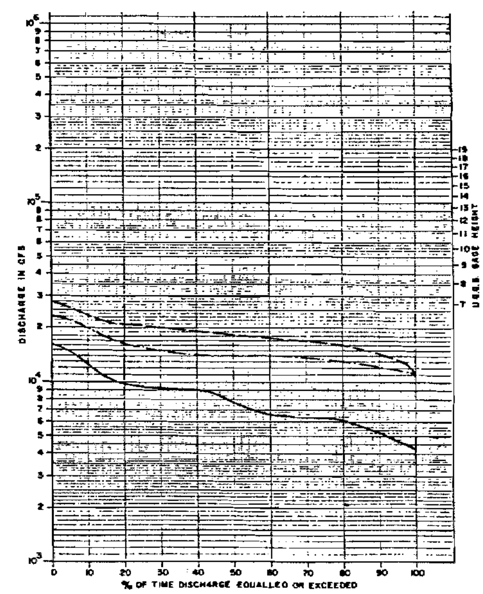
JUNE



JULY



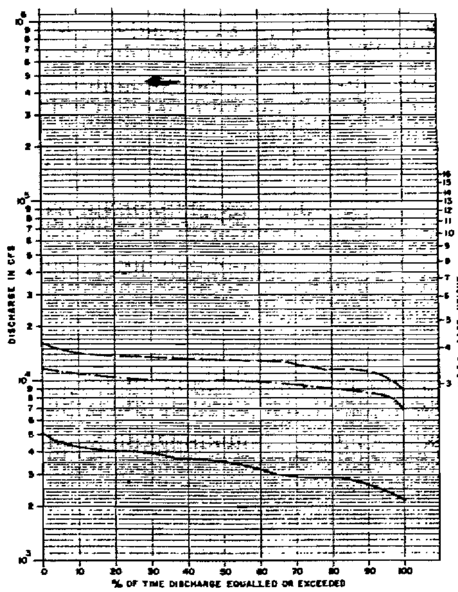
NOVEMBER



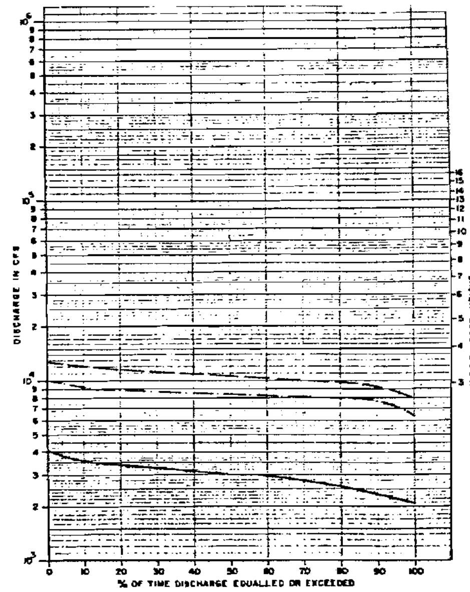
DECEMBER

10 | 9 | 8 | 7

G



JANUARY

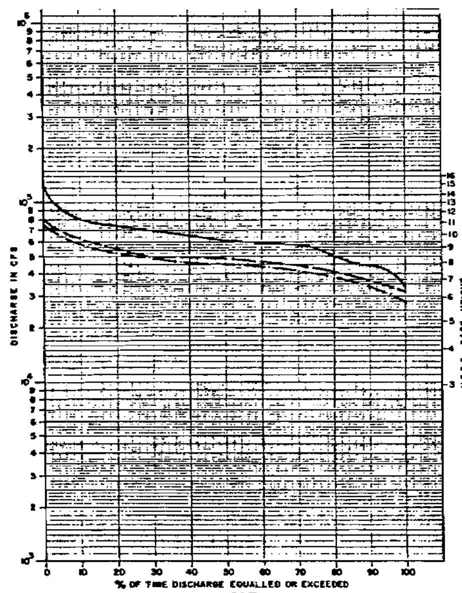


FEBRUARY

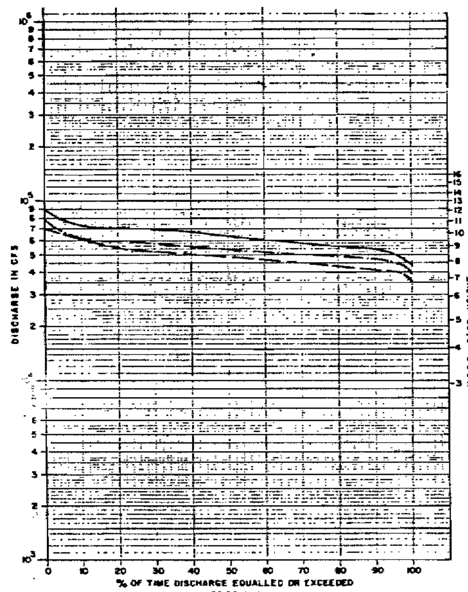
F

E

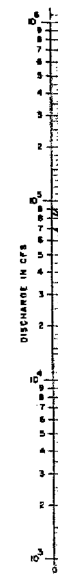
D



JUNE

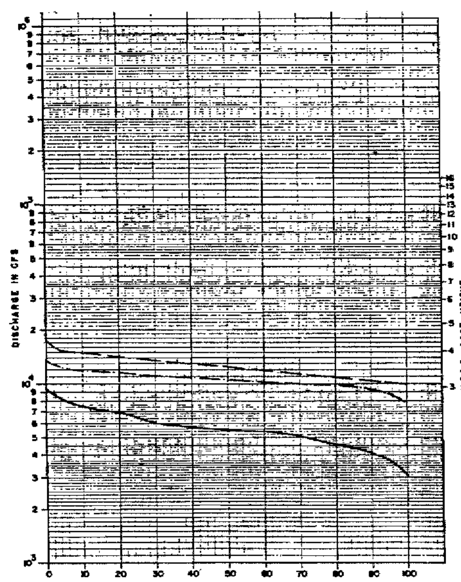


JULY

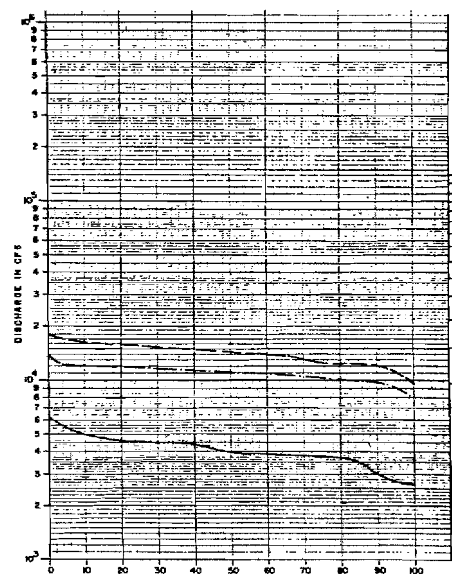


C

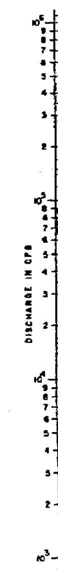
B



NOVEMBER



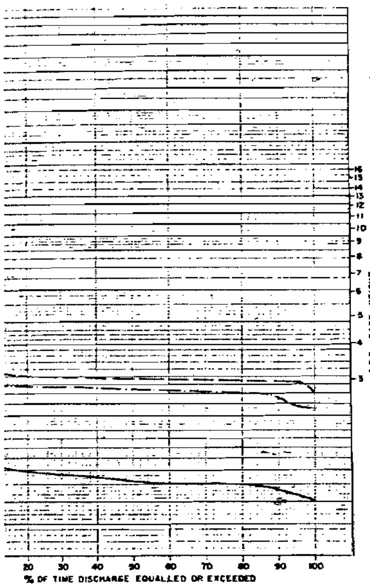
DECEMBER



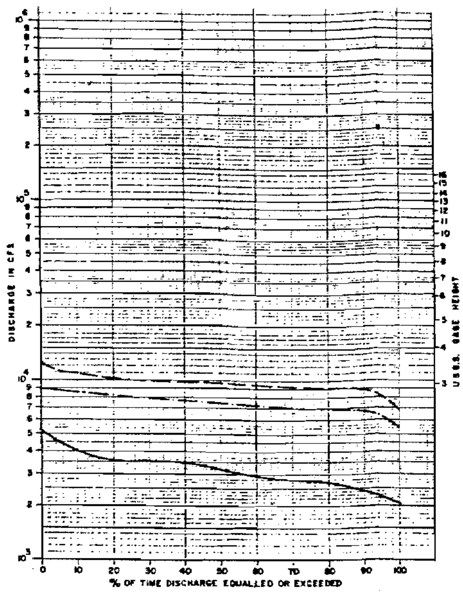
A

DRAWING No. ____ SHEET ____ OF ____ REV.

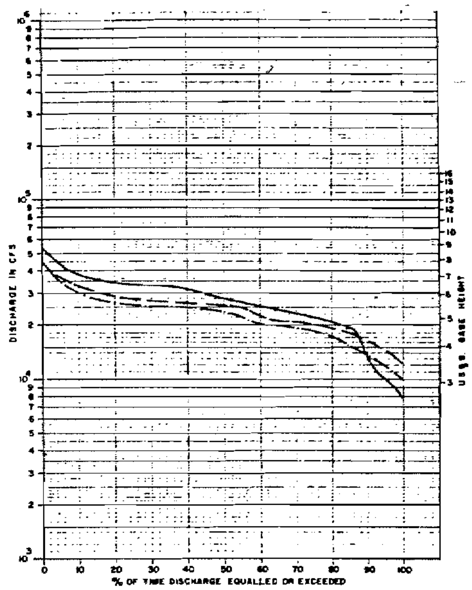
10 | 9 | 8 | 7



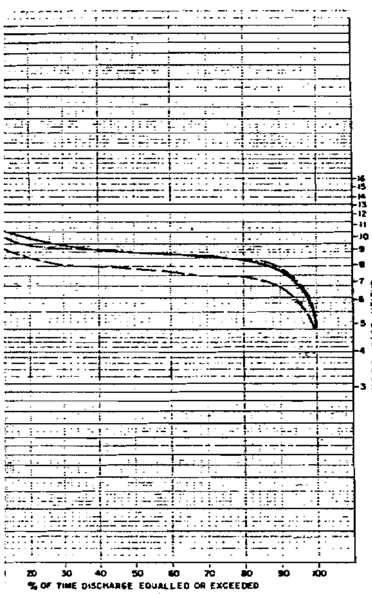
MARCH



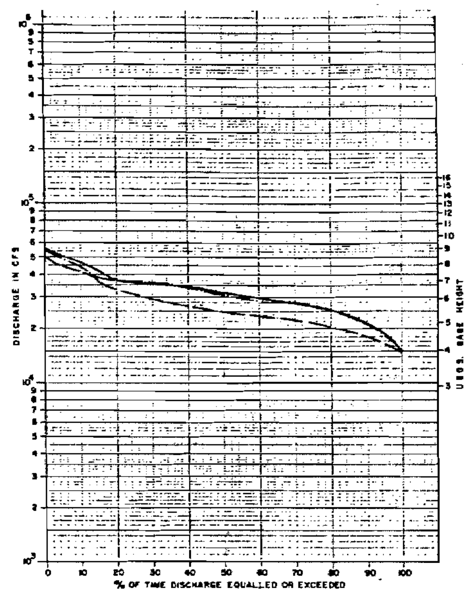
APRIL



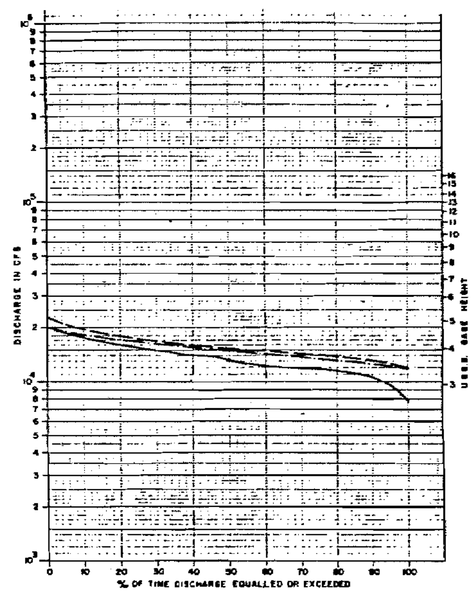
MAY



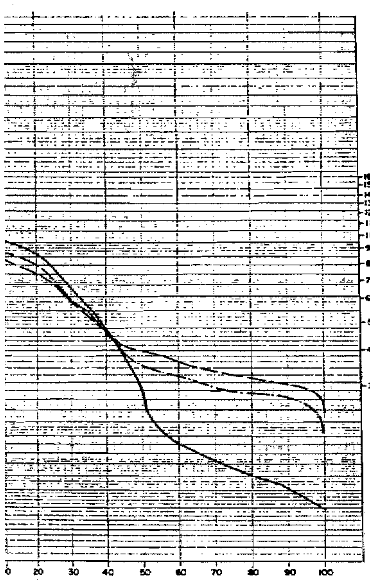
AUGUST



SEPTEMBER



OCTOBER



ANNUAL

NOTES:

1. ———— PRE-PROJECT FLOW
   — — — CASE A (OPTIMAL POWER FLOW)
   —·—·— CASE D (MINIMAL FISHERIES IMPACT)
2. CURVES GENERATED FROM 30 YEARS RECORD OF SYNTHESIZED AND SIMULATED AVERAGE MONTHLY FLOWS.

FIGURE 3.7

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

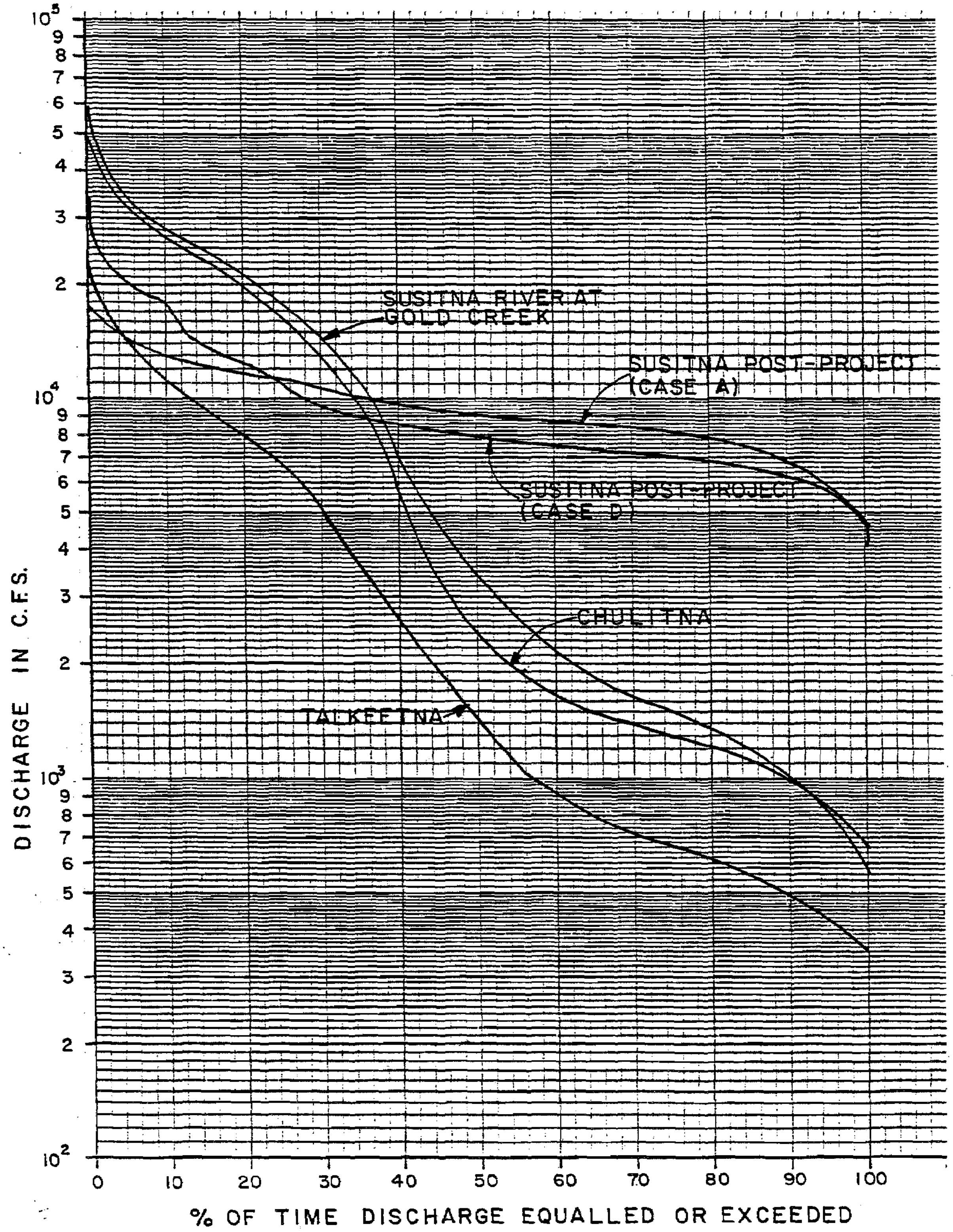
MONTHLY AND ANNUAL FLOW DURATION CURVES

SUSITNA RIVER AT SUNSHINE

R&M CONSULTANTS, INC.

DATE JANUARY 1982 | SCALE NONE | PROJECT 052310

DATE	NO.	REVISIONS	CH.	APP.	APP.



PREPARED BY:

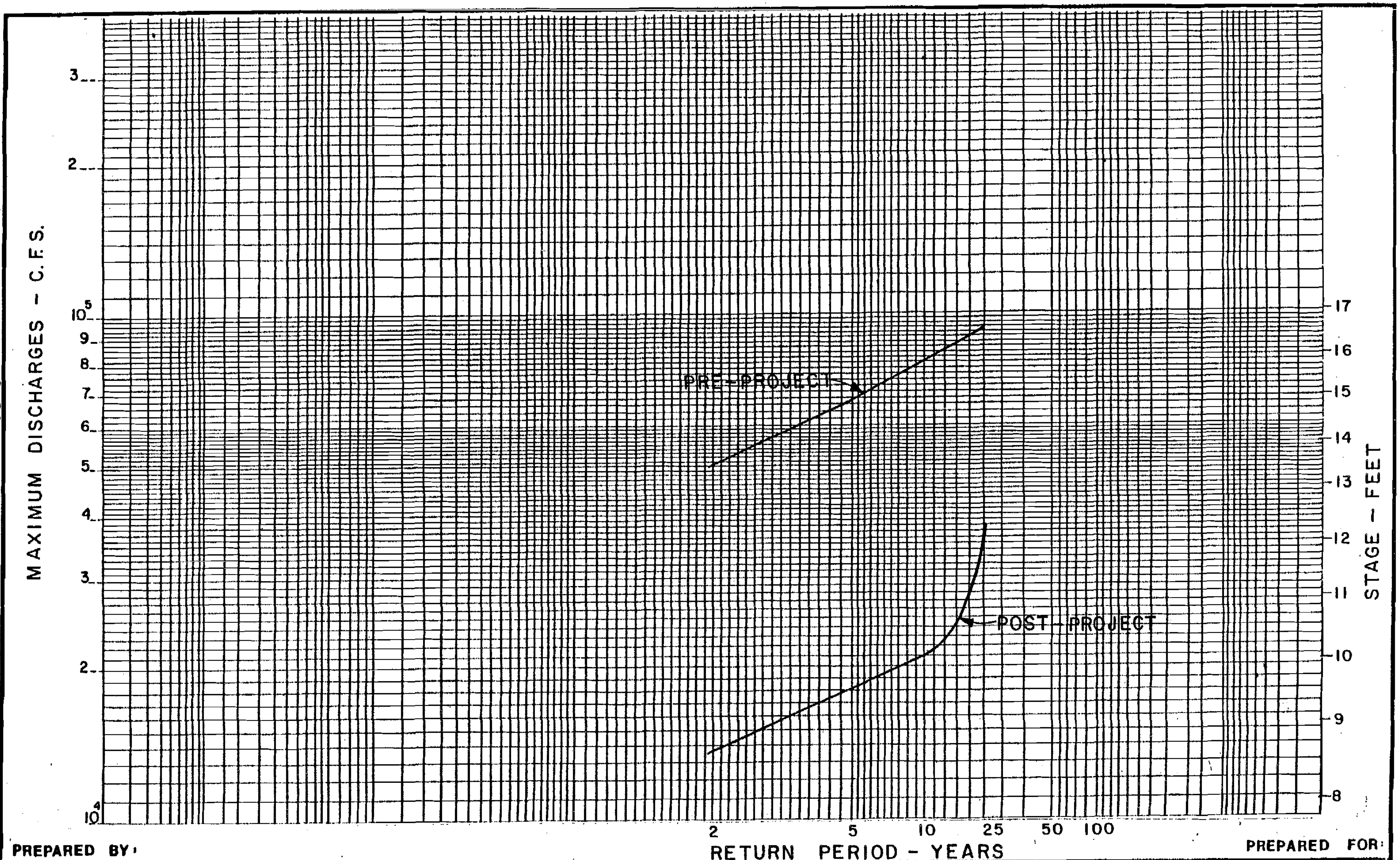
R&M CONSULTANTS, INC.

PREPARED FO

ANNUAL FLOW DURATION CURVES AT
SUSITNA-CHULITNA-TALKEETNA CONFLUENCE

FIG. 3.8

ACRES



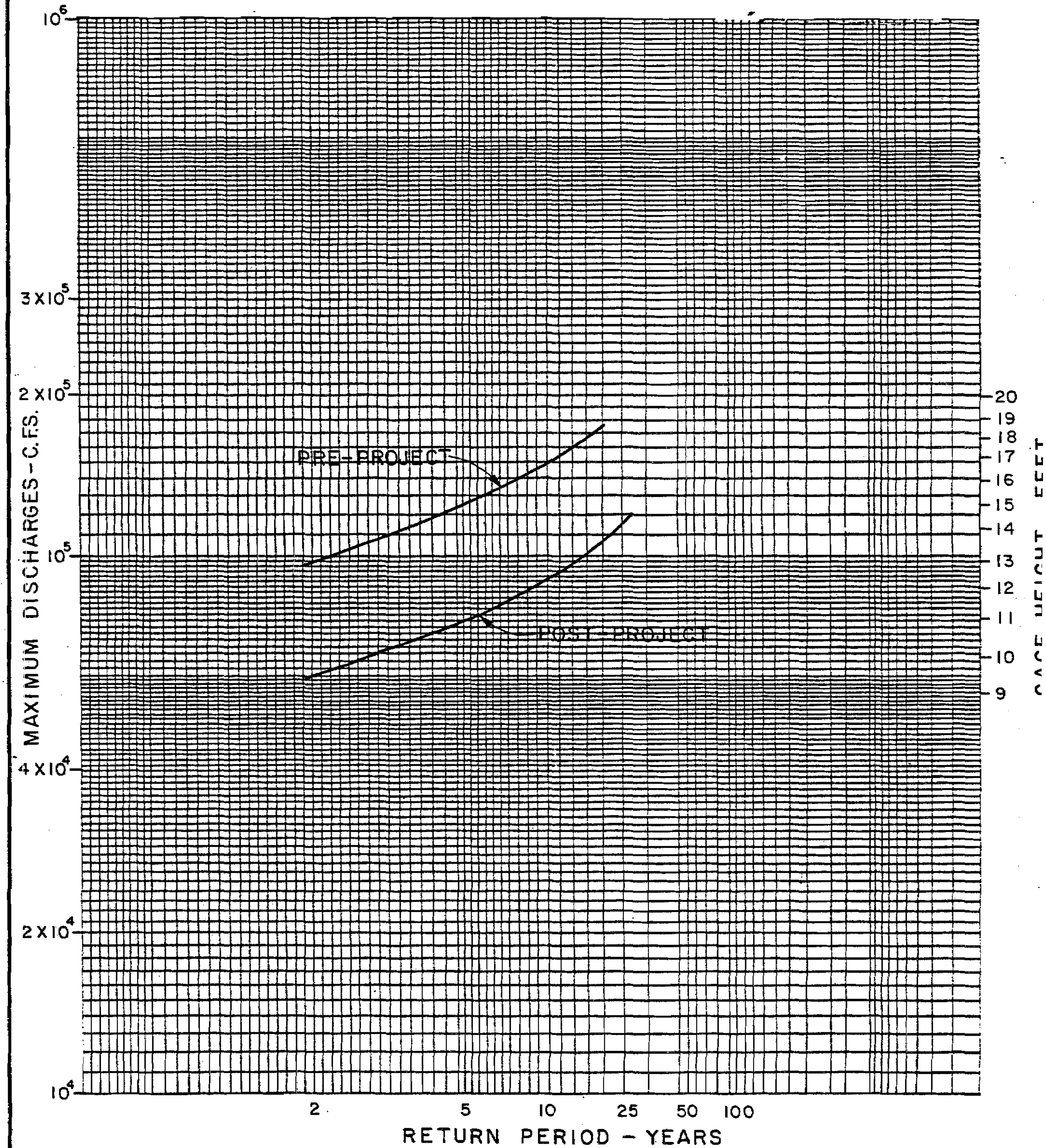
PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER AT GOLD CREEK
PRE AND POST PROJECT

PREPARED FOR:

ACRES



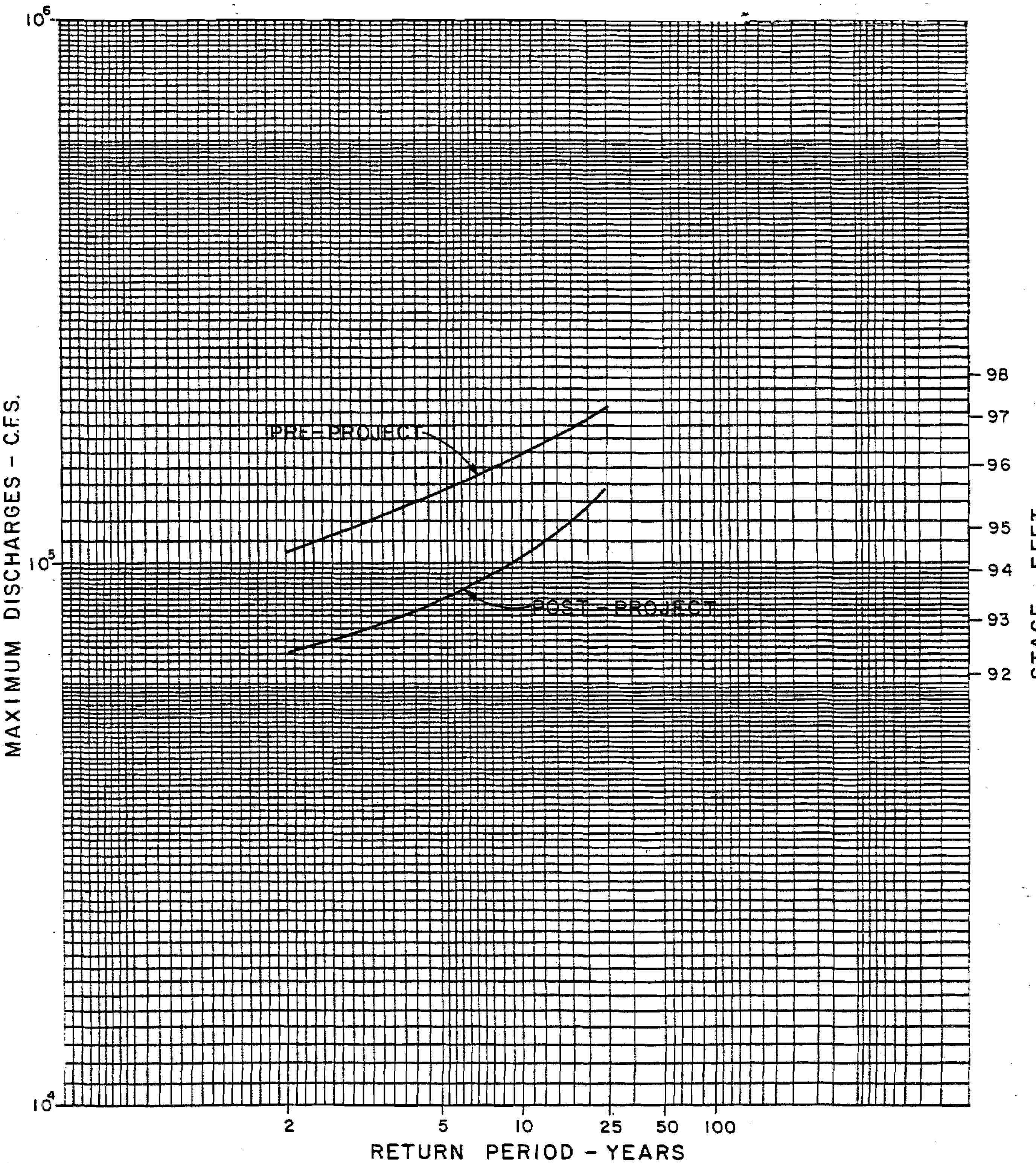
PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER AT SUNSHINE
PRE AND POST PROJECT
DISCHARGE - STAGE FREQUENCY CURVES

FIG. 3.10

PREPARED F



PREPARED BY:

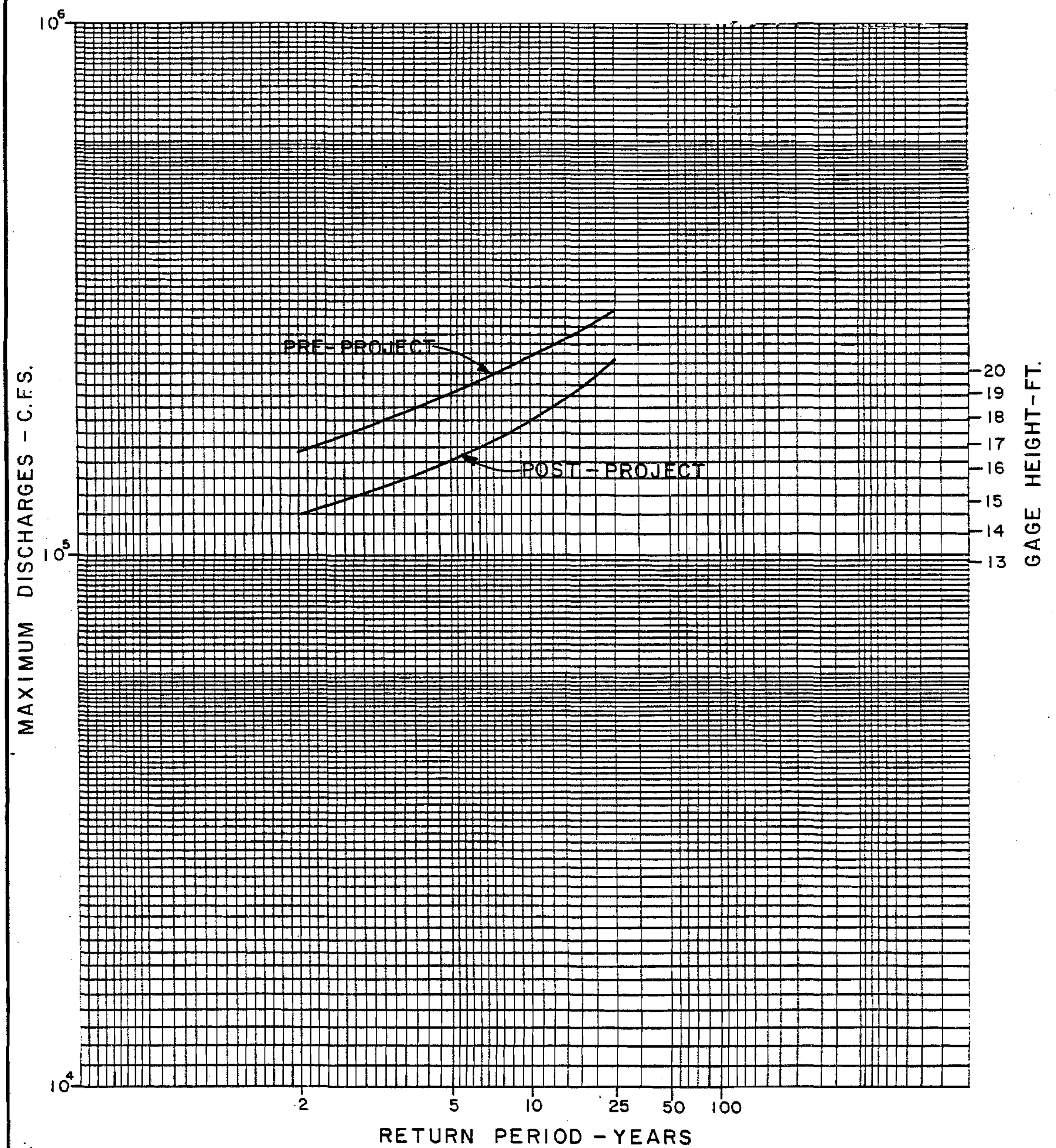
R&M CONSULTANTS, INC.

SUSITNA RIVER AT DELTA ISLANDS
PRE AND POST PROJECT
DISCHARGE - STAGE FREQUENCY CURVE

PREPARED FOR:

ACRES

FIG. 3.11



PREPARED BY:

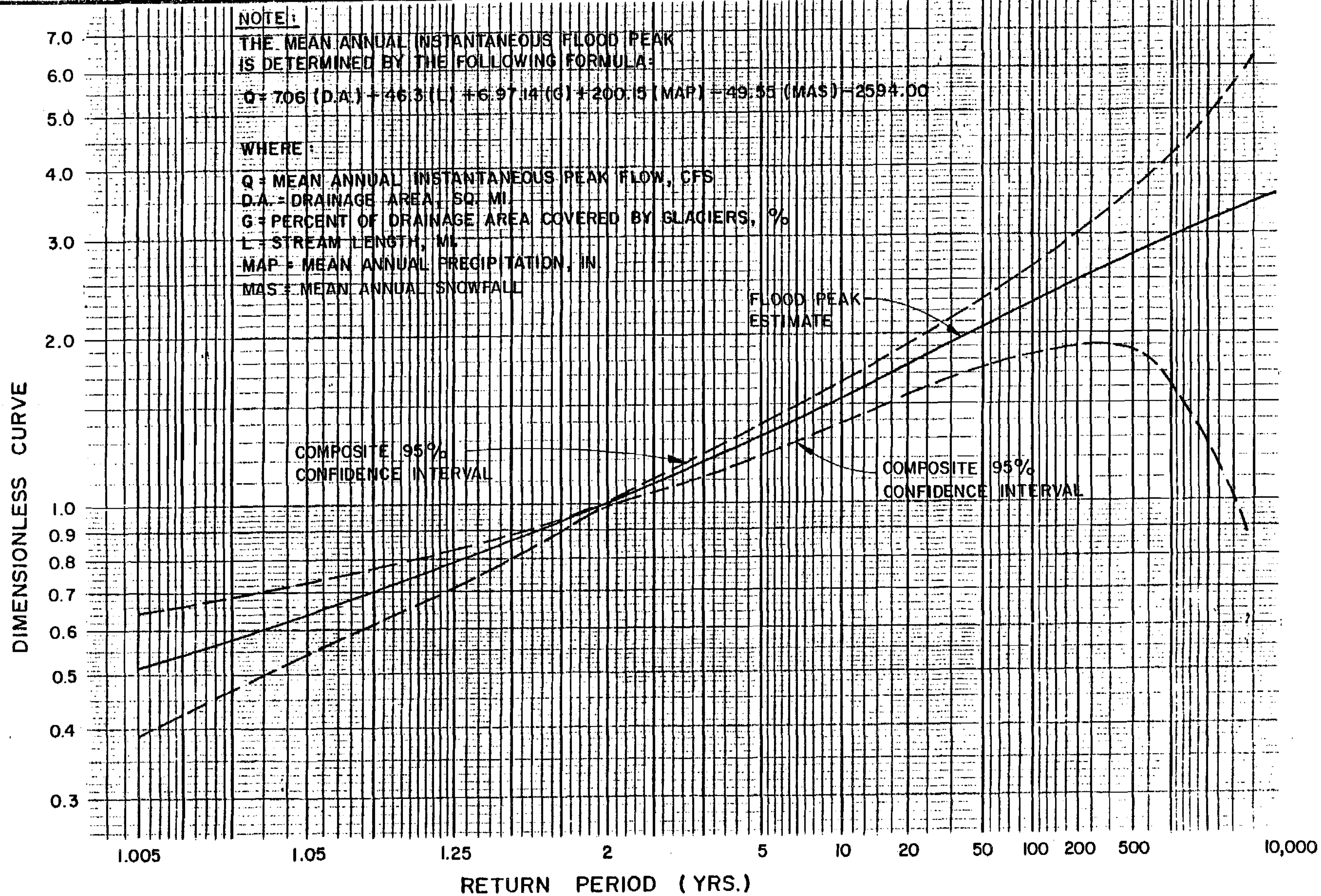
R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

SUSITNA RIVER AT SUSITNA STATION
PRE AND POST PROJECT
DISCHARGE - STAGE FREQUENCY CURVE

FIG. 3.12



Prepared by:

R&M CONSULTANTS, INC.

Prepared for:

ACRES

DESIGN DIMENSIONLESS REGIONAL FREQUENCY CURVE
ANNUAL INSTANTANEOUS FLOOD PEAKS

FIGURE 3.13

4 - SEDIMENT REGIME

4.1 - Suspended Sediment

The concentration of suspended sediment in glacial meltwater streams in Alaska is 10-20 times the concentration in nearby non-glacial streams (Guymon, 1974). Most of the suspended sediment is transferred during the summer months. The Susitna River transfers over 98 percent of its annual sediment load during the months of May through October (Corps of Engineers, 1975).

In general, there is no simple relationship between sediment transport and water discharge in glacial meltwater streams (Østrem, 1975). Suspended sediment concentration varies with time as well as with discharge over periods of one year (seasonal), one to twenty days (flood sequence), and one day (diurnal). A hysteresis effect has been observed by various authors (Østrem, 1975; Everts, 1976) when the ratio of suspended concentration to water discharge was plotted by month or through a flood. Visual inspection of sediment discharge records for the Susitna River at Gold Creek indicate a similar phenomena, with large variations in sediment concentrations with only minor increases in streamflow.

Despite the problems in reliably establishing a sediment discharge - streamflow relationship, some estimate of annual suspended sediment discharge is necessary for engineering and environmental studies. Consequently, power curve equations were fit to available data for seven stations within the Susitna River basin. The equations for each station are given in Table 4.1, together with the coefficient of determination. The curves for each station are plotted on Figures 4.1 through 4.5. On the mainstem Susitna, the sediment concentration drops for a given flow when moving downstream, due to the larger particles settling out and the larger volume of water downstream.

The annual suspended sediment duration curves for all seven stations are plotted on Figure 4.6. These were estimated using the annual flow duration curves and the suspended sediment rating curve for each station. Despite the fact that sediment concentrations decrease while moving downstream, the total sediment discharge is increasing due to the increased flow volume.

4.2 - Bedload

Bedload data from the Susitna River was nonexistent until summer of 1981. Three bedload samples have been collected by the U.S. Geological Survey and R&M Consultants at Susitna River at Gold Creek, Chulitna River near Talkeetna River, Talkeetna River near Talkeetna, and Susitna River at Sunshine. Bedload transport rates for the three dates are shown in Table 4.2. Estimates of bed material size distribution were made at numerous cross-sections between Talkeetna and Devil Canyon, using the grid sampling technique (Kellerhals and Bray, 1971). The bed material size distribution at these sites is tabulated in Table 4.3.

The U.S. Geological Survey estimated total sediment load for ten samples taken at the Denali gage using the modified Einstein procedure. A bedload rating curve based on the USGS estimates was established in the Corps of Engineers 1975 report and is shown is Figure 4.7. Using flow-duration curves, the Corps report estimated the annual bedload at Denali to be 1,588,000 tons per year. However, Neill (1981) has commented that bedload computations for gravel rivers are not very reliable, with different procedures producing estimates varying by orders of magnitude.

From the limited bedload data collected in 1981, it can be inferred that the Susitna River has relatively little bedload below Devil Canyon until the confluence with the Chulitna River is reached. Most of the bedload is contributed by the glaciers in the Alaska Range, although some is contributed by downstream tributaries and bank erosion. All bedload entering the reservoirs will be trapped. In addition, post-project flows will be less than that measured on August 26, 1981, when only 380 tons/day of bedload transport were measured. Most of the river between Devil Canyon and the Chulitna confluence is well-armored. Under post-project conditions, bedload contribution from the Susitna River above the Chulitna confluence may be considered negligible except for extreme flood events.

The Chulitna River is the major contributor of bedload at the confluence near Talkeetna, as shown on Table 4.2, and will thus have the major influence on sedimentation and river morphology at and downstream of the confluence.

4.3 - Reservoir Trap Efficiency

The volumes of Watana and Devil Canyon reservoirs are so large that is has been assumed in past studies that 100-percent entrapment would occur. This is believed to be a valid assumption for the larger sediment sizes, but it is possible that the very fine suspended sediment may remain in suspension and pass through the reservoirs. A literature search of sedimentation processes in glacial lakes indicated trap efficiencies on the order of 65 to 75%. (Zieler, 1973; Østrem, 1975). Kamloops Lake, a 3-million ac-ft glacial lake in British Columbia, trapped an estimated 67% of the incoming sediment, with median sediment size about 2 microns near the lake outlet (Pharo and Carmack, 1979). The suspended sediment size distribution analysis at Vee Canyon indicates that 85% of the incoming sediment is larger than 2 microns. Kamloops Lake has an annual bulk residence time of about 60 days. Watana Reservoir has an annual bulk residence time of about 660 days.

The long bulk residence time in Watana Reservoir indicates that an ice cover will probably form on the reservoir before the sediment-laden river water can pass through the reservoir. Once on ice cover forms, essentially quiescent conditions should occur in the reservoir. A settling column study of a water sample from the Susitna River indicated that suspended sediment concentrations would decrease by about 95% in 3 days under quiescent conditions. This would tend to indicate that clarity of water in the upper portion of the reservoir should improve fairly rapidly once an ice cover forms.

It is likely that trap efficiencies greater than 70% will occur, based on suspended size distribution, annual bulk residence time, and the suspended sediment settling characteristics under quiescent conditions. For planning purposes, trap efficiencies of 70% and 100% were assumed as the limits for trap efficiency. All bedload will be trapped by the reservoirs. The trapping of the bedload will have the most significant impact on the downstream river morphology.

Reservoir sedimentation is discussed more completely in Reservoir Sedimentation (R&M, 1982).

4.4 - Bed Material Movement

The stability of a particle resting on the bed or channel bank is a function of stream velocity, depth of flow, the angle of inclined surface on which it rests and its geometric and sedimentation characteristics (Stevens and Simons, 1971). However, the interaction of the above factors is quite complex, and obtaining data for all parameters is often impractical under natural conditions. In order to determine at what flow rates the various reaches of the Susitna River above Talkeetna would be stable, an engineering approach for the design of stable alluvial channels was used.

Two major variables affecting channel design are velocity and shear stress. Determining the shear stress is quite difficult. Consequently, velocity is often used as the most important factor in designing stable alluvial channels. Various techniques have been developed which estimate the maximum channel velocity so that no scouring occurs for values of velocity equal to or less than the maximum velocity. However, the maximum permissible velocities varies with the sediment carrying characteristics of the channel. Fortier and Scobey (1926) recognized this problem, and introduced an increase in their listed values of maximum permissible velocities when water was transporting colloidal silt.

Various engineering formulas for maximum permissible velocity were presented by Simons and Senturk (1976). The formula selected for analysis was that derived by Neill (1967). Neill's formula uses data readily available for the Susitna River, and gives results in the same range as Fortier and Scobey's. The formula as presented by Neill is:

$$\frac{u^2}{\left(\frac{\rho s}{\rho}\right) - 1\ gD} = 2.5 \left(\frac{D}{d}\right)^{-0.20}$$

where:

U	=	maximum permissible velocity, ft/sec
ρ	=	density of water, lb/ft^3
ρ_s	=	density of sediment, lb/ft^3 (assumed to be 165 lb/ft^3)
g	=	gravitational constant, 32 ft/sec^2
D	=	bed material diameter, ft
d	=	average depth, ft

The above stability criterion was developed for use on uniform bed material or on the median (D_{50}) size in mixed bed material with moderate size dispersion. Neill (1968) later indicated that the bed material mixture remained fairly stable until the D_{50} size became mobile, at which time general movement of the bed would occur. The stability criteria was designed to use vertically-averaged local velocities (mean column velocities), thus identifying bed stability on only a short segment of the river cross-sectional width. However, only average velocity across each cross-section is available. The results from the equation would thus indicate when bed movement across the entire cross-section is imminent. Bedload normally does not move uniformly across the width of a river, but is concentrated in a relatively narrow band. Therefore, the results of this analysis are not strictly accurate, but do provide an adequate indicator of bed movement occurence.

In order to estimate the D_{50} size of bed material which would be at the point of movement at a particular cross-section for a given flow rate, the above formula was re-arranged so that bed material diameter was the unknown value. The average velocity and average depth were obtained from runs of the HEC-2 model for different flow rates. The formula in its re-arranged version is:

$$D = \frac{u^{2.5}}{464.43\ d^{0.25}}$$

TABLE 4.1

SUSPENDED SEDIMENT DISCHARGE EQUATIONS
SUSITNA RIVER BASIN

Station	Equation	Number of Samples	Coefficient of Determination (r^2)
Susitna River near Denali	$q_s = 1.43\ (10^{-4})\ q^{2.122}$	51	0.891
MacLaren River near Paxson	$q_s = 8.04\ (10^{-6})\ q^{2.523}$	32	0.931
usitna River near Cantwell	$q_s = 6.33\ (10^{-8})\ q^{2.784}$	37	0.881
usitna River at Gold Creek	$q_s = 2.39\ (10^{-6})\ q^{2.354}$	286	0.735
hulitna River near Talkeetna	$q_s = 2.63\ (10^{-5})\ q^{2.151}$	20	0.948
alkeetna River near Talkeetna	$q_s = 1.94\ (10^{-6})\ q^{2.409}$	63	0.832
usitna River at Susitna Station	$q_s = 3.09\ (10^{-6})\ q^{2.146}$	22	0.885

q = Streamflow, cfs
q_s = Suspended sediment discharge, tons/day

Using the above formula and hydraulic parameters obtained from runs of HEC-2, estimates were made of the median material size at the point of movement at flow rates of 9,700; 17,000; 34,500; and 52,000 cfs. The median bed material size at the point of movement is described on Figures 4.8 through 4.13, working downstream from Devil Canyon to Talkeetna. Included on the plots are the bed material size distribution in the reach described on the figures. To assist in classifying the size range of sediment which is being moved, a sediment grade scale is included on the bed movement figures. The bed material movement curves are for given cross-sections in each river reach. Table 4.5 correlates the cross-sections with river miles. Table 4.4 gives average velocities at selected cross-sections at the same flow rates.

By comparing the bed material movement curves to the bed material size distribution, predictions can be made of the effect of reducing the streamflow, i.e. reducing the mean annual flood from 52,000 cfs to 11,000 cfs. Once the median bed material size is moved, general movement of the bed would occur. In general, bed material size ranges from coarse gravel to cobble throughout most of the river. Some movement of the median bed material size (from the grid samples) could occur above 35,000 cfs throughout much of the river, although these samples were primarily taken along the upper shore. It is believed that an armor layer consisting of cobbles and boulders exists throughout most of the river.

At 13,000 cfs, it appears that little bed material movement will occur in the main channel except in the region of river miles 124.5, 131.5 and 133 and near the confluence with the Chulitna River, where bed material size is in the coarse gravel range, somewhat smaller than in most of the rest of the river.

4.5 - Contribution of Sediment Downstream

Contributions of sediment downstream of Devil Canyon are primarily from talus slopes, mass wasting, erosion of river banks, and sediment contributed by tributary streams. The locations and types of sediment sources between Devil Canyon and Talkeetna are summarized in Table 4.6.

TABLE 4.2

1981 BEDLOAD TRANSPORT DATA
SUSITNA RIVER BASIN

Station	Date	Water Discharge (cfs)	Total Bedload Transport Rate (tons/day)
Susitna R. at Gold Creek	7/22/81	37,200	2,180
Chulitna R.[1]	7/22/81	31,900	3,450
Talkeetna R.	7/21/81	16,800	1,940
Susitna R. at Sunshine	7/22/81	89,000	3,520
Susitna R. at Gold Creek	8/26/81	25,900	380
Chulitna R.	8/25/81	22,500	5,000
Talkeetna R.	8/25/81	9,900	800
Susitna R. at Sunshine	8/26/81	61,900	4,520
Susitna R. at Gold Creek	9/28/81	8,540	1
Chulitna R.	9/29/81	6,000	3,820
Talkeetna R.	9/29/81	2,910	30
Susitna R. at Sunshine	9/30/81	19,100	400

1 Bedload data gathered approximately 4 miles below Chulitna River gaging site on 7/22/81. Data gathered at Chulitna gaging site on other dates.

