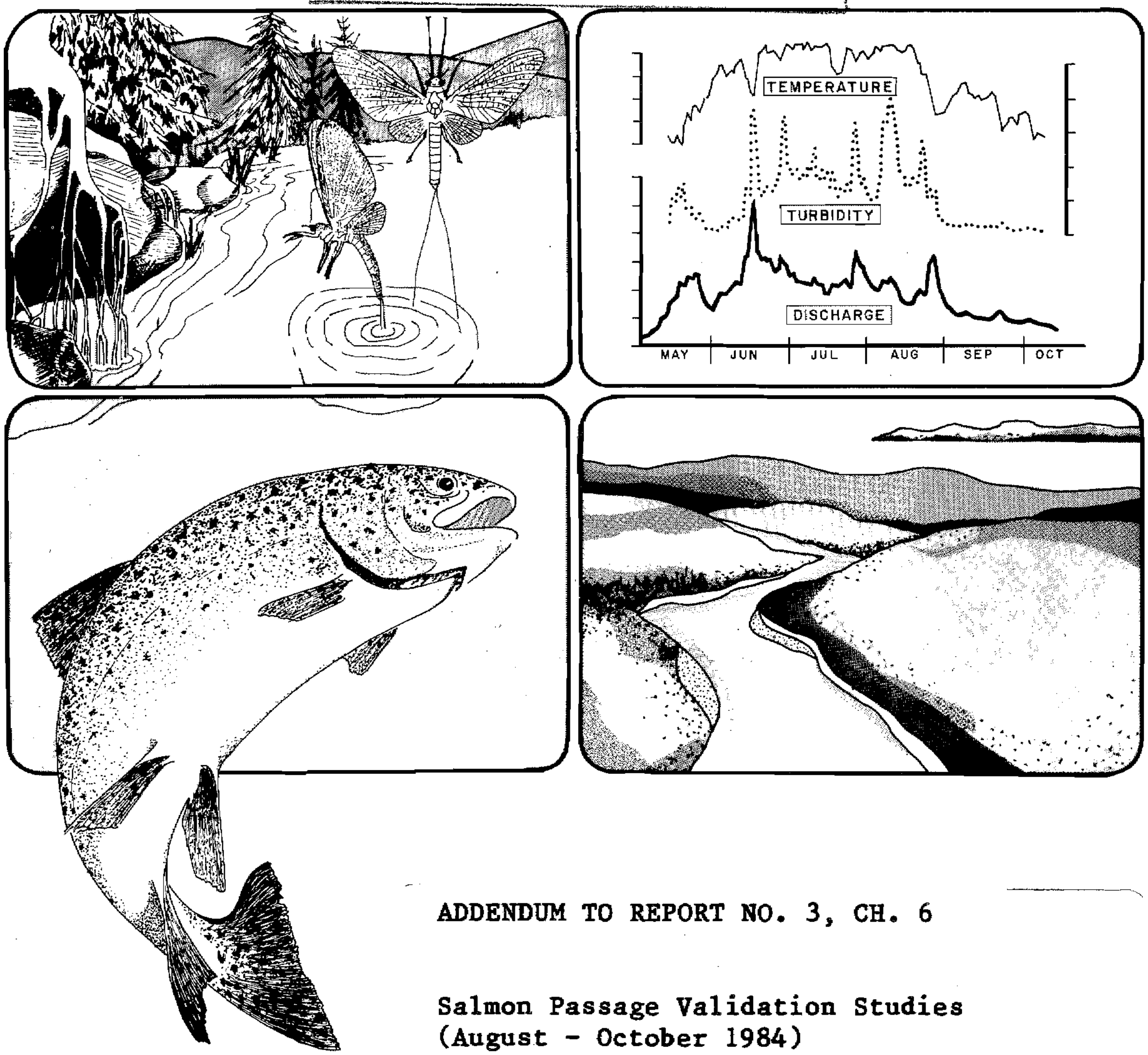

ADDENDUM TO REPORT NO. 3, CH. 6

Salmon Passage Validation Studies (August - October 1984)

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

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ADDENDUM TO REPORT NO. 3, CH. 6

Salmon Passage Validation Studies (August - October 1984)

Prepared for:

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June 1985

NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING THIS REPORT SHOULD BE DIRECTED TO THE ALASKA POWER AUTHORITY SUSITNA PROJECT OFFICE

PREFACE

This report is an addendum to one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna Hydro Aquatic Studies program was initiated in November 1980. Reports prepared by the ADF&G prior to 1983 on this subject are available from the APA.

This addendum revises and supplements portions of Chapter 6 of the 1984 ADF&G Su Hydro Studies Report Number 3, An Evaluation of Passage Conditions for Adult Salmon in Sloughs and Side Channels of the Middle Susitna River. This addendum provides the most current information on passage requirements for salmon based on the presently available information. The need for reevaluation of previously established local flows and mainstem discharges required for successful and unsuccessful salmon passage at selected slough and side channel sites in the middle reach of the Susitna River (RM 95 to 152) was necessitated based on an assessment of the results of the 1984 Passage Validation Studies (PVS). In addition, a review of presently available passage related data indicated that collection of additional data, or further evaluations of existing data, were needed to more adequately assess salmon passage conditions in these habitats. Results of the 1984 PVS, which were previously presented in a draft technical memorandum (ADF&G 1984), have been incorporated into this addendum along with all revised and updated data.

