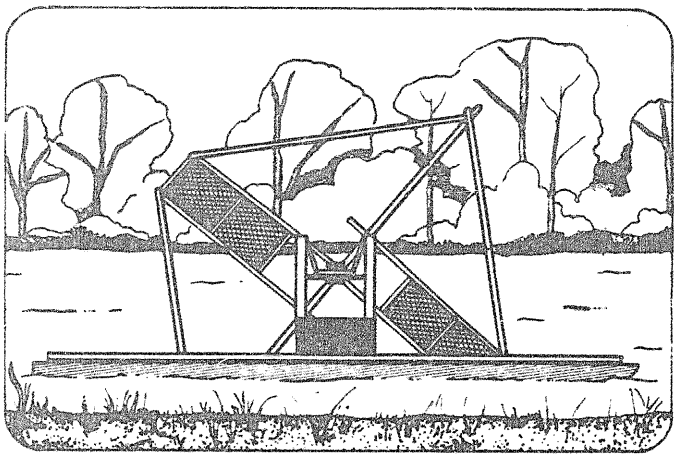
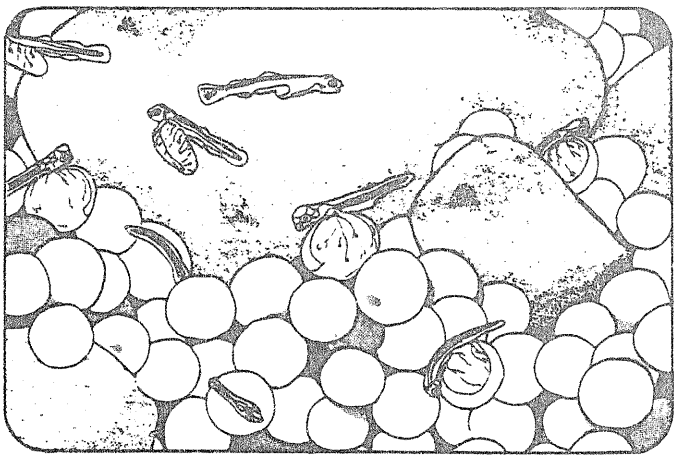
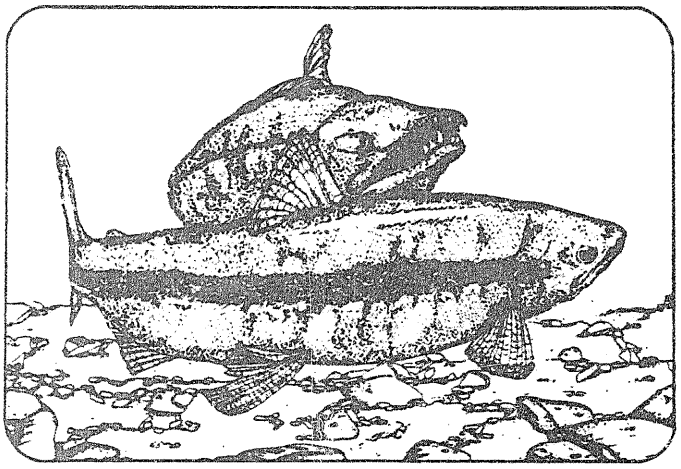
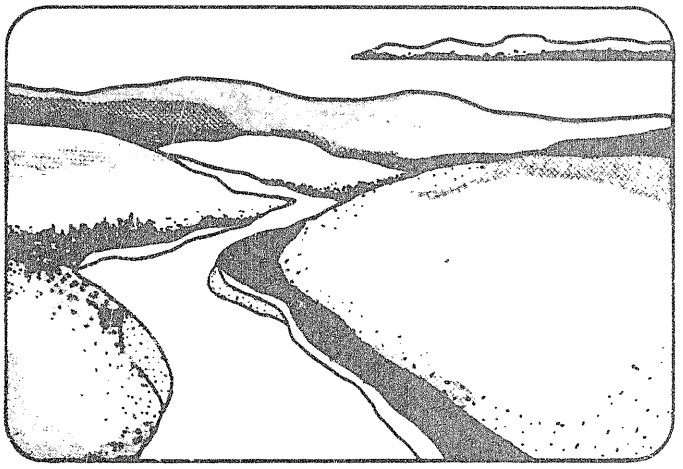

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES

REPORT NO. 3 Part I, Chapter 1

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

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FORWARD

Part I, "Basin-wide Hydrologic and Water Quality Investigations", is a compilation of the physical and chemical data collected by the ADF&G Su Hydro Aquatic Studies team during the FY 84 open water field season (May-October, 1983). In certain cases, the the 1983 data bases have been combined with the ADF&G 1981 and 1982 data bases, along with other data bases from other subcontractors (R&M Consultants and AEIDC) in order to present a most up to complete listing of currently available data. These data are arranged by data type for ease of use by user agencies.

Part I is divided into five chapters:

Chapter 1 Stage/discharge investigations of the Susitna River basin.

Chapter 2 Channel geometry investigations of the Susitna River basin.

Chapter 3 Continuous water temperature investigations of the Susitna River basin.

Chapter 4 Water quality ivestigations of the Susitna River basin.

Chapter 5 Dissolved gas concentration investigations of the Susitna River basin.

GLOSSARY FOR PART I OF REPORT # 3

Backwater Area - A body or accumulation of water with little or no velocity resulting from a hydraulic (e.g. mainstem discharge) or physical (e.g. beaver dam) barrier which occurs at the mouth of or within a side channel or slough.

Berm - The ledge or shelf at the head of a side slough or side channel that separates the side slough or channel from the mainstem Susitna River or other side channels.

Breaching - Any of the three conditions of overtopping of the head of a side channel or side slough (see also initial, intermediate, and controlling breaching discharges).

Controlling Breaching Discharge - The breaching condition in which mainstem discharges at Gold Creek are equal to or greater than the mainstem discharge required to directly govern the hydraulic characteristics within a side slough or side channel. This condition can be denoted as equalling the segment of the flow rating curve beginning with the point of inflection and beyond.

Cross Section Profile - A profile describing the cross sectional geometry of a channel.

Datapod - An instrument used to continuously measure and record various enviornmental variables e.g. air or water temperature, stage, and dissolved gas concentration (refer to Chapters 1, 2 and 5).

Discharge - Water volume passing a fixed location at a specific point in time. The term specifically refers to the moving water in the mainstem habitat.

DSM - Data Storage Module used in the datapod system to store data (refer to Chapters 1 and 2).

Flow - Water volume passing a specific location at a specific point in time. The term specifically refers to moving water in side channel, side slough, upland slough, tributary mouth, and tributary habitats.

Gaging Station - A station at a site which has been established for monitoring stage, flow and/or discharge.

Gradient - Rate of change in vertical elevation per unit horizontal distance.

Head - The upstream confluence or point of origin of a lotic water body.

Inflection Point - The point on a rating curve at which the line describing the data changes slope.

Initial Breaching Discharge - The mainstem discharge at Gold Creek which represents the initial point when mainstem water begins to enter the upstream head (berm) of a side slough or channel.

Intermediate Breaching Discharge - The range of mainstem discharges at Gold Creek representative of the conditions between the Initial and Controlling Breaching Discharges. This range occurs from immediately after mainstem surface water begins to overtop the upstream head (berm) of a side slough or side channel up to the point when the mainstem discharge begins to govern the hydraulic characteristics of the site.

Mainstem Habitat - Consists of those portions of the Susitna River that normally convey water throughout the year. Both single and multiple channel reaches are included in this habitat category. Groundwater and tributary inflow appear to be inconsequential contributors to the overall characteristics of mainstem habitat. Mainstem habitat is typically characterized by high water velocities and well armored streambeds. Substrates generally consist of boulder and cobble size materials with interstitial spaces filled with a grout-like mixture of small gravels and glacial sands. Suspended sediment concentrations and turbidity are high during summer due to the influence of glacial melt-water. Discharges recede in early fall and the mainstem clears appreciably in October. An ice cover forms on the river in late November or December.

Mean Daily Discharge - The computed mean discharge per 24 hour period for a gaging station. All USGS discharge data are in this format.

Monitoring Station - A station set up for the collection of a particular data base.

Mouth - The downstream confluence of one or more water bodies with another water body.

Overtopping - See breaching.

Peripheral Habitats - Aquatic habitats peripheral to the mainstem Susitna River habitat (e.g. side channel, side slough, upland slough, tributary mouth and/or tributary habitats.

Pool - A portion of a water course that is relatively deep and slow-moving in comparison to the rest of the water course.

Project Datum - A series of elevations tied to sea level that are used by project personnel to tie relative data bases together.

Rating Curve - A curve that is constructed from data representing two dependent variables (e.g. stage, flow or discharge data) that describes the relationship between the two variables at a site.

Riffle - A portion of a water course that is relatively shallow and fast-running in comparison to the rest of the water course.

Side Channel Habitat - Consists of those portions of the Susitna River that normally convey water during the open water season but become appreciably dewatered during periods of low mainstem discharge. Side channel habitat may exist either in well defined overflow channels, or in poorly defined water courses flowing through partially submerged gravel bars and islands along the margins of the mainstem river. Side channel streambed elevations are typically lower than the mean monthly water surface elevations of the mainstem Susitna River observed during June, July and August. Side channel habitats are characterized by shallower depths, lower velocities and smaller streambed materials than the adjacent habitat of the mainstem river.

Side Slough Habitat - is located in overflow channels between the edge of the floodplain and the mainstem and side channels of the Susitna River. It is usually separated from the mainstem and/or side channels by well vegetated bars. An exposed alluvial berm often separates the head of the slough from mainstem discharge or side channel flows. The controlling streambed/bank elevations at the upstream end of the side sloughs are slightly less than the water surface elevations of the mean monthly discharges of the mainstem Susitna River observed for June, July, and August. At intermediate and low-discharge periods, the side sloughs convey clear water from small tributaries and/or upwelling groundwater. These clear water inflows are essential contributors to the existence of this habitat type. The water surface elevation of the Susitna River generally causes a backwater to extend well up into the slough from its lower end. Even though this substantial

backwater exists, the sloughs function hydraulically very much like small stream systems and several hundred feet of the slough channel often conveys water independent of mainstem backwater effects. At high discharges the water surface elevations of the mainstem river is sufficient to overtop the upper end of the slough. Surface water temperatures in the side sloughs during summer months are principally a function of air temperature, solar radiation, and the temperature of the local runoff.

Staff Gage - A device used to instantaneously monitor stage at a site.

Stage - A measure of water depth which can be converted to water, surface elevation when surveyed to a benchmark at a site. It can be converted to true water surface elevation if it is tied into project datum.

Thalweg Profile - A longitudinal profile that describes the streambed elevation of the deepest portion or middle of mainstem, tributary, slough or other riverine habitats.

Tributary Habitat - consists of the full complement of hydraulic and morphologic conditions that occur in the tributaries. Their seasonal flow, sediment, and thermal regimes reflect the integration of the hydrology, geology, and climate of the tributary drainage. The physical attributes of tributary habitat are not dependent on mainstem conditions.

Tributary Mouth Habitat - extends from the uppermost point in the tributary influenced by mainstem Susitna River or slough backwater effects to the downstream extent of the tributary plume which extends into the mainstem Susitna River or slough.

Turbid - The condition of water quality at a site when water clarity is decreased by inorganic and/or organic suspended materials. Turbidity levels often exceed 50 NTU's.

Upland Slough Habitat - differs from side slough habitat in that the upstream end of the slough does not interconnect with the surface waters of the mainstem Susitna River or its side channels even at high mainstem discharges. These sloughs are characterized by the presence of beaver dams and an accumulation of silt covering the substrate resulting from the absence of mainstem scouring discharges.

Water Surface Elevation - The elevation of the water surface.

WSEL - See water surface elevation.

Stage and Discharge Investigations of the Susitna River Basin.

1984 Report No. 3, Chapter 1

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Susitna Hydro Aquatic Studies
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ABSTRACT

(To be written)

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1.0 INTRODUCTION AND OBJECTIVES

1.1 Background

The Alaska Department of Fish and Game (ADF&G) Su Hydro Aquatic Feasibility Study Team has collected stage and discharge data throughout much of the Susitna River basin since 1981. The primary emphasis on the stage and discharge data collection program has been to define the relationship that mainstem discharge has on stage (water surface elevation) in the mainstem portion of the river and stage and discharge within peripheral side channel, side slough, upland slough, and tributary habitats. Although measurements of stage and discharge have been obtained in the lower river (Cook Inlet to Talkeetna reach), the emphasis of the data collection program has been largely oriented to the reach of the Susitna River from Talkeetna upstream to the Devil Canyon as project related impacts are expected to be most severe in this reach.

Results of these investigations (ADF&G 1982, 1983) have indicated that the range of mainstem discharges experienced during 1981 and 1982 were relatively higher for 1981 and normal for 1982 as compared to the historical 25 year mainstem discharge conditions (Figure 1-1) (USGS 1978). It was found that for the range of mainstem discharges from 8,000 to 30,000 cfs, the relationship between water surface elevation in the mainstem and mainstem discharge is relatively well defined at various mainstem locations between Talkeetna and Devil Canyon.

An understanding of the relationship between mainstem discharge and the hydraulic characteristics of side sloughs was obtained for the range of

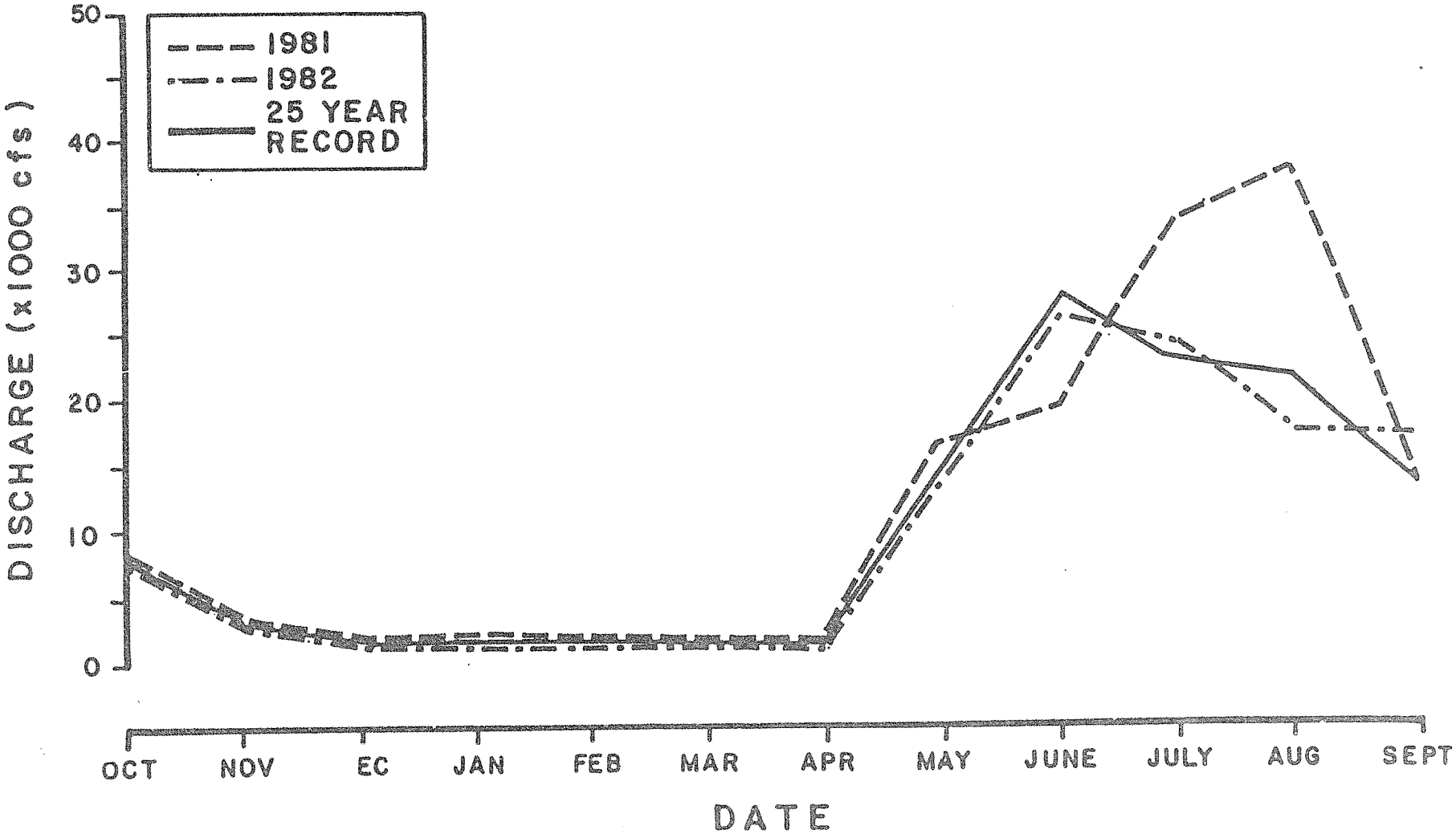

Figure 1-1 Comparison of the Gold Creek (USGS 15292000) mean daily mainstem discharge 25 year record to the 1981-1982, May - October, mean daily mainstem discharge at Gold Creek, (USGS 152920( ).

mainstem discharges from 8,000 to 30,000 cfs. Flows in side slough habitats during low to moderate mainstem discharges (when the head portions were not breached) was observed to consist primarily of ground water and surface water runoff. During these nonbreached conditions, side slough flow showed only an indirect relationship to mainstem discharge. With the occurrence of moderately high and high mainstem discharges, breaching (overtopping) of side slough habitats was observed to occur. With sufficient breaching by the mainstem, the flow conditions within these habitats was observed to become directly related to mainstem discharge. Generally, it was found that side sloughs in the Talkeetna to Devil Canyon reach breached in the range of mainstem discharges from 22,000 to 28,000 cfs. In addition, backwater areas were observed to occur to varying degrees at the mouths of many of the side slough habitats during moderate to high mainstem discharges. Results of investigations in side channel habitats show that hydraulic responses to mainstem discharges are similar to those occurring in side slough habitats, although lower mainstem discharges initiate these response in side channel habitats.

Investigations in upland slough habitats have shown that the hydraulic characteristics in these habitats are less directly related to mainstem discharges than they are in side slough or side channel habitats. Upland slough habitats were found to not overtop. Extensive backwater areas were, however, observed to occur at the mouths of many of the upland slough habitats during moderate to high mainstem discharges.

Stage and discharge data were also obtained in seven tributaries in the Talkeetna to Devil Canyon reach. From these data, preliminary rating

curves were developed for six of these tributaries (Whiskers Creek, Gash Creek, Lane Creek, Waterfall Creek, Indian River, and Portage Creek).

1.2 Objectives

The FY84 open water field season (May-October, 1983) stage and discharge data collection program was specifically designed to expand the evaluation of the stage and discharge relationships occurring in mainstem and peripheral habitats in the Talkeetna to Devil Canyon reach of the Susitna River. Specific objectives for each habitat type are presented below.

1.2.1 Mainstem Habitats

The objectives of the 1983 open water season stage data collection program conducted in the mainstem Susitna River between Talkeetna and Devil Canyon were to:

1) Collect sufficient water surface elevation data at selected mainstem locations to define the relationship of mainstem water surface elevation to mainstem discharge for the full range of mainstem discharges occurring during the 1983 open water season. This information will be used by project engineers to further evaluate the predictive accuracy of various hydraulic simulation models;

2) Collect water surface elevation data at selected mainstem locations adjacent to the selected side channel, side and upland slough, and tributary mouth study locations to evaluate if and how mainstem discharge influences the hydrological characteristics of these peripheral habitats.

1.2.2 Side Channel, Side Slough, and Upland Slough Habitats

The objectives of the FY84 open water season stage and discharge data collection program conducted at side channel and slough (upland and side) habitats between Talkeetna and Devil Canyon were to:

1) Collect sufficient stage and discharge measurements within selected side channel and slough (upland and side) habitats to develop stage/discharge rating curves covering the full range of mainstem discharges experienced during the 1983 open water field season;

2) Collect measurements of water surface elevations within selected side channel and slough (upland and side) habitats to further evaluate whether and how the water surface elevation in these peripheral habitats are influenced by mainstem discharge;

3) Collect measurements of stage and discharge within selected side channel and slough (upland and side) habitats to support analysis of the effects of local (i.e., site) flow conditions on the availability and utilization of these habitats for fish passage, spawning and rearing (refer to Fish Habitat Study) and to determine

if and how mainstem discharges influence these local flow conditions.

1.2.3 Tributary Habitats

The objectives of the 1983 stage/discharge monitoring program conducted at tributary habitats located between Talkeetna and Devil Canyon were to:

1) Collect sufficient stage and discharge measurements within selected tributaries in the Talkeetna to Devil Canyon reach to develop stage/discharge rating curves covering the full range of conditions experienced during the 1983 open water field season;

2) Collect measurements of stage and discharge within selected tributary and tributary mouth habitats to support analyses of fish habitats in these habitat zones.

2.0 METHODS

2.1 Site Selection

2.1.1 Mainstem Habitats

Locations at which stage monitoring stations were placed in the mainstem between Talkeetna and Devil Canyon are presented in Table 1-1. Sites were selected, based on consultation with the project engineer, to:

1) Provide mainstem water surface elevation data over the full range of mainstem flow conditions occurring during the 1983 open water field season to project engineers for use of calibration of various hydraulic models;

2) Provide mainstem water surface elevation data to be used in determining the influence that mainstem discharge has on the hydraulic characteristics of selected side channel, upland and side slough, and tributary mouth habitats.

All stage data collected in the mainstem in the Talkeetna to Devil Canyon reach of the Susitna River (Figure 1-2) is referenced to mainstem discharge obtained at the U.S.G.S. Gold Creek gaging station (15292000). The Gold Creek discharge gaging station was selected as the index station because of its relative close proximity to stage monitoring stations in this reach and its extensive period of record.

Table 1-1. Locations of 1983 open water field season mainstem stage monitoring stations in the Talkeetna to Devil Canyon reach of the Susitna River.

Sampling Site	River Mile	Gage No.
Mainstem at Whiskers Slough Mouth	101.2	101.2M4
Mainstem at Whiskers Slough Head	101.5	101.5M6
Talkeetna Fishwheel Station	103.0	103.0F1
Right Bank at LRX 9	103.2	103.2M1
Left Bank at LRX 9	103.2	103.2M1
Right Bank at LRX 10B	105.9	105.9M1
Right Bank at LRX 10C	106.4	106.4M1
Right Bank at LRX 11	106.7	106.7M1
Left Bank at LRX 12	108.4	108.4M
Mainstem at Slough 6A Mouth	112.3	112.3W1
Left Bank at LRX 16	112.4	112.4M2
Right Bank at LRX 18	113.0	113.0M1
Mainstem Below Lane Creek Mouth	113.4	113.4M6
Mainstem at Lane Creek Mouth	113.6	113.6M9
Mainstem Above Lane Creek Mouth	113.7	113.7M5
Mainstem Above Mainstem 2 Mouth	114.4	114.4M1
Mainstem Above Mainstem 2 NW Head	115.5	115.5M4
Mainstem Above Mainstem 2 NE Head	115.9	115.9M2
Curry Fishwheel Station	120.6	120.0F1
Right Bank at LRX 24	120.7	120.7M1
Right Bank at LRX 28	124.4	124.4M1
Side Channel at Slough 8A Mouth	125.3	125.3M4
Right Bank at LRX 29	126.1	125.3M3
Mainstem Above Slough 8A NE Head	127.1	125.3M6
Right Bank at LRX 31	128.7	128.7M1
Right Bank at LRX 32	129.7	129.7M1
Right Bank at LRX 33	130.1	130.1M1
Right Bank at LRX 34	130.5	130.5M1
Right Bank at LRX 35	130.8	130.9M1
Mainstem B/L Fourth of July Creek	131.1	131.1M3
Left Bank at LRX 37	131.8	131.8M1
Mainstem at Side Channel 10 Mouth	133.8	133.8M6
Left Bank at LRX 40	134.3	134.3M1
Side Channel B/L Slough 11 Mouth	135.3	135.3M4
Side Channel A/B Slough 11 Mouth	135.3	135.3M2
Mainstem at Slough 16B Mouth	138.0	138.0M2
Mainstem at Head of Slough 16B	138.3	138.0M4
Right Bank at LRX 49	138.3	138.3M1
Left Bank at LRX 50	138.5	138.5M1
Left Bank at LRX 51	138.9	138.9M1
Mainstem at Slough 19 Mouth	139.8	140.0M2
Right Bank at LRX 53	140.1	140.1M1
Mainstem at Side Channel 21 Mouth	140.6	140.6M1

Table 1-1 (Continued).

Sampling Site	River Mile	Gage No.
Right Bank at LRX 54	140.8	140.8M1
Right Bank at LRX 55	141.6	141.6M1
Right Bank at LRX 56	142.1	142.1M1
Right Bank at LRX 57	142.3	142.0M2
Mainstem at Slough 22 Head	144./	144.3M1
Left Bank at LRX 61	148.7	148.7M1
Left Bank at LRX 62	148.9	148.9M1

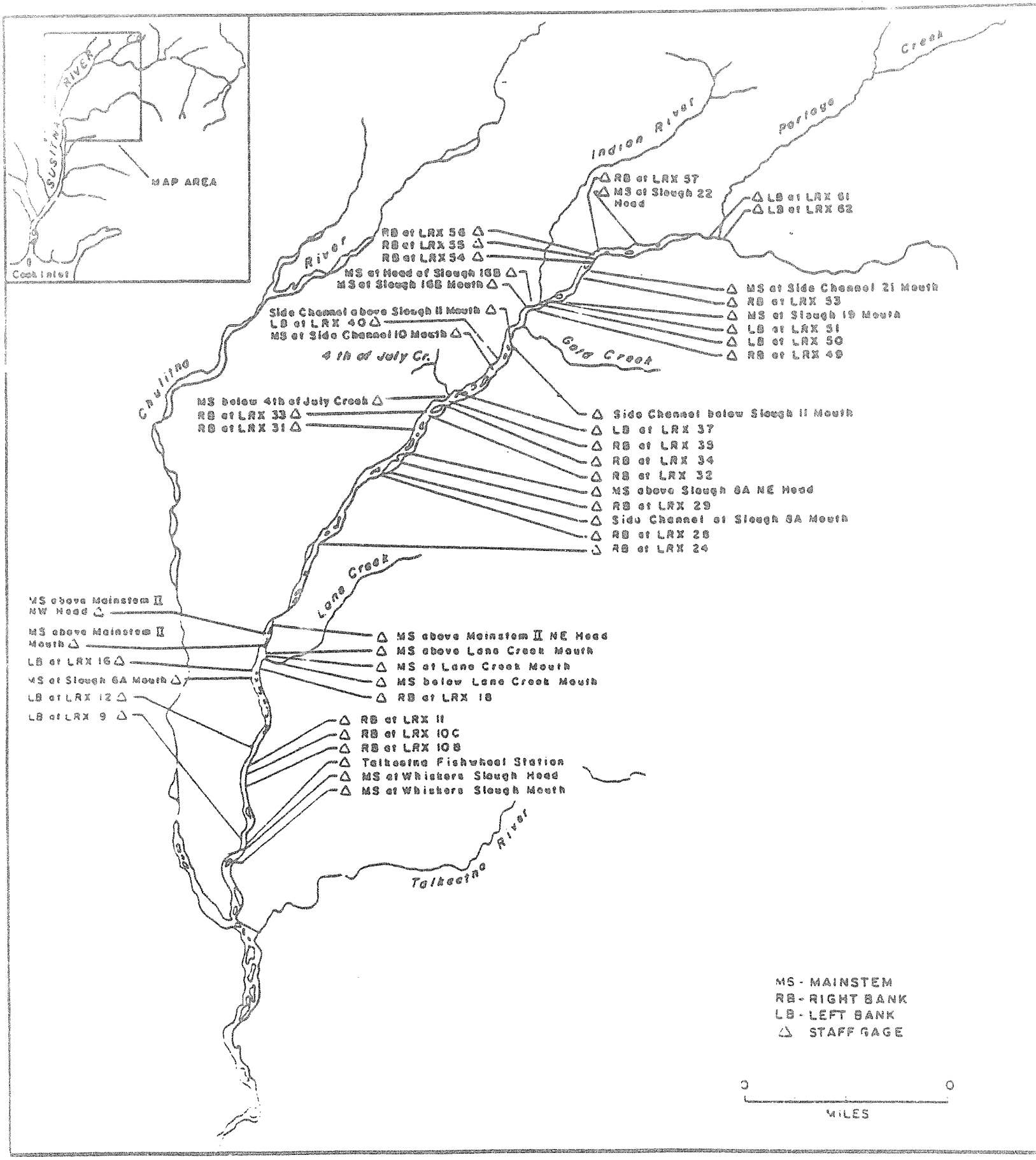

Figure 1-2 Mainstem staff gage location in the Talkeetna to Devil Canyon reach of the Susitna River for the open water season of 1983.

2.1.2 Side Channel, Side Slough, and Upland Slough Habitats

Stage and discharge were monitored at five side channel and 11 slough (9 side and 2 upland) study sites located between Talkeetna and Devil Canyon (Table 1-2, Figure 1-3). Sites were selected for study, based on consultations with the project engineers and biologist, to:

1) Provide baseline water surface elevation and discharge data to assist in determining the influence that mainstem discharge has on several key hydraulic characteristics of side channel and slough habitats (i.e., breaching, backwater and flow regime conditions); and,

2) Provide water surface elevation data to support evaluations of fish habitats by project biologists in side channel and slough habitats.

Stage was monitored within the mouth portion, free-flowing portion, and head portion of each study site. In addition, discharge was monitored within the free-flowing portion of each study site. The stage data obtained within the mouth portion of each study site was used to evaluate the presence and extent of backwater as a function of mainstem flow. The stage and discharge data obtained within the free-flowing portion of each study site was used to formulate the site flow rating curve and evaluate the effect that mainstem discharge has on the site stage and discharge. The stage data obtained at the head portion of each study site was used to determine the mainstem discharge required to breach the head of the study site. Mainstem discharge was indexed to the U.S.G.S. Gold Creek gaging station (15292000).

Table 1-2. Side channel and side and upland slough sites in the Talkeetna to Devil Canyon reach selected for stage/discharge studies during the 1983 open water field season.

Site	River Mile	Habitat Type
Whiskers Slough	101.2	Side Slough
Slough 6A	112.3	Upland
Slough 8	113.6	Side Slough
Mainstem 2	114.4	Side Channel
Slough 8A	125.3	Side Slough
Slough 9	128.3	Side Slough
Side Channel 10	133.8	Side Channel
Lower Side Channel 11	135.0	Side Channel
Slough 11	135.3	Side Slough
Upper Side Channel 11	136.2	Side Channel
Slough 16B	137.8	Side Slough
Slough 19	139.7	Upland Slough
Slough 20	140.1	Side Slough
Side Channel 21	140.6	Side Channel
Slough 21	141.8	Side Slough
Slough 22	144.2	Side Slough

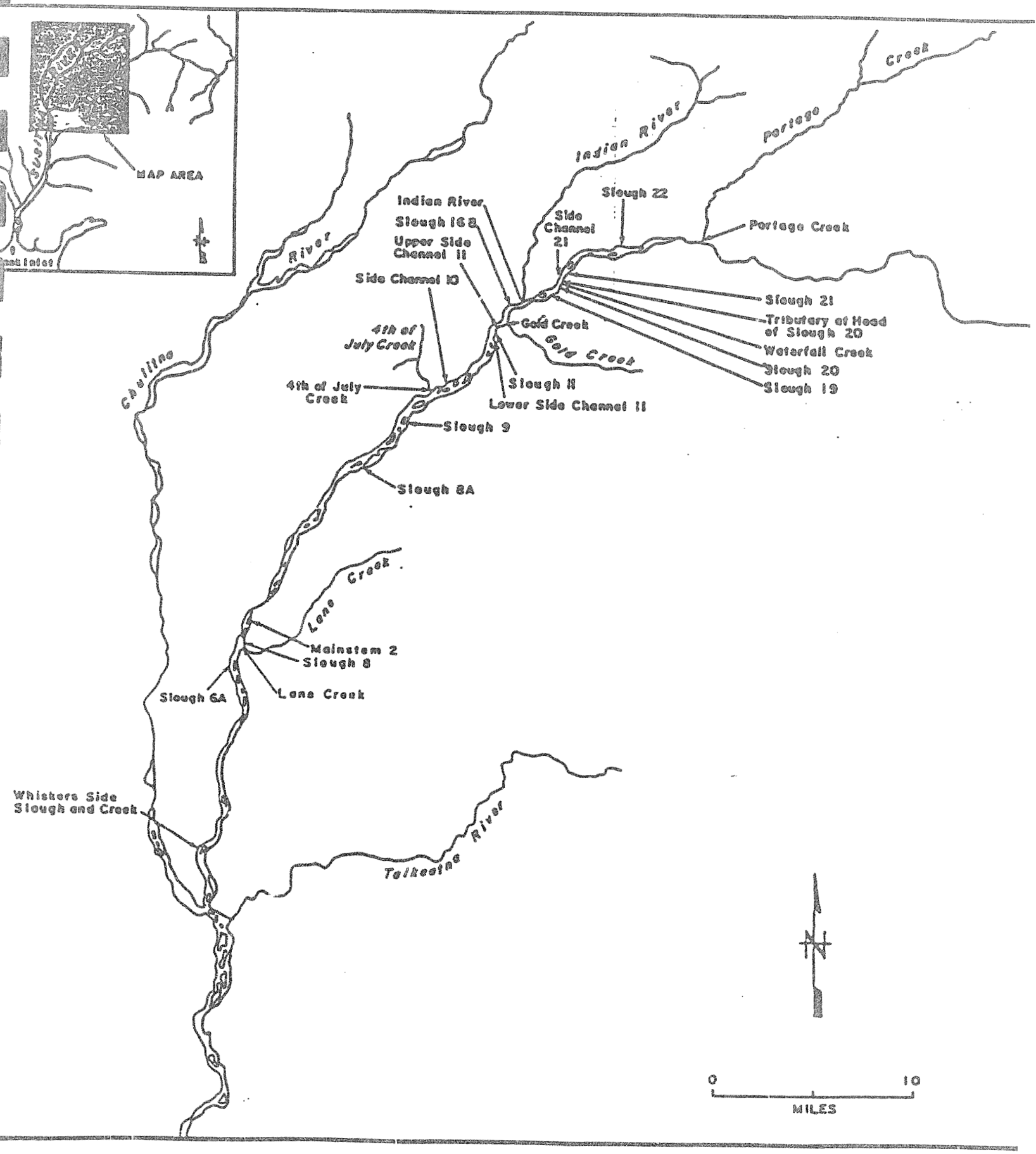

Figure 1-3 Side channel, slough and tributary sites selected for the stage/discharge studies for the 1983 open water field season.

2.1.3 Tributary Habitats

Stage and discharge were monitored at seven tributaries located between Talkeetna and Devil Canyon (Table 1-3, Figure 1-3). Stations were placed in areas optimal for the collection of discharge data. Study sites were selected based on consultation with the project engineer to provide baseline stage and discharge data to be used to develop rating curves and support evaluations of fish habitat by project biologists.

2.2 Field Data Collection

2.2.1 Stage

Measurements of stage were obtained utilizing either standard staff gages or continuous data recorders with associated pressure transducers (datapods).

Stage data obtained using standard Leopold and Stevens (0.00-3.33 ft.) staff gages were determined to the nearest one-hundredth of a foot. An assigned elevation, which is referenced to a temporary benchmark (TBM), was determined for each gage with the TBM's surveyed to a known elevation (project datum). This allowed all resultant stage readings to be converted to true water surface elevations. Staff gage installation and monitoring procedures can be found in the ADF&G Su Hydro Aquatics Studies Procedures Manual Final Draft (ADF&G 1981a, 1983a). Measurements of stage obtained with staff gage readings were obtained at least twice monthly during the open water field season at each stage

Table 1-3. Tributary study sites in the Talkeetna to Devil Canyon reach selected for stage/discharge studies during 1983 open water field season.

Site	River Mile	TRM
Whiskers Creek	101.4	0.4
Lane Creek	113.6	0.3
Fourth of July Creek	131.1	0.2
Gold Creek	136.7	0.2
Indian River	138.6	0.6
Waterfall Creek	140.3	0.1
Tributary at Head of Slough 20	140.6	0.1
Portage Creek	148.9	0.4

monitoring station within each study area. In addition, selected staff gages located in the mainstem Susitna River were monitored more often to ensure that the full range of mainstem discharge conditions occurring during the 1983 open water season were evaluated.

The system used to continually monitor and record stage incorporated a pressure transducer and electronic interface unit (designed by Dryden and LaRue Consulting Engineers; Anchorage, Alaska) to record depth of water over the transducer probes in millivolts (mV). Every 0.5 mV represents 1.0 inch of water depth over the transducer probe. The transducer probes utilized have a range of 1 to 80 inches of water with an accuracy of 0.2 mV (i.e., 0.4 inches of water). The stream gage datapods are programmed to record average millivolt readings at 60 minute intervals on a UV-erasable, solid state Data Storage Module (DSM). Using a 60-minute recording interval, the DSM reaches capacity in 40 days and then must be exchanged for an erased (clean) DSM. Procedures involved in the installation and monitoring of the datapods can be found in the FY84 ADF&G Su Hydro Aquatic Studies Procedures Manual, Final Draft (ADF&G 1984).

2.2.2 Discharge Procedures

Discharge measurements were obtained in the free-flowing portion of the study area utilizing standard U.S.G.S. techniques employing either a Price AA or Pygmy meters. At the time of the discharge measurement, a stage measurement was also obtained. Procedures utilized in obtaining discharge measurements are found in the FY84 ADF&G Su Hydro Aquatic Studies Procedures Manual, Final Draft (ADF&G 1983).

2.3 Analytical Approach

2.3.1 Mainstem Habitats

All stage data obtained at mainstem habitats were reduced to true water surface elevations (as referenced to project datum). These data, along with corresponding average daily discharges of the mainstem recorded at Gold Creek (USGS 15292000) were plotted as simple stage/discharge rating curves with water surface elevation presented on the y axis and mean daily mainstem discharge on the x axis. At least squared regression equation describing the relationship of each plot was also derived for each plot.

2.3.2 Side Channel, Side and Upland Slough Habitats

All stage data obtained at side side channel and slough (side and upland) habitats were reduced to true water surface elevations (as referenced to project datum) and plotted against the mean daily mainstem discharge recorded at Gold Creek (USGS 15292000). In addition, stage data collected in conjunction with discharge data at the stage/discharge monitoring station located in the free-flowing portion of each study site were plotted as simple stage/discharge rating curves. Measured site discharge was also plotted with corresponding mean daily mainstem discharge as measured at Gold Creek (15292000).

2.3.3 Tributary Habitats

All stage measurements obtained in tributaries were converted to true water surface elevations as referenced to project datum. Measurements of stage obtained from staff gage readings in conjunction with discharge measurements in Whiskers, Lane, and Fourth of July Creeks and the unnamed tributary at the head of Slough 20 were plotted as simple stage/discharge rating curves. At sites at which stage was monitored with continuous data recorders (Portage and Gold Creeks, and Indian River) measurements of water depth were reduced to mean daily discharge. Measurements of water depth obtained in conjunction with discharge measurements were plotted as simple rating curves. Based on these rating curves, discharge levels were estimated from the continuous record of water depth for Portage Creek, Indian River, and Gold Creek.

3.0 RESULTS

3.1 Mainstem Habitats

Mean daily discharge of the Susitna River was continually monitored by the USGS at their Cantwell (15291500), Gold Creek (15292000), Sunshine (15292780), Susitna Station (15294350), and Yentna River (15294300) gaging stations during 1983. The USGS 1983 water year (October 1982 - September 1983) discharge data are tabulated in Appendix Tables 1-A-1 - 1-A-5 and plotted in Figure 1-4. In addition, the mean daily discharge of the Susitna River at the USGS Gold Creek gaging station (15292000), for the 1983 open water field season is plotted with the 1981 and 1982 open water field season mean daily discharge in Figure 1-5 (USGS 1981, 1982, 1983).

Stage was monitored at 46 stations in the mainstem from Talkeetna to Devil Canyon during the 1983 open water field season. All stage measurements were converted to true water surface elevations as referenced to project datum. These water surface elevations, along with corresponding mean daily discharge of the mainstem Susitna River as measured at the USGS Gold Creek gaging station (15292000) are tabulated in Appendix Table 1-A-6. These data were used to generate simple water surface elevation/discharge curves (Appendix Figures 1-A-1 - 1-A-23). The mainstem water surface elevations obtained at LRX 53 include only the 1983 data. The 1983 and 1982 staff gage sites were not in the exact location for each years observations. The mainstem water surface elevations obtained for LRX 32 were actually observed upstream of LRX 32 approximately 100-200 feet.

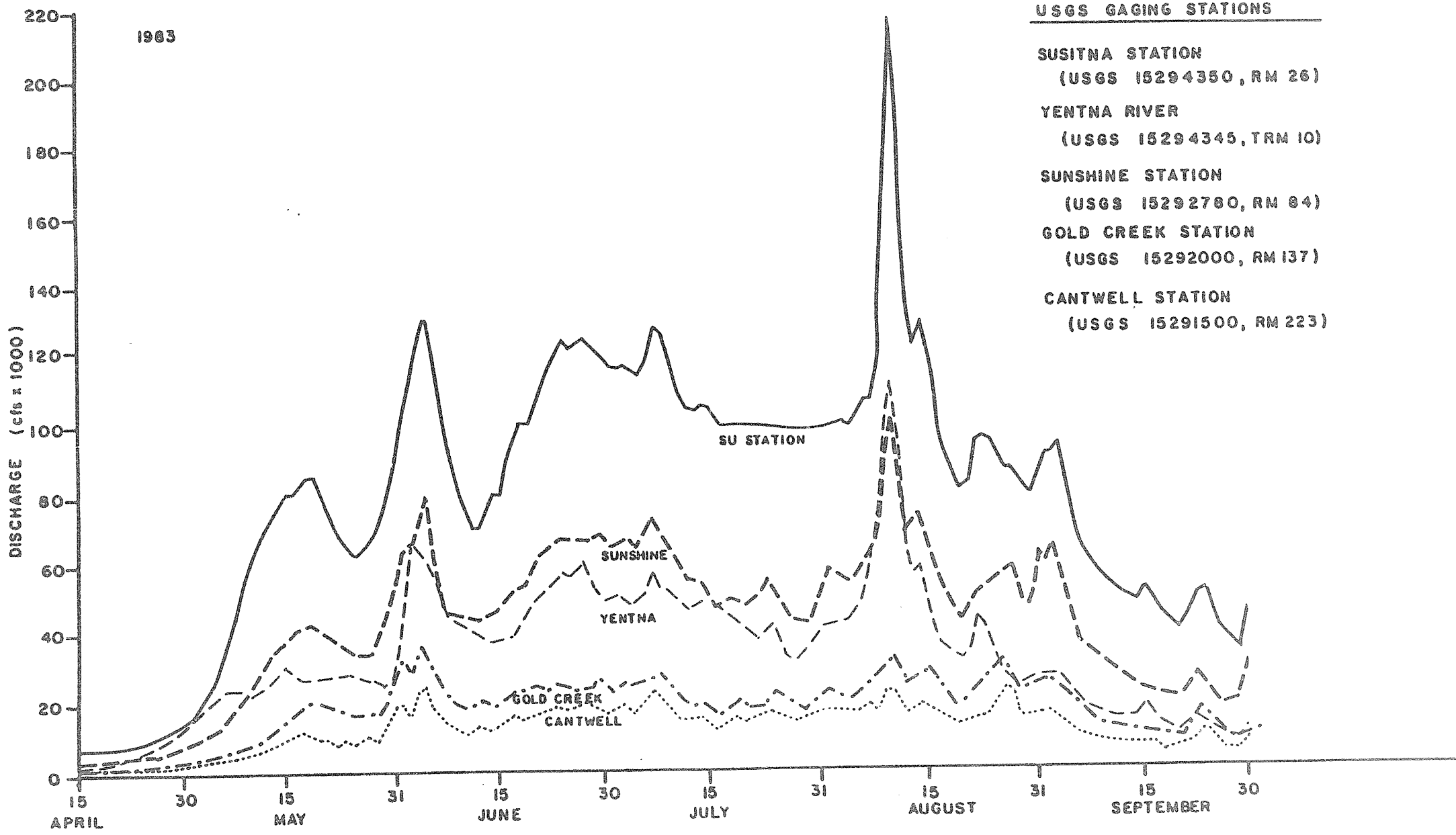

Figure 1-4 Comparison of mean daily discharge for the USGS gaging stations at Susitna Station, Yentna River, Sunshine Station, Gold Creek Station and Cantwell Station.