TABLE 4.3

SUSITNA: LOWER RIVER CROSS SECTIONS
BED MATERIAL DISTRIBUTION ANALYSIS

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

TABLE 4.4
AVERAGE VELOCITIES AT SELECTED CROSS-SECTIONS

Cross Section	RM	Average Velocities (ft/sec) Given Flow Rates at Gold Creek 9,700	17,000	34,500	52,000
LRX-4	99.6	5.27	4.32	4.78	4.47
LRX-7	101.5	3.15	3.86	5.31	6.09
LRX-11	106.7	2.53	3.60	5.64	6.89
LRX-20	117.2	3.15	4.13	5.13	4.86
LRX-24	120.7	3.80	5.34	8.25	10.34
LRX-25	121.6	4.71	6.94	7.99*	10.12
LRX-29	126.1	3.71	5.04	7.66*	9.50
LRX-35	130.9	3.52	5.04	8.12	10.44
LRX-40	134.3	4.12	5.43	7.67	9.29
LRX-41	134.7	5.71	7.63	5.95*	5.71
LRX-44	136.4	5.54	6.36	7.13*	7.99
LRX-45	136.7	4.28	5.86	9.13	11.53
LRX-50	138.5	3.17	4.37	6.87	8.63
LRX-53	140.2	3.83	5.01	7.62*	9.56
LRX-54	140.8	4.53	5.72	6.93*	7.63
LRX-55	141.5	3.55	4.66	6.63*	7.77
LRX-61	148.7	4.25	5.67	8.64	10.45
LRX-68	150.2	3.24	4.54	7.21	8.89

* Sloughs and/or side channels are blocked off below 20,000 cfs by gravel berms at upstream end.

TABLE 4.5
SUSITNA RIVER PROFILE DATA SUMMARY

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

TABLE 4.5 (cont.)

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

TABLE 4.5 (cont.)

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

TABLE 4.6

SEDIMENT SOURCES DOWNSTREAM OF DEVIL CANYON

Location	Sediment Source and Type
Vicinity of RM 149.5	Talus slopes delivering material at each steep narrow ravine. Valley walls controlled by bedrock outcrops.
Island at RM 149.3	Cobble and gravel material on midchannel bar at river expansion. Island surface paved with cobbles and boulders, intermixed with sand and gravel. Bedrock controls both river banks.
Downstream of Island	Bedrock controls both banks, but some talus slopes delivering material.
Mouth of Portage Creek	Creek is delivering coarse gravels, cobbles, and a few boulders, developing an alluvial fan into the river. Fan is truncated where Susitna River flow becomes significant. Significant bedload delivered at high flows.
Vicinity of RM 148	Local change in river gradient has caused formation of a mid-channel bar in the river expansion.
Island at RM 147	Island is well vegetated above normal high water, with its banks paved with cobbles. Some sand deposition exists in the backwater zone on the downstream end of the island.
Downstream of Island at RM 147	Alluvial deposition exists on the right bank where the main channel is abutted against left bank.

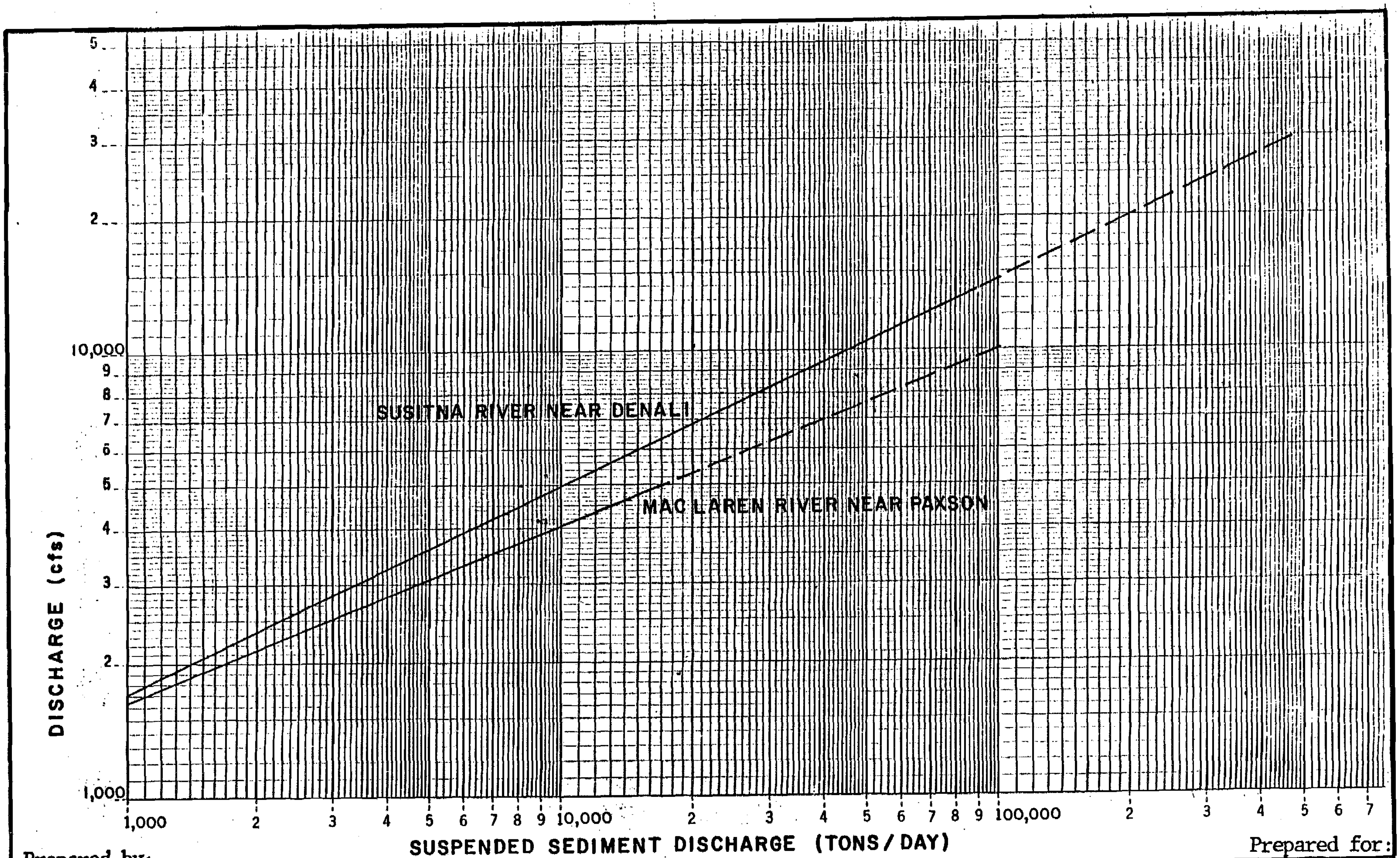
Location	Sediment Source and Type
RM 145.3	Some erosion along the main channel exists, along with mass slumping. A mid-channel gravel bar exists where the river has eroded laterally, widened, reduced its velocity and deposited bedload at high flows. The bar may continue to grow, forcing the channel into the right bank.
Tributary on left bank at RM 144.8	30-foot wide stream is very stable with vegetation leading down to a predominantly boulder/cobble bed. It does not deliver significant sediment to the river.
RM 143	Moderate erosion and scalloping of the right bank. Several mid-channel bars exist, but appear to be unstable, with young brush growing on them.
Near RM 142	River is trying to erode into the island on left bank downstream of LRX-56. Gravel is being deposited in the center channel and trying to create a split channel configuration.
Upstream of RM 141.5	Acitve erosion of the island on the left bank of the main channel. The river is undercutting the bank, causing slumping into the river, with the sediment being only temporarily held by coarser material and vegetative roots. A mid-channel gravel bar is building.
RM 141 to RM 139	The river is meandering across the valley, eroding valley wall material and depositing it on mid-channel bars.
RM 138.9	Glacial/fluvial deposit of gravel and cobbles on the right bank appears erodible at high flows. Topsoil over the gravel alluvial deposits would erode at high flows, although it is stabilized with vegetation.

Location	Sediment Source and Type
Mouth of Indian River	Indian River is a steep stream capable of contributing considerable bedload during high flows, although there is no glacial input. Material near its mouth is coarse gravel and cobbles, as smaller material is carried away by the Susitna River. The cobble material helps stabliize the right bank of the Susitna. An alluvial fan has been built out into the Susitna River, forcing it into the south valley wall.
RM 138.3	Moderate to active erosion along the left valley wall for approximately 1,000 feet, leaving a cobble paved bank.
RM 137.2	Moderate to active erosion on the right bank on an outside bend, extending for about 1,000 feet. Erosion occurs at high flows; at normal flow, cobble material armors the bank, resisting erosion.
Mouth of Gold Creek	Gold Creek bed is paved with boulders.
Downstream of Gold Creek bridge	Moderate to active erosion of topsoil and gravelly material along the right bank. Primarily, though, the river is reasonably stable, with shallow sloughs and gently sloping gravel bars along the left bank. At high flows, there will be some scour and deposition in the high water channels.
Between RM 135.4 and RM 134	The valley wall is being eroded by the left bank high water channel, contributing a moderate amount of sediment during high flows.

Location	Sediment Source and Type
RM 134.3	Active erosion and undercutting of the past alluvial deposit on the right bank to just downstream of LRX-40. There is also moderate erosion of the steep high bank on the left bank, with vegetative mat overhanging the bank. Erosion extends for about 1,000 feet along the left bank.
RM 132.5	Erosion of sand and gravel on a mid-channel bar is causing short-term local transport of bed materials.
Mouth of Fourth of July Creek	Little sediment build-up at the creek mouth indicates that the creek does not carry much sediment. The creek slope is relatively gentle as it enters into the Susitna River.
Sherman	The channel is constricted by alluvial deposits on both banks, with the bank lines well armored with cobbles and boulders, resisting erosion.
RM 130	A few areas of instability are located along the intermediate gravel bar.
RM 128	The river broadens into a braided pattern, with the main channel meandering from the west to the east edge, causing unstable intermediate gravel bars.
RM 124	Moderate erosion and slumping of fine material for about 800 feet along the left bank.
RM 123.5	Active erosion along the right bank.
Curry	Although the left bank is an alluvial deposit, it appears quite stable.

Location	Sediment Source and Type
Curry to RM 116.4	A typical split-channel condition exists in this reach, with no unusual erosion or breaks in the river gradient. The river is very stable due to coarse bed material armoring the bed and due to well established vegetation above the normal high water mark.
RM 116.4 to RM 103.2	The river remains stable, flowing in a well-paved bed with well-established vegetation on the banks. Several large remnant boulders are in the channel, probably deposited from glacial processes.
RM 103.2 to RM 102.4	Erosion in this reach can occur only at high water levels, as a cobble paved bankline lies beneath two to three feet of soil. The left bank at LRX-8 is eroding at the outside of the meander, but only at high flows. Deposition is occurring upstream and downstream of LRX-8 along the right bank.
RM 102.4 to RM 101.5	The western floodplain elevation lowers at RM 102, becoming more erodible. The channel splits and start to meander in the braided/split channel pattern. The shifting channels appear to be caused by a sudden decrease in gradient, deposition of bed material, and erodible banks. The banks at LRX-7 are moderately erodible at high flow.
Mouth of Whiskers Creek	Bed material is cobble with a thin layer of fine sediments. The creek joins the west sub-channel on the outside of a meander, helping to keep Susitna sediments away from the mouth. The right bank materials in the west sub-channel have five to six feet of fine material overlaying easily erodible gravel.

Location	Sediment Source and Type
Downstream of Whiskers Creek	Fine material overlaying gravels would erode at high water levels. A mid-channel bar covered with young vegetation appears to be well established, helping to keep the major sub-channel to the east.
RM 101.0	The main channel joins the west sub-channel. A scallop in the right bank indicates turbulence during extreme flows. Numerous gravel bars appear with the river becoming wider and shallower. Several examples of cross-channel flow reflect the instability of the bed through the lower reach.
RM 100.5	The floodplain elevation lowers, with bank material appearing easily erodible at moderate to high flows. Bank erosion in this reach is accelerated by undercutting of trees which fall into the river, creating sweepers, turbulence and niching of the bank.
RM 100	The west side of the channel is in a very unstable condition. Easily moved bed material creates numerous gravel bars which catch debris, forcing the river to create new channels which are constantly moving back and forth.
RM 99.6	Along east bank, erosion will probably occur only at high flows. An ice jam occurred here in 1981, and is believed to occur virtually every year. Vegetation along the banks is primarily controlled by ice action.



Prepared by:

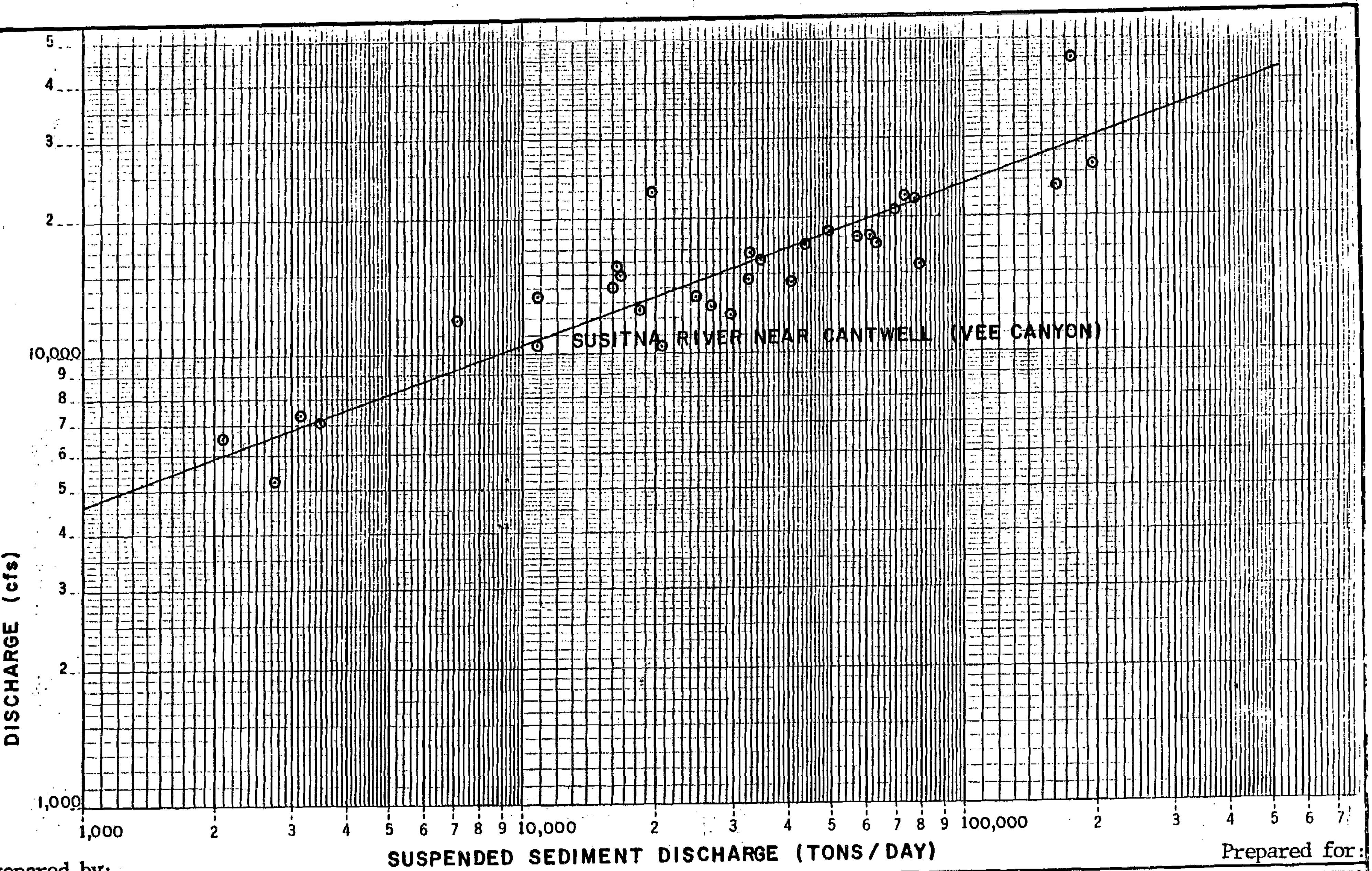
R&M CONSULTANTS, INC.

SUSPENDED SEDIMENT RATING CURVES
SUSITNA RIVER NEAR DENALI AND
MAC LAREN RIVER NEAR PAXSON

Prepared for:

ACRES

FIGURE 4.1



Prepared by:

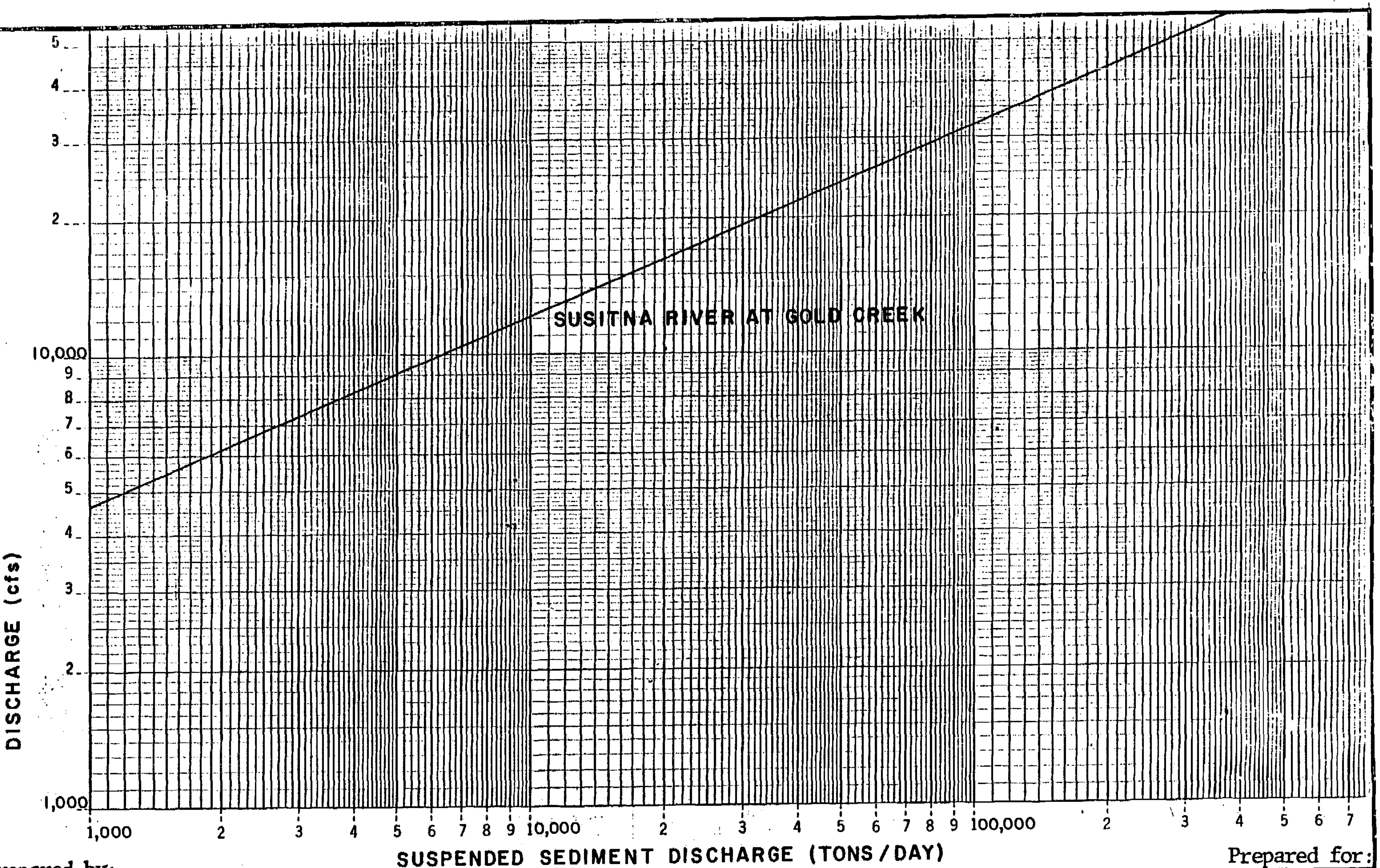
R&M CONSULTANTS, INC.

SUSPENDED SEDIMENT RATING CURVE
SUSITNA RIVER NEAR CANTWELL (VEE CANYON)

Prepared for:

ACRES

FIGURE 4.2



Prepared by:

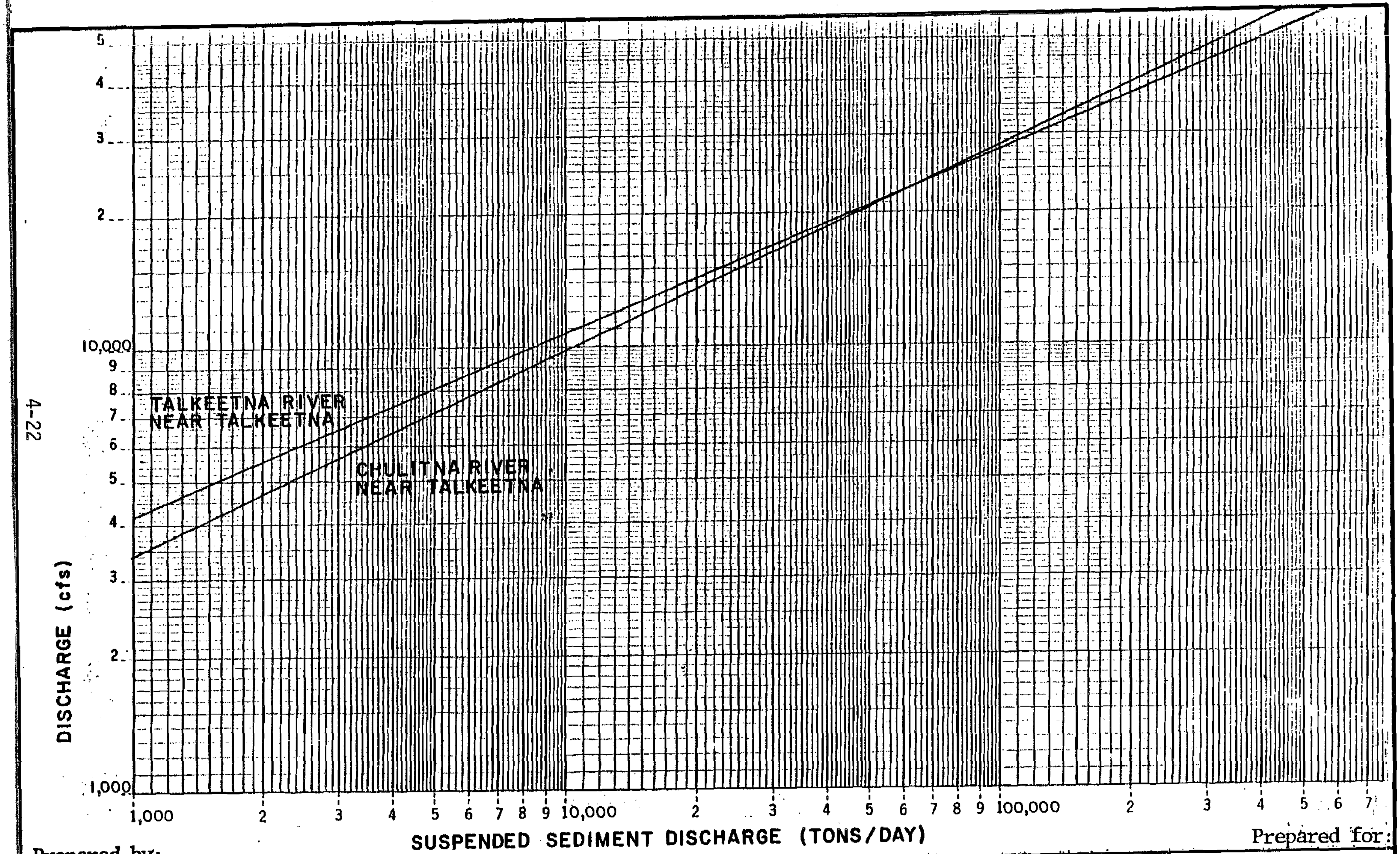
R&M CONSULTANTS, INC.

Prepared for:

ACRES

SUSPENDED SEDIMENT RATING CURVES
SUSITNA RIVER AT GOLD CREEK

FIGURE 4.3



Prepared by:

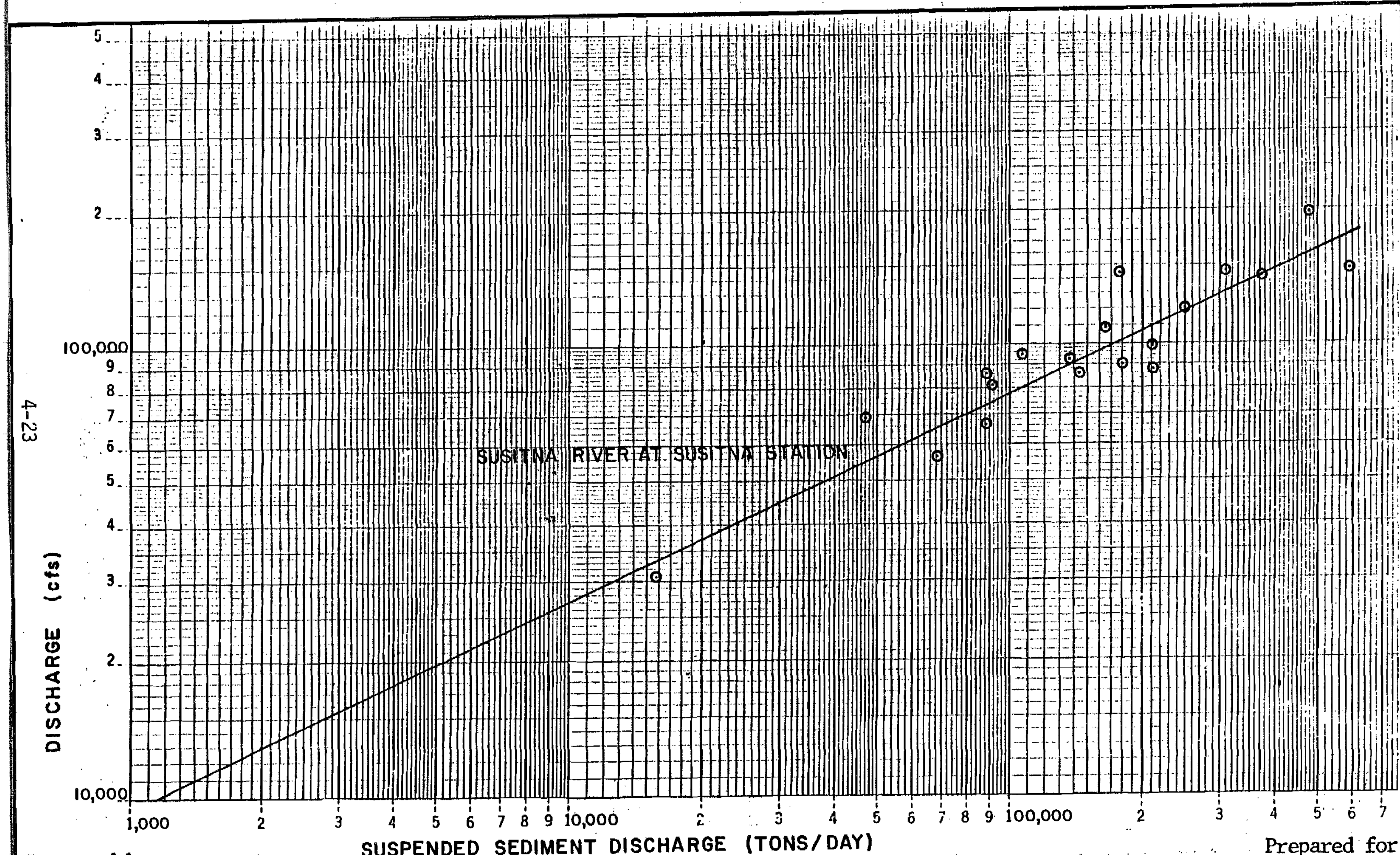
R&M CONSULTANTS, INC.

SUSPENDED SEDIMENT RATING CURVES
CHULITNA AND TALKEETNA RIVERS

Prepared for:

ACRES

FIGURE 4.4

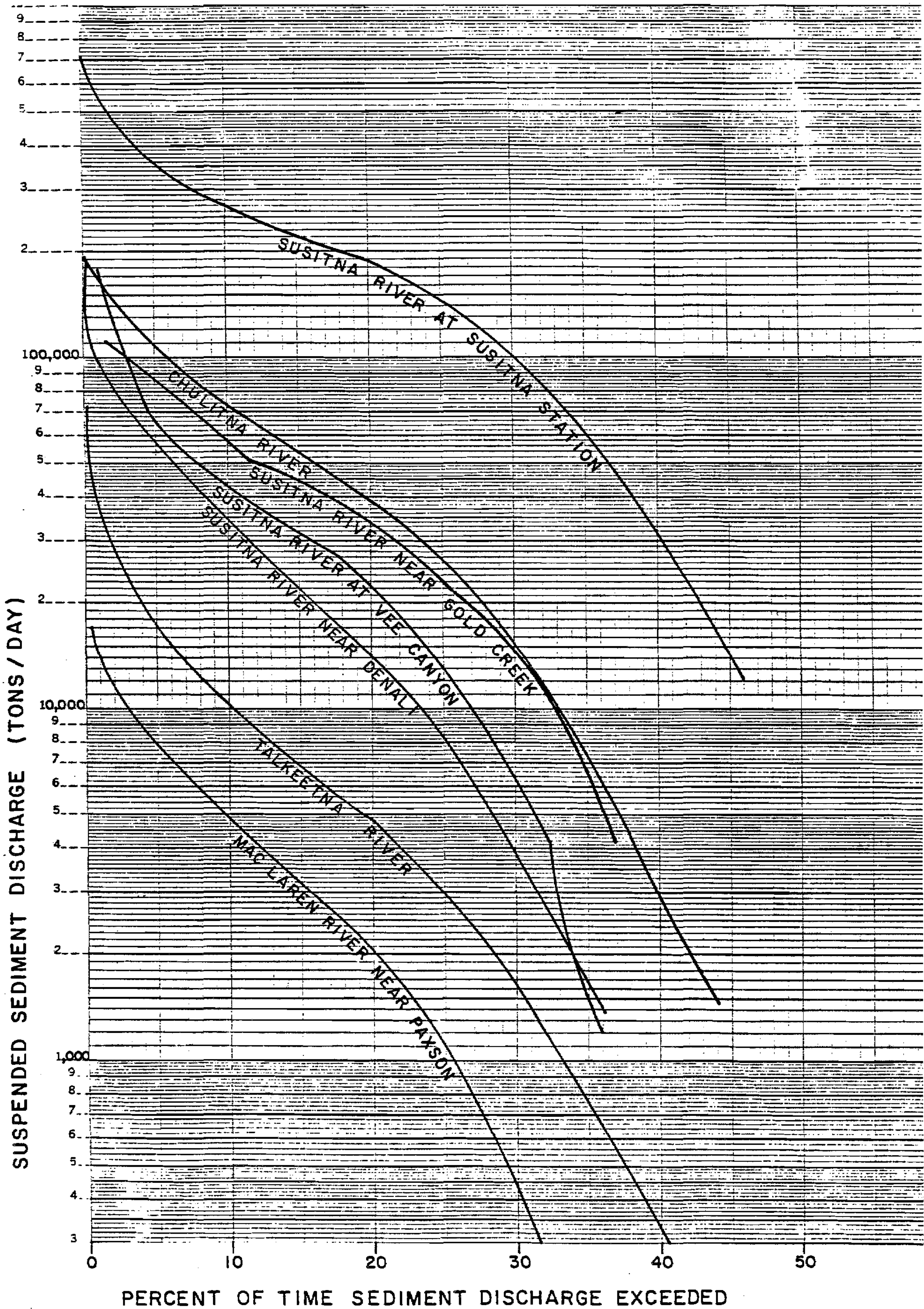


Prepared by: R&M CONSULTANTS, INC.

Prepared for: ACRES

SUSPENDED SEDIMENT RATING CURVE
SUSITNA RIVER AT SUSITNA STATION

FIGURE 4.5



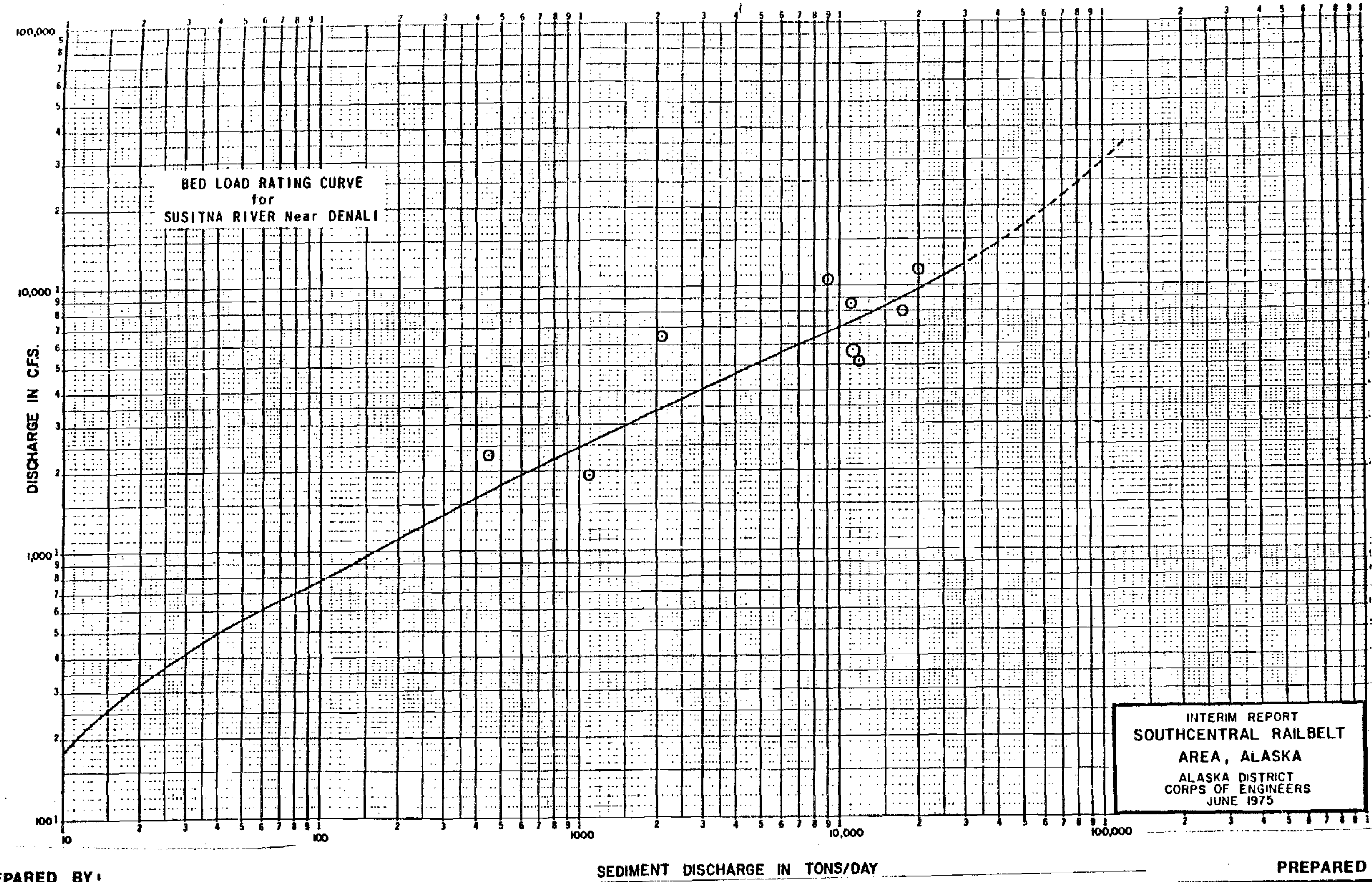
Prepared by:

R&M CONSULTANTS, INC.

Prepared fo

ANNUAL SUSPENDED SEDIMENT DURATION CURVES

FIGURE 4.6



PREPARED BY:

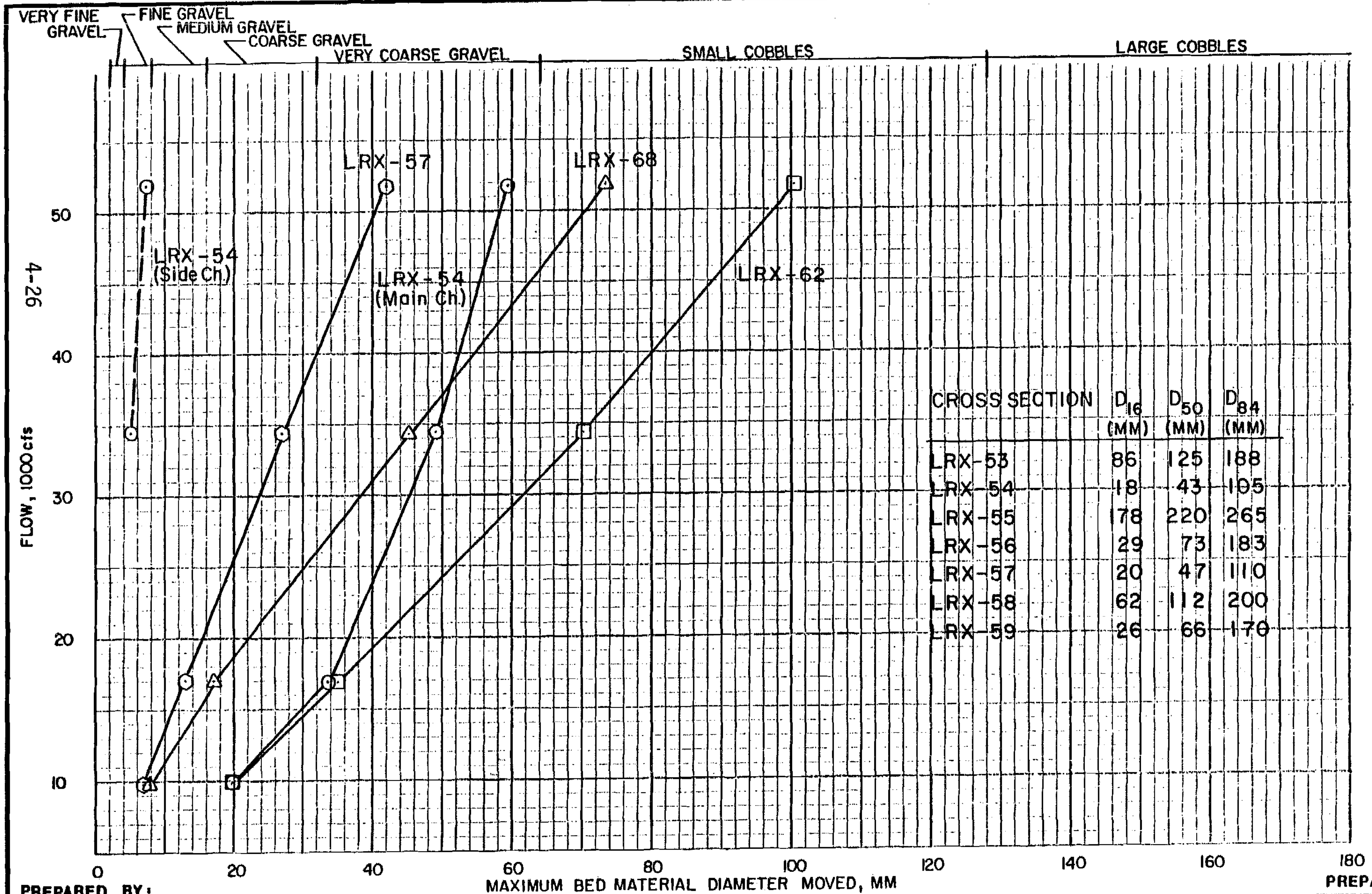
R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

ESTIMATED BEDLOAD RATING CURVE
SUSITNA RIVER AT DENALI

FIGURE 4.7



CROSS SECTION	D_{16} (MM)	D_{50} (MM)	D_{84} (MM)
LRX-53	86	125	188
LRX-54	18	43	105
LRX-55	178	220	265
LRX-56	29	73	183
LRX-57	20	47	110
LRX-58	62	112	200
LRX-59	26	66	170

PREPARED BY:

R&M CONSULTANTS, INC.

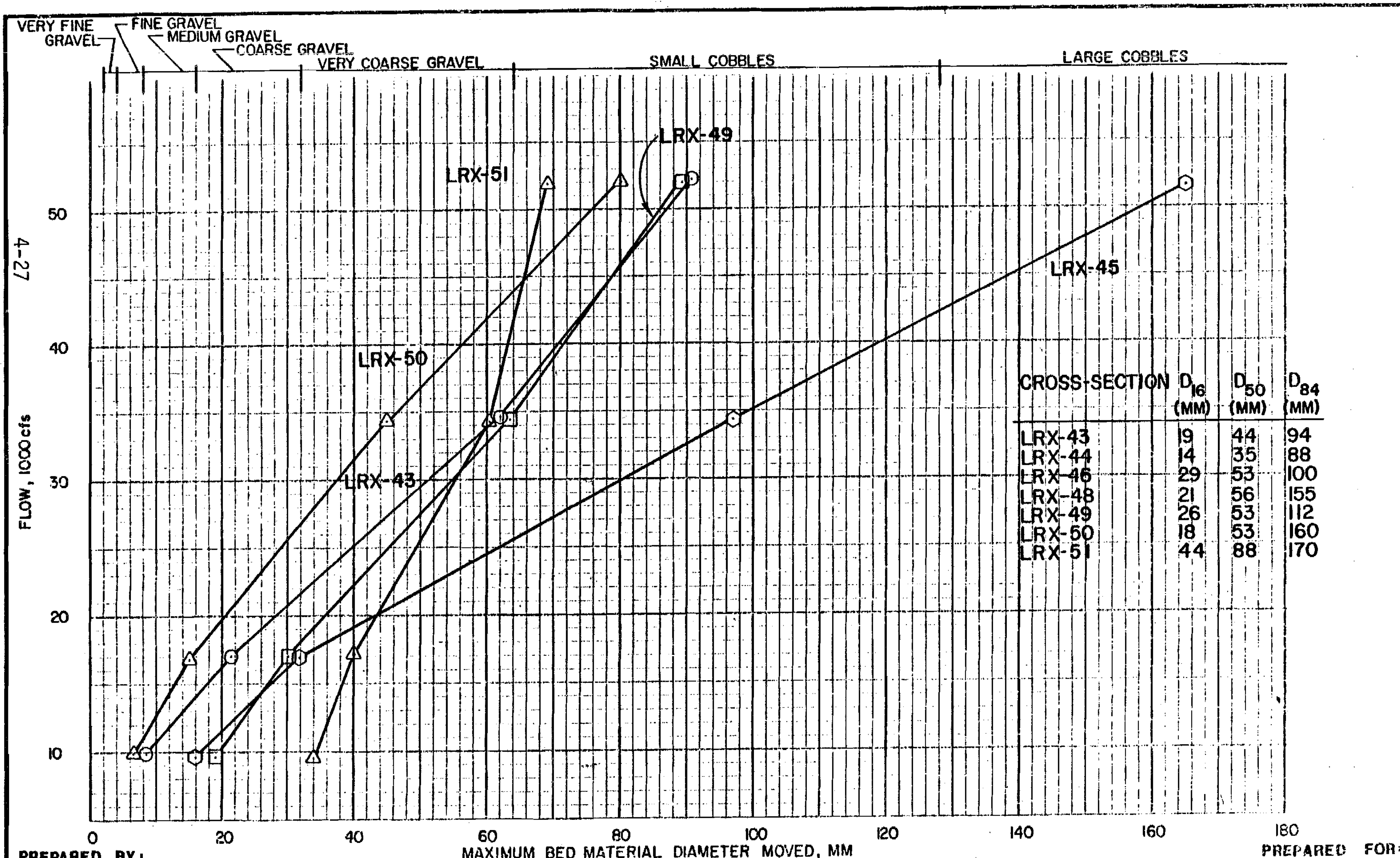
PREPARED FOR:

ACRES

BED MATERIAL MOVEMENT CURVES

LRX -54, -57, -62, -68

FIGURE 4.8



PREPARED BY:

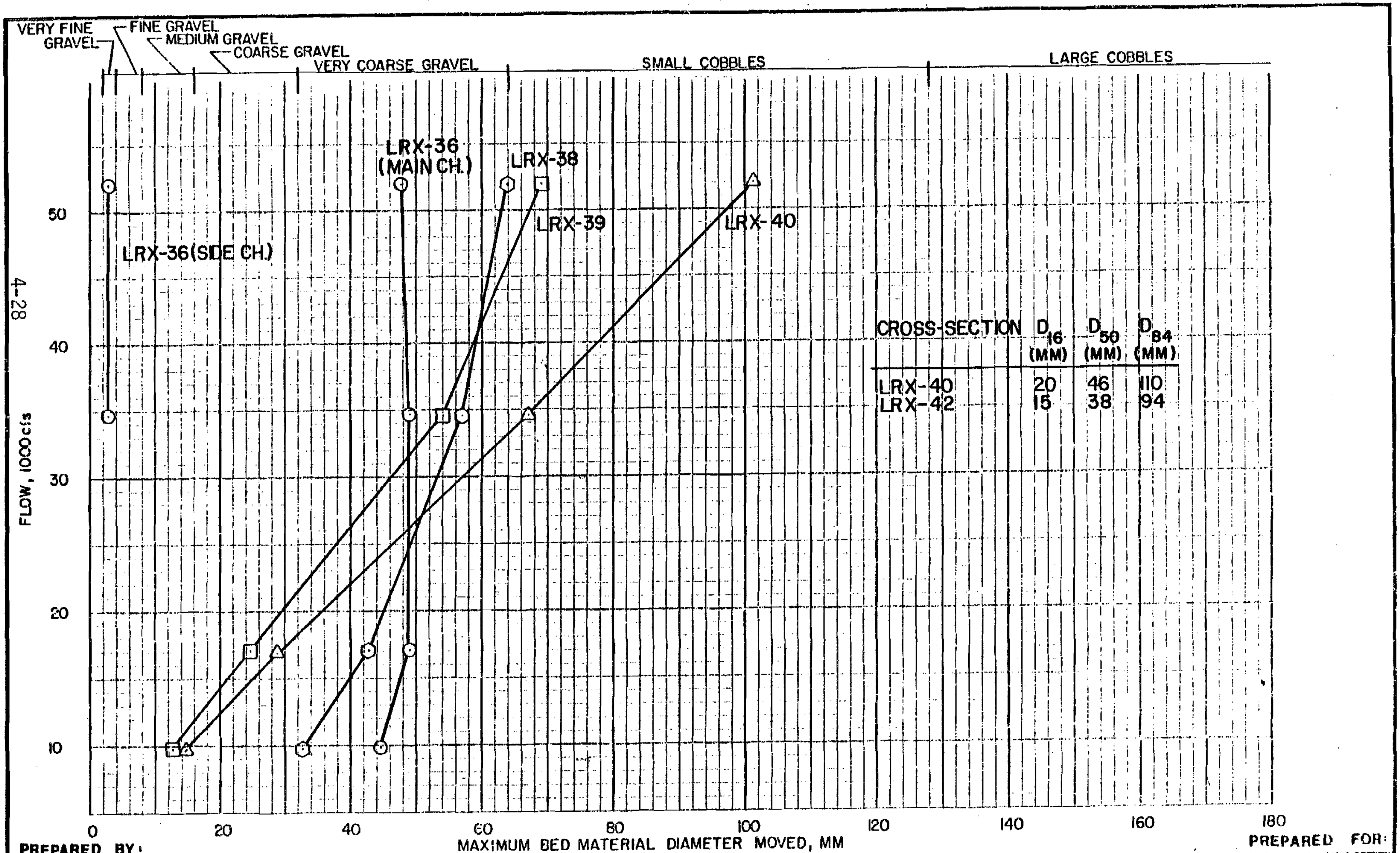
R&M CONSULTANTS, INC.