ADDENDUM TO ALASKA DEPARTMENT OF FISH AND GAME

REPORT NO. 3, CHAPTER 6:

SALMON PASSAGE VALIDATION STUDIES

AUGUST - OCTOBER, 1984

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ABSTRACT

An interim evaluation of the effects that mainstem discharge and local flow have on passage conditions for adult salmon at selected slough and side channel habitats of the middle reach of the Susitna River was previously presented in Sautner et al. (1984). Due to the limited data available for this interim evaluation, the Passage Validation Studies (PVS) were initiated during the 1984 open water field season to collect additional physical and biological data to reevaluate the passage criteria and the local flow and mainstem discharge values required for successful and unsuccessful salmon passage within these habitats. In addition, the methodologies used for the backwater and local flow analyses were revised to reflect the additional data which were

collected. Physical data collected included channel cross section and thalweg profiles, substrate assessments, and local flow measurements. Biological data consisted of salmon passage criteria based on visual observations of adult chum salmon movement in selected slough and side channel habitats.

The salmon passage criteria previously presented in Sautner et al. (1984) were reevaluated and revised based on these data using a modified analytical approach. The revised analysis resulted in the development of a single set of salmon passage criteria thresholds for defining successful and unsuccessful passage conditions at study sites. A total of 85 passage reaches were identified at slough and side channel sites during the 1984 PVS compared to 74 passage reaches identified in Sautner et al. (1984). Using the revised criteria thresholds as guidelines, a reevaluation of the breaching, backwater, and local flow analyses for these passage reaches indicates that mainstem discharge and local flow requirements for successful and unsuccessful passage are similar to values previously established. The most significant differences occurred in the backwater analysis for some sites, where required mainstem discharges decreased over 1,000 cfs. Water depth was determined to be the primary physical variable affecting passage conditions at passage reaches; passage conditions were not greatly affected by changes in passage reach length. Variations in channel configuration and substrate size were assumed to have a negligible influence on the salmon passage criteria. The revised passage criteria thresholds are based on an upper thalweg depth of 0.5 feet thereby voiding all previous analyses that utilized 0.67 feet as the upper limit of thalweg depth.

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1.0 INTRODUCTION

1.1 Background

Preliminary field studies of passage conditions for adult chum salmon (*Oncorhynchus keta*) in selected slough and side channel spawning habitats of the middle reach of the Susitna River (Figure 1) were conducted during the 1982 (ADF&G 1983a: Appendix B) and 1983 (Sautner et al. 1984) open-water field seasons. These studies evaluated the influence of selected channel geometry and hydraulic characteristics on chum salmon passage into and within these habitats. The 1982 and 1983 reports provided the basis for identifying locations presenting potential passage problems for salmon within slough and side channel habitats. In addition, these studies established interim salmon passage criteria (criteria curves) utilized for estimating the mainstem discharges and local flows required to provide successful and unsuccessful passage conditions for adult chum salmon migrating into and within these habitats.

This addendum revises and supplements salmon passage data previously reported in Sautner et al. (1984) and presents the results of the 1984 Passage Validation Studies (PVS). The 1984 PVS was undertaken to verify and/or refine the interim salmon passage criteria and flow requirements previously established in Sautner et al. (1984). The initial salmon passage criteria curves presented in Sautner et al. (1984) were based on a review of limited salmon passage field data and observations collected during 1982 and 1983 combined with the professional judgement of project fisheries biologists and hydraulic engineers. Due to the limited field data available for the development of these curves, it was necessary to obtain additional field data in 1984 to validate the 1983 salmon passage criteria. As indicated by the additional data and analyses from the 1984 PVS, the criteria curves from Sautner et al. (1984) were refined to more closely represent natural passage conditions for chum salmon in this report .

It was also necessary to refine the local flow analysis presented in Sautner et al. (1984). This analysis is primarily based on flow estimates derived from limited cross section data and associated rating curves, interpretation of aerial photography, and at some sites, from observations by field personnel. Because of these limitations, only 38 of 74 passage reaches could be evaluated for the initial local flow analysis. In addition, the accuracy of the estimates developed was questionable, as only limited flow measurements were available for comparison and validation. For these reasons, additional cross section and local flow data were collected during the 1984 PVS to provide a more complete data base to evaluate local flow requirements at all currently identified passage problem areas.