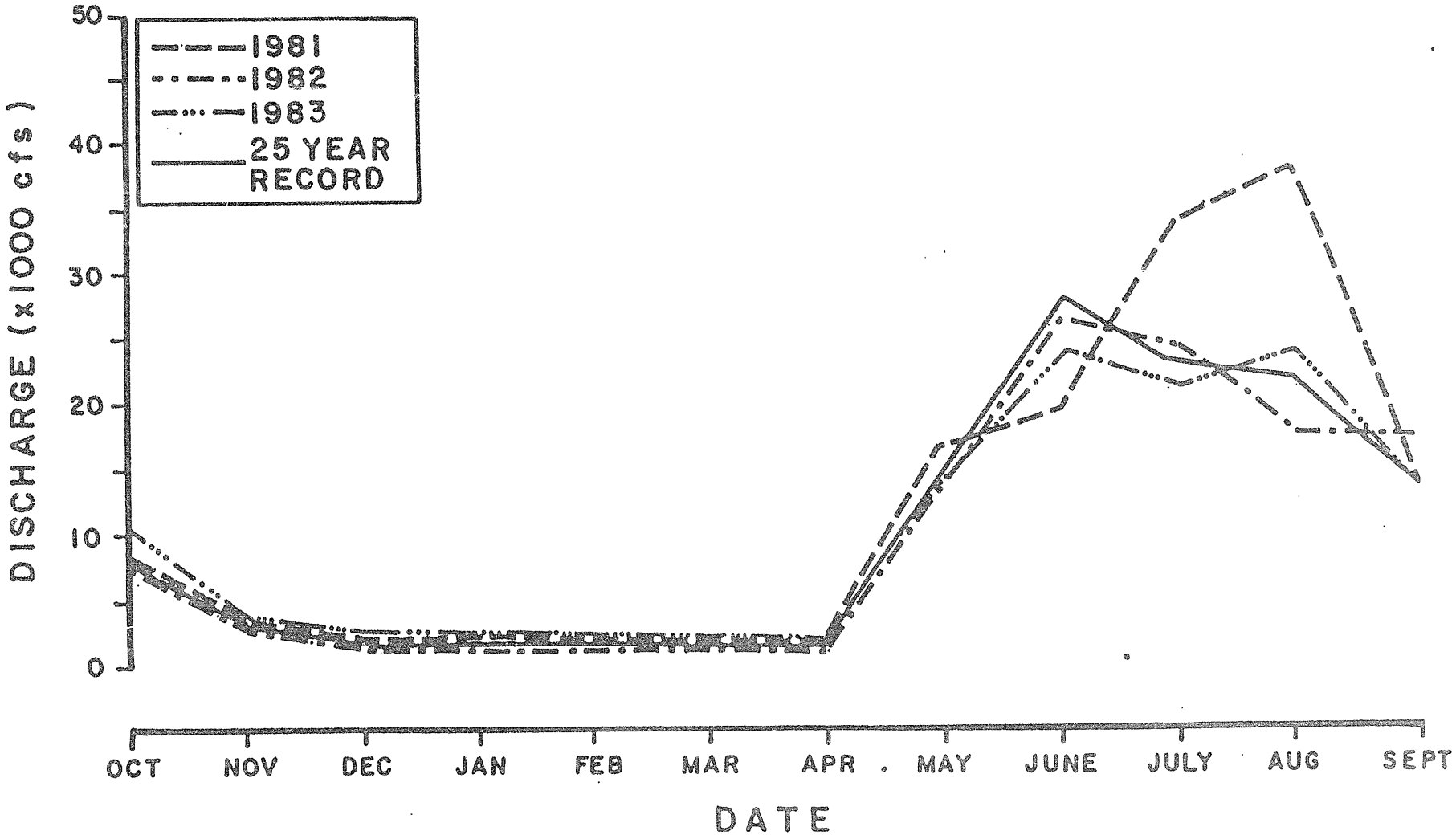

Figure 1-5 Comparison of mainstem discharge obtained at Gold Creek (USGS 15292000) for 1981, 1982 and 1983 open water field seasons (May - October).

3.2 Side Channels

Measurements of stage and discharge were obtained during the 1983 open water field season at selected sites within five side channels in the Talkeetna to Devil Canyon reach of the Susitna River. Results of these investigations are addressed below by site.

3.2.1 Mainstem 2 Side Channel (RM 114.4)

3.2.1.1 Site Description

Mainstem 2 Side Channel (Figure 1-3) is located on the east bank of the Susitna River at river mile 114.4. It is approximately one mile in length and is separated from the mainstem by two relatively large vegetated islands. A fork, approximately 0.3 miles upstream of the mouth of this side channel, divides the channel into two forks, referred to as the northeast (NE) and northwest (NW) channels. Prior to breaching, flow in the side channel is provided by local surface water runoff and groundwater inflow. Subsequent to breaching, the majority of the flow is provided by turbid water from the mainstem. A substantial area of backwater exists at the mouth of this side channel during low and high mainstem flows.

During the 1983 open water field season, stage was monitored at seven sites within this side channel, at which streamflow was also monitored at two of these sites (Figure 1-6).

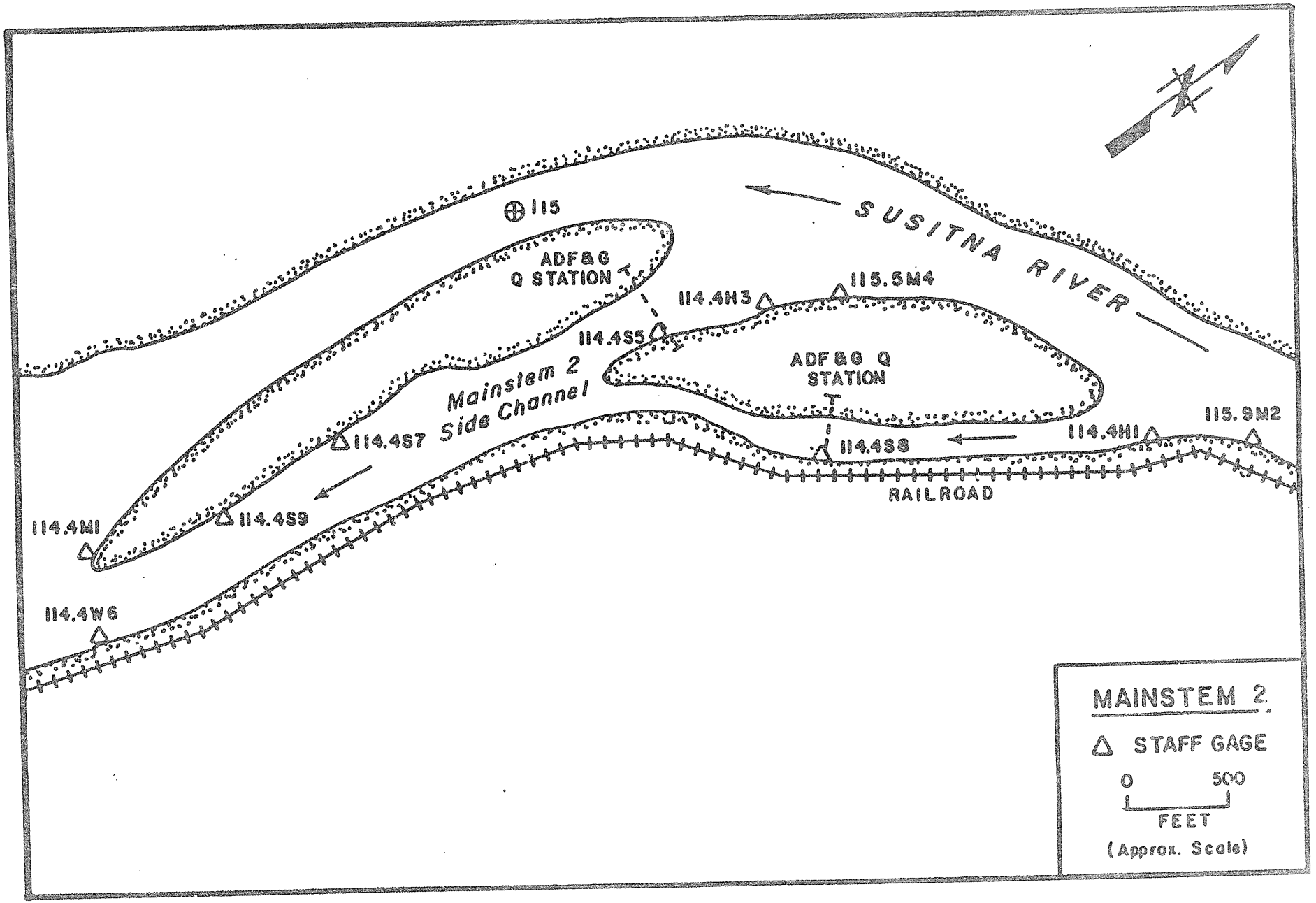

Figure 1-6 Site map of Mainstem II Side Channel which is located on the east bank of the Susitna River at river mile 114.4.

3.2.1.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-4. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring station are presented in Appendix Figures 1-A-28 - 1-A-31. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.2.1.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained within the free-flowing portions of the NW and NE channels of the Mainstem 2 Side Channel study site (Appendix Table 1-A-8). From these measurements, simple stage/stream flow rating curves were developed for each channel (Figures 1-7 and 1-8). In addition, the streamflow data obtained in each channel was plotted against the corresponding mainstem discharge at Gold Creek (Figures 1-9 and 1-10). These curves represent the breached hydraulic condition of each channel.

Table 1-4. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Mainstem 2 Side Channel.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Discharge (cfs)
114.4H1 (NE Head)	1.81	23,000 - 31,700
114.4S8 (NE Q-Site)	2.47	10,000 - 31,000
114.4H3 (NW Head)	2.66	13,600 - 31,700
114.4S5 (NW Q-Site)	3.13	10,000 - 27,400
114.4S7 (Upper Backwater)	2.93	16,000 - 31,700
114.4S9 (Lower Backwater)	2.38	18,600 - 31,700
114.4W6 (Mouth)	4.79	7,230 - 31,700

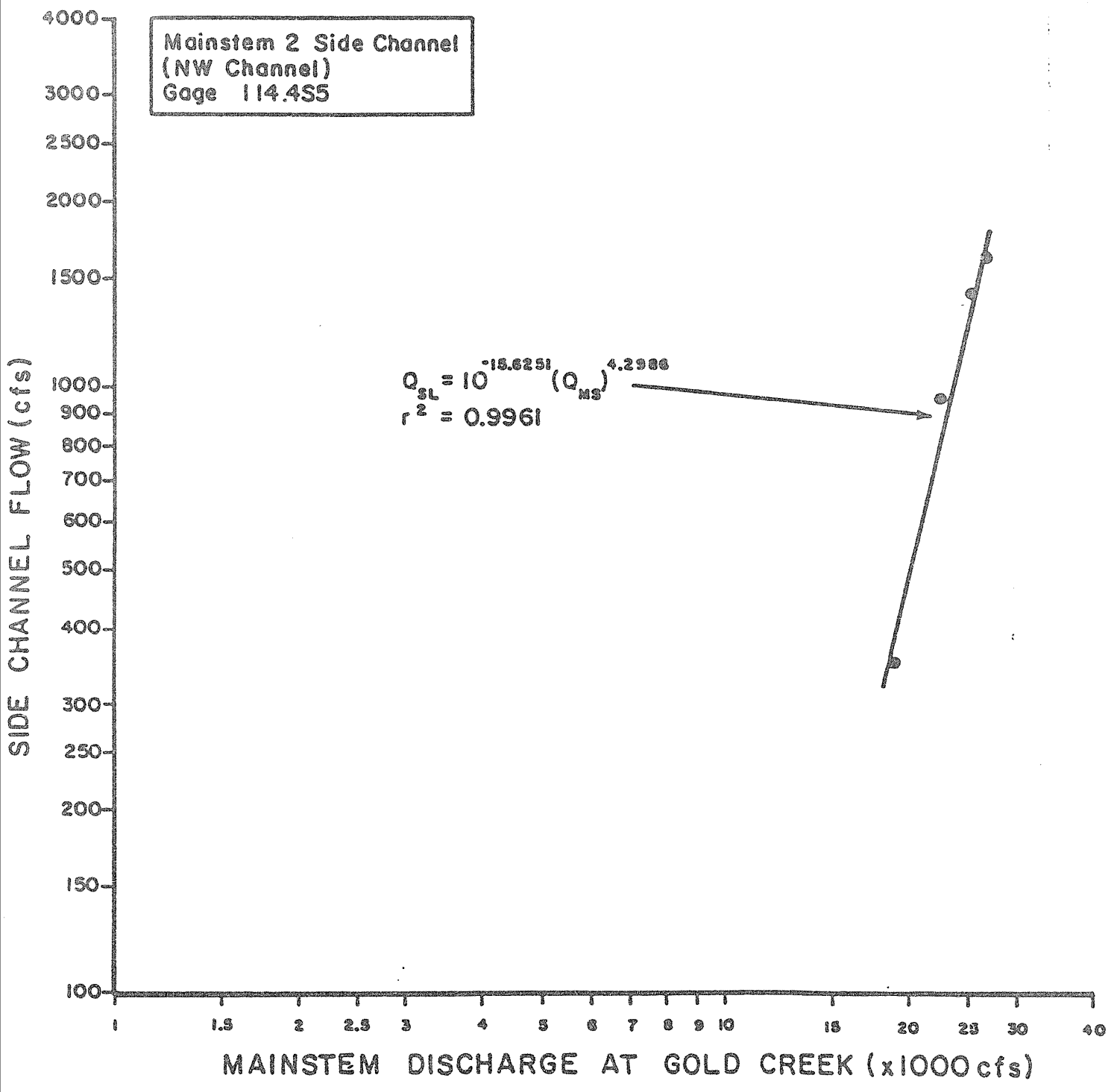

Figure 1-7 Stage versus flow rating curve for Mainstem II Side Channel (N.W. Channel) staff gage 114.4S5.

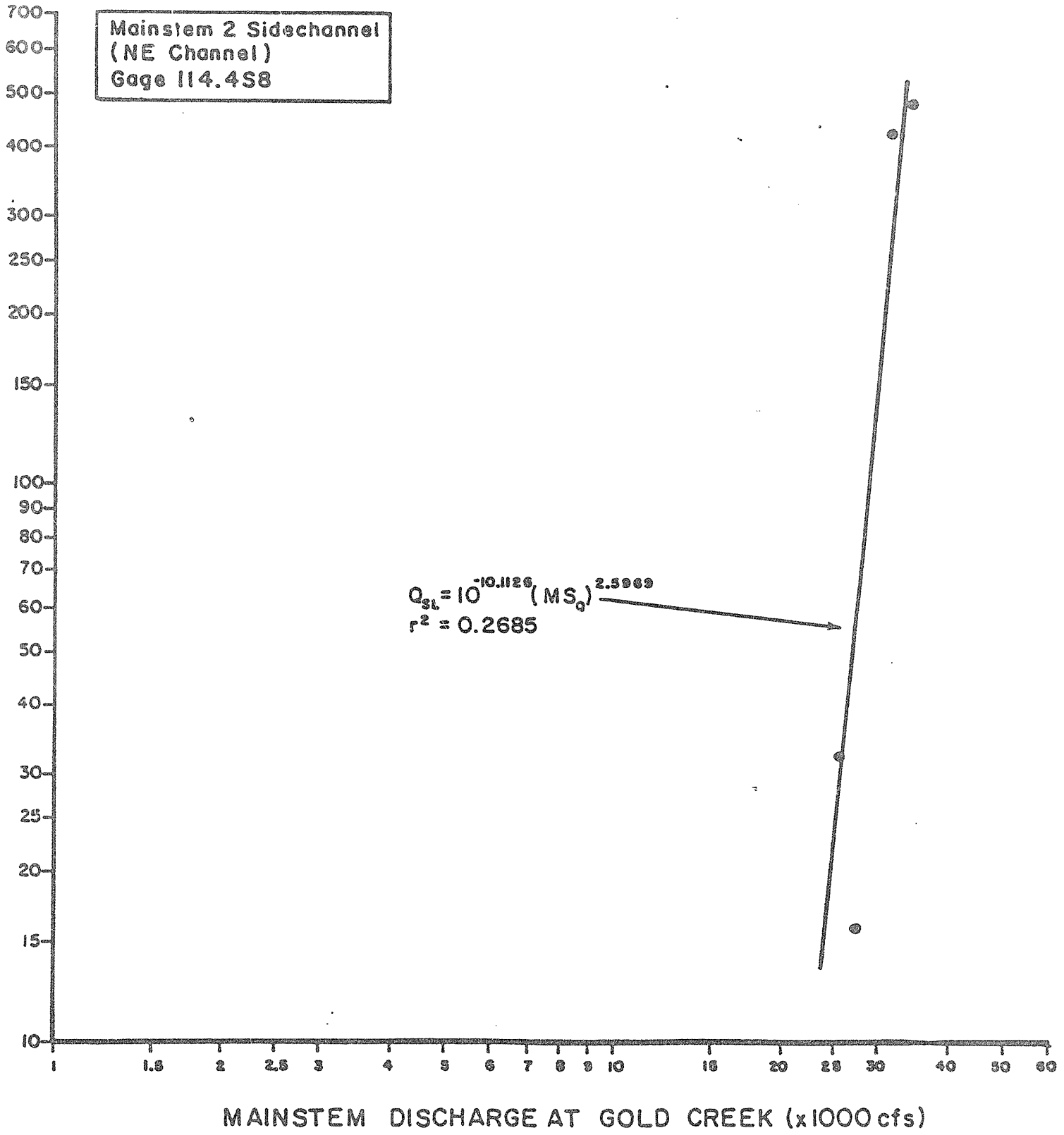

Figure 1-8 Stage versus flow rating curve for Mainstem II Side Channel (N.E. Channel), staff gage 114.4S8.

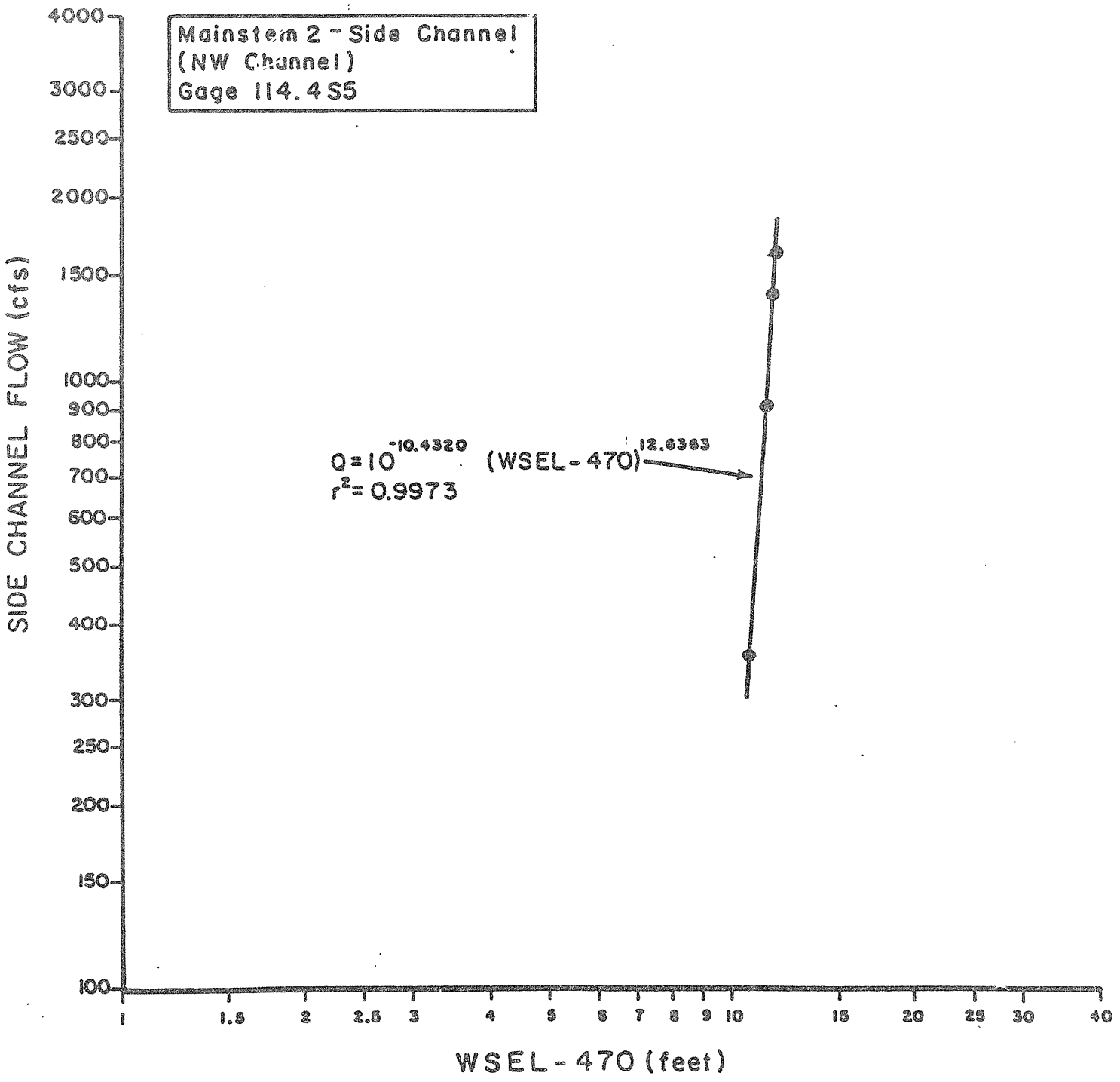

Figure 1-9 Side Channel flow versus mainstem discharge rating curve for Mainstem II (N.W. Channel), staff gage 114.455.

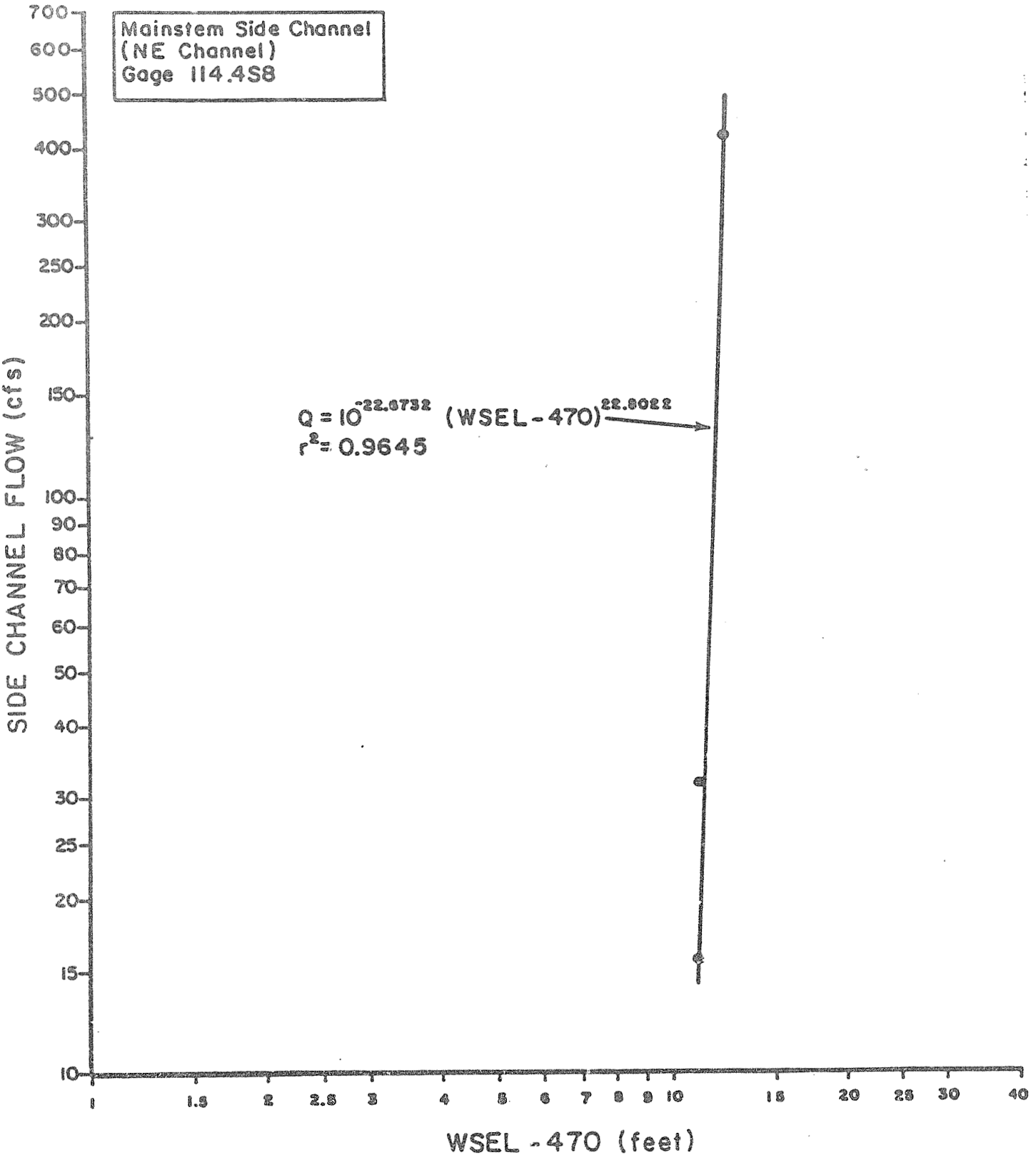

Figure 1-10 Side Channel flow versus mainstem discharge rating curve for Mainstem II (N.E. Channel), staff gage 114.4S8.

3.2.1.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in the NW and NE channels become governed by the mainstem at controlling breaching discharges of 16,000 and 25,000 cfs at Gold Creek, respectively. These controlling breaching discharges compare to lowest observed breaching discharges for the NW and NE channels of 12,000 and 23,000 cfs at Gold Creek, respectively.

3.2.1.5 Backwater

A substantial area of backwater occurs at the mouth of this side channel during periods of low and high mainstem flow. Based on available stages and channel geometry data (see Chapter 2), the area of backwater extended to a point at least 2,000 feet upstream at mainstem discharges ranging from 16,000 to 31,700 cfs., at Gold Creek. At a mainstem discharge of 7,000 cfs, however, this area of backwater became reduced in size extending approximately only 800 feet up the side channel.

3.2.2 Side Channel 10 (RM 133.8)

3.2.2.1 Site Description

Side Channel 10 (Figure 1-3) is located on the west bank of the Susitna River at river mile 133.8. It is approximately 0.4 miles in length and is separated from the mainstem by a large gravel bar. Prior to

breaching, flow in this side channel is provided by local surface runoff and groundwater seepage. Subsequent to breaching, the majority of the flow in this side channel is provided by turbid water from the mainstem. A substantial area of backwater exists at the mouth of this side channel at moderate to high mainstem flows.

During the 1983 open water field season, stage was monitored at seven sites within this side channel, at which discharge was also monitored at three of these sites (Figure 1-11).

3.2.2.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-5. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-37 - 1-A-39. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.2.2.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained within the free-flowing portion of the Side Channel 10 study site (Figure 1-11,

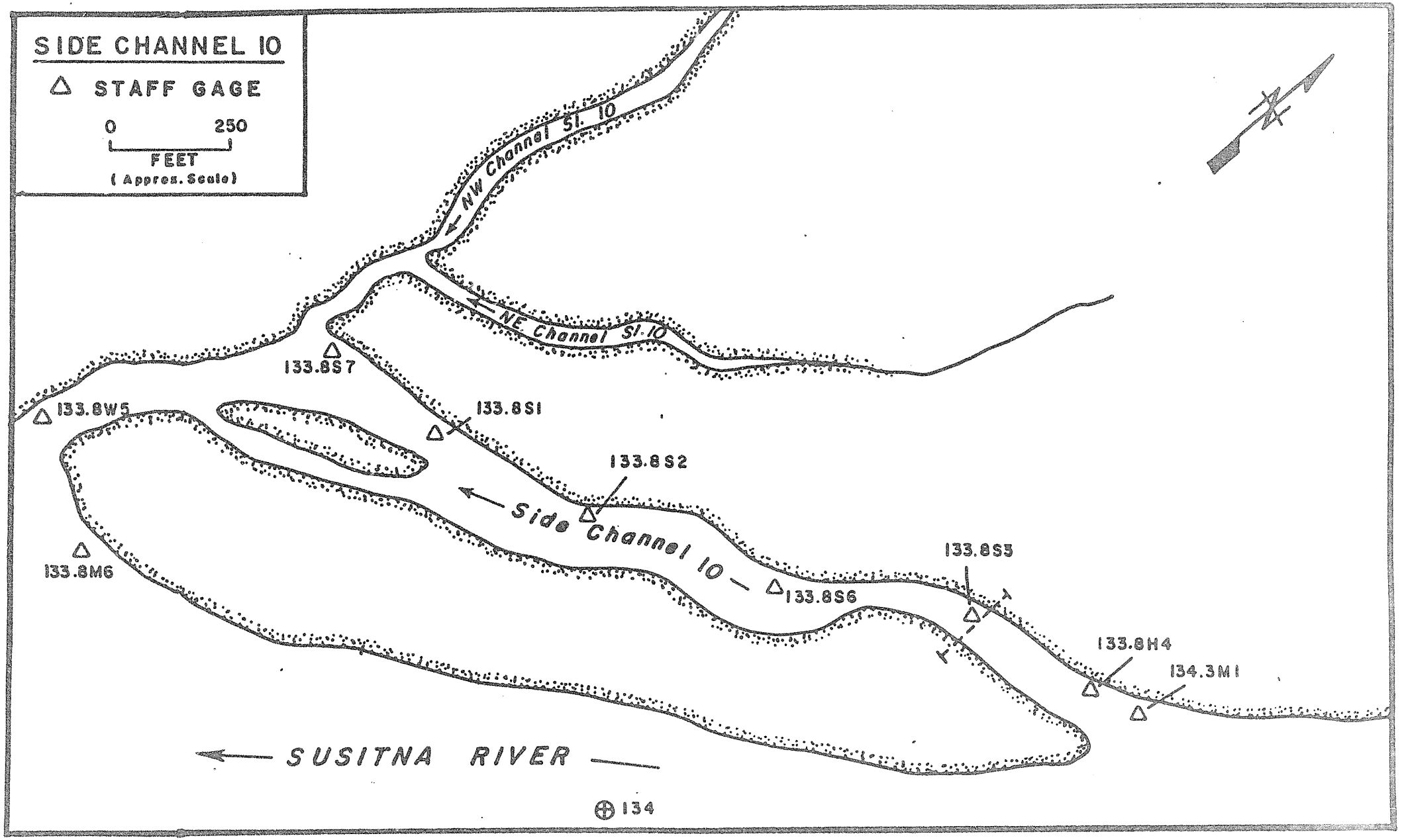

Figure 1-11 Site map of Side Channel 10, which is located on the west bank of the Susitna River at river mile 133.8.

Table 1-5. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Channel 10.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Discharge (cfs)
133.8H4 (Head)	2.00	19,100 - 29,900
133.8S3 (Q-Site)	3.99	12,200 - 31,900
133.8S6	1.22	12,700 - 23,300
133.8S2	1.95	12,200 - 31,900
133.8S1	2.52	12,200 - 31,900
133.8W5 (Mouth)	3.50	12,200 - 31,900

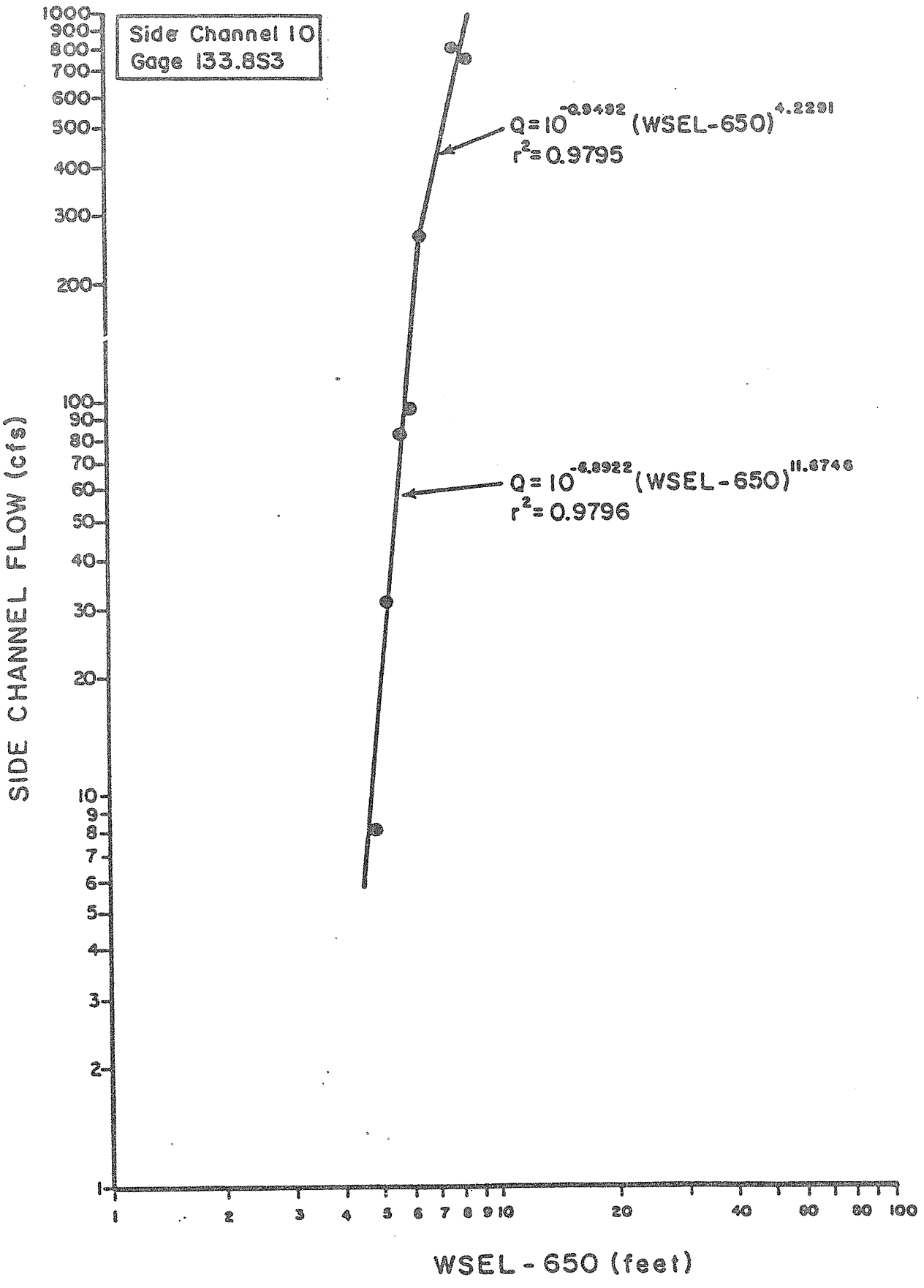

Figure 1-12 Stage versus flow rating curve for Side Channel 10, staff gage 133.8S3.

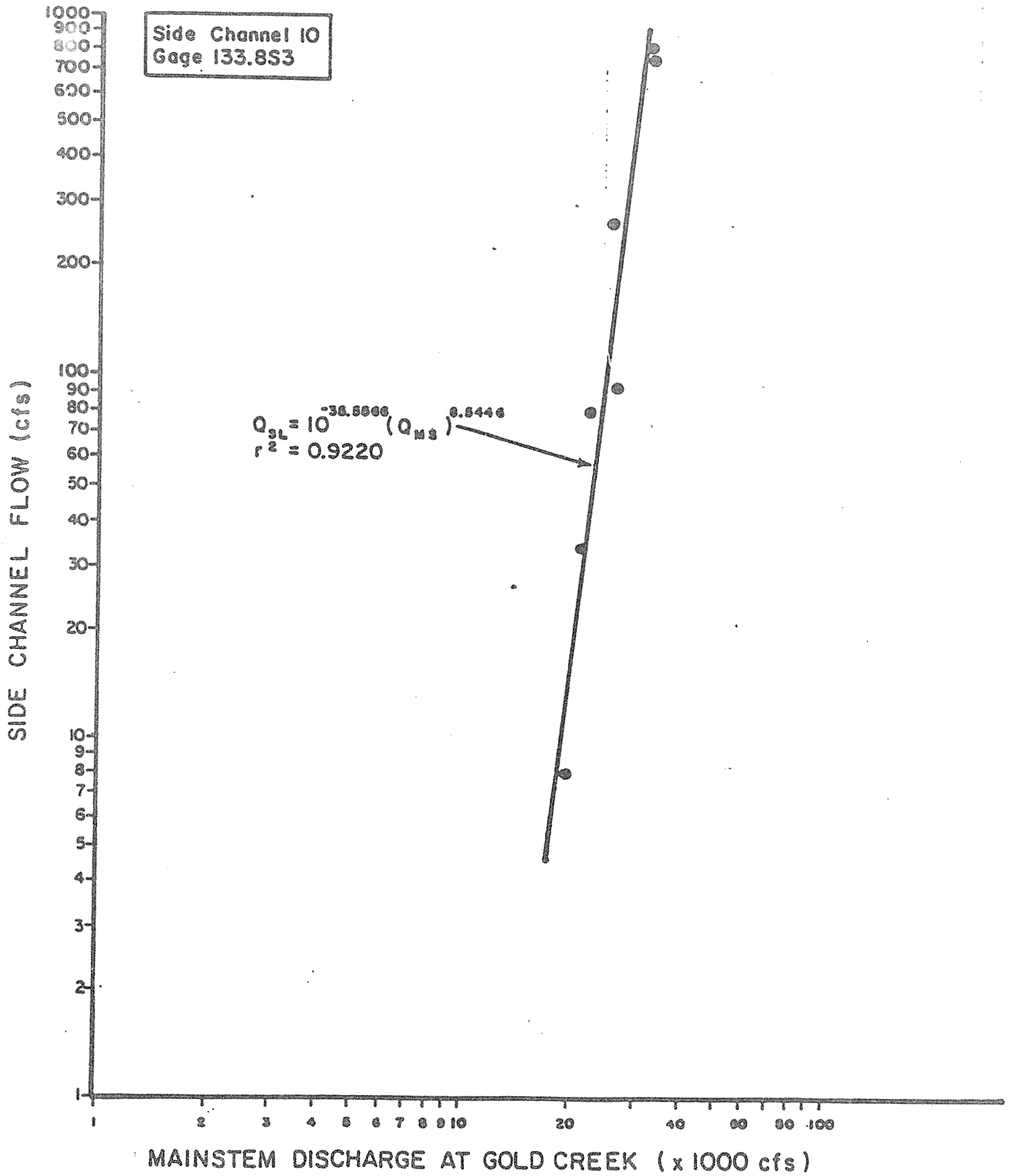

Figure 1-13 Side Channel flow versus mainstem discharge rating curve for Side Channel 10, staff gage 133.853.

Appendix Table 1-A-9). From the flow measurements obtained at this site, a simple stage/stream flow rating curve was constructed (Figure 1-12). In addition, streamflow data obtained at this monitoring site was plotted against corresponding mainstem discharge at Gold Creek at time of measurement (Figure 1-13). The stage/stream flow relationship in this side channel changes during stream flows approaching 300 cfs due to the difference in channel geometry between the head portion and discharge station.

3.2.2.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side channel become governed by the mainstem at a controlling breaching discharge of 19,000 cfs at Gold Creek. This controlling breaching discharge is the same as the lowest observed breaching discharge for this side channel.

3.2.2.5 Backwater

An area of backwater was observed to occur throughout the 1983 open water field season at the confluence of the side channel and the mainstem Susitna River. Based on stage and channel geometry data (see Chapter 2), the area of backwater extended to a point at least 900 ft upstream at mainstem discharges as low as 16,000 cfs at Gold Creek. From the comparison of water surface elevation to the Slough 10 complex thalweg profile, a reduced area of backwater area also occurred at mainstem discharges of 12,000 cfs.

3.2.3 Lower Side Channel 11 (RM 134.6)

3.2.3.1 Site Description

Lower Side Channel 11 (Figure 1-3) is located on the east bank of the Susitna River at river mile 134.6. It is approximately 0.7 miles in length and is separated from the mainstem by a well vegetated island. Just upstream of the confluence of Slough 11, the channel divides into two forks, a NE fork and NW fork. Prior to breaching, flow in this side channel is provided by the clear water flow from Slough 11 and local runoff and groundwater seepage. Subsequent to sufficient breaching, the majority of the flow is provided by turbid water from the mainstem. No backwater was observed at the mouth of this side channel.

During the 1983 open water field season, stage was monitored at four sites within this side channel, at which discharge was monitored at one of these sites (Figure 1-14).