PREPARED FOR:

BED MATERIAL MOVEMENT CURVES

LRX -43,-45,-49,-50,-51

FIGURE 4.9



CROSS-SECTION	D_{16} (MM)	D_{50} (MM)	D_{84} (MM)
LRX-40	20	46	110
LRX-42	15	38	94

PREPARED BY:

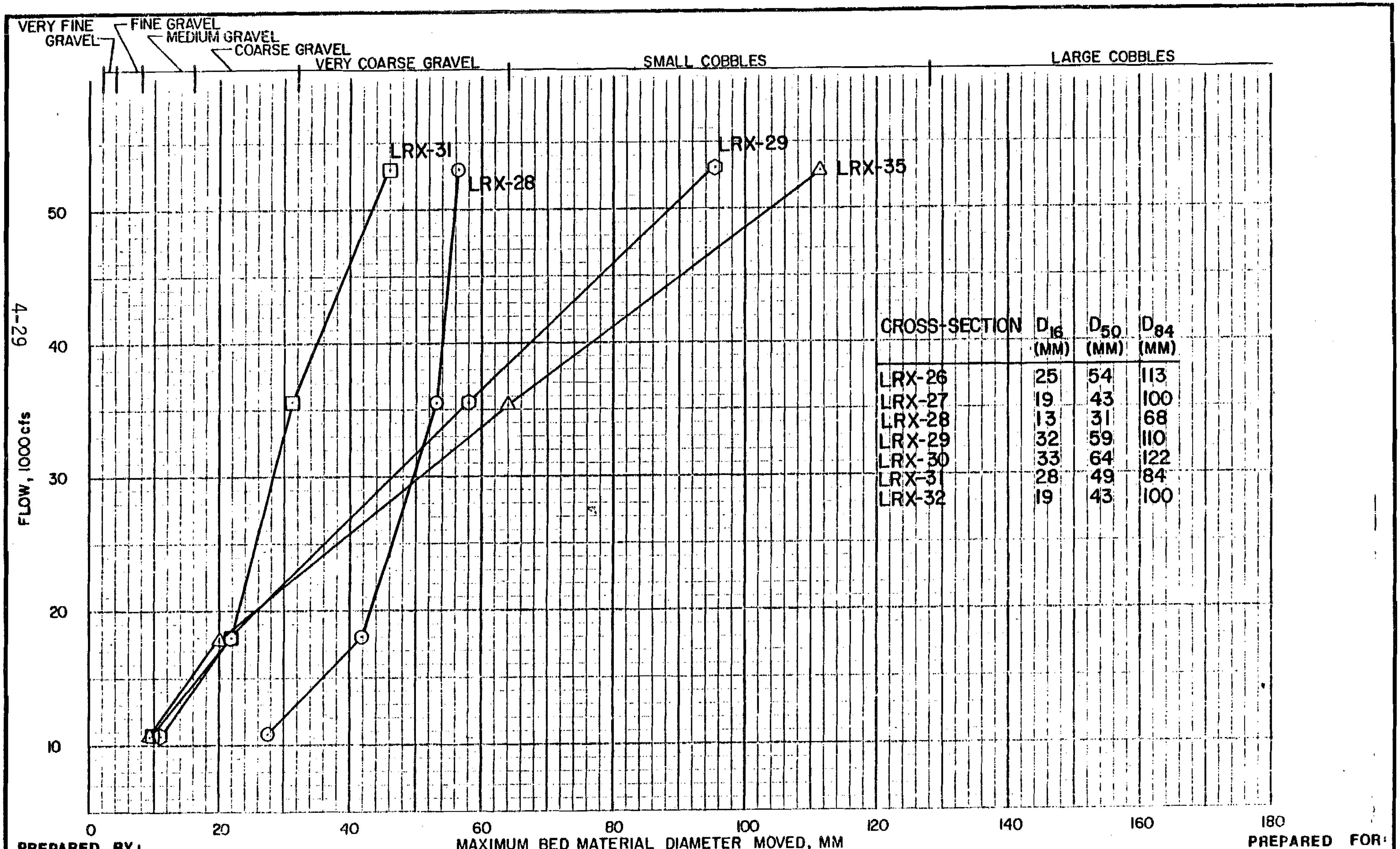
R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

BED MATERIAL MOVEMENT CURVES
LRX -36, -38, -39, -40

FIGURE 4.10



CROSS-SECTION	D_{16} (MM)	D_{50} (MM)	D_{84} (MM)
LRX-26	25	54	113
LRX-27	19	43	100
LRX-28	13	31	68
LRX-29	32	59	110
LRX-30	33	64	122
LRX-31	28	49	84
LRX-32	19	43	100

PREPARED BY:

R&M CONSULTANTS, INC.

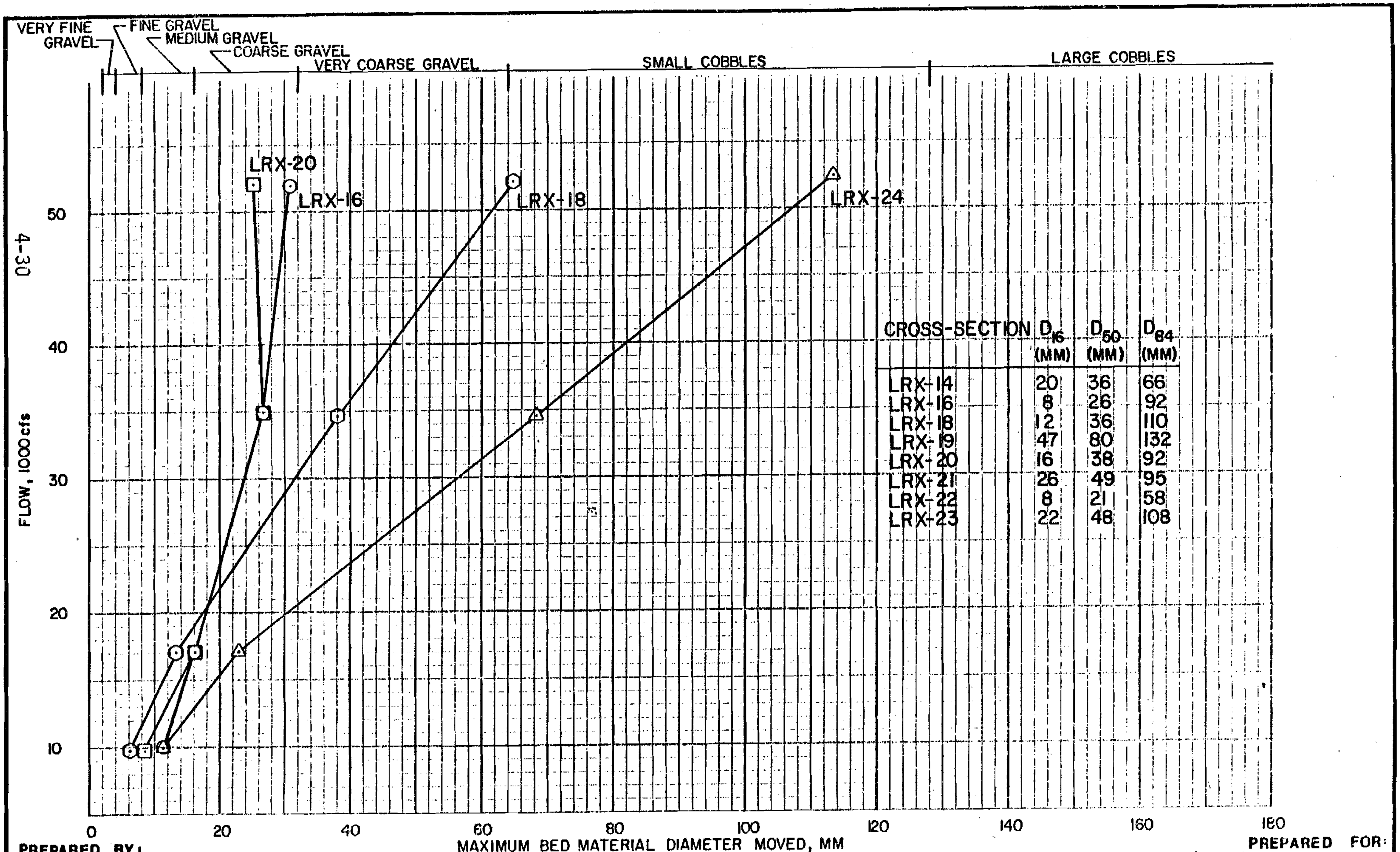
BED MATERIAL MOVEMENT CURVES

LRX-28,-29,-31,-35

PREPARED FOR:

ACRES

FIGURE 4.11



PREPARED BY:

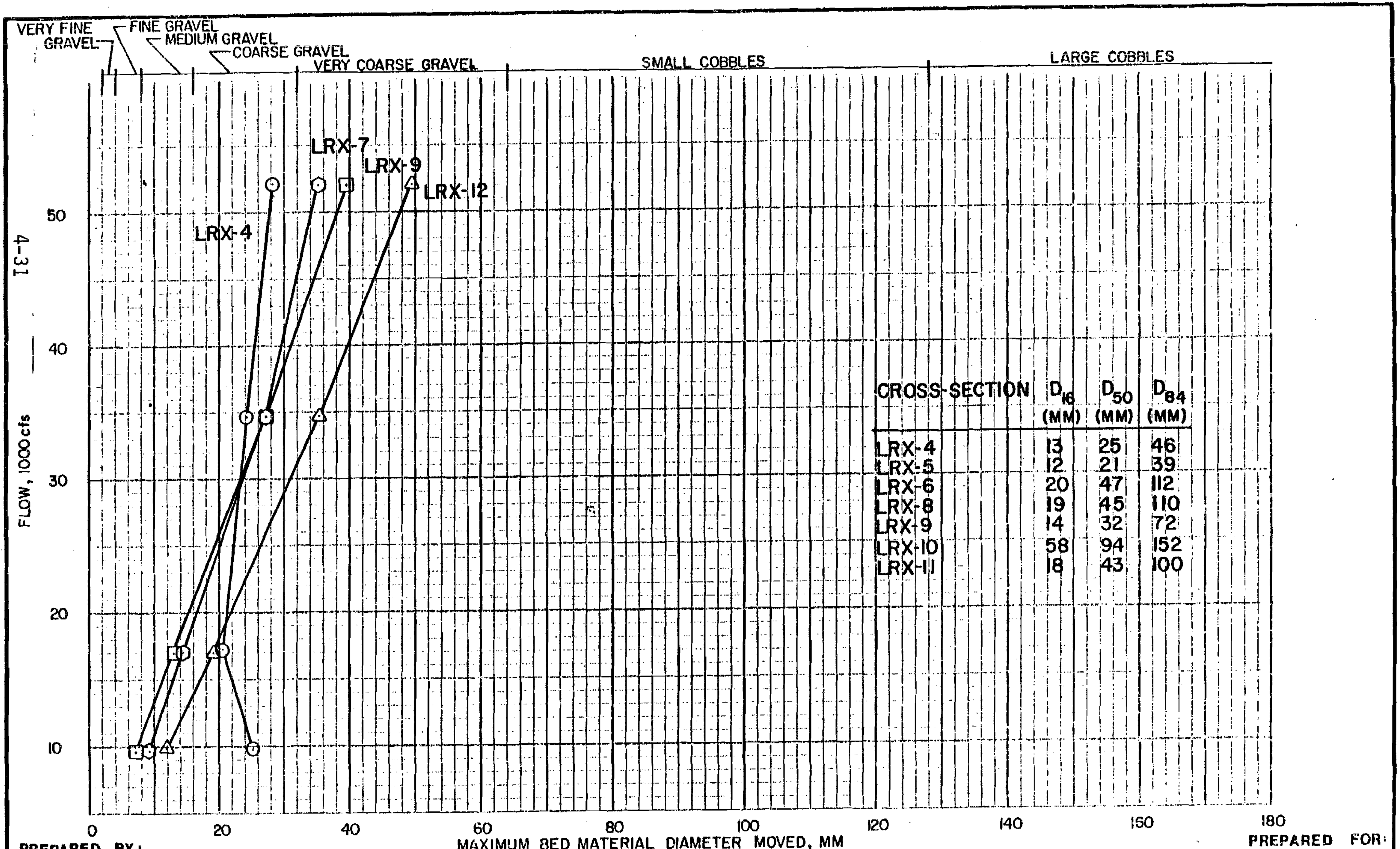
R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

BED MATERIAL MOVEMENT CURVES
LRX-16, -18, -20, -24

FIGURE 4.12



CROSS-SECTION	D_{16} (MM)	D_{50} (MM)	D_{84} (MM)
LRX-4	13	25	46
LRX-5	12	21	39
LRX-6	20	47	112
LRX-8	19	45	110
LRX-9	14	32	72
LRX-10	58	94	152
LRX-11	18	43	100

PREPARED BY:

R&M CONSULTANTS, INC.

BED MATERIAL MOVEMENT CURVES
LRX -4, -7, -9, -12

PREPARED FOR:

ACRES

FIGURE 4.13

5 - QUALITATIVE ANALYSIS

5.1 - Response Relationships

Hydropower development in the upper Susitna Basin will change the sediment and flow regimes downstream of the project until the effects are either diluted by tributaries or until related dominant geomorphic processes override the project induced changes. Flow of water and sediment are the independent variables which determine river channel morphology, and for which the project will establish a new regime for. The remaining channel dimensions, shapes, patterns and hydraulic parameters will be forced to respond and perhaps eventually establish a new balance.

Morphologic parameters that are dependent on and would respond to altered water discharge and sediment load include:

- d - mean depth, determined by dividing the area by top width
- w - surface width of channel
- $\frac{w}{d}$ - channel shape, width-depth ratio
- S - Slope, river gradient
- D - bed material size, D_{50}
- M_L - meander wave length
- γ - Sinuosity

When considering a specific river reach there is a defined pattern that the river has developed or is striving to achieve. A pattern change could occur if the independent inflow variables of sediment load and water discharge were changed. However, certain constraints are imposed onto the system which could predominate and locally override both the independent and dependent variables. The potential constraints consist primarily of remnants from past geologic processes such as valley walls, bedrock outcrops, and glacial/fluvial processes.

Based on research results of Lacey (1929-30), Blench (1937), Lane (1955), Leopold and Maddock (1953), Santos-Cayudo and Simons (1972) and Schumm (1971), the following general statements concerning a river's response to altered water discharge and sediment load can be made.

(1) Depth is directly proportional to the cube root of discharge and inversely related to the bed-material discharge.

(2) Channel width is directly proportional to the square root of discharge.

(3) Channel width is directly related to sediment load.

(4) Channel shape (width-depth ratio) is directly related to sediment load.

(5) Meander wavelength is directly related to discharge and to sediment load.

(6) Gradient is inversely related to discharge and directly related to sediment load and grain size.

(7) Sinuosity is related to slope and inversely related to sediment load.

These qualitative relationships are used as guidelines in determining potential changes to river morphology as a result of flow and sediment regulation. The base premise of these relationships is that the river has a full opportunity to form channel(s) within its own sediments. Limitations on the Susitna Rivers freedom of movement are discussed in the following sections.

5.2 - River Pattern and Channel Characteristics

Control

Some 15,000 to 20,000 years ago, the Susitna River valley betweeen Devil Canyon and Talkeetna was the route of glacial ice flows. Recession of the glaciers formed some of the surficial features present within the valley. Several of these remnant forms and depositions impose controls on the river behavior and act as an independent variable along with flow and sediment.

Presence of several terraces in the valley bottom indicate that as the ice receded, a larger quantity of water and sediment was available and the older river bed was at a higher elevation. The process of degradation through the periglacial deposits has been by a preferential sorting mechanism, in that the river has moved the small and medium sized particles down the system and either formed temporary alluvial deposits within the floodplain or flushed the material to and beyond Talkeetna. This process of downcutting and reworking of the glacial sediments has developed an armor layer of cobble sized material around the main channel perimeter.

The presence of the armor layer around and along the river channel is not verified by subsurface excavations. However, numerous observations were made during the hydrographic surveys conducted in the fall of 1980, when the water level was low and water clear. Exceptions assuredly do exist, but the armor layer is a definite control feature of the system that limits or retards channel movement.

Bedrock controls the river through Devil Canyon and intermittently downstream to Curry. Although no direct evidence exists that the channel bed is on bedrock, it is believed to influence the river gradient in some locations upstream of Gold Creek. The more obvious influence of bedrock on river behavior is along the valley walls where the channel flows impinge on it. At several locations, the bedrock limits movement on one side, thereby magnifying the influence of processes that may occur along the opposite valley wall. This situation exists at the confluence of several tributaries. These steep gradient streams have delivered a significant quantity of sediments to the Susitna mainstem and have formed conical shaped alluvial deposits. Due to the steep gradient of these streams, a portion of the material delivered by the tributaries is larger than that which the Susitna normally carries. Therefore, the progressive encroachment has narrowed and deepened the channel against the bedrock valley wall. These constrictions establish hydraulic control points that influence the flow of water, ice and sediment.

Several small tributaries have pronounced alluvial fans which have formed on the valley bottoms. These depositional features are considered periglacial because of the established vegetation and the incised channel. During deglaciation, abundance of glacial debris and meltwaters provided large quantities of sediment to the valley. Subsequent stabilization of the basin resulted in a reduction of sediment, allowing the streams to develop a channel through the alluvial fan. Presently these fans are relatively stable and are not expected to grow significantly. During torrential events, reworking of the deposits and episodic delivery of sediments can be expected.

Patterns

Four river patterns are evident on the Susitna River: single channel, split channel, braided, and multi-channel. Characteristics of each are shown in Figures 5.1 through 5.4. These characteristic patterns are used in Section 5.3 when describing the various river reaches. In general, the Susitna River has either a single channel or split channel configuration above the confluence with the Chulitna. Near the Chulitna confluence, the Susitna assumes a braided pattern for the remainder of its length. In the reach from RM 61 to 42, a combined pattern is evident, with a braided pattern on the western floodplain and a multi-channel pattern on the eastern floodplain. The pattern of braided rivers contrasts sharply with the pattern of other common river types. An explanation for this phenomenon has been offered by several investigators (Fahnestock, 1963; Leopold, et al., 1964; Leopold and Wolman, 1957; Mackin, 1948; Henderson, 1966; Church, 1972). Although each explained reasonably the cause of braiding with respect to the individual study, the resulting conclusions often conflicted with others. The cause of braiding has been variously attributed by different authors to abundant sediment load, large and sudden discharge variations, erodible banks, and high gradients. It appears that braiding results from all of these characteristics rather than being dependent on only one. Mollard (1973) developed a scheme to define the influencing factors on alluvial river patterns. This scheme expresses braiding as a result of high rates of bedload transport, low channel stability, high sediment supply, high gradients and low upstream flow regulation.

5.3 Regime Analysis of Susitna River Reaches

Project released flows will vary considerably from the natural flow regime. Generally the Susitna River at Gold Creek exceeds its mean annual flow of 9,650 cfs during the months of May through September and drops to 1,000 to 3,000 cfs during the winter months. At Gold Creek the mean annual flood (recurrence interval of about 2 years) is 49,500 cfs, and for river reaches considered to be in regime corresponds to bankfull flow. Bankfull flow is regarded as the dominant discharge that shapes the river channel to accomodate it. For the purposes of qualitatively assessing the response of the river to regulated flow and sediment conditions, bankfull flow is often used as the baseline. Post project flows and sediment loads will be reduced significiantly below this baseline and therefore will effect the dependent variables.

For example, a stable single-channel reach of the Susitna upstream of the Chulitna confluence has a bankfull width of about 600 feet. Assuming a dominant discharge equal to the mean annual flood, 49,500 cfs, and applying a generalized form of Lacey's regime width equation:

$$W = CQ^{\frac{1}{2}}$$

yields a value for C of 2.70, very close to Lacey's original value of 2.67. Reversing the procedure for a post-project dominant discharge of 13,000 cfs yields a regime width of 310 feet. This relationship indicates that the project will result eventually in a substantial narrowing of the channel, not only by abandonment of side channels in multi-channel reaches, but also in width reduction in the main channel. Due to reduction in suspended and bed sediment loads, this process will be very slow, covering many decades or longer.

Downstream of the Susitna and Chulitna River confluence a braided river pattern prevails. Dominant discharge in a briaded system is that which produces a stage that overtops the intermediate active gravel bars. When this occurs the bed material is set in motion, and changes in channel network configuration and shape normally result. Regulating Susitna flow will reduce the frequency of the threshold from a mean annual flood to a flood that would be expected to occur with a recurrence interval of 5 to 10 years or greater (Table 3.14). Under post-project conditions, the frequency of occurrence of dramatic changes in river morphology will decrease, resulting in a more stabilized floodplain, decreased number of subchannels and increased vegetative cover.

A summary of river patterns by reach is presented on Table 5.1. Each reach was defined by distinguishable breaks in bed slope and observable changes in river pattern. A general decrease in slope is associated with the downstream progression of the river with the exception of the reach from RM 149 to RM 144. The gentle slope through this reach indicates that bedrock may control the bed gradient. The river profiles for the Susitna River and its major tributaries are shown in Figure 5.5 and 5.6.

RM 149 to RM 144

Pattern

Through this reach, the Susitna flows in a predominately single channel confined by valley walls (Figures 5.7 and 5.8). At locations where the valley bottom widens, deposition of gravel/cobbles has formed mid-channel or side-channel bars. Occasionally a vegetated island or fragmentary floodplain has formed to a top elevation above normal flood levels, and vegetation has become established.

Control Features

Frequent occurrence of bedrock outcrops along the valley wall indicates that the river slope may be controlled by bedrock. This hypothesis is further supported because the average slope from the downstream end of Devil Canyon to RM 144 is less than the next downstream reach, and there appears to be no correlation between the bankfull stage and mean annual flood. Presence of cobbles and boulders in the bed material (Figure 5.7) aids in stabilization of the channel geometry.

Processes

Portage Creek joins the Susitna at RM 148.9 and has formed a gravel and cobble fan at the confluence. This steep-gradient, non-glacial stream delivers significant coarse grained sediment to the Susitna. The Portage Creek fan geometry is dependent on Susitna stages and transport capabilities.

Summary of Potential Post-Project Morphological Changes

- The channel is stable and little change in form is expected.
- Portage Creek fan will progress out into the Susitna until equilibrium with the regulated Susitna stage is established. Perching of the stream mouth is not expected.

RM 144 to RM 139

Pattern

A broadening of the valley bottom has allowed the river through this reach to develop a split channel form with intermittent well-vegetated islands (Figures 5.9 and 5.10) A correlation exists between bankfull discharge and mean-annual flood.

Control Features

Where the main channel impinges on valley walls or terraces, a cobble armour layer (Figure 5.9) has developed with a top elevation at roughly bankfull flood stage. At RM 144, a periglacial alluvial fan of coarse sediments confines the river to a single channel.

Processes

Reworking of alluvial deposits is frequently evident through this reach. Erosion of islands is evident where a channel impinges against the alluvial deposits. Frequent mid-channel bars, composed of gravel, are mobile during moderate floods. These active bed sediments reform along with subchannel pattern changes.

Summary of Potential Post-Project Morphological Changes

- Erosion of valley walls and terraces will decrease dramatically due to the armour layer.
- Reworking of alluvial deposits in the main channel will continue but at a reduced rate.
- Main channel form will progress slowly to a more uniform sinuous pattern.
- Subchannels may become inactive.
- Tributary at RM 144 could become perched. It may not be able to regrade its coarse bed sediments to meet the regulated Susitna water level.

RM 139 to RM 129.5

Pattern

This river reach is characteristized by a well defined split channel configuration. Vegetated islands separate the main channel from the side channels. Side channels occur frequently in the alluvial floodplain (Figure 5.12) and are delivered Susitna water only at flows above 15,000 to 20,000 cfs. Often, valley bottom springs flow into sloughs. There is a good correlation between bankfull stage and the mean annual flood.

Controls

Where the main channel impinges valley walls or terraces, a cobble armour layer (Figure 5.11) has developed with a top elevation at roughly bankfull flood stage. The main channel bed has been frequently observed to be well armoured.

Primary tributaries include Indian River, Gold Creek and Fourth of July Creek. Each have built an alluvial fan into the valley bottom, constricting the Susitna to a single channel. Each constriction has establishes a hydraulic control point that regulates water surface profiles at varying discharges and associated hydraulic parameters.

The railroad bridge location takes advantage of the Gold Creek fan constriction and further stablizes this constriction. One mile downstream of the bridge, the main channel impinges the bedrock valley wall and orients the river southward. Ice jams have been reported to commonly occur at this location, and backwater behind the jams causes water to spill into the east floodplain, contributing to the formation of the subchannels.

Processes

Indian River joins the Susitna at RM 138.5 and has formed a gravel fan at the confluence. This steep-gradient, non-glacial stream delivers significant coarse grained sediment to the Susitna. The fan extends several hundred feet upstream and downstream of the present mouth. The stream gradient is dependent on the Susitna stage and does not have difficulty in adjusting to a variable Susitna stage.

The Gold Creek bed is composed of cobbles and boulders. The mouth is presently very steep. Because the confluence is at the outside of a Susitna meander, Gold Creek bedload sediments are readily transported by the Susitna. This creek has difficulty adjusting to a variable Susitna stage.

Fourth of July Creek has a relative gentle gradient as it flows into a Susitna subchannel. It is a non-glacial stream with a cobble bed.

Comparison of 1951 and 1980 air photos indicates a few changes in bank lines and island planform, but generally the channel delineation is stable. Although visible evidence indicates that a majority of the main channel is well armoured with cobbles, there are several active gravel bars through this reach. A partial source of this sediment is from erosion of alluvial deposits. Currently, active erosion is occurring on the west bank between RM 134 and RM 135. At RM 132.5, several active gravel bars exhibit a braided river pattern. It has been observed that during moderate flows, these mid-channel gravel bars erode and reform. These processes indicate a long duration, small volume, but relative continuous movement of gravel bed material. A common feature associated with the beds of side channels and sloughs at the bifuration point is a cobble berm. These berms act as control weirs, limiting delivery of main channel surface water to flows greater than 15,000 to 20,000 cfs.

Summary of Potential Post-Project Morphological Changes

- Indian River will continue to extend its alluvial deposits into the Susitna. Indian River should easily grade its bed to meet the regulated Susitna Stage.
- Gold Creek gradient is presently very steep as it enters the Susitna. The cobble and boulder bed will resist regrading the bed to meet the regulated Susitna stage.
- Fourth of July Creek gradient is currently relatively flat and should easily adjust to the regulated Susitna stage.
- Erosion of valley walls, terrace deposits and alluvial banks will reduce dramatically due to the armour layer.
- Reworking of active gravel bed materials will continue at a reduced rate. Main channel form will slowly progress to a more uniform sinuous pattern.
- Several of the sloughs and subchannels could be blocked off from the Susitna main channel at the regulated stage. Where these channels rejoin the Susitna, gradual siltation and vegetation encroachment will occur.

RM 129.5 to RM 119

Pattern

River patterns through this reach are similar to those discussed in the previous reach. The most prominent characteristic between Sherman and Curry is that the main channel prefers to flow against the west valley wall and the east floodplain has several sidechannels and sloughs (Figure 5.14). The alluvial fan at Curry (Figure 5.13) constricts the Susitna to a single channel and terminates the above described pattern. A fair correlation exists between bankfull stage and mean annual flood through this reach. Comparison of 1950 and 1980 airphotos reveals occasional local changes in banklines and island planform.

Controls

The west valley wall is generally nonerodible and occasionally has exposed bedrock outcrops. The resistant boundary on one side of the main channel has generally forced a uniform channel configuration with a well armoured perimeter. The west valley wall is relatively straight and uniform except at RM 128 and 125.5. At these locations bedrock outcrops protrude out and deflect the main channel to the east side of the floodplain.

Processes

At RM 128 and RM 125.5, where the main channel crosses over to the east floodplain, a tendency to braid is exhibited. The river has an opportunity to increase its breadth, to decrease its depth and to deposit a portion of its bedload. The broadened channel flows against the resistive east bank, regains its shape and resumes its preferred western route. In comparing 1980 aerial photos with 1950 photos, it can be seen that similar processes have been ongoing through this era. Some erosion of the east channel alluvial deposits has occurred but no dramatic changes are evident. There is moderate erosion of fine material along the left bank near RM 124 (Figure 5.13).

Cobble berms at the bifurcation of subchannels and sloughs are prevalent through this reach. A possible explanation for this phenomena may be as follows. Even when a river pattern appears straight, such as when the main channel flows against the west valley wall, streamlines will meander within the channel. This process develops secondary currents that flow in a helicoidal direction. The total sediment load is directed away from the hard surface toward the opposite bank. Depending upon flow, local hydraulics, and other controls, the sediment may either be re-entrained or deposited along the bank. As the flow increases and spills into the side channels, the coarser sediments are delivered to the sidechannels. When the coarse sediment encounters a shallow channel with lower velocities, it will drop out and deposit. As flow recedes, the flow over the berm may channelize, developing a minor incised channel on the downstream side of the berm, and eroding a niche into it. This niche provides a temporary waterway at moderate flows.

The minor tributaries along this river reach all appear to have fairly stable, but steep, basins. Contribution of sediment to the river will be episodic during extreme precipitation events. Of prime importance is that the tributaries and springs will deliver fresh water to the east subchannels and sloughs.

<u>Summary of Potential Post-Project Morphological Changes</u>

- Erosion of valley walls, terraces and alluvial deposits will reduce dramatically.
- At RM 128 and RM 125.5, reworking of gravel bed material will continue, but at a reduced rate. Main channel form will become more uniform.
- Cobble berms at the side channels and sloughs will control and perhaps block main channel flow from entering them.
- The river should continue its preferred and stable route along the west valley wall.

RM 119 to RM 104

Pattern

Through this reach the river is a very stable, predominantly incised single channel pattern (Figure 5.16) with a few islands.

Control

The channel banks are well armored with cobbles and boulders (Figure 5.15), and visual inspection indicates that the bed is also. Several large boulders occur intermittently along the main channel, and are believed to have been transported down the valley during glacial ice movement. They provide local obstruction to flow and navigation, but do not have a significant impact on channel morphology.

Processes

The bankfull flow and the mean annual flood criteria do not appear to apply to this reach. Flow at 53,000 cfs is lower than the vegetated island and bank elevations. It appears that this reach is capable of transporting all sediment delivered to it. In addition, this broad low-relief valley delivers little or no sediment to the system. In effect, it appears that this reach acts as a conduit carrying the total sediment load through it.

Erosional and depositional processes are almost indetectable. Comparison of 1951 and 1980 aerial photographs reveals no significant changes in channel morphology. Gravel bars above the 18,000 cfs flow level appear to have the same form, with only one exception at RM 114. There have been some changes in the alluvial gravel deposits, minor erosion of the islands, and some stabilization of the floodplain adjacent to the east bank. These processes are representative of the system.

Summary of Post Project Morphological Changes

- No consequential changes in the channel morphology are expected.

RM 104 to RM 95

Pattern

At the confluence of Susitna, Chulitna and Talkeetna Rivers, there is a dramatic change in the Susitna pattern from a split channel to a braided pattern (Figures 5.17 and 5.18). Emergence from mountainous confined upstream basins into the lowland unconfined basin has introduced the ability of the river systems to develop laterally. Ample bedload transport and a gradient decrease also assist in establishing conditions to support the braided pattern.

The Chulitna River has a similar mean annual flow as the Susitna, yet its drainage basin is about 40 percent smaller. Its glacial tributaries are much closer to the confluence than the Susitna, and a majority of the Chulitna River's length is confined by rock valley walls. As it emerges from the incised canyon 20 miles upstream of the confluence, the river transforms into a braided pattern with moderate vegetative growth on the intermediate gravel bars. At about a midpoint between the canyon and confluence, the Chulitna exhibits a highly braided pattern with no vegetation on intermediate gravel bars and evident recent lateral instability. This pattern continues beyond the confluence and the impression is given that the Susitna is tributary to the dominant Chulitna River. The split channel Talkeetna River is tributary to the dominant braided pattern.

Control

Terraces generally bound the broad floodplain but provide little control over channel morphology. General floodplain instability results from the three river system striving to balance out the combined flow and sediment regime.

Processes

Referencing Figure 5.19 it can be seen that considerable movement of channel boundaries has occured in the three rivers between 1951 and 1980. The background is 1980 aerial photography and the dark lines delineate 1951 channel boundaries as defined by vegetation limits.

In the Susitna River, there has been some lateral movement of the vegetation lines, with both erosion and stabilization of alluvial deposits with vegetation. The river has maintained the basic braided river pattern.

Since 1951, there has been a progressive movement of the Chulitna River main channel from the south edge of the floodplain towards the north. As a result, a remarkable amount of vegetated floodplain on the north bank has eroded. Continued movement to the north is limited because the lateral migration is progressing up the valley slope. During a mid-summer flood in 1981, the Chulitna main channel relocated from the north side of the floodplain to near the central floodplain. Cause of this change is unknown but could be related to the limited northward movement, debris accumulation or some anomalie that occurred during the flood event. The broad fan-shaped active floodplain gives the impression that the Chulitna is currently aggrading. This concept is further evidenced by inundation of the established vegetation along the north floodplain that is killing the spruce trees. Although not supported by field data, it appears that a rise in the gravel floodplain bed has occurred recently. Glacier instability far upstream could be the source of flow and sediment regime changes that are influencing apparent instability near its mouth. Continued measurements of bedload transport rate, elevations and stage/discharge relationships will be required to determine with confidence the stability of the Chulitna.

The Talkeetna River has had several channel changes upstream of the railroad, but the bridge and bank revetment have stabilized the river as it enters the Susitna River. In 1979, the bankline around the village of Talkeetna was stabilized with rock riprap.

Preliminary bedload measurements indicate that the Chulitna is the main source of bed-material transport and provides roughly 4000 tons per day. Through the 90-day summer flow period this would produce 360,000 tons per year or a volume of 240,000 c.y. per year. Assuming that 50% of this were no longer transportable by the reduced flood regime downstream of the Susitna and was deposited over a length of 10 miles on an active floodplain width of 3000 feet, an aggradation rate of about ½ inch per year would result. This would raise the average bed level 1-foot every 25 years. The above simplistic analysis indicates that continued monitoring of the sediment balance at the confluence is advisable.

<u>Summary of Potential Post Project Morphological Changes</u>

(a) Chulitna River will continue to expand and extend its alluvial deposits. Decreasing the summer flow magnitude in the Susitna River will allow the Chulitna to extend alluvial deposits to the east and south. This could induce erosion of the east bankline towards the railroad.

(b) Increased deposition at the confluence will cause backwater up the Susitna River. Lateral instability will continue after the project.

(c) The Talkeetna River will maintain the ability to create its channel into the Susitna system. No consequential interactions can be foreseen at this time.

RM 95 to 61

Pattern

Downstream of the three-river confluence, the Susitna continues its braided pattern, with multiple channels interlaced through a sparsely vegetated floodplain.

The channel network consists of the main channel, usually one or two subchannels and a number of minor channels (Figure 5.20). The main channel is easy to identify when viewing the river at low flows, as its surface water width is greater than that of other channels. Observations of cross-sections of the river floodplain indicates that the main channel thalweg is 5 to 10 feet deeper than in other channels. The main channel meanders irregularly through the wide gravel floodplain and intermittently flows against the vegetated floodplain. It has the ability to easily migrate laterally within the active gravel floodplain, as the main channel is simply reworking the gravel that the system previously deposited (Figure 5.20). When the main channel flows against vegetated bank lines, erosion is retarded due to the vegetation and/or bank materials that are more resistant to erosion. Flow in the main channel should persist throughout the entire year.

Subchannels are usually positioned near or against the vegetated floodplain and are generally on the opposite side of the floodplain from the main channel. These channels normally bifurcate (split) from the main channel when it crosses over to the opposite side of the floodplain and then terminate when the main channel meanders back across the floodplain and intercepts them. These channels have smaller geometric dimensions than the main channel, and their thalweg is generally about 5 feet higher. Their flow regime is dependent on the main channel stage and on local behavior at the point of bifurcation. Flow may or may not persist throughout the year.

Minor channels are considered to be those relatively shallow, wide channels that flow over the gravel floodplains and complete the interlaced braided pattern. These channels are very unstable and generally short-lived.

Control

The main channel is intermittently controlled laterally where it flows against terraces. Since the active floodplain is very wide, the presence of terraces has little significance except for determining the general orientation of the river system. An exception is where the terraces constrict the river to a single channel at the Parks Highway bridge. Subchannels are directly dependent on main channel flow and sediment regime, and generally react to the same. Minor channels react to both of the larger channels behavior.

Processes

For braided rivers that have the ability to form channel networks within the river sediments, bankfull floods are considered to be the dominant discharge. Floods of greater magnitude do not significantly increase the river's stage because of a sudden increase in flow width. Flows above bankfull stage move gravel from bars into the channels and change the channels' shape and network.

Dramatic changes in channel position and form occur whenever the river attains bankfull stage. At this stage, the active gravel floodplain is subject to movement, with considerable local scouring and filling. The main channel can change its lateral location dramatically, intercepting the other channels at different locations and therefore forcing them to readjust. Generally, it can be said that the geometric dimensions of the main channel will remain uniform. The minor channels react to other predominant processes such as main channel and major subchannel movements, debris accumulations and local sediment movement. When the flow recedes, the channels merely reflect the most recent governing processes.

Through this reach of river, debris accumulations participate heavily in forming the gravel floodplain and channel network. Debris accumulations along the periphery of active gravel floodplain bars are common. Evidence indicates that the debris controls several of the minor channels and influences the meandering pattern of major subchannels and the main channel. Debris accumulations can grow, move, dissipate or emerge during floods greater than bankfull stage, and it is impossible to predict debris locations and local river response to this process.

Summary of Potential Post-Project Morphological Changes

- Under post-project conditions, the bankfull flood (mean annual flood under pre-project conditions) could be expected to have a recurrence interval of once every five to ten years. This will tend to decrease the frequency of occurrence of both bed material movement and of changes in braided channel shape, form and network.

- Over a long period, a trend towards relative stabilization of the floodplain features should occur. The main channel and major subchannels could progress to a more uniform meandering pattern. The active gravel floodplain may develop a vegetative cover and the minor subchannels become relatively inactive. It must be recognized that an extreme flood generated by either the Chulitna River, Talkeetna River, or both, could mask this process and delay observable changes for several years.

RM 61 to RM 42

Pattern

Downstream of the Kashwitna River confluence, the Susitna River branches out into multiple channels separated by islands with established vegetation (Figures 5.21 and 5.22). This reach of the river has been named Delta Islands because it resembles the distributary channel network common with large river deltas. The multiple channels are forced together by terraces just upstream of the Deshka River.

Through this reach, the very broad floodplain and channel network can be divided into three categories:

1. Western braided channels
2. Eastern split channels
3. Intermediate meandering channels

The western braided channel network is considered to be the main portion of this very complex river system. Although not substantiated by river surveys, it appears to constitute the largest flow area and lowest thalweg elevation. The primary morphologic parameter that has maintained the western side as the prime conveyor of water (and probably sediment) is the fact that the western braided channels is the shortest distance between the point of bifurcation to the confluence of the Delta Island channels. Therefore it has the steepest gradient and highest potential energy for conveyance of water and sediment.

Controls

Terraces bound the very broad floodplain and only provide general orientation of the channel network. The floodplain appears to be filled with river deposited alluvial sediments which the river can readily massage. Vegetation retards channel changes, but should not be considered to control channel positions.

Processes

The basic processes described for the Sunshine Station reach would be applicable for the western braided channels. The active gravel floodplain is subject to major changes during bankfull floods. A main channel prevails that has an irregular meandering pattern, the largest channel geometric dimensions, and conveys water throughout the year.

The distributary channels branching off the western channels collect along the east valley wall and form the eastern split channels. A split channel system differs from a braided system in that there is more relative stability and the channels are generally deeper with respect to width. A better defined and more uniform meandering pattern reduces the channel gradient, which aids in maintaining channel stability. Distribution of water and sediment from the west to east is dependent on the flow and sediment regime of the Susitna River as well as local behavior at each of the channel bifurcation points. Quantity of sediment and flow delivered eastward is expected to be highly variable from year to year.

Several intermediate channels meander through the vegetated islands. These channels are expected to be deep with respect to width, and have a relative gentle gradient because of the pronounced meandering patterns. These channels react to the regime behavior of the western and eastern channels.

Upon comparing the 1951 aerial photos with 1980 aerial photos, dramatic changes were revealed in the Delta Islands between the Little Willow Creek and Willow Creek confluence (RM 48 to RM 52). The western braided channels eroded away a considerable amount of the islands and opened up a major flow connection between the west and east. This major change could instigate long-term changes in the lower Delta Island channel network form for several years. In viewing this area during late summer, 1981, it appeared to be very unstable; again the governing control appears to be the steeper gradient in the western braided channels.

Summary of Potential Post-Project Morphological Changes

- The Delta Island reach is a very complex and unstable channel network. There exists a very broad floodplain filled with varying channel types. Project-induced changes in flow and sediment regime realized at this reach will be diluted by contribution from tributaries and by the Susitna satisfying its sediment load by reworking the wide floodplain alluvial deposits. Basic changes in the overall channel network are not expected.

- Local changes could occur in the main channel lateral position but basic channel geometry should remain relatively similar. To quantify post project morphology changes with respect to the natural system would be extremely difficult, if not impossible.

RM 42 to RM 0

Pattern

Downstream of the Delta Islands, the Susitna River gradient decreases as it approaches the ocean. The river's basic pattern tends toward a split channel configuration as it adjusts to the lower energy slope. There are short reaches where a tendency to braid emerges in the river pattern. Downstream of RM 20, the river branches out into delta distributary channels.

Control

Terraces constrict the floodplain near the Deshka River confluence and at Susitna Station. Further downstream the terraces have little or no influence on the river.

The Yentna River joins the Susitna at RM 28 and is a major contributor of flow and sediment.

Tides in the Cook Inlet rise above 30 feet and therefore will control the water surface profile and to some degree the sediment regime of the lower river. River elevation of 30 feet exists at about RM 20 and corresponds to where the Susitna begins to branch out into its delta channels.

Processes

The vegetated floodplain consists of alluvial deposits with surface features revealing old meander scrolls and filled-in channels. The well established vegetation helps to retard erosional processes and channel migrations, but these processes are definately on-going. In comparing 1951 and 1980 aerial photographs for the river reach at Deshka River confluence (RM 40 to RM 42), there can be seen significant channel movements, bank erosion and deposition, with bankline movement of several hundred feet (Figure 5.23).

Several highwater channels and/or sloughs branch off the main channel into the wide floodplain. These channels appear to be very stable except for the occasion where the main channel migrates laterally and intercepts one of the stems. Delivery of water and sediment to these subsystems is directly dependent on the main channel flow regime and associated stage.

The Yentna River contributes about 40 percent of the mean annual flow to the Susitna River as measured at Susitna station. At the confluence, considerable changes in bank lines have occurred since 1951 as a result of each of these systems adjusting to each other (Figure 5.24). Because of the variable flow and sediment delivered by each of these systems during events, on an annual basis or even long-term, instability of channel morphology at the confluence is expected to continue.

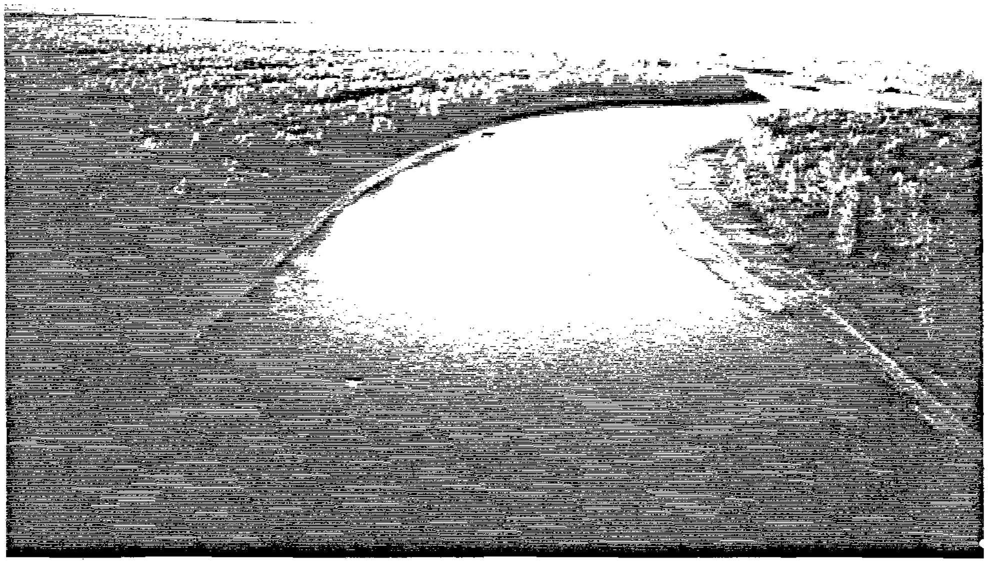
At RM 19, Alexander Slough branches off the main channel network. It also marks the beginning of the Susitna River distribution through the delta into Cook Inlet. Alexander Slough outlet has drawn attention recently because it is the prime navigation corridor downstream to Alexander Creek. Comparing aerial photos, there are no noticeable significant changes in the slough outlet configuration, gravel bars or banklines. The slough flow is directly related to the Susitna main channel flow and stage. Because Alexander Slough is a major distributary that feeds straight and direct to tidal waters, it is believed that an outlet will naturally be maintained during normal summer flow regimes.

Summary of Potential Post-Project Morphological Changes

- Effects of the project on river morphology through this reach of river would be extremely difficult or impossible to quantify. The above qualitative discussion has simply brought out some of the natural processes and observable changes that have occurred over the last 30 years. The dilution effect of major and minor tributaries as well as the balancing of changes by the Susitna River system should mask any measurable changes that could occur as a result of the project for several decades.

TABLE 5.1
SUSITNA RIVER REACH DEFINITIONS

River Mile	Average Slope	Predominent Channel Pattern
RM 149 to 144	0.00195	Single channel confined by valley walls. Frequent bedrock control points.
RM 144 to 139	0.00260	Split channel confined by valley wall and terraces.
RM 139 to 129.5	0.00210	Split channel confined occasionally by terraces and valley walls. Main channels, side channels sloughs occupy valley bottom.
RM 129.5 to 119	0.00173	Split channel with occasional tendency to braid. Main channel frequently flows against west valley wall. Subchannels and sloughs occupy east floodplain.
RM 119 to 104	0.00153	Single channel frequently incised and occasional islands.
RM 104 to 95	0.00147	Transition from split channel to braided. Occasionally bounded by terraces. Braided through the confluence with Chulitna and Talkeetna Rivers.
RM 95 to 61	0.00105	Braided with occasional confinement by terraces.
RM 61 to 42	0.00073	Combined patterns: western floodplain braided, eastern floodplain split channel.
RM 42 to 0	0.00030	Split channel with occasional tendency to braid. Deltaic distributary channels begin forming at about RM 20.



RIVER MILE 103.2

Single Channel

- Stable
- Non-erodible banks; controlled by valley walls, bedrock or armor layer consisting of gravel/cobbles.
- Channel may be either straight or meandering; in straight channels, thalweg often meanders across channel.
- Occasional fragmentary alluvial deposits in floodplain.

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FO

SINGLE-CHANNEL RIVER PATTERN

ACRES

FIG. 5.1

RIVER MILE 124.4

Split Channel

- Main channel behaves similar to single channel at low flow.
- Side channels provide flood relief at high flows (greater than 20,000 cfs).
- Islands well established with vegetation.
- Gravel/cobble bed material.
- Mean annual flood correlates with bankfull flow.
- Channels are moderately stable.

PREPARED BY:

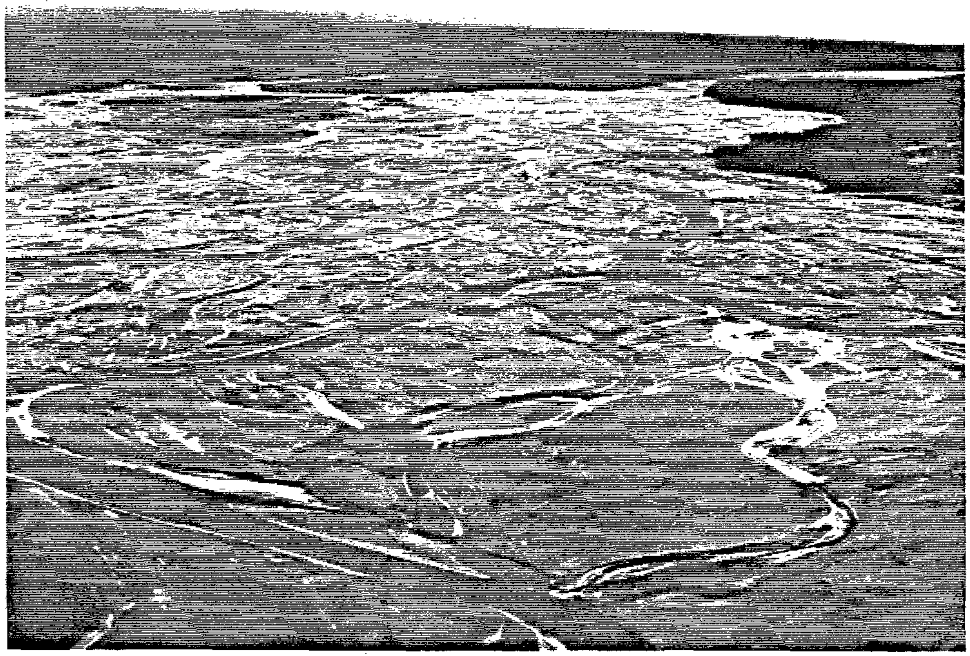
R&M CONSULTANTS, INC.

SPLIT-CHANNEL RIVER PATTERN

PREPARED FOR

ACRES

FIG. 5.2



CHULITNA RIVER NEAR CONFLUENCE WITH SUSITNA RIVER

Braided Channel

- Floodplain is very wide and shallow even at flood flow.
- Multiple and interlacing channels in unvegetated gravel floodplain.
- Move large quantities of bed material during flows greater than bankfull.
- Results from combination of high rates of bedload transport, low channel stability, high sediment supply, high gradients and low upstream flow regulation.