To more adequately assess the effects of mainstem discharge and local flow on salmon passage conditions in slough and side channel habitats in 1984 , it was necessary to further evaluate the relationship between these two water sources. The available hydrologic data bases of Susitna River habitats were used to evaluate the relationship between mainstem

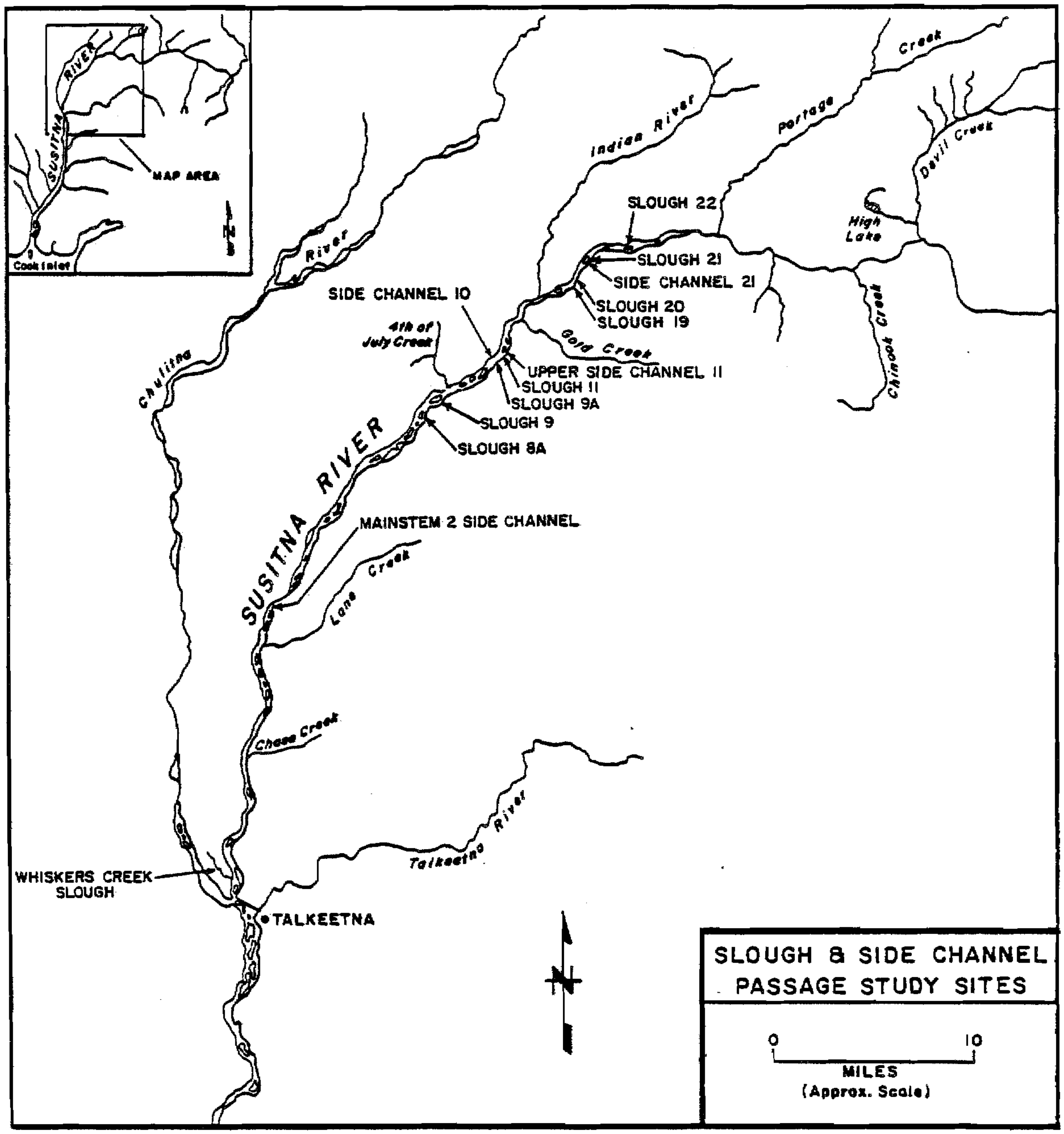

Figure 1. Geographic location of passage study sites in slough and side channel habitats of the middle Susitna River, Alaska, 1984.

discharges and local flows within these habitats. This information will provide more reliable local flow data for evaluating passage conditions for the local flow analyses.

1.2 Objectives

To address the deficient areas in the previous salmon passage analyses, the PVS was initiated during the 1984 open water field season to pursue the following field objectives:

1) Collect physical (hydraulic and substrate) and biological (salmon passage) data at various slough and side channel habitats in the middle Susitna River to determine if the previously established salmon passage criteria curves (Sautner et al. 1984) are valid or required revisions; and,

2) Collect additional cross section and local flow data to expand and refine the local flow analysis presented in Sautner et al. (1984).

Preliminary results of the 1984 PVS were initially presented in a November 30, 1984 draft technical memorandum (ADF&G 1984). Based on these results, the following objectives were addressed in this addendum to supplement the salmon passage analyses presented in Sautner et al. (1984):

1) Refine the 1983 passage criteria curves (Sautner et al. 1984) which were developed from data collected during 1982 and 1983 and professional judgement;

2) Revise previously established mainstem discharge and local flow requirements for successful and unsuccessful chum salmon passage based on revisions to the 1983 passage criteria curves;

3) Evaluate all new passage reaches established during the 1984 PVS to determine mainstem discharges and local flows required for successful and unsuccessful passage conditions;

4) Refine and expand the local flow analysis using additional cross section and local flow data collected during the 1984 PVS; and,

5) Evaluate the presently available hydrologic data bases of the middle Susitna River to evaluate the relationship between mainstem discharges and local flows at selected slough and side channel habitats.