3.2.3.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-6. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement

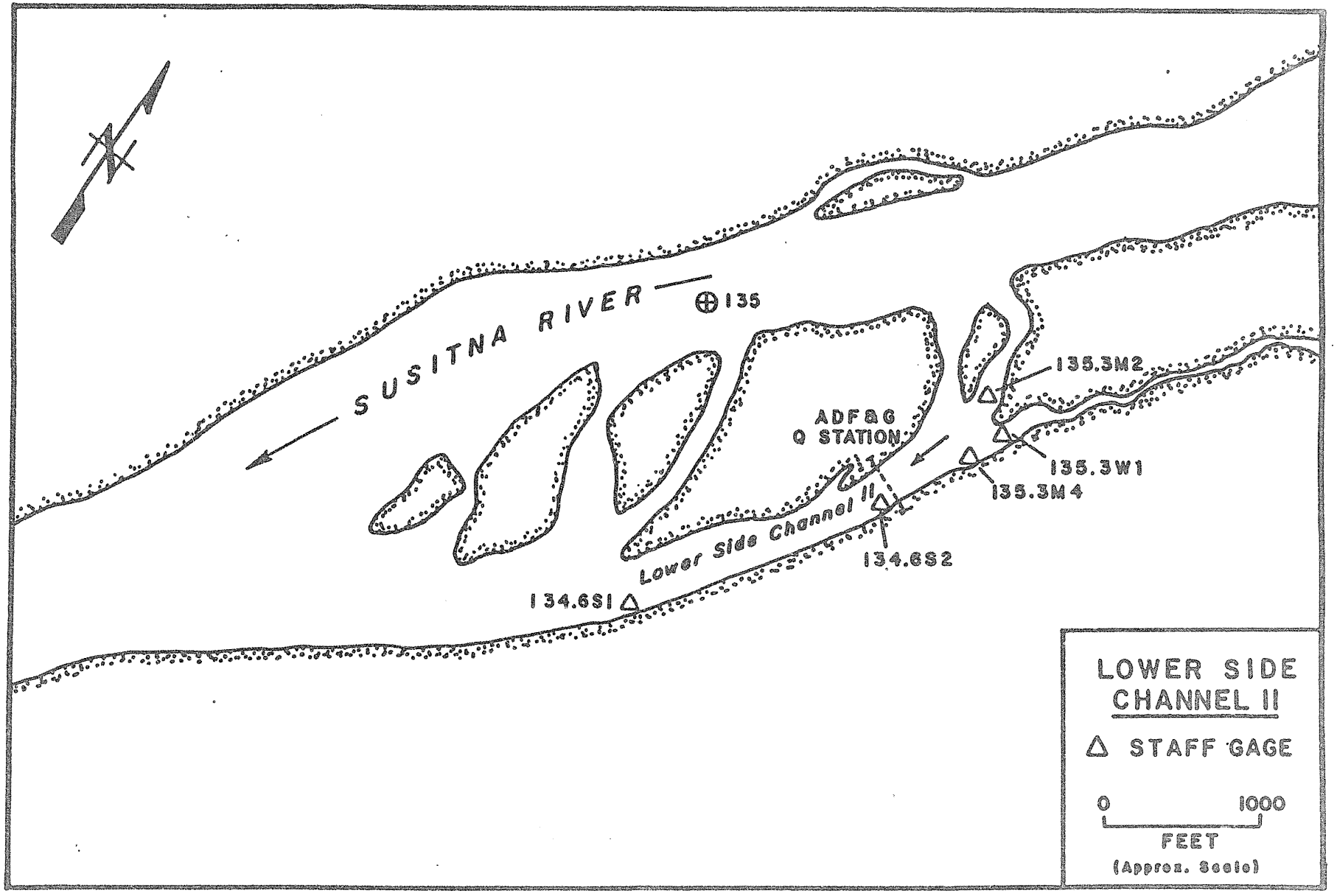

Figure 1-14 Site map of Lower Side Channel 11, which is located at the east bank of Susitna River at river mile 134.6.

Table 1-6. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Lower Side Channel 11.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Discharge (cfs)
134.6S1	2.48	8,010 - 31,900
134.6S2	2.50	8,010 - 31,900
135.3M4	4.48	7,950 - 31,900
135.3M2	2.95	5,020 - 31,900

for each monitoring site are presented in Appendix Figures 1-A-40)-A-41). Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.2.3.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained within the free-flowing portion of the Lower Side Channel 11 study site (Appendix Table 1-A-8). From these measurements, a simple stage/stream flow rating curve was constructed (Figure 1-15). In addition, the streamflow data obtained at this monitoring station was plotted against the corresponding mainstem discharge at Gold Creek at time of measurement (Figure 1-16). Both these curves represent streamflow flow during breached conditions.

3.2.3.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side channel become governed by the mainstem at a controlling breaching discharge of 5,000 cfs at Gold Creek. This controlling breaching discharge is the same as the lowest observed breaching discharge for this side channel.

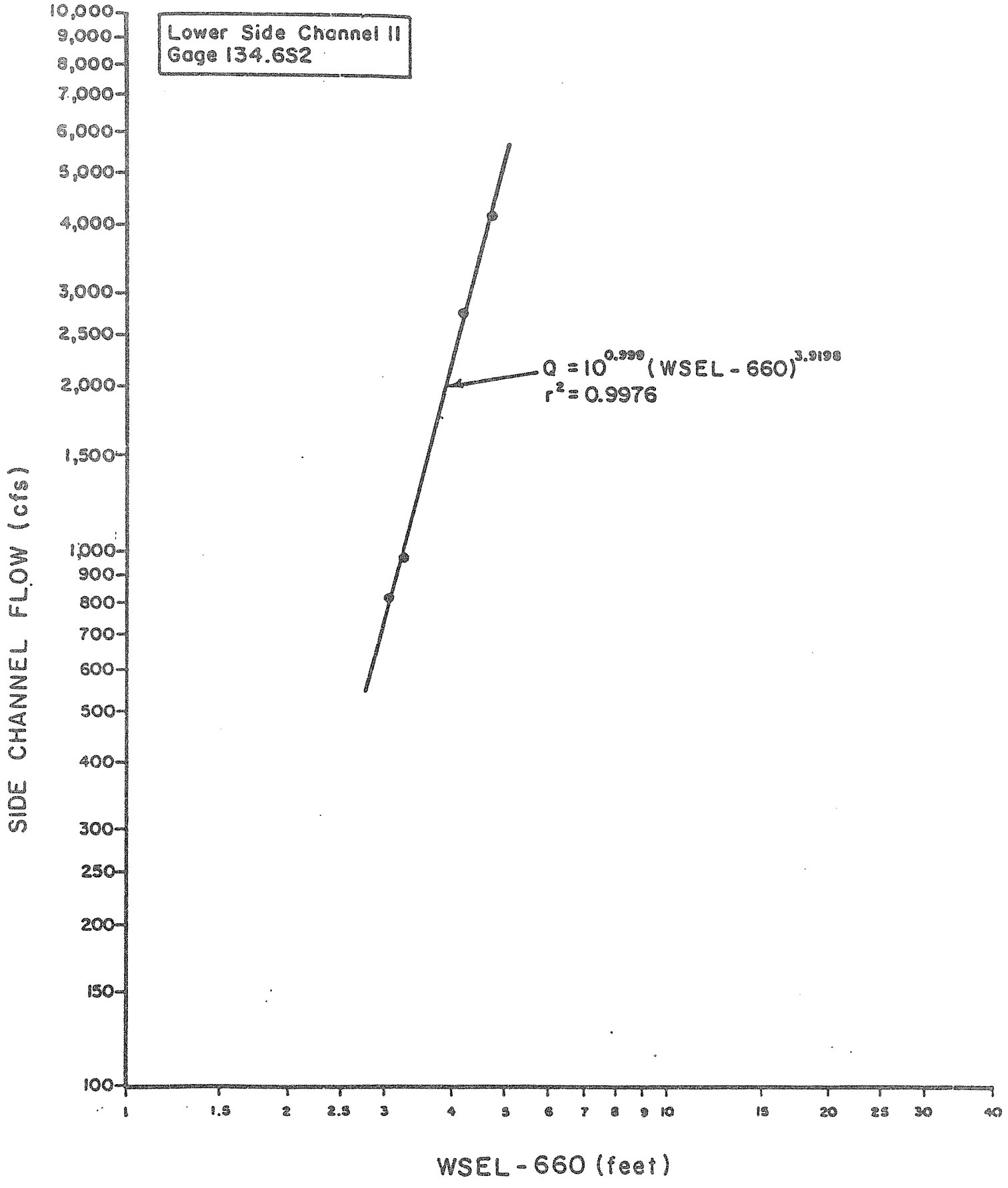

Figure I-15 Stage versus flow rating curve for Lower Side Channel II, staff gage 134.6S2.

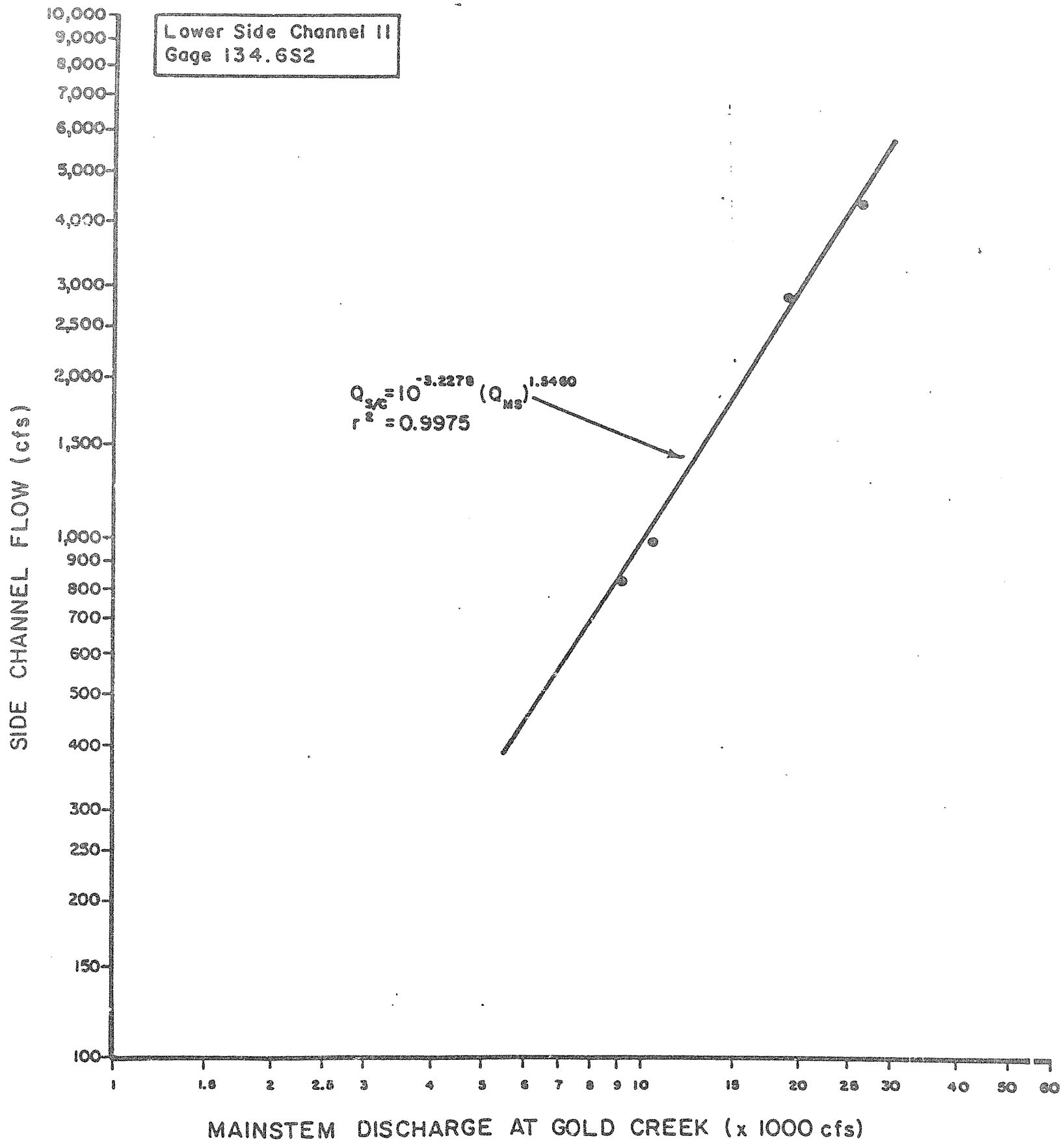

Figure 1-16 Side Channel flow versus mainstem discharge rating curve for Lower side Channel 11, staff gage 134.6S2.

3.2.3.5 Backwater

No area of backwater was observed to occur at the mouth of this side channel at any of the mainstem discharges observed during the 1983 open water field season.

3.2.4 Upper Side Channel 11 (RM 136.2)

3.2.4.1 Site Description

Upper Side Channel 11 (Figure 1-3) is located on the east bank of the Susitna River at river mile 136.2. It is approximately 0.4 miles in length and is separated from the mainstem by a large vegetated island. The head of Slough 11 confluences this side channel just below its head. Prior to breaching, flow in the side channel is provided by local runoff and groundwater seepage. Subsequent to sufficient breaching, the majority of the flow is provided by turbid water from the mainstem. An area of backwater occurs at the mouth of this side channel at moderate mainstem discharge.

During the 1983 open water field season, stage was monitored at five sites within this side channel at which streamflow was also monitored at one of these sites (Figure 1-17).

3.2.4.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring

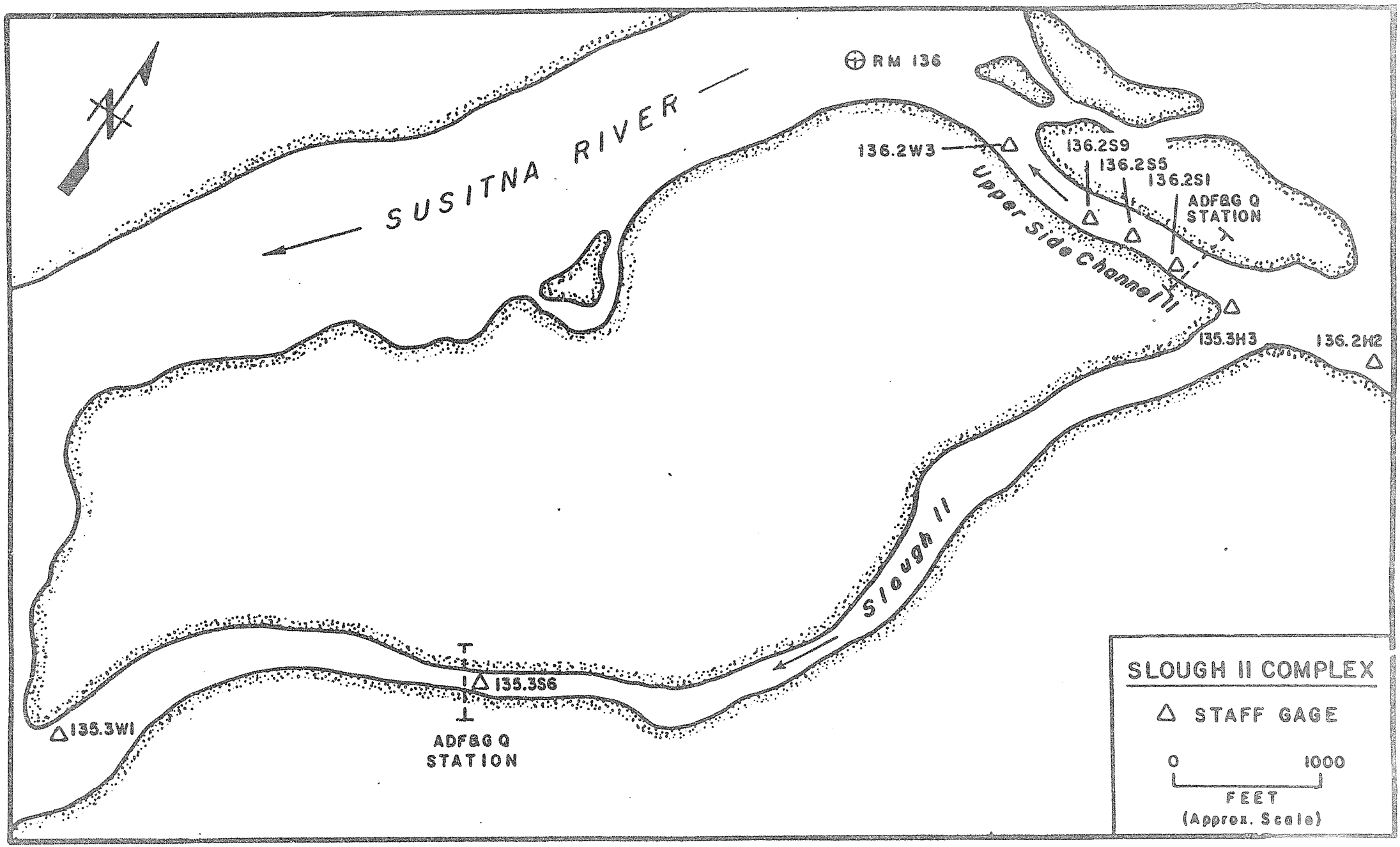

Figure I-17 Site map of Upper Side Channel 11, which are located on the east bank of the Susitna River at river mile 136.2.

Table 1-7. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Upper Side Channel 11.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Discharge (cfs)
136.2H2 (Head)	2.56	16,000 - 31,900
136.2S1 (Q-Site)	2.81	12,200 - 36,000
136.2S5	1.38	11,400 - 26,000
136.2S4	2.87	11,400 - 31,700
136.2W3 (Mouth)	2.72	11,400 - 31,700

station are presented in Table 1-7. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-43 - 1-A-45. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.2.4.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained within the free-flowing portion of the Upper Side Channel 11 study site (Appendix Table 1-A-8). From these measurements a simple stage/stream flow rating curve was developed, (Figure 1-18). The stage to streamflow relationship occurring in this sidechannel is found to change during the upper range of stream flows with a point of inflection estimated to occur at a flow of 403 cfs. Only one flow measurement was obtained while the side channel was not breached. In addition, streamflow obtained at this monitoring station was plotted against corresponding mainstem discharge at Gold Creek (Figure 1-19).

3.2.4.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions

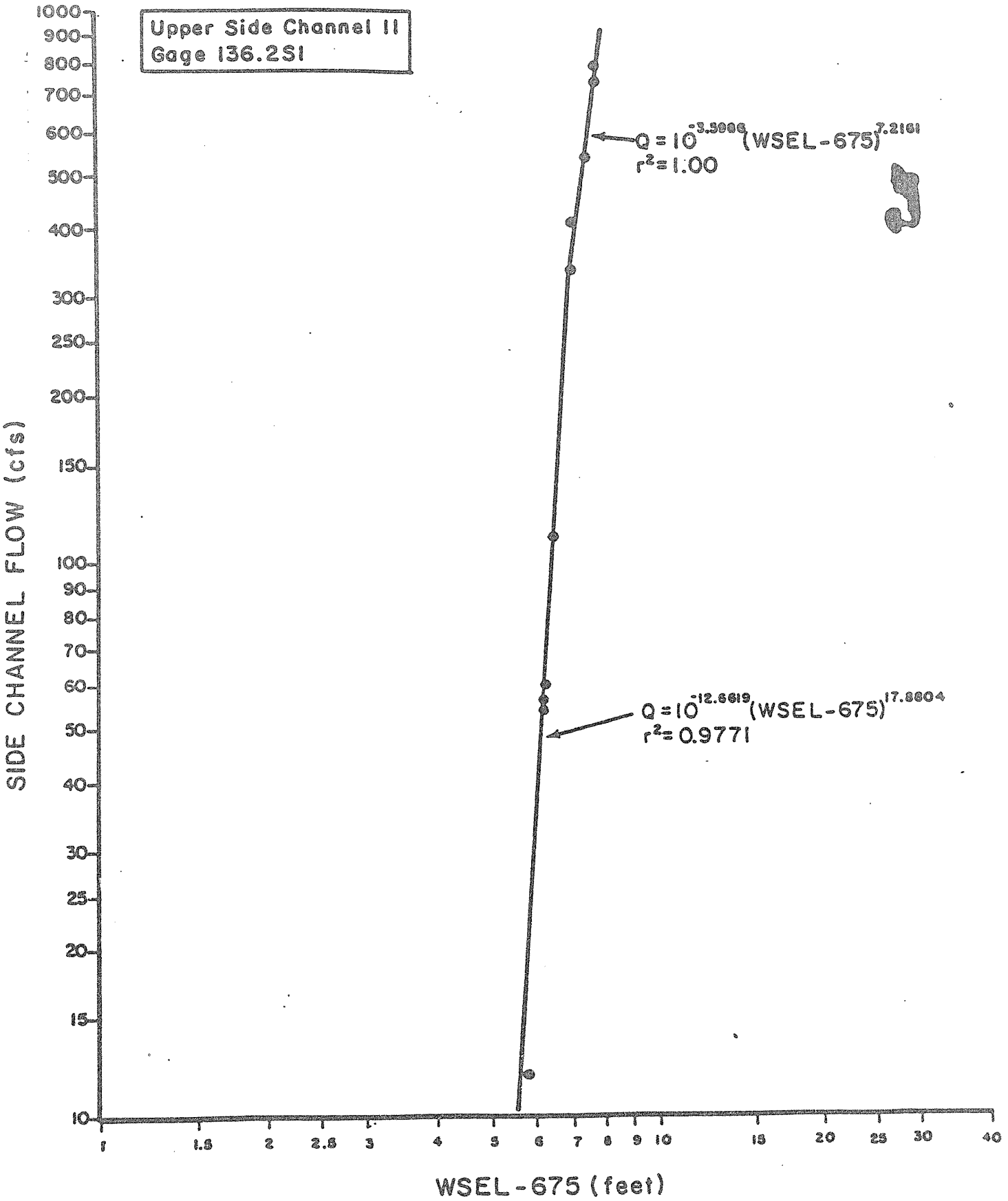

Figure 1-18 Stage versus flow rating curve for Upper Side Channel 11, staff gage 136.2S1.

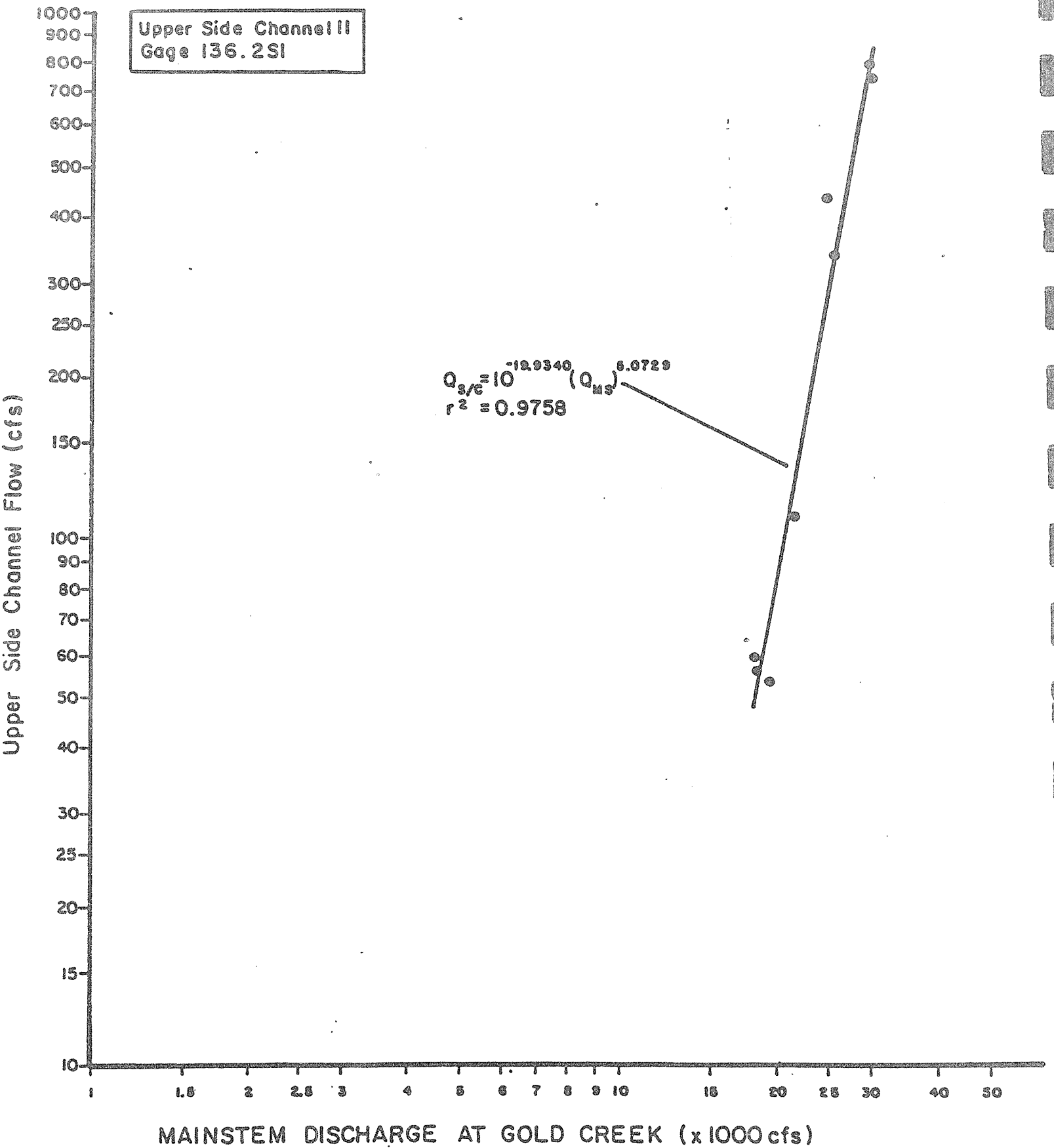

Figure 1-19 Side Channel flow versus mainstem discharge rating curve for Upper Side Channel 11, staff gage 136.2S1.

present in this side channel become governed by the mainstem at the controlling breaching discharge of 16,000 cfs at Gold Creek. This controlling breaching discharge compares to the lowest observed breaching discharge of 13,000 cfs at Gold Creek for this side channel.

3.2.4.5 Backwater

An area of backwater was observed to occur at the mouth of the side channel during periods of moderate and high mainstem discharges. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater was observed to occur at the mouth of this side channel to a point at least 400 ft. upstream at mainstem discharges as low as 11,400 cfs at Gold Creek.

3.2.5 Side Channel 21 (RM 141.2)

3.2.5.1 Site Description

Side Channel 21 (Figure 1-3) is located on the east bank of the Susitna River at river mile 141.2. It is approximately 0.9 miles in length and is separated from the mainstem by a series of well vegetated islands and gravel bars. Prior to breaching, flow in the side channel is provided by flow from Slough 21 and local runoff and groundwater seepage. Subsequent to breaching, flow in the side channel is provided overflow channels which provide turbid water from the mainstem. Backwater has been observed at the mouth of this side channel at high mainstem flows.

During the 1983 open water field season, stage was monitored at seven locations within this side channel study site, at which streamflow was monitored at two of these stage monitoring stations (Figure 1-20).

3.2.5.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-8. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at time of measurement for each monitoring site are presented in Appendix Figures 1-A-50 - 1-A-52. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.2.5.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained at two locations within the free-flowing portion of Side Channel 21 (Figure 1-20, Appendix Table 1-A-8). From these measurements, simple stage/stream flow rating curves were constructed for each location (Figures 1-21 and 1-22). Both curves represent streamflow conditions in the side channel during periods while the side channel was both breached and unbreached. In addition, discharge data obtained at each location was plotted

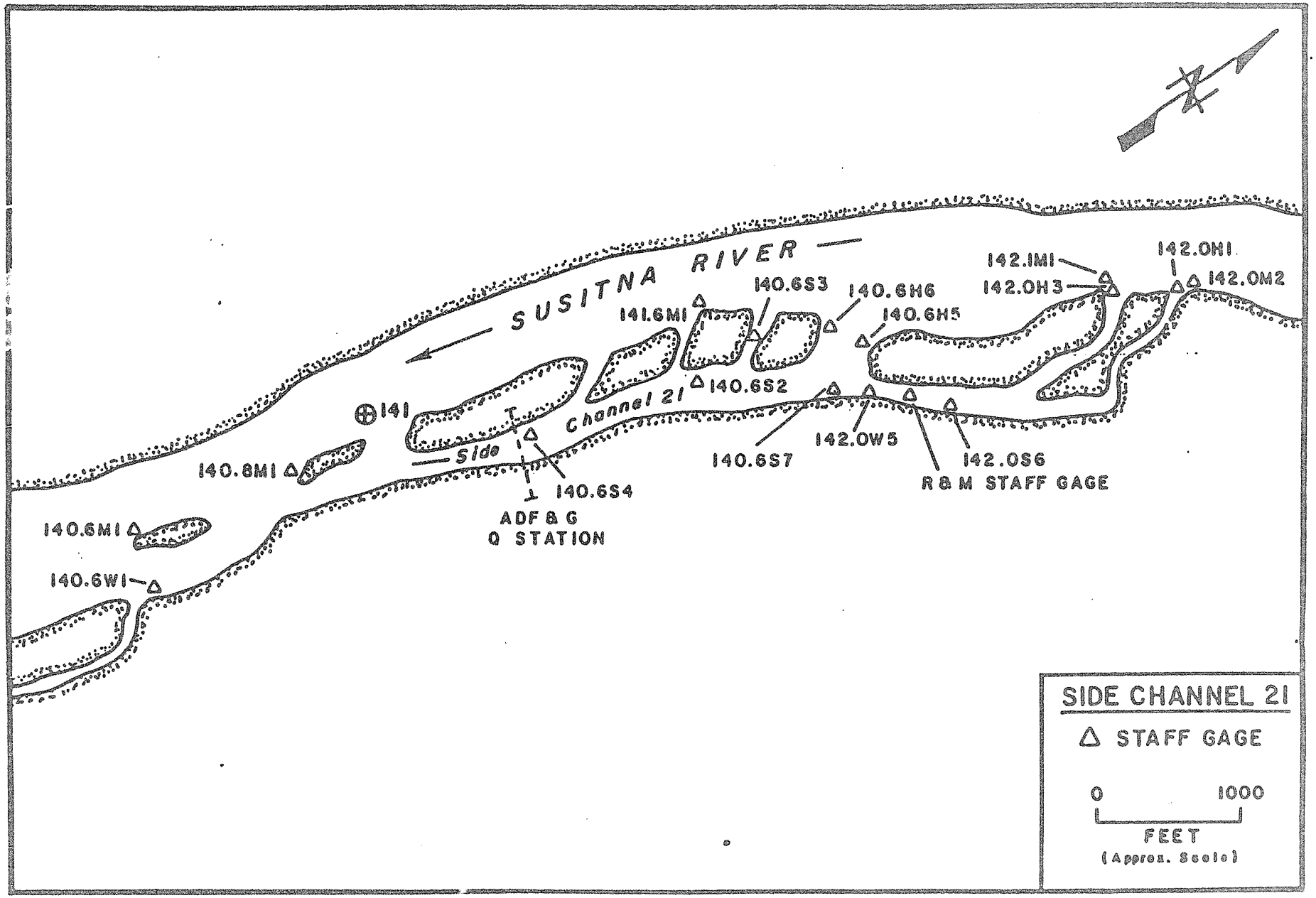

Figure 1-20 Site map of Side Channel 21, which is located on the east bank of the Susitna River at river mile 141.2.

Table 1-8. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Channel 21.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Discharge (cfs)
140.6H5 (Upper A6)	1.12	21,600 - 33,000
140.6H6 (Lower A6)	0.74	26,000 - 33,000
140.6S3 (A5)	2.88	11,600 - 33,000
140.6S2	2.02	11,100 - 33,000
140.6S7 (Upper Q-Site)	1.45	11,000 - 29,900
140.6S4 (Lower Q-Site)	2.29	10,700 - 33,000
140.6W1 (Mouth)	3.31	7,230 - 33,000

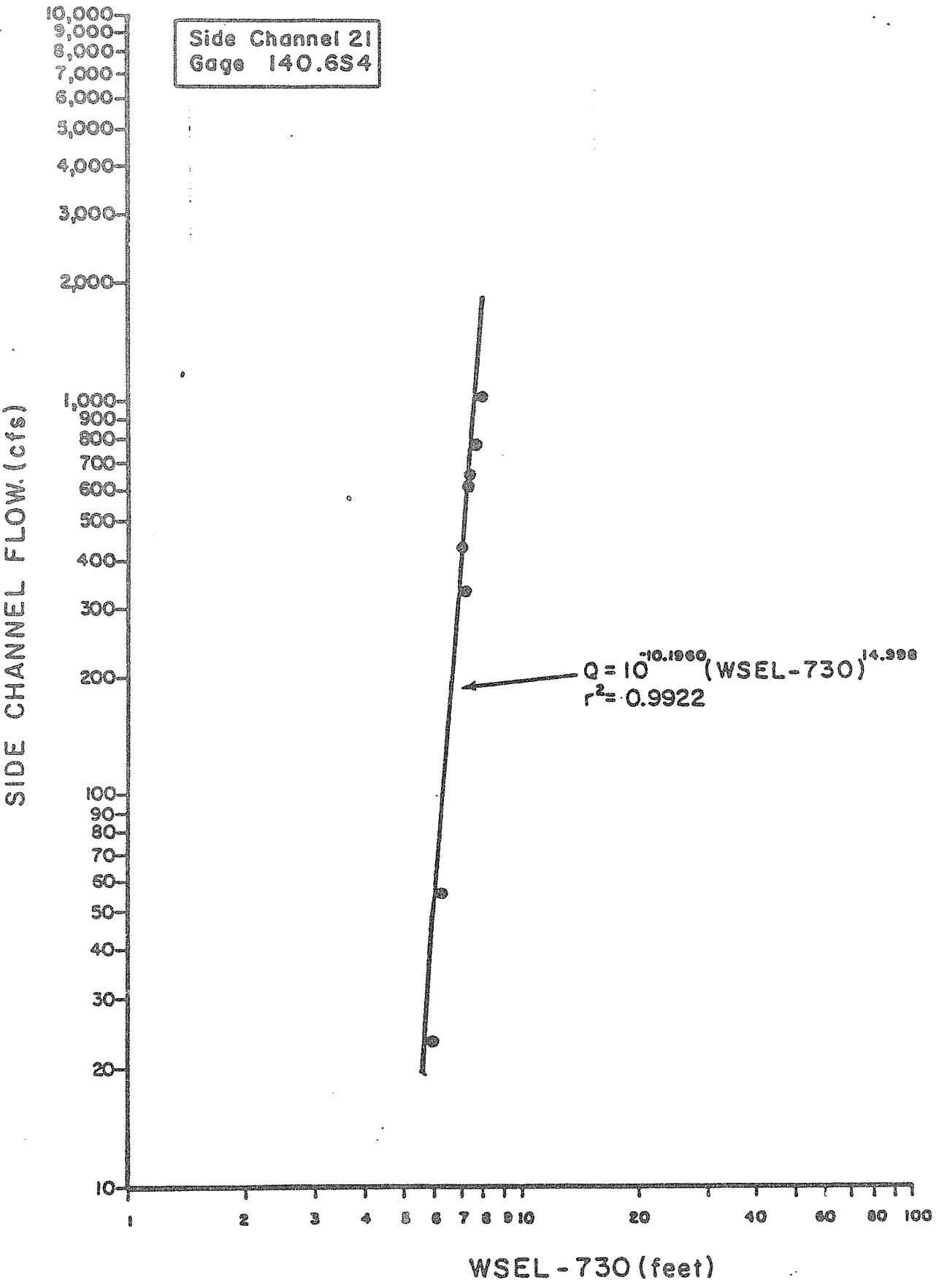

Figure 1-21 Stage versus flow rating curve for Side Channel 21, staff gage 140.6S4.

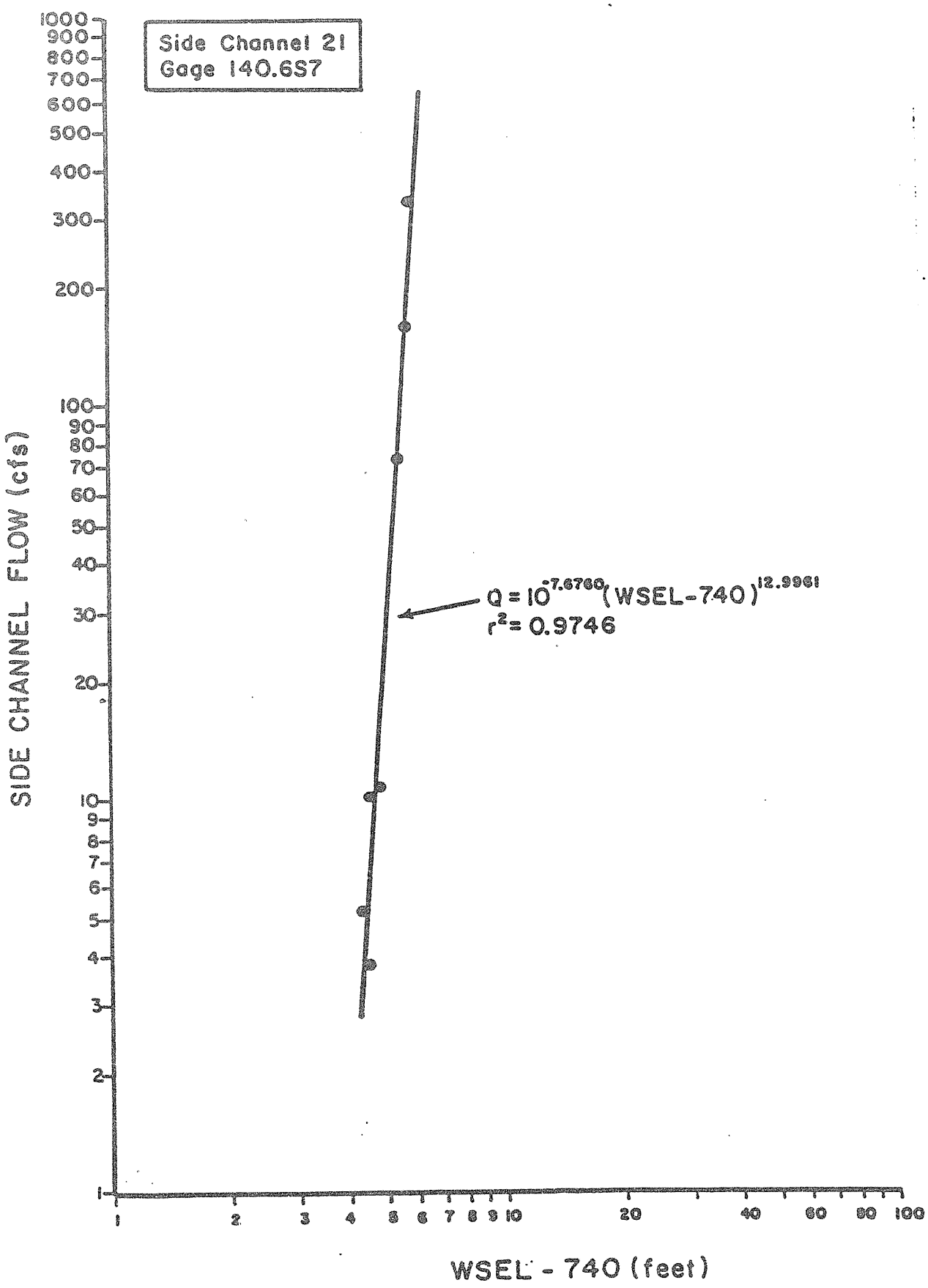

Figure 1-22 Stage versus flow rating curve for Side Channel 21, staff gage 140.6S7.

against corresponding mainstem discharge at Gold Creek (Figures 1-23 and 1-24). These curves only represent streamflow conditions in the side channel flow while the side channel was breached.

3.2.5.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side channel become governed by the mainstem at a controlling mainstem discharge of 12,000 cfs at Gold Creek. This controlling breaching discharge is the same as the lowest observed breaching discharge for the A5 overflow channel.

3.2.5.5 Backwater

An area of backwater was observed to occur at the mouth of this side channel during periods of high mainstem discharge. Based on available stage and channel geometry (see Chapter 2). This side channel has been observed to have an area of backwater high mainstem discharges.

3.3 Side Sloughs

Measurements of stage and discharge were obtained during the 1983 open water field season at selected locations within nine side slough study sites located in the Talkeetna to Devil Canyon reach of the Susitna River (Table 1-2). Results of these investigations are discussed below by site.

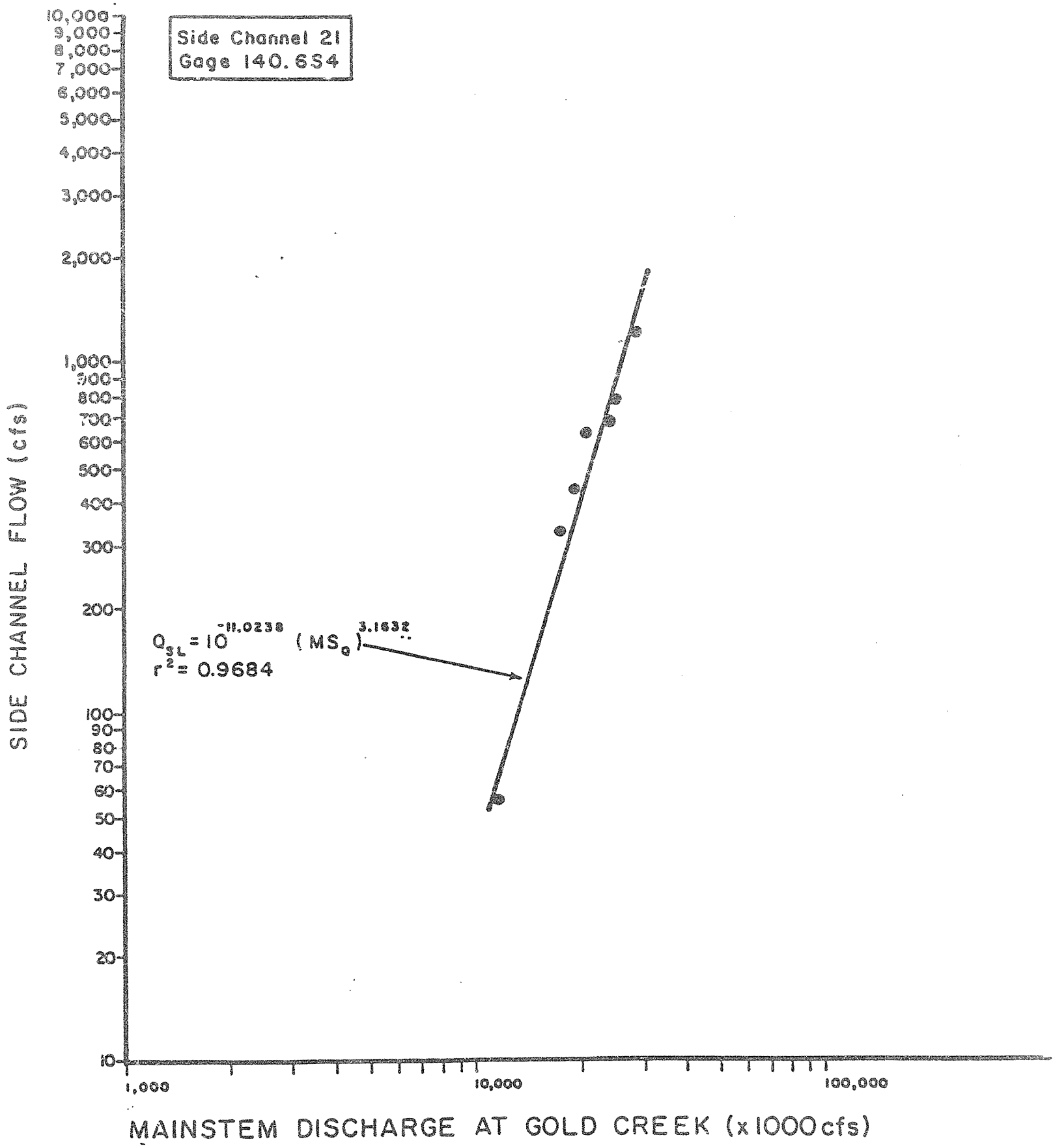

Figure 1-23 Side Channel flow versus mainstem discharge rating curve for Side Channel 21, staff gage 140.6S4.