PREPARED BY:

R&M CONSULTANTS, INC.

BRAIDED-CHANNEL RIVER PATTERN

PREPARED FOR

FIG. 5.3

DELTA ISLANDS

Multi-Channel (Delta Islands)

- Very broad floodplain with little lateral control.
- Multiple channels consist of a mix of braided, split channel and single channels within floodplain.
- Relatively unstable, subject to major local changes during single flood events.
- Large amount of fine suspended sediment helps stabilize banks; dense vegetation effective in trapping sediment.
- Bed material consists of gravel/sand with pockets of silt.

PREPARED BY:

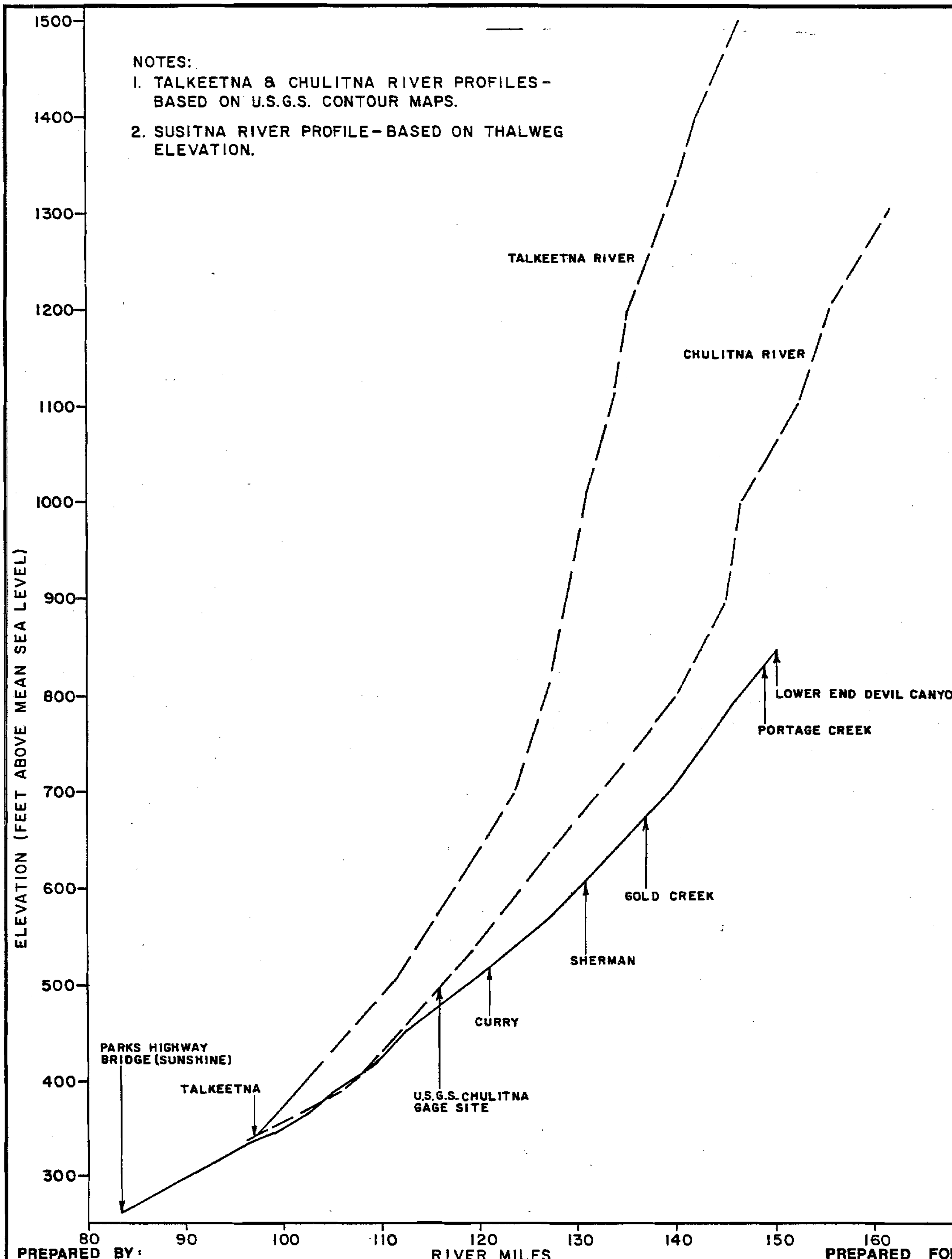
R&M CONSULTANTS, INC.

MULTI-CHANNEL RIVER PATTERN

FIG. 5.4

PREPARED FOR

ACRES



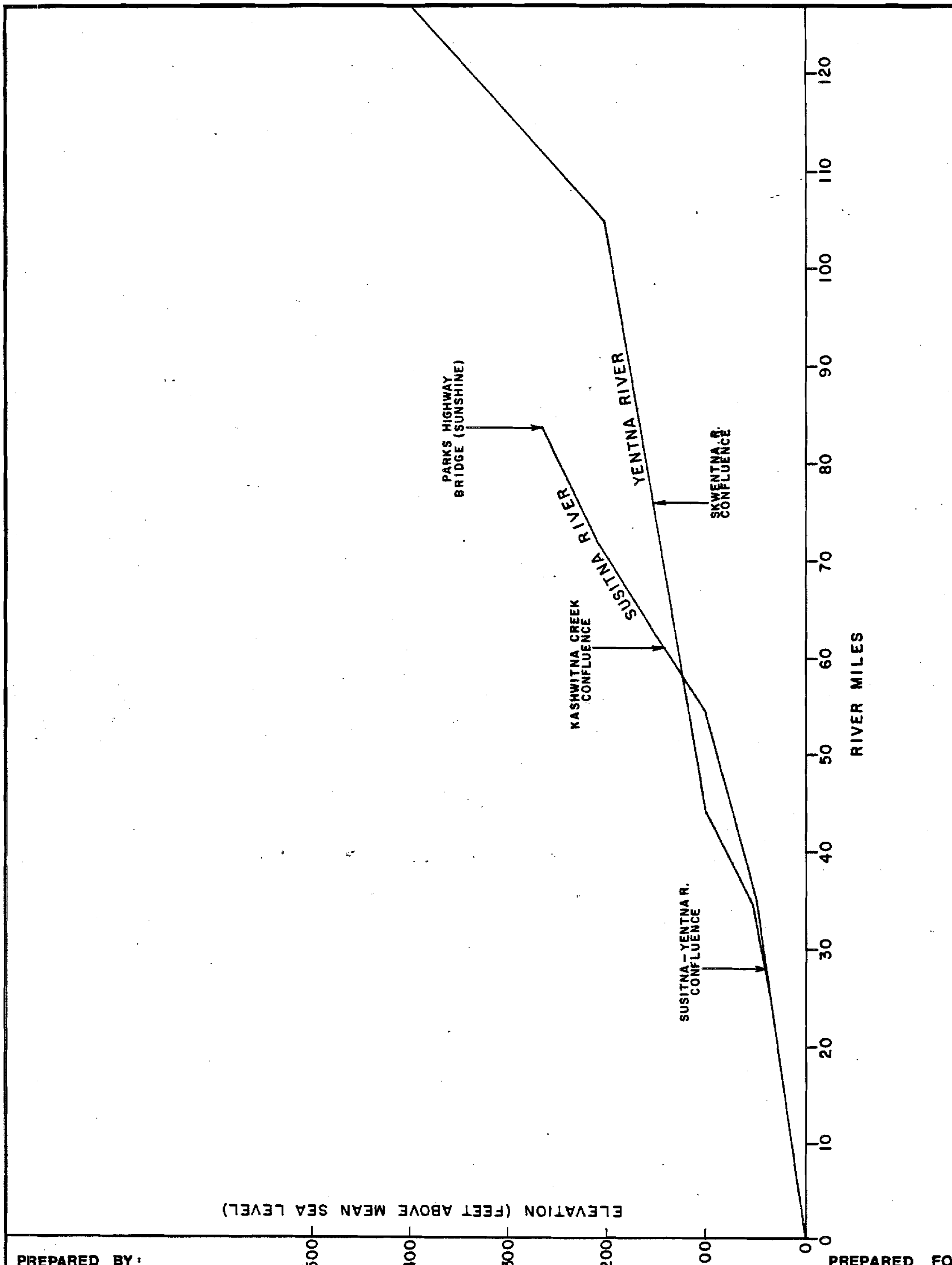
PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FO

RIVER PROFILE, SUSITNA RIVER AND TRIBUTARIES ABOVE SUNSHINE

FIGURE 5.5



PREPARED BY:

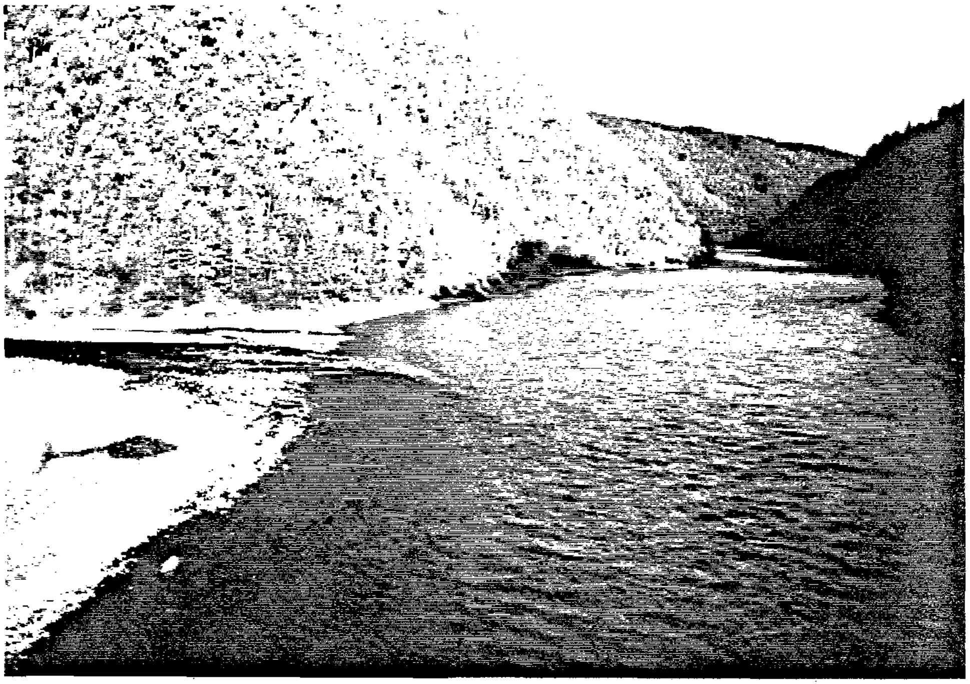
R&M CONSULTANTS, INC.

PREPARED FOR:

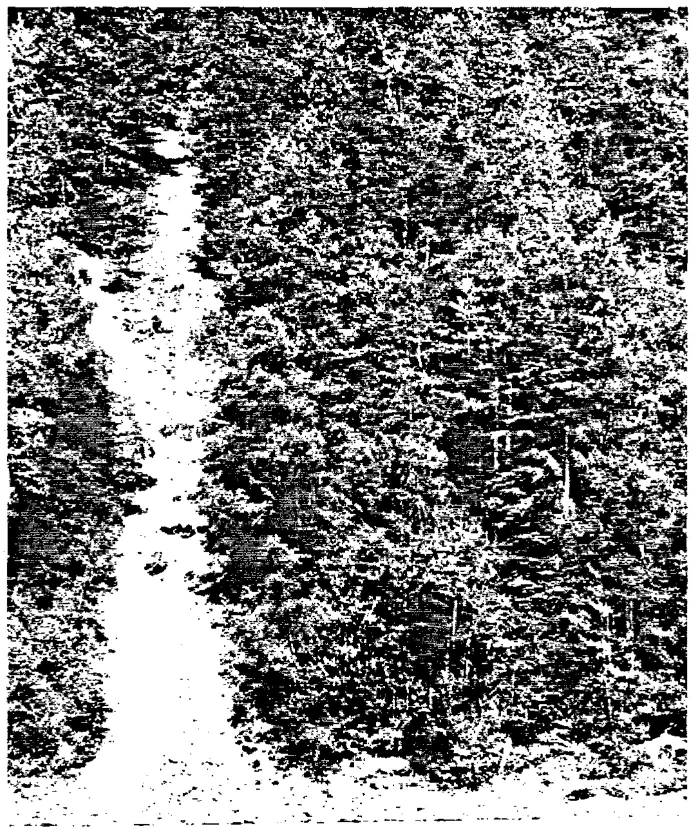
ACRES

RIVER PROFILE, SUSITNA RIVER AND TRIBUTARIES BELOW SUNSHINE

FIGURE 5.6



Looking Upstream at Portage Creek, River Mile 148.8



Talus Slide

PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER
REACH RM 149 TO RM 144

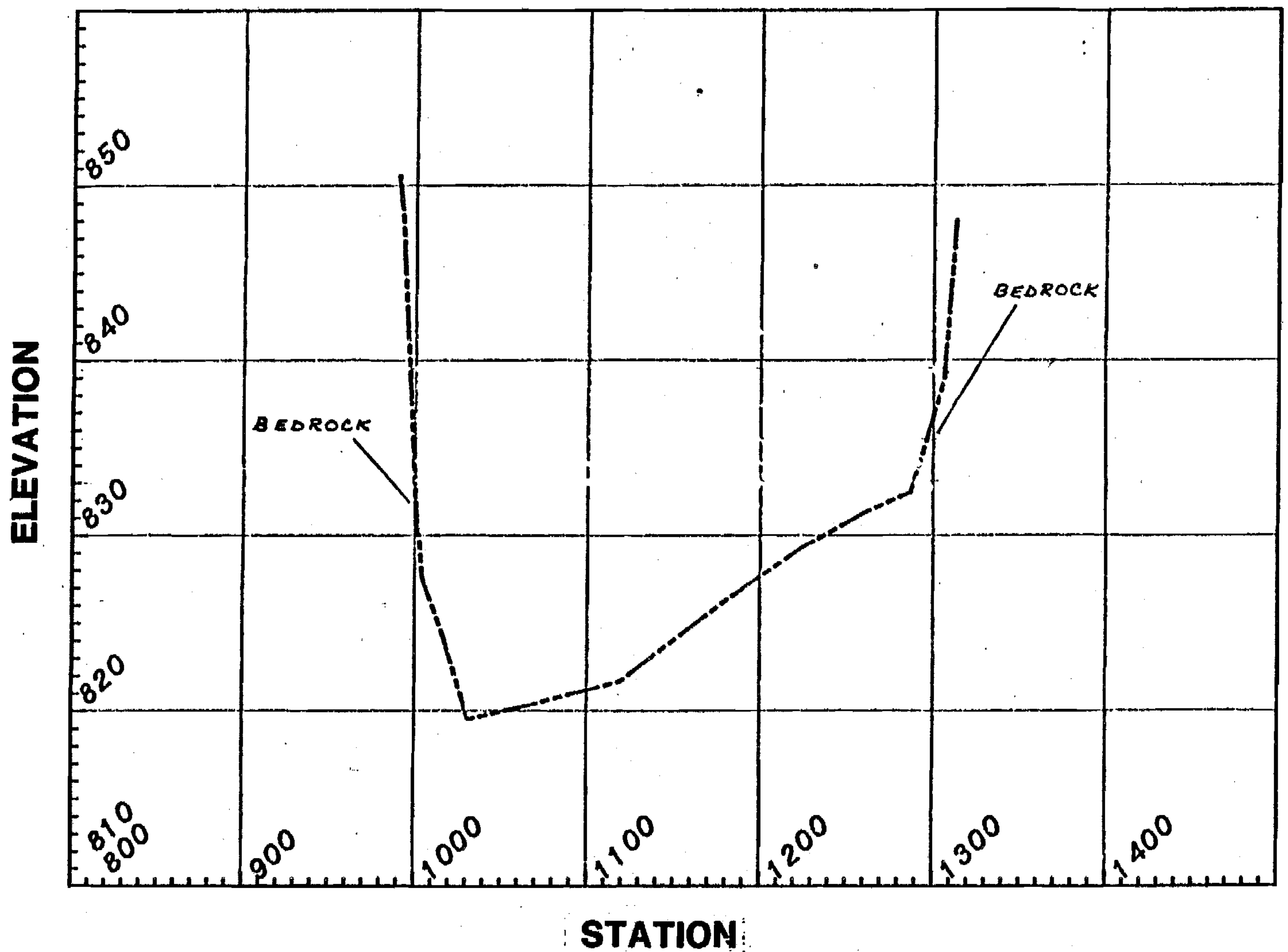
FIG. 5.7

PREPARED FOR

ACRES

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 61



5-29

PREPARED BY:

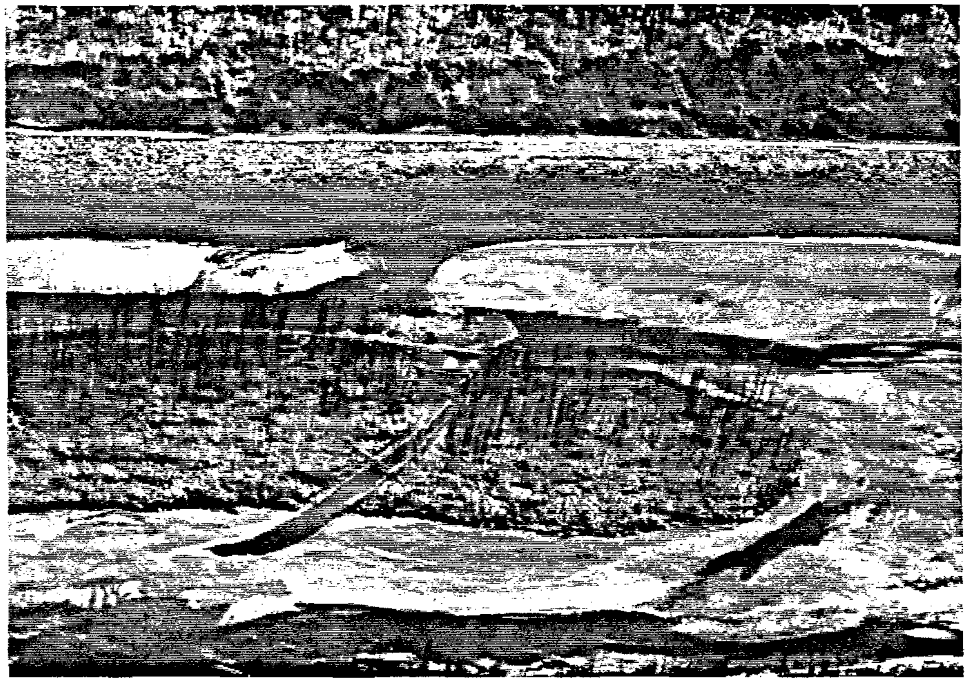
R&M CONSULTANTS, INC.

CROSS-SECTION
RM 148.7

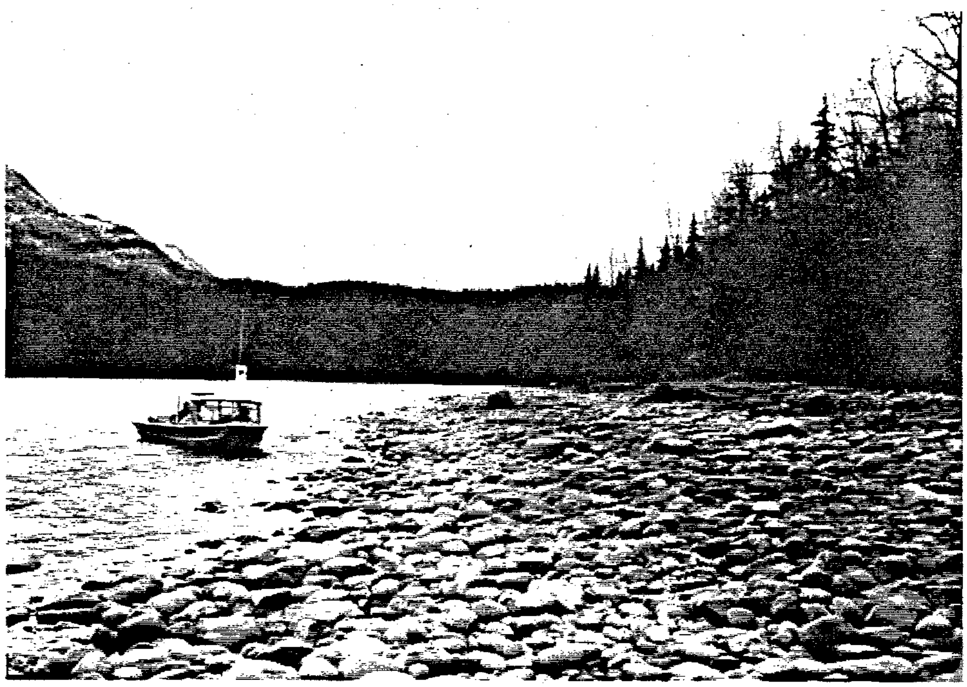
PREPARED FOR:

ACRES

FIGURE 5.8



Split Channel, River Mile 141.5



Gravel/Cobble Bed Material, River Mile 140.1

PREPARED BY:

R&M CONSULTANTS, INC.

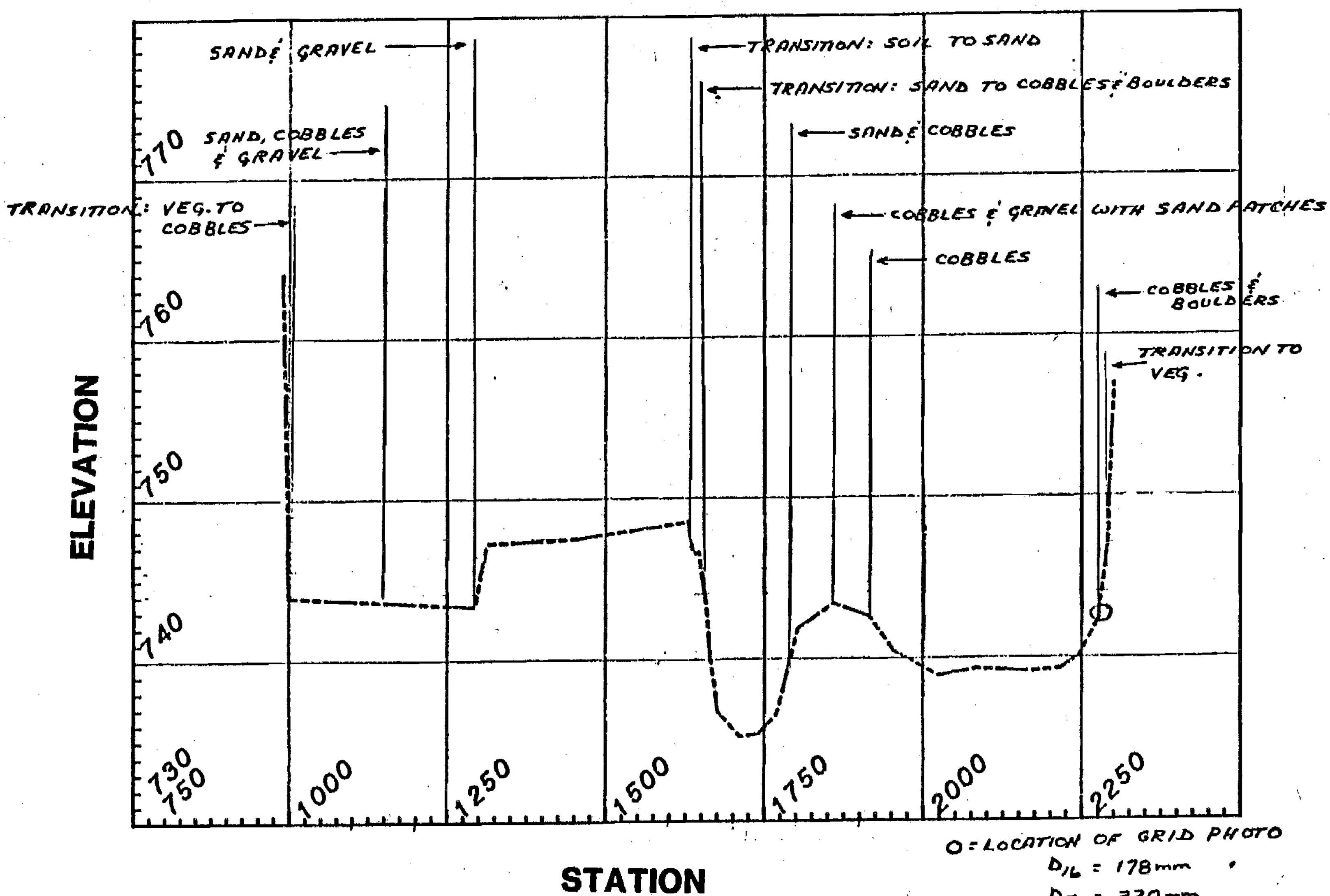
SUSITNA RIVER
REACH RM 144 TO RM 139

PREPARED FOR:

ACRES

FIG. 5.9

CROSS-SECTION Number 55



O = LOCATION OF GRID PHOTO

D_{16} = 178 mm

D_{50} = 220 mm

D_{84} = 265 mm

PREPARED BY:

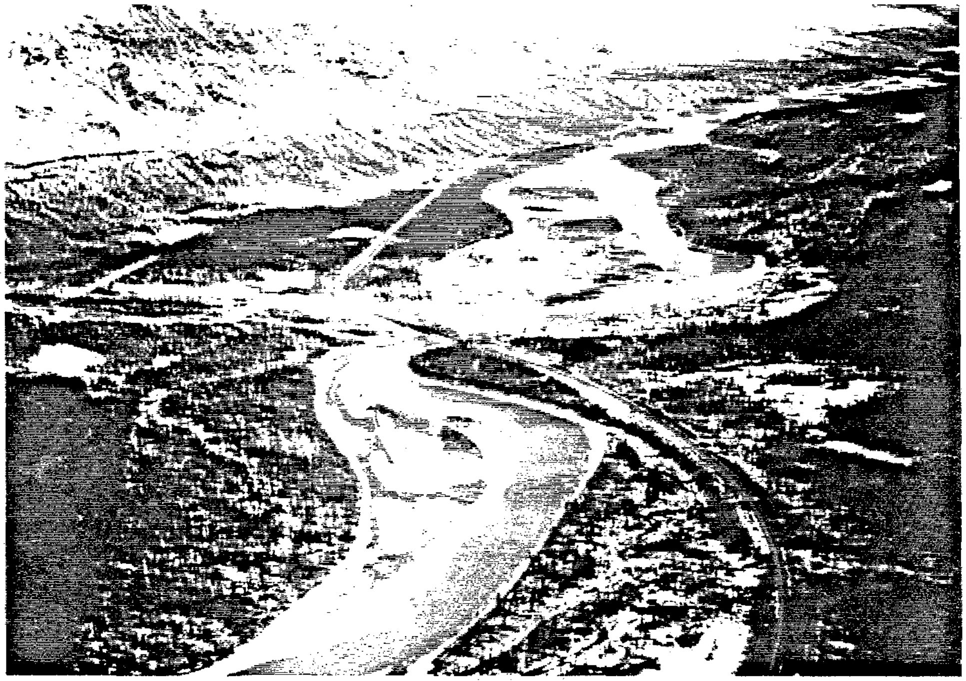
R&M CONSULTANTS, INC.

CROSS-SECTION
RM 141.5

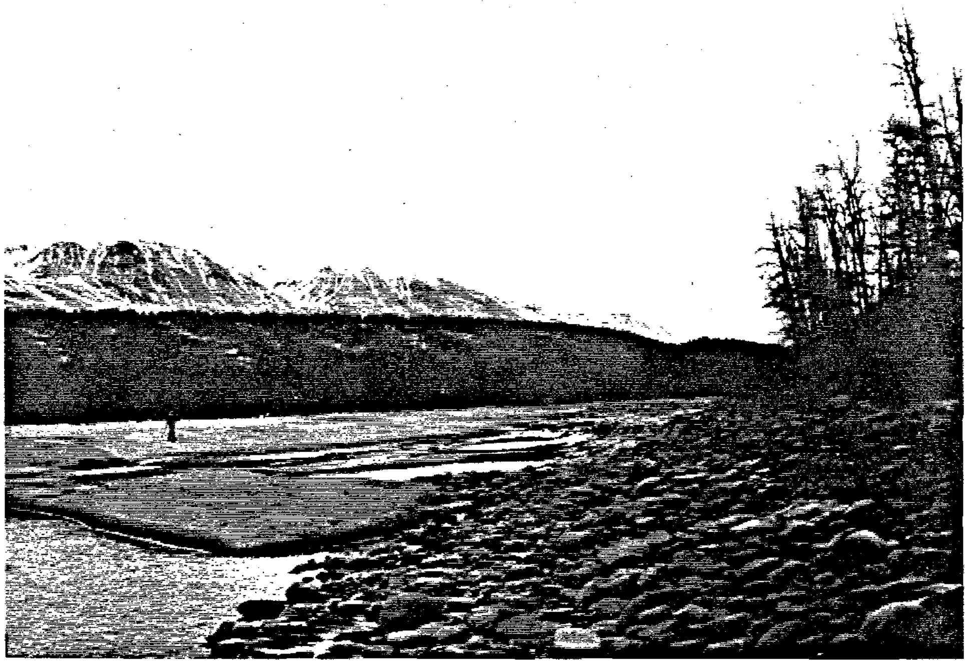
PREPARED FOR:

ACRES

FIGURE 5.10



Gold Creek Railroad Bridge, River Mile 136.7



Gravel/Cobble Bed Material and Sand Bar, River Mile 137.4

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR

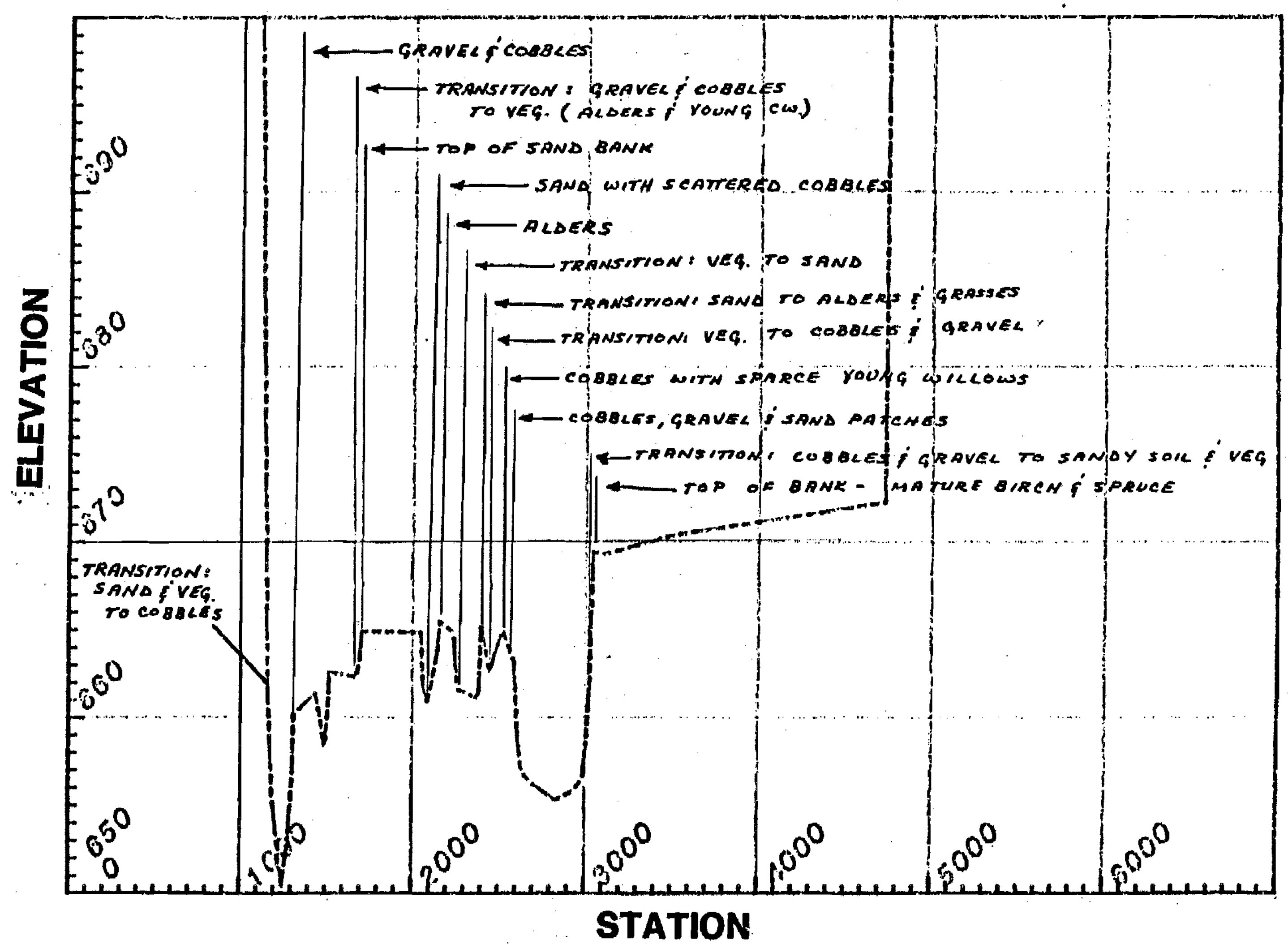
ACRES

SUSITNA RIVER
REACH RM 139 TO RM 129.5

FIG. 5.11

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 41



PREPARED BY:

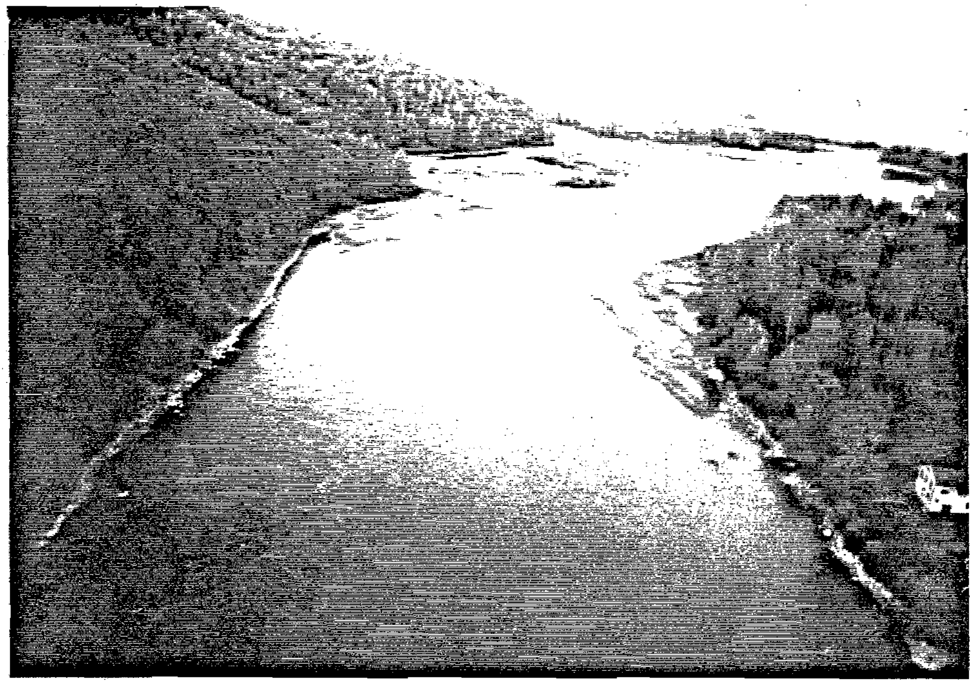
R&M CONSULTANTS, INC.

CROSS-SECTION
RM 134.7

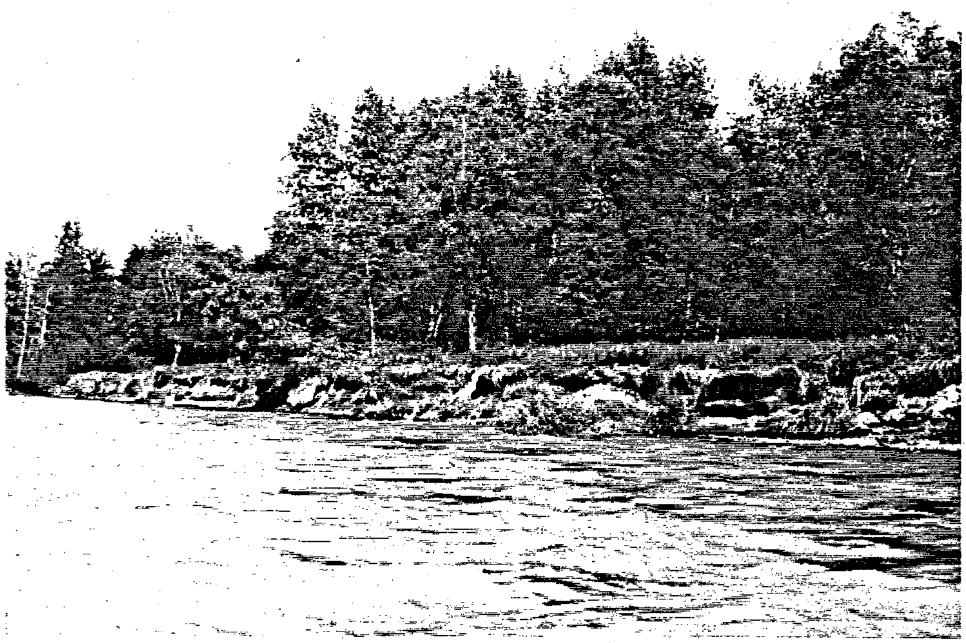
PREPARED FOR:

ACRES

FIGURE 5.12



Curry, River Mile 120.7



Sloughing Banks, River Mile 124

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR:

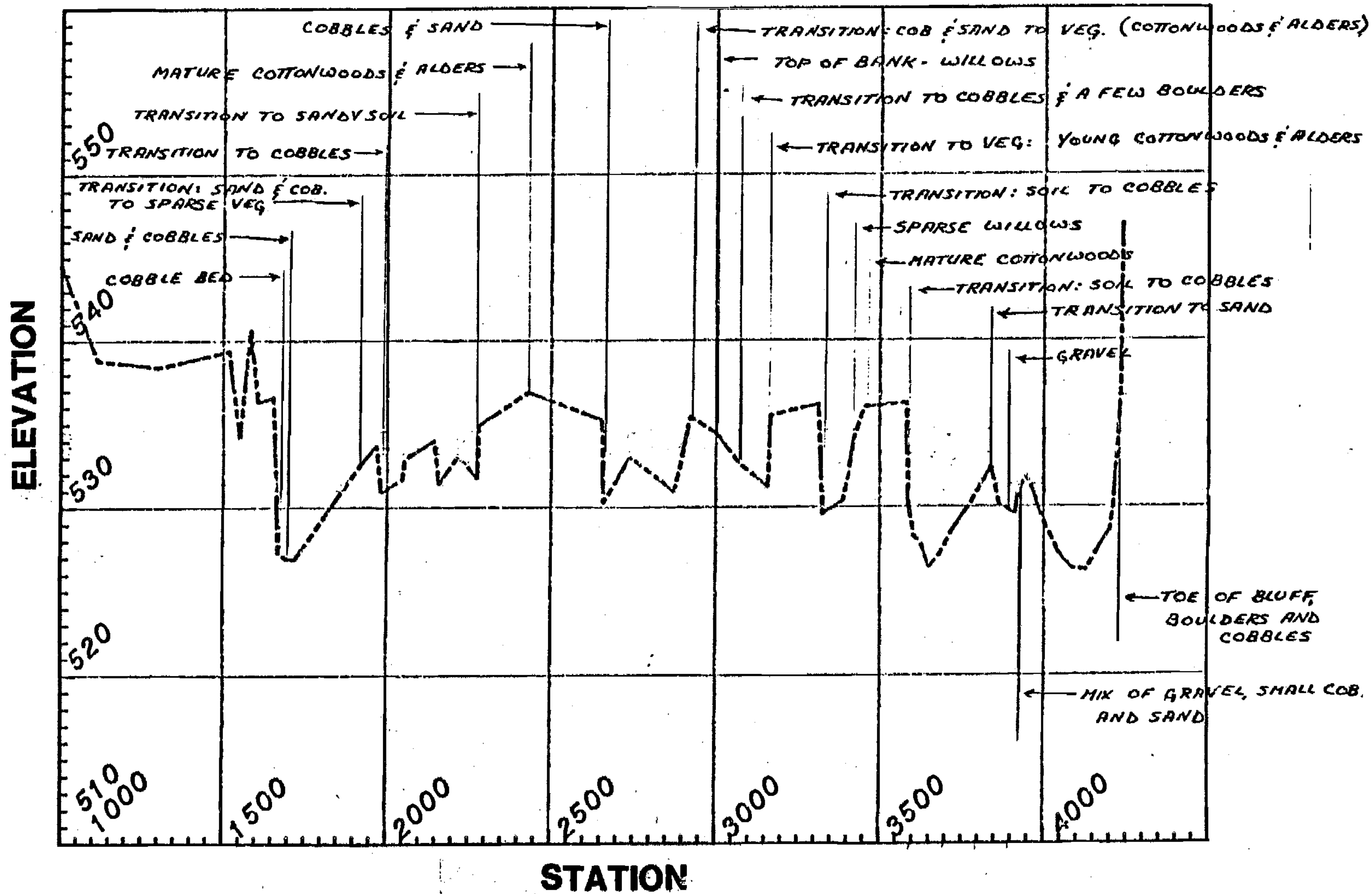
ACRES

SUSITNA RIVER
REACH RM 129.5 TO RM 119

FIG. 5.13

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 25



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 121.6

PREPARED FOR:

ACRES

FIGURE 5.14

River Mile 104

Gravel/Cobble/Boulder Bed Material, River Mile 112.7

PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER
REACH RM 119 TO RM 104

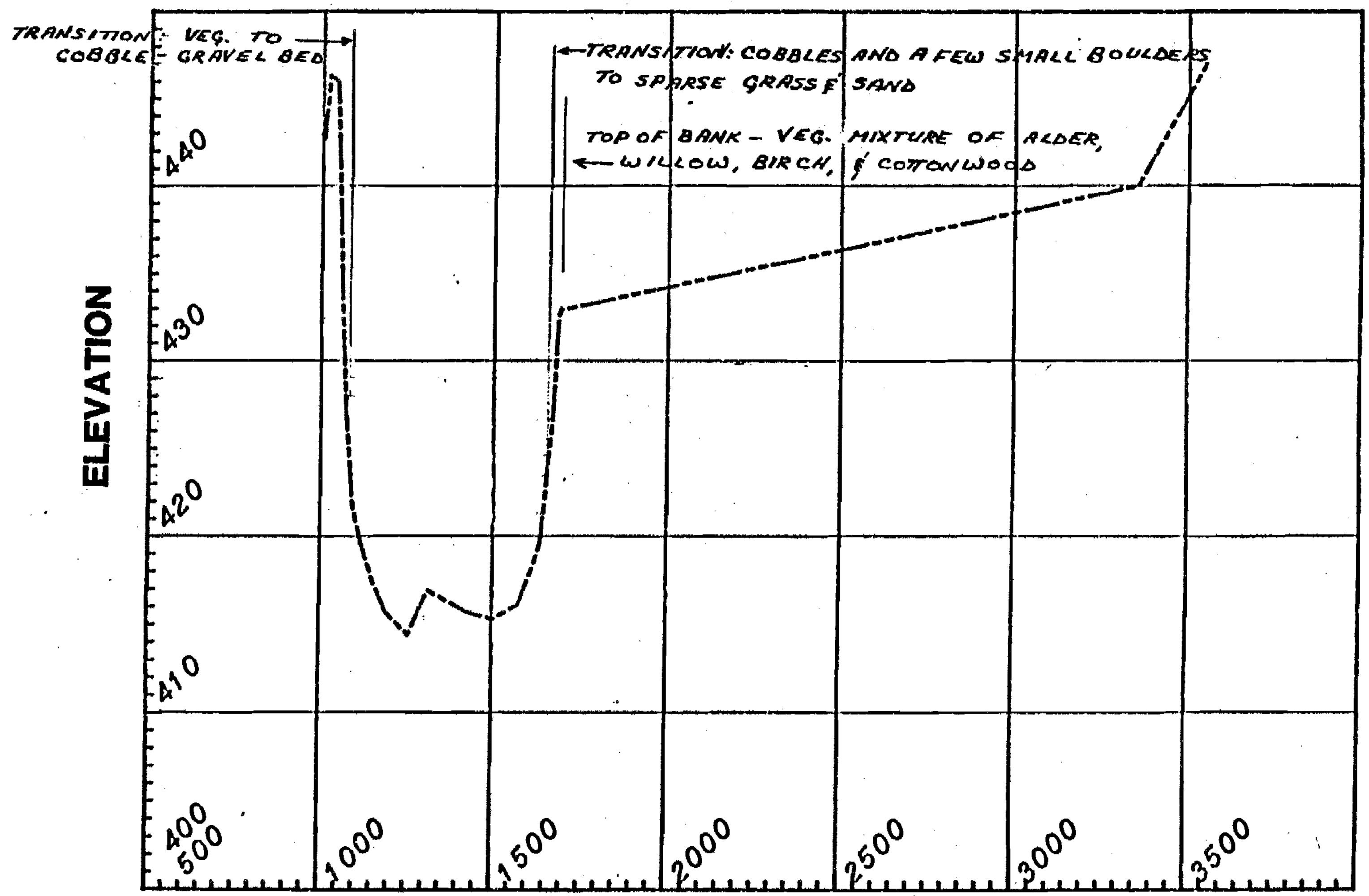
PREPARED FOR:

ACRES

FIG. 5.15

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 12



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 108.4

PREPARED FOR:

ACRES

FIGURE 5.16

Susitna-Chulitna Confluence, Looking Downstream

Gravel/Small Cobble Bed Material, River Mile 101.5

PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER
REACH RM 104 TO RM 95

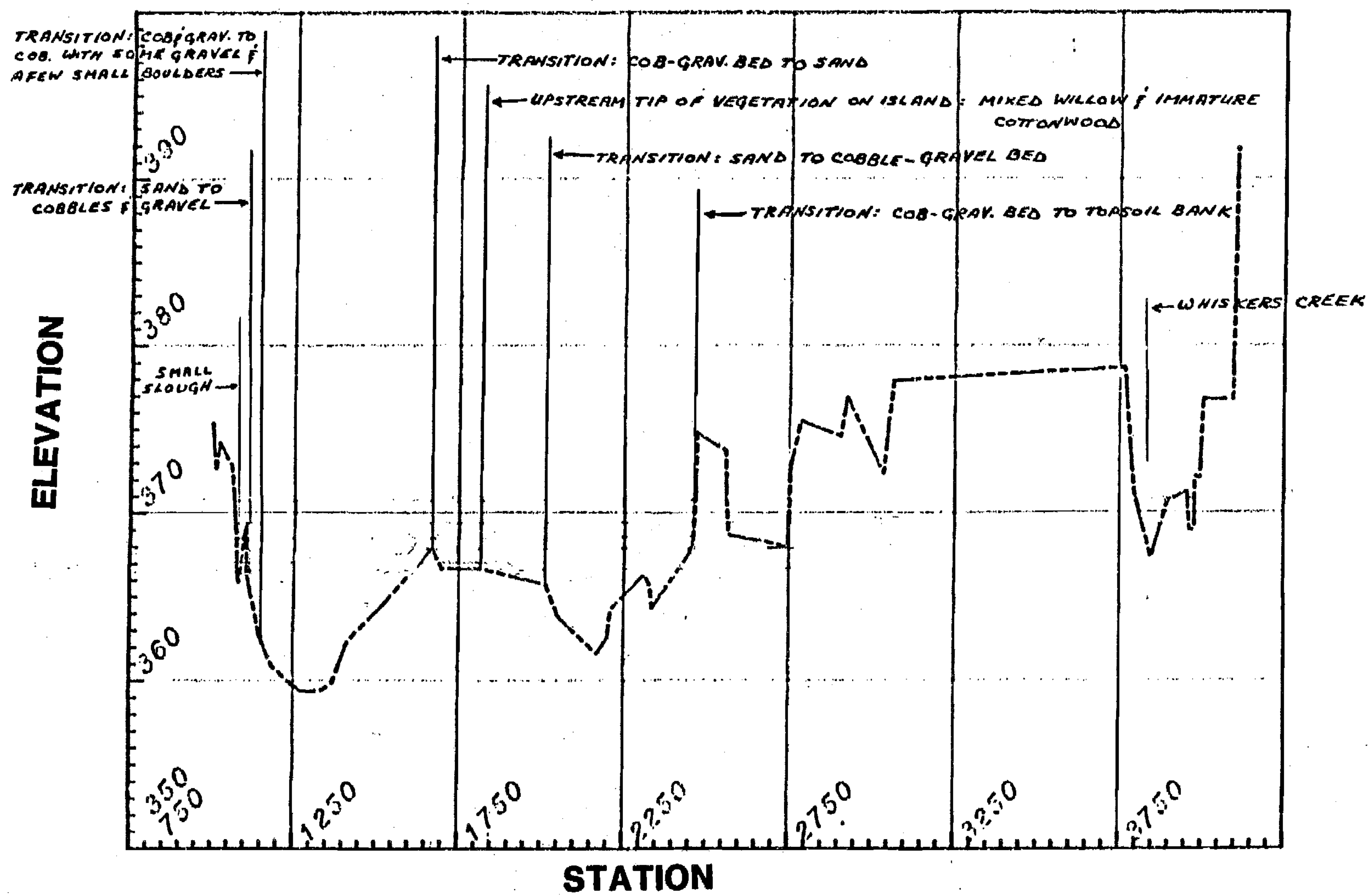
PREPARED FOR:

ACRES

FIG. 5.17

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 7



PREPARED BY:

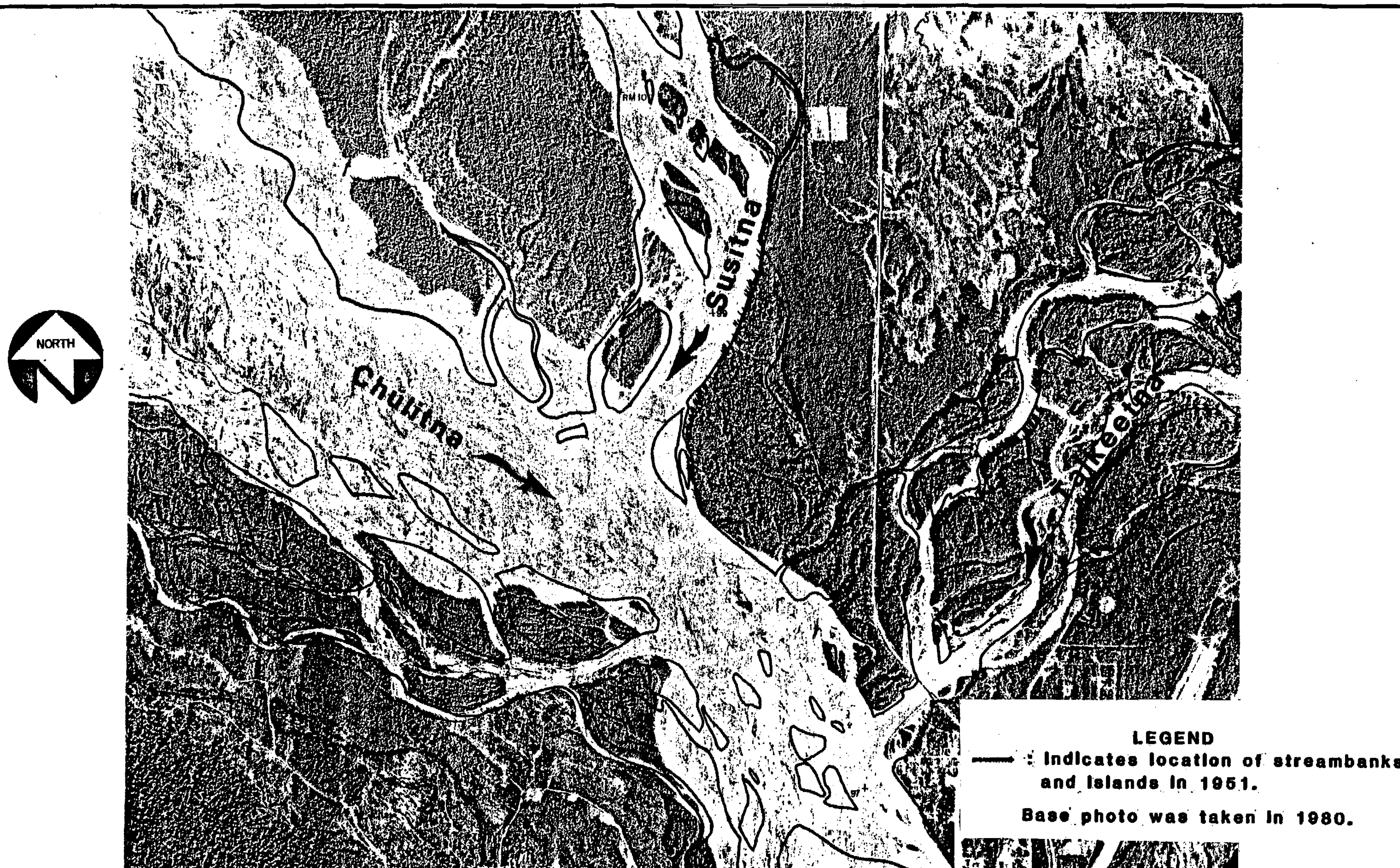
R&M CONSULTANTS, INC.