2.0 METHODS

2.1 Site Selection

Salmon passage conditions were evaluated at 13 slough and side channel sites in the middle reach of the Susitna River (Table 1). With the exception of Side Channel 10, these sites represent the major slough and side channel spawning locations for chum salmon in the Susitna River drainage upstream of Talkeetna. Sloughs 8A, 9, 9A, 11 and 21 are primary spawning areas for chum salmon while the remaining sites support lesser concentrations of spawning chum salmon. Although Side Channel 10 has not been utilized by spawning chum salmon in the past, it was selected for study because of its potential as a mitigation evaluation site. Discharge related passage problems have been previously identified at all the study sites (Sautner et al. 1984) with the exception of Slough 19. Slough 19 was included as a study site because spawning chum salmon had previously been observed at this site (Barrett et al. 1984) and no previous passage evaluations had been conducted.

2.2 Field Methods

2.2.1 Determination of Salmon Passage Criteria

Data from field observations of migrating chum salmon were collected within passage reaches at various slough and side channel habitats to establish minimum passage requirements (lengths and depths) necessary to provide successful and unsuccessful salmon passage conditions. Fish passage observations primarily focused on chum salmon due to their more restrictive passage requirements (Scott and Crossman 1973) and because they are the major salmon species presently utilizing slough and side channel habitats in the middle Susitna River (ADF&G 1983a: Appendix B).

Three conditions were defined to classify the relative degree of difficulty encountered by salmon: 1) successful passage, 2) successful passage with difficulty and exposure, and 3) unsuccessful passage. Fish passage observations were subjectively ranked into one of these three categories based on the characteristics outlined below.

<u>Successful Passage</u>: Fish passage into and/or within a spawning area is uninhibited. Characteristics of this category are:

1) exposure of the fish above water is negligible; and,

2) uninterrupted movement of the fish passing through a reach.

Successful passage conditions would not adversely affect natural production of salmon upstream of the area.

<u>Successful Passage With Difficulty and Exposure</u>: Fish passage into and/or within a spawning area is accomplished, but with stress and exposure to predation. Characteristics of this category are:

Table 1. Summary of passage study sites and corresponding river miles in the middle Susitna River.

Study Site	River Mile
Whiskers Creek Slough	101.2
Mainstem 2 Side Channel	114.4
Slough 8A	125.3
Slough 9	128.3
Slough 9A	133.2
Side Channel 10	133.8
Slough 11	135.3
Upper Side Channel 11	136.1
Slough 19	140.0
Slough 20	140.1
Side Channel 21	140.6
Slough 21	141.8
Slough 22	144.2

1) exposure of the dorsal surface of the fish above water;

2) one or more pauses by the fish (e.g., stranding, changing directions, or resting) within a passage reach due to shallow water conditions; or,

3) repeated attempts by the fish to navigate a passage reach before succeeding.

This condition of passage may potentially reduce the level of successful spawning in the area and, over a long period of time, may result in a decline in natural production upstream of the area.

Unsuccessful Passage: Fish passage into and/or within a spawning area may be accomplished by a limited number of fish which, because of excessive exposure, are more susceptible to increased stress and predation. Characteristics of this category are:

1) absence of fish above a passage reach;

2) exposure of the dorsal surface of the fish above water including partial exposure of eyes, gills, lateral line or caudal fin;

3) one or more pauses by the fish within a passage reach resulting in unsuccessful navigation; or,

4) death of the fish while attempting navigation of a passage reach.

Unsuccessful passage conditions may eventually eliminate or greatly reduce the natural production upstream of the area.

These field passage data were later used to develop the salmon passage criteria as described in Section 2.3.1.

2.2.2 Identification of Passage Reaches

Locations where potential salmon passage problems exist due to restrictions imposed by the physical habitat (i.e, water depth) are referred to as passage reaches. A passage reach is defined as a portion of the channel, at the mouth of or within a study site, which is potentially limiting to salmon migration into spawning areas.

Passage reaches were initially identified in the field by locating areas where water depth was potentially limiting passage of adult chum salmon. At each identified passage reach, a transect was established perpendicular to the flow of water to represent the depth characteristics of the passage reach and provide a consistent point of measurement. Representative transects were established at the shallowest or most critical point of the passage reach and marked with wood stakes and rebar headpins. The physical habitat characteristics of individual passage reaches were defined by measuring lengths, widths, and water depths using the established transect as a reference point. The criteria used to establish passage reach lengths, widths, and depths are presented below.