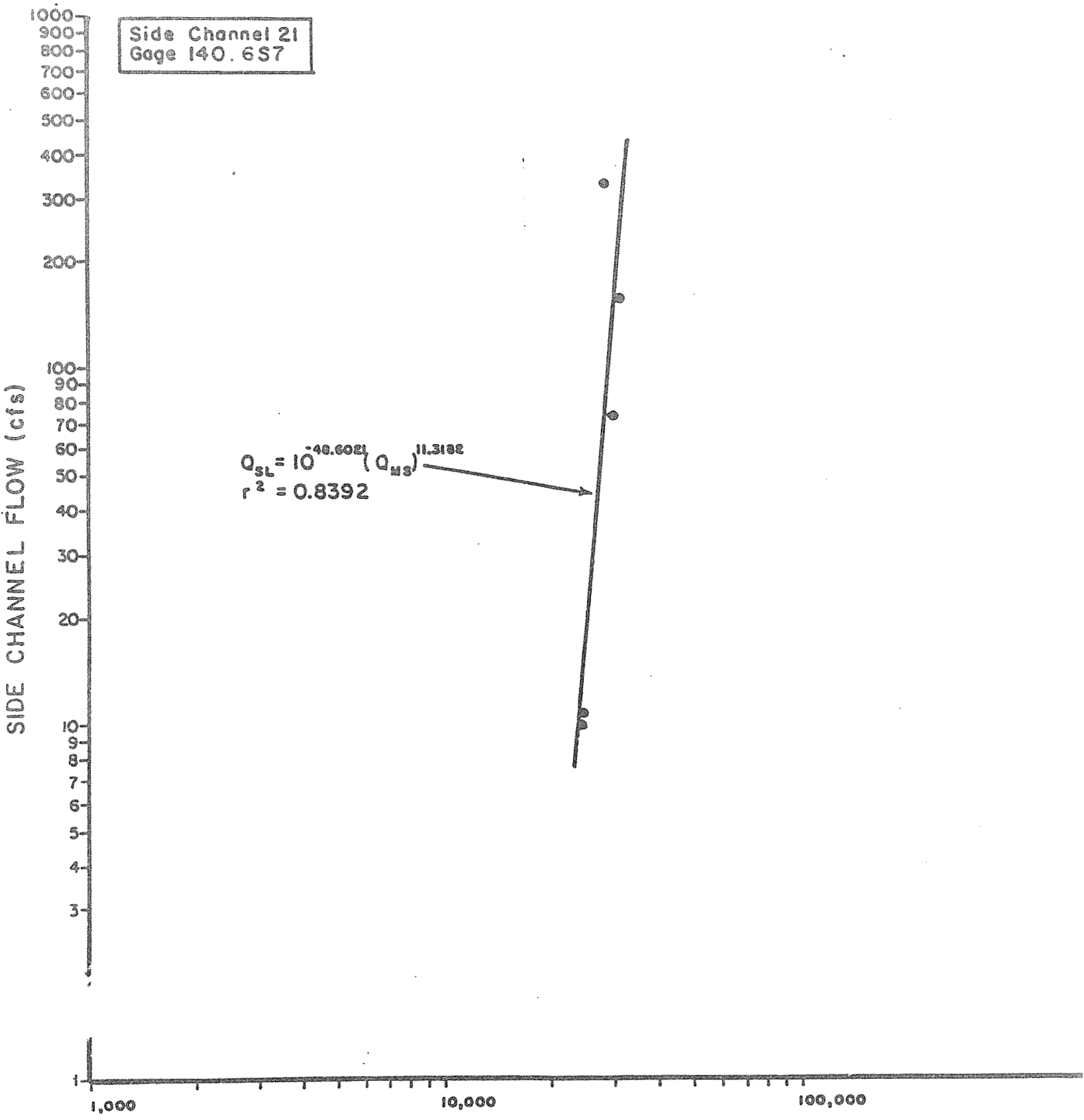

Figure 1-24 Side Channel flow versus mainstem discharge rating curve for Side Channel 21, staff gage 140.6S7.

3.3.1 Whiskers Side Slough (RM 101.2)

3.3.1.1 Site Description

Whiskers Side Slough (Figure 1-3) is located on the west bank of the Susitna River at river mile 101.2. It is approximately 0.6 miles in length and is separated from the mainstem by a well vegetated island. Prior to overtopping, flow in this side slough is primarily provided by Whiskers Creek with additional smaller flow contributions provided by local runoff and groundwater seepage. Subsequent to sufficient breaching, flow in the side slough is provided by both Whiskers Creek and turbid water from the mainstem. A substantial area of backwater occurs at the mouth of this side slough at moderately low to high mainstem flows.

During the 1983 open water field season, stage was monitored at three sites within this side slough at which streamflow was also measured at one of these sites (Figure 1-25).

3.3.1.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-9. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station within Whiskers

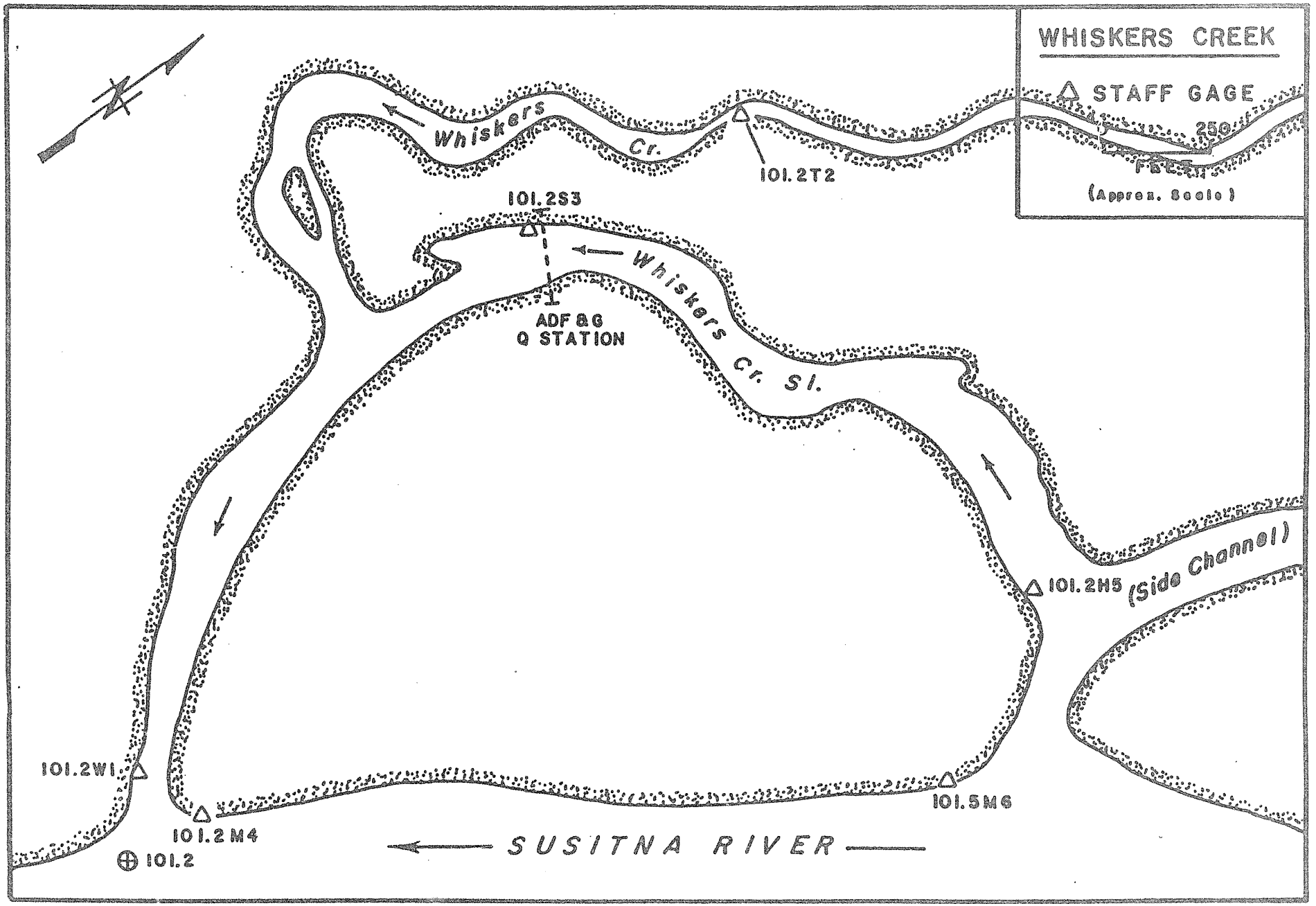

Figure 1-25 Site map of Whiskers Side Slough, which is located on the west bank of the Susitna River at river mile 101.2.

Table 1-9. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Whiskers Side Slough at RM 101.2.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
101.2H5 (Head	1.12	12,200 - 18,600
101.2S3 (Q-Site)	2.03	8,440 - 37,000
101.2W1 (Mouth)	3.96	8,440 - 37,000

Side Slough are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented at Appendix Figures 1-A-24 - 1-A-25. Measurements of slough flow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.1.3 Stage/Discharge Relationships

Measurements of stage and streamflow were obtained within the free-flowing portion of Whiskers Creek Side Slough above its confluence with Whiskers Creek (Figure 1-25, Appendix Table 1-A-8). From these measurements a simple stage/streamflow rating curve was developed (Figure 1-26). This curve represents streamflow conditions during both breached and unbreached conditions. Insufficient flow data was available during the breached condition to plot the slough flow to that of mainstem discharge.

3.3.1.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 23,000 cfs at Gold Creek. This controlling breaching discharge compares to the lowest observed breaching discharge of 22,000 cfs at Gold Creek for this side slough.

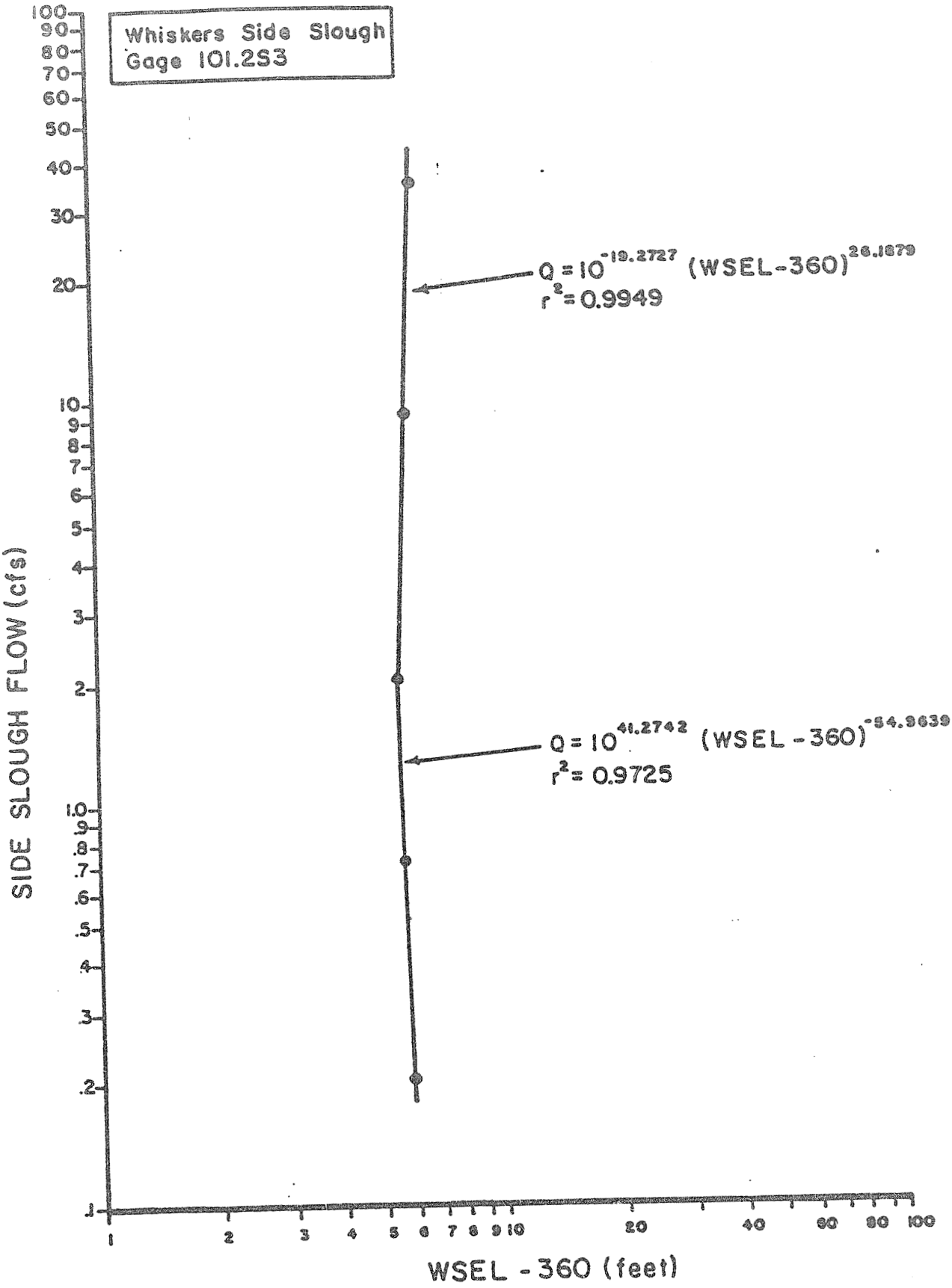

Figure 1-26 Stage versus flow rating curve for Whiskers Side Slough, staff gage, 101.2S3.

3.3.1.5 Backwater

A substantial area of backwater occurs at the mouth of this slough during periods of low to high mainstem discharge. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this side slough at mainstem flows at Gold Creek as low as 8,440 cfs.

3.3.2 Side Slough 8 (RM 133.6)

3.3.2.1 Site Description

Side Slough 8, also known as Lane Creek Slough, is located on the east bank of the Susitna River at river mile 133.6, (Figure 1-3). It is approximately 0.4 miles in length and is separated from the mainstem by a well vegetated bar. Prior to breaching, flow in this side slough is provided by local runoff and groundwater seepage. Subsequent to sufficient breaching, flow is provided from turbid water in the mainstem. An area of backwater occurs at the mouth of this side slough during periods of moderate to high mainstem flows.

During the 1983 open water field season, stage was monitored at three sites within this side slough, at which streamflow was also measured at one of these sites (Figure 1-27).

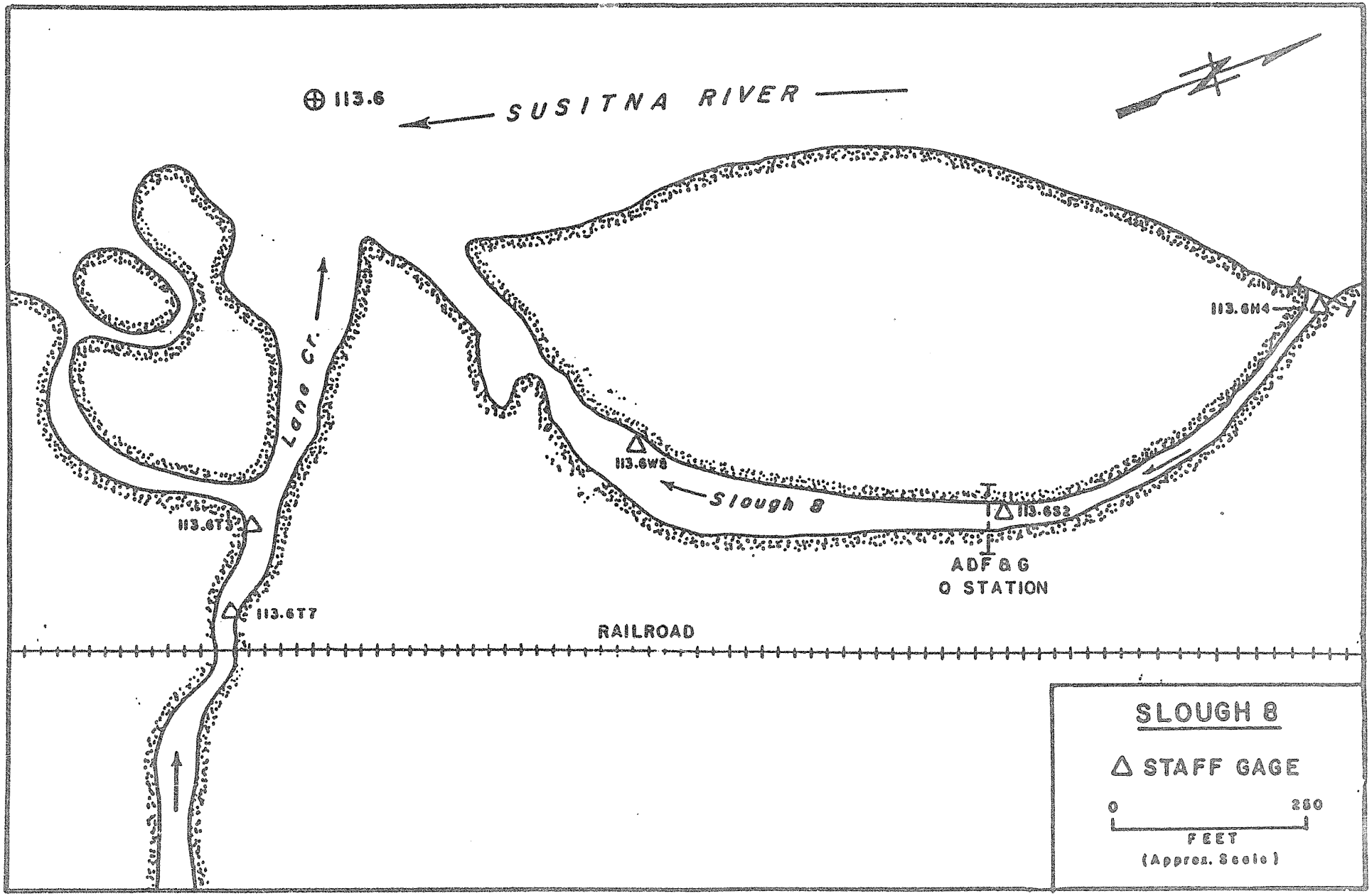

Figure 1-27 Site map of Side Slough 8, which is located on the east bank of the Susitna River at river mile 113.6.

3.3.2.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-10. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented at Appendix Figures 1-A-27 - 1-A-28. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.2.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained within the free-flowing portion of Side Slough 8 (Appendix Table 1-A-8). From these measurements, a simple stage/streamflow rating curve was constructed (Figure 1-28). In addition, streamflow data obtained at this site were plotted against corresponding mainstem discharge at Gold Creek at the time of measurement (Figure 1-29). Both of these plots represent streamflow conditions during periods when the slough was both breached and not breached by mainstem discharge.

Table 1-10. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 8 (Lane Creek Slough) at RM 133.6.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
113.6H4 (Head)	0.80	26,000 - 32,000
113.6S2 (Q-Site)	2.78	9,640 - 32,000
113.6W8	3.92	9,640 - 31,900

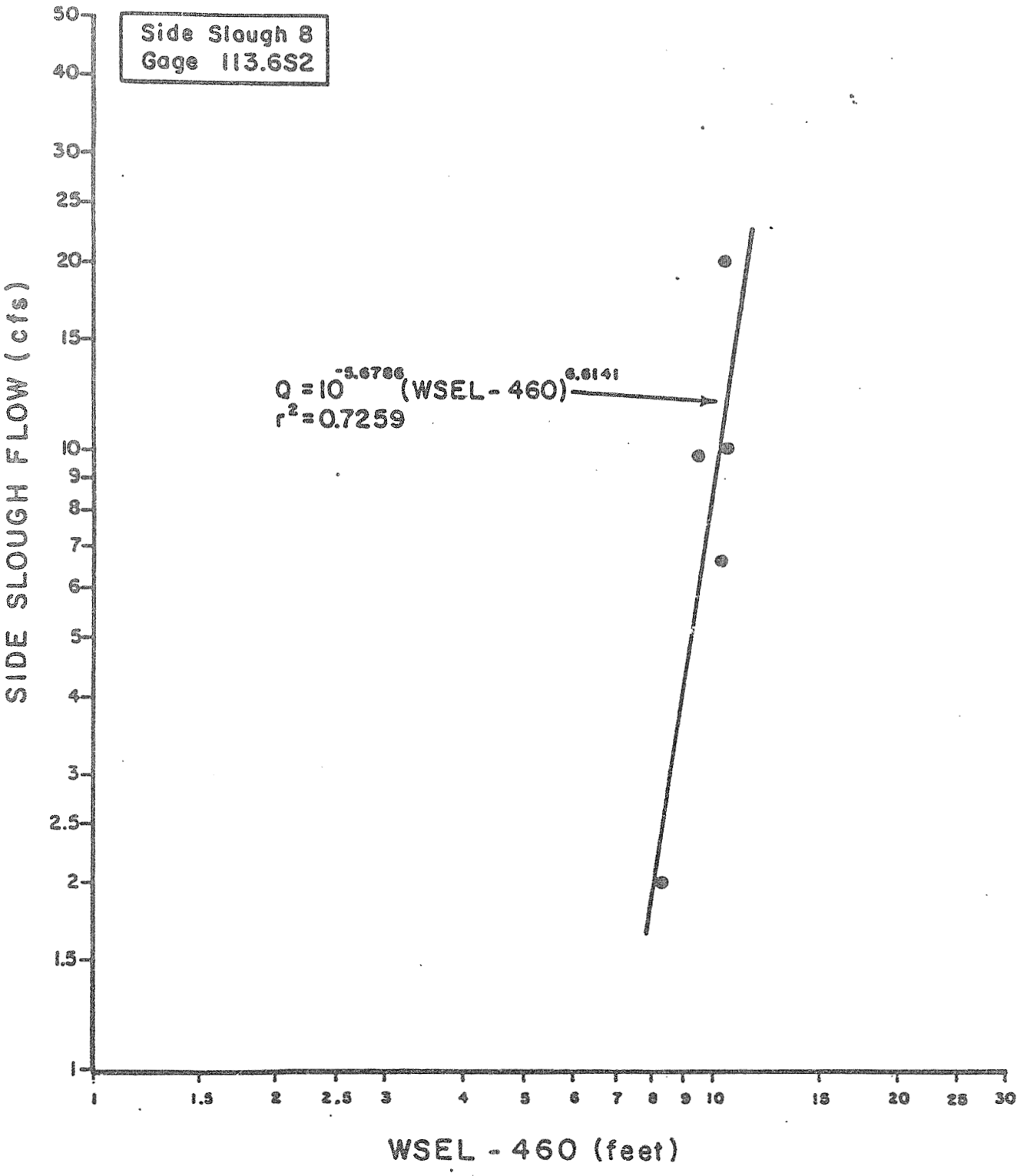

Figure 1-28 Stage versus flow rating curve for Slough 8, staff gage 113.6S2.

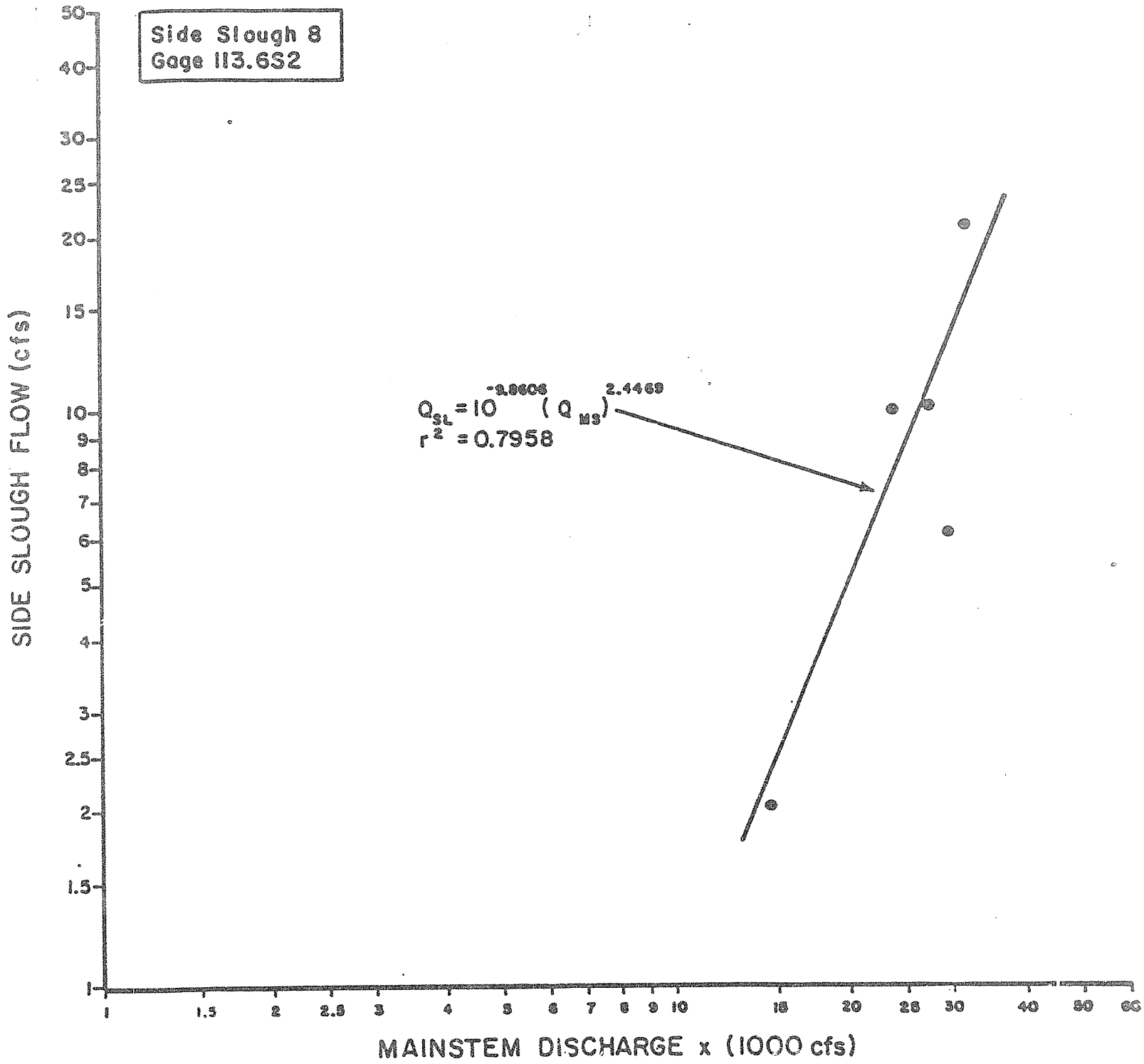

Figure 1-29 Slough flow versus mainstem discharge rating curve for Side Slough 8, staff gage 113.6S2.

3.3.2.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 24,000 cfs at Gold Creek. This controlling discharge is the same as the lowest observed breaching discharge for this site.

3.3.2.5 Backwater

An area of backwater was observed to occur at the mouth of this slough during periods of moderate to high mainstem discharge. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this side slough at mainstem flows at Gold Creek as low as 11,600 cfs.

3.3.3 Side Slough 8A (RM 125.3)

3.3.3.1 Site Description

Side Slough 8A (Figure 1-3) is located on the east bank of the Susitna River at river mile 125.3. It is approximately two miles in length and is separated from the mainstem by two relatively large vegetated islands. Approximately 0.5 miles upstream of the mouth, the channel divides into two forks, a NW fork and NE fork. Two beaver dams are present on the side slough with one occurring just downstream of the

fork and one just upstream of the fork in the NE channel. Prior to overtopping, flow in the side slough is provided by local runoff and groundwater seepage. Subsequent to overtopping, flow is primarily provided as turbid water from the mainstem. A substantial area of backwater occurs at the mouth of this side channel during periods of to high mainstem flows.

During the 1983 open water field season, stage was monitored at nine sites within this side slough, at which slough flow was also measured at three of these sites (Figure 1-30).

3.3.3.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-11. Measurements of water surface elevations along with corresponding mainstem discharge at Gold Creek at the time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at the time of measurement for each monitoring station are presented in Appendix Figures 1-A-32 - 1-A-34. Measurements of streamflow along with corresponding measurement of water surface elevation and mainstem discharge at Gold Creek at time of measurement are presented in Appendix Table 1-A-8.

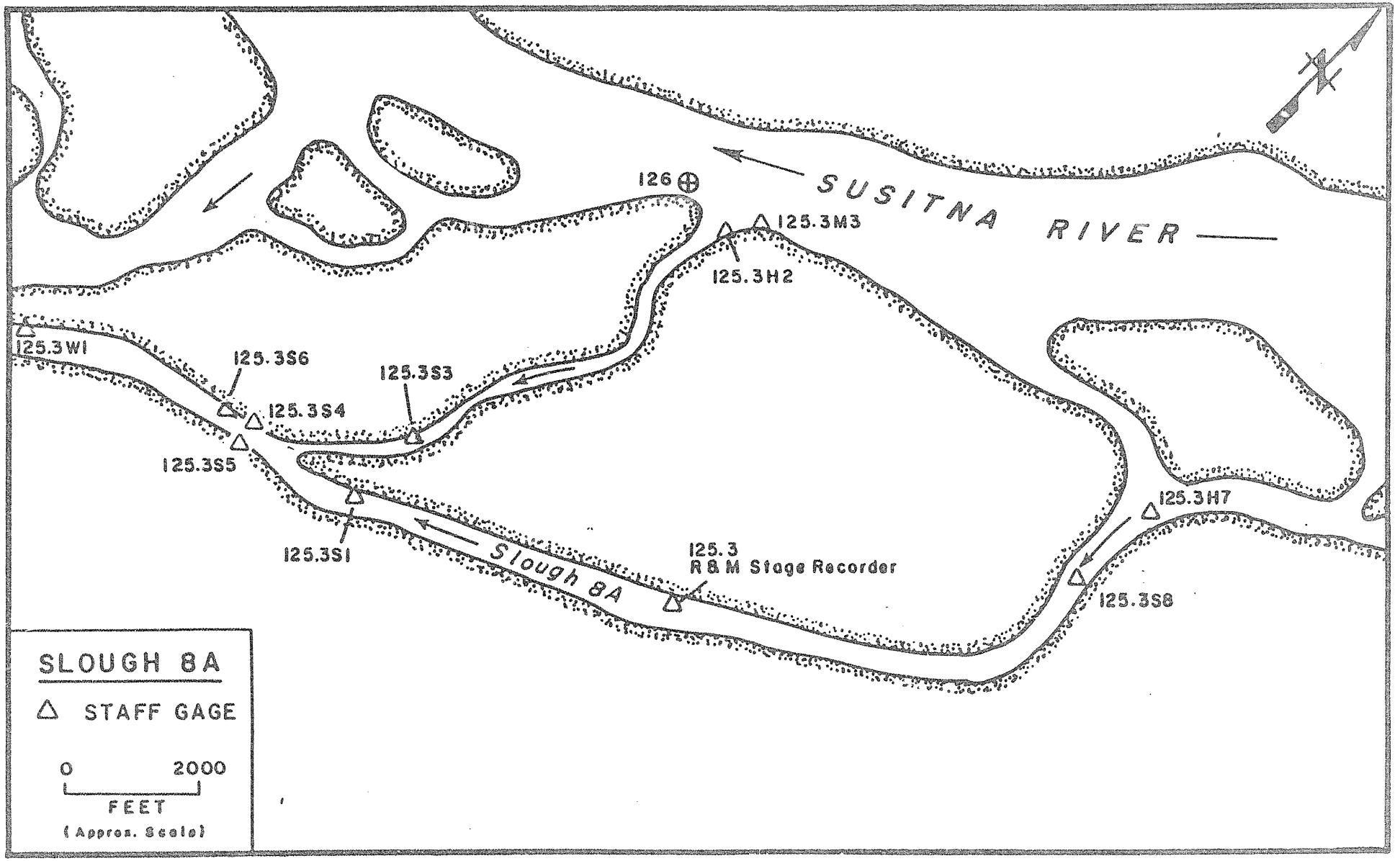

Figure 1-30 Site map of Side Slough 8A, which is located on the east bank of the Susitna River at river mile 125.3.

Table 1-11. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 8A at RM 125.3.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
125.3H7 (NE Head)	Dewatered	5,000 - 31,000
125.3S8	0.55	20,600 - 31,000
125.3S1 (NE Channel Q-Site)	1.16	5,400 - 31,000
125.3H2 (NW Head)	0.50	27,400 - 32,000
125.3S3 (NW Q-Site)	0.80	10,600 - 31,000
125.3S5	0.45	7,230 - 31,000
125.3S4	0.65	7,230 - 31,000
125.3S6 (Backwater)	2.61	7,230 - 31,000
125.3W5 (Mouth)	3.42	7,230 - 36,000

3.3.3.3 Stage/Discharge Relationship

Measurements of stage and streamflow were obtained at three locations within the free-flowing portion of Side Slough 8A, (Appendix 1-A-8). From these measurements, simple stage/streamflow rating curves were developed (Figures 1-31 to 1-33). These curves represent streamflow during periods while the slough was breached and not breached by mainstem water with the exception for the curve for the NE channel which only represents streamflow conditions during unbreached periods. Flow data obtained at each discharge station other than the discharge station in the NE channel was also plotted against the corresponding mainstem discharge at Gold Creek (Figures 1-34 and 1-35). Due to an absence of breaching flows in the NE channel, this site was not plotted against mainstem discharge.

3.3.3.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present the NW and NE forks of this side slough become governed by the mainstem at a controlling mainstem discharge of 27,000 cfs at Gold Creek respectively. These controlling flows are the same as the lowest observed breaching discharge for each fork.

3.3.3.5 Backwater

An area of backwater was observed to occur at the mouth of this side slough during periods of low to high mainstem discharge. Based on

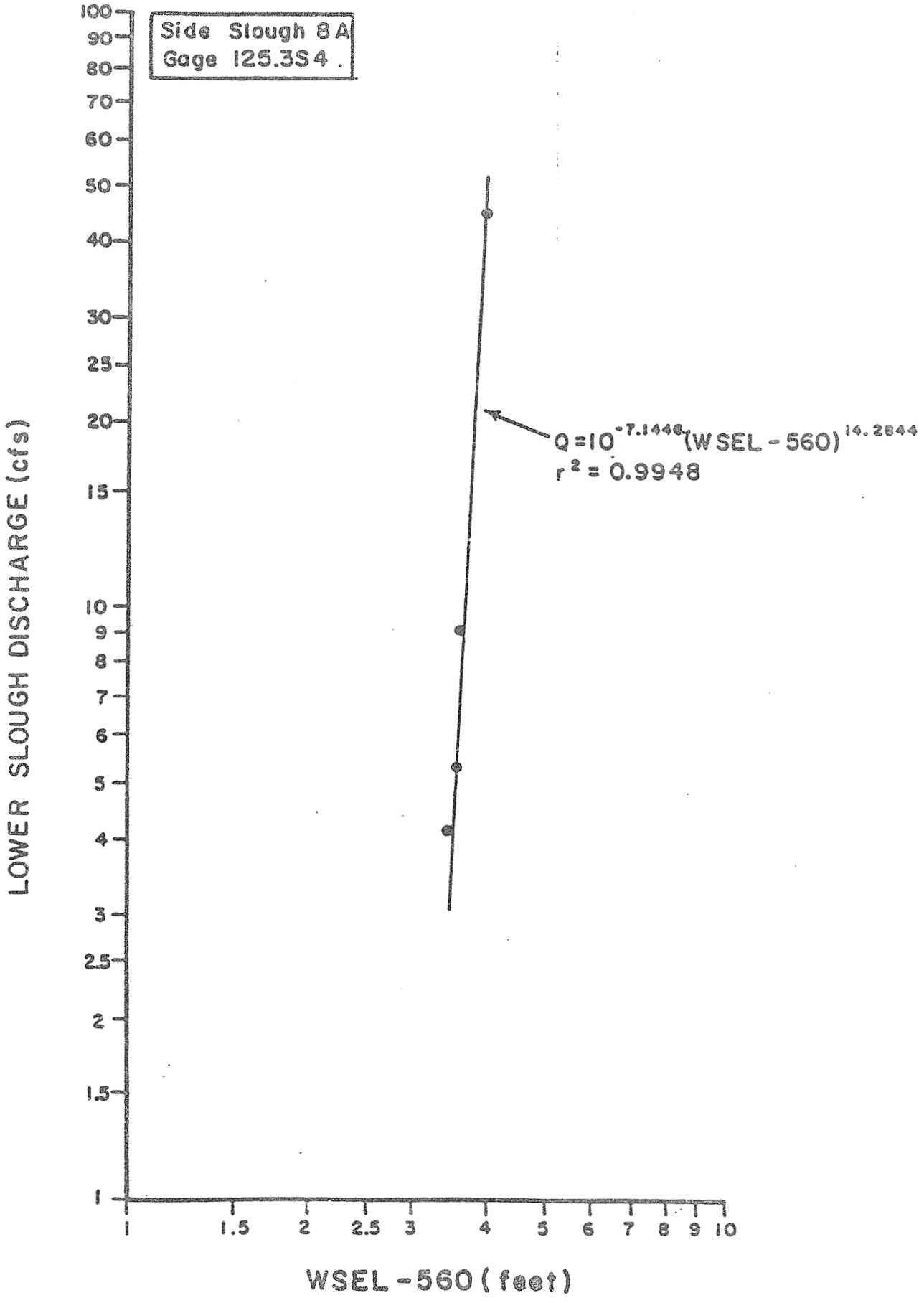

Figure 1-31 Stage versus flow rating curve for Side Slough 8A, staff gage 125.3S4.

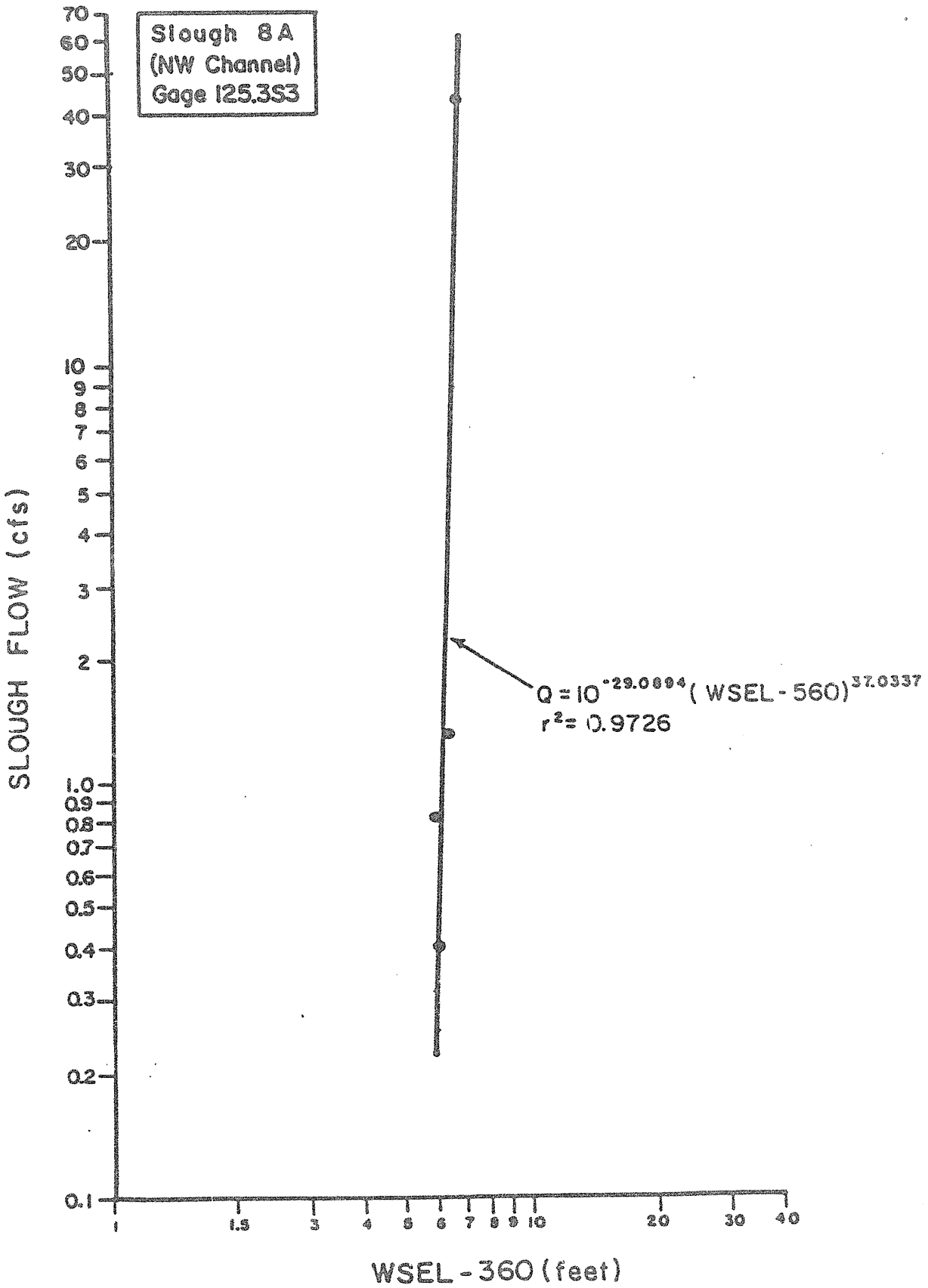

Figure 1-32 Stage versus flow rating curve for Side Slough 8A, staff gage 125.3S3.

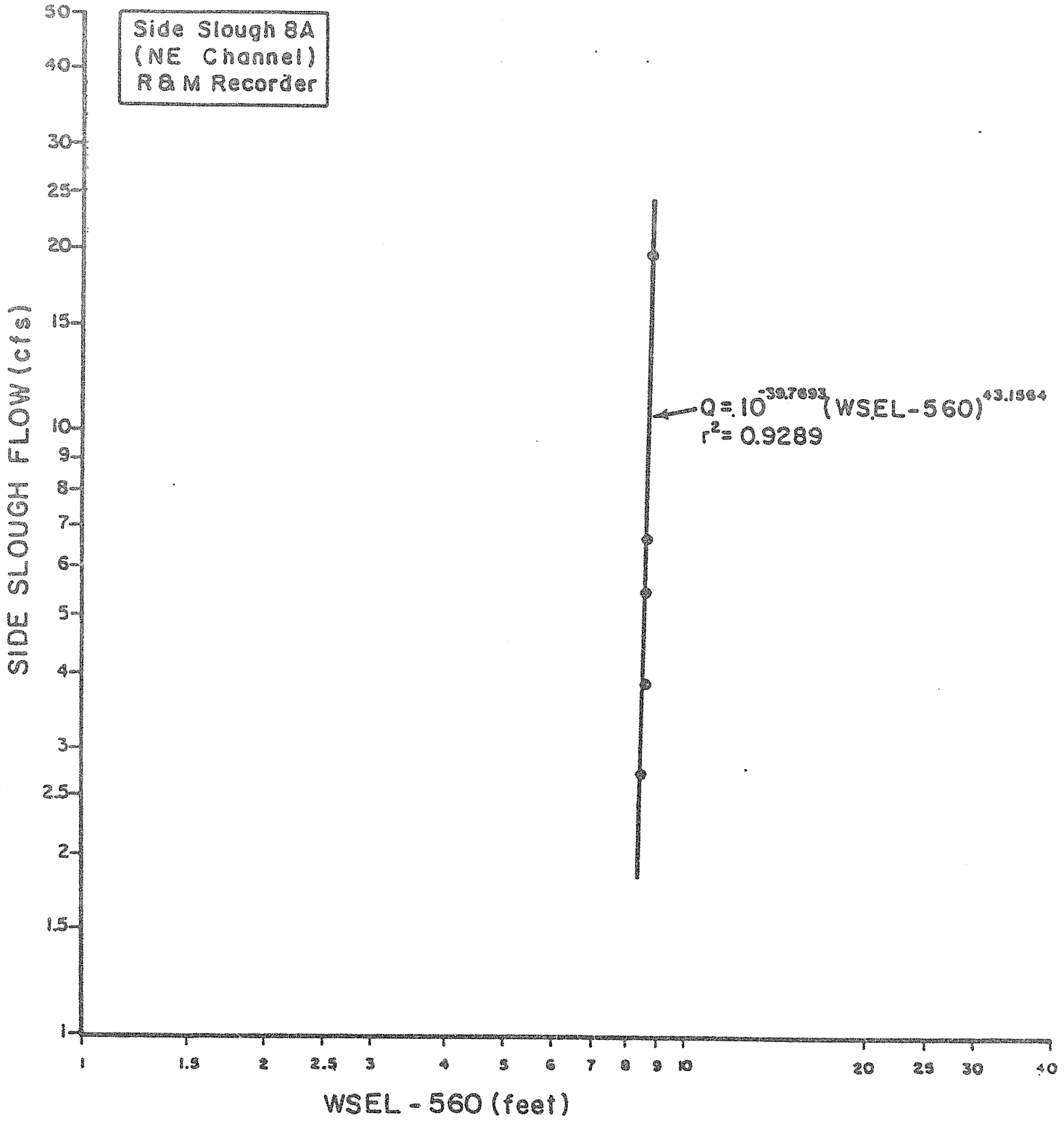

Figure 1-33 Stage versus flow rating curve for Side Slough 8A, staff gage at R&M recorder.