CROSS-SECTION
RM 101.5

PREPARED FOR:

ACRES

FIGURE 5.18



PREPARED BY:

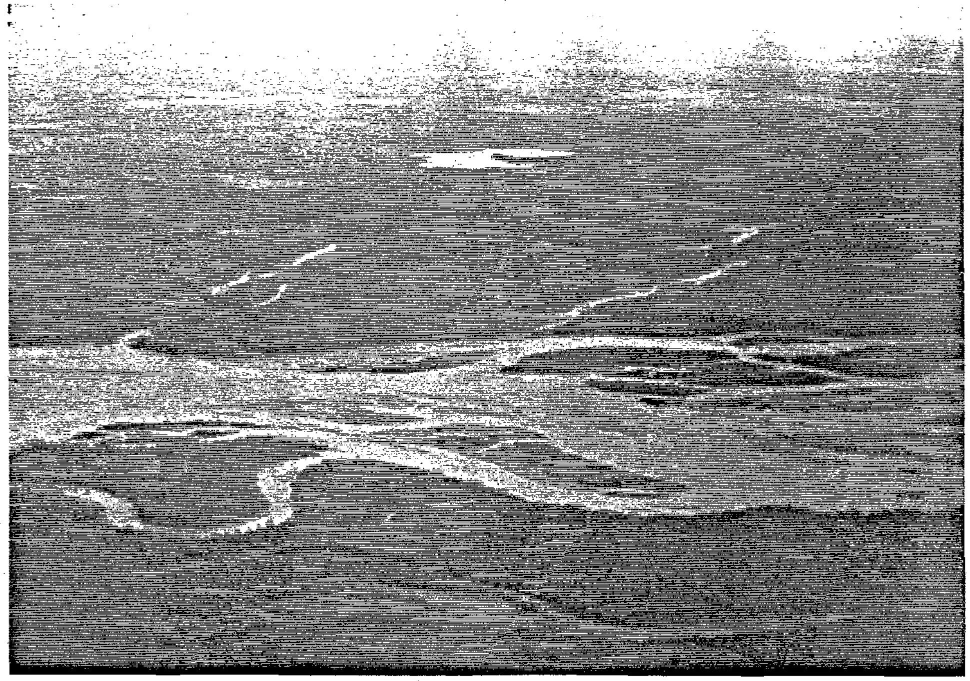
R&M CONSULTANTS, INC.

1951-1980 AERIAL PHOTO COMPARISON
SUSITNA-CHULITNA-TALKEETNA CONFLUENCE

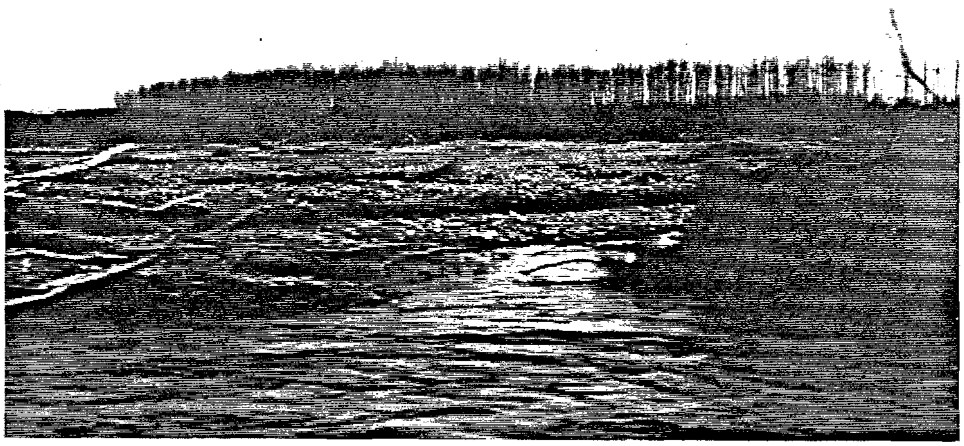
Figure 5.19

PREPARED FOR:

ACRES



River Mile 79.5



Brush Pile-up on Gravel Bar

PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER
REACH RM 95 TO RM 61

FIG. 5.20

PREPARED FOR:

ACRES

Delta Islands

Erosion of Sand and Gravel Bar

PREPARED BY:

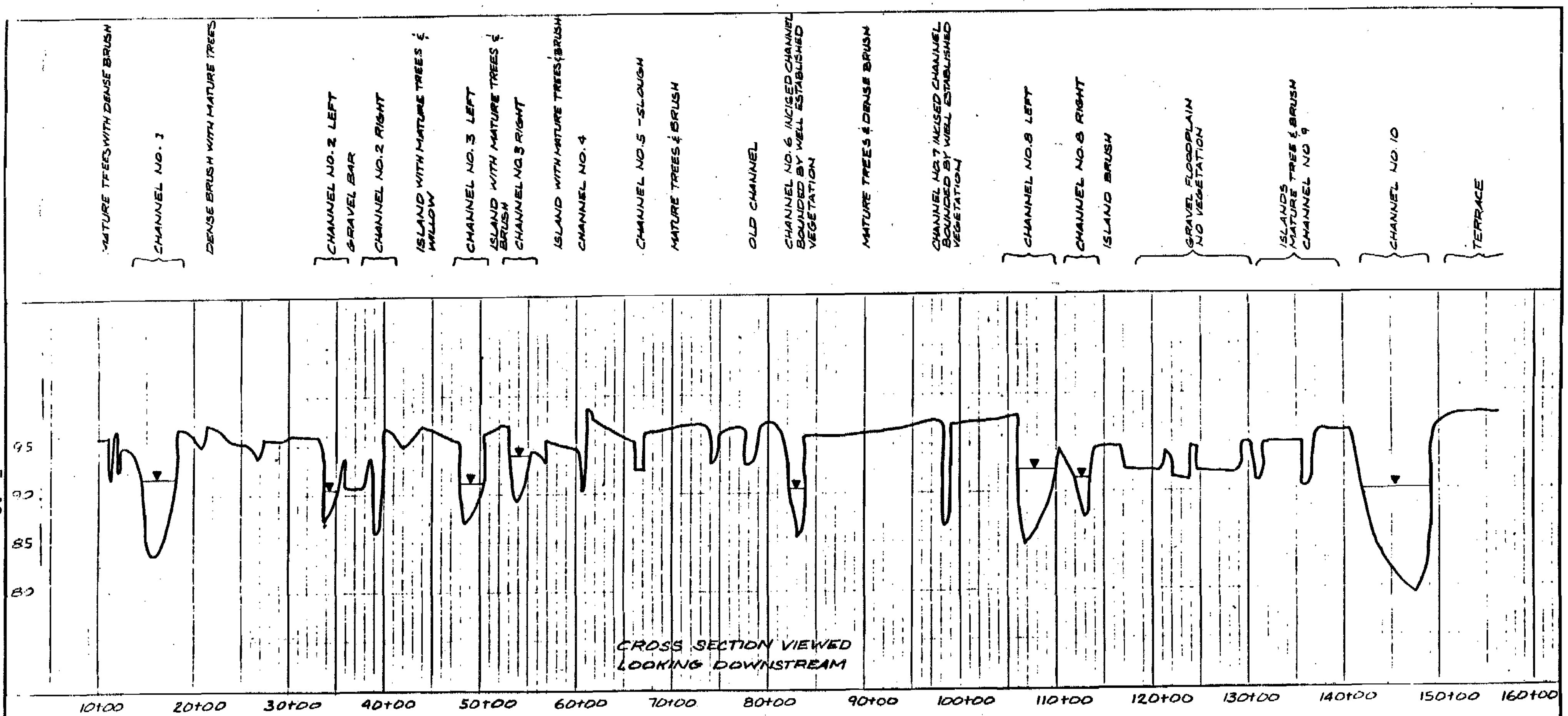
R&M CONSULTANTS, INC.

SUSITNA RIVER
REACH RM 61 TO RM 42

PREPARED FOR:

ACRES

FIG. 5.21



NOTE:

- ELEVATIONS BASED ON ASSUMED DATUM
- BANKFULL ELEVATION IS 95.0 FT.
- CROSS SECTION BASED ON RECONNAISSANCE FIELD SURVEY AND REGIME RELATIONSHIPS, ALL ELEVATIONS AND STATIONS APPROXIMATE
- ▼ INDICATES TOP ICE LEVEL ON MAR. 19, 1981
- CROSS SECTION LOCATED 8000' DOWNSTREAM OF WILLOW CREEK CONFLUENCE

FIGURE 5.22

ACRES

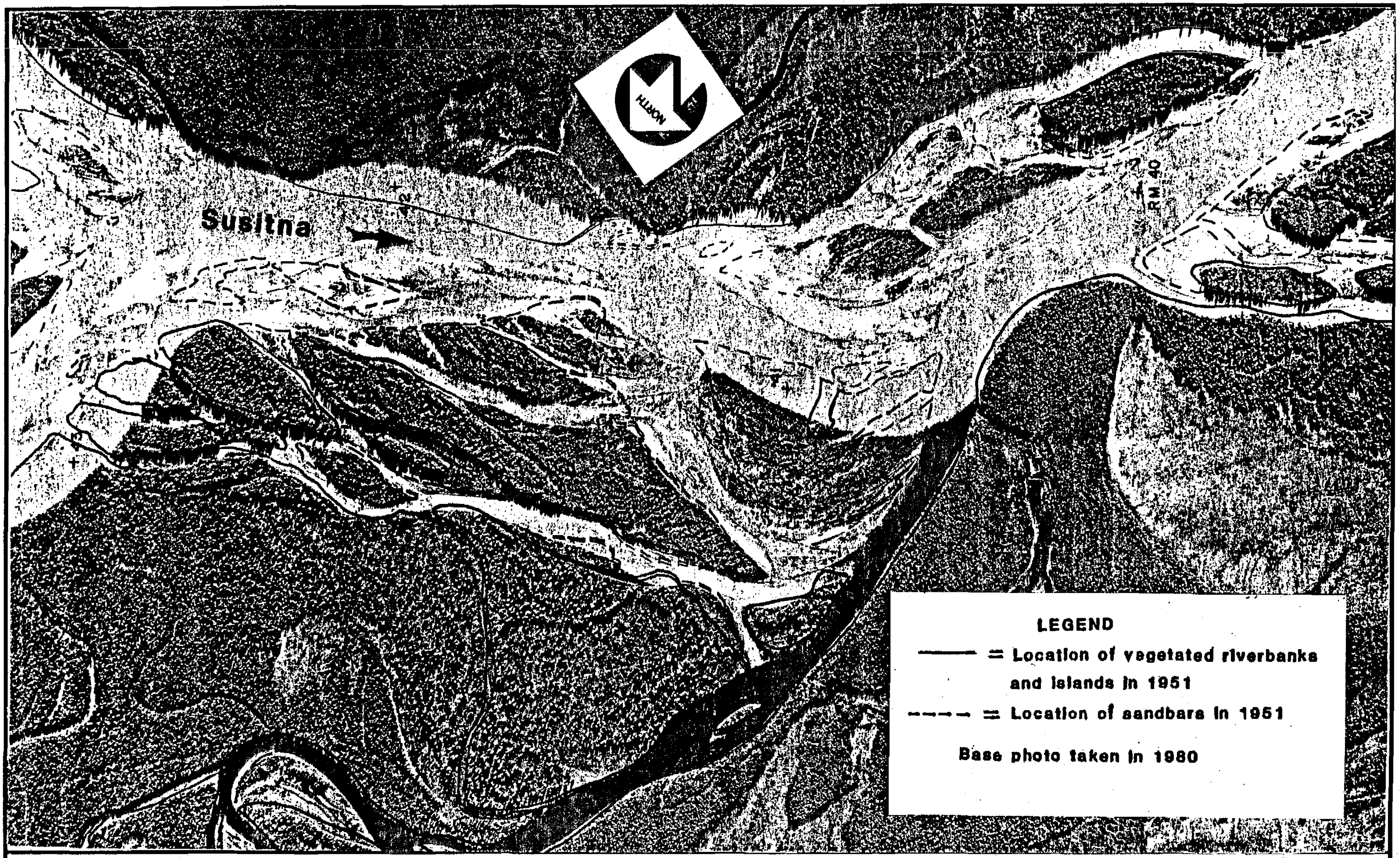
ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

SUSITNA RIVER SYNTHESIZED CROSS SECTION DELTA ISLANDS

R&M CONSULTANTS, INC.

MARCH 1981

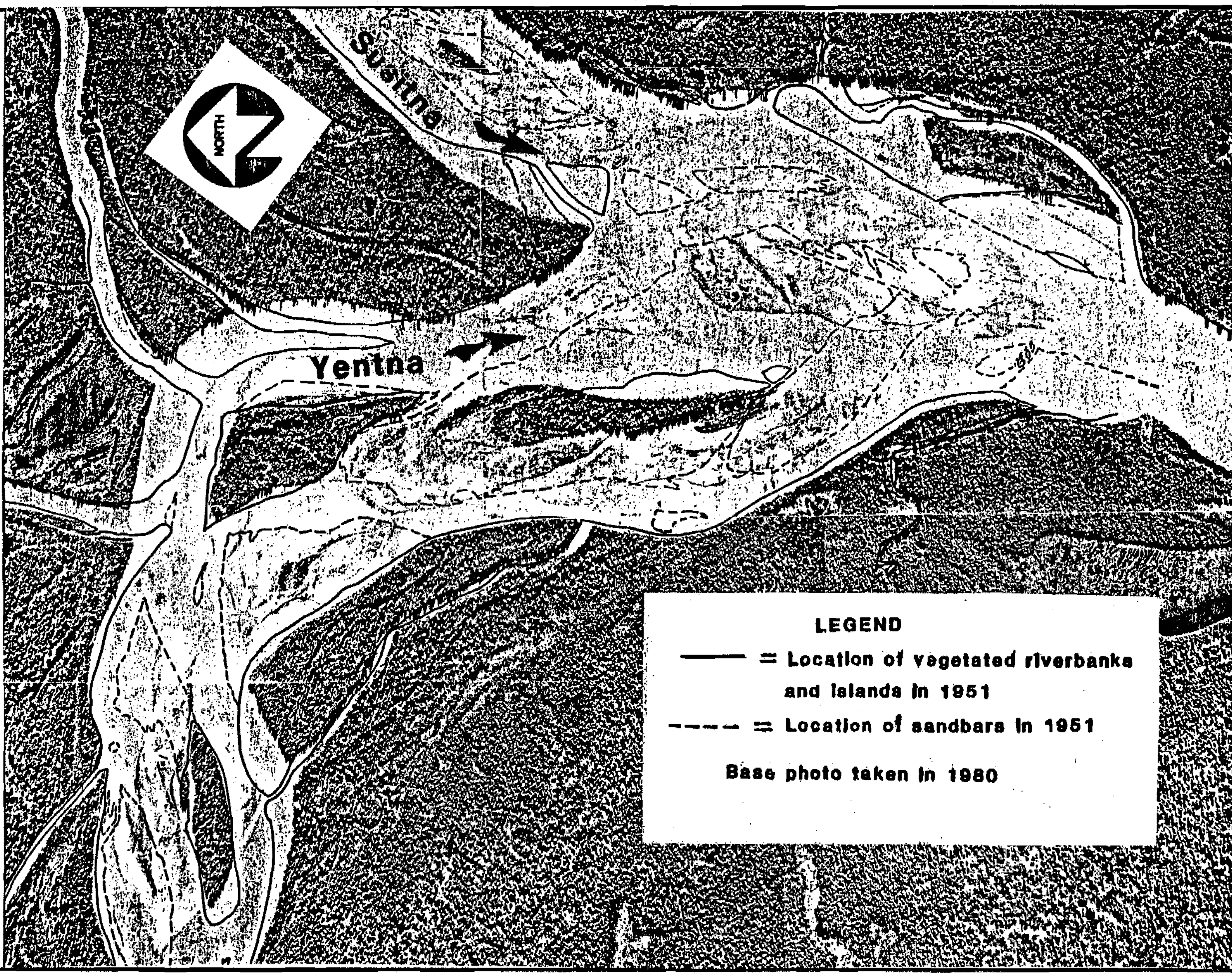


R&M CONSULTANTS, INC.

1951-1980 AERIAL PHOTO COMPARISON
SUSITNA-DESHKA CONFLUENCE

Figure 5.23

ACRES



PREPARED BY:

R&M CONSULTANTS, INC.

1951-1980 AERIAL PHOTO COMPARISON

SUSITNA-YENTNA CONFLUENCE

Figure 5.24

PREPARED FOR:

ACRES

6 - SIDE CHANNELS AND SLOUGHS

6.1 - Present and Projected Flow Regime

Many of the side channels and sloughs between Devil Canyon and Talkeetna are overflow channels, with water flowing into the channels only above certain flows (Figure 6.1). Several of the sidechannels are important as either main stem spawning grounds or as access to spawning grounds. Often, the sloughs have gravel berms on the upstream end, effectively restricting open channel flow from the Susitna River through the side channels until the berm is overtopped. The critical flow rate for overtopping of the berm occurs between 15,000 and 20,000 cfs. The location of the upstream end of the side channels and sloughs which are either blocked or partially blocked are tabulated in Table 6.1. For modelling in the HEC-2 water surface profile model, it was assumed that flow into the side channels and sloughs was restricted below 20,000 cfs.

Despite the fact that flow into the upstream end of the channels was often blocked, water was still found in the side channels and sloughs due to seepage through the riverbed gravels, backwater effects at the lower end of the the channel, and/or the occurrence of springs and small streams entering the channel. The water in the blocked side channels is usually relatively clear, especially when compared to the silt-laden water flowing in the main channel.

Water surface elevations were modelled from Devil Canyon to Talkeetna, using the Corps of Engineers' HEC-2 model. Water surface elevations determined from the model studies are shown for selected cross-sections in Attachment C. A complete compilation at all cross-sections is included in the closeout report for 3.06 - Hydraulic Studies.

The model assumes an uniform water surface elevation across any cross-section. However, this uniform water surface elevation does not occur naturally, as demonstrated in Tables 6.2 and 6.3 by the differing water surface elevations of different channels on a cross-section. The disparity in water surface elevations is due to the differing hydraulic characteristics of the channels, to backwater effects, and to the inflow of springs. Consequently, the results of the HEC-2 model should be viewed as being somewhat uncertain in the side channels, especially at flows less than 20,000 cfs. The most valuable data on water surface elevations in the side channels would be actual observations at varying stages. Even then, it is probable that the relationship of the side channel stage to flow at Gold Creek will vary depending on whether data are gathered on a rising or falling limb of the hydrograph.

TABLE 6.1

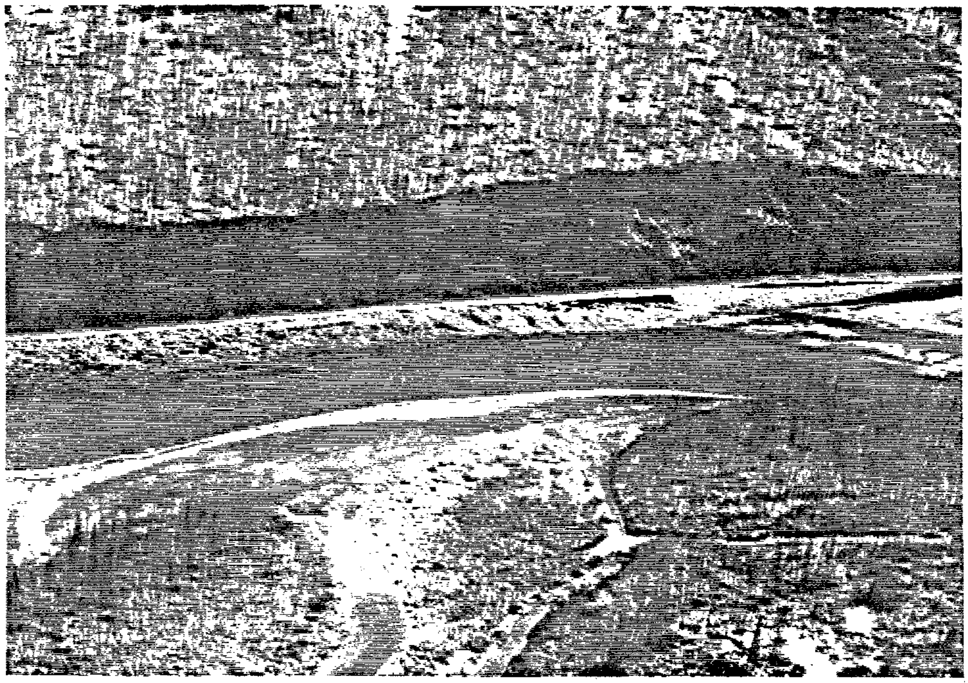
LOCATION OF BLOCKED AND PARTIALLY BLOCKED SIDE CHANNELS

Blocked Side Channels	Partially Blocked Side Channels
RM 100.8	RM 99.8
RM 101.5	RM 100.6
RM 109.0	RM 115.8
RM 109.3	RM 121.6
RM 114.0	RM 121.8
RM 118.2	RM 123.0
RM 120.0	RM 125.9
RM 121.5	RM 126.1
RM 122.5	RM 126.9
RM 125.1	RM 129.7
RM 127.0	RM 129.8
RM 127.1	RM 131.6
RM 129.3	RM 131.8
RM 130.8	RM 132.6
RM 132.1	RM 136.5
RM 133.8	RM 141.0
RM 133.9	
RM 134.7	
RM 134.9	
RM 135.1	
RM 135.3	
RM 136.4	
RM 138.2	
RM 139.3	
RM 140.5	
RM 141.4	
RM 141.5	
RM 141.7	
RM 141.8	
RM 142.2	
RM 142.3	
RM 143.6	
RM 144.7	
RM 145.9	

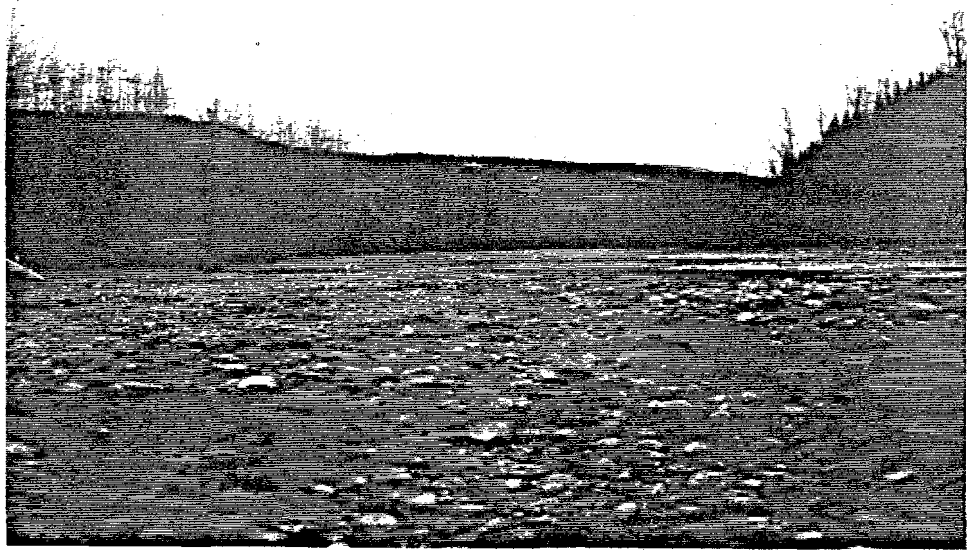
TABLE 6.3

HEC-2 SUMMARY - SUPPLEMENTAL INFORMATION
Variation in Water Surface Elevation Between Channels

Station Number	Date of Survey	Flow (cfs)	Water Surface Elevation (ft.) Main Channel	Side Channel(s)	Comments
LRX-3	8/31/81	22300	343.7(L)		L - left channel
LRX-4	8/31/81	22300	351.4(M)	351.5(L), 352.6(R)	M - middle channel
LRX-7	8/31/81	22300	367.6(L)	368.0(R)	R - right channel
LRX-9	8/31/81	22300	381.0(M)		SL - slough
LRX-16	8/31/81	22300	457.4(L)	457.6(R), 455.9(ctr.SL) 457.3(RSL)	
LRX-19	8/31/81	22300	489.7(M)		
LRX-24	8/31/81	22300	523.8(M)		
LRX-28	8/31/81	22300	557.7(M)	556.4(L), 557.2(R)	
LRX-29	8/31/81	22300	572.4(R)	574.0(LSL)	ponded water in left slough
LRX-31	8/31/81	22300	598.2(R)	594.8(ctr.SL), 593.0(LSL)	
LRX-35	8/31/81	22300	619.6(M)		
LRX-36	9/1/81	21100	622.4(L)	621.6(R)	
LRX-39	9/1/81	21100	648.5(R)	647.0(L), 646.1(LSL)	
LRX-40	9/1/81	21100	657.4(M)		
LRX-42	9/1/81	21100	672.2(R)	669.5(LSL)	Flowing water in left slough
LRX-43	9/1/81	21100	673.5(R)	673.5(ctr SL), 674.8(LSL)	
LRX-44	9/1/81	21100	683.8(R)	681.8(ctr SL) 682.8(L.SL)	
LRX-45	9/1/81	21100	686.4(M)		
LRX-47	9/1/81	21100	693.7(M)	691.1(LSL	
LRX-48	9/1/81	21100	695.3(R)	692.7(LSL)	
LRX-51	9/1/81	21100	709.6(M)		
LRX-53	9/1/81	21100	725.4(R)	725.1(LSL)	
LRX-55	9/1/81	21100	743.6@LB 744.9@RB	743.1(LSL)	
LRX-59	9/1/81	21100	788.3(M)		
LRX-62	9/1/81	21100	838.3(M)		
LRX-68	9/1/81	21100	853.8(M)		



Overflow Channel, River Mile 142.2



Bed Material, River Mile 141.5

PREPARED BY:

R&M CONSULTANTS, INC.

SUSITNA RIVER
OVERFLOW CHANNELS

FIG. 6.1

PREPARED FOR:

ACRES

7 - ICE PROCESSES

7.1 - Pre-Project Ice Conditions

The river ice conditions observed through the winter of 1980-81 on the Susitna River are summarized Ice Observations - 1980-81 (R&M, 1981a). The following section is a synopsis of that report. For more detailed information on conditions during freezeup and breakup, readers are referred to the Ice Observation report. The description and data in that report will provide input needed for modeling of the ice cover development for pre- and post- project conditions.

Very limited records are available for the Susitna River basin relating to river ice regime, especially during the freezeup process. Personnel from the Alaska Railroad indicated that over the past twenty years there has been no serious flooding or ice jamming related to ice cover development on the Susitna. As a result, they have kept no records of dates for first occurrence of frazil ice in the river or dates for ice cover formation at key locations.

However, the U.S. Geological Survey has freezeup dates for selected sites on the Susitna River. At Gold Creek, October 15-28 is the range of dates noted for first occurrence of frazil ice. It should be noted that this range of dates indicates only first occurrence of frazil ice at the gaging station and may not truly reflect the ice regime within a particular river reach.

During the winter of 1980-81, frazil ice was first observed on October 11 in the Susitna River below Devil Canyon. From then until early December, when the ice cover began forming, the concentration and strength of ice floes varied depending on variations in climatic conditions in the basin.

At several locations along the river between Talkeetna and Portage Creek, frazil slush tended to accumulate. These locations were related primarily to bedrock outcrops along the banks or to constrictions in the channel, (both natural and those due to growth of shore ice). Table 7.1 lists the key river sections where heavy frazil ice accumulations were observed during freezeup in 1980. Many of these same locations were the site of ice jams during breakup the following spring.

Though frazil slush accumulated to 100% coverage in places, the slush blanket did not consolidate and form ice bridges. The ice cover on the river from the Susitna-Chulitna confluence upstream appeared to form entirely by a process of juxtaposition. Depending on conditions at the leading edge of the ice cover, floes were either carried underneath the ice cover or added to the upstream end. When velocity of flow was too high or the ratio of ice cover thickness to water depth too low, floes were dragged under the ice sheet, thus thickening the ice cover until equilibrium was reached and upstream progression could occur. Formation of the ice cover was initiated in the Susitna just above the confluence with the Chulitna River. No severe changes in water level were observed during the formation process. On the average, water level rose 2 to 4 feet during ice cover formation. However, as the leading edge of the ice cover progressed upstream through certain reaches, levels rose enough to cause water to begin spilling into side channels which were previously dry or had formed an ice cover prior to freezeup in the main channel. Listed below are locations of the primary side channels carrying overflow due to rising water levels as the ice cover developed from the confluence to Gold Creek.

- West channel between RM 112 & 113
- East side channels between R&M 113.8 & 114.8
- Far west channel below Curry between RM 119.2 & 120.4
- Far east channel between RM 121.1 & 122.3
- Slough on the east side of the floodplain between RM 122.4 & 123.0
- East channels near Skull Creek confluence between RM 124.4 & 125.9
- East channel between RM 132.5 & 133.4

Complete ice cover development from the Susitna-Chulitna confluence to Devil Canyon took approximately two weeks during 1980. By the end of February, the average river ice thickness at Gold Creek was 2.9 feet, very close to the historical average for that site.

Overall, there were no observable changes in river channel configuration due to ice cover formation. Water levels were low enough that less resistant alluvial banks and vegatation on the banks and mid-channel islands were not adversely affected by movement of ice floes in the channel or development of the ice cover. For the most part, flow was confined within the armored portion of the river bed.

However, in the spring, ice jams and general breakup of the ice cover had a more noticeable effect on river banks and vegetation. Location of ice jams observed during the May of 1981 are listed in

Table 7.2. Comparison of this table with Table 7.1 will verify that ice jams occurred in many of the same locations where accumulation of frazil ice was observed during freezeup.

As described in Table 7.2, the most significant changes in banks and vegetation occurred from the Susitna-Chulitna confluence upstream to RM 101.5. Several new ice scars in the vicinity of Whiskers Creek confluence and new bank erosion were observed after the ice released.

7.2 - Post-Project Ice Conditions

Ice growth simulation studies conducted by Acres American, Inc., are summarized in the report Hydraulic and Ice Studies (R&M, 1982a). The ice simulation studies, using reservoir water temperatures from other studies, river hydraulic conditions determined from the HEC-2 Water Surface Profile studies and varying climatic conditions, have determined that once both dams are built, water temperatures downstream of Devil Canyon will not drop to 32°F until approximately 15 kilometers above the Susitna-Chulitna confluence. Even though the water temperature drops to 32°F, ice cover formation will be insignificant above Talkeetna under post-project conditions. Under pre-project conditions, the Susitna River contributes 70-80% of the frazil ice appearing at the Chulitna-Susitna confluence, with most of the frazil ice being formed in the Devil Canyon reach. This frazil ice generation will be essentially eliminated once Devil Canyon Dam is constructed, greatly diminishing the ice delivered to the lower Susitna River. This is likely to delay ice cover formation on the lower river, although this effect can not be quantified at this time.

Under post-project conditions, ice processes should not play any significant role in the shaping of the river morphology above Talkeetna. Little or no ice cover should form in the mainstem above the Chulitna-Susitna confluence. No ice jamming should occur in this reach, since little ice cover will form in it. The ice run from the upper river will be trapped in the reservoirs.

Little data are available for ice conditions below Talkeetna. Post-project winter water levels will be 1 to 2 feet higher than pre-project levels, due to winter power releases 6,000 to 8,000 cfs greater than pre-project levels. However, the lower river has such a broad floodplain that, should staging or ice jams occur, there are several flow relief channels. Consequently, ice processes have some influence on channel processes in that they may redirect the main flow, but do not affect the overall pattern of the river.

TABLE 7.1

LOCATION OF ICE ACCUMULATIONS

DURING FREEZEUP - 1980

Location	Description
RM 105.3 - 105.6 between LRX 10 & 11	
RM 110.3-110.4 near LRX-13	Return to single channel from split channel with turbulent flow.
RM 111.5 - near LRX-14	Local change in gradient.
RM 121 - just above Curry	Multiple channels join to form single channel at Curry. Rock wall on right bank. Shore ice growth from the left bank constricting the channel.
RM 122.6	Channel constricting, right bank bed-rock.
RM 123.3-123.7 near LRX-27 rock.	Channel constricting, right bank bed-
RM 126.0-126.5 - near LRX-29	Channel constriction to single channel, prominent bedrock outcrop on the right bank at RM 126.5.
RM 128.5 - near LRX-31	Prominent bedrock point on right bank, wide shore ice on left bank constricting the channel.
RM 131 - just above Sherman	Split channels join to form single channel at Sherman. Channel constricted by shore ice growth.
RM 135.7 - near LRX-43	Prominent rock point on the right bank.

TABLE 7.2

ICE JAM LOCATIONS DURING BREAKUP

MAY, 1981

Location	Description
Susitna-Chulitna to LRX-7 (RM 101.5)	Largest ice jam observed during breakup. Water and ice observed well up into vegetation on both sides of the floodplain. New ice scars on trees on mid-channel islands near LRX-7 after release of ice jam. Increased bank scour above LRX-3 and in the vicinity of LRX-8 along the left bank.
RM 112.6 to 113.4	Key of the jam near LRX-17 extending upstream through single channel to Lane Creek confluence. Heavy overflow into below LRX-17. No new ice scars or signs of bank scour apparent after release of the jam.
RM 115.1 to 115.5	Ice jam initiated by rock point on the right bank. Heavy overflow through channel between the islands at RM 115.3.
RM 119.1 to 119.9	Ice jams of varying magnitude occur nearly every year through this reach. Overflow in all side channels to the west of the main channel. No signs of bank scour or effects on vegatation after release of the jam.
RM 120.8 to 121.0	Small ice jam formed above Curry where mulitple channels join. Channel confined by bedrock wall on the right bank and Deadhorse Creek floodplain deposits on the left bank.
RM 126.0 to 127.0	Ice jam through the constricted reach at LRX-29. Bedrock outcrops along right bank hindered ice movement. Overflow in far east channel beginning at RM 126.7.

Location	Description
RM 129.6 to 130.5	Ice jam caused by local breaks in gradients near LRX-32. Bedrock walls and outcrops in the channel bed may have influenced formation of the jam. Little change in water level upstream, due to overflow relief in east channel below Sherman.
RM 135.7 to 136.1	Jam initiated by rock outcrop on the right bank at LRX-43. Overflow in side channel at LRX-44.
RM 139.0 to 139.8	Jam in the main channel above prominent rock point on the left bank. Overflow through the east channel.
RM 142.1 to 143.1	Ice jam initiated at channel constriction.

BIBLIOGRAPHY

1. Alaska, University, Arctic Environmental Information and Data Center. 1974. Alaska regional profiles; southcentral region. Alaska Office of the Governor Juneau, AK. 253 pp.

2. Baxter, R.M. and Glaude, P. 1980. Environmental Effects of Dams of Impoundments in Canada, Experience and Prospects. Department of Fisheries and Oceans, Bulletin 205, Ottawa.

3. Blench, T. 1969. Mobile-Bed Fluviology. University of Alberta Press, Edmonton, Alberta.

4. Bray, D.I. 1972. Generalized Regime-Type Analysis of Alberta Rivers. Ph.D. Thesis, presented to the University of Alberta, Edmonton, Canada, 232 p.

5. Brune, G.M. 1953. Trap Efficiency of Reservoirs. Trans. Am. Geophys. Union, June. U.S. Dept. Agr. Misc. Publ. 970, p. 884.

6. Church, M.A. 1972. Baffin Island sandurs. A study of arctic fluvial processes. Geological Survey Canada Bulletin 216, Information Canada, Ottawa, 208 p.

7. Dolan, R., Howard, A. and Gallenson, A. 1974. Man's Impact on the Colorado River in the Grand Canyon, American Scientist, 62(4), pp. 392-401.

8. Everts, C.H. 1976. Sediment discharge by glacier-fed rivers in Alaska. Pages 907-923 in Rivers '76. Vol. 2, Symposium of Inland Waterways for Navigation, Flood Control and Water Diversions. 3rd Annual Symposium, Colorado State University, Fort Collins, Colorado. Waterways, Harbors and Coastal Engineering Div., American Society of Civil Engineers, New York, NY.

9. Fahnestock, R.K. 1963. Morphology and hydrology of a glacial stream, U.S. Geol. Surv. Prof. Paper 422-A.

10. Fortier, S. and Scobey, F.C. 1926. Permissible canal velocities, Trans. ASCE. Vol. 89, pp. 940-956.

11. Freethey, G.W. and Scully, D.R. 1980. Water Resources of the Cook Inlet Basin, Alaska, U.S. Geol. Surv., Atlas HA-620, 4 sheets.

12. Gottschalk, L.C. 1964. Reservoir Sedimentation, in Chow, V.T. (Ed.) Handbook of Applied Hydrology. McGraw-Hill, New York.

13. Guymon, G.L. 1974. Regional sediment yield analysis of Alaskan streams, ASCE Proc., Vol. 100, n. HY1, p. 41-51.

14. Henderson, F.M. 1966. Open channel flow, MacMillan, New York, 522 p.

15. Kellerhals, R. and Bray, D.I. 1971. Sampling procedures for coarse fluvial sediments, J. Hydraulics Div., ASCE, August.

16. Kellerhals, R., Church, M., and Davies, L.B. 1977. Morphological Effects of Interbasin River Diversions, in Third National Hydroelectrical Conference, Quebec, 30-31, May 1977, Canadian Society for Civil Engineering, pp. 833-851.

17. Kellerhals, R. and Gill, D. 1973. Observed and Potential Downstream Effects of Large Storage Projects in Norhtern Canada. Proceedings, 11th International Congress on Large Dams Madrid, pp. 731-754.

18. King, N.J. 1961. An Example of Channel Aggradation Induced by Flood Control. U.S. Geological Survey Prof. Papers 424B, 15, pp. 29-32.

19. Lacey, G. 1929-30. Stable Channels in Alluvium, Proceedings, Institute of Civil Engineers, England.

20. Lane, E.W. 1955. The importance of fluvial morphology in hydraulic engineering: Am. Soc. Civil Eng. Proc., v. 81, No. 745, 17 pp.

21. Leopold, L.B. and Maddock, Thomas Jr. 1953. The hydraulic geometry of stream channels and some physiographic implications: U.S. Geol. Surv. Prof. Paper 242, 57 pp.

22. Leopold, L.B. and Wolman, M.G. 1957. River channel patterns: braided, meandering and straight, U.S. Geol. Surv. Prof. Paper 282-B.

23. Leopold, L.B., Wolman M.G. and Miller, J.P. 1964. Fluvial processes in geomorphology. W.H. Freeman and Company, San Francisco, 522 pp.

24. Mackin, J.H. 1948. Concept of the graded river. Geological Society America Bulletin. Vol. 59, No. 5, pp. 463-511.

25. Mollard, J.D. 1973. Airphoto interpretation of fluvial features. In Fluvial processes and sedimentation, Proc., Hydrology Symposium held at Univ. Alberta, Edmonton. Thorn Press Limited, Ottawa, Canada, 38 p.

26. Moore, C.M. 1969. Effects of Small Structures on Peak Flow, In Moore, C.M. and Morgan, C.W. (Eds.), Effects of Watershed Changes on Streamflow, University Texas Press, Austin, pp. 101-117.

27. Neill, C.R. 1968. A re-Examination of Beginning of Movement for Coarse Granular Bed Materials. Hydro. Res. Stn., Wallingford, England, Internal Report.

28. Neill, C.R. 1981. Letter Review of Susitna River Morphology Studies, December 16.

29. Neill, C.R. 1967. Mean velocity criterion for scour of coarse uniform bed material, IAHR, 12th Congress, Fort Collins, Colorado.

30. Østrem, G. 1975. Sediment transport in glacial meltwater streams. Pages 101-122 in A.V. Jopling and B.C. McDonald, eds. Glaciofluvial and glaciolacustrine sedimentation. Society of Economic Paleontologists and Mineralogists, Tulsa, Oklahoma, Special Publication 23.

31. Petts, G.E. 1977. Channel Response to Flow Regulation: the Case of the River Derwent, Derbyshire, in Gregory, K.J. (Ed.), River Channel Changes, John Wiley & Sons, New York, pp. 145-164.

32. Pharo, C.H. and Carmack, E.D. 1979. Sedimentation Processes in a Short Residence-Time Intermontane Lake, Kamloops Lake, British Columbia. Sedimentology. 26:523-541.

33. R&M Consultants, Inc. 1981a. Susitna Hydroelectric Project, Ice Observations - 1980-81, prepared for Acres American Incorporated and Alaska Power Authority, August.

34. R&M Consultants, Inc. 1981b. Susitna Hydroelectric Project, Regional Flood Studies, prepared for Acres American Incorporated and Alaska Power Authority, December.

35. R&M Consultants, Inc. 1982a. Susitna Hydroelectric Project, Hydraulic and Ice Studies, prepared with Acres American Incorporated for Alaska Power Authority, March.

36. R&M Consultants, Inc. 1982b. Susitna Hydroelectric Project, Reservoir Sedimentation, prepared for Acres American Incorporated and Alaska Power Authority, January.

37. Santos - Cayudo, J., and Simons, D.B. 1972. River response, Chap. 1 in H.W. Shen, ed., Environmental impacts on rivers, Water Resources Publ., Fort Collins, Colorado.

38. Schumm, S.A. 1971. Fluvial geomorphology - the historical perspective, in Chap. 4, Vol. I, H.W. Shen, ed., River mechanics, Water Resources Publ., Fort Collins, Colorado.

39. Shulits, S. 1934. Experience with Bed Degradation below Dams on European Rivers, Engineering News Rec., June, pp. 838-839.

40. Simons, D.B. and Senturk, F. 1977. Sediment transport technology, Water Resources Publications, Fort Collins, Colorado, p. 465.

41. Stabler, H. 1925. Does Desilting Affect Cutting Power of Stream? Engineering News Record, December 95, 24, p. 960.

42. Stanley, J.W. 1951. Retrogression of the Lower Colorado River after 1935. Discussion: T. Blenck; E.W. Lane; J.W. Stanley, Transactions, American Society of Civil Engineers, Vol. 116, Paper No. 2453.

43. Stevens, M.A. and Simons, D.B. 1971. Stability analyses for coarse granular material on slopes, Chap. A in H.W. Shen, ed., River Hydraulics, Vol. 1, Fort Collins, Colorado.

44. Taylor, K.V. 1978. Erosion Downstream of Dams, in Environmental Effects of Large Dams, Report by the Committee on Environmental Effects of the United States Committee on Large Dams, American Society of Civil Engineers, New York, New York, pp. 165-186.

45. Trihey, E.W. 1981. Utilization of Time Series Streamflow Data in the Determination of Project Effects on Physical Habitat for Spawning and Incubating Pink Salmon. Presented at the Western Division of the American Fisheries Society Symposium, Acquisition and Utilization of Aquatic Habitat Inventory Information, October 28-30, Portland, Oregon.

46. Tutt, D.B. 1979. Kootenay River Diversion Project River Regime and Morphology Studies, in Fourth National Hydroelectrical Conference, River Basin Management, Vancouver, B.C., May 7-8, 1979, Canadian Society for Civil Engineering, pp. 530-554.