Passage Reach Length: The longitudinal distance of a passage reach along the thalweg channel defined by the upstream and downstream points at which water depth is no longer limiting to salmon passage. The length limits were defined at thalweg water depths of 0.50 feet and 0.67 feet which correspond to threshold passage depths presented in passage Criteria Curves I and II, respectively (Sautner et al. 1984).[1]

Passage Reach Width: The distance from left water's edge (LWE) to right water's edge (RWE) of a passage reach transect.

Passage Reach Depth: The depth of water within a passage reach which a fish must navigate through in order to proceed upstream. In the field, thalweg depth (maximum depth) was measured as an indicator of the water depth affecting passage. The point of thalweg depth at a passage reach transect was marked with a flagged spike or a staff gage for a consistent point of measurement. However, for analytical purposes it has been determined that the thalweg depth was not a representative variable of passage conditions. For this reason, passage depth, defined as an average of the mean depth and thalweg depth at a passage reach transect, was used for analytical purposes. As a result, thalweg depth measurements were converted to passage depths during the data analysis using cross section survey data (see Section 2.3.1) and were used in all subsequent passage analyses.

Passage reach lengths and widths were measured with a fiberglass surveyor's tape. A standard surveying rod or staff gage was used to measure the thalweg depth at each transect. Passage reach length, width, and depth measurements were collected at the same time observations of fish passage were made.

2.2.3 Physical Habitat Variables Used to Evaluate Passage Reach Conditions

Selected physical habitat data were collected to aid in evaluating the effects of mainstem discharge and local flow on passage reach conditions at slough and side channel study sites. Habitat data collected included survey data for development of thalweg and cross section profiles, substrate and channel morphology data, and stage and flow measurements. Detailed procedures used in the collection of these data are presented in ADF&G (1983b), Quane et al. (1984), and Sautner et al. (1984).

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[1] Criteria Curve II was eliminated following an analysis of the data and all passage reach lengths previously defined in the field by the 0.67 foot depth were redefined from thalweg profiles using the 0.5 foot depth (see Section 2.3.1).

Thalweg surveys had been completed during the 1982 and 1983 field seasons at all passage study sites except Slough 19. Therefore, survey data for the development of a thalweg profile were collected at Slough 19 to complete the set of thalweg profiles for all study sites. The Slough 19 thalweg data were surveyed to a temporary bench mark (TBM) and included additional data points at passage reaches to better define these areas.

Cross section profile data had been sporadically collected at passage reaches during the 1981, 1982 and 1983 field seasons. A primary objective of the 1984 PVS was to obtain cross section profiles at as many study sites as possible. Cross sections were surveyed at passage reach transects which were typically located at the shallowest or most critical point of the passage reach. These data were collected to provide an accurate representation of the channel morphology present at each passage reach. Included in the cross section surveys were measurements of the streambed and water surface elevations at the upstream and downstream limits of a passage reach.

Substrate conditions at each passage reach were evaluated to characterize the influence of substrate and channel configuration on salmon passage conditions. Substrate data were collected by visually classifying the substrate present in the passage reach into the two dominant size groups based on the substrate size classification system presented in Table 2.

The channel configuration of each passage reach was also subjectively ranked as either a uniform or a non-uniform channel. A uniform passage reach was characterized by a relatively straight, unbraided channel that concentrated the flow of water through one main channel. In contrast, a non-uniform passage reach was characterized by a braided, irregular channel that dispersed the flow of water over a wide area.

Stage and flow data were collected during the 1982 and 1983 open water field seasons. Additional stage and flow data were collected at selected study sites during the 1984 field season to complement these data. Staff gages were utilized to obtain stage data at passage reaches where backwater and/or breaching effects were not completely identified. All mainstem discharge values related to these staff gages were referenced from the USGS gaging station at Gold Creek [USGS 1984 (gage #15292000, RM 136.7)] unless otherwise indicated. Local flow measurements were collected within slough and side channel sites using either a Marsh-McBirney electrical current meter or a Scientific Instruments Pygmy flow meter following techniques described in ADF&G (1983b).

Table 2. Substrate size classification system used for the 1984 Passage Validation Studies.

Substrate Type	Symbol	Size Class
SILT	SI	very fines
SAND	SA	fines
SMALL GRAVEL	SG	1/4-1"
LARGE GRAVEL	LG	1-3"
RUBBLE	RU	3-5"
COBBLE	CO	5-10"
BOULDER	BO	10"

2.3 Analytical Methods

2.3.1 Salmon Passage Criteria

The analytical approach for evaluating the physical conditions affecting salmon passage in sloughs and side channels involved two steps. The first step involved the development of plots of passage criteria data (passage depth versus passage reach length) to describe successful and unsuccessful passage conditions. Plots were constructed for uniform passage reaches, non-uniform passage reaches, and all passage reaches combined. The second step involved a comparison of these passage criteria plots to the previously developed passage criteria curves presented in Sautner et al. (1984) to determine if revisions to the previous passage criteria were required to more accurately represent natural passage conditions.

Prior to development of the passage criteria plots, the thalweg depth data required adjustments in order to be comparable to the 1982-1983 passage criteria. Thalweg depth measurements collected in the field were converted to passage depth, which is considered to be a more accurate indicator of the water depth affecting salmon passage. Passage depth is defined as an average of the mean depth and the thalweg depth of a passage reach transect.