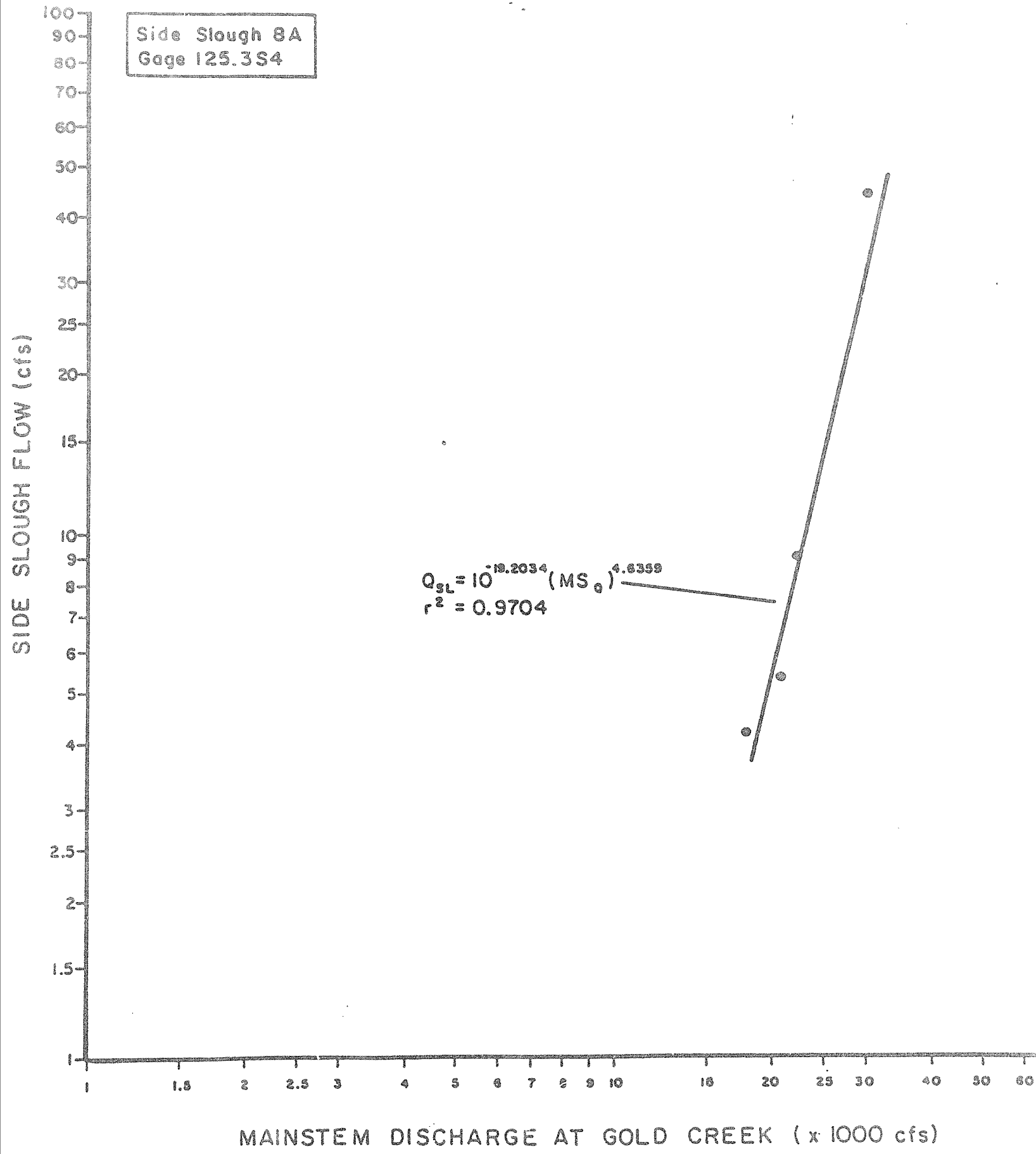

Figure 1-34 Slough flow versus mainstem discharge rating curve for Side Slough 8A, staff gage 125 3S4.

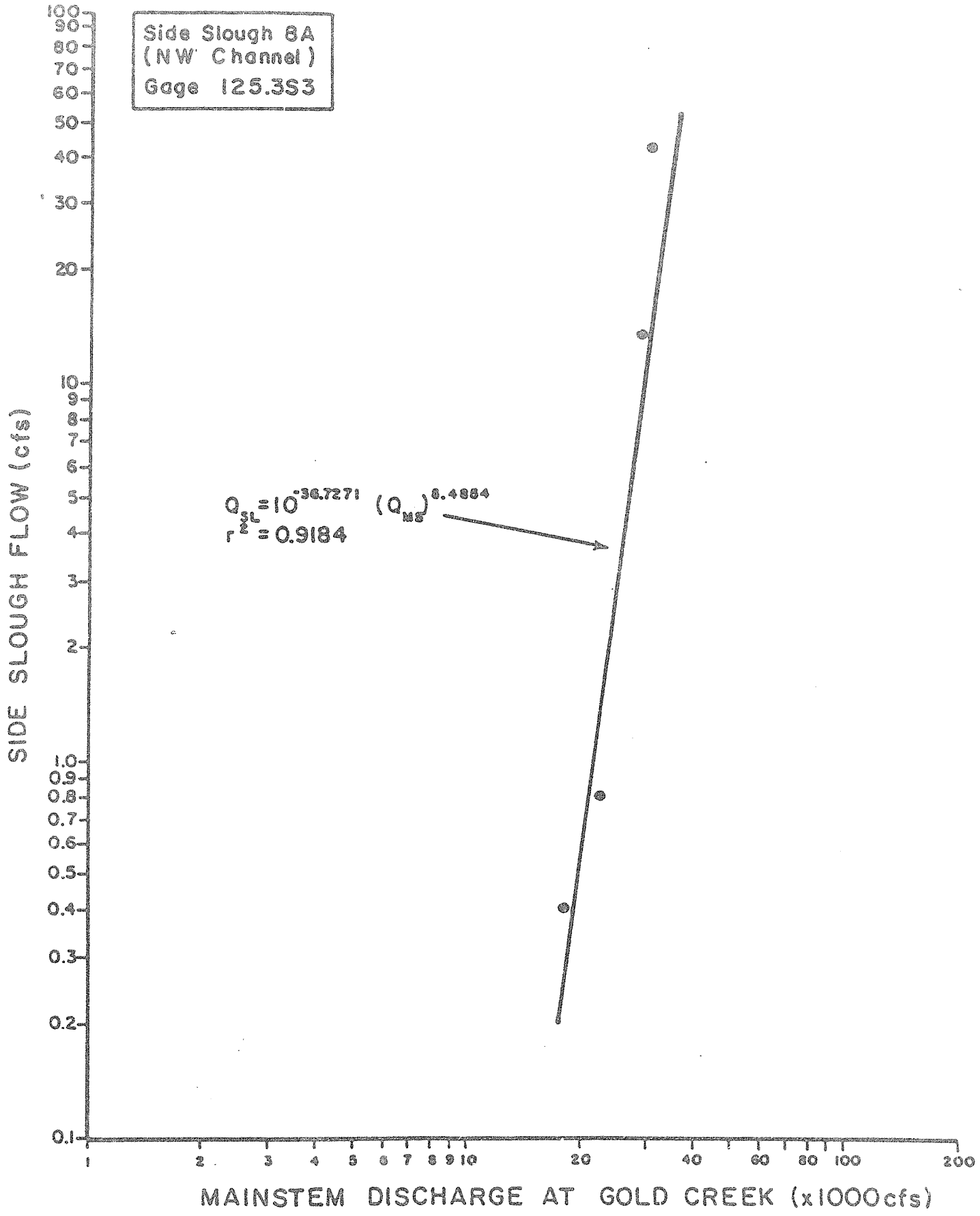

Figure 1-35 Slough flow versus mainstem discharge rating curve for Side Slough 8A, staff gage 125.3S3.

available stage and channel geometry (see Chapter 2) data, a substantial area of backwater occurs at the mouth of this side slough at mainstem flows at Gold Creek as low as 7,230 cfs.

3.3.4 Side Slough 9 (RM 128.3)

3.3.4.1 Site Description

Side Slough 9 (Figure 1-3) is located on the east bank of the Susitna River at river mile 128.3. It is approximately 1.2 miles in length and is separated from the mainstem by a large vegetated island. Prior to breaching, flow in the slough is provided by two small tributaries, local runoff, and groundwater seepage. Subsequent to sufficient breaching, flow is primarily provided as turbid water from the mainstem. An area of backwater occurs at the mouth of this side slough at moderate to high mainstem discharge at Gold Creek.

During the 1983 open water field season, stage was monitored at three sites within this side slough, at which streamflow was also measured at one of these sites (Figure 1-36).

3.3.4.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-12. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at

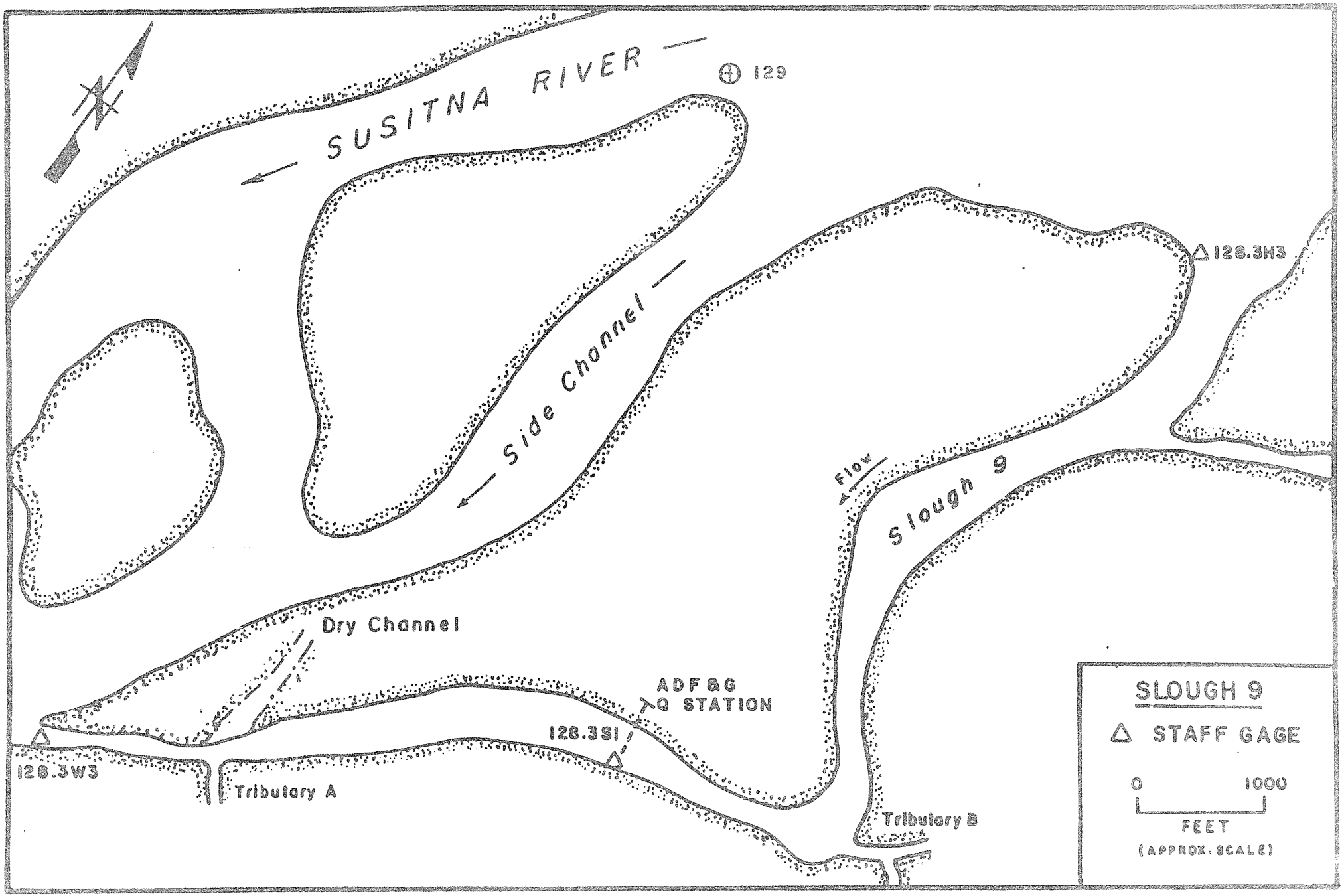

Figure 1-36 Site map of Side Slough 9, which is located on the east bank of the Susitna River at river mile 128.3.

Table 1-12. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 9 at RM 128.3.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
128.3H2 (Head)	0.44	17,800 - 22,700
128.3S1 (Q-Site)	1.25	10,700 - 30,000
128.3W3 (Mouth)	4.40	8,760 - 36,000

the time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at the time of measurement for each monitoring station are presented in Appendix Figures 1-A-35 - 1-A-36 . Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at time of measurement are presented in Appendix Table 1-A-8.

3.3.4.3 Stage/Discharge Relationships

Measurements of stage and streamflow were obtained at one site within the free-flowing portion of Side Slough 9 (Figure 1-36). These 1983 streamflow measurements and those obtained by R&M Consultants and ADF&G in 1982 were plotted as a simple stage/streamflow rating curve (Figure 1-37). The stage measurements obtained simultaneously with the streamflow measurements in 1982 have been found to be slightly higher than the stage measurements corresponding to the 1983 streamflow measurements. This variation has been attributed to stream bed movement. Because of difference between the 1982 and 1983 stage observations two lines have been constructed depicting the stage/streamflow relationships occurring for 1982 and 1983. In addition, the 1983 streamflow measurements obtained while the slough was breached have also been plotted with the corresponding mainstem discharge at Gold Creek (Figure 1-38).

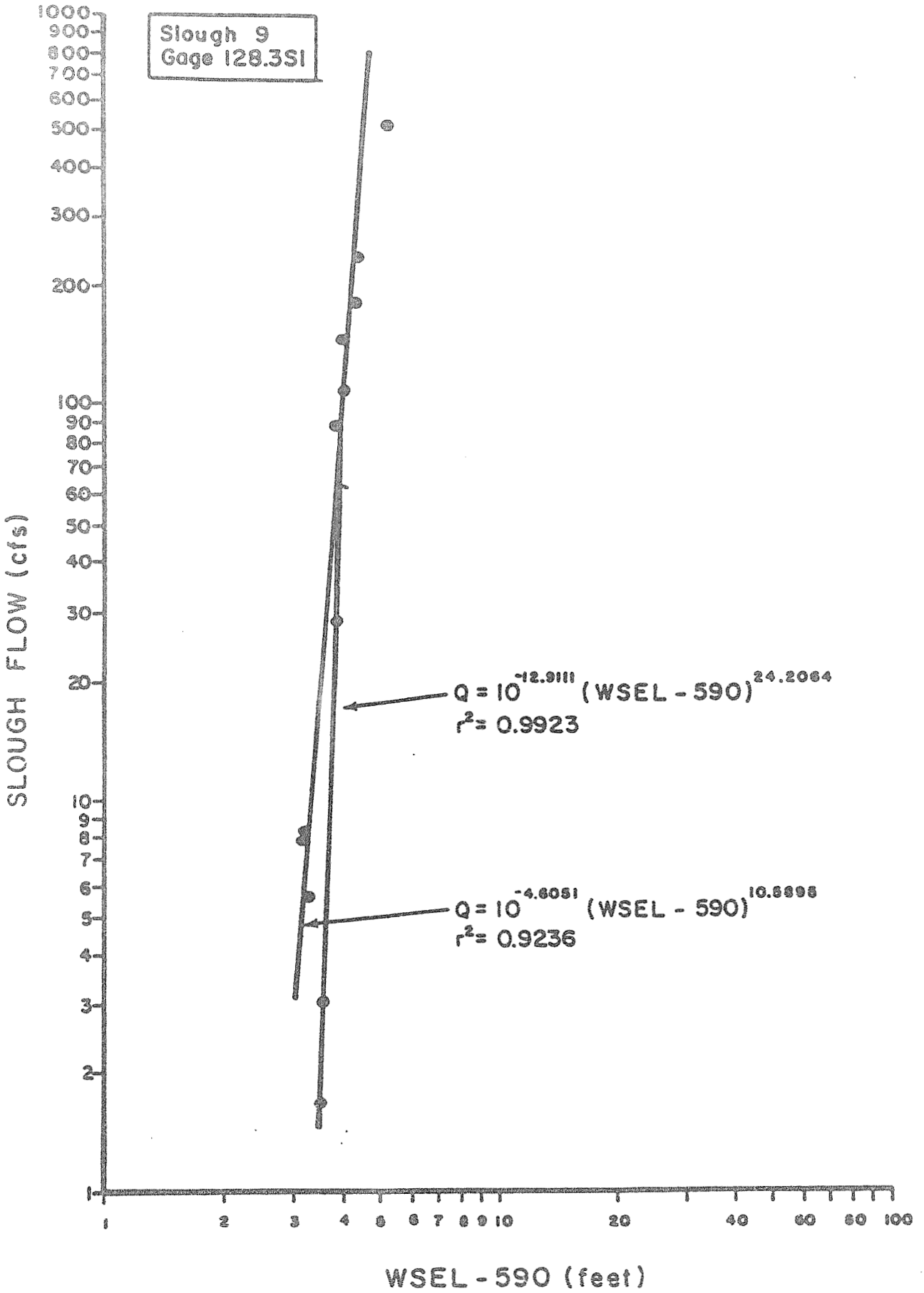

Figure 1-37 Stage versus flow rating curve for Side Slough 9, staff gage 128.3S1.

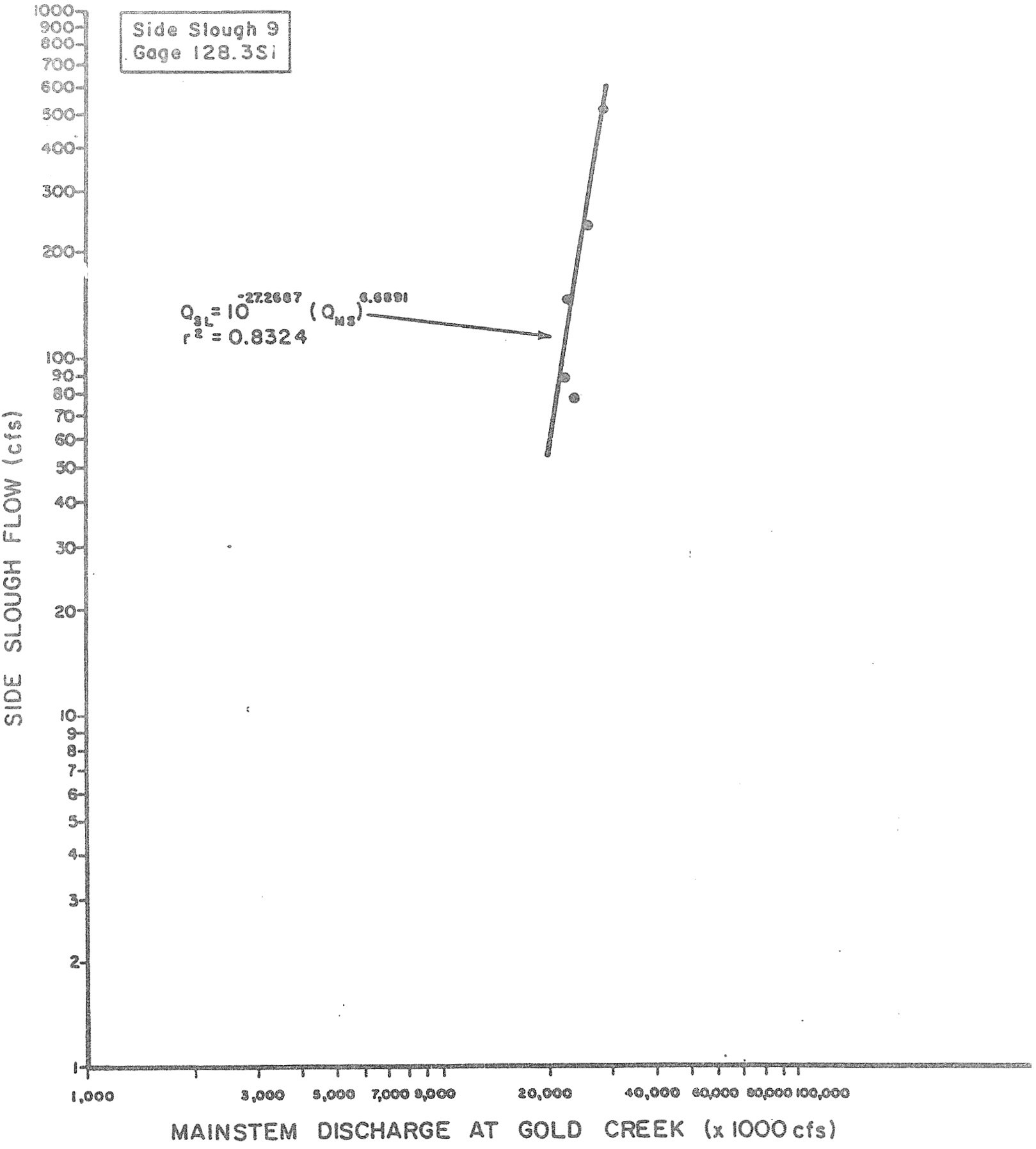

Figure 1-38 Slough flow versus mainstem discharge rating curve for Side Slough 21, staff gage 128.3S1.

3.3.4.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling discharge of 19,000 cfs at Gold Creek respectively. This controlling discharge compares to the lowest observed breaching discharge of 16,000 cfs at Gold Creek for this site.

3.3.4.5 Backwater

An area of backwater to occur at the mouth of this side slough during periods of moderate to high mainstem discharges. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this side slough at mainstem flows as low as 15,200 cfs.

3.3.5 Side Slough 11 (RM 135.7)

3.3.5.1 Site Description

Side Slough 11 (Figure 1-3) is located on the east bank of the Susitna River at river mile 135.7. It is approximately 0.9 miles in length and is separated from the mainstem by a large vegetated island. Prior to overtopping, flow in this side slough is provided by local runoff and groundwater seepage. Subsequent to overtopping, flow is primarily

provided as turbid water from the mainstem. An area of backwater occurs at the mouth of this side slough during moderate and high mainstem flows.

During the 1983 open water field season, stage was monitored at three sites within this side slough at which streamflow was also measured at one of these sites (Figure 1-39).

3.3.5.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-13. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station within Side Slough 11 are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented at Appendix Figures 1-A-41. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.5.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Side Slough 11 (Figure 1-39,

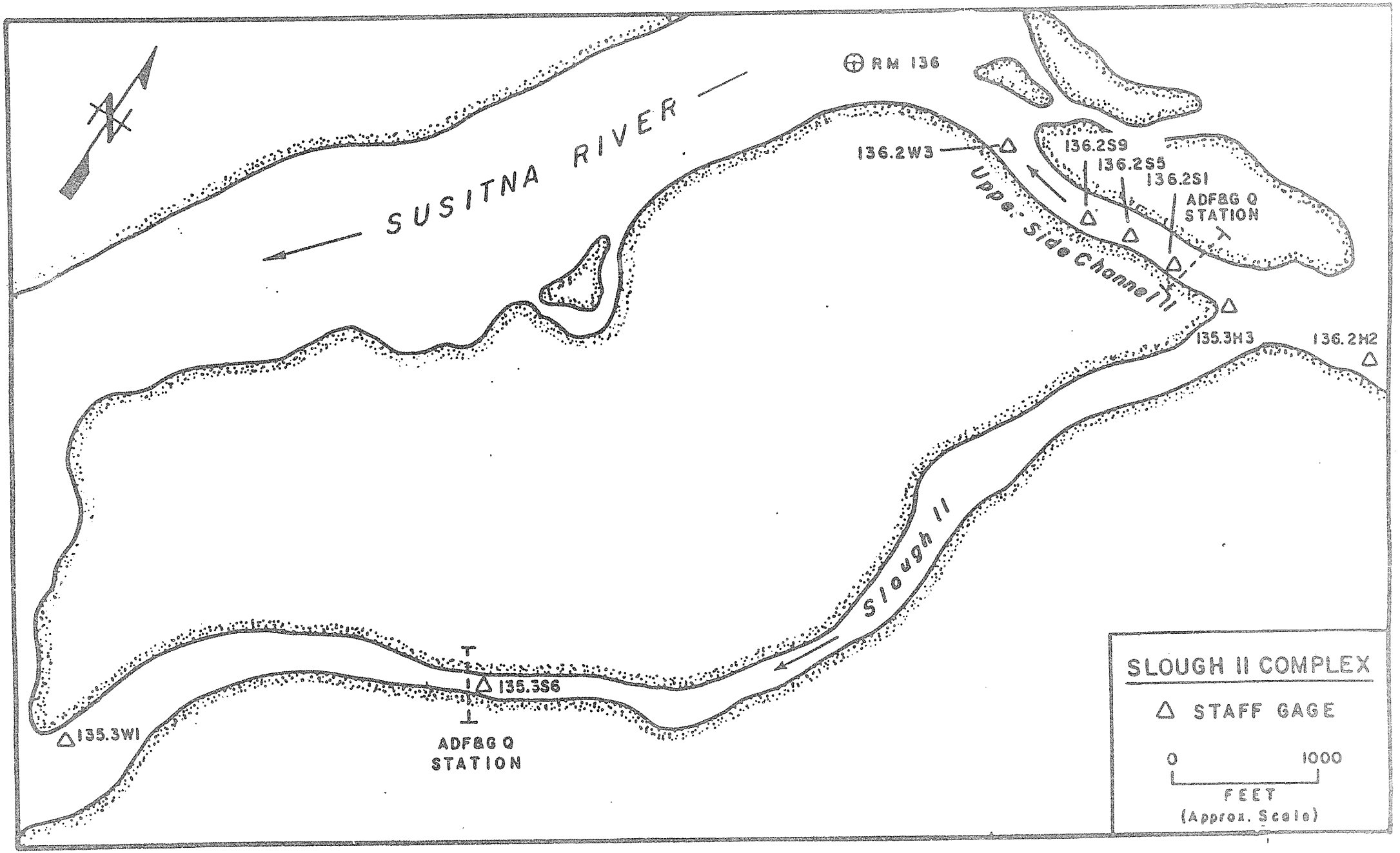

Figure 1-39 Site map of Side Slough 11, which is located on the east bank of the Susitna River at river mile 136.2.

Table 1-13. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 11 at RM 135.7.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
135.3H3 (Head)	Dewatered	less than 40,000
135.356 (Q-Site)	0.18	4,900 - 36,000
135.3W1 (Mouth)	4.00	7,230 - 31,900

Appendix Table 1-A-8). From these measurements a simple stage/streamflow rating curve was constructed (Figure 1-40). This curve represents only streamflow conditions during unbreached conditions. Because the slough was not breached by mainstem water, streamflow measurements were not plotted against corresponding mainstem discharge.

3.3.5.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 42,000 cfs at Gold Creek. This controlling discharge is the same as the initial breaching discharge for this site.

3:3.5.5 Backwater

An area of backwater was observed to occur at the mouth of this slough during periods of moderate to high mainstem discharge. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this side slough at a mainstem discharge as low as 10,600 cfs. This backwater area is localized within the vicinity of the mouth of the slough.

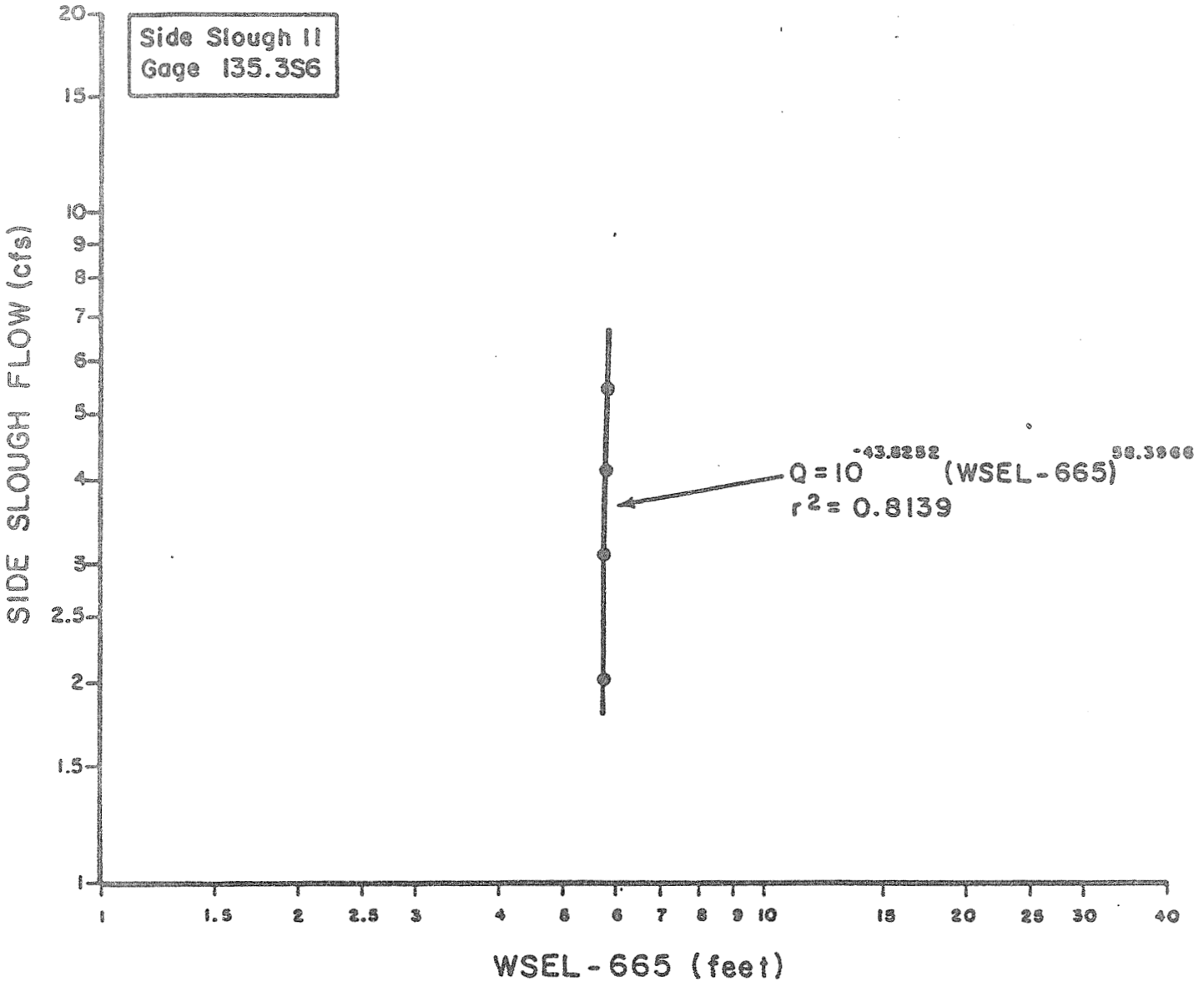

Figure 1-40 Stage versus flow rating curve fot Side Slough 11, staff gage 135.386.

3.3.6 Side Slough 16B (RM 137.8)

3.3.6.1 Site Description

Side Slough 16B is located on the west bank of the Susitna River at river mile 137.8 (Figure 1-3). It is approximately 0.4 miles in length and is separated from the mainstem by a large vegetated island. Prior to breaching, flow in this side slough is provided by local runoff and groundwater seepage. Subsequent to sufficient breaching, flow in this side slough is primarily provided by turbid water from the mainstem. An area of backwater has not been observed at the mouth of this side slough.

During the 1983 open water field season, stage was monitored at three sites within this side slough at which streamflow was also measured at one of the sites (Figure 1-41).

3.3.6.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-14. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-45 -

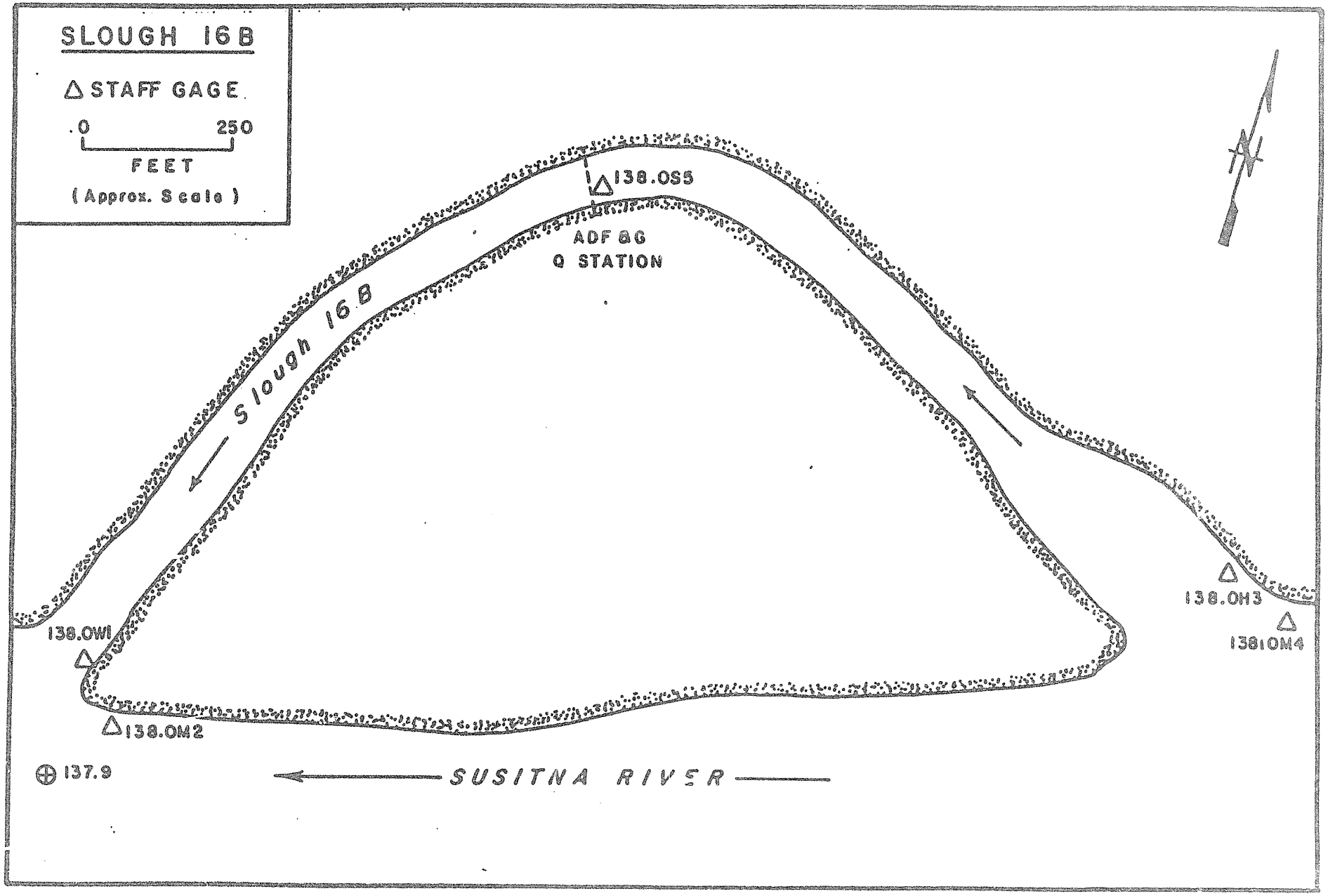

Figure 1-41 Site map of Side Slough 16B, which is located on the west bank of the Susitna River at river mile 137.8.

Table 1-14. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 16B at RM 137.8.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
138.0H3 (Head)	1.42	20,200 - 31,900
138.0S5 (Q-Site)	1.64	11,700 - 28,200
138.0W1 (Mouth)	2.78	11,700 - 31,900

1-A-46. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.6.3 Stage/Discharge Relationships

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Side Channel 16B (Figure 1-41) (Appendix Table 3). From these measurements, a simple stage/streamflow rating curve was developed (Figure 1-42). This curve represents streamflow conditions during both breached and nonbreached conditions. In addition, the streamflow data obtained while the slough was breached was plotted against the corresponding mainstem discharge at Gold Creek (Figure 1-43).

3.3.6.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 23,000 cfs at Gold Creek. This controlling discharge compares to the lowest observed breaching discharge of 20,000 cfs for this site.

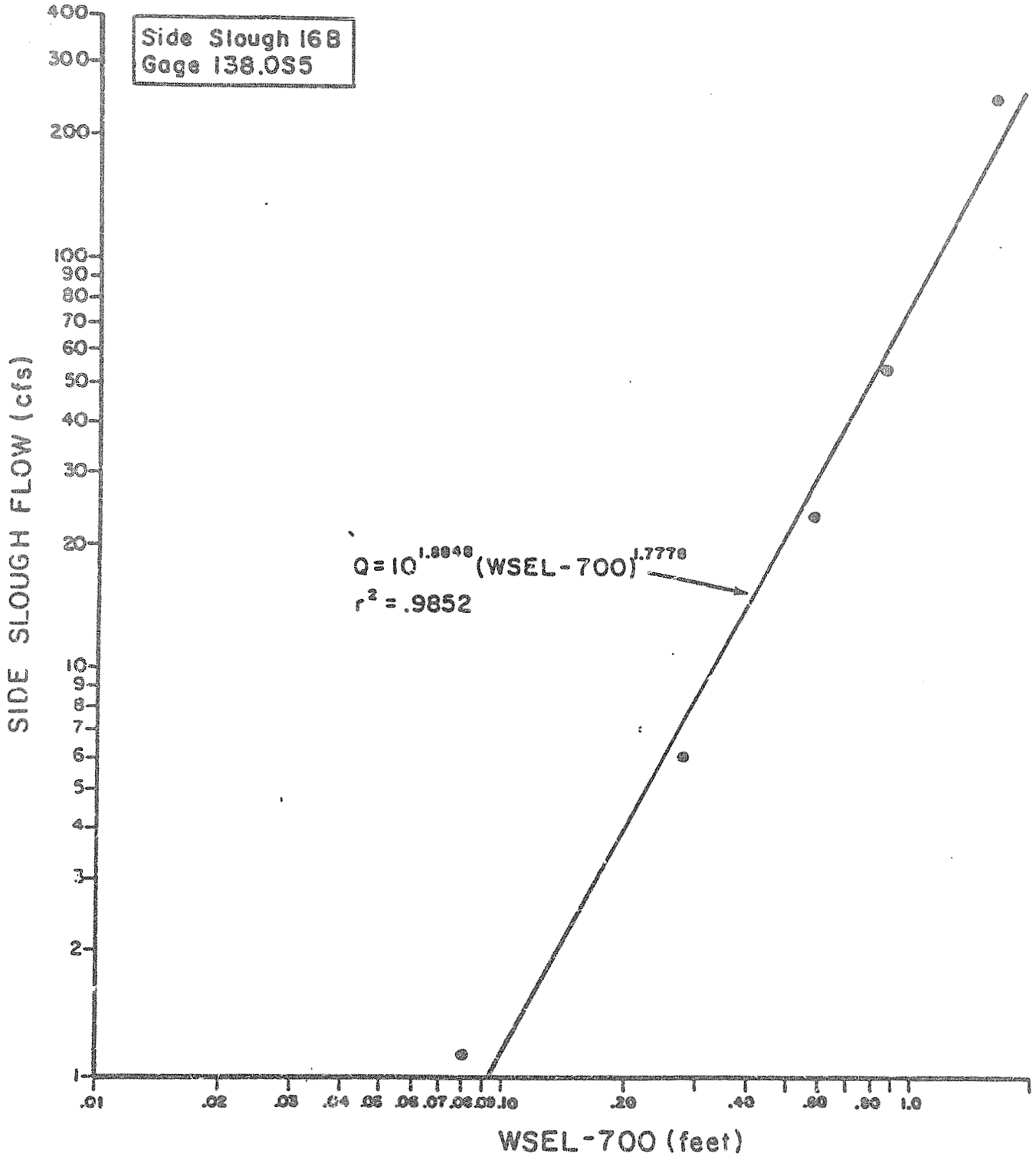

Figure 1-42 Stage versus flow rating curve for Side Slough 16B, staff gage 138.0S5.