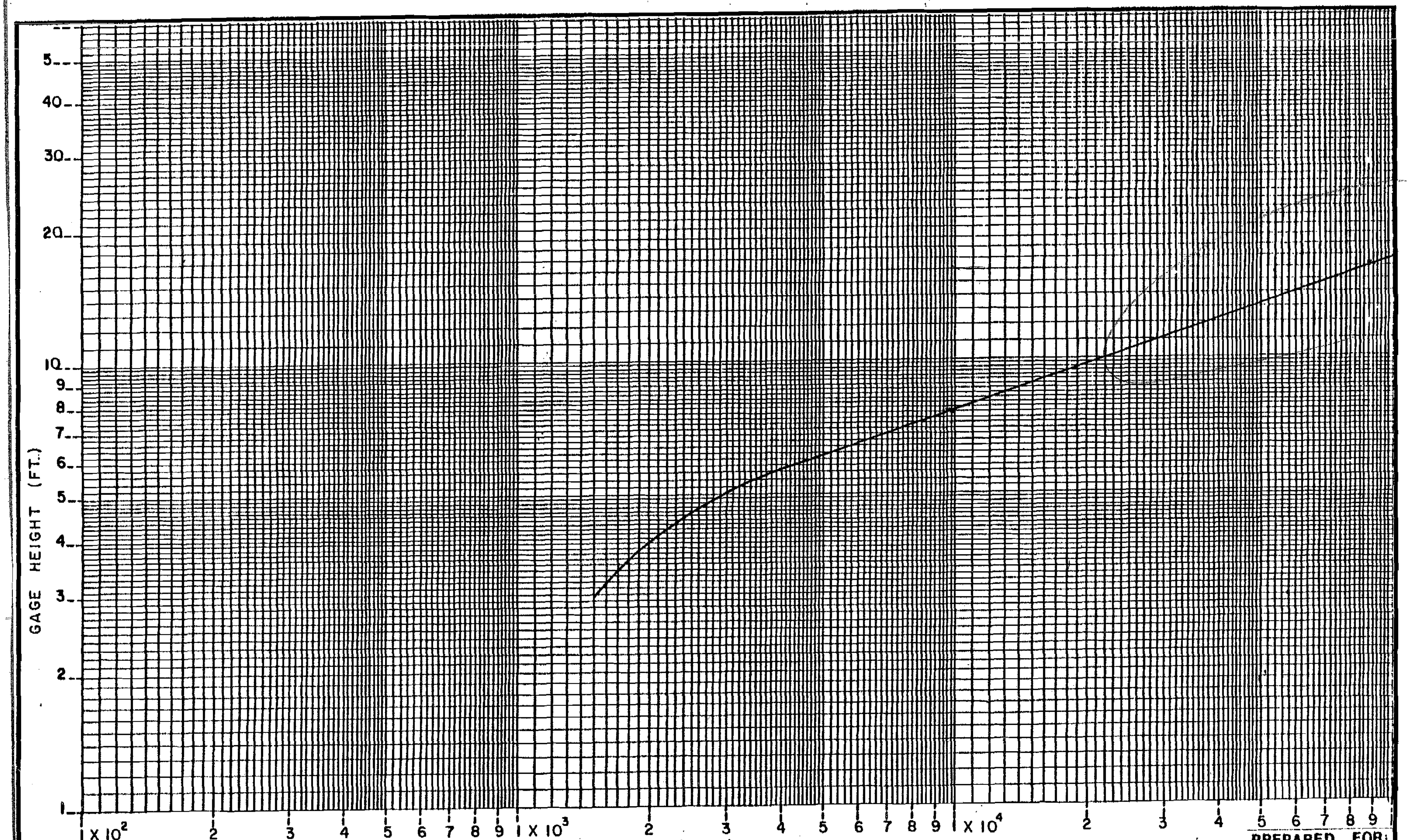
47. U.S. Army Corps of Engineers, Alaska District . 1975. Hydroelectric power development, upper Susitna River basin, southcentral railbelt area, Alaska. Draft environmental impact statement. Anchorage, AK. 998 pp.

48. Woodward-Clyde Consultants. 1980. Interim report on seismic studies for Susitna hydroelectric project. Subtasks 4.01 through 4.08. Acres American Inc., Buffalo, NY. Report for Alaska Power Authority. 1 vol.

49. Ziegler, T. 1973. Material Transportundersokelser i norske bre-elver 1971: Rept. No. 41/73, Hydrologisk avdeling, Norges, vassdrags - og elecktrisitetsvesen, 91 p. (English summary).

ATTACHMENT A

SUSITNA RIVER STAGE-DISCHARGE
RATING CURVES AND TABLES



PREPARED BY:

PREPARED FOR:

R&M CONSULTANTS, INC.

RATING CURVE FOR SUSITNA RIVER AT GOLD CREEK

ACRES

FIG. A.1

REDRAWN FROM U.S.G.S. DISCHARGE TABLE No. 10

9-210
Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 15292000

Table No. 10

Begin ___ ___ ___ ___ (YR. MO. D. HR.)

Rating table for Susitna River at Gold C, Alaska

from Oct. 1, 1967 to ____, from ____ to ____, from ____ to ____

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
.00	1500		5.00	2900	120	7.00	7200	300	9.00	15000	500	11.00	27000	800	13.00	44000	1100	15.00	68000	1300
.10	1550		.10	3020	120	.10	7500		.10	15500		.10	27800		.10	45100		.10	69300	
.20	1600		.20	3140	140	.20	7800		.20	16000		.20	28600		.20	46200		.20	70600	
.30	1650		.30	3280	140	.30	8100	300	.30	16500		.30	29400		.30	47300		.30	71900	
.40	[illegible]		.40	3420	160	.40	8400	350	.40	17000	500	.40	30200		.40	48400		.40	73200	1300
.50	1725		.50	3580	160	.50	8750		.50	17500	600	.50	31000		.50	49500		.50	74500	1500
.60	1800		.60	3740	160	.60	9100		.60	18100		.60	31800		.60	50600		.60	76000	
.70	1850		.70	3900	200	.70	9450	350	.70	18700		.70	32600		.70	51700		.70	77500	
.80	1900		.80	4100	200	.80	9800	400	.80	19300		.80	33400		.80	52800		.80	79000	
.90	1950		.90	4300	200	.90	10200		.90	19900		.90	34200	800	.90	53900	1100	.90	80500	
.00	2040	60	6.00	4500	250	8.00	10600		10.00	20500		12.00	35000	900	14.00	55000	1300	16.00	82000	
.10	2100	60	.10	4750		.10	11000		.10	21100		.10	35900		.10	56300		.10	83500	
.20	2160	80	.20	5000		.20	11400		.20	21700		.20	36800		.20	57600		.20	85000	
.30	2240	80	.30	5250		.30	11800		.30	22300		.30	37700		.30	58900		.30	86500	
.40	2320	80	.40	5500		.40	12200		.40	22900	600	.40	38600		.40	60200		.40	88000	
.50	2400	100	.50	5750	250	.50	12600	400	.50	23500	700	.50	39500		.50	61500		.50	89500	
.60	2500		.60	6000	300	.60	13000	500	.60	24200		.60	40400		.60	62800		.60		
.70	2600		.70	6300		.70	13500		.70	24900		.70	41300		.70	64100		.70		
.80	2700		.80	6600		.80	14000		.80	25600		.80	42200		.80	65400		.80		
.90	2800	100	.90	6900	300	.90	14500	500	.90	26300	700	.90	43100	900	.90	66700	1300	.90		

This table is applicable for open-channel conditions. It is based on 14 discharge measurements made during 1967-1972 ____ and is ____ well defined between 4,000 cfs and 65,000 cfs.

Comp. by [illegible] date 5-3-72

Ckd. by ____ date ____

This rating was reproduced from g.ht. record during period 1967-1972.
The original is lost

U.S. GOVERNMENT PRINTING OFFICE 1967 OF—249-765

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 15372720

Table No. 01

Begin ____ ____ ____ ____ (YR. MO. D. HR.)

Rating table for ______________________________

from ____________ *to* ____________, *from* ____________ *to* ____________, *from* ____________ *to* ____________

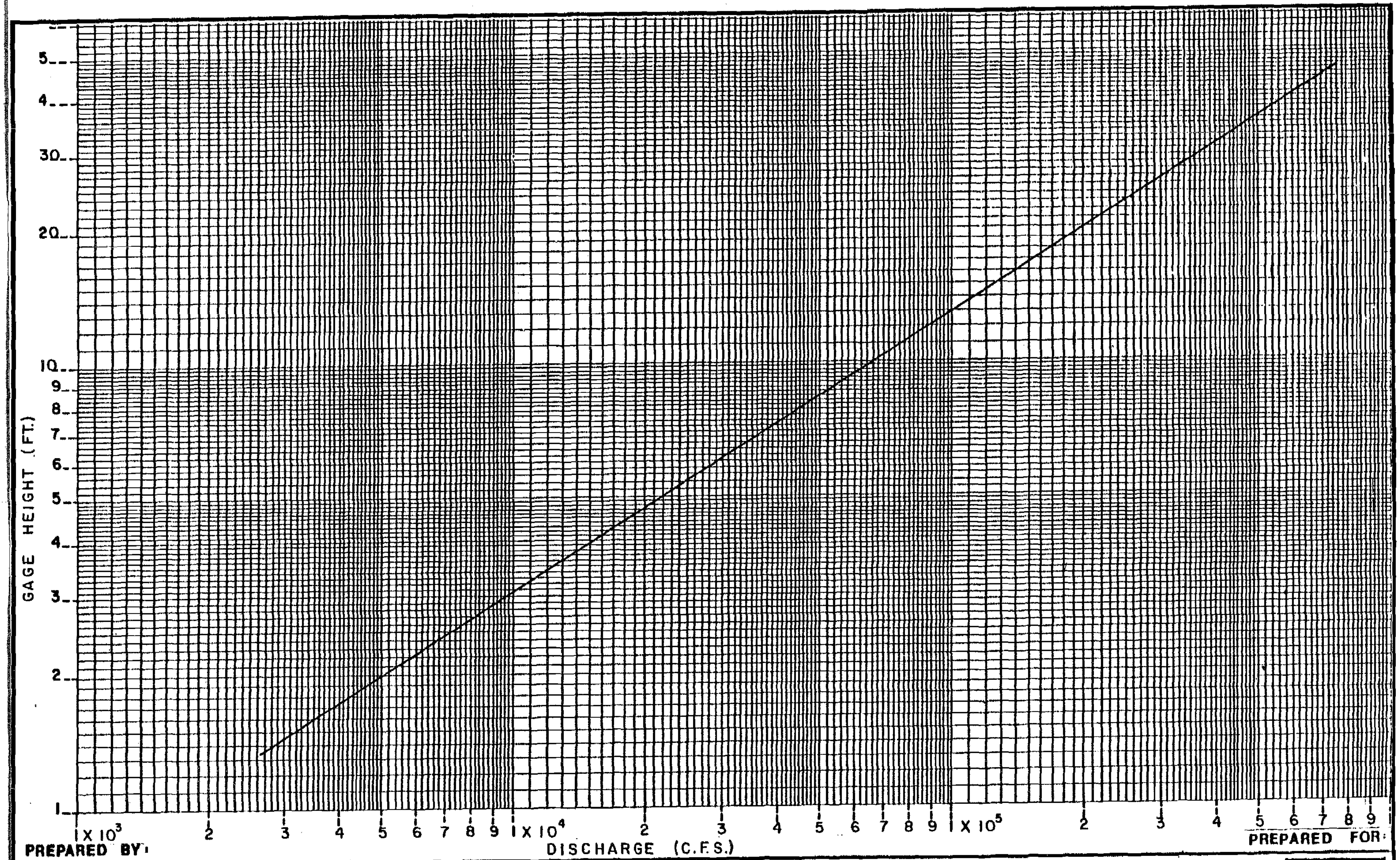
Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*	*Feet*	*Cfs*	*Cfs*
15.00	124,900	1400	.00			.00			.00			.00			.00			.00		
.10	126,300		.10			.10			.10			.10			.10			.10		
.20	127,700		.20			.20			.20			.20			.20			.20		
.30	129,100		.30			.30			.30			.30			.30			.30		
.40	130,500		.40			.40			.40			.40			.40			.40		
.50	131,900		.50			.50			.50			.50			.50			.50		
.60	133,300		.60			.60			.60			.60			.60			.60		
.70	134,700		.70			.70			.70			.70			.70			.70		
.80	136,100		.80			.80			.80			.80			.80			.80		
.90	137,500	1400	.90			.90			.90			.90			.90			.90		
16.00	138,900		.00			.00			.00			.00			.00			.00		
.10			.10			.10			.10			.10			.10			.10		
.20			.20			.20			.20			.20			.20			.20		
.30			.30			.30			.30			.30			.30			.30		
.40			.40			.40			.40			.40			.40			.40		
.50			.50			.50			.50			.50			.50			.50		
.60			.60			.60			.60			.60			.60			.60		
.70			.70			.70			.70			.70			.70			.70		
.80			.80			.80			.80			.80			.80			.80		
.90			.90			.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on ______ discharge measurements made during ______________________________

______________________________ and is ____________ well defined between ____________ cfs and ____________ cfs.

Comp. by ______ date ______

Ckd. by ______ date ______



PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

RATING CURVE FOR SUSITNA RIVER AT SUNSHINE

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 15292780

Table No. 21

Begin ___ ___ ___ ___ (YR. MO. D. HR.)

Rating table for Susitna River @ Sunshine, Alaska

from ______ *to* ______, *from* ______ *to* ______, *from* ______ *to* ______

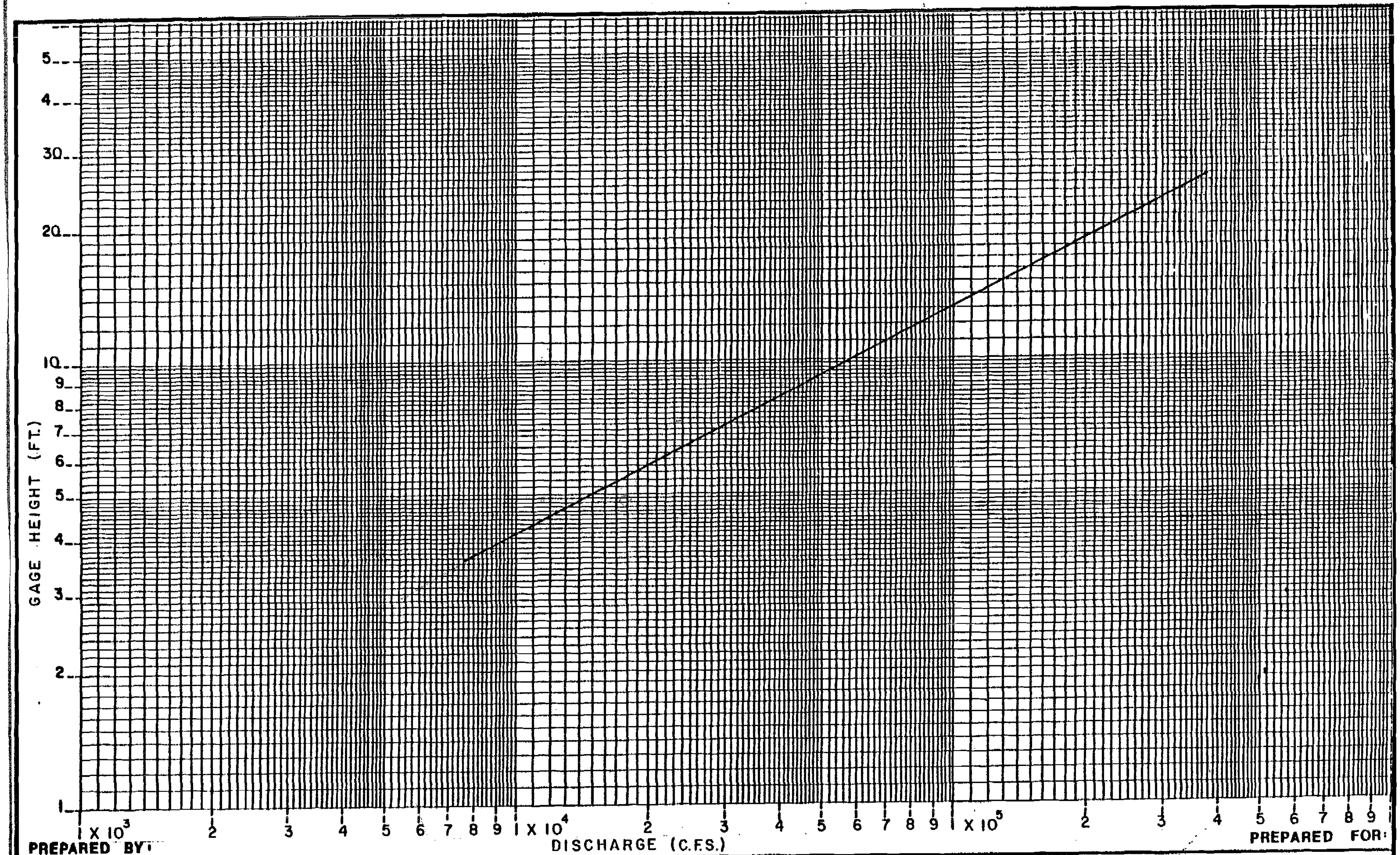
Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
.00			3.00	9640	[illegible]	5.00	21,900	[illegible]	7.00	37,200	900	9.00	55,900	[illegible]	11.00	77,000	[illegible]	13.00	99,900	1200
.10			.10	10,100		.10	22,600		.10	38,100	900	.10	56,900		.10	78,100		.10	101,100	
.20			.20	10,600	500	.20	23,300		.20	[illegible]		.20	57,900		.20	79,200		.20	102,300	
.30			.30	11,100	600	.30	24,000		.30	[illegible]		.30	58,900		.30	80,300		.30	103,500	
.40			.40	11,700		.40	24,700		.40	40,[illegible]		.40	59,900		.40	81,400		.40	104,700	
.50			.50	12,300		.50	25,400		.50	41,600		.50	60,900		.50	82,500		.50	105,900	
.60			.60	12,900		.60	26,100	700	.60	42,500		.60	61,900		.60	83,600		.60	107,100	
.70			.70	13,500		.70	26,800	[illegible]	.70	43,400		.70	62,900		.70	84,700		.70	108,300	
.80			.80	14,100		.80	27,600		.80	44,300		.80	63,900	1000	.80	85,800		.80	109,500	
.90			.90	14,700		.90	28,400		.90	45,200		.90	64,900	1100	.90	86,900		.90	110,700	[illegible]
.00			4.00	15,300		6.00	29,200		8.00	46,100		10.00	66,000		12.00	88,000	1100	14.00	111,900	1300
.10			.10	15,900		.10	30,000		.10	47,000		.10	67,100		.10	89,100	1200	.10	113,200	
.20			.20	16,500		.20	30,800		.20	47,900	[illegible]	.20	68,200		.20	90,300		.20	114,500	
.30			.30	17,100		.30	31,600		.30	48,900	1000	.30	69,300		.30	91,500		.30	115,800	
.40			.40	17,700	700	.40	32,400		.40	49,900		.40	70,400		.40	92,700		.40	117,100	
.50			.50	18,400		.50	33,200		.50	50,900		.50	71,500		.50	93,900		.50	118,400	
.60			.60	19,100		.60	34,000		.60	51,900		.60	72,600		.60	95,100		.60	119,700	
.70			.70	19,800		.70	34,800		.70	52,900		.70	73,700		.70	96,300		.70	121,000	
.80			.80	20,500		.80	35,600		.80	53,900		.80	74,800		.80	97,500		.80	122,300	
.90			.90	21,200	700	.90	36,400		.90	54,900	1000	.90	75,900	1100	.90	98,700	1200	.90	123,600	1300

This table is applicable for open-channel conditions. It is based on 5 discharge measurements made during 1981 and is fairly well defined between 19,000 cfs and [illegible] cfs.

$Q = 1723 (G - 0)^{1.67}$

Comp. by [illegible] date [illegible]

Ckd. by DK date 11-18-81



PREPARED BY:

PREPARED FOR:

R&M CONSULTANTS, INC.

RATING CURVE FOR SUSITNA RIVER AT SUSITNA STATION

REDRAWN FROM U.S.G.S. DISCHARGE TABLE No. 02

FIG. A.3

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 15294350

Table No. 02

Begin _ _ _ _ _ _ _ _ (YR. MO. D. HR.)

Rating table for Susitna River at Susitna Station

from Oct. 1, 1978 to ...., from .... to ...., from .... to ....

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
.00			8.00	36,500	900	10.00	56,700	1100	12.00	81,200	1300	14.00	110,100	1600	16.00	143,300	1800	18.00	180,900	2000
.10			.10	37,400		.10	57,800	1100	.10	82,500	1300	.10	111,700		.10	145,100		.10	182,900	
.20			.20	38,300		.20	58,900	1100	.20	83,800	1400	.20	113,300		.20	146,900		.20	184,900	
.30			.30	39,200		.30	60,000	1200	.30	85,200		.30	114,900		.30	148,700		.30	186,900	
.40			.40	40,100	900	.40	61,200		.40	86,600		.40	116,500		.40	150,500		.40	188,900	
.50			.50	41,000	1000	.50	62,400		.50	88,000		.50	118,100		.50	152,300		.50	190,900	
.60			.60	42,000		.60	63,600		.60	89,400		.60	119,700		.60	154,100		.60	192,900	
.70			.70	43,000		.70	64,800		.70	90,800		.70	121,300		.70	155,900	1800	.70	194,900	2000
.80	26,400	800	.80	44,000		.80	66,000		.80	92,200		.80	122,900	1600	.80	157,700	1900	.80	196,900	2100
.90	27,200		.90	45,000		.90	67,200		.90	93,600	1400	.90	124,500	1700	.90	159,600		.90	199,000	
7.00	28,000		9.00	46,000		11.00	68,400		13.00	95,000	1500	15.00	126,200		17.00	161,500		19.00	201,100	
.10	28,800		.10	47,000		.10	69,600	1200	.10	96,500		.10	128,900		.10	163,400		.10		
.20	29,600		.20	48,000	1000	.20	70,800	1300	.20	98,000		.20	129,600		.20	165,300		.20		
.30	30,400		.30	49,000	1100	.30	72,100		.30	99,500		.30	131,300		.30	167,200		.30		
.40	31,200	800	.40	50,100		.40	73,400		.40	101,000		.40	133,000		.40	169,100		.40		
.50	32,000	900	.50	51,200		.50	74,700		.50	102,500		.50	134,700		.50	171,000	1900	.50		
.60	32,900		.60	52,300		.60	76,000		.60	104,000		.60	136,400		.60	172,900	2000	.60		
.70	33,800		.70	53,400		.70	77,300		.70	105,500		.70	138,100		.70	174,900		.70		
.80	34,700		.80	54,500		.80	78,600		.80	107,000	1500	.80	139,800	1700	.80	176,900		.80		
.90	35,600	900	.90	55,600	1100	.90	79,900	1300	.90	108,500	1600	.90	141,500	1800	.90	178,900	2000	.90		

This table is applicable for open-channel conditions. It is based on 10 discharge measurements made during 1977-78 and is fairly well defined between 28,000 cfs and 200,000 cfs.

Comp. by LSL date 2-16-79

Ckd. by .... date ....

U.S. GOVERNMENT PRINTING OFFICE : 1967 O—245-765

9-210
(Rev. 2-67)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Sta. No. 15294350

Table No. 02

Begin ___ ___ ___ ___ (YR. MO. D. HR.)

Rating table for SUSITNA RIVER AT SUSITNA STATION

from OCT 1, 1978 *to* ________, *from* ________ *to* ________, *from* ________ *to* ________

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
19.00	201,100	2200	.00			.00			.00			.00			.00			.00		
.10	203300	2200	.10			.10			.10			.10			.10			.10		
.20	205500	2200	.20			.20			.20			.20			.20			.20		
.30	207700	2200	.30			.30			.30			.30			.30			.30		
.40	209900	2300	.40			.40			.40			.40			.40			.40		
.50	212200	2300	.50			.50			.50			.50			.50			.50		
.60	214500	2300	.60			.60			.60			.60			.60			.60		
.70	216800	2300	.70			.70			.70			.70			.70			.70		
.80	219100	2300	.80			.80			.80			.80			.80			.80		
.90	221400	2300	.90			.90			.90			.90			.90			.90		
20.00	223700	2300	.00			.00			.00			.00			.00			.00		
.10	226000	2300	.10			.10			.10			.10			.10			.10		
.20	228300	2300	.20			.20			.20			.20			.20			.20		
.30	230600	2300	.30			.30			.30			.30			.30			.30		
.40	232900	2300	.40			.40			.40			.40			.40			.40		
.50	235,200		.50			.50			.50			.50			.50			.50		
.60			.60			.60			.60			.60			.60			.60		
.70			.70			.70			.70			.70			.70			.70		
.80			.80			.80			.80			.80			.80			.80		
.90			.90			.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on ______ discharge measurements made during ________________

________________ and is ________ well defined between ________ cfs and ________ cfs.

Comp. by JDM date 801205

Ckd. by ______ date ______

U.S. GOVERNMENT PRINTING OFFICE : 1967 OF—246-765

ATTACHMENT B

FLOW VARIABILITY RATIOS

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1950	11510	21900	1.90	20200	1.75	16700	1.45	16200	1.41
1951	14090	24700	1.75	23900	1.70	22500	1.60	17800	1.26
1952	5419	28000	5.17	26700	4.93	17000	3.14	9570	1.77
1953	19270	31000	1.61	30100	1.56	26400	1.37	22400	1.16
1954	17280	23000	1.33	23000	1.33	22800	1.32	21600	1.25
1955	9319	19500	2.09	18300	1.96	17900	1.92	14500	1.56
1956	17660	39400	2.23	36200	2.05	32400	1.83	26200	1.48
1957	13750	31000	2.25	30500	2.22	28800	2.09	21800	1.59
1958	12900	25000	1.94	23700	1.84	21700	1.68	18500	1.43
1959	15990	39600	2.48	37200	2.33	30700	1.92	27300	1.71
1960	15780	40000	2.53	35800	2.27	27900	1.77	23700	1.50
1961	17360	29400	1.69	26100	1.50	22300	1.28	21700	1.25
1962	12590	36000	2.86	29600	2.35	23000	1.83	20300	1.61
1963	19030	45000	2.36	42900	2.25	37100	1.95	33900	1.78
1964	4307	37100	8.61	26400	6.13	14200	3.30	7740	1.80
1965	12900	37900	2.94	37300	2.89	30400	2.36	21200	1.64
1966	9645	23300	2.42	22600	2.34	20400	2.12	15300	1.59
1967	15480	31200	2.02	30200	1.95	29700	1.92	24600	1.59
1968	16177	39700	2.45	37000	2.29	33800	2.09	29100	1.80
1969	11045	26500	2.40	24400	2.21	20500	1.86	16200	1.47
1970	11380	21600	1.90	19500	1.71	18100	1.59	16300	1.43
1971	3745	9500	2.54	8830	2.36	7640	2.04	5680	1.52
1972	21890	55500	2.54	43600	1.99	37000	1.69	29800	1.36
1973	8235	17000	2.06	16400	1.99	15400	1.87	13500	1.64
1974	16180	33600	2.08	33200	2.05	32400	2.00	26400	1.63
1975	15350	31000	2.02	30400	1.98	28300	1.84	24100	1.57
1976	12620	17000	1.35	16000	1.35	15100	1.20	14000	1.11
1977	12680	33100	2.61	30400	2.40	24500	1.93	21500	1.70
1978	11950	20500	1.72	19400	1.62	17700	1.48	14900	1.25
1979	13870	34400	2.48	33900	2.44	29400	2.12	22700	1.64
1980	12060	21000	1.74	20800	1.72	17900	1.48	15100	1.25
# of Val.	31								
Average	13270		2.45		2.24		1.87		1.51
Standard Dev.	4240		1.33		0.96		0.46		0.20

susi8/b2

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
June

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1950	19600	34000	1.73	32100	1.64	27000	1.38	22400	1.14
1951	20790	35800	1.72	32100	1.54	29800	1.43	25200	1.21
1952	32370	43300	1.34	42300	1.31	39500	1.22	37000	1.14
1953	27320	37700	1.38	37200	1.36	35500	1.30	31000	1.13
1954	25250	30100	1.19	29500	1.17	28500	1.13	25800	1.02
1955	29860	38000	1.27	37300	1.25	36000	1.20	34600	1.16
1956	33340	51500	1.54	49900	1.50	46800	1.40	40300	1.21
1957	30160	40600	1.35	39900	1.32	38400	1.27	35400	1.17
1958	25700	28000	1.09	28000	1.09	28000	1.09	28000	1.09
1959	23320	29300	1.26	27900	1.20	26000	1.11	24300	1.04
1960	15530	18700	1.20	17100	1.10	16900	1.09	16000	1.03
1961	29450	54000	1.83	52000	1.77	42700	1.45	36800	1.25
1962	43270	79900	1.85	75200	1.74	64700	1.50	53200	1.23
1963	26000	26000	1.00	26000	1.00	26000	1.00	26000	1.00
1964	50580	85900	1.70	81900	1.62	75000	1.48	63500	1.26
1965	25720	39900	1.55	37200	1.45	33000	1.28	27200	1.06
1966	32953	58400	1.77	56600	1.72	49200	1.49	39800	1.21
1967	29513	38800	1.31	37400	1.27	34800	1.18	31500	1.07
1968	31550	39500	1.25	38900	1.23	38100	1.21	36500	1.17
1969	15503	21900	1.41	20900	1.35	18700	1.21	17500	1.13
1970	18630	30800	1.65	30100	1.62	26100	1.40	20400	1.10
1971	32930	66300	2.01	59000	1.79	48300	1.47	38200	1.16
1972	34430	70700	2.05	65600	1.91	53500	1.55	39800	1.16
1973	27800	52800	1.90	45300	1.63	40900	1.47	34600	1.24
1974	17870	29800	1.67	27000	1.51	22700	1.27	19700	1.10
1975	32310	44000	1.36	42200	1.31	37100	1.15	32600	1.01
1976	24380	33300	1.37	32100	1.32	29800	1.22	28600	1.17
1977	37970	52600	1.39	52200	1.37	48300	1.27	41500	1.09
1978	19050	24300	1.28	23800	1.25	23100	1.21	20600	1.08
1979	24690	32500	1.32	31200	1.26	29400	1.19	26400	1.07
1980	29080	43200	1.49	40300	1.39	34700	1.19	31300	1.08
# of Val.	31								
Average	27970		1.49		1.42		1.28		1.13
Standard Dev.	7740		0.27		0.23		0.15		0.07

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
July

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1950	22600	32500	1.44	29600	1.31	26300	1.16	24500	1.08
1951	22570	25000	1.11	24800	1.10	24600	1.09	23800	1.05
1952	26390	41700	1.58	40400	1.53	33900	1.28	29100	1.10
1953	20200	26200	1.30	24300	1.20	22800	1.13	21000	1.04
1954	20360	28700	1.41	26600	1.31	24500	1.20	21800	1.07
1955	27560	39000	1.42	38300	1.39	34200	1.24	30900	1.12
1956	31090	32000	1.03	32000	1.03	32000	1.03	32000	1.03
1957	23310	34500	1.48	31300	1.34	26300	1.13	24900	1.07
1958	22880	32400	1.42	32100	1.40	25900	1.13	23800	1.04
1959	25000	32000	1.28	30700	1.23	29500	1.18	26500	1.06
1960	22980	37500	1.63	36100	1.57	32900	1.43	26100	1.14
1961	24570	30300	1.23	27100	1.10	26100	1.06	25500	1.04
1962	25850	32700	1.26	28600	1.11	27700	1.07	26600	1.03
1963	34400	49000	1.42	46300	1.35	42900	1.25	39200	1.14
1964	22950	33200	1.45	29100	1.27	27100	1.18	25800	1.12
1965	27840	37700	1.35	34900	1.25	32000	1.15	30500	1.10
1966	19864	31800	1.60	29800	1.50	25100	1.26	21800	1.10
1967	26800	50000	1.87	46300	1.73	38900	1.45	32500	1.21
1968	26922	32000	1.21	31600	1.20	29400	1.11	28400	1.07
1969	16103	20900	1.30	20200	1.25	19100	1.19	17700	1.10
1970	22660	29100	1.28	27700	1.22	25000	1.10	23000	1.02
1971	23950	38300	1.60	35800	1.49	31800	1.33	26500	1.11
1972	22770	27200	1.19	26400	1.16	25500	1.12	25500	1.12
1973	18250	22900	1.25	22400	1.23	22200	1.22	20300	1.11
1974	18800	26300	1.40	25000	1.33	21900	1.16	20300	1.08
1975	27720	33900	1.22	32500	1.17	30700	1.11	29200	1.05
1976	18940	22800	1.11	21600	1.14	19700	1.04	19300	1.02
1977	22870	30000	1.31	29700	1.30	27900	1.22	25100	1.10
1978	21020	24100	1.15	23300	1.11	22500	1.07	21600	1.03
1979	28880	39300	1.36	34800	1.20	32600	1.13	31700	1.10
1980	32660	49700	1.52	45100	1.38	36800	1.13	33700	1.03
# of Val.	31								
Average	24150		1.36		1.29		1.17		1.08
Standard Dev.	4240		0.18		0.16		0.10		0.04

susi8/b4

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
August

Year	Mean Monthly Flow $-Q_M$ (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1949	24250	35000	1.44	34000	1.40	31900	1.32	30900	1.27
1950	19880	27600	1.39	26200	1.32	24800	1.25	23600	1.19
1951	19670	30600	1.56	26900	1.37	24200	1.23	21100	1.07
1952	20920	41900	2.00	37400	1.79	30100	1.44	26800	1.28
1953	20610	28100	1.36	26600	1.29	25400	1.23	22100	1.07
1954	26100	41000	1.59	40300	1.54	33300	1.28	28300	1.08
1955	25750	56900	2.21	54000	2.10	43100	1.67	29900	1.16
1956	24530	31000	1.26	31000	1.26	30900	1.26	28600	1.17
1957	20540	26600	1.30	24900	1.21	21400	1.04	20900	1.02
1958	22540	47800	2.12	45900	2.04	38300	1.70	30200	1.34
1959	31180	59700	1.91	56700	1.82	49100	1.57	41700	1.34
1960	23590	33300	1.41	30500	1.29	27700	1.17	25600	1.09
1961	22100	26000	1.18	26000	1.18	26000	1.18	26000	1.18
1962	23550	30600	1.30	28700	1.22	25500	1.08	24100	1.02
1963	23670	35000	1.48	32700	1.38	30300	1.28	25400	1.07
1964	16440	21600	1.31	21500	1.31	20200	1.23	18100	1.10
1965	21120	33600	1.59	33000	1.56	30600	1.45	26000	1.23
1966	21825	33500	1.53	31400	1.44	26900	1.23	23200	1.06
1967	32622	76000	2.33	69300	2.12	55400	1.70	42200	1.29
1968	17167	21800	1.27	21600	1.26	20500	1.19	19900	1.16
1969	8879	16800	1.89	15800	1.78	14300	1.61	12100	1.36
1970	19980	31600	1.58	29500	1.48	26100	1.31	22900	1.15
1971	31910	77700	2.40	72700	2.28	57900	1.81	41900	1.31
1972	19290	26400	1.37	24900	1.29	22200	1.15	21000	1.09
1973	20290	30500	1.50	29900	1.47	27800	1.37	21300	1.05
1974	16220	22300	1.37	21300	1.31	18900	1.17	17600	1.09
1975	18090	24800	1.37	23400	1.29	21600	1.19	19900	1.10
1976	19800	32000	1.62	30000	1.52	28600	1.44	24900	1.26
1977	19240	26200	1.36	24600	1.28	23400	1.22	21500	1.12
1978	16390	20900	1.28	20800	1.27	20500	1.25	19500	1.19
1979	20460	28400	1.39	27600	1.35	25800	1.26	24000	1.17
1980	20960	31100	1.48	27700	1.32	24500	1.17	24100	1.15
# of Val.	32								
Average	21550		1.57		1.49		1.33		1.16
Standard Dev.	4725		0.33		0.30		0.20		0.10

susi8/b5

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
September

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1949	15650	25400	1.62	24600	1.57	21300	1.36	18100	1.16
1950	8301	12000	1.45	11300	1.36	10700	1.29	9940	1.20
1951	21240	31800	1.50	31500	1.48	30600	1.44	24800	1.17
1952	14480	30000	2.07	27700	1.91	21500	1.48	16800	1.16
1953	15270	20000	1.31	19400	1.27	18900	1.24	18100	1.19
1954	12920	17000	1.32	17000	1.32	16700	1.29	15300	1.18
1955	14290	23300	1.63	22900	1.60	20600	1.44	17700	1.24
1956	18330	25000	1.36	25000	1.36	25000	1.36	22000	1.20
1957	19800	27000	1.36	24400	1.23	22100	1.12	20600	1.04
1958	7550	8500	1.13	8500	1.13	8500	1.13	8500	1.13
1959	16920	41000	2.42	38000	2.25	31500	1.86	23000	1.36
1960	20510	40100	1.96	36200	1.76	30500	1.49	24700	1.21
1961	13370	16200	1.21	15800	1.18	14500	1.08	14400	1.08
1962	15890	31000	1.95	28700	1.81	24900	1.57	19700	1.24
1963	12320	16100	1.31	15800	1.28	15400	1.25	14500	1.18
1964	9511	14100	1.47	12900	1.35	12000	1.25	10600	1.11
1965	19350	30100	1.56	27800	1.44	24700	1.28	21000	1.09
1966	11753	17300	1.47	16000	1.36	14300	1.22	12900	1.10
1967	16867	31800	1.89	31500	1.87	29100	1.73	22900	1.36
1968	8815	13400	1.52	13100	1.49	12200	1.38	11300	1.28
1969	5093	6780	1.33	6640	1.30	6300	1.24	5860	1.15
1970	9121	13600	1.49	12900	1.41	12400	1.36	10900	1.20
1971	14440	27000	1.87	25900	1.79	22900	1.59	18600	1.29
1972	12400	26400	2.13	23300	1.88	19600	1.58	16300	1.31
1973	9074	18000	1.98	16100	1.77	13800	1.52	11400	1.26
1974	12250	20900	1.71	20500	1.67	18000	1.47	13500	1.10
1975	16310	28600	1.75	25400	1.56	20900	1.28	19600	1.20
1976	6881	9280	1.35	9040	1.31	8150	1.18	7170	1.04
1977	12640	16900	1.34	16800	1.33	15700	1.24	14500	1.15
1978	8607	12400	1.44	12000	1.39	11200	1.30	10600	1.23
1979	10770	15000	1.39	14500	1.35	13600	1.26	12300	1.14
1980	13280	28000	2.10	24900	1.88	20100	1.51	16200	1.22
# of Val.	32								
Average	13250		1.61		1.52		1.37		1.19
Standard Dev.	4190		0.32		0.27		0.18		0.08

susiß/b6

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
October

Year	Mean Monthly Flow $-Q_M$ (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1949	6334	20100	3.17	16300	2.57	12900	2.04	8960	1.41
1950	3848	5800	1.51	5530	1.44	5260	1.37	4950	1.29
1951	5571	11000	1.97	10200	1.83	9230	1.66	7520	1.35
1952	8202	12500	1.52	11700	1.43	11100	1.35	10700	1.30
1953	5604	8700	1.55	8480	1.51	8120	1.45	7330	1.31
1954	5370	6500	1.21	6500	1.21	6500	1.21	6190	1.15
1955	4951	8600	1.74	8260	1.67	7240	1.46	6160	1.24
1956	5806	7200	1.24	7200	1.24	7200	1.24	7200	1.24
1957	8212	12600	1.53	11300	1.38	10300	1.25	9400	1.14
1958	4811	6600	1.37	6400	1.33	5990	1.25	5610	1.17
1959	6558	11900	1.81	11100	1.69	10700	1.63	8770	1.34
1960	7794	14500	1.86	13600	1.74	12500	1.60	10600	1.36
1961	5916	12500	2.11	12000	2.03	10400	1.76	7320	1.24
1962	6723	10100	1.50	9830	1.46	9150	1.36	7970	1.19
1963	6449	9310	1.44	9130	1.42	8900	1.19	8070	1.25
1964	6291	9620	1.53	9520	1.51	8890	1.41	8050	1.30
1965	7205	18200	2.53	17300	2.40	15100	2.10	11300	1.57
1966	4162	7530	1.81	7280	1.75	6990	1.68	5770	1.39
1967	4900	8010	1.63	7660	1.56	6850	1.40	6210	1.27
1968	3822	5400	1.41	5270	1.38	5060	1.32	4670	1.22
1969	3124	4220	1.35	4160	1.33	4000	1.28	3810	1.22
1970	5288	9000	1.70	8040	1.52	7020	1.33	6340	1.20
1971	5847	8280	1.42	8230	1.41	7740	1.33	7190	1.23
1972	4826	7000	1.45	6830	1.17	6210	1.29	5430	1.12
1973	3733	6000	1.61	5940	1.59	5640	1.51	5000	1.34
1974	3739	7530	2.01	6210	1.66	5720	1.53	5370	1.43
1975	7739	13000	1.68	12000	1.55	10300	1.33	9700	1.25
1976	3874	5400	1.39	5040	1.30	4830	1.25	4340	1.12
1977	7571	11000	1.45	9820	1.29	9020	1.19	8890	1.17
1978	4907	6570	1.34	6480	1.32	6120	1.25	5700	1.16
1979	7311	12200	1.67	11200	1.53	10100	1.38	8930	1.22
# of Val.	31								
Average	5690		1.66		1.56		1.43		1.26
Standard Dev.	1450		0.39		0.31		0.23		0.10

susi8/b7

Comparison of Peak Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1958	10460	16000	1.53	16000	1.53	16000	1.53	14200	1.36
1959	7413	13000	1.75	13000	1.75	12700	1.71	11300	1.52
1960	13890	35700	2.57	33300	2.40	29600	2.13	21500	1.55
1961	10100	16000	1.58	15000	1.50	13100	1.30	12700	1.26
1962	7743	16500	2.13	16000	2.07	14900	1.92	12200	1.58
1963	11060	28500	2.58	26600	2.41	22600	2.04	19600	1.77
1964	2355	4000	1.70	4000	1.70	4000	1.70	3330	1.41
1965	7452	12000	1.61	12000	1.61	12000	1.61	12000	1.61
1966	3971	9110	2.29	6700	1.68	6020	1.52	5740	1.45
1967	12400	22000	1.77	21000	1.69	20700	1.67	18100	1.46
1968	10940	25400	2.32	23900	2.18	22200	2.03	18400	1.68
1969	6001	12300	2.05	11700	1.95	10100	1.68	8160	1.36
1970	9643	19000	1.97	17700	1.83	16100	1.67	13900	1.44
1971	4468	11000	2.46	10300	2.31	8860	1.98	6710	1.50
1972	9765	23800	2.44	20000	2.05	16700	1.71	12800	1.31
# of Val.	15								
Average	8510		2.05		1.91		1.75		1.48
Standard Dev.	3270		0.38		0.31		0.23		0.14

Comparison of Peak Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

June

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1958	23170	29000	1.25	28300	1.22	27300	1.18	23900	1.03
1959	23660	33400	1.41	33100	1.40	32300	1.37	29500	1.25
1960	17390	22000	1.27	21700	1.25	21200	1.22	19100	1.10
1961	20490	29200	1.43	27600	1.35	25900	1.26	24900	1.22
1962	20620	38000	1.84	34100	1.65	29700	1.35	25300	1.23
1963	17750	27700	1.56	24300	1.37	23000	1.30	18900	1.06
1964	40330	45000	1.12	45000	1.12	45000	1.12	43000	1.07
1965	20070	30000	1.49	28000	1.40	24900	1.24	21900	1.09
1966	21740	29000	1.33	27700	1.27	26100	1.20	24100	1.11
1967	25520	56000	2.19	40800	1.60	34300	1.34	30200	1.18
1968	29000	38800	1.34	37900	1.31	35900	1.24	33600	1.16
1969	18560	28100	1.51	26300	1.42	24800	1.34	24500	1.32
1970	19670	33000	1.68	29700	1.51	25400	1.29	21600	1.10
1971	22180	44500	2.01	41600	1.88	38300	1.73	28400	1.28
1972	17900	28000	1.56	25800	1.44	23300	1.30	20300	1.13
1980	22490	30200	1.34	27400	1.22	25000	1.11	23700	1.05
# of Val.	16								
Average	22530		1.52		1.40		1.29		1.15
Standard Dev.	5650		0.29		0.19		0.14		0.09

Comparison of Peak Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

July

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1958	25010	31700	1.27	30700	1.22	27700	1.11	26100	1.04
1959	25650	36400	1.42	31500	1.22	30200	1.18	29100	1.13
1960	23650	33400	1.41	31500	1.33	29300	1.29	25700	1.09
1961	27420	38900	1.42	36500	1.33	32800	1.20	30200	1.10
1962	27720	36800	1.35	32900	1.21	31000	1.14	29600	1.09
1963	28950	34000	1.17	34000	1.17	34000	1.17	34000	1.17
1964	24930	27000	1.08	27000	1.08	27000	1.08	26000	1.04
1965	23230	27400	1.18	27100	1.17	26400	1.14	24800	1.07
1966	23750	30500	1.28	29900	1.26	28700	1.21	27100	1.14
1967	35570	71200	2.00	61400	1.73	47300	1.33	40900	1.15
1968	30140	35400	1.17	35000	1.16	33600	1.11	31700	1.05
1969	20820	26000	1.25	24700	1.19	24000	1.15	23800	1.14
1970	26100	34800	1.33	33200	1.27	30200	1.16	28200	1.08
1971	27280	42600	1.56	40100	1.47	35900	1.32	31800	1.17
1972	25770	34100	1.32	33600	1.30	33100	1.28	29700	1.15
1980	34950	55800	1.60	47900	1.37	40800	1.17	38500	1.10
# of Val.	16								
Average	26930		1.36		1.28		1.19		1.11
Standard Dev.	3980		0.22		0.15		0.08		0.04

Comparison of Peak Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

August

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1958	20760	33800	1.63	31900	1.54	29100	1.40	25900	1.25
1959	22100	34000	1.54	29100	1.32	28000	1.27	25300	1.14
1960	19320	25000	1.29	25000	1.29	25000	1.29	25000	1.29
1961	24580	40000	1.63	37700	1.53	33600	1.37	27600	1.12
1962	21980	36700	1.67	32700	1.49	26600	1.21	23200	1.06
1963	18390	20000	1.09	20000	1.09	20000	1.09	19700	1.07
1964	20250	28000	1.38	25800	1.27	23100	1.14	21300	1.05
1965	22550	34400	1.53	34000	1.51	31700	1.41	27700	1.23
1966	27720	37600	1.36	36700	1.33	34800	1.26	29300	1.06
1967	33670	73000	2.17	71000	2.11	56300	1.67	42200	1.25
1968	20710	29800	1.44	29000	1.40	26800	1.29	24600	1.19
1969	11300	22500	1.99	21400	1.89	18800	1.66	15100	1.34
1970	24660	35600	1.44	33700	1.37	31500	1.40	27600	1.12
1971	23810	45000	1.89	40900	1.72	36100	1.52	29400	1.23
1972	20970	27200	1.30	25800	1.23	24400	1.16	22700	1.08
1980	20780	32500	1.56	28100	1.35	26500	1.28	25200	1.21
# of Val.	16								
Average	22100		1.56		1.47		1.34		1.17
Standard Dev.	4690		0.28		0.26		0.17		0.09

Comparison of Peak Flows to Average Monthly Flow
Chulitna River near Talkeetna
No. 15292400
September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1958	8000	9200	1.15	9200	1.15	9200	1.15	9200	1.15
1959	9957	20200	2.03	18600	1.87	15700	1.58	12400	1.25
1960	12420	23000	1.85	21000	1.69	18000	1.45	15600	1.26
1961	16030	30700	1.92	28200	1.76	23200	1.45	19300	1.20
1962	13490	35500	2.63	30500	2.26	24400	1.81	18000	1.33
1963	11330	14000	1.24	14000	1.24	14000	1.24	12700	1.12
1964	9235	15000	1.62	14000	1.52	13000	1.42	11000	1.19
1965	22260	41100	1.85	34800	1.56	30800	1.38	23900	1.07
1966	12200	18000	1.48	17000	1.39	14600	1.19	13700	1.12
1967	12510	21700	1.73	20600	1.65	17500	1.40	16100	1.28
1968	7375	10500	1.42	10300	1.40	9810	1.33	9330	1.27
1969	6704	9680	1.44	9390	1.40	8760	1.31	7980	1.19
1970	11330	19300	1.70	19000	1.68	17900	1.58	15400	1.36
1971	11080	16900	1.53	16600	1.50	16000	1.44	14500	1.31
1972	12120	29100	2.40	25300	2.09	19300	1.59	16400	1.35
1980	3240	12900	1.57	12000	1.46	10400	1.26	8830	1.07
# of Val.	16								
Average	11520		1.72		1.60		1.41		1.22
Standard Dev.	3770		0.39		0.29		0.17		0.10

susi8/b12

Comparison of Peak Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1958	4195	6200	1.48	6000	1.43	5600	1.33	5030	1.20
1959	4723	7800	1.65	7400	1.57	7070	1.50	6030	1.28
1960	5135	10900	2.12	9750	1.90	8800	1.71	7140	1.39
1961	5777	12500	2.16	11600	2.01	10100	1.75	7750	1.34
1962	3506	7820	2.23	7190	1.82	6380	1.82	5050	1.44
1963	8062	12000	1.49	12000	1.49	12000	1.49	10300	1.28
1964	5642	15300	2.71	12700	2.25	10000	1.77	7580	1.34
1965	6071	9400	1.55	9400	1.55	9400	1.55	9400	1.55
1966	4682	8500	1.81	8170	1.74	8000	1.71	6630	1.42
1967	3483	5800	1.67	5600	1.50	5180	1.49	4520	1.30
1968	2898	4400	1.52	4150	1.43	3820	1.32	3480	1.20
1969	4578	7700	1.68	6960	1.31	6010	1.25	5740	1.25
1970	3826	5000	1.31	4930	1.29	4770	1.25	4450	1.16
1971	5439	11000	2.02	10300	1.89	8830	1.62	7050	1.30
# of Val.	14								
Average	4858		1.81		1.66		1.54		1.32
Standard Dev.	1324		0.38		0.28		0.20		0.11