A relationship between thalweg and passage depth was developed using linear regression techniques. The surveyed cross section data were used to evaluate the mean depth corresponding to a specific thalweg depth. The mean and thalweg depths were averaged to obtain the passage depth. Thalweg depths were selected to range from 0.1 to 1.0 feet to represent a typical range of conditions at passage reaches. Passage reaches within Sloughs 8A, 9, 9A, 11 and 21, Upper Side Channel 11 and Slough 21 were used in the analysis. Cross sections where multiple channels existed (e.g. braided channels) were excluded due to their non-uniformity resulting in varying water surface elevations within the cross section.

The following equation was derived, based on the above data, to estimate passage depths (d_p) from thalweg depths (d_t). The relationship has a correlation coefficient (r) equal to .995.

$$d_p = 0.75\, d_t^{\,1.02} \quad \text{where } d_p = \text{Passage Depth and}$$
$$d_t = \text{Thalweg Depth}$$

An adjustment was also required for a portion of the passage length data collected in the field. Initially, passage reach lengths were measured based on thalweg water depth limits of 0.50 feet and 0.67 feet, which correspond to threshold passage depths presented in Criteria Curves I and II, respectively (Sautner et al. 1984). However, during the 1984 field season it became apparent that passage reach length measurements using the Criteria Curve II thalweg water depth limit of 0.67 feet included areas which did not present passage problems to migrating salmon. Field observations during 1984 indicated that a thalweg water depth of 0.50 feet was a more appropriate upper limit. Subsequent analysis of the data also supported the elimination of 0.67 feet as a thalweg water depth limit in the passage analysis. Therefore, those lengths measured using a thalweg water depth limit of 0.67 feet were adjusted to represent lengths established by using a thalweg water depth of 0.50 feet. This was accomplished by drawing a scaled diagram of each affected passage reach including appropriate streambed and water surface elevations based on thalweg and cross section survey data. A new passage reach length was then measured directly from each diagram using an upstream and downstream thalweg water depth limit of 0.50 feet.

Following the appropriate adjustments to passage length and depth values, all data points were plotted by categories of fish passage (successful, successful with difficulty and exposure and unsuccessful). Three plots of the passage data were developed depicting 1) data collected at uniform passage reaches, 2) data collected at non-uniform passage reaches, and 3) all data combined.

The original criteria curves were then superimposed on these passage criteria plots to evaluate the accuracy of these previously established curves by comparing the distribution of the passage data in relation to the criteria curves. Based on the results of these comparisons, appropriate revisions were made to the passage criteria to better represent the relationship between passage reach length and passage depth.

2.3.2 Passage Reach Evaluations

This study utilizes the same basic analytical approach for evaluating passage conditions in the middle Susitna River as was presented in Sautner et al. (1984). This conceptual approach is based on a procedure involving three steps.

1) Definition of the salmon passage criteria (water depth and reach length) required for successful and unsuccessful salmon passage (The analytical methods utilized to complete this step are presented in section 2.3.1.).

2) Identification of all the passage reaches within the selected study sites which do not provide successful passage conditions for migrating salmon under all flow conditions based upon the passage criteria established in step one.

3) Evaluation of each passage reach in terms of its hydraulic characteristics, and determination of mainstem discharges and/or local flows required to provide successful passage conditions as defined in step one.

The final step consists of three hydraulic analyses: a breaching analysis, a backwater analysis, and a local flow analysis. The first two of these analyses evaluate the independent effects of mainstem breaching and backwater on passage conditions at passage reaches. The third analysis evaluates the independent effects of local flow on passage conditions at selected passage reaches only. The relative influence of mainstem discharge on local flow was also evaluated.

In each of the three analyses, length and depth of passage reaches were used as the primary criteria to evaluate salmon passage conditions. The discharge and/or flow requirements resulting from each analysis are defined for conditions that fulfill threshold passage conditions for successful and unsuccessful passage. By defining these upper and lower boundaries, the middle condition of "successful with difficulty and exposure" is also defined.

A flow duration curve [presented in Sautner et al. (1984)] was developed for the period from August 20 to September 20 based on mainstem discharge data collected at Gold Creek over a 35 year period (USGS gage #15292000). This curve was used to evaluate the percentage of time that the discharge requirements for passage reaches are equalled or exceeded. The mainstem discharge data collected at Gold Creek were also used to evaluate the number of years that the discharge requirements for passage reaches were equalled or exceeded for at least one day during the study period.

2.3.2.1 Verification of Passage Reaches

Passage reaches were initially identified in this study from field observations made during the 1984 open water season (see Section 2.2.2) using salmon passage criteria previously established in Sautner et al. (1984). As a result, it was necessary to reevaluate the passage reaches initially identified in the field based on the revised 1984 passage criteria thresholds to determine if they still qualified as passage reaches under the new passage criteria. The verification process consisted of comparing the range of physical conditions observed at each passage reach with the revised passage criteria thresholds. Passage reaches which fell below the successful passage threshold for at least one set of flow conditions were verified as passage reaches for further analysis. Passage reaches which consistently fell above the successful passage threshold for the observed range of physical conditions were eliminated from further consideration since this was an indication that passage problems did not exist at these sites.