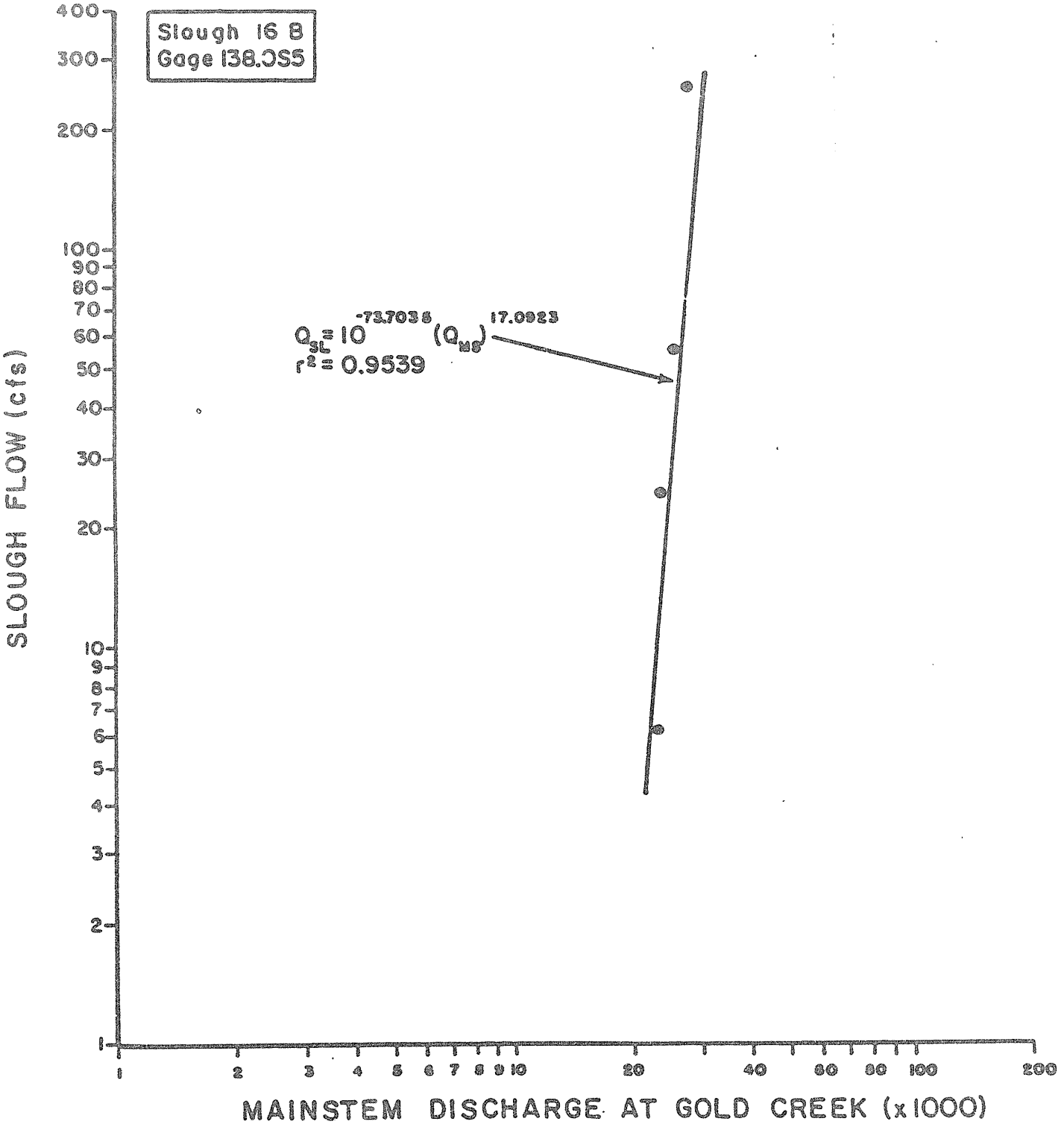

Figure 1-43 Slough flow versus mainstem discharge rating curve for Side Slough 16B, staff gage 138.0S5.

3.3.6.5 Backwater

Based on available stage and channel geometry (see Chapter 2) data, an area of backwater has not been observed to occur at the mouth of this slough.

3.3.7 Side Slough 20 (RM 140.2)

3.3.7.1 Site Description

Side Slough 20 is located on the east bank of the Susitna River at river mile 140.2 (Figure 1-3). It is approximately 0.5 miles in length and is separated from the mainstem by a vegetated island. Prior to breaching, flow in this side slough is provided primarily by two small tributaries and local runoff and groundwater seepage. Subsequent to sufficient breaching, flow is provided primarily by turbid water from the mainstem and the larger of the two tributaries (Waterfall Creek). An area of backwater occurs at the mouth of this side slough during periods of low to high mainstem flows.

During the 1983 open water field season, stage was monitored at three sites within this side slough, at which streamflow was also measured at one of these sites (Figure 1-44).

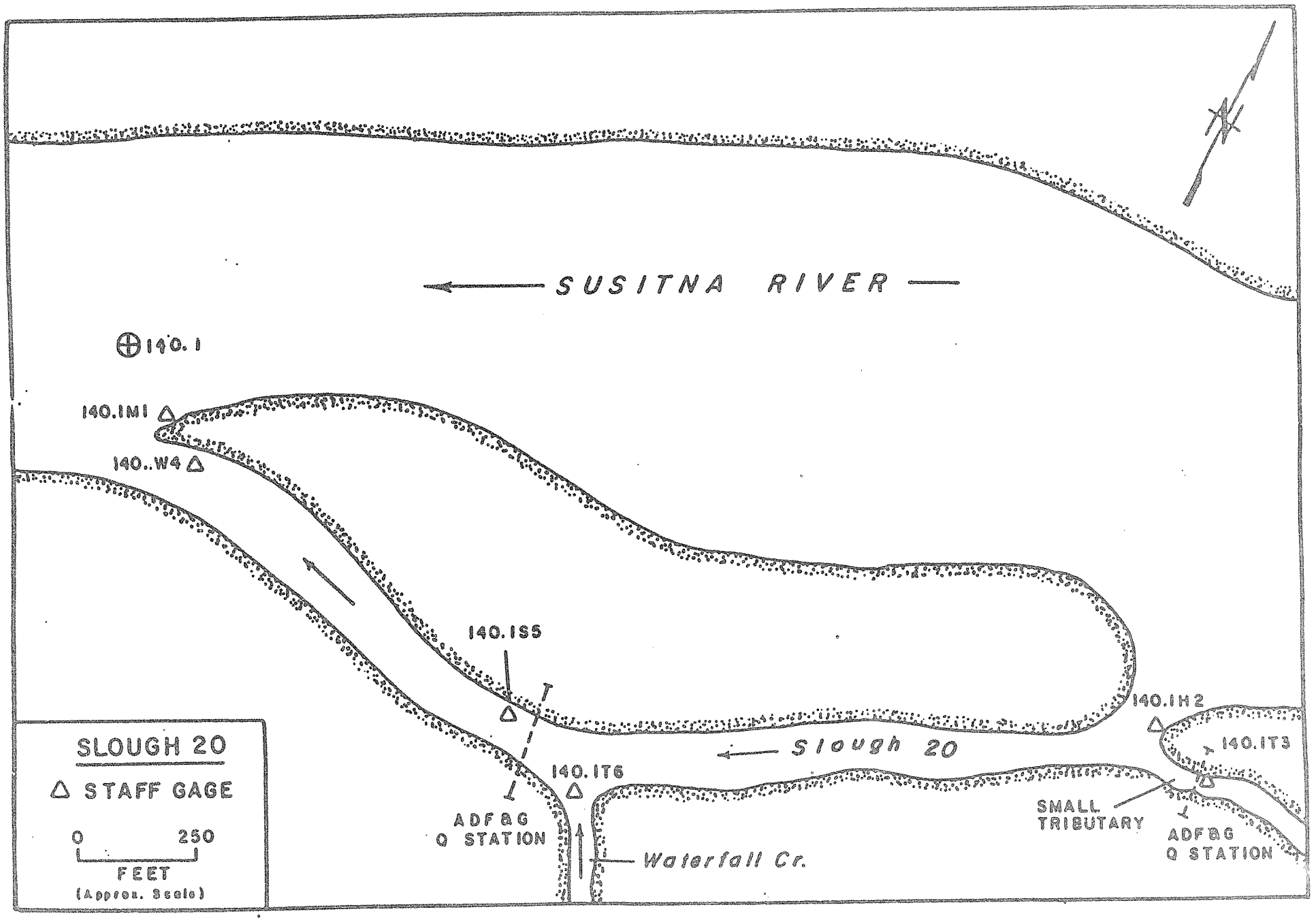

Figure 1-44 Site map for Side Slough 20, which is located on the east bank of the Susitna River at river mile 140.2.

3.3.7.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-15. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station within Side Slough 20 are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-48 - 1-A-49. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.7.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Side Slough 20 (Appendix Table 1-A-8). From these measurements, a simple stage/streamflow rating curve was developed (Figure 1-45). This curve represents streamflows during both breached and unbreached conditions. In addition, the streamflow data obtained while the slough was breached was plotted against the corresponding mainstem discharge at Gold Creek (Figure 1-46).

Table 1-15. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 20 at RM 140.2.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
140.1H3 (Head)	0.99	21,500 - 32,500
140.1S5 (Q-Site)	1.26	8,480 - 32,500
140.1W4 (Mouth)	2.43	7,230 - 32,500

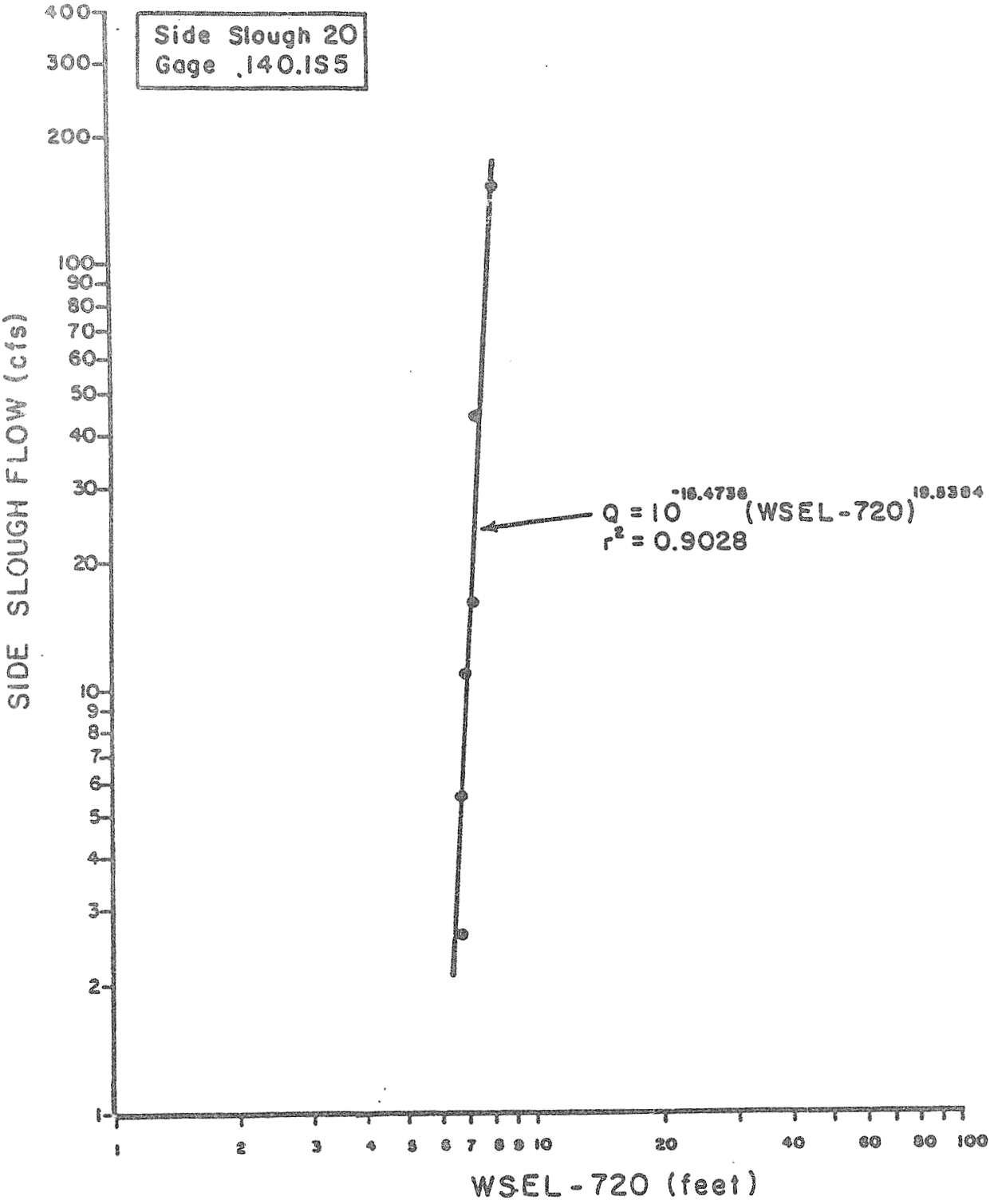

Figure 1-45 Stage versus flow rating curve for Side Slough 20, staff gage 140.1S5.

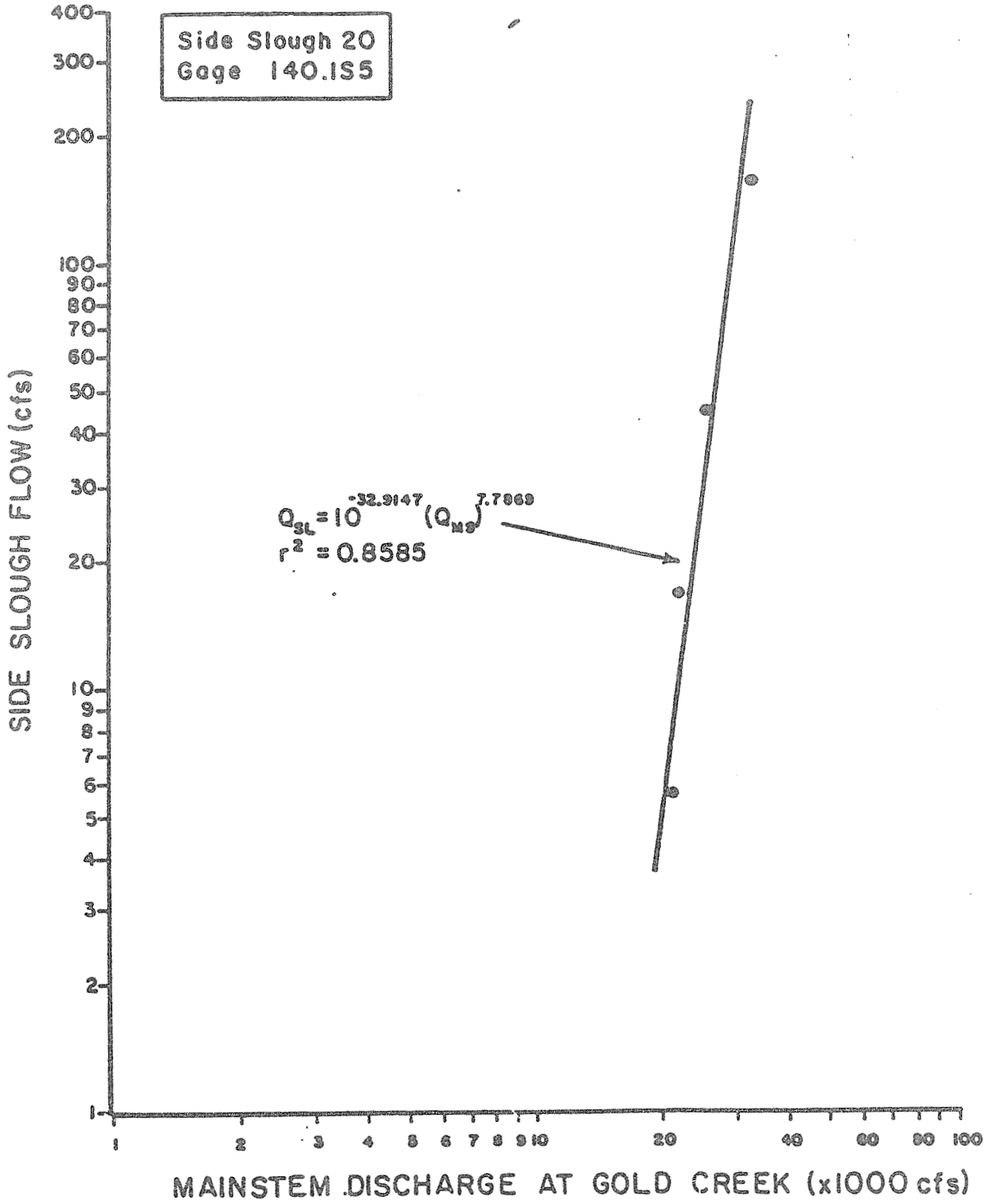

Figure 1-46 Slough flow versus mainstem discharge rating curve for Side Slough 20, staff gage 140.1S5.

3.3.7.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 23,000 cfs at Gold Creek. This controlling discharge compares to the lowest observed breaching discharge of 22,000 cfs at Gold Creek for this site.

3.3.7.5 Backwater

An area of backwater was observed to occur at the mouth of this slough during periods of moderate to high mainstem discharge. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs in the immediate vicinity of the mouth of this side slough at a mainstem flows as low as 7,230 cfs at Gold Creek.

3.3.8 Side Slough 21 (RM 141.8)

3.3.8.1 Site Description

Side Slough 21 is located on the east bank of the Susitna River at river mile 141.8 (Figure 1-3). It is approximately 0.5 miles in length and is separated from the mainstem by a large vegetated island. Approximately half way up the side slough, the channel divides into two forks, a NW and NE fork. Prior to breaching, the flow in this side slough is provided by groundwater seepage and local runoff. Subsequent to

sufficient breaching, flow in the side channel is provided by turbid water from the mainstem. An area of backwater does not occur at the mouth of this side slough.

During the 1983 open water field season, stage was monitored at four sites within this side slough, at which streamflow was also monitored at one of these site (Figure 1-47).

3.3.8.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-16. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-53 - 1-A-54. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.8.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow was obtained at one site within the free-flow portion of Side Slough 21 (Appendix Table

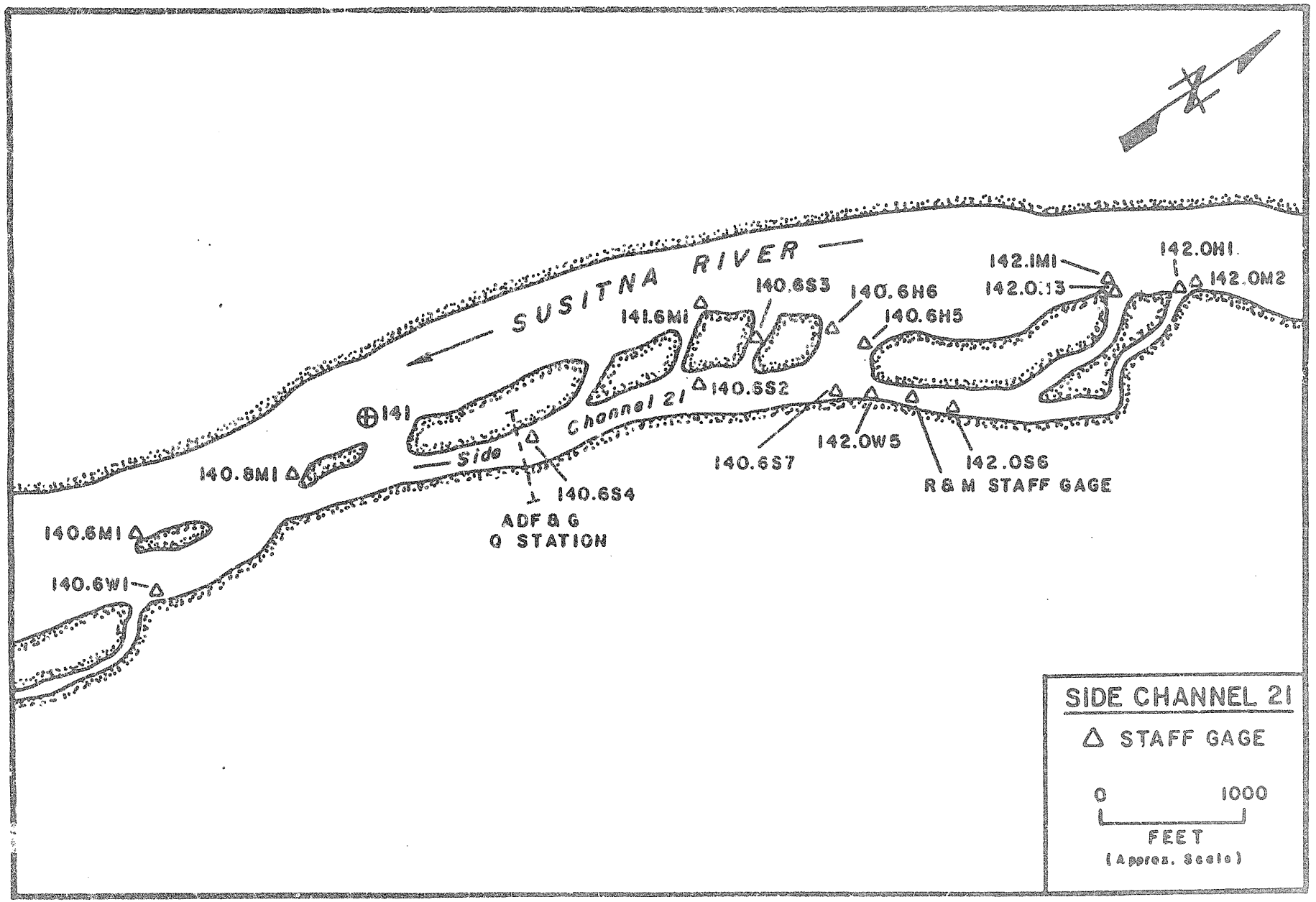

Figure 1-47 Site map for Side Slough 21, which is located on the east bank of the Susitna River at river mile 141.8.

Table 1-16. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 21 at RM 141.8.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
142.0H1 (NE Head)	0.65	28,200 - 33,000
142.0H3 (NW Head)	0.74	25,600 - 33,000
142.0S6 (Q-Site)	2.18	2,900 - 33,000
142.0W5 (Mouth)	2.06	7,230 - 33,000

1-A-8). From these measurements a simple stage/streamflow rating curve was developed (Figure 1-48). This curve represents streamflows during both breached and nonbreached conditions In addition, the streamflow data obtained while this slough was breached was plotted against the corresponding mainstem discharge (Figure 1-49).

3.3.8.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in the NW and NE channels of this side slough become governed by the mainstem at controlling discharges of 25,000 and 28,000 cfs at Gold Creek respectively. These controlling discharges compare to the NW and NE channels of 23,000 and 26,000 cfs at Gold Creek respectively.

3.3.8.5 Backwater

Based available stage and channel geometry (see chapter 2) data and field observations no backwater was found to occur in this side slough.

3.3.9 Side Slough 22 (RM 144.2)

3.3.9.1 Site Description

Side Slough 22 is located on the north bank of the Susitna River at river mile 144.2 (Figure 1-3). It is approximately 0.5 miles in length and is separated from the mainstem by a narrow vegetated island. Prior

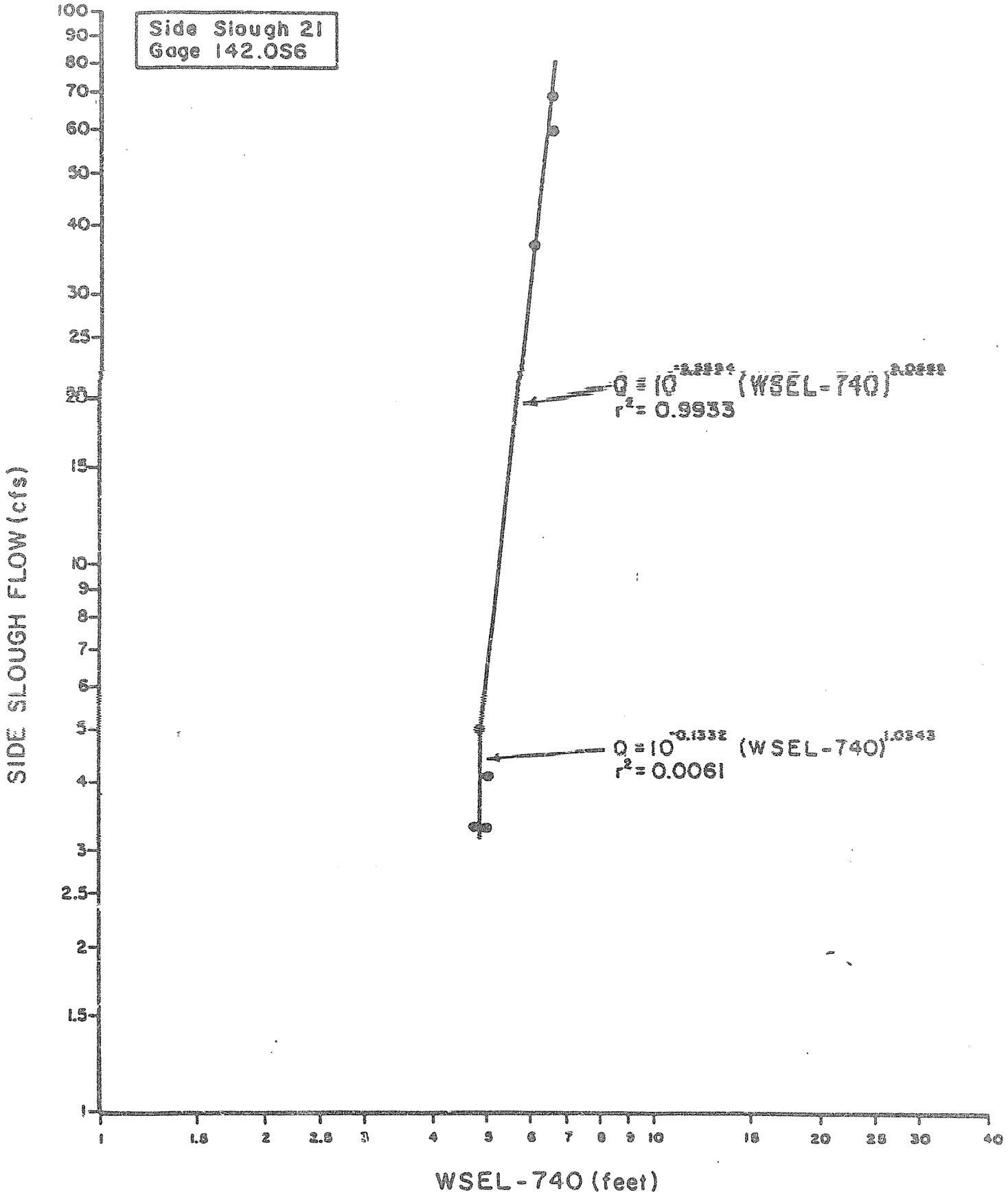

Figure 1-48 Stage versus flow rating curve for Side Slough 21, staff gage 142.056.

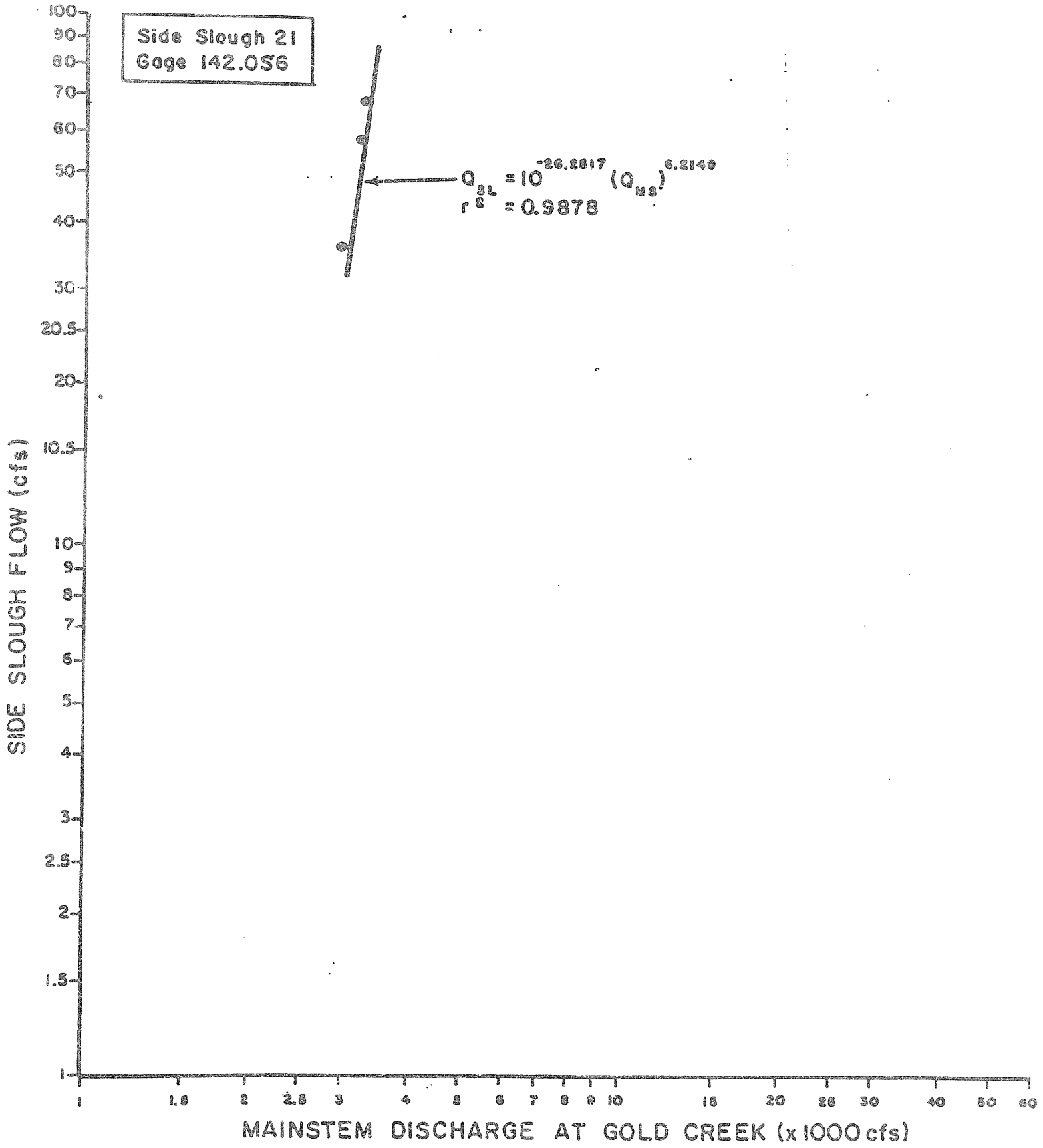

Figure 1-49 Slough flow versus mainstem discharge rating curve for Side Slough 21, staff gage 142.056.

to breaching, flow in this side slough is provided by a small tributary and local runoff and groundwater seepage. Subsequent to sufficient breaching, flow is provided by turbid water from the mainstem. Very little backwater occurs at the mouth of this side slough.

During the 1983 open water field season, stage was monitored at four sites within this side slough at which streamflow was also measured at one of these sites (Figure 1-50).

3.3.9.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-17. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-55 - 1-A-56. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.3.9.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one

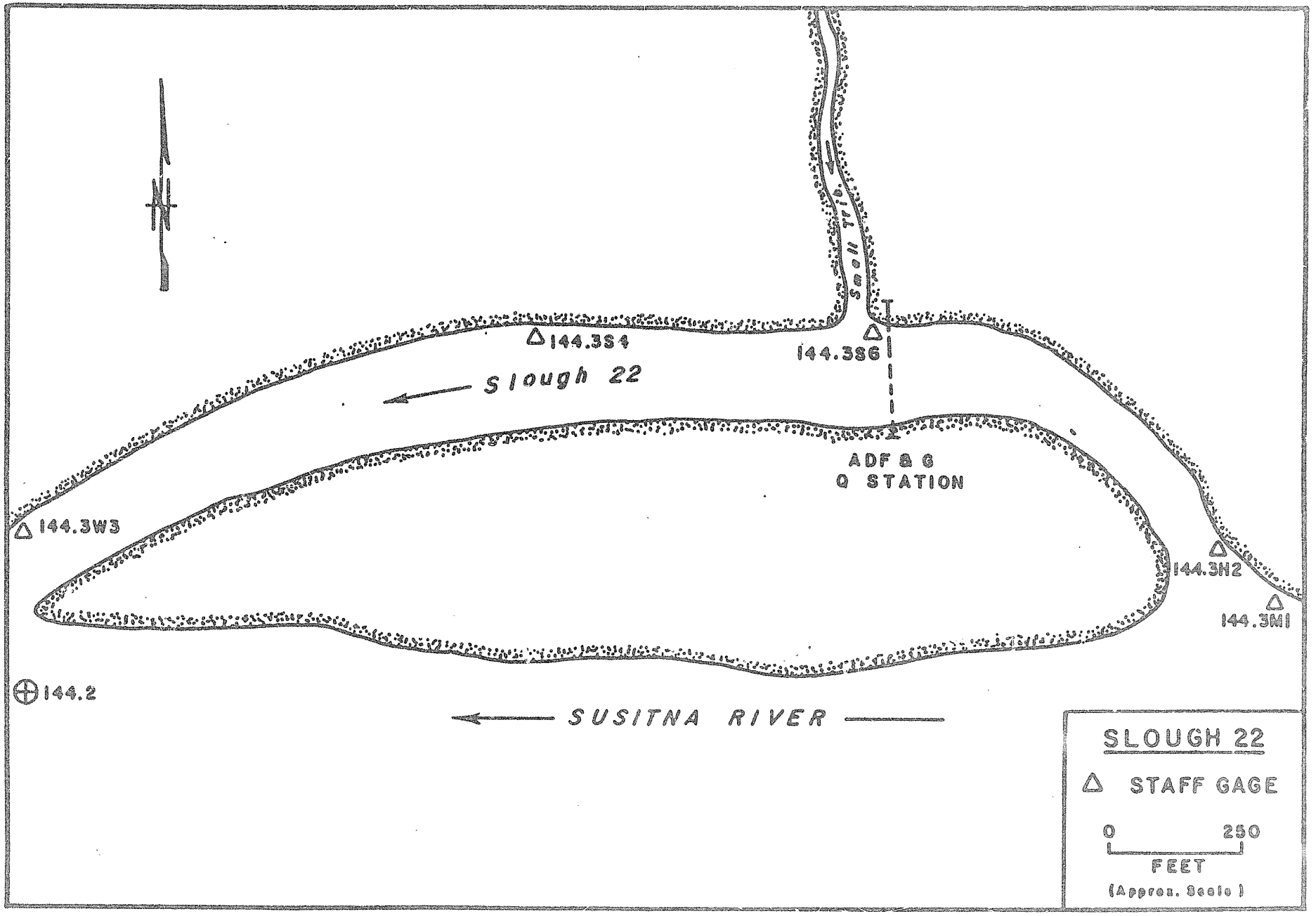

Figure 1-50 Site map for Side Slough 22, which is located on the north bank of the Susitna River at river mile 144.2.

Table 1-17. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Side Slough 22 at RM 144.2.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
144.3H2 (Head)	1.65	21,700 - 31,900
144.3S6 (Q-Site)	1.84	10,600 - 28,200
144.3S4	2.06	10,600 - 29,900
144.3W3	1.46	10,600 - 28,200

site within the free-flowing portion of Side Slough 22 (Appendix Table 1-A-8). From these measurements, a simple stage/streamflow rating curve was developed (Figure 1-51). This curve only represents streamflows during breached conditions. In addition, the streamflow data obtained at this site was plotted against the corresponding mainstem discharge at the time of measurement (Figure 1-52).

3.3.9.4 Mainstem Controlling and Breaching Discharges

Based on available streamflow and water surface elevation data and the professional opinion of the project engineer, the hydraulic conditions present in this side slough become governed by the mainstem at a controlling mainstem discharge of 23,000 cfs at Gold Creek. This controlling discharge compares the lowest observed breaching discharge of 20,000 cfs at Gold Creek for this site.

3.3.9.5 Backwater

Based on available stage and channel geometry (see Chapter 2) data and field observations very little backwater occurs at the mouth of this side slough.

3.4 Upland Sloughs

Measurements of stage and streamflow were obtained during the 1983 open water field season at selected sites within two upland sloughs located

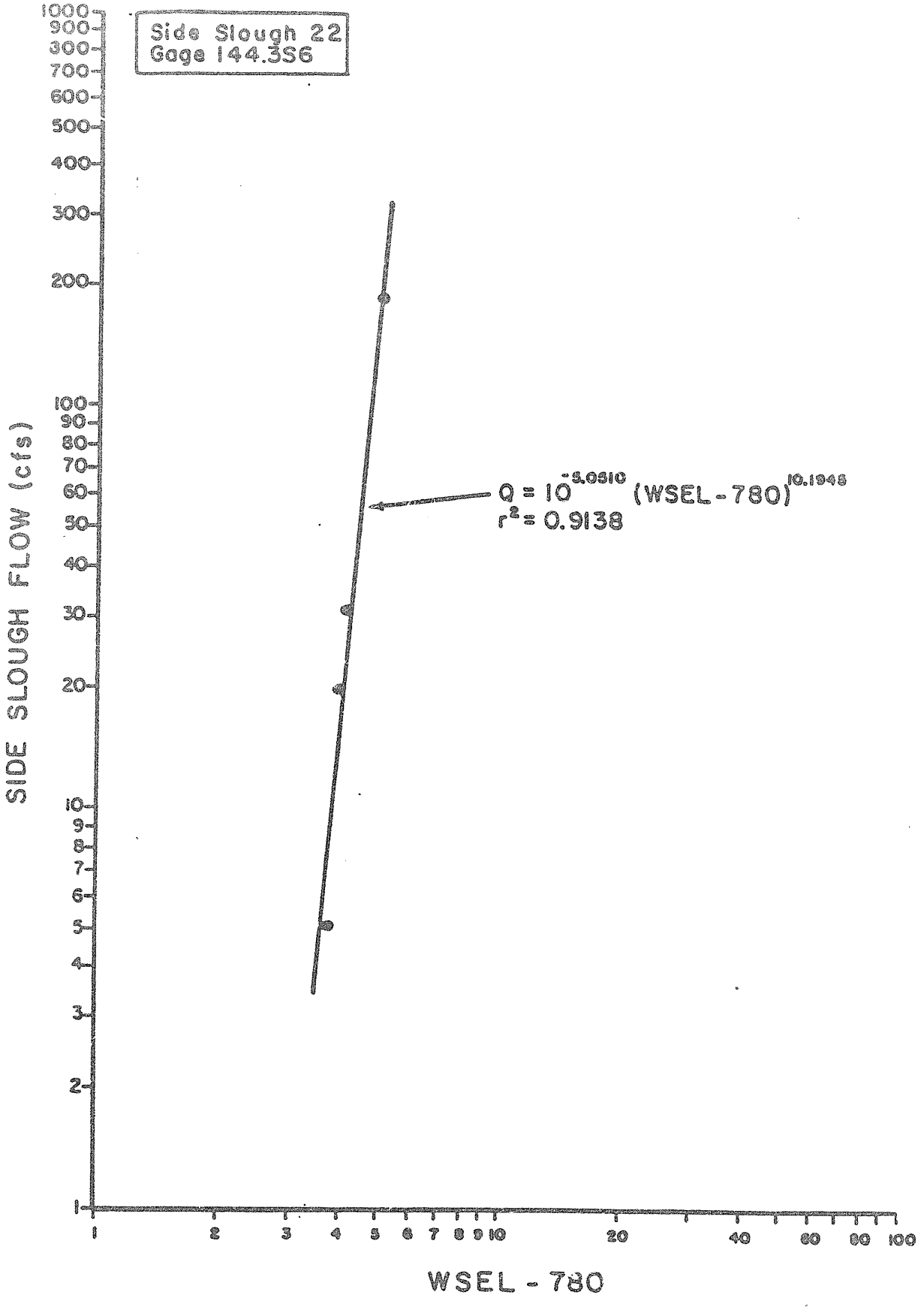

Figure 1-51 Stage versus flow rating curve for Side Slough 22, staff gage 144.356.

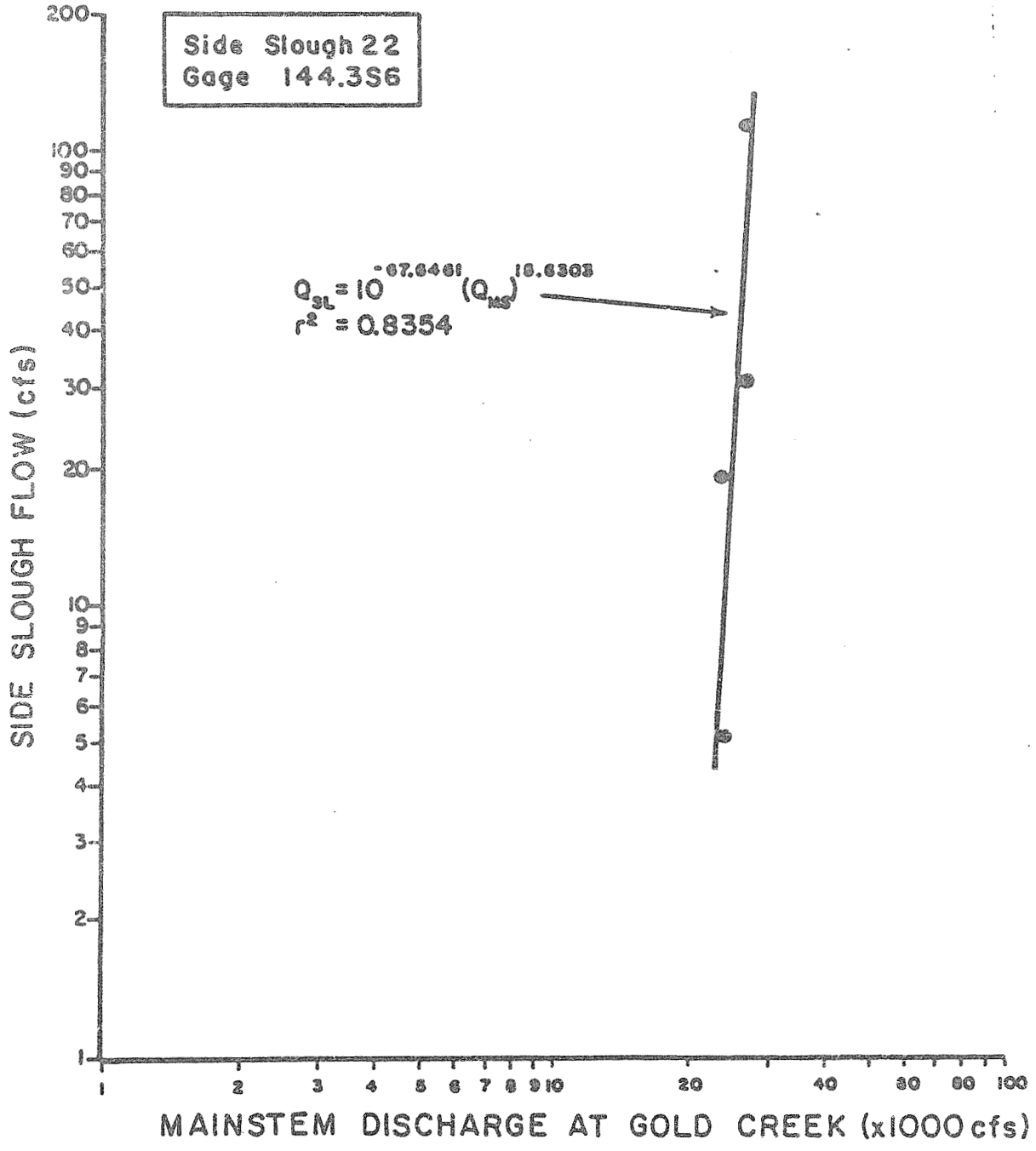

Figure 1-52 Slough flow versus mainstem discharge rating curve for Side Slough 22, staff gage 144.3S6.

in the Talkeetna to Devil Canyon reach of the Susitna River. Results of these investigations are discussed below by site.

3.4.1 Upland Slough 6A (RM 112.3)

3.4.1.1 Site Description

Upland Slough 6A (Figure 1-3) is located on the west bank of the Susitna River at river mile 112.3. As in all upland sloughs, it has no connection with the mainstem other than at it's mouth. The primary sources of flow for this slough originate from local runoff from pondage caused by a beaver dam. A substantial area of backwater occurs at the mouth of this upland slough during periods of low to high mainstem flows.