Comparison of Peak Flows to Average Monthly Flow

Talkeetna River near Talkeetna

No. 15292700

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1965	3474	14300	4.12	12100	3.48	9060	2.61	5890	1.70
1966	2410	5890	2.44	5750	2.39	5020	2.08	3700	1.54
1967	4112	7500	1.82	7430	1.81	7360	1.79	6140	1.49
1968	8840	19000	2.15	17500	1.98	16600	1.88	14600	1.65
1969	3869	13500	3.49	11100	1.87	8430	2.18	6000	1.55
1970	3950	7900	2.00	7520	1.90	6690	1.69	5630	1.43
1971	2145	4980	2.32	4940	2.30	4420	2.06	3360	1.57
1972	3516	12600	3.58	10400	2.96	8520	2.42	5790	1.65
1973	3860	6920	1.79	6770	1.75	6640	1.72	5840	1.51
1974	5678	15000	2.64	14400	2.54	13000	2.29	9340	1.64
1975	4084	12200	2.99	11900	2.91	10100	2.47	7210	1.77
1976	3439	5000	1.45	4500	1.31	4110	1.20	3880	1.13
1977	4244	12800	3.02	12500	2.95	9530	2.25	7090	1.67
1978	2950	4750	1.61	4670	1.58	4340	1.47	3870	1.31
1979	7790	20700	2.66	20200	2.59	16700	2.14	11800	1.51
1980	4820	10000	2.07	9670	2.01	8170	1.70	6650	1.38
# of Val.	16								
Average	4324		2.51		2.33		2.00		1.53
Standard Dev.	1782		0.76		0.60		0.39		0.16

Comparison of Peak Flows to Average Monthly Flow
Talkeetna River near Talkeetna
No. 15292700
June

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1964	17080	27000	1.58	25000	1.46	23000	1.35	20400	1.19
1965	11090	16700	1.51	15200	1.37	13600	1.23	12300	1.11
1966	12970	24000	1.85	23400	1.80	21200	1.63	16400	1.26
1967	9286	15400	1.66	13400	1.44	11500	1.24	11100	1.20
1968	14100	22000	1.56	20500	1.45	18200	1.29	16300	1.16
1969	5207	7120	1.37	6800	1.31	6060	1.16	5880	1.13
1970	7979	17900	2.24	16500	2.07	11700	1.47	9060	1.14
1971	19040	33700	1.77	30200	1.59	26500	1.39	22900	1.20
1972	12700	27500	2.17	22400	1.76	17000	1.34	14200	1.12
1973	12210	25000	2.05	21200	1.74	19200	1.57	15600	1.28
1974	8030	14100	1.76	11200	1.39	9420	1.17	8670	1.08
1975	13180	18600	1.41	15900	1.21	14300	1.08	14100	1.07
1976	10580	17200	1.63	16200	1.53	15000	1.42	12900	1.22
1977	18280	27100	1.48	24700	1.35	23500	1.29	20900	1.14
1978	7429	12900	1.74	9900	1.33	8920	1.20	7870	1.06
1979	12010	20500	1.71	19200	1.60	17000	1.42	14000	1.17
1980	11380	15000	1.32	14700	1.29	12900	1.13	11800	1.04
# of Val.	17								
Average	11910		1.69		1.51		1.32		1.15
Standard Dev.	3800		0.27		0.22		0.15		0.07

Comparison of Peak Flows to Average Monthly Flow

Talkeetna River near Talkeetna

No. 15292700

July

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1964	9810	12800	1.30	11900	1.21	10500	1.07	10100	1.03
1965	12180	19500	1.60	19200	1.58	16300	1.34	14200	1.17
1966	10100	20200	2.00	19300	1.91	15200	1.50	11500	1.14
1967	12000	40000	3.17	28300	2.25	20700	1.64	16000	1.27
1968	11230	15000	1.34	14300	1.27	13300	1.18	12700	1.13
1969	7080	9100	1.29	8510	1.20	8170	1.15	7520	1.06
1970	10320	16500	1.60	13700	1.33	12300	1.19	11100	1.08
1971	11760	18600	1.58	17300	1.47	15100	1.28	13200	1.12
1972	12030	13500	1.12	13100	1.09	12900	1.07	12500	1.04
1973	7676	9920	1.29	9610	1.25	9210	1.20	8380	1.09
1974	7755	9680	1.25	9200	1.19	8590	1.11	8270	1.07
1975	12070	17800	1.47	17300	1.43	15000	1.24	13600	1.13
1976	9026	14400	1.60	12500	1.38	11000	1.22	9990	1.11
1977	9344	16800	1.80	13500	1.44	11700	1.25	10400	1.11
1978	10790	14800	1.37	13000	1.20	12300	1.14	11300	1.05
1979	14440	28000	1.94	25100	1.74	19700	1.36	16900	1.17
1980	13900	29500	2.12	22100	1.59	16700	1.20	14400	1.04
# of Val.	17								
Average	10710		1.64		1.44		1.25		1.11
Standard Dev.	2120		0.49		0.30		0.15		0.06

Comparison of Peak Flows to Average Monthly Flow
Talkeetna River near Talkeetna
No. 15292700
August

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1964	8396	11900	1.42	11100	1.32	11000	1.31	9650	1.15
1965	11150	21400	1.92	20900	1.87	17900	1.61	14600	1.31
1966	10730	19800	1.85	19100	1.78	15100	1.41	12400	1.16
1967	14160	34700	2.45	27600	1.95	23600	1.67	18500	1.31
1968	7546	9900	1.31	9200	1.22	8290	1.10	8020	1.06
1969	3787	7900	2.09	7450	1.97	6810	1.80	5400	1.43
1970	8752	12700	1.45	11600	1.33	11100	1.27	9790	1.12
1971	16770	63000	3.76	50400	3.01	35800	2.13	24300	1.45
1972	9576	14000	1.46	13700	1.43	12900	1.35	10600	1.11
1973	9927	24000	2.42	21300	2.15	16400	1.65	11600	1.17
1974	7704	18800	2.44	14300	1.86	9330	1.21	7760	1.01
1975	8487	12900	1.52	12100	1.43	10200	1.20	9770	1.15
1976	8088	11700	1.45	10500	1.30	10200	1.26	9420	1.16
1977	8005	11300	1.41	9990	1.25	9390	1.17	8550	1.07
1978	7001	10500	1.50	10200	1.46	9440	1.35	8740	1.25
1979	8274	15800	1.91	15000	1.81	12600	1.52	10200	1.23
1980	7220	12700	1.76	11100	1.54	9630	1.33	8500	1.18
# of Val.	17								
Average	9151		1.89		1.69		1.43		1.19
Standard Dev.	2922		0.62		0.45		0.27		0.12

Comparison of Peak Flows to Average Monthly Flow

Talkeetna River near Talkeetna

No. 15292700

September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1964	3815	5100	1.34	5000	1.31	4690	1.23	4180	1.10
1965	10610	23400	2.21	19000	1.79	16600	1.56	13200	1.24
1966	5370	8900	1.66	7400	1.38	6410	1.19	6050	1.13
1967	6971	13300	1.91	13100	1.88	12100	1.74	9630	1.38
1968	4120	6640	1.61	6380	1.55	5730	1.39	5290	1.28
1969	2070	3220	1.56	2970	1.43	2660	1.29	2400	1.16
1970	5993	14700	2.45	12600	2.10	9910	1.65	7310	1.22
1971	5990	12000	2.00	11000	1.84	9640	1.61	7830	1.31
1972	8709	19800	2.27	16200	1.86	13300	1.53	11400	1.31
1973	3861	7500	1.94	6830	1.77	5860	1.52	4830	1.25
1974	4763	9200	1.93	8540	1.79	7120	1.49	5390	1.13
1975	7960	14900	1.87	13600	1.71	10700	1.34	9970	1.25
1976	3205	4010	1.25	3790	1.18	3410	1.06	3280	1.02
1977	5826	8450	1.45	8030	1.38	7260	1.25	6840	1.17
1978	3513	6400	1.82	5450	1.55	4770	1.36	4350	1.24
1979	4039	6760	1.67	6080	1.51	5860	1.45	4560	1.13
1980	5400	18600	3.44	14900	2.76	10400	1.93	7440	1.38
# of Val.	17								
Average	5428		1.91		1.69		1.45		1.22
Standard Dev.	2192		0.51		0.37		0.22		0.10

susi8/b18

Comparison of Peak Flows to Average Monthly Flow

Talkeetna River near Talkeetna

No. 15292700

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1964	3115	4820	1.55	4610	1.48	4180	1.34	3840	1.23
1965	4438	10200	2.30	9050	2.04	7610	1.71	6080	1.37
1966	2388	4170	1.75	3970	1.66	3610	1.51	3200	1.34
1967	2029	2940	1.45	2860	1.41	2660	1.31	2440	1.20
1968	1637	2280	1.39	2200	1.34	2080	1.27	1920	1.17
1969	1450	2100	1.45	2070	1.43	1910	1.32	1730	1.19
1970	2817	5200	1.85	4570	1.62	3870	1.37	3430	1.22
1971	2632	3600	1.37	3530	1.34	3170	1.20	3090	1.17
1972	3630	6120	1.69	5510	1.52	4750	1.31	4090	1.13
1973	1807	3000	1.66	2760	1.53	2560	1.42	2240	1.24
1974	1987	3260	1.64	3110	1.57	2810	1.41	2480	1.25
1975	2884	5100	1.77	4830	1.67	4480	1.55	3950	1.37
1976	1857	2400	1.29	2270	1.22	2200	1.18	2040	1.10
1977	3268	5400	1.65	5020	1.54	4520	1.38	4080	1.25
1978	1660	2380	1.43	2310	1.39	2090	1.26	1830	1.18
1979	3370	6700	1.99	5870	1.74	5120	1.52	4270	1.27
# of Val.	16								
Average	2559		1.64		1.53		1.38		1.23
Standard Dev.	854		0.26		0.19		0.14		0.08

Comparison of Peak Flows to Average Monthly Flow

Susitna River at Susitna Station

No. 15294350

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	1 Day Peak Flow Q_1/Q_M	3-Day Peak Flow Q_3	3-Day Peak Flow Q_3/Q_M	7-Day Peak Flow Q_7	7-Day Peak Flow Q_7/Q_M	15-Day Peak Flow Q_{15}	15-Day Peak Flow Q_{15}/Q_M
1975	47540	121000	2.55	114000	2.40	103000	2.17	81000	1.70
1976	70460	115000	1.63	113000	1.60	101000	1.43	83100	1.18
1977	56180	128000	2.28	121000	2.15	105000	1.87	91000	1.62
1978	48670	66000	1.36	65300	1.34	62800	1.29	58800	1.21
1979	81260	136000	1.67	134000	1.65	121000	1.49	105000	1.29
1980	66580	124000	1.86	116000	1.74	99200	1.49	85100	1.28
# of Val.	6								
Average	61780		1.89		1.81		1.62		1.38
Standard Dev.	13295		0.44		0.39		0.33		0.22

susi8/b20

Comparison of Peak Flows to Average Monthly Flow

Susitna River at Susitna Station

No. 15294350

June

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1975	128800	161000	1.25	152000	1.18	141000	1.09	137000	1.06
1976	107000	131000	1.22	13000	1.21	128000	1.20	116000	1.08
1977	165900	195000	1.18	191000	1.15	186000	1.12	175000	1.05
1978	90930	118000	1.30	114000	1.25	113000	1.24	103000	1.13
1979	119900	158000	1.32	150000	1.25	133000	1.11	122000	1.02
1980	142900	173000	1.21	164000	1.15	152000	1.06	149000	1.04
# of Val.	6								
Average	125900		1.25		1.20		1.14		1.06
Standard Dev.	26510		0.05		0.05		0.07		0.04

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Susitna Station
No. 15294350
July

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1975	135700	171000	1.26	159000	1.17	155000	1.14	148000	1.09
1976	115200	146000	1.27	139000	1.21	126000	1.09	123000	1.07
1977	143900	166000	1.15	161000	1.12	152000	1.06	146000	1.01
1978	117600	130000	1.11	126000	1.07	120000	1.02	119000	1.01
1979	142500	175000	1.23	169000	1.19	155000	1.09	153000	1.07
1980	181400	226000	1.25	215000	1.19	203000	1.12	189000	1.04
# of Val.	6								
Average	139380		1.21		1.16		1.09		1.05
Standard Dev.	23950		0.07		0.05		0.04		0.03

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Susitna Station
No. 15294350
August

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		15-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{15}	Q_{15}/Q_M
1975	91360	113000	1.24	109000	1.19	105000	1.15	99800	1.09
1976	99650	138000	1.38	134000	1.34	125000	1.25	115000	1.15
1977	125500	151000	1.20	144000	1.15	141000	1.12	135000	1.08
1978	102100	130000	1.27	130000	1.27	126000	1.23	120000	1.17
1979	128200	160000	1.25	157000	1.22	146000	1.14	141000	1.10
1980	126400	163000	1.29	153000	1.21	142000	1.12	141000	1.12
# of Val.	6								
Average	112200		1.27		1.23		1.17		1.12
Standard Dev.	16300		0.06		0.07		0.06		0.04

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Susitna Station
No. 15294350
September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1975	77740	122000	1.57	110000	1.41	100000	1.28	93800	1.21
1976	48910	93800	1.92	84100	1.72	69700	1.43	56400	1.15
1977	83810	119000	1.42	109000	1.30	99600	1.19	92000	1.10
1978	55500	83400	1.50	77900	1.40	72100	1.30	69200	1.25
1979	74340	118000	1.59	113000	1.52	108000	1.45	90900	1.22
1980	91200	135000	1.48	122000	1.34	108000	1.18	98600	1.08
# of Val.	6								
Average	71910		1.58		1.45		1.31		1.17
Standard Dev.	16440		0.18		0.15		0.12		0.07

Comparison of Peak Flows to Average Monthly Flow
Susitna River at Susitna Station
No. 15294350
October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow Q_1	Q_1/Q_M	3-Day Peak Flow Q_3	Q_3/Q_M	7-Day Peak Flow Q_7	Q_7/Q_M	15-Day Peak Flow Q_{15}	Q_{15}/Q_M
1974	19520	35000	1.79	30000	1.54	26300	1.35	25200	1.29
1975	31550	61000	1.93	54600	1.73	45400	1.44	39400	1.25
1976	30140	43000	1.43	36000	1.19	33000	1.09	31000	1.03
1977	38230	77400	2.02	68400	1.79	56700	1.48	51000	1.33
1978	36810	50000	1.36	48000	1.30	45400	1.23	43500	1.18
1979	58640	93300	1.59	90600	1.55	86000	1.47	74800	1.28
# of Val.	6								
Average	35815		1.69		1.52		1.34		1.23
Standard Dev.	12990		0.27		0.23		0.16		0.11

Comparison of Low Flows to Average Monthly Flow

Susitna River at Gold Creek

No. 15292000

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Peak Flow		3-Day Peak Flow		7-Day Peak Flow		14-Day Peak Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{14}	Q_{14}/Q_M
1951	14090	5200	0.37	6070	0.43	8600	0.61	12200	0.87
1952	5419	1100	0.20	1200	0.22	1390	0.26	1460	0.27
1953	14270	10700	0.56	12000	0.62	13200	0.69	16100	0.84
1954	19280	8800	0.51	8800	0.51	8800	0.51	12300	0.71
1955	9319	4500	0.48	4500	0.48	4500	0.48	4500	0.48
1956	17660	1500	0.08	1970	0.11	4930	0.28	8820	0.50
1957	13750	4300	0.31	4300	0.31	4300	0.31	5760	0.42
1958	12900	3420	0.27	3880	0.30	4840	0.38	7130	0.55
1959	15990	3400	0.21	3400	0.21	3400	0.21	4540	0.28
1960	15780	7600	0.48	7600	0.48	7600	0.48	7600	0.48
1961	17360	9000	0.52	9000	0.52	9000	0.52	12700	0.73
1962	12590	4500	0.36	4500	0.36	4500	0.36	4500	0.36
1963	19030	3400	0.18	3400	0.18	3400	0.18	3400	0.18
1964	4307	900	0.21	900	0.21	900	0.21	1040	0.27
1965	12900	2200	0.17	2200	0.17	2870	0.22	4690	0.36
1966	9645	3400	0.35	3400	0.35	3400	0.35	3990	0.41
1967	15480	1700	0.11	1800	0.12	2140	0.14	5010	0.32
1968	16177	2200	0.14	2230	0.14	2340	0.14	3160	0.20
1969	11045	3200	0.29	3400	0.31	3890	0.35	5730	0.52
1970	11380	1800	0.16	1900	0.17	2240	0.20	5330	0.47
1971	3745	1400	0.37	1470	0.39	1570	0.42	1820	0.49
1972	21890	2500	0.11	3030	0.14	5930	0.27	14000	0.64
1973	8235	1400	0.17	1400	0.17	1600	0.19	2540	0.31
1974	16180	2200	0.14	2470	0.15	3260	0.20	5880	0.36
1975	15350	2500	0.16	2770	0.18	3540	0.23	6170	0.40
1976	12620	3800	0.30	4600	0.36	7190	0.57	11100	0.88
1977	12680	1900	0.15	1930	0.15	2100	0.17	3440	0.27
1978	11950	2500	0.21	3300	0.28	5610	0.47	10300	0.86
1979	13870	2500	0.18	2700	0.19	3260	0.24	4840	0.35
1980	12060	3700	0.31	4100	0.34	5260	0.44	8520	0.71
# of Val.	31								
Average	13270		0.26		0.28		0.34		0.48
Standard Dev.	4240		0.14		0.14		0.15		0.21

susi8/b28

Comparison of Low Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
August

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1949	24250	15200	0.63	16100	0.66	17100	0.71	17700	0.73
1950	19880	11000	0.55	11300	0.57	14200	0.71	15900	0.80
1951	19670	15600	0.79	16300	0.83	17400	0.88	17900	0.91
1952	20920	13500	0.65	13800	0.66	14500	0.69	14900	0.71
1953	20610	16400	0.80	16600	0.81	16900	0.82	17700	0.86
1954	26100	24000	0.92	24000	0.92	24000	0.92	24000	0.92
1955	25750	13600	0.53	14400	0.56	17200	0.67	20800	0.81
1956	24530	18000	0.73	18000	0.73	18000	0.73	19900	0.81
1957	20540	16700	0.81	16900	0.82	18300	0.89	19000	0.93
1958	22540	11000	0.49	11300	0.50	12300	0.55	14700	0.65
1959	31180	16700	0.54	17100	0.55	18400	0.59	20800	0.67
1960	23590	19000	0.81	19300	0.82	20700	0.88	21700	0.92
1961	22100	13800	0.62	14200	0.64	17300	0.78	18700	0.85
1962	23550	23000	0.98	23000	0.98	23000	0.98	23000	0.98
1963	23670	16500	0.70	17700	0.75	20300	0.86	21900	0.93
1964	16440	12000	0.73	12300	0.75	13700	0.83	15000	0.91
1965	21120	10000	0.47	10100	0.48	12300	0.58	17500	0.83
1966	21825	16400	0.75	16900	0.77	18800	0.86	20100	0.92
1967	32622	18900	0.58	19300	0.59	21600	0.66	27400	0.84
1968	17167	12600	0.73	12900	0.75	14000	0.82	14400	0.84
1969	8879	5280	0.59	5400	0.61	5620	0.63	5810	0.65
1970	19980	12700	0.64	12900	0.65	14500	0.73	17200	0.86
1971	31910	16700	0.52	17500	0.55	20200	0.63	22400	0.70
1972	19290	12900	0.67	13200	0.68	14700	0.76	17900	0.93
1973	20290	11100	0.55	11200	0.55	13100	0.65	17600	0.87
1974	16220	8100	0.50	8550	0.53	10500	0.65	13300	0.82
1975	18090	11800	0.65	12700	0.70	14600	0.81	15900	0.88
1976	19800	9340	0.47	10100	0.51	11900	0.60	14300	0.72
1977	19240	10000	0.52	11100	0.58	13700	0.71	16700	0.87
1978	16390	10400	0.63	10500	0.64	10900	0.67	13100	0.80
1979	20460	14000	0.68	14500	0.71	15700	0.77	16700	0.82
1980	20960	13900	0.66	14500	0.69	15000	0.72	17700	0.84
# of Val.	31								
Average	21550		0.65		0.67		0.74		0.83
Standard Dev.	4725		0.13		0.12		0.11		0.09

Comparison of Low Flows to Average Monthly Flow
Susitna River at Gold Creek
No. 15292000
July

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1950	22600	18000	0.80	18700	0.83	20000	0.88	20600	0.91
1951	22570	18200	0.81	19000	0.84	20700	0.92	22200	0.98
1952	26390	17200	0.65	17900	0.68	19500	0.74	22200	0.84
1953	20200	17200	0.85	17500	0.87	18100	0.90	19000	0.94
1954	20360	19000	0.93	19000	0.93	19000	0.93	19000	0.93
1955	27560	20200	0.73	20500	0.74	21500	0.78	23700	0.86
1956	31090	26600	0.86	28200	0.91	29100	0.94	30400	0.98
1957	23310	18900	0.81	19600	0.84	21200	0.91	22100	0.95
1958	22880	19000	0.83	20300	0.89	21300	0.93	21600	0.94
1959	25000	19900	0.80	21000	0.84	21500	0.86	23500	0.94
1960	22980	14900	0.65	15100	0.66	16700	0.73	18200	0.79
1961	24570	23000	0.94	23000	0.94	23000	0.94	23600	0.96
1962	25850	20900	0.81	21700	0.84	22900	0.89	24800	0.96
1963	34400	23600	0.69	23900	0.69	29100	0.85	31400	0.91
1964	22950	14800	0.64	15400	0.67	16900	0.74	19600	0.85
1965	27840	20700	0.74	21200	0.76	22100	0.79	24700	0.89
1966	19864	16200	0.82	16400	0.83	16900	0.85	17600	0.89
1967	26800	19400	0.72	20100	0.75	21000	0.78	21200	0.79
1968	26922	21400	0.79	23200	0.86	24000	0.89	24300	0.90
1969	16103	11800	0.73	12500	0.78	13900	0.86	15600	0.97
1970	22660	16500	0.73	17200	0.76	18600	0.82	21300	0.94
1971	23950	14500	0.61	15800	0.66	18700	0.78	20700	0.86
1972	22770	17400	0.76	17700	0.78	18200	0.80	19500	0.86
1973	18250	14200	0.78	14500	0.79	14900	0.82	15800	0.87
1974	18800	14900	0.79	15100	0.80	16900	0.90	18800	1.00
1975	27720	23400	0.84	24100	0.87	25500	0.92	26300	0.95
1976	18940	15100	0.80	16100	0.85	17900	0.95	18500	0.98
1977	22870	18000	0.79	18000	0.79	19300	0.84	21600	0.94
1978	21020	19400	0.92	19800	0.94	20200	0.96	20300	0.97
1979	28880	21800	0.75	21900	0.76	25800	0.89	26200	0.91
1980	32660	24800	0.76	25300	0.77	27500	0.84	30700	0.94
# of Val.	31								
Average	24150		0.78		0.80		0.86		0.92
Standard Dev.	4240		0.08		0.08		0.07		0.05

Comparison of Low Flows to Average Monthly Flow

Susitna River at Gold Creek

No. 15292400

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1949	6334	3300	0.52	3400	0.54	3640	0.57	3830	0.60
1950	3848	1500	0.39	1570	0.41	1810	0.47	2600	0.68
1951	5571	2900	0.52	3000	0.54	3170	0.57	3610	0.65
1952	8202	5100	0.62	5170	0.63	5260	0.64	5490	0.67
1953	5604	2400	0.43	2540	0.45	3200	0.57	3780	0.67
1954	5370	4600	0.86	4600	0.86	4600	0.86	4600	0.86
1955	4951	2800	0.57	3000	0.61	3350	0.68	3730	0.75
1956	5806	4500	0.78	4500	0.78	4500	0.78	4500	0.78
1957	8212	5400	0.66	5800	0.71	6230	0.76	7140	0.87
1958	4811	3500	0.73	3500	0.73	3500	0.73	3890	0.81
1959	6558	3700	0.56	3770	0.57	4030	0.61	4520	0.69
1960	7794	3800	0.49	3970	0.51	4230	0.54	4920	0.63
1961	5916	4600	0.78	4600	0.78	4600	0.78	4600	0.78
1962	6723	4800	0.71	4900	0.73	5200	0.77	5460	0.81
1963	6449	3100	0.48	3270	0.51	3800	0.59	4690	0.73
1964	6291	3000	0.48	3490	0.55	3910	0.62	4400	0.70
1965	7205	2800	0.39	2930	0.41	3090	0.43	3240	0.45
1966	4162	1800	0.43	1900	0.46	2100	0.50	2470	0.59
1967	4900	2900	0.59	3000	0.61	3140	0.64	3510	0.72
1968	3822	2600	0.68	2670	0.70	2820	0.74	2940	0.77
1969	3124	1700	0.54	1700	0.54	1810	0.58	2360	0.76
1970	5288	4000	0.76	4000	0.76	4000	0.76	4210	0.80
1971	5847	3600	0.62	3730	0.64	3970	0.68	4470	0.76
1972	4826	3200	0.66	3400	0.70	3830	0.79	4610	0.96
1973	3733	2000	0.54	2000	0.54	2140	0.57	2440	0.65
1974	3739	1700	0.45	1700	0.45	1800	0.48	2050	0.55
1975	7739	3600	0.47	3800	0.49	4200	0.54	5420	0.70
1976	3874	3000	0.77	3000	0.77	3090	0.80	3400	0.88
1977	7571	4600	0.61	4670	0.62	5160	0.68	6040	0.80
1978	4906	2870	0.58	3190	0.65	3560	0.73	4100	0.84
1979	7311	5050	0.69	5090	0.70	5200	0.71	5510	0.75
# of Val.	31								
Average	5690		0.59		0.61		0.65		0.73
Standard Dev.	1450		0.13		0.12		0.11		0.11

Comparison of Low Flows to Average Monthly Flow

Susitna River at Gold Creek

No. 15292000
September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1949	15650	9160	0.59	9400	0.60	10500	0.67	11600	0.74
1950	8301	6000	0.72	6100	0.73	6240	0.75	6600	0.80
1951	21240	11700	0.55	12900	0.61	15700	0.74	17700	0.83
1952	14480	9500	0.66	9830	0.68	10300	0.71	11600	0.80
1953	15270	8880	0.58	9430	0.62	10600	0.69	12300	0.81
1954	12920	7400	0.57	7560	0.59	8210	0.64	10300	0.80
1955	14290	8600	0.60	8960	0.63	9610	0.67	10600	0.74
1956	18330	14000	0.76	14000	0.76	14000	0.76	17100	0.93
1957	19800	14200	0.72	15000	0.76	18000	0.91	19400	0.98
1958	7550	6600	0.87	6600	0.87	6600	0.87	6600	0.87
1959	16920	9650	0.57	10200	0.60	10400	0.61	10700	0.63
1960	20510	13900	0.68	14100	0.69	15100	0.74	17000	0.83
1961	13370	11500	0.86	11600	0.87	12100	0.91	13200	0.99
1962	15890	10700	0.67	11300	0.71	11900	0.75	12100	0.76
1963	12320	9340	0.76	9430	0.77	9570	0.78	10100	0.82
1964	9511	7440	0.78	7600	0.80	7860	0.83	8490	0.89
1965	19350	9280	0.48	9380	0.48	13900	0.72	18300	0.95
1966	11753	8160	0.69	8560	0.73	8830	0.75	10300	0.88
1967	16867	8440	0.50	8830	0.52	9320	0.55	10700	0.63
1968	8815	5400	0.61	5430	0.62	5460	0.62	6150	0.70
1969	5093	3710	0.73	3760	0.74	3920	0.77	4260	0.84
1970	9121	5000	0.55	5170	0.57	5290	0.58	7070	0.78
1971	14440	8160	0.57	8260	0.57	9250	0.64	10100	0.70
1972	12400	5500	0.44	5670	0.46	5790	0.47	8710	0.70
1973	9074	5500	0.61	5670	0.62	6030	0.66	6720	0.74
1974	12250	8310	0.68	8470	0.69	9080	0.74	9320	0.76
1975	16310	10900	0.67	11100	0.68	11600	0.71	15400	0.94
1976	6881	5620	0.82	5800	0.84	5930	0.86	6220	0.90
1977	12640	9520	0.75	9750	0.77	10200	0.81	12200	0.97
1978	8607	4900	0.57	5100	0.59	5530	0.64	6460	0.75
1979	10770	8220	0.76	8510	0.79	8720	0.81	9330	0.87
1980	13280	8890	0.67	8980	0.68	9160	0.69	10300	0.78
# of Val.	32								
Average	13250		0.66		0.68		0.72		0.82
Standard Dev.	4190		0.11		0.11		0.10		0.10

susi8/b32

Comparison of Low Flows to Average Monthly Flow
Chulitna River near Talkeetna
No. 15292400
June

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1958	23170	18000	0.78	18000	0.78	18600	0.80	20900	0.90
1959	23660	11000	0.46	13700	0.58	16400	0.69	17700	0.75
1960	17390	13000	0.75	13700	0.79	14500	0.83	15500	0.89
1961	20490	10800	0.53	10800	0.53	11700	0.57	15500	0.76
1962	20620	12500	0.61	12700	0.62	13200	0.64	16100	0.78
1963	17750	12200	0.69	12400	0.70	13700	0.77	13900	0.78
1964	40330	37000	0.92	37000	0.92	37000	0.92	37600	0.93
1965	20070	12000	0.60	14000	0.70	16300	0.81	17200	0.86
1966	21740	9200	0.42	10900	0.50	17600	0.81	21200	0.98
1967	25520	16000	0.63	17700	0.69	18600	0.73	20700	0.81
1968	29000	20600	0.71	21200	0.73	22200	0.77	26500	0.91
1969	18560	8580	0.46	8990	0.48	9650	0.52	12000	0.65
1970	19670	14000	0.71	14300	0.73	15100	0.77	19100	0.97
1971	22180	10000	0.45	10000	0.45	11900	0.54	15600	0.70
1972	17900	11200	0.63	11700	0.65	12500	0.70	15400	0.86
1980	22490	15000	0.67	15800	0.70	19700	0.88	21700	0.96
# of Val.	16								
Average	22530		0.63		0.66		0.73		0.84
Standard Dev.	5650		0.14		0.13		0.12		0.10

Comparison of Low Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1958	10460	3000	0.29	3370	0.32	4250	0.41	6560	0.63
1959	7413	3400	0.46	3400	0.46	3400	0.46	3400	0.46
1960	13890	2300	0.17	2870	0.21	3770	0.27	5940	0.43
1961	10100	2100	0.21	2630	0.26	4360	0.43	7040	0.70
1962	7743	3200	0.41	3200	0.41	3200	0.41	3200	0.41
1963	11060	2100	0.19	2100	0.19	2100	0.19	2100	0.19
1964	2355	1400	0.59	1400	0.59	1400	0.59	1430	0.61
1965	7452	2600	0.35	2600	0.35	2600	0.35	2600	0.35
1966	3971	2100	0.53	2100	0.53	2100	0.53	2100	0.53
1967	12400	1700	0.14	1970	0.16	2670	0.22	5530	0.45
1968	10940	2000	0.18	2130	0.19	2440	0.22	3470	0.32
1969	6001	2600	0.43	2770	0.46	3030	0.50	3840	0.64
1970	9643	2400	0.25	2600	0.27	3090	0.32	5130	0.53
1971	4468	1200	0.27	1300	0.29	1540	0.34	2170	0.49
1972	9765	1700	0.17	2170	0.22	4070	0.42	7820	0.80
# of Val.	15								
Average	8511		0.31		0.33		0.38		0.50
Standard Dev.	3270		0.15		0.13		0.12		0.16

Comparison of Low Flows to Average Monthly Flow
Chulitna River near Talkeetna
No. 15292400
August

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1958	20760	12000	0.58	12500	0.60	13600	0.66	15500	0.75
1959	22100	16000	0.72	16400	0.74	17400	0.79	18900	0.86
1960	19320	14000	0.72	14000	0.72	14000	0.72	14000	0.72
1961	24580	16100	0.66	16800	0.68	18500	0.75	22000	0.90
1962	21980	15800	0.72	16200	0.74	17000	0.77	18200	0.83
1963	18390	16000	0.87	16000	0.87	16000	0.87	16900	0.92
1964	20250	15000	0.74	15000	0.74	17100	0.84	19400	0.96
1965	22550	11000	0.49	11300	0.50	12500	0.55	17300	0.77
1966	27720	20000	0.72	20700	0.75	23600	0.85	25100	0.91
1967	33670	20200	0.60	20500	0.61	22100	0.66	28700	0.85
1968	20710	11200	0.54	12600	0.61	14000	0.70	16800	0.81
1969	11300	7500	0.66	7500	0.66	7570	0.67	7650	0.68
1970	24660	17700	0.72	17900	0.73	18800	0.76	21900	0.89
1971	23810	14000	0.59	14700	0.62	16400	0.69	18200	0.76
1972	20970	12600	0.60	13200	0.63	14600	0.70	19000	0.91
1980	20784	12300	0.59	12800	0.62	13500	0.65	16300	0.78
# of Val.	16								
Average	22100		0.66		0.68		0.73		0.83
Standard	4690		0.10		0.09		0.09		0.08

Comparison of Low Flows to Average Monthly Flow
Chulitna River near Talkeetna
No. 15292400
July

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow		3-Day Low Flow		7-Day Low Flow		14-Day Low Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{14}	Q_{14}/Q_M
1958	25010	19000	0.76	20200	0.81	21000	0.84	22900	0.92
1959	25650	20300	0.79	20800	0.81	21600	0.84	22100	0.86
1960	23650	17000	0.72	17300	0.73	19000	0.80	20600	0.87
1961	27420	22100	0.81	22300	0.81	23400	0.85	23900	0.87
1962	27220	25000	0.92	25000	0.92	25000	0.92	25000	0.92
1963	28950	23000	0.79	23000	0.79	23000	0.79	25400	0.88
1964	24430	21000	0.86	21000	0.86	21000	0.86	23500	0.96
1965	23230	19800	0.85	19900	0.86	20000	0.86	22800	0.98
1966	23750	17200	0.72	17400	0.73	17600	0.74	20000	0.84
1967	35570	27600	0.78	28000	0.79	29100	0.82	30300	0.85
1968	30140	23600	0.78	24900	0.83	26600	0.88	28800	0.96
1969	20820	14400	0.69	15500	0.74	16200	0.78	17600	0.85
1970	26100	21000	0.80	21300	0.32	22000	0.84	23800	0.91
1971	27280	17000	0.62	18000	0.66	19000	0.70	21900	0.80
1972	25770	19600	0.76	20200	0.78	21400	0.83	22300	0.87
1980	34948	26600	0.76	27200	0.78	28500	0.82	31300	0.90
# of Val.	16								
Average	26930		0.78		0.80		0.82		0.89
Standard	3980		0.07		0.06		0.05		0.05

susi8/b36

Comparison of Low Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1958	4197	2910	0.69	2940	0.70	3060	0.73	3290	0.78
1959	4723	3000	0.64	3070	0.65	3230	0.68	3500	0.74
1960	5135	2500	0.49	2600	0.51	2760	0.54	3130	0.62
1961	5777	3100	0.54	3270	0.57	3400	0.59	3850	0.67
1962	3506	1700	0.48	1800	0.51	1870	0.53	1940	0.55
1963	8062	4800	0.60	4800	0.60	4800	0.60	5590	0.69
1964	5642	3300	0.58	3330	0.59	3410	0.60	3690	0.65
1965	6071	2950	0.49	2950	0.49	2950	0.49	2950	0.49
1966	4682	2000	0.43	2000	0.43	2170	0.46	2630	0.56
1967	3483	1900	0.55	1930	0.55	2040	0.59	2390	0.69
1968	2898	1900	0.66	2000	0.69	2190	0.76	2330	0.80
1969	4578	3000	0.66	3000	0.66	3030	0.66	3170	0.75
1970	3826	3000	0.78	3000	0.78	3030	0.79	3170	0.83
1971	5439	2900	0.53	3000	0.55	3170	0.58	3700	0.68
# of Val.	14								
Average	4858		0.58		0.59		0.61		0.68
Standard Dev.	1324		0.10		0.10		0.10		0.10

susi8/b35

Comparison of Low Flows to Average Monthly Flow

Chulitna River near Talkeetna

No. 15292400

September

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1958	8000	6800	0.85	6800	0.85	6800	0.85	6800	0.85
1959	9957	6800	0.68	7000	0.70	7210	0.72	7460	0.75
1960	12420	7400	0.60	7470	0.60	7780	0.63	10700	0.86
1961	16030	9680	0.60	9990	0.62	11300	0.70	12900	0.80
1962	13490	8130	0.60	8170	0.61	8440	0.63	8990	0.67
1963	11330	10000	0.88	10000	0.88	10000	0.88	10000	0.88
1964	9235	6220	0.67	6850	0.74	7120	0.77	7380	0.80
1965	22260	10700	0.48	10700	0.48	17600	0.79	19900	0.89
1966	12200	8480	0.70	8660	0.71	9000	0.74	10500	0.86
1967	12510	6000	0.48	6400	0.51	7300	0.58	8760	0.70
1968	7375	4150	0.56	4260	0.58	4570	0.62	5360	0.73
1969	6704	4320	0.64	4410	0.66	4800	0.72	5350	0.80
1970	11330	5000	0.44	5000	0.44	5290	0.47	7040	0.62
1971	11080	6000	0.54	6170	0.50	6470	0.58	7540	0.68
1972	12120	6000	0.50	6090	0.50	6330	0.52	7470	0.62
1980	8240	6080	0.74	6270	0.76	6540	0.79	7690	0.93
# of Val.	16								
Average	11520		0.62		0.64		0.69		0.78
Standard Dev.	3770		0.13		0.13		0.12		0.10

susi8/b38

Comparison of Low Flows to Average Monthly Flows
Talkeetna River near Talkeetna
No. 15292700
June

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1964	17080	11000	0.64	11300	0.66	12300	0.72	13500	0.79
1965	11090	7120	0.64	7460	0.67	8700	0.78	9560	0.86
1966	12970	6420	0.49	7990	0.62	9130	0.70	9940	0.77
1967	9286	6200	0.67	6370	0.69	6660	0.72	7400	0.80
1968	14100	9500	0.67	9830	0.70	10600	0.75	12600	0.89
1969	5207	3440	0.66	3540	0.68	3730	0.72	4400	0.85
1970	7979	4700	0.59	5040	0.63	5700	0.71	6830	0.86
1971	19040	4750	0.25	4880	0.26	8450	0.44	16300	0.86
1972	12700	8560	0.67	8730	0.69	9030	0.71	10900	0.86
1973	12210	6260	0.51	6720	0.55	7630	0.62	9260	0.76
1974	8030	5200	0.65	5810	0.72	6470	0.81	7330	0.91
1975	13180	8810	0.67	9500	0.72	10500	0.80	11700	0.89
1976	10580	6040	0.57	7480	0.71	7640	0.72	8820	0.83
1977	18280	13300	0.73	13900	0.76	14200	0.78	15700	0.86
1978	7429	4540	0.61	4800	0.65	5660	0.76	7080	0.95
1979	12010	7090	0.59	7390	0.62	7710	0.64	9300	0.77
1980	11380	8000	0.70	8330	0.73	10400	0.91	10900	0.96
# of Val.	17								
Average	11910		0.61		0.65		0.72		0.85
Standard Dev.	3800		0.11		0.11		0.10		0.06

Comparison of Low Flows to Average Monthly Flows

Talkeetna River near Talkeetna

No. 15292700

May

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1965	3474	960	0.28	960	0.28	960	0.28	1100	0.32
1966	2410	540	0.22	577	0.24	687	0.29	1060	0.44
1967	4112	550	0.13	617	0.15	900	0.22	1860	0.45
1968	8840	1650	0.19	1750	0.20	2050	0.23	3000	0.34
1969	3869	1000	0.26	1100	0.28	1300	0.34	1750	0.45
1970	3950	800	0.20	850	0.22	1010	0.26	2030	0.51
1971	2145	650	0.30	683	0.32	743	0.35	932	0.43
1972	3516	800	0.23	850	0.24	971	0.28	1290	0.37
1973	3860	850	0.22	900	0.23	1010	0.26	1500	0.39
1974	5678	900	0.16	1000	0.18	1240	0.22	2010	0.35
1975	4084	600	0.15	633	0.15	693	0.17	936	0.23
1976	3439	1300	0.38	1500	0.44	2200	0.64	3030	0.88
1977	4244	660	0.16	673	0.16	739	0.17	1340	0.32
1978	2950	700	0.24	723	0.25	813	0.28	1810	0.61
1979	7790	1800	0.23	2070	0.27	2760	0.35	3790	0.49
1980	4820	2100	0.44	2200	0.46	2410	0.50	2900	0.60
# of Val.	16								
Average	4324		0.24		0.25		0.30		0.45
Standard Dev.	1732		0.08		0.09		0.12		0.15

Comparison of Low Flows to Average Monthly Flows
Talkeetna River near Talkeetna
No. 15292700
August

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1964	8396	5300	0.63	5430	0.65	6140	0.73	7100	0.85
1965	11150	5300	0.48	5570	0.50	6560	0.59	9280	0.83
1966	10730	7520	0.70	7650	0.71	8070	0.75	9010	0.84
1967	14160	8550	0.60	8720	0.62	9750	0.69	13000	0.92
1968	7546	5720	0.76	5960	0.79	6530	0.87	7110	0.94
1969	3787	2100	0.55	2110	0.56	2170	0.57	2230	0.59
1970	8752	6000	0.69	6220	0.71	6870	0.78	7800	0.89
1971	16770	7500	0.45	7670	0.46	8430	0.50	9570	0.57
1972	9576	6400	0.67	6500	0.68	6970	0.73	8380	0.88
1973	9927	5220	0.53	5330	0.54	5910	0.60	7680	0.77
1974	7704	3680	0.48	3940	0.51	4760	0.62	6200	0.80
1975	8487	4920	0.58	5130	0.60	5980	0.70	7020	0.83
1976	8088	4190	0.52	4370	0.54	5170	0.64	6480	0.80
1977	8005	4780	0.60	4840	0.60	5560	0.69	7360	0.92
1978	7001	3890	0.56	4100	0.59	4390	0.63	5160	0.74
1979	8274	4580	0.55	5180	0.63	6140	0.74	6530	0.79
1980	7220	4320	0.60	4530	0.63	4780	0.66	5960	0.83
# of Val.	17								
Average	9151		0.59		0.61		0.68		0.81
Standard Dev.	2922		0.08		0.09		0.09		0.10

Comparison of Low Flows to Average Monthly Flows

Talkeetna River near Talkeetna

No. 15292700

July

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1964	9820	7810	0.80	8190	0.83	8420	0.86	9310	0.95
1965	12180	8400	0.69	8490	0.70	9050	0.74	10600	0.87
1966	10100	5870	0.58	6220	0.62	6510	0.64	8640	0.86
1967	12600	8600	0.68	8800	0.70	8980	0.71	9370	0.74
1968	11230	9000	0.80	9000	0.80	9410	0.84	9770	0.87
1969	7080	5300	0.75	5680	0.80	6050	0.85	6840	0.97
1970	10320	7300	0.71	7690	0.75	8150	0.79	9110	0.88
1971	11760	7000	0.60	7670	0.65	8710	0.74	9750	0.83
1972	12030	9800	0.81	9880	0.82	10400	0.86	11300	0.94
1973	7676	5800	0.76	5870	0.76	6140	0.80	6700	0.87
1974	7755	6440	0.83	6560	0.85	6960	0.90	7220	0.93
1975	12070	8690	0.72	8940	0.74	9560	0.79	10600	0.88
1976	9026	6310	0.70	6620	0.73	7380	0.82	8440	0.94
1977	9344	7310	0.78	7350	0.79	7630	0.82	8580	0.92
1978	10790	8110	0.75	8610	0.80	10200	0.95	10200	0.95
1979	14440	9180	0.64	9550	0.66	11900	0.82	12300	0.85
1980	13900	10000	0.72	10100	0.73	10800	0.78	13000	0.97
# of Val.	17								
Average	10710		0.72		0.75		0.81		0.90
Standard Dev.	2120		0.07		0.07		0.07		0.06

Comparison of Low Flows to Average Monthly Flows

Talkeetna River near Talkeetna

No. 15292700

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	1 Day Low Flow Q_1/Q_M	3-Day Low Flow Q_3	3-Day Low Flow Q_3/Q_M	7-Day Low Flow Q_7	7-Day Low Flow Q_7/Q_M	14-Day Low Flow Q_{14}	14-Day Low Flow Q_{14}/Q_M
1964	3115	1910	0.61	2030	0.65	2170	0.70	2340	0.75
1965	4438	2150	0.48	2220	0.50	2410	0.54	2770	0.62
1966	2388	1100	0.46	1170	0.49	1270	0.53	1510	0.63
1967	2029	1500	0.74	1500	0.74	1540	0.76	1610	0.79
1968	1637	1200	0.73	1200	0.73	1240	0.76	1340	0.82
1969	1450	1100	0.76	1100	0.76	1100	0.76	1150	0.77
1970	2817	2000	0.71	2000	0.71	2000	0.71	2170	0.77
1971	2632	1800	0.68	1830	0.69	1910	0.73	2130	0.81
1972	3630	2000	0.55	2130	0.59	2400	0.66	3020	0.83
1973	1807	1200	0.66	1200	0.66	1260	0.67	1360	0.75
1974	1967	1200	0.61	1200	0.61	1390	0.71	1450	0.74
1975	2884	1200	0.42	1230	0.43	1330	0.46	1710	0.59
1976	1857	1400	0.75	1470	0.79	1530	0.82	1680	0.90
1977	3268	1600	0.49	1700	0.52	1900	0.58	2360	0.72
1978	1660	1120	0.67	1280	0.77	1380	0.83	1450	0.87
1979	3370	2200	0.65	2250	0.67	2300	0.68	2430	0.72
# of Val.	16								
Average	2559		0.62		0.64		0.68		0.76
Standard Dev.	854		0.11		0.11		0.11		0.09

susi8/b41

Comparison of Low Flows to Average Monthly Flows

Talkeetna River near Talkeetna

No. 15292700

September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1964	3815	3080	0.81	3160	0.83	3230	0.85	3410	0.89
1965	10670	5100	0.48	5130	0.48	6560	0.62	8170	0.77
1966	5370	3500	0.65	3600	0.67	3980	0.74	4600	0.86
1967	6971	3140	0.45	3280	0.47	3540	0.51	4200	0.60
1968	4120	2500	0.61	2530	0.61	2610	0.63	2890	0.70
1969	2070	1700	0.82	1700	0.82	1700	0.82	1730	0.84
1970	5993	3530	0.59	3600	0.60	3680	0.61	4750	0.79
1971	5990	3400	0.57	3470	0.58	3770	0.63	4090	0.68
1972	8709	4600	0.53	4700	0.54	5110	0.59	6210	0.71
1973	3861	2420	0.63	2480	0.64	2610	0.68	2860	0.74
1974	4763	2860	0.60	2930	0.62	3280	0.69	3570	0.75
1975	7960	4720	0.59	4830	0.61	5700	0.72	7740	0.97
1976	3205	2600	0.81	2700	0.84	2910	0.91	3100	0.97
1977	5826	3820	0.66	4030	0.69	4200	0.72	4960	0.85
1978	3513	2200	0.63	2300	0.65	2500	0.71	2760	0.78
1979	4039	3220	0.80	3230	0.80	3280	0.81	3400	0.84
1980	5400	2700	0.50	2730	0.51	2900	0.54	3470	0.64
# of Val.	17								
Average	5428		0.63		0.64		0.69		0.79
Standard Dev.	2192		0.12		0.12		0.11		0.11

Comparison of Low Flows to Average Monthly Flows
Susitna River at Susitna Station
No. 15294350
June

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	1 Day Low Flow Q_1/Q_M	3-Day Low Flow Q_3	3-Day Low Flow Q_3/Q_M	7-Day Low Flow Q_7	7-Day Low Flow Q_7/Q_M	14-Day Low Flow Q_{14}	14-Day Low Flow Q_{14}/Q_M
1975	128800	102000	0.79	106000	0.82	110000	0.85	118000	0.92
1976	107000	61800	0.58	69300	0.65	84500	0.79	97900	0.91
1977	165900	130000	0.78	143000	0.86	155000	0.93	158000	0.95
1978	90930	62800	0.69	65700	0.72	66300	0.73	76900	0.85
1979	119900	99000	0.83	101000	0.84	103000	0.86	111000	0.93
1980	142900	110000	0.77	113000	0.79	126000	0.88	138000	0.97
# of Val.	6								
Average	125900		0.74		0.78		0.84		0.92
Standard Dev.	26510		0.09		0.08		0.07		0.04

Comparison of Low Flows to Average Monthly Flows
Susitna River at Susitna Station
No. 15294350
May