All passage reaches thus identified and verified were sequentially numbered in ascending order beginning at the downstream end of each site. The upstream limit of the identification procedure was defined as the first passage reach beyond the upstream limit of utilization by spawning salmon.

2.3.2.2 Breaching Analysis

The breaching analysis in this study follows the same methods that were presented in Sautner et al. (1984). Since breaching affects all passage reaches within a site, the breaching analysis for each site is applicable to the entire study site. Initial breaching and controlling discharge values have been previously determined for each slough and side channel study site with the exception of Slough 9A (Quane et al. 1984; Sautner et al. 1984). Estimates of the initial breaching and controlling discharge values for Slough 9A were determined from stage data, aerial photos and field observations. Passage reach conditions are considered to be successful under controlling discharge conditions.

2.3.2.3 Backwater Analysis

The backwater analysis utilized in this study is conceptually similar to the analysis presented in Sautner et al. (1984) with the exception that specific steps involved in the analysis were modified to fit the revised passage criteria. This analysis evaluates the influence that mainstem backwater has on passage conditions at passage reaches located in or near the mouth area of each study site prior to breaching. As in the 1984 analysis, local flow was considered to be an insignificant factor affecting backwater relative to the effects of mainstem discharge and was therefore not considered in the analysis.

Passage conditions are affected by backwater when the water surface elevation of the mainstem influenced backwater submerges the highest point of elevation within a passage reach. For successful conditions the backwater must submerge the passage reach by the appropriate water depth which corresponds to the revised passage criteria for a reach length of zero feet. Thus, the first part of the backwater analysis involved computing the appropriate water surface elevations required to provide successful and unsuccessful passage conditions at each passage reach affected prior to breaching. Mainstem discharges corresponding to these water surface elevations were calculated from rating curve equations representing the hydraulic relationships in the mouth areas of each study site. These mainstem discharge values represent the minimum discharges required to meet the threshold conditions for successful and unsuccessful passage.

2.3.2.4 Local Flow Analysis

The primary objective of the local flow analysis was to estimate the amount and frequency of occurrence of the local flow which is required to provide successful or unsuccessful salmon passage conditions at a passage reach. The specific analysis followed is outlined below and is depicted schematically in Figure 2. Results of the analysis are approximate; many assumptions were made for the analysis, each of which can potentially introduce error to the estimates.

1. Obtain a surveyed cross section and water surface elevation that are representative of the most difficult passage condition within a passage reach.

2. Determine the energy gradient at each passage reach which is assumed equal to the steeper of the water surface slopes upstream and downstream of the cross section.