During the 1983 open water field season, stage was monitored at two locations within this upland slough at which streamflow was also measured at one of these site (Figure 1-53).

3.4.1.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek for each monitoring station are presented in Table 1-18. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table

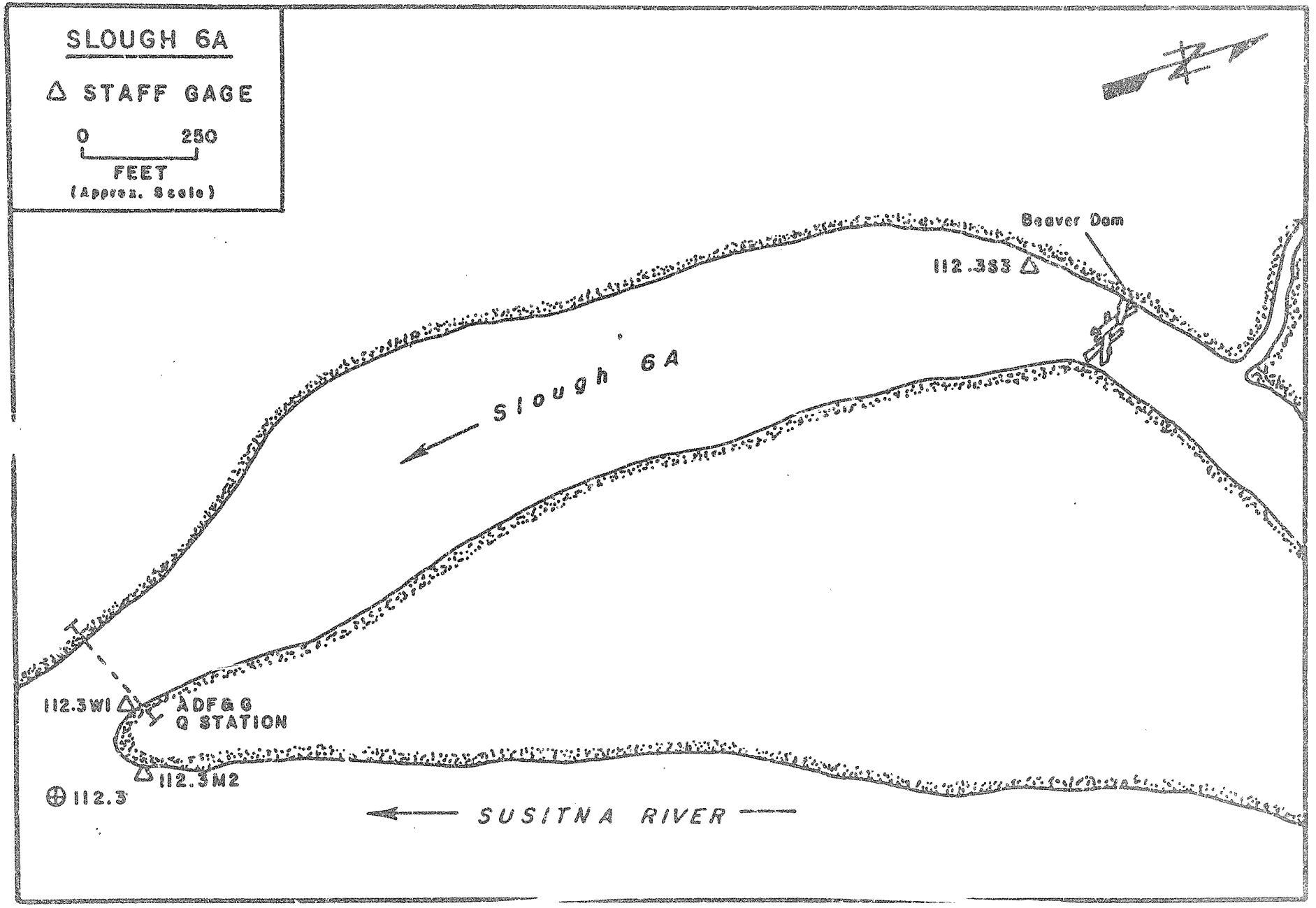

Figure 1-53 Site map for Upland Slough 6A, which is located on the west bank of the Susitna River at river mile 112.3.

Table 1-18. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Upland Slough 6A, RM 112.3.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
112.3W1	3.33	7,230 - 32,000
112.3S3	2.49	10,600 - 31,700

1-A-7. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figure 1-A-26.

Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.4.1.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site in Upland Slough 6A (Figure 1-53, Appendix Table 3). Because of the influence of backwater at this site, a stage/streamflow rating curve could not be constructed.

3.4.1.4 Backwater

A substantial area of backwater occurs at the mouth of this upland slough during periods of low to high mainstem discharges. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this upland slough at mainstem discharge levels as low as 7,230 cfs.

3.4.2 Upland Slough 19 (RM 140.0)

3.4.2.1 Site Description

Upland Slough 19 (Figure 1-3) is located on the east bank of the Susitna River at river mile 140.0. As in all upland sloughs, it has no connection with the mainstem other than at it's mouth. The primary sources of flow originate from local runoff and ground water seepage. A substantial area of backwater occurs at the mouth of this slough during periods at low to high mainstem flows.

During the 1983 open water field season, stage was monitored at three locations within this upland slough at which streamflow was also measured at one of these sites (Figure 1-54).

3.4.2.2 General Results

Ranges of water surface elevation and corresponding ranges of mainstem discharge at Gold Creek at time of measurement for each stage monitoring station are presented in Table 1-19. Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at time of measurement obtained at each monitoring station are presented in Appendix Table 2. Plots of water surface elevation versus corresponding mainstem discharge at Gold Creek at time of measurement for each monitoring site are presented in Appendix Figures 1-A-47 - 1-A-48. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

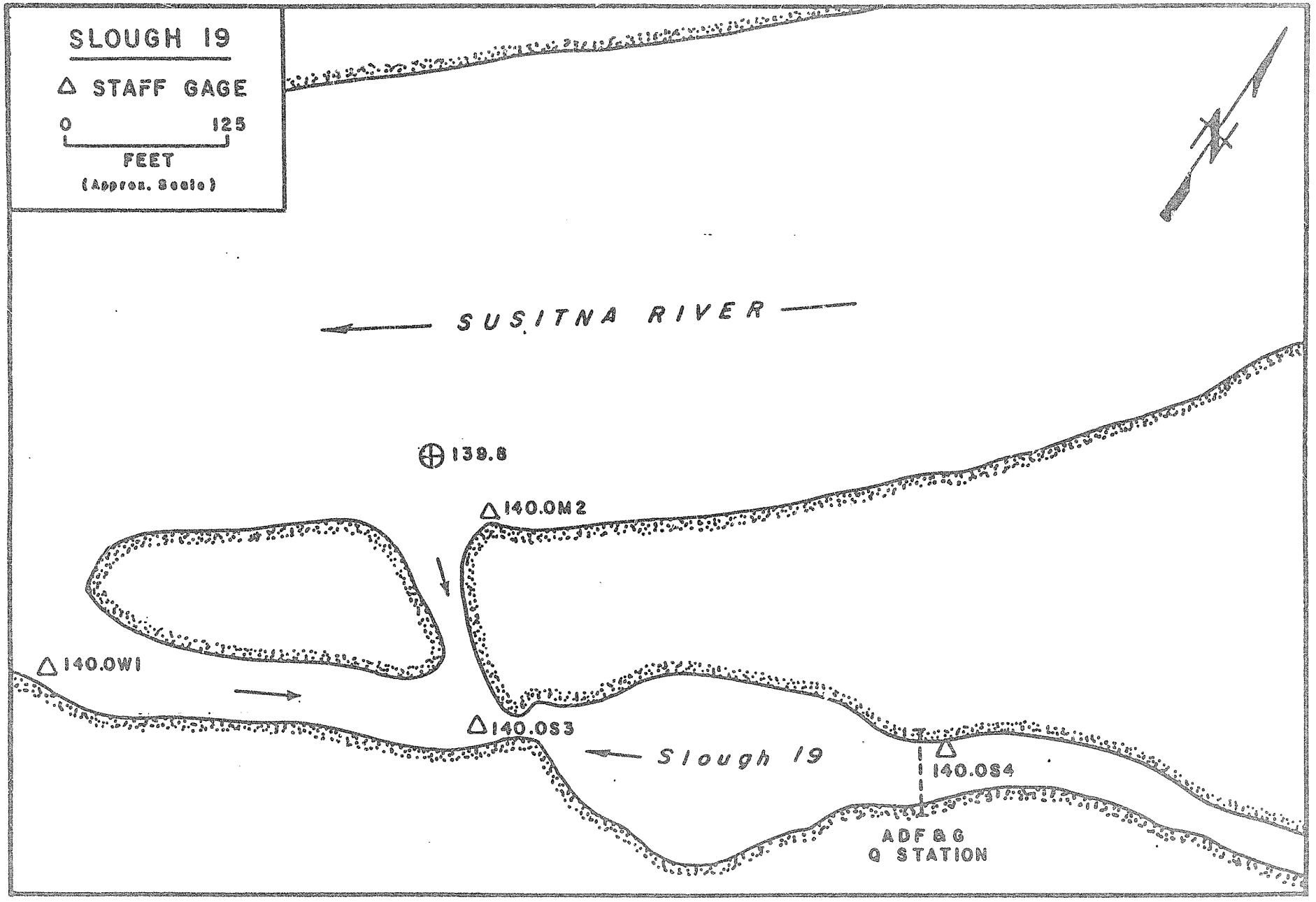

Figure 1-54 Site map of Upland Slough 19, which is located on the east bank of the Susitna River at river mile 140.0.

Table 1-19. Ranges of water surface elevation and corresponding mainstem discharge at the time of measurement for each stage monitoring location within Upland Slough 19 at RM 140.0.

Gage Site	Range of Water Surface Elevation (ft)	Range of Corresponding Mainstem Mainstem Discharge (cfs)
140.0W1	3.74	7,230 - 33,000
140.0S3	3.17	10,700 - 30,000
140.0S4	2.21	10,700 - 29,900

3.4.2.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site in Upland Slough 19 (Figure 1-54, Appendix Table 1-A-8). Because of the influence of backwater at this site, a stage/streamflow rating curve could not be constructed.

3.4.2.4 Backwater

A substantial area of backwater occurs at the mouth of this upland slough during periods of low to high mainstem flows. Based on available stage and channel geometry (see Chapter 2) data, an area of backwater occurs at the mouth of this side slough at a mainstem flow as low as 10,000 cfs.

3.5 Tributaries

Simultaneous measurements of stage and streamflow were obtained within selected tributaries within the Talkeetna to Devil Canyon reach of the Susitna River. These results are presented below by tributary site.

3.5.1 Whiskers Creek (RM 101.4)

3.5.1.1 Site Description

Whiskers Creek (Figure 1-3) is located on the west bank of the Susitna

River at river mile 101.4. It can be characterized as a relatively narrow, meandering stream containing many pools and riffles. It confluences with Whiskers Creek Slough approximately 0.2 miles upstream of the slough's confluence with the mainstem Susitna River. During periods of high mainstem flows, an area of backwater occurs in the mouth of the creek.

During the 1983 open water field season stage and streamflow were measured at one location within this creek (Figure 1-55).

3.5.1.2 General Results

Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at the time of measurement obtained at each monitoring station in Whiskers Creek are presented in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.5.1.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Whiskers Creek (Figure 1-55, Appendix Table 1-A-8). These measurements were used to construct a stage/streamflow rating curve (Figure 1-56).

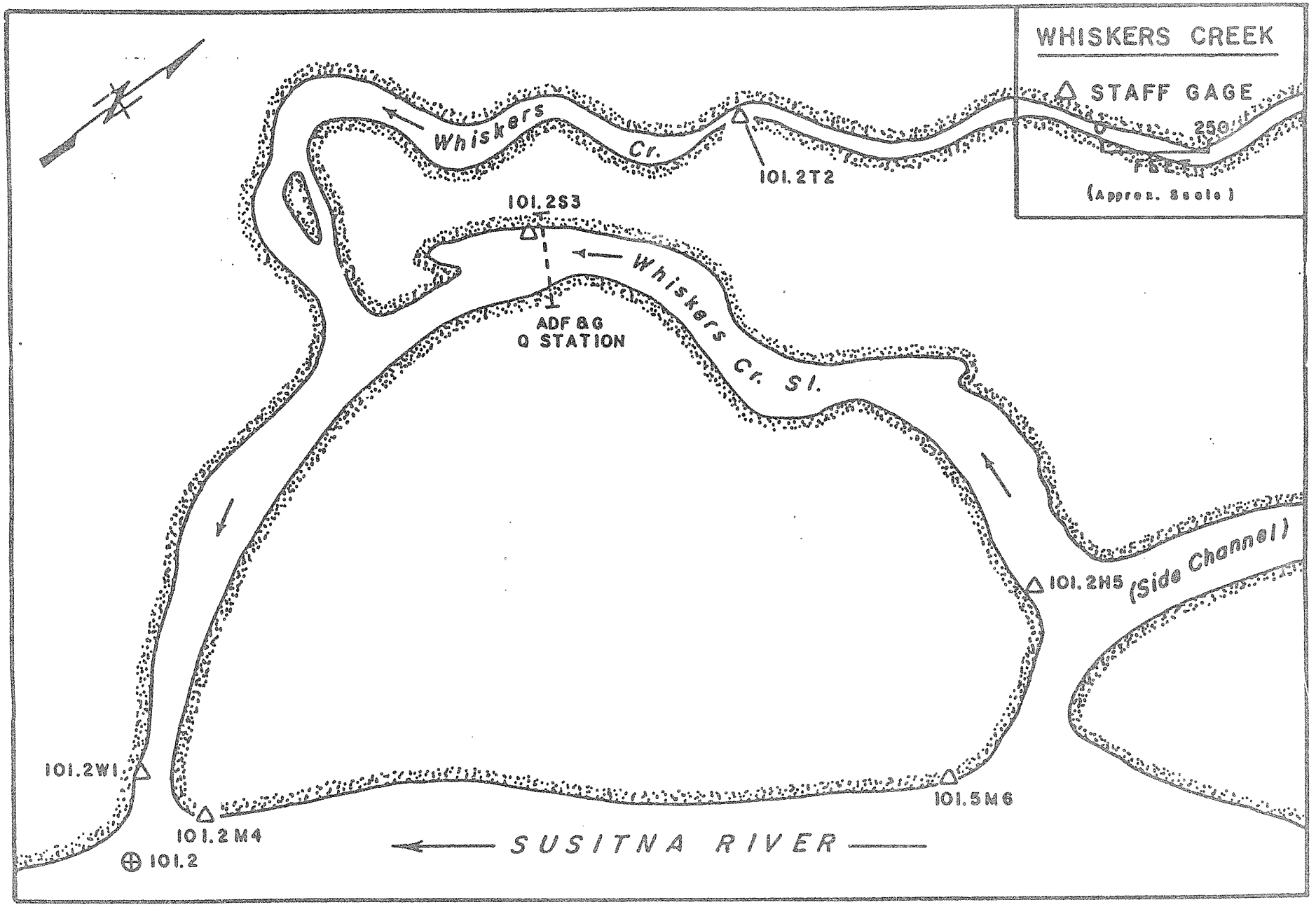

Figure 1-55 Site map of Whiskers Creek, which is located on the west bank of the Susitna River at river mile 101.4.

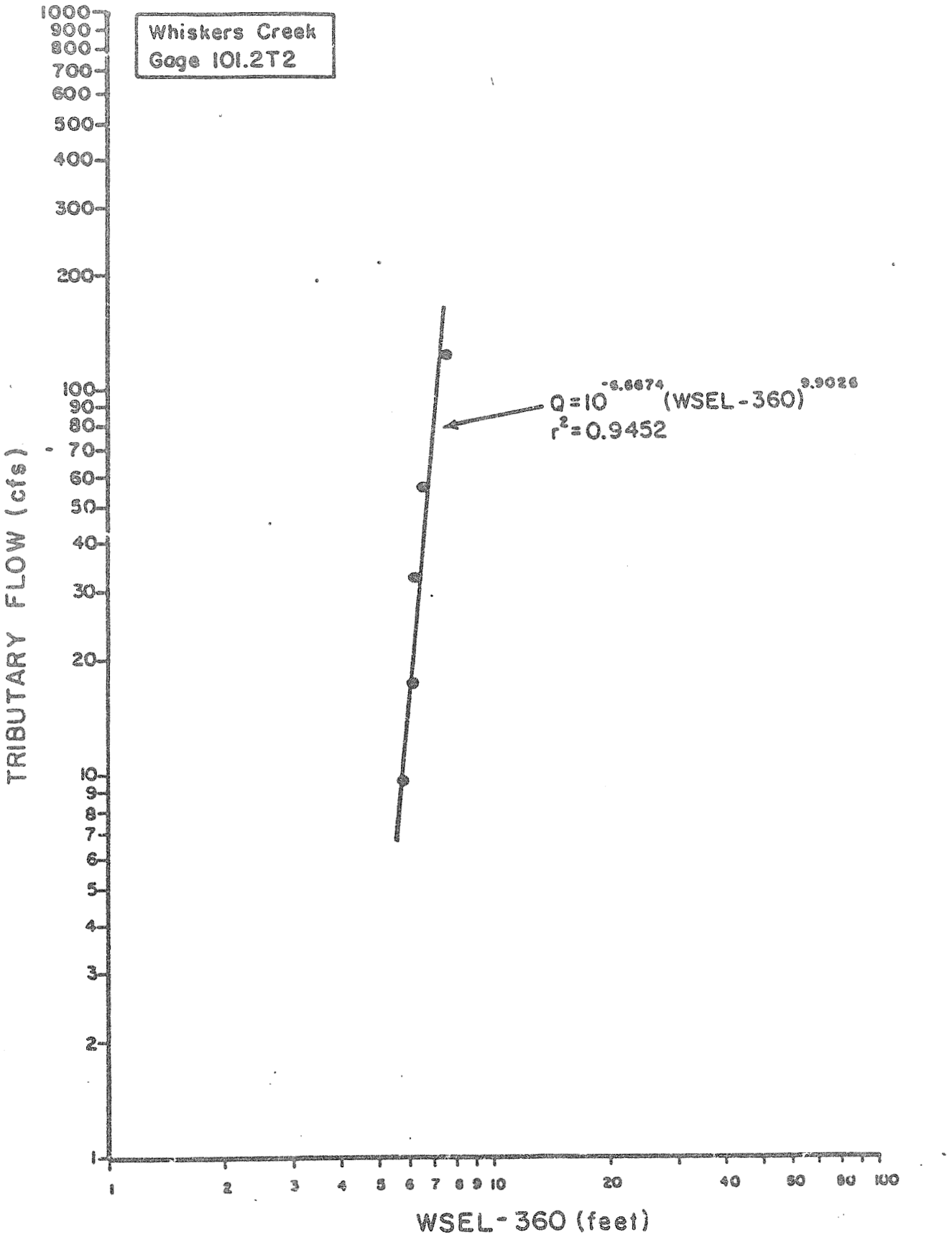

Figure 1-56 Stage versus flow rating curve for Whiskers Creek, staff gage 101.2T2.

3.5.2 Lane Creek (RM 113.6)

3.5.2.1 Site Description

Lane Creek (Figure 57) is located on the east bank of the Susitna River at river mile 113.6. It can be characterized as a relatively narrow, shallow, fast running, clear water stream containing many pools and riffles.

During the 1983 open water field season, stage was monitored at two locations within Lane Creek, at which streamflow was also measured at one of the locations (Figure 58).

3.5.2.2 General Results

Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at the time of measurement obtained at each monitoring site in Lane Creek are presented in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.5.2.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Lane Creek (Figure 1-57, Appendix Table 1-A-8). These measurements were used to construct a simple stage/streamflow rating curve (Figure 1-58).

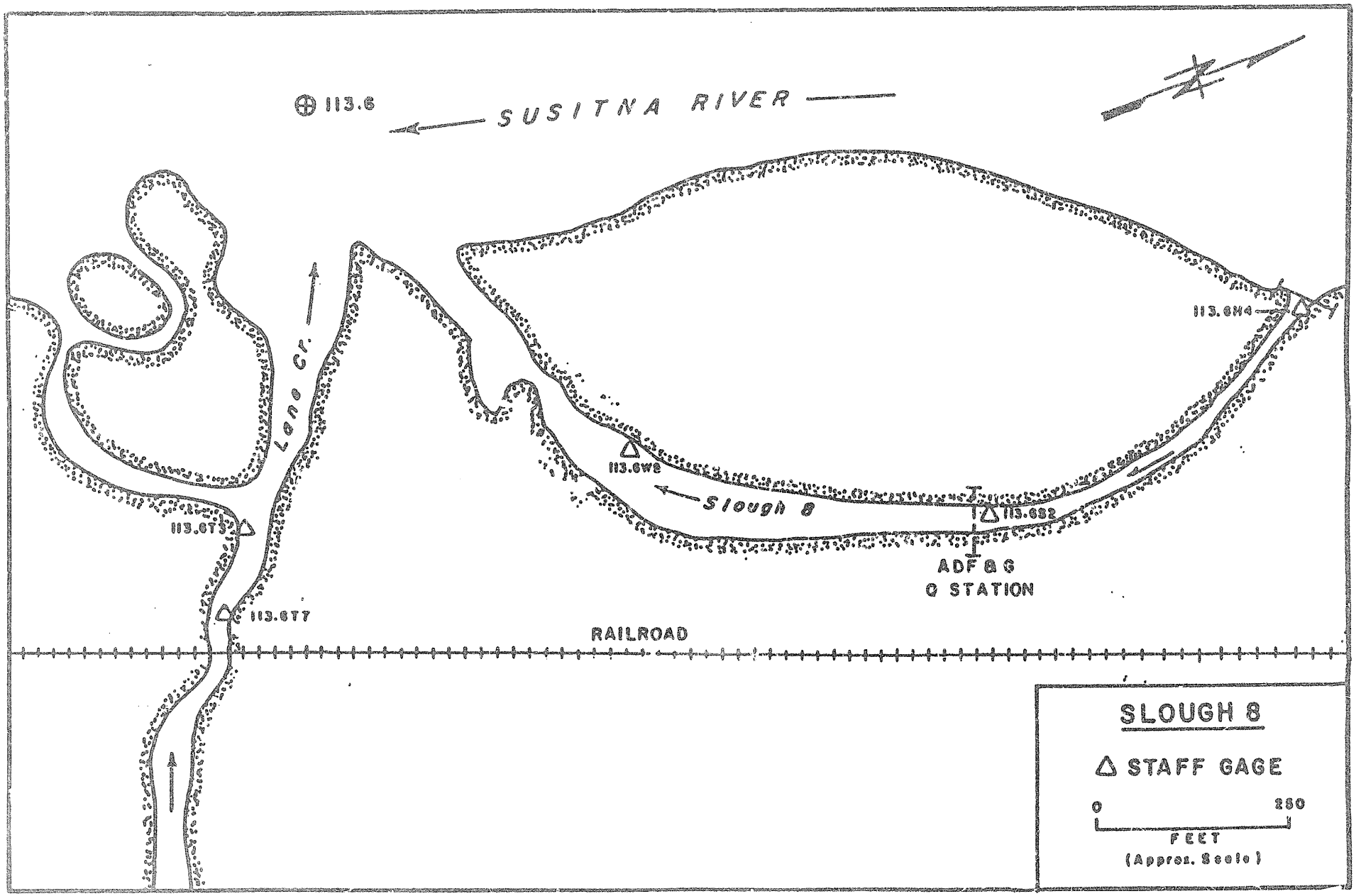

Figure 1-57 Site map of Lane Creek, which is located on the east bank of the Susitna River at river mile 113.6

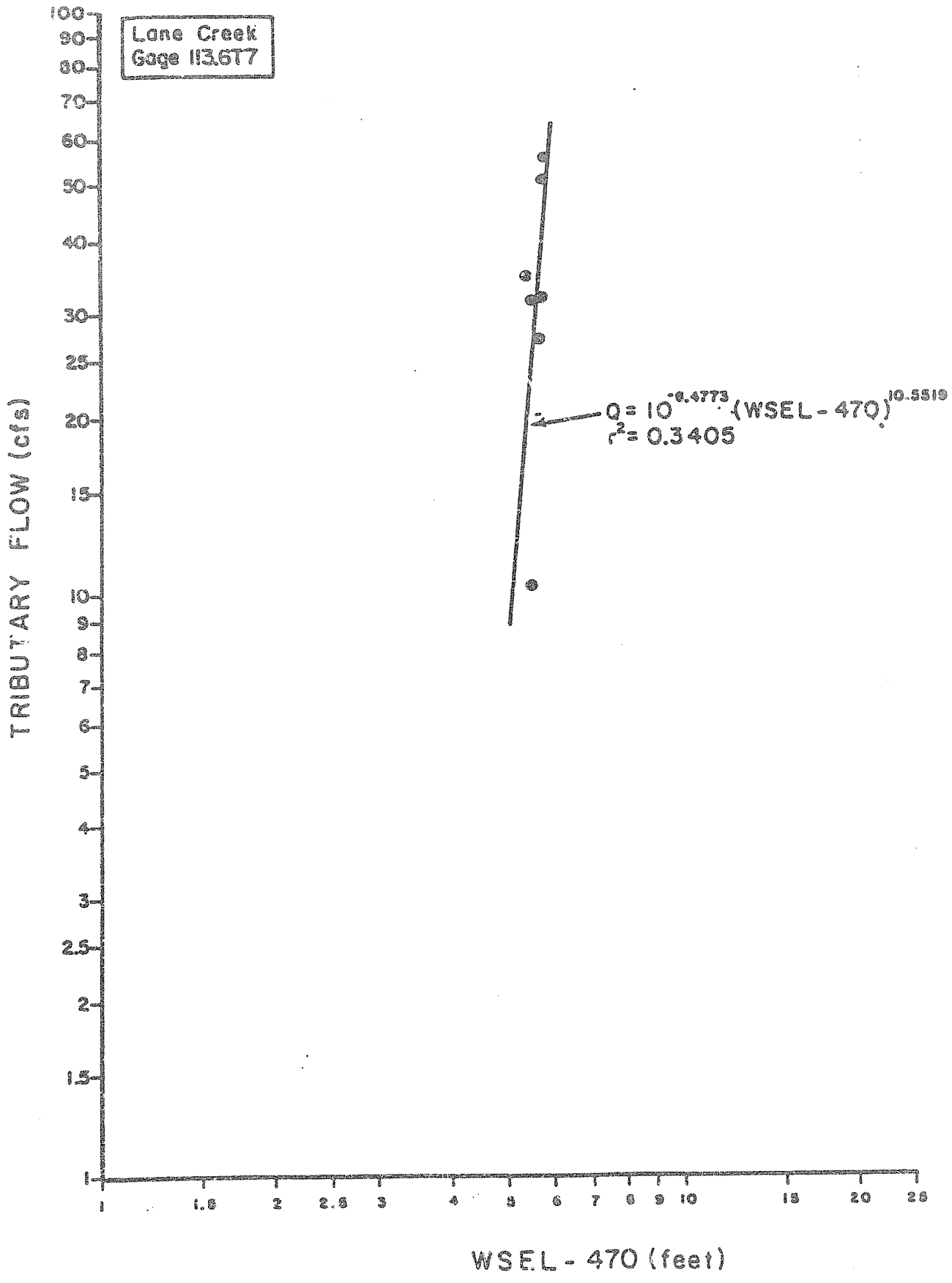

Figure 1-58 Stage versus flow rating curve for Lane Creek, staff gage 113.677.

3.5.3 Fourth of July Creek (RM 131.1)

3.5.3.1 Site Description

Fourth of July Creek (Figure 1-3) is located on the west bank of the Susitna River at river mile 131.1. It can be characterized as a relatively steep gradient, narrow, shallow, fast-running clear water stream which overflows its bank during periods of high streamflow.

During the 1983 open water field season, stage and streamflow was monitored at one site within this creek (Figure 1-59).

3.5.3.2 General Results

Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at the time of measurement obtained at each monitoring station in Fourth of July Creek in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.5.3.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Fourth of July Creek (Figure 1-59, Appendix Table 1-A-8). These measurements were used to construct a simple stage/streamflow rating curve (Figure 1-60).

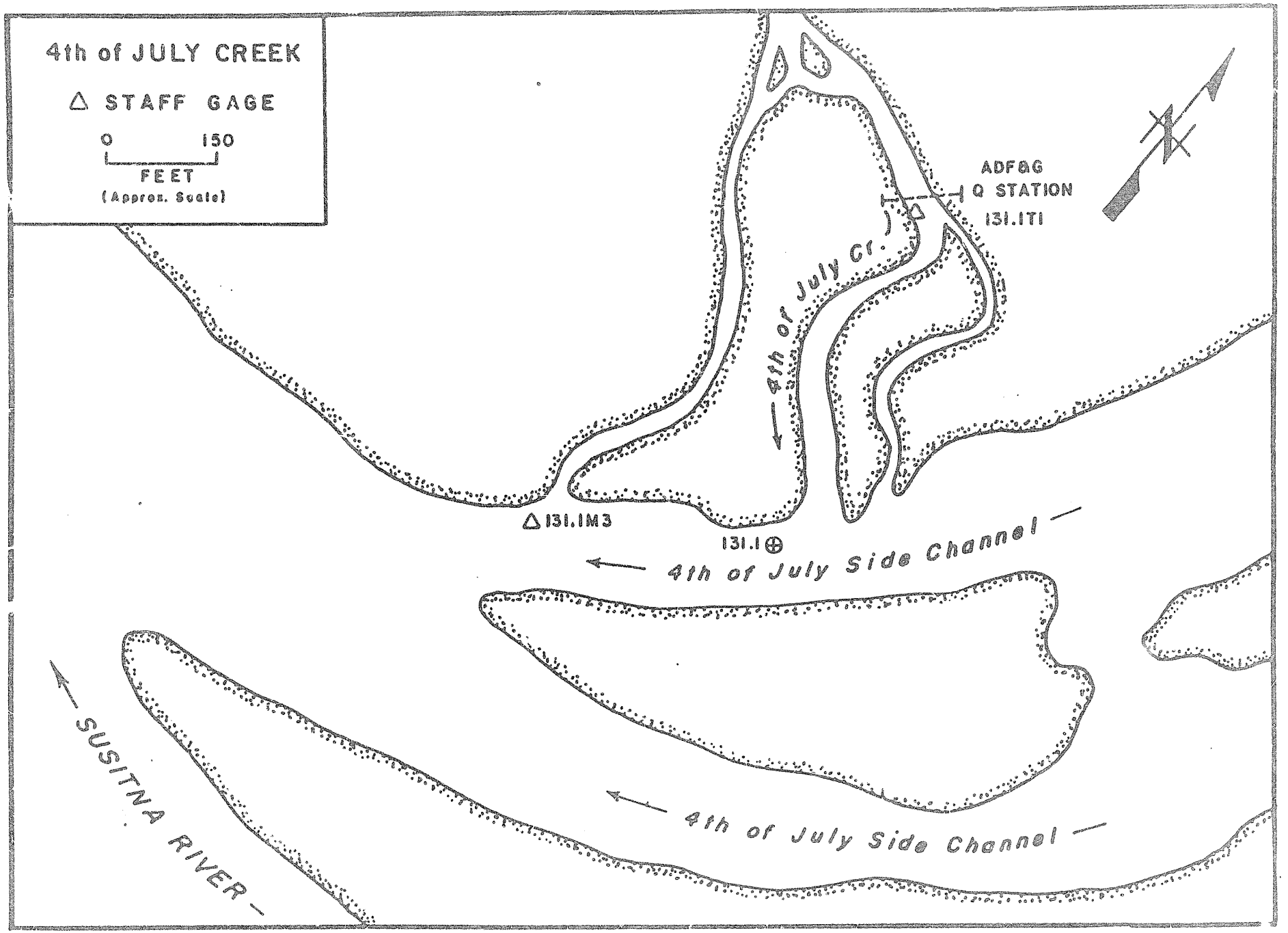

Figure 1-59 Site map of Fourth of July Creek, which is located on the west bank of the Susitna River at river mile 131.1.

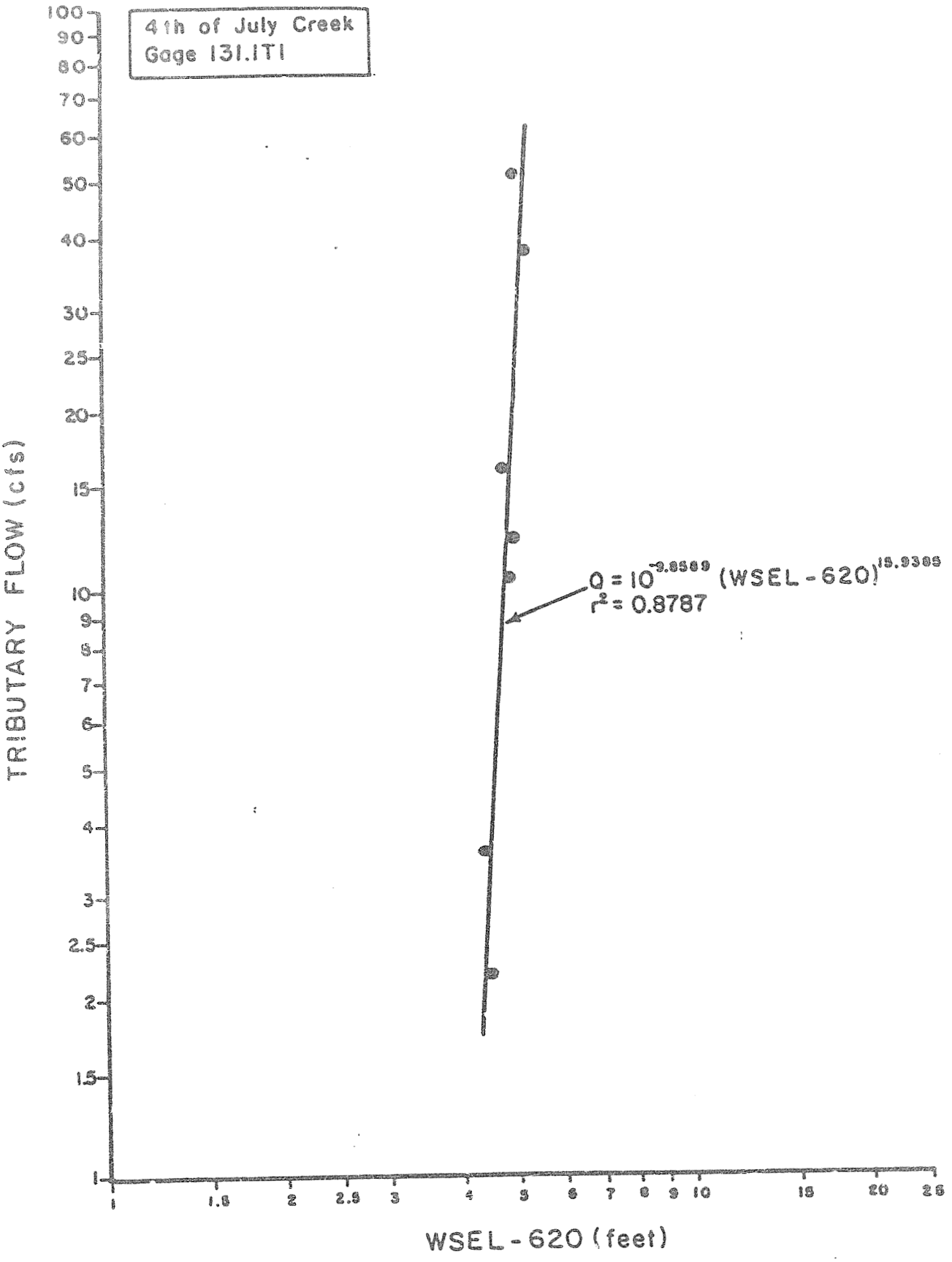

Figure 1-60 Stage versus flow rating curve for Fourth of July Creek staff gage 131.1T1.

3.5.4 Waterfall Creek (RM 140.1)

3.5.4.1 Site Description

Waterfall Creek (Figure 1-3) is a tributary to Slough 20 located on the east bank of the Susitna River at river mile 140.1. It can be characterized as a relatively small steep gradient stream that has many pools and riffles.

During the 1983 open water field season, stage and streamflow was measured at one site within this creek (Figure 1-61).

3.5.4.2 General Results

Measurements of water surface elevation along with corresponding measurements of mainstem discharge at Gold Creek at the time of measurements are presented in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.5.4.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of Waterfall Creek. (Figure 1-61, Appendix Table 1-A-8). Insufficient data were obtained to construct a stage/streamflow rating curve.

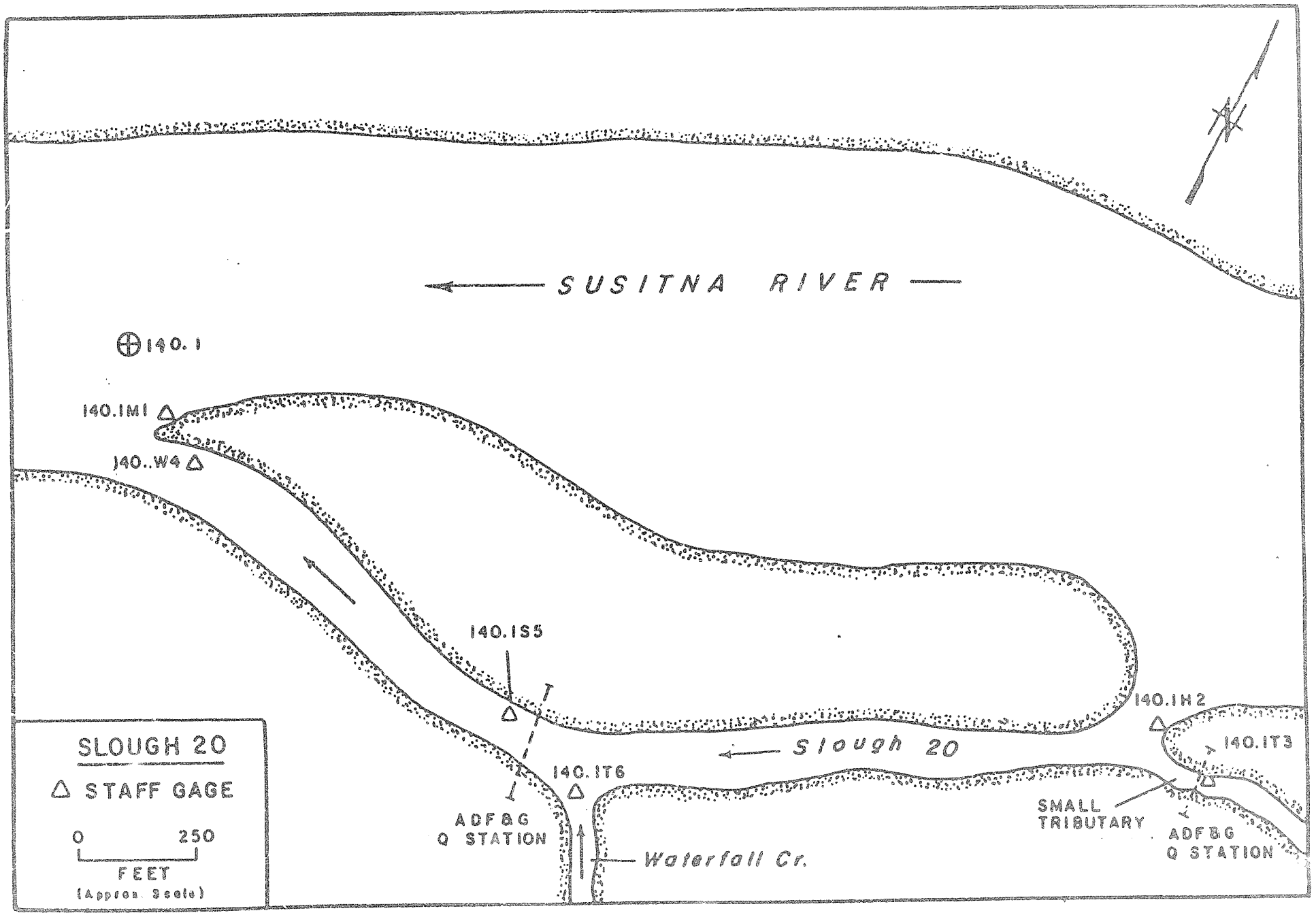

Figure 1-61 Site map of Waterfall Creek, which is located on the east bank of the Susitna river at river mile 140.1.

3.5.5 Unnamed Tributary At Upper Slough 20 (RM 140.1)

3.5.5.1 Site Description

This unnamed stream (Figure 1-3) is a small tributary to Slough 20 located on the east bank of the Susitna River at river mile 140.1. It can be characterized as a relatively narrow, meandering clear water stream and during periods of moderate to high streamflow in Slough 20, an area of backwater occurs at the mouth of this tributary.

During the 1983 open water field season, stage and streamflow was measured at one site within this tributary (Figure 1-62).

3.5.5.2 General Results

Measurements of water surface elevation along with corresponding mainstem discharge at Gold Creek at the time of measurement at each monitoring station are presented in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8.

3.5.5.3 Stage/Discharge Relationship

Simultaneous measurements of stage and streamflow were obtained at one site within the free-flowing portion of this tributary (Figure 1-62,

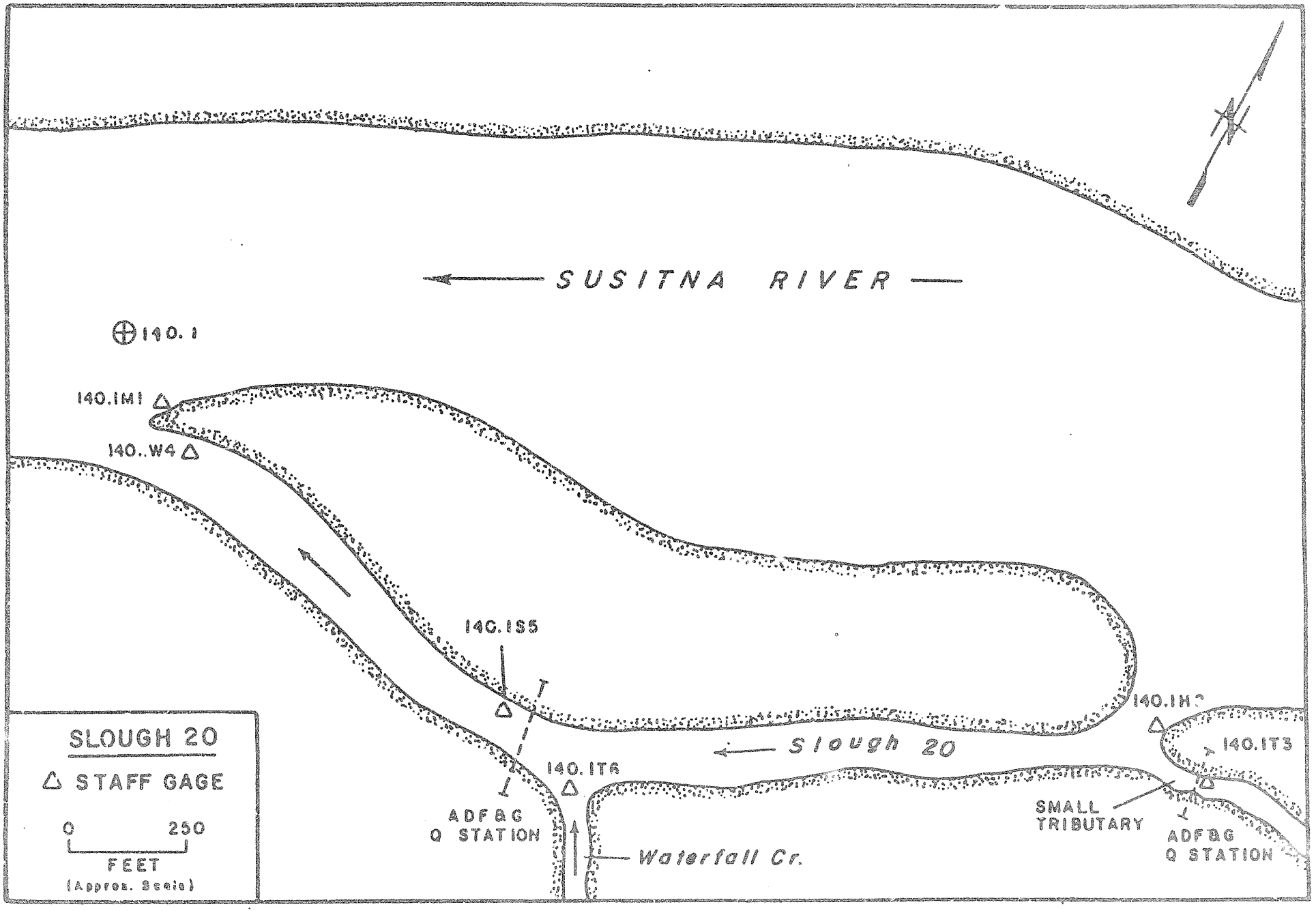

Figure 1-62 Site map of a small unnamed tributary at Upper Slough 20, which is located on the east bank of the Susitna River at river mile 140.1.