Year	Mean Monthly Flow -Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1975	47540	9000	0.19	9330	0.20	10100	0.21	14100	0.30
1976	70460	30000	0.43	41300	0.59	62700	0.89	63000	0.89
1977	56180	7500	0.13	8000	0.14	9500	0.17	19000	0.34
1978	48670	11000	0.23	12300	0.25	17600	0.36	36700	0.75
1979	81260	18000	0.22	21000	0.26	32600	0.40	55000	0.68
1980	66580	20000	0.30	22700	0.34	31300	0.47	46600	0.70
# of Val.	6								
Average	61780		0.25		0.30		0.42		0.61
Standard Dev.	13295		0.10		0.16		0.26		0.24

Comparison of Low Flows to Average Monthly Flows
Susitna River at Susitna Station
No. 15294350
August

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1975	91360	57600	0.63	63600	0.70	71200	0.78	80000	0.88
1976	99650	56800	0.57	61700	0.62	71900	0.72	82800	0.83
1977	125500	76200	0.61	80900	0.64	96600	0.77	116000	0.92
1978	102100	66400	0.65	68400	0.67	72500	0.71	83600	0.82
1979	128200	78900	0.62	88800	0.69	99900	0.78	116000	0,90
1980	126400	92000	0.73	95300	0.75	103000	0.81	111000	0.88
# of Val.	6								
Average	112200		0.64		0.68		0.76		0.87
Standard Dev.	16300		0.05		0.05		0.04		0.04

susi8/b45

Comparison of Low Flows to Average Monthly Flows

Susitna River at Susitna Station

No. 15294350

July

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	Q_1/Q_M	3-Day Low Flow Q_3	Q_3/Q_M	7-Day Low Flow Q_7	Q_7/Q_M	14-Day Low Flow Q_{14}	Q_{14}/Q_M
1975	135700	108000	0.80	113000	0.83	114000	0.84	121000	0.89
1976	115200	93400	0.81	95400	0.83	100000	0.87	107000	0.93
1977	143900	124000	0.86	127000	0.88	134000	0.93	141000	0.98
1978	117600	106000	0.90	109000	0.93	115000	0.98	117000	0.99
1979	142500	110000	0.77	111000	0.78	129000	0.91	133000	0.93
1980	181400	145000	0.80	148000	0.82	160000	0.88	176000	0.97
# of Val.	6								
Average	139380		0.82		0.85		0.90		0.95
Standard Dev.	23950		0.05		0.05		0.05		0.04

susi8/b48

Comparison of Low Flow and Average Monthly Flows

Susitna River at Susitna Station

No. 15294350

October

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow Q_1	1 Day Low Flow Q_1/Q_M	3-Day Low Flow Q_3	3-Day Low Flow Q_3/Q_M	7-Day Low Flow Q_7	7-Day Low Flow Q_7/Q_M	14-Day Low Flow Q_{14}	14-Day Low Flow Q_{14}/Q_M
1974	19520	11000	0.56	11300	0.58	12100	0.62	13600	0.70
1975	31550	16000	0.51	17300	0.55	18900	0.60	22700	0.72
1976	30140	23000	0.76	24000	0.80	26400	0.88	29300	0.97
1977	38230	19000	0.50	19700	0.52	21300	0.56	24800	0.65
1978	36810	26000	0.71	26700	0.73	30000	0.81	35100	0.95
1979	58640	33800	0.58	34200	0.58	36100	0.62	41400	0.71
# of Val.	6								
Average	35815		0.60		0.63		0.68		0.78
Standard Dev.	12990		0.11		0.11		0.13		0.14

Comparison of Low Flows to Average Monthly Flows

Susitna River at Susitna Station

No. 15294350

September

Year	Mean Monthly Flow - Q_M (cfs)	1 Day Low Flow		3-Day Low Flow		7-Day Low Flow		14-Day Low Flow	
		Q_1	Q_1/Q_M	Q_3	Q_3/Q_M	Q_7	Q_7/Q_M	Q_{14}	Q_{14}/Q_M
1975	77740	47800	0.61	48000	0.62	57700	0.74	73700	0.95
1976	48910	37000	0.76	37300	0.76	38600	0.79	39200	0.80
1977	83810	59200	0.71	64000	0.76	69400	0.83	81200	0.97
1978	55500	29000	0.52	30000	0.54	32100	0.58	40100	0.72
1979	74340	51800	0.70	52200	0.70	53100	0.71	56900	0.77
1980	91200	80000	0.88	80700	0.88	81100	0.89	83700	0.92
# of Val.	6								
Average	71910		0.70		0.71		0.76		0.86
Standard Dev.	16440		0.12		0.12		0.11		0.10

susi8/f2

Comparison of Annual Low Daily Flows to Annual Low Monthly Flow
Susitna River at Gold Creek
Station Number 1529200

Year	1-Day Low Flow Q_1	Q_1/Q_m	3-Day Low Flow Q_3	Q_3/Q_m	7-Day Low Flow Q_7	Q_7/Q_m	14-Day Low Flow Q_{14}	Q_{14}/Q_m	30-Day Low Flow Q_{30}	Q_{30}/Q_m	60-Day Low Flow Q_{60}	Q_{60}/Q_m	90-Day Low Flow Q_{90}	Q_{90}/Q_m
1950	600	0.76	600	0.76	614	0.78	648	0.82	674	0.93	716	0.99	797	1.10
1951	740	1.00	740	1.00	740	1.00	740	1.00	740	1.00	772	1.04	823	1.11
1952	880	1.00	880	1.00	880	1.00	880	1.00	880	1.00	899	1.02	932	1.06
1953	820	1.00	820	1.00	820	1.00	820	1.00	820	1.00	822	1.00	888	1.08
1954	780	1.00	780	1.00	780	1.00	780	1.00	780	1.00	854	1.09	956	1.23
1955	1100	1.00	1100	1.00	1100	1.00	1100	1.00	1100	1.00	1150	1.05	1230	1.12
1956	940	1.00	940	1.00	940	1.00	940	1.00	940	1.00	945	1.01	953	1.01
1957	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1300	1.08
1958	1100	0.96	1100	0.96	1100	0.96	1100	0.96	1140	0.99	1200	1.05	1280	1.11
1959	980	1.00	980	1.00	980	1.00	980	1.00	980	1.00	1040	1.06	1160	1.18
1960	1100	0.92	1100	0.92	1100	0.92	1100	0.92	1100	0.92	1220	1.02	1310	1.09
1961	1500	0.83	1500	0.83	1500	0.83	1500	0.83	1610	0.92	1800	1.03	2010	1.15
1962	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1450	1.04	1540	1.10
1963	830	1.00	830	1.00	830	1.00	830	1.00	830	1.00	915	1.10	1110	1.34
1964	660	0.93	660	0.93	660	0.93	660	0.93	683	0.96	728	1.02	794	1.11
1965	860	1.00	860	1.00	860	1.00	860	1.00	863	1.00	882	1.03	908	1.06
1966	1300	1.00	1300	1.00	1300	1.00	1300	1.00	1300	1.00	1300	1.00	1330	1.02
1967	1100	0.94	1100	0.94	1100	0.94	1100	0.94	1130	0.97	1180	1.01	1250	1.07
1968	1800	0.94	1800	0.94	1800	0.94	1830	0.96	1870	0.98	1880	0.99	1890	0.99
1969	700	0.97	700	0.97	700	0.97	700	0.97	700	0.97	723	1.00	750	1.04
1970	750	0.98	750	0.98	750	0.98	750	0.98	750	0.98	773	1.01	790	1.03
1971	950	1.00	950	1.00	950	1.00	950	1.00	950	1.00	970	1.02	1020	1.07
1972	1600	0.94	1600	0.94	1600	0.94	1640	0.96	1680	0.98	1760	1.03	1850	1.08
1973	1000	1.00	1000	1.00	1000	1.00	1000	1.00	1000	1.00	1010	1.01	1070	1.07
1974	700	0.97	700	0.97	700	0.97	700	0.97	707	0.97	730	1.01	762	1.05
1975	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1410	1.01	1440	1.03
1976	900	1.00	900	1.00	900	1.00	900	1.00	900	1.00	916	1.02	928	1.03
1977	1500	1.00	1500	1.00	1500	1.00	1500	1.00	1500	1.00	1550	1.03	1590	1.06
1978	1600	1.00	1600	1.00	1600	1.00	1600	1.00	1600	1.00	1620	1.01	1650	1.03
1979	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1230	1.03	1260	1.05
1980	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1400	1.00	1450	1.04
Average		0.97		0.97		0.97		0.98		0.99		1.02		1.08
Standard Dev.		0.05		0.05		0.05		0.05		0.02		0.03		0.07

susi8/f1

Comparison of Annual Low Daily Flows to Annual Low Monthly Flow
Susitna River near Cantwell
Station Number 15291500

Year	1-Day Low Flow		3-Day Low Flow		7-Day Low Flow		14-Day Low Flow		30-Day Low Flow		60-Day Low Flow		90-Day Low Flow	
	Q_1	Q_1/Q_m	Q_3	Q_3/Q_m	Q_7	Q_7/Q_m	Q_{14}	Q_{14}/Q_m	Q_{30}	Q_{30}/Q_m	Q_{60}	Q_{60}/Q_m	Q_{90}	Q_{90}/Q_m
1962	940	1.00	940	1.00	940	1.00	940	1.00	940	1.00	972	1.03	1050	1.12
1963	720	1.00	720	1.00	720	1.00	720	1.00	740	1.00	740	1.03	777	1.08
1964	400	0.93	400	0.93	400	0.93	400	0.93	419	0.98	446	1.04	488	1.14
1965	680	1.00	680	1.00	680	1.00	680	1.00	681	1.00	694	1.02	718	1.06
1966	650	1.00	650	1.00	650	1.00	650	1.00	650	1.00	651	1.00	667	1.03
1967	500	0.97	500	0.97	500	0.97	500	0.97	510	0.99	536	1.04	571	1.11
1968	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00	1200	1.00
1969	480	0.99	480	0.99	480	0.99	480	0.99	484	1.00	492	1.01	511	1.05
1970	420	0.99	420	0.99	420	0.99	420	0.99	420	0.99	428	1.00	442	1.04
1971	460	0.98	460	0.98	460	0.98	460	0.98	465	0.99	474	1.01	500	1.06
1972	850	0.97	850	0.97	850	0.97	850	0.97	850	0.97	873	1.00	892	1.02
Average		0.98		0.98		0.98		0.98		0.99		1.02		1.06
Standard Dev.		0.02		0.02		0.02		0.02		0.01		0.02		0.04

susi8/f4

Comparison of Annual Low Daily Flows to Annual Low Monthly Flow
Talkeetna River near Talkeetna
Station Number 15292700

Year	1-Day Low Flow		3-Day Low Flow		7-Day Low Flow		14-Day Low Flow		30-Day Low Flow		60-Day Low Flow		90-Day Low Flow	
	Q_1	Q_1/Q_m	Q_3	Q_3/Q_m	Q_7	Q_7/Q_m	Q_{14}	Q_{14}/Q_m	Q_{30}	Q_{30}/Q_m	Q_{60}	Q_{60}/Q_m	Q_{90}	Q_{90}/Q_m
1965	540	1.00	540	1.00	540	1.00	540	1.00	540	1.00	559	1.04	580	1.07
1966	390	0.99	390	0.99	390	0.99	390	0.99	393	0.99	405	1.03	446	1.13
1967	420	0.98	420	0.98	420	0.98	420	0.98	425	1.00	448	1.05	481	1.13
1968	740	1.00	740	1.00	740	1.00	740	1.00	741	1.00	754	1.01	774	1.04
1969	380	1.00	380	1.00	380	1.00	380	1.00	380	1.00	384	1.01	398	1.05
1970	440	1.00	440	1.00	440	1.00	440	1.00	440	1.00	444	1.01	456	1.04
1971	400	1.00	400	1.00	400	1.00	400	1.00	400	1.00	420	1.04	448	1.11
1972	400	0.77	400	0.77	400	0.77	411	0.79	434	0.84	481	1.00	539	1.12
1973	500	0.87	500	0.87	500	0.87	514	0.89	533	0.92	566	0.99	599	1.04
1974	450	0.93	450	0.93	450	0.93	450	0.93	458	0.95	485	1.01	516	1.07
1975	500	0.98	500	0.98	500	0.98	500	0.98	500	0.98	512	1.01	538	1.06
1976	460	0.98	460	0.98	460	0.98	460	0.98	463	0.99	471	1.00	479	1.02
1977	500	0.99	500	0.99	500	0.99	500	0.99	505	1.00	516	1.02	534	1.06
1978	460	0.95	460	0.95	461	0.95	466	0.96	473	0.98	497	1.02	531	1.09
1979	540	0.94	540	0.94	540	0.94	541	0.94	548	0.95	576	1.00	611	1.06
1980	700	1.00	700	1.00	700	1.00	700	1.00	700	1.00	713	1.02	742	1.06
Average		0.96		0.96		0.96		0.96		0.98		1.02		1.07
Standard Dev.		0.06		0.06		0.06		0.06		0.04		0.02		0.03

susi8/f5

Comparison of Annual Low Daily Flows to Annual
Low Monthly Flow
Susitna River at Susitna Station
Station Number 15294350

Year	1-Day Low Flow Q_1	Q_1/Q_m	3-Day Low Flow Q_3	Q_3/Q_m	7-Day Low Flow Q_7	Q_7/Q_m	14-Day Low Flow Q_{14}	Q_{14}/Q_m	30-Day Low Flow Q_{30}	Q_{30}/Q_m	60-Day Low Flow Q_{60}	Q_{60}/Q_m	90-Day Low Flow Q_{90}	Q_{90}/Q_m
1975	6500	0.95	6500	0.95	6500	0.95	6500	0.95	6720	0.98	6920	1.01	7230	1.05
1976	5200	0.97	5200	0.97	5200	0.97	5200	0.97	5310	0.99	5370	1.00	5580	1.04
1977	6000	0.96	6000	0.96	6000	0.96	6000	0.96	6180	0.99	6490	1.04	7220	1.16
1978	6400	0.91	6400	0.91	6400	0.91	6430	0.91	6520	0.99	6590	1.00	6680	1.01
1979	6500	0.75	6500	0.75	6500	0.75	6640	0.76	6830	0.97	7100	1.01	7500	1.07
1980	8600	0.97	8630	0.97	8700	0.98	8800	0.99	8870	1.00	8960	1.01	9210	1.03
Average		0.92		0.92		0.92		0.92		0.99		1.10		1.06
Standard		0.09		0.09		0.09		0.08		0.01		0.01		0.05

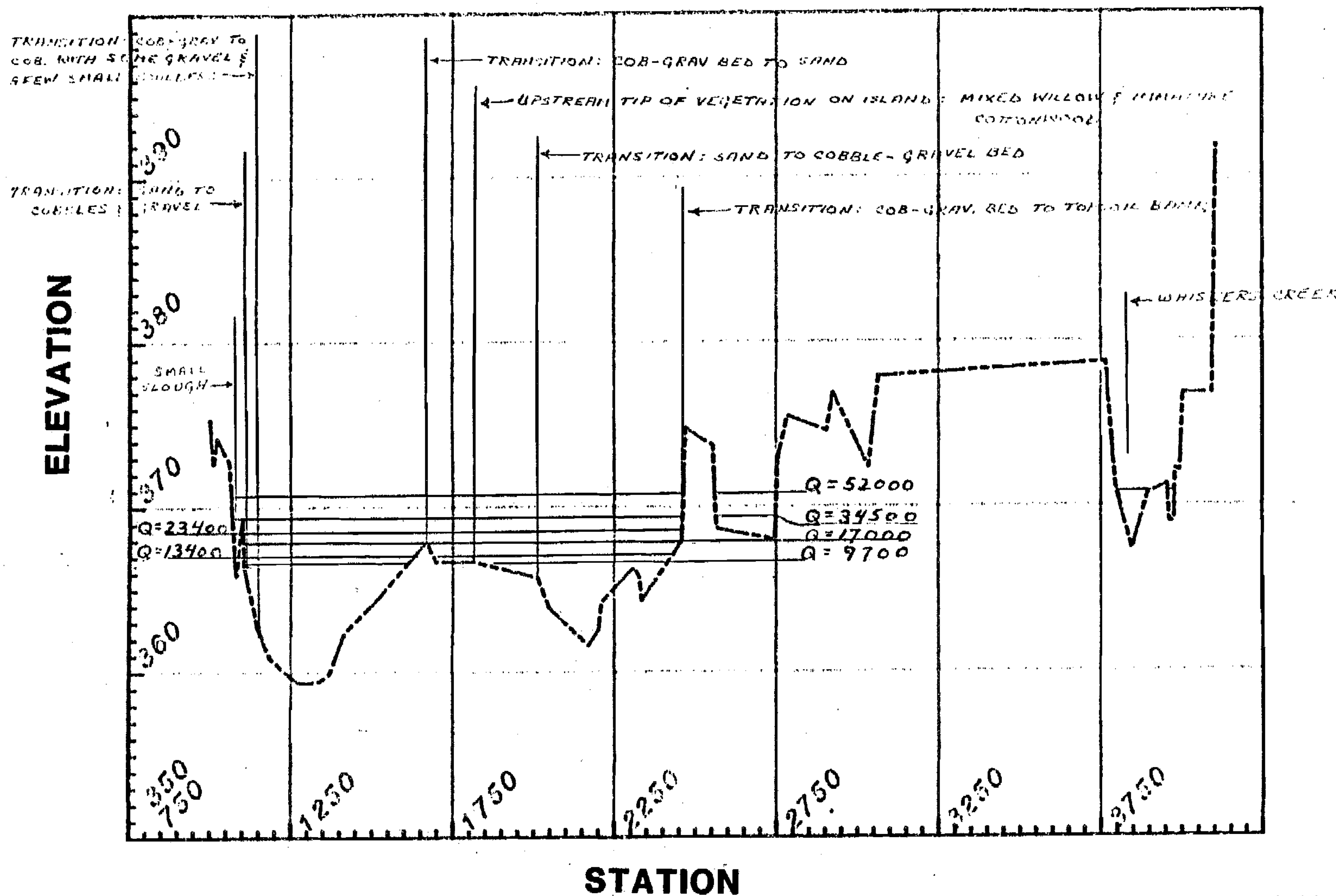
ATTACHMENT C

WATER SURFACE ELEVATIONS

r29/g3

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 7



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 101.5

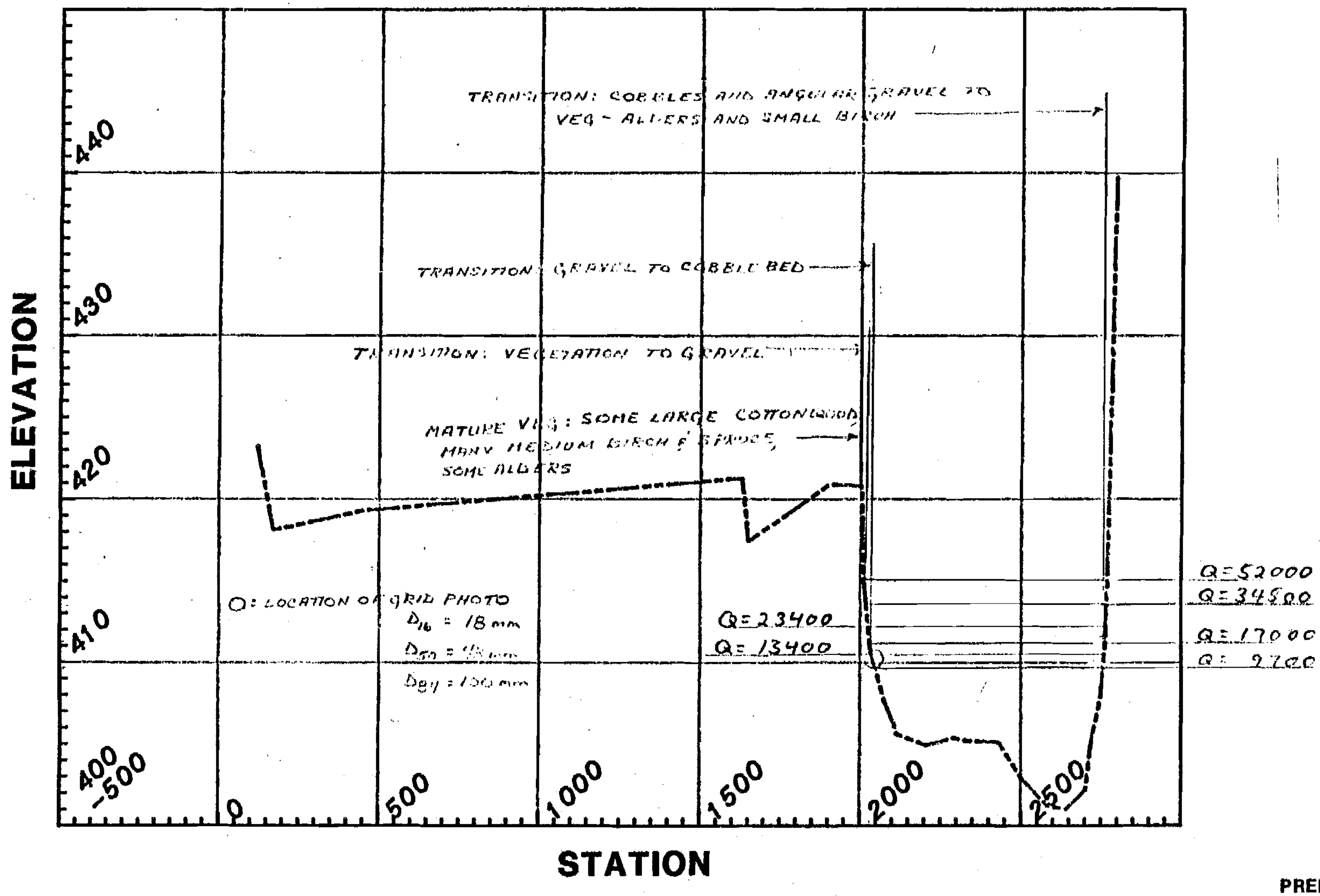
PREPARED FOR:

ACRES

FIGURE C.1

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 11



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 106.7

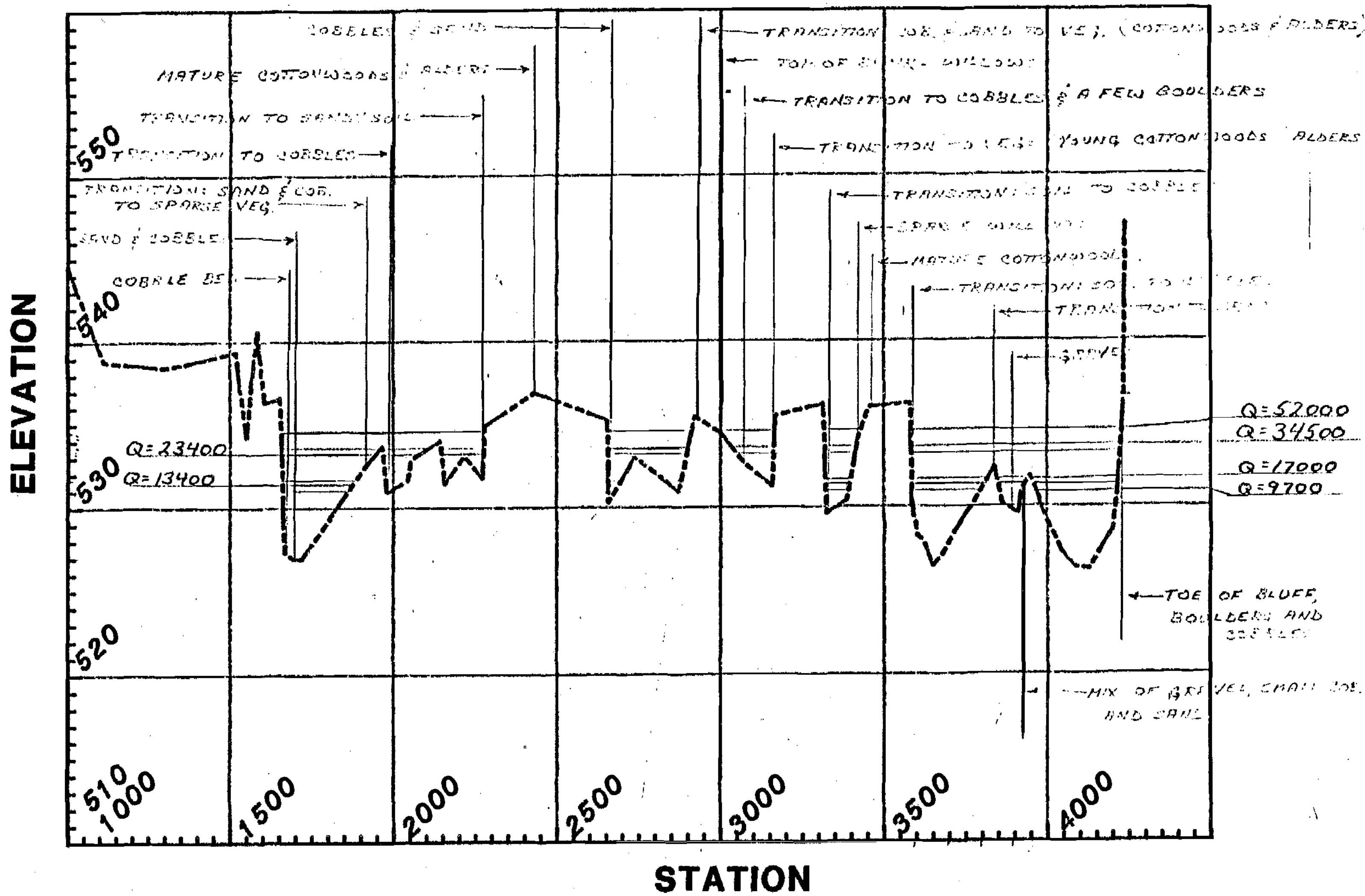
PREPARED FOR:

ACRES

FIGURE C.2

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 25



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 121.6

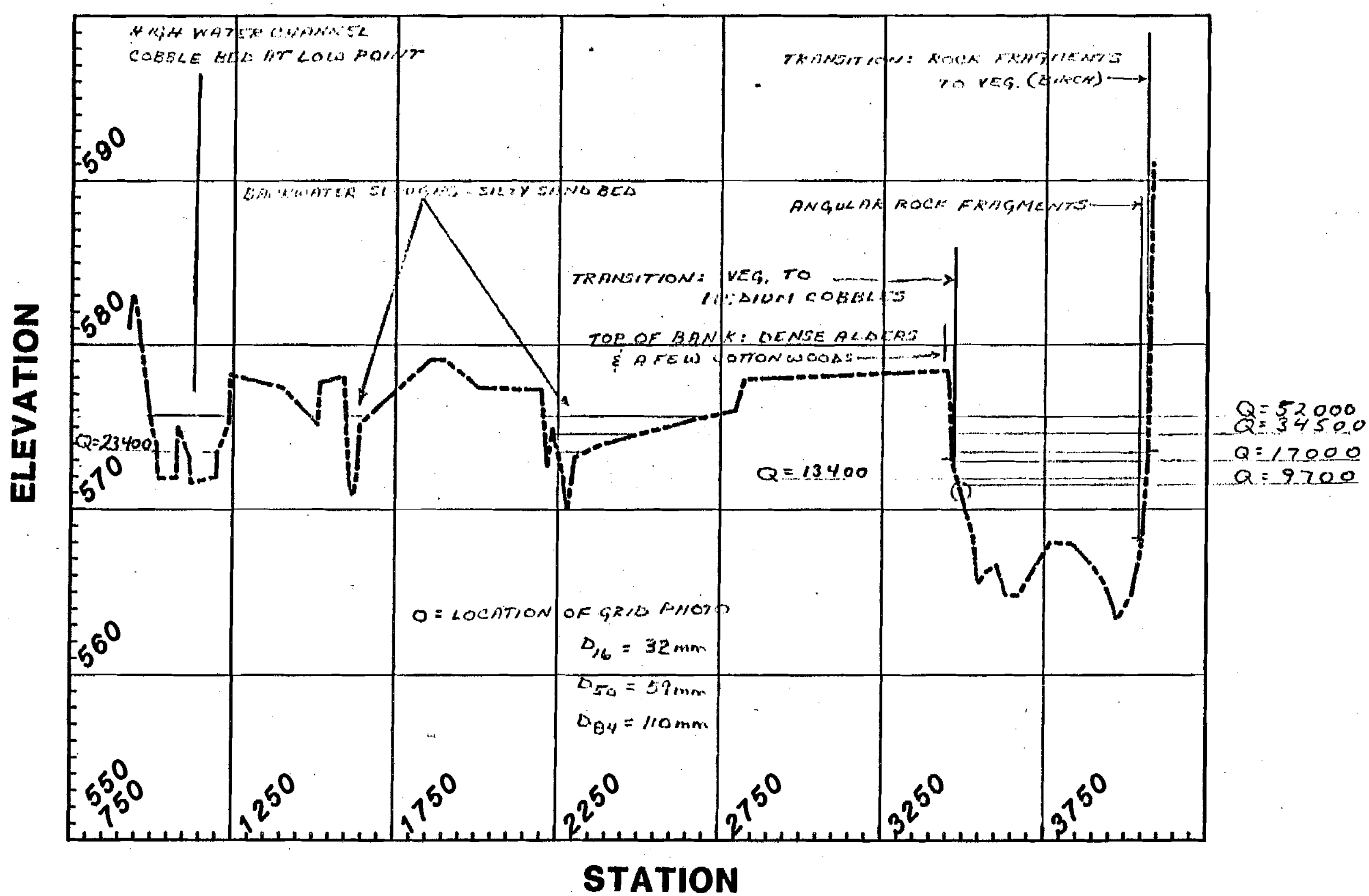
PREPARED FOR:

ACRES

FIGURE C.3

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 29



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 126.1

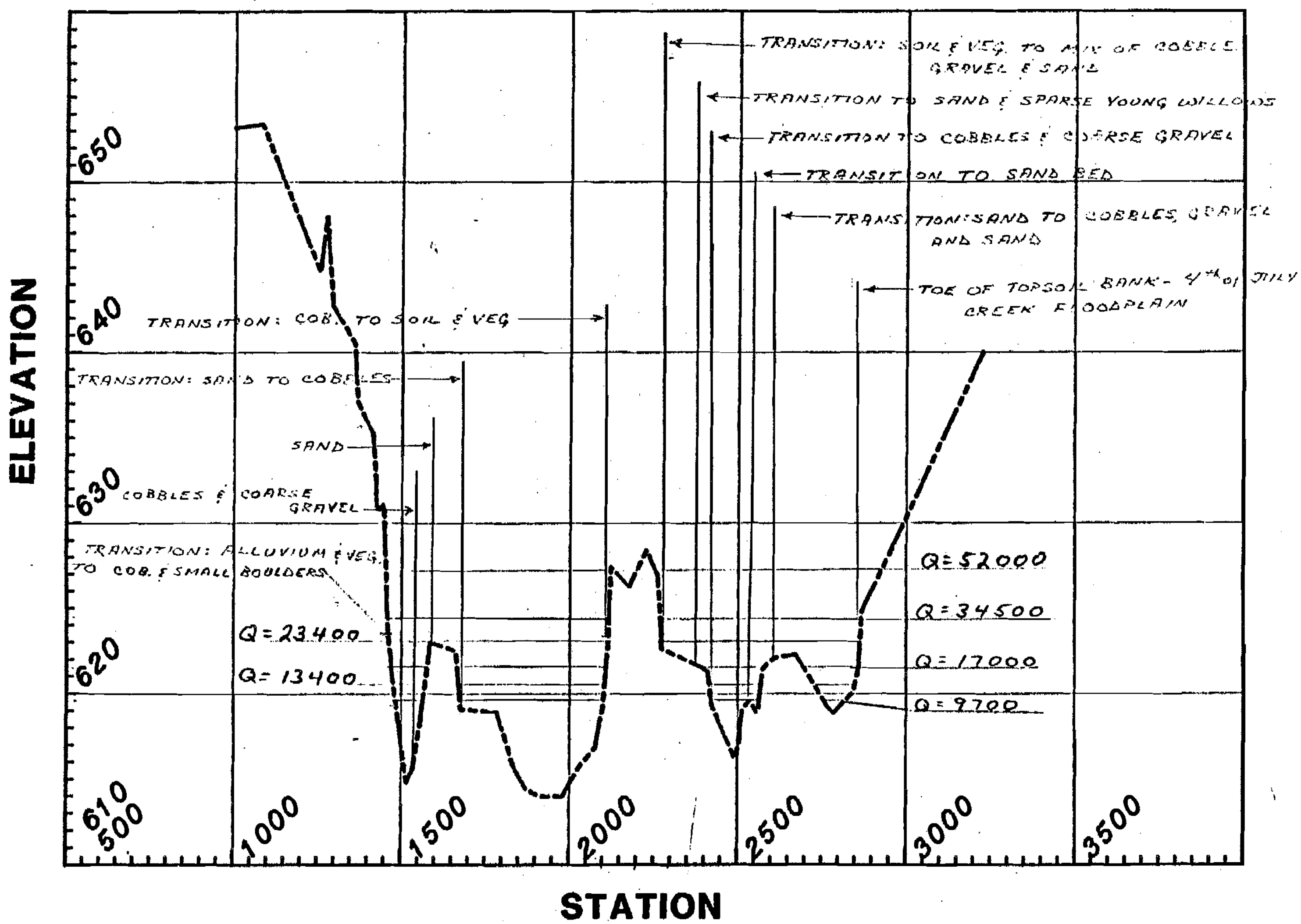
PREPARED FOR:

ACRES

FIGURE C.4

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 36



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 131.2

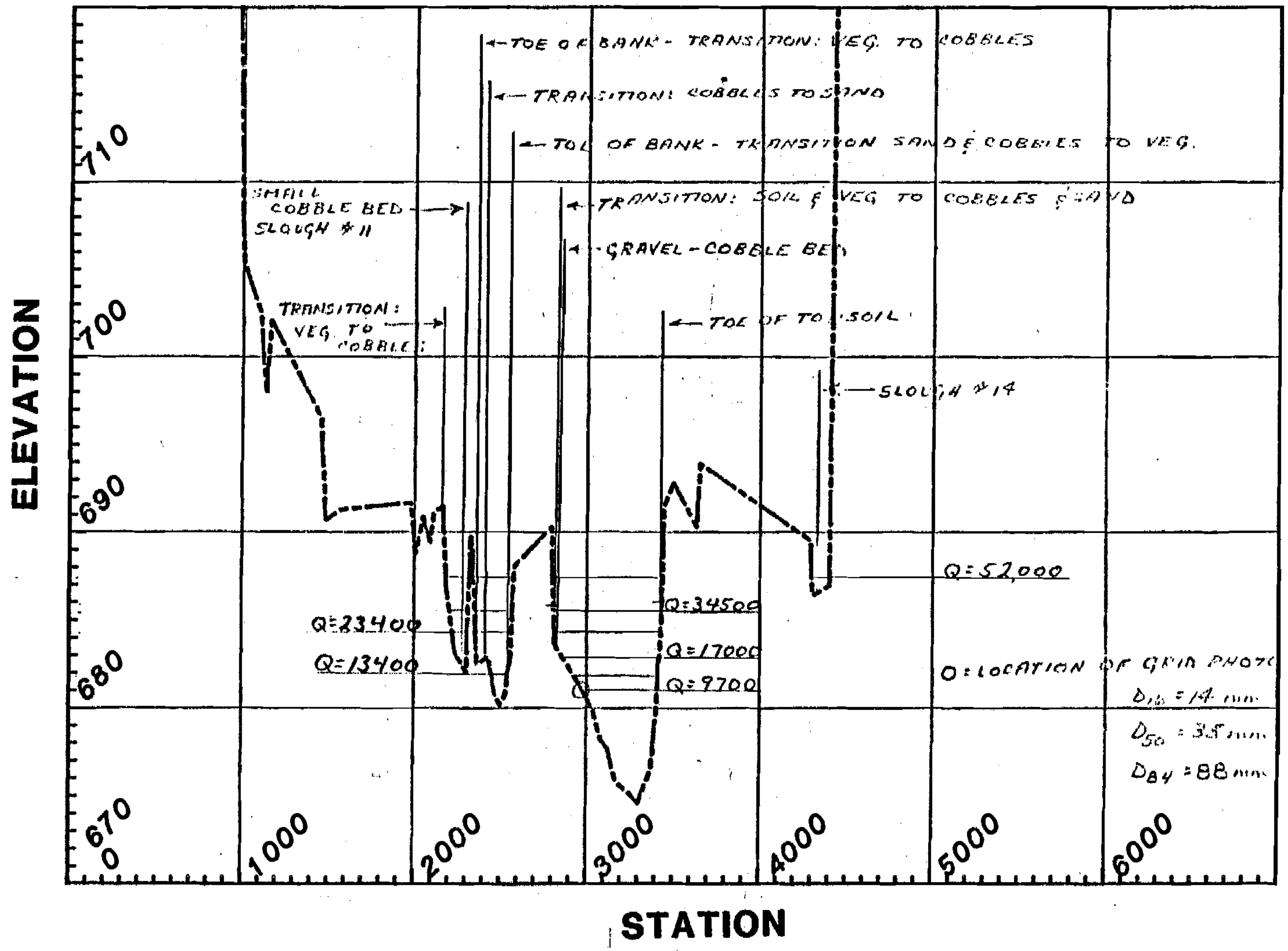
PREPARED FOR:

ACRES

FIGURE C.5

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 44



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 136.4

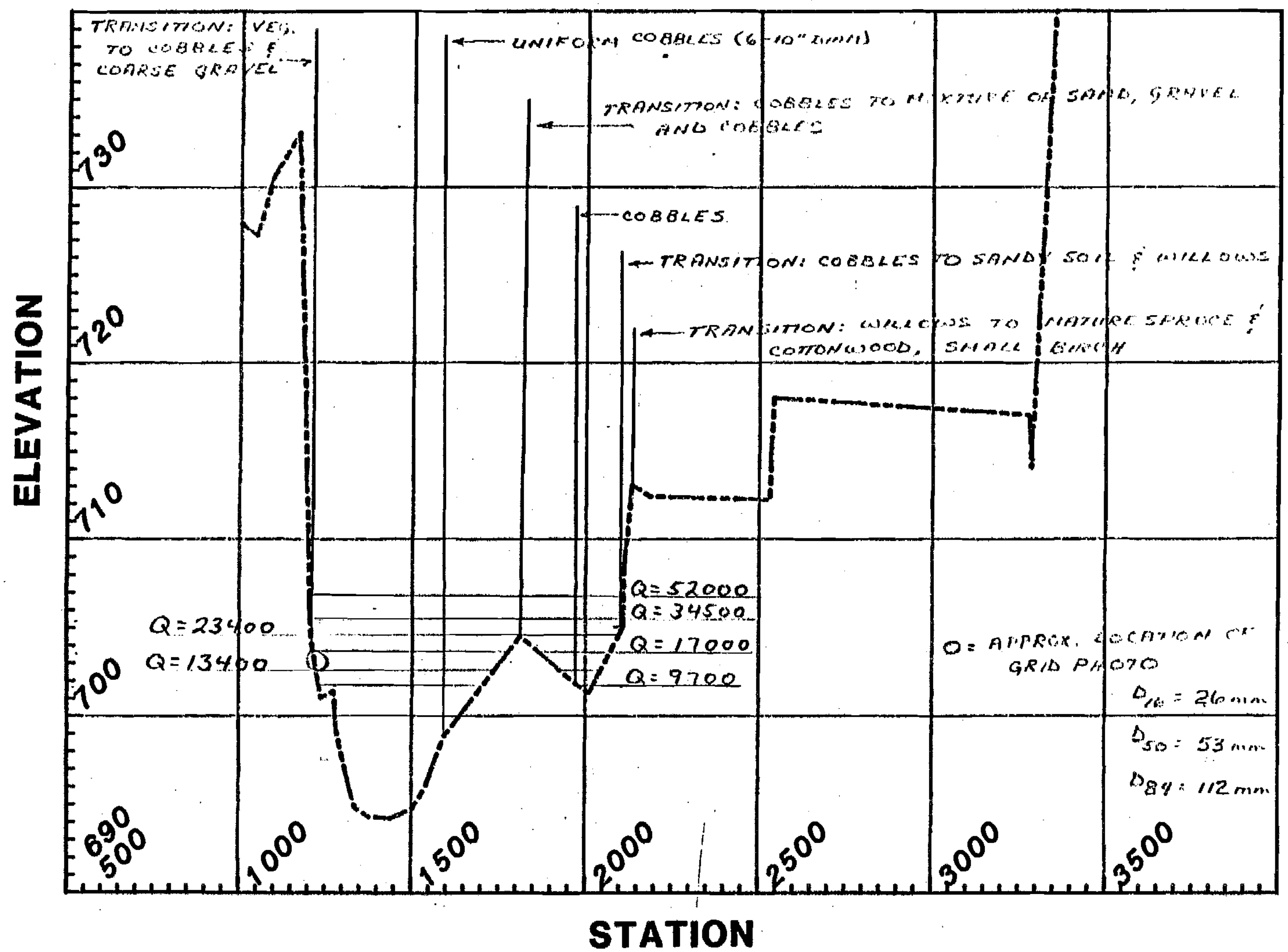
PREPARED FOR:

ACRES

FIGURE C.6

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 49



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 138.2

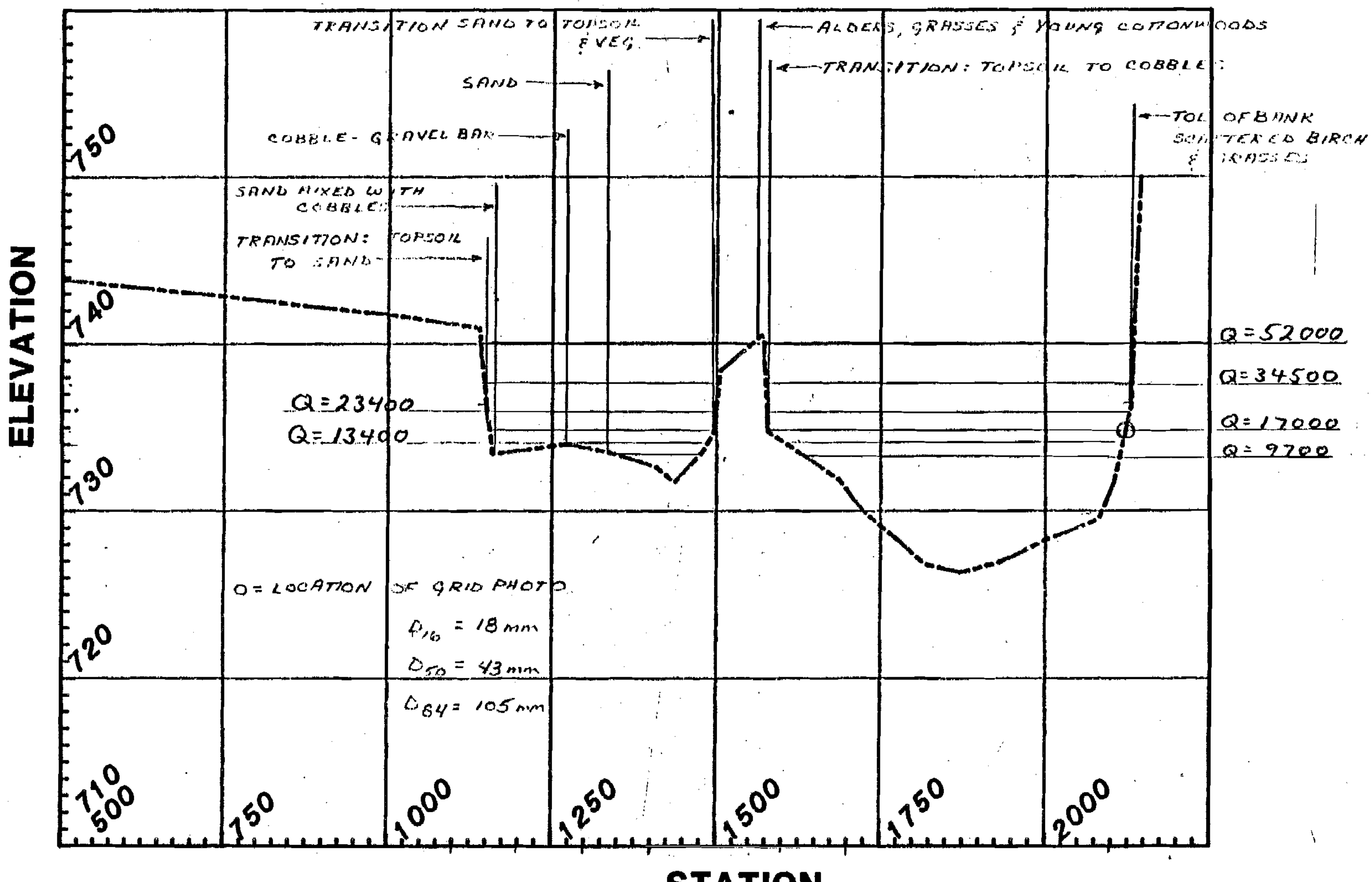
PREPARED FOR:

ACRES

FIGURE C.7

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 54



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 140.8

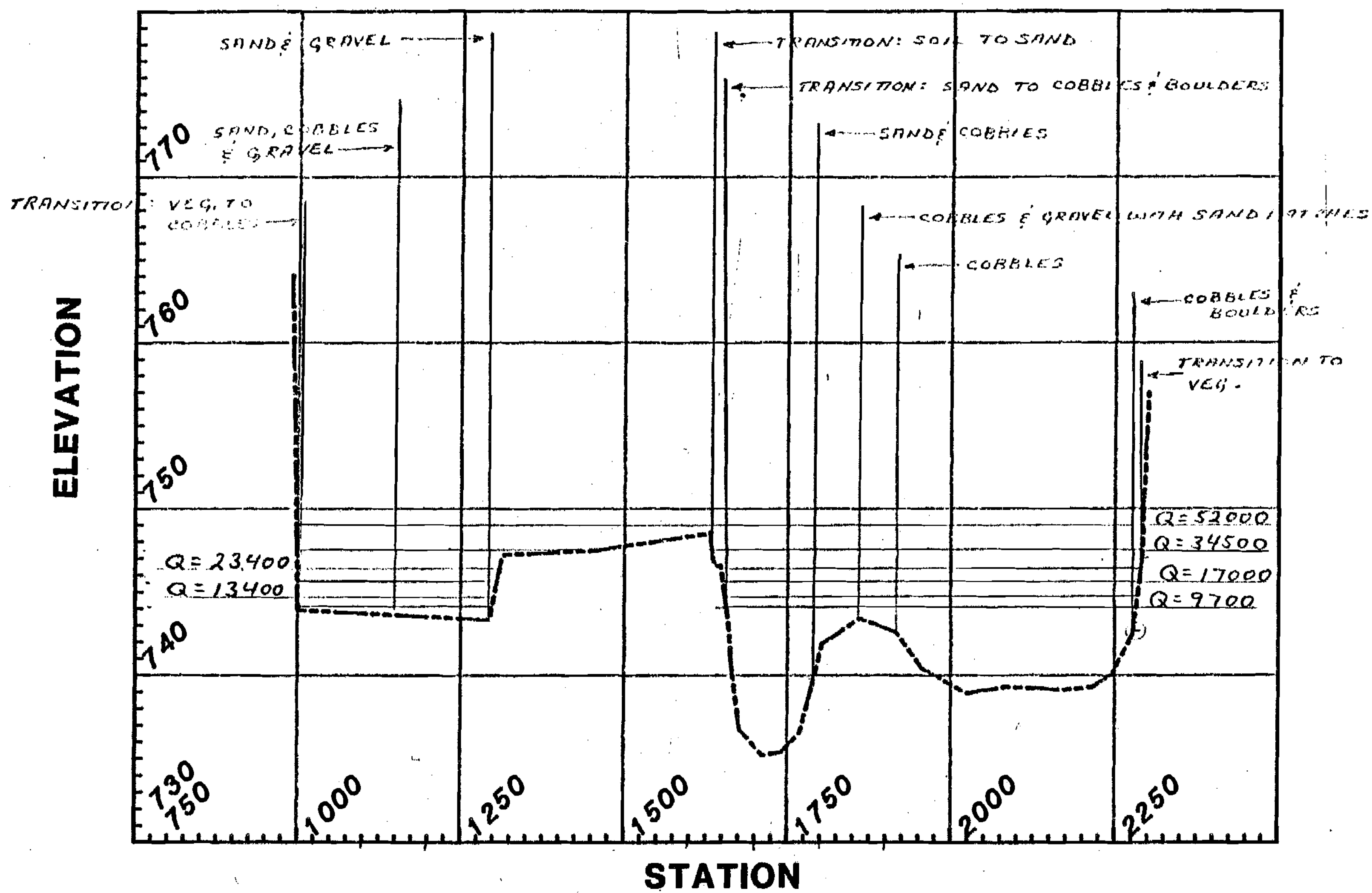
PREPARED FOR:

ACRES

FIGURE C.8

SUSITNA HYDROELECTRIC PROJECT

CROSS-SECTION Number 55



PREPARED BY:

R&M CONSULTANTS, INC.

CROSS-SECTION
RM 141.5

PREPARED FOR:

ACRES

FIGURE C.9