Appendix Table 1-A-8). These measurements were used to construct simple stage/streamflow rating curve (Figure 1-63).

3.5.6 Gold Creek (RM 136.8)

3.5.6.1 Site Description

Gold Creek (Figure 1-3) is a medium sized tributary that confluences with the Susitna River on the east bank at river mile 136.8. It can be characterized as a relatively steep gradient, fast running, clear water stream having many pools and riffles.

During the 1983 open water field season, stage was monitored at two sites within Gold Creek. At one of the monitored with staff gages and sites stage was continuously monitored using a continuous depth recorder and associated pressure transducer. In addition, streamflow was periodically monitored at the site at which stage was continuously monitored. (Figure 1-64).

3.5.6.2 General Results

Measurements of stage (water surface elevation) obtained from staff gage observations along with corresponding mainstem discharge at Gold Creek obtained at each monitoring station within Gold Creek are presented in Appendix Table 1-A-9. Measurements of streamflow along with the corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in

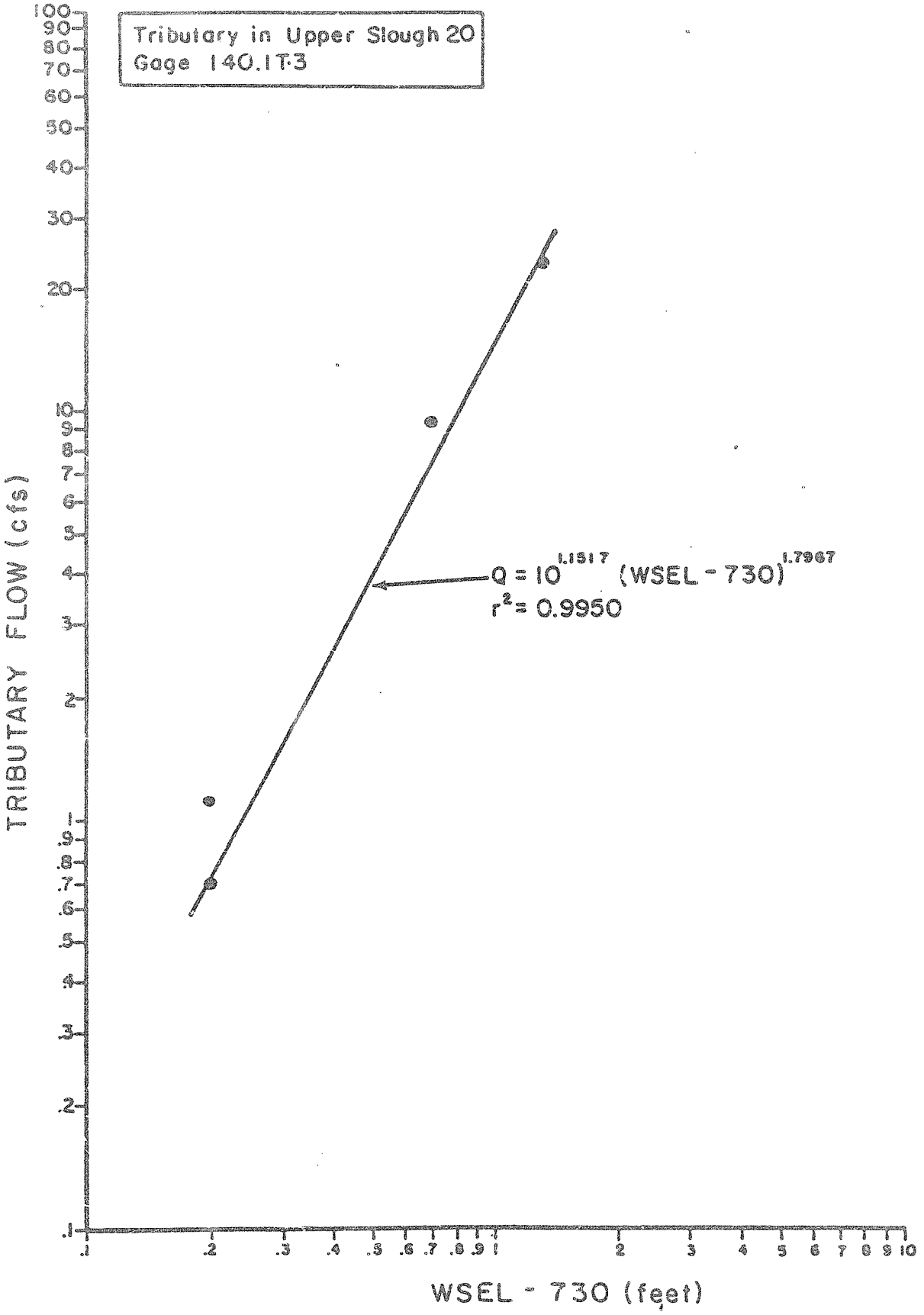

Figure 1-63 Stage versus flow rating curve for tributary in Upper Slough 20, staff gage 140.1T3.

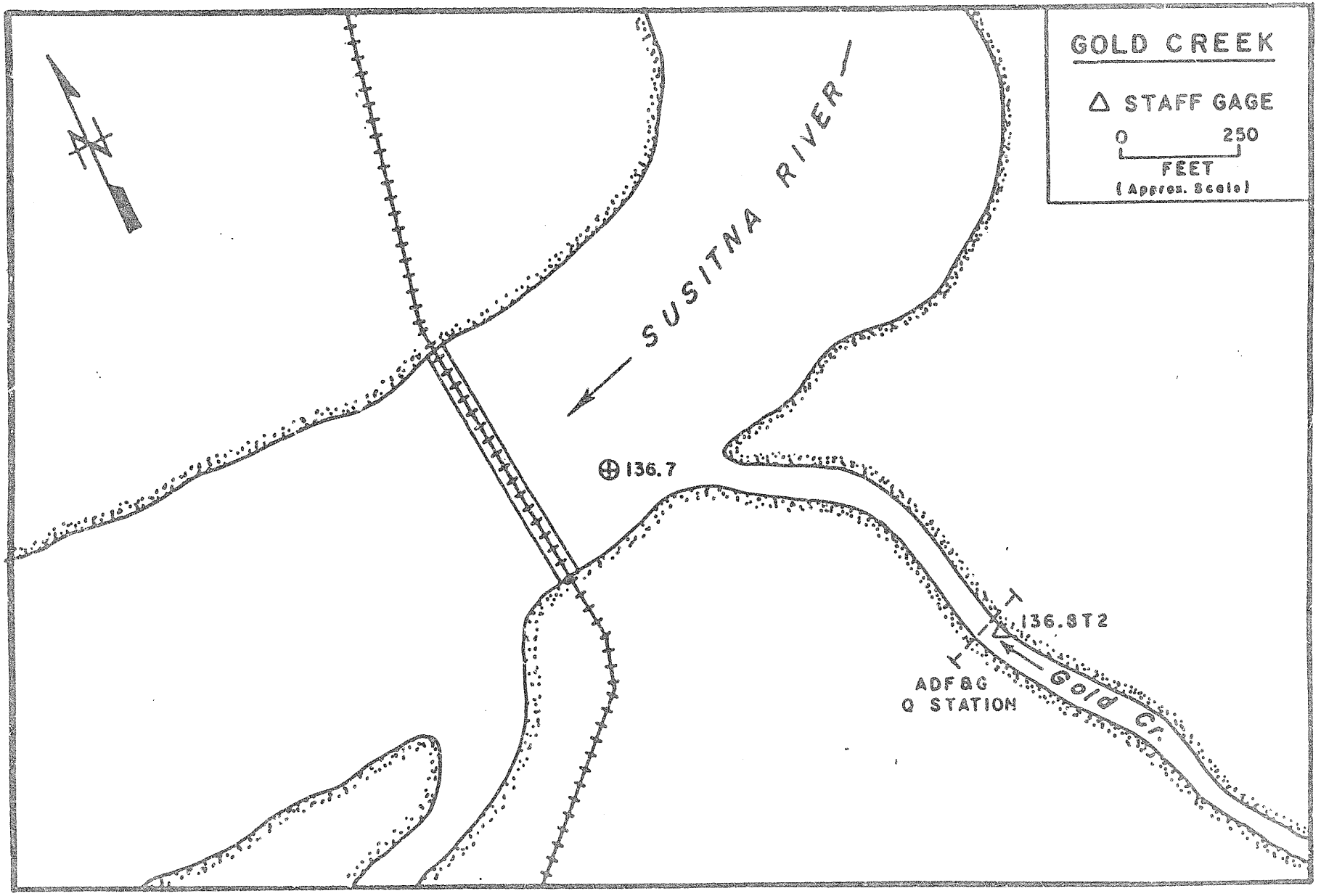

Figure 1-64 Site map of of Gold Creek, which is located on the east bank of the Susitna River at river mile 136.7.

Appendix Table 1-A-8. Measurements of streamflow along with the corresponding measurement of water depth obtained at the pressure transducer are presented in Table 1-20.

3.5.6.3 Stage/Discharge Relationship

Simultaneous measurements of water depth and streamflow were obtained at the site of the continuous stage recorder within Gold Creek. These measurements were used to construct a simple rating curve (Figure 1-65). The least squared regression equation for these depth of water and streamflow measurements was used to determine hourly streamflow data from the continuous water depth readings. Mean daily streamflow was then determined from these hourly streamflow records and are presented in Appendix Table 1-A-10.

3.5.7 Indian River (RM 138.6)

3.5.7.1 Site Description

Indian River (Figure 1-3) is a relatively large tributary to the Susitna River which confluences with the Susitna River on the west bank at river mile 138.6. It can be characterized as a relatively large, fast running, clear water, stream consisting of many pools and riffles.

Table A-20. Streamflow (cfs) and water depth measurements obtained at the Gold Creek tributary continuous stage recorder for 1983.

Date	Time	Water Depth (ft)	Streamflow (cfs)
830806	1600	0.77	34
830827	1700	0.87	51
830629	1500	0.87	56
830808	1800	1.53	154

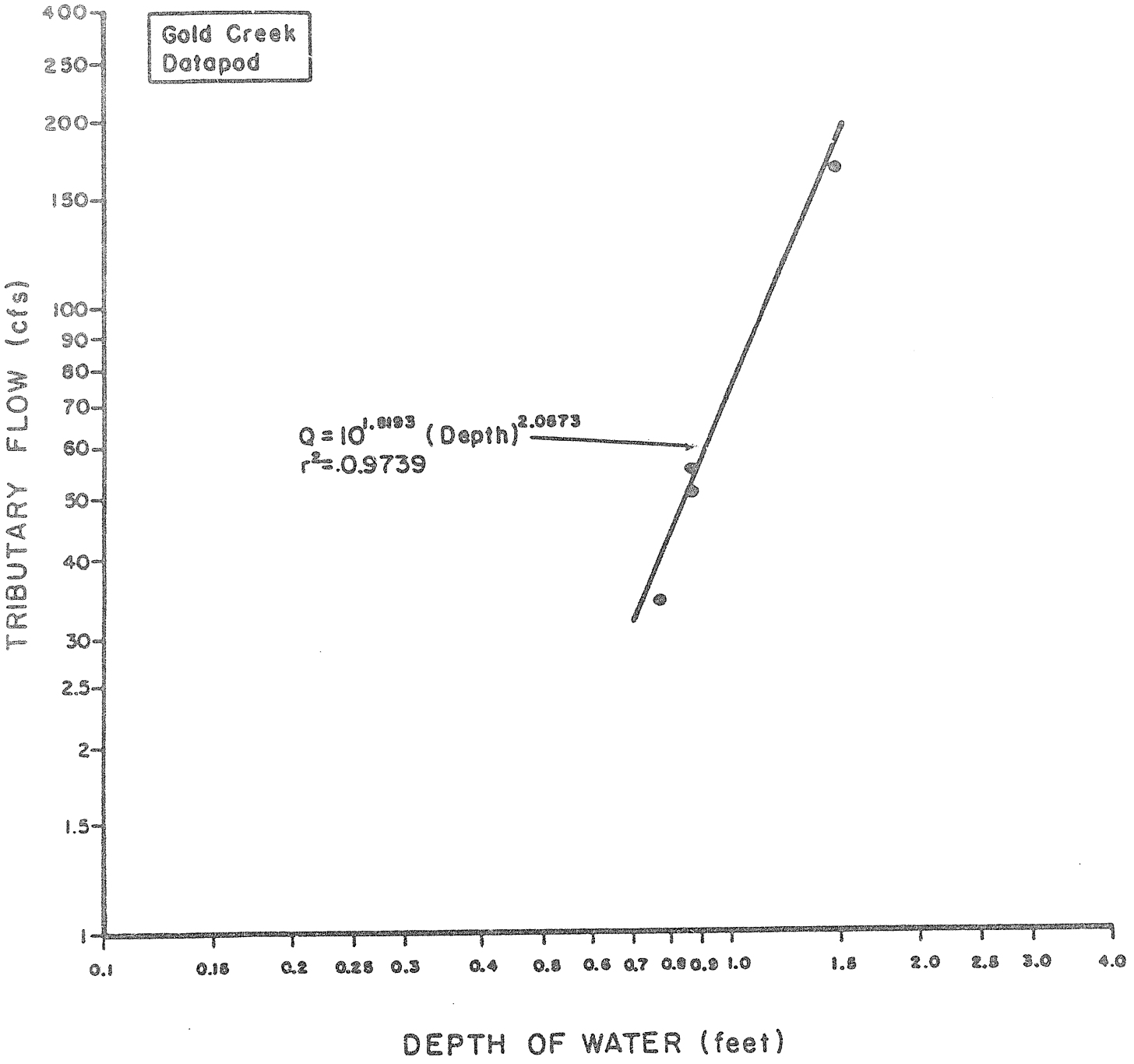

Figure 1-65 Depth of water (feet) versus flow rating curve for Gold Creek, continuous stage recorder.

During the 1983 open water field season, stage was monitored at two sites within Indian River using both a continuous depth recorder and associated pressure transducer and staff gages. In addition, streamflow was peri recorded. (Figure 1-66).

3.5.7.2 General Results

Measurements of water surface elevation obtained from staff gage observations along with corresponding mainstem discharge at Gold Creek obtained at the monitoring station within Indian River are presented in Appendix Table 1-A-9. Measurements of streamflow along with corresponding measurements of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 3. Measurements of streamflow along with the corresponding measurement of water depth obtained at the pressure transducer are presented in Table 1-21.

3.5.7.3 Stage/Discharge Relationship

Simultaneous measurements of water depth and streamflow were obtained at the site of the continuous stage recorder within Indian River. These measurements were used to construct a simple rating curve (Figure 1-67). The equation to the line (a least squared regression equation) for these depth of water and flow measurements was used to determine hourly streamflows in Indian River from the continuous water depth readings. Mean daily streamflow were then determined from the hourly streamflow record and are presented in Appendix Table 1-A-11.

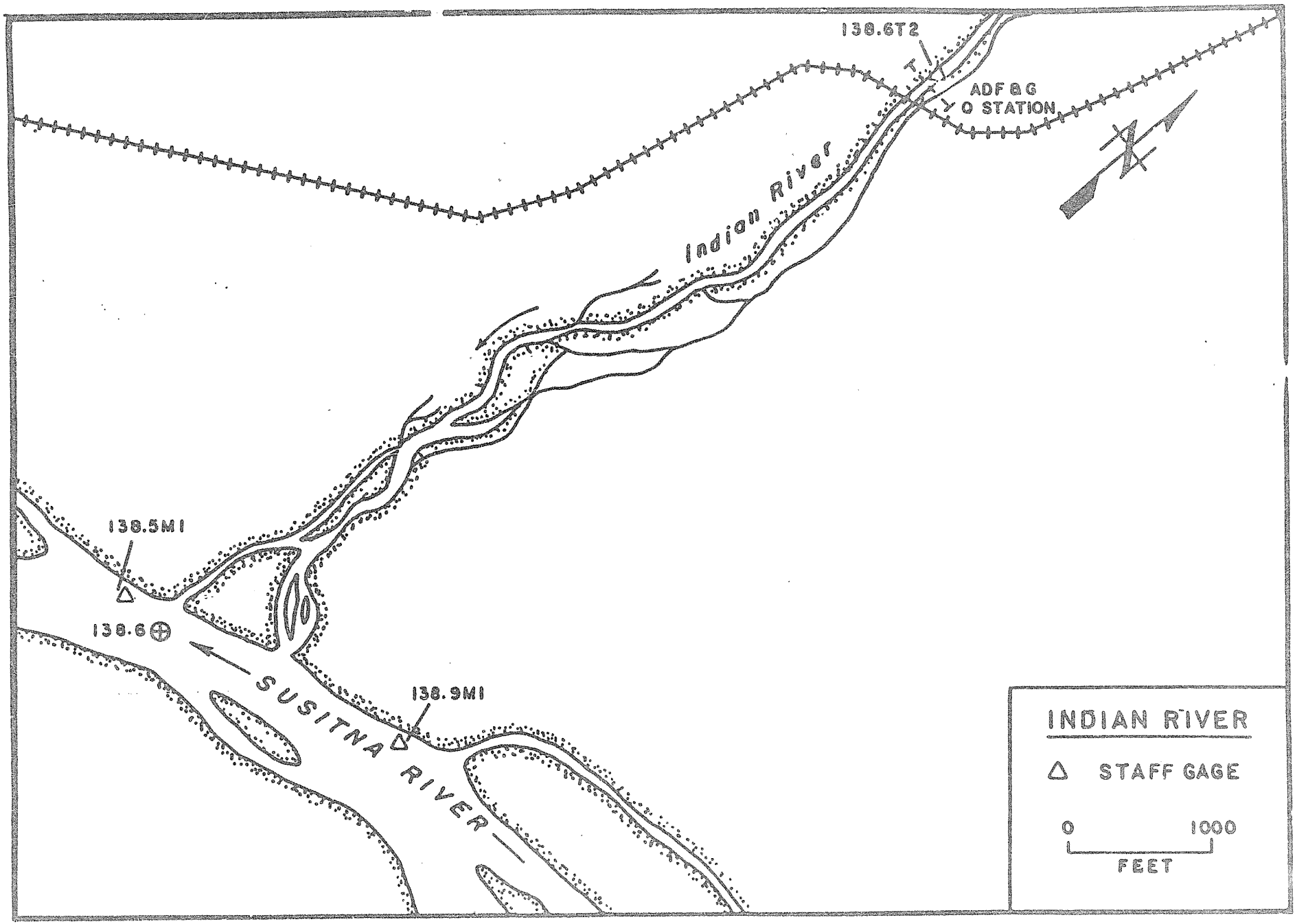

Figure 1-66 Site map of Indian River, which is located on the west bank of the Susitna River at river mile 138.6.

Table 1-21. Streamflow (cfs) and water depth measurements obtained at the Indian River tributary continuous stage recorder for 1983.

Date	Time	Water Depth (ft)	Streamflow (cfs)
830705	1200	1.50	459
830827	1200	1.50	338
830913	0900	1.40	242
830712	1600	1.30	173
830728	1830	1.20	98

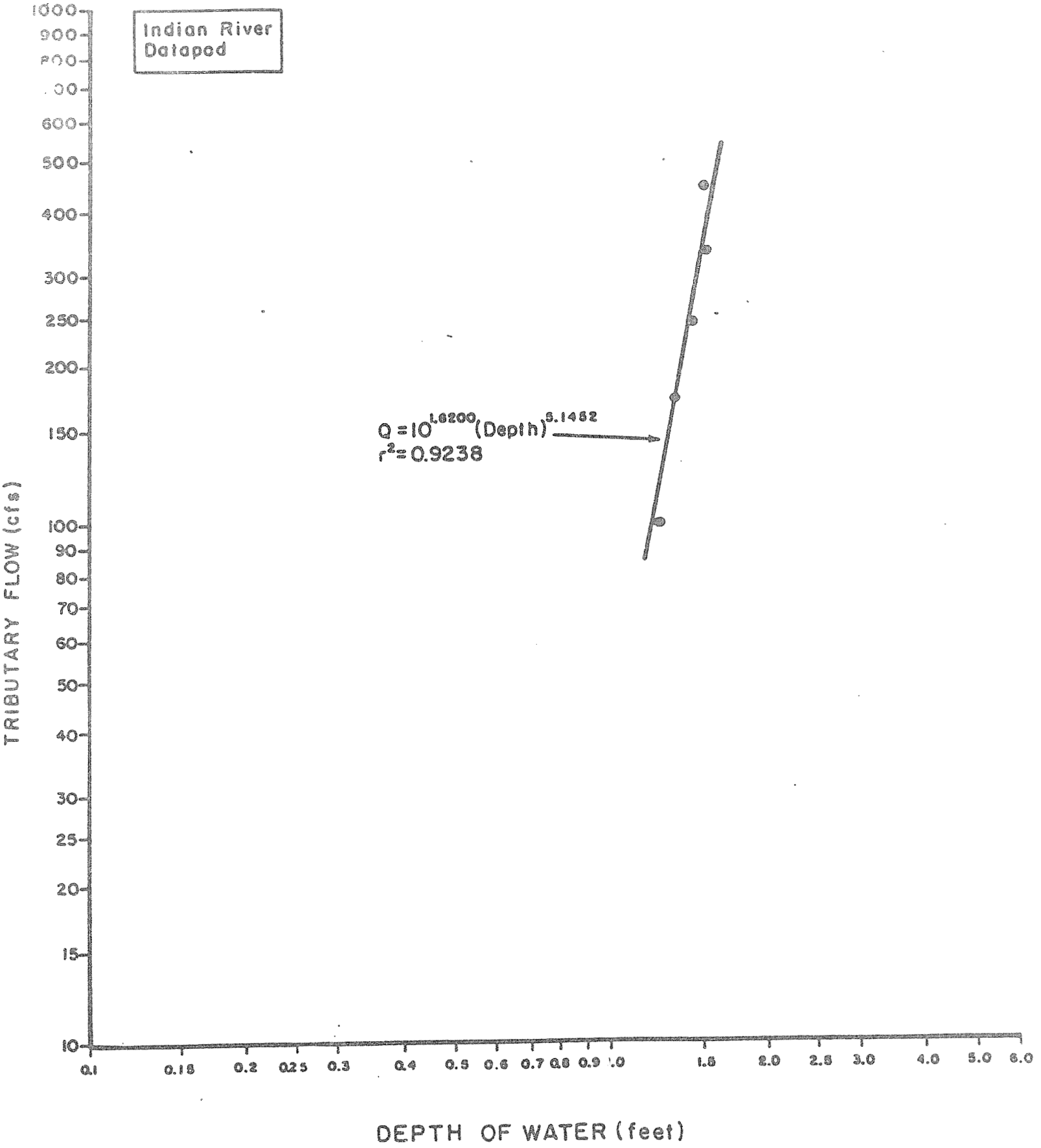

Figure 1-67 Depth of water (feet) versus flow rating curve for Indian River, continous stage recorder.

A comparison of the measured streamflows to that estimated from the depth of water record indicate that at higher streamflows (greater than 350 cfs) the streamflow record may be in error. This has been attributed to movement in the area of the monitoring station.

3.5.8 Portage Creek (RM 148.8)

3.5.8.1 Site Description

Portage Creek (Figure 1-3) is a relatively large, fast running, clear water stream that has many pools and riffles. It confluences with the north bank of the Susitna River at river mile 148.8.

During the 1983 open water field season, stage was monitored at one site within Portage Creek using a continuous stage recorder and a staff gage. In addition, streamflow was periodically measured at this site (Figure 1-68).

3.5.8.2 General Results

Measurements of streamflow along with the corresponding measurement of water surface elevation and mainstem discharge at Gold Creek at the time of measurement are presented in Appendix Table 1-A-8. Measurement of streamflow along with the corresponding measurement of water depth obtained at the pressure transducer are presented in Table 1-22.

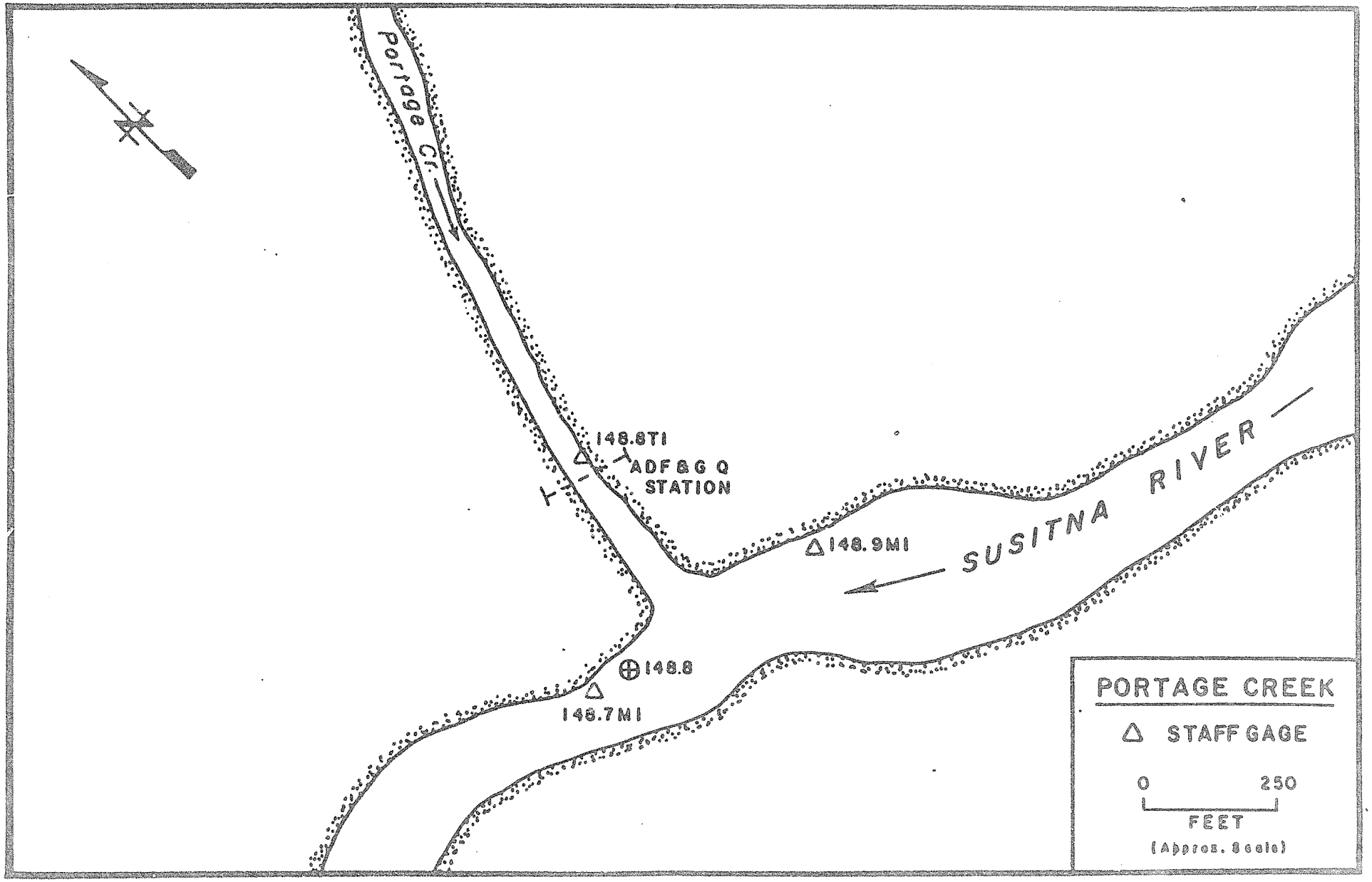

Figure 1-68 Site map of Portage Creek which is located on the west bank of the Susitna River, river mile 148.8.

Table 1-22. Streamflow (cfs) and water depth measurements obtained at the Portage Creek tributary continuous stage recorder for 1983.

Date	Time	Water Depth (ft)	Streamflow (cfs)
830702	1200	1.83	1055
830828	1200	1.70	789
830730	1100	0.87	267

3.5.8.3 Stage/Discharge Relationship

Simultaneous measurements of water depth and streamflow were obtained at the site of the continuous stage recorder within Portage Creek. These measurements were used to construct a simple rating curve (Figure 1-69). The equation to the line (a least squared regression equation) for these depth of water and streamflow measurements was used to determine hourly streamflow in Portage Creek from the continuous water depth readings. Mean daily streamflow was then determined from the hourly streamflow record and are presented in Appendix Table 1-A-12.

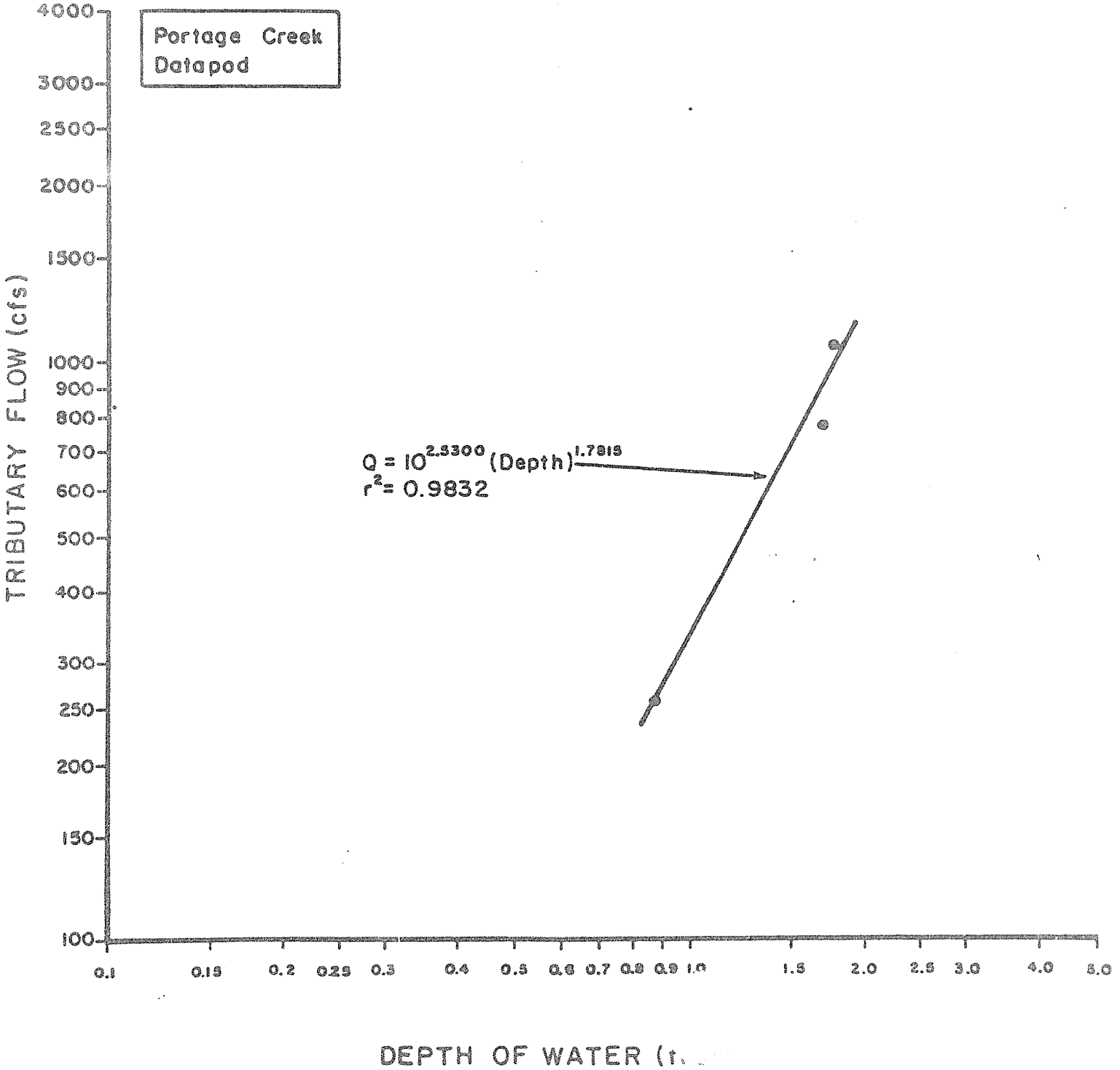

Figure 1-69 Depth of water (feet) versus flow rat... ...ve for Portage Creek, continous stage recorder.

4.0 DISCUSSION

Stage and discharge data were collected in the mainstem and its peripheral habitats during the 1983 open water field season to determine the influences that mainstem discharge has on the water surface elevation of the mainstem at selected locations and to evaluate the influences that mainstem discharge has on various hydraulic conditions present in peripheral habitats.

Streamflows experienced during the 1983 open water field season generally followed the historical 25 year streamflow record as they did in 1982 (Figures 1-1 and 1-5) . This compares to the streamflows experienced during the 1981 open water field season which were higher than the historical 25 year streamflow record during the July to August period.

During the 1983 open water field season, streamflows ranged from a low of 7,500 cfs on October 9 to a high of 36,000 cfs at Gold Creek on June 5. Generally, streamflows increased during May, peaked in June, and decreased during September and October (Figure 1-5).

Based on 1982 (ADF&G, 1983) and 1983 data, the relationship between mainstem water surface elevation and discharge is relatively well defined for mainstem discharges at Gold Creek ranging from 7,500 to 35,000 cfs.

Mainstem discharge was found to influence various hydraulic conditions present within side channel, side slough, and upland slough habitats. Moderate to high levels of mainstem discharge caused backwater areas to form at the mouths of many of the side channels, side sloughs, and upland sloughs evaluated. In general, the size and extent of these backwater areas increased as mainstem discharge increased.

Mainstem discharge was also found to influence, to varying degrees, the water surface elevation and streamflow conditions that occur within side channels and side sloughs depending on whether the head portions of these sites were breached by the mainstem. Prior to breaching (overtopping), the streamflow conditions present within these habitats are only indirectly related to mainstem discharge. Under these conditions, streamflows are small and water surface elevations remain relatively stable. Streamflow is primarily contributed by groundwater upwelling or seepage, surface water runoff, and tributary inflow.

With the occurrence of breaching of a side channel or side slough by progressively higher levels of mainstem discharge, a succession of events occurs within these habitats.

The first event that occurs in the succession of mainstem breaching is the initial overtopping of the head portion of these habitats. The mainstem discharge at which this initial overtopping occurs is referred to as the "breaching discharge". This initial breaching may or may not significantly influence the hydraulic characteristics of a side channel or side slough due to the low quantity of flow entering the head portion

and due to specific geomorphological features of a site. At some point, as progressively higher levels of mainstem discharge overtop the head portion of a side channel or side slough, the hydraulic characteristics of a site begin to become governed by mainstem discharge. The mainstem discharge at which this initially occurs is referred to as the "controlling breaching discharge:. The period between the initial "breaching discharge" and the "Controlling breaching discharge" is referred to as the "intermediate breaching discharge" condition. Depending upon the geomorphological character of the heads of side channels and side slough the "controlling mainstem breaching discharge' and the "breaching discharge" may be very close if not the same mainstem discharge.

In general, initial breaching discharges for side channels are lower than those for side sloughs. Initial mainstem breaching discharges for side channel selected for study in the middle reach of the Susitna River vary from 5,000 to 20,000 (cfs) as measured at the USGS Gold Creek gaging station. These compare to mainstem breaching discharges for studied side sloughs in the middle reach of the Susitna River which vary from 16,000 to 42,000 (cfs) as measured at the USGS Gold Creek gaging station. (Table 1-23).

These breaching discharges compare to controlling breaching discharges ranging from 5,000 to 25,000 cfs and 19,000 to 42,000 cfs (Table 1-23) as measured at the USGS Gold Creek gaging station for side channels and side sloughs, respectively. In general, the controlling breaching discharges are closer to the breaching discharges in side channels than

Table 1-23. Initial breaching and controlling mainstem discharges for selected side channels and side sloughs in the Talkeetna to Devil Canyon reach of the Susitna River.

Site	RM	Lowest Observed Mainstem Breaching Discharge (cfs)	Controlling Mainstem Discharge (cfs)
Side Channels			
Mainstem II Side Channel			
NW Channel	114.4	12,000	16,000
NE Channel	115.5	23,000	25,000
Side Channel 10	134.2	19,000	19,000
Lower Side Channel 11	135.0	5,000	5,000
Upper Side Channel 11	136.2	13,000	16,000
Side Channel 21			
Downstream of A5	140.6	12,000	12,000
Upstream of A5	141.9	20,000	
Side Sloughs			
Whiskers Creek Side Slough	101.2	22,000	23,000
Side Slough 8	113.6	24,000	24,000
Side Slough 8A			
NW Channel	126.2	27,000	27,000
NE Channel	126.7	33,000	33,000
Side Slough 9	128.3	16,000	19,000
Side Slough 11	136.4	42,000	42,000
Side Slough 16B	138.2	20,000	23,000
Side Slough 20	140.6	22,000	23,000
Side Slough 21			
NW Channel	142.2	23,000	25,000
NE Channel	142.3	26,000	28,000
Side Slough 22	144.7	20,000	23,000

in side sloughs. The reasons for this may be linked to certain geomorphological features present in side channels that differ from those present in side sloughs. The cross sectional profile of the head portion of a side channel is much flatter and rounded than that of a side slough, allowing a larger quantity of water to flow over the head of a side channel at the initial point of overtopping. This causes a more immediate influence of mainstem discharge on the hydraulic characteristics of a side channel. With the occurrence of controlling breaching discharges, both the water surface elevation and streamflow within these habitats increases dramatically.

These initial breaching and controlling breaching discharges presented are based on a combined interpretation of field survey and water surface elevation data, aerial photography, field observations, and the professional judgement of our hydraulic engineering consultant. In addition, the figures are based on mean daily mainstem discharge as measured at the USGS Gold Creek gaging station rather than site specific discharge measurements. Because of this, some error may be associated with the figures, however, the error is believed to be small mounting to approximately 15% as such, the figures presented represent our best estimate of breaching and controlling discharges for the studied sites.

Simultaneous measurements of stage and streamflow obtained within the free-flowing portion of each side channel or side slough were plotted as simple rating curves. These curves describe the relationship between water surface elevation within each site to streamflow at the site. Because of variable influences of mainstem discharge on the hydraulics

at the gaging station, many of the plots were subdivided into breached and nonbreached conditions.

Stage and streamflow measurements were also obtained in two upland sloughs located in the Talkeetna to Devil Canyon reach of the Susitna River. Because of the influence of backwater at these habitats, rating curves describing the relationship of site streamflow to water surface elevation could not be constructed.

Significant areas of backwater occurred at the mouth of each of the upland sloughs evaluated during periods of low to high mainstem discharge. These backwater areas created substantial increases in water depths and reductions in water velocities in the mouth areas of these habitats.

Because upland sloughs are not hydraulically connected the the mainstem at their heads, the streamflow in these sites was not found to be directly related to mainstem discharge. The major contributors to streamflow in the upland sloughs evaluated included surface water runoff and groundwater upwelling.

Stage and streamflow measurements were obtained at eight tributaries located in the Talkeetna to Devil Canyon reach of the Susitna River. From these data, rating curves describing the relationship between tributary streamflow and water surface elevation were constructed.

Three of the tributaries studied contributed flow to side slough habitats whereas the remaining tributaries evaluated emptied directly into the mainstem Susitna River, except Fourth of July Creek, which empties into Whiskers Side Slough and Waterfall Creek, which empties in Side Slough 20, were found to provide a significant contribution of flow to these side sloughs. This tributary inflow provide the majority of streamflow in these side sloughs when the sloughs were not breached by mainstem discharge. Whiskers Creek was found to contribute as much as 90% of the flow to Whiskers Side Slough when the slough was not breached with Water Fall Creek providing as much as 80% of the total discharge found in Side Slough 20 during a non-breached hydraulic condition.

All of the tributaries studied provided clear water plumes where they confluenced with their joining sloughs, side channel or mainstem habitats. The extent of these clear water plumes were found to vary being dependant on both the volume of flow of the tributary and its confluencing body.

Continuous measurements of streamflow were estimated for Gold Creek, Indian River, and Portage Creek for the months of May to October, 1983. These flow data are estimates determined from continuous depth of water measurements and provide the general magnitude and variability of stream flows for these tributaries. At Indian River, the streamflow record may be in error in the range of 20% for those flows exceeding 300 (cfs) due to stream bed movement found to occur at the discharge station. Overall, these three tributaries exhibit similar trends with streamflow generally increasing during late May and early June, presumably due to

snow melt and decreasing in October. Peak flows occurred on August 8, August 31, and September 30 respectively for each of these tributaries, with Portage Creek having an additional high flow on August 21. These peak flows are assumed to be the result of rain storms, including the flow for Portage Creek on August 21, which appears to have resulted from a localized storm. Stream flow for Portage Creek, Indian River, and Gold Creek on August 9, 1983 (a period of high flow) was 200 (cfs) and 2,045 (cfs) (Appendix Tables 1-A-10 - 1-A-12), respectively. The total of these three tributaries provided approximately 16% of the mainstem discharge at Gold Creek (15292000) of 29,900 (cfs) occurring for the same day.

Overall, stage and streamflow for the tributaries studied in the Talkeetna to Devil Canyon reach of the Susitna River have been developed into stage and streamflow rating curves with the exception of Water Fall Creek, and continuous streamflow records have been estimated for Gold Creek, Indian River, and Portage Creek. Further streamflow data may be necessary if fishery studies are to be conducted on these tributaries to define streamflow using the present rating curves. Stream bed movement may dramatically affect the rating curves and during periods of peak flow many of these tributaries are subject to changes in their channel geometry.

5.0 CONTRIBUTORS

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