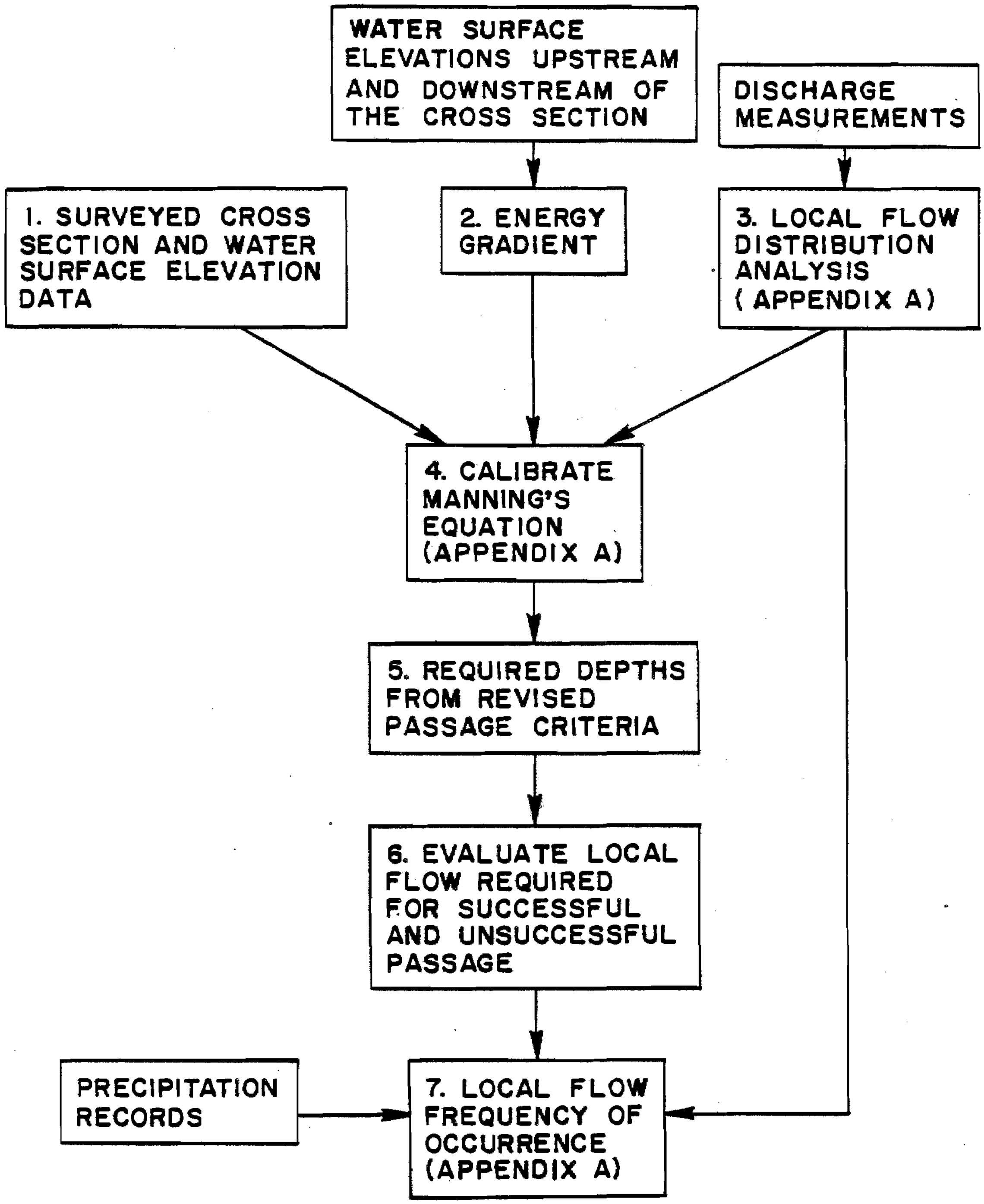

Figure 2. Schematic diagram of steps followed in the local flow analysis at a passage reach.

3. Determine the local flow corresponding to the surveyed water surface elevation at each passage reach.

4. Given passage reach substrate size and channel uniformity, calibrate Manning's equation to the surveyed water surface elevation and to the corresponding local flow by selecting a Manning's roughness coefficient from a range of acceptable values.

5. Select the required passage depths from the given reach length and the revised passage criteria for successful and unsuccessful passage.

6. Determine the local flows corresponding to the required passage depths for successful and unsuccessful passage using the calibrated Manning's Equation.

7. Estimate the frequencies of occurrence of these local flows which correspond to successful and unsuccessful passage conditions.

Cross section and water surface elevation survey data were collected following methods presented in Section 2.2.3. For assumed uniform flow conditions at passage reaches, the water surface slope is equal to the energy gradient. The energy gradient was generally taken to be the steeper of the upstream and downstream water surface slopes. In cases where the slope was not measured in the field, the water surface slope was obtained from thalweg profile data.

To provide estimates of the local flow corresponding to the surveyed water surface elevation at a passage reach, local flow measurements were collected at selected study sites as described in Section 2.2.3. At some passage reaches, flow was measured concurrently with the water surface elevation measurements. At passage reaches lacking corresponding flow measurements, a local flow distribution analysis was conducted to relate known flows at other passage reaches and discharge gages to the flow at these passage reaches. A detailed description of this analysis is provided in Appendix A.

Manning's Equation was used to establish a relation between required passage depths and local flows at the passage reaches. The equation was calibrated for each passage reach where measured water surface elevation data were available. At sites where water surface elevations were not obtained, the equation was calibrated by comparison with equations from nearby and similar passage reaches. At nearly 40 percent of the passage reaches, Manning's Equation could not be calibrated by using reasonable roughness coefficient values; at these sections, a concept of excluded flow was introduced to account for the difference between the measured and calculated flows. Excluded flow is an assumed constant flow volume which flows between and through the rocks in areas of the cross section that are inadequately surveyed using normal techniques. The analytical procedures and assumptions for calibration of Manning's Equation are described in Appendix A.

The estimated local flows required for successful and unsuccessful passage were analyzed to evaluate their frequencies of occurrence. Groundwater infiltration and precipitation runoff were assumed to be the sources for local flow in the sloughs and side channels. Breaching and backwater effects were not considered. Appendix A presents the detailed methods used to evaluate the frequency of occurrence of the local flow at a passage reach.

3.0 RESULTS

3.1 Salmon Passage Criteria

Physical habitat data were collected during the 1984 open water field season to describe the physical conditions affecting passage of adult chum salmon into and within spawning habitats of the middle reach of the Susitna River. These data were collected at passage reaches within all study sites, with the exception of Side Channel 10. A summary of the data collected during 145 observations of chum salmon passage is presented in Table 3. Each row of data represents a single set of passage observations collected at a specific passage reach. Included in each data set is the number of observations recorded for each category of passage corresponding to the given set of physical parameters collected at the passage reach on the same day. For example, in the second row, six observations of unsuccessful passage were recorded at a passage reach which had a thalweg depth of 0.18 feet, a passage depth of 0.13 feet, a passage reach length of 62 feet, and a uniform channel with large gravel/small gravel substrate. Some data sets include observations under two categories of passage, indicating that for the given set of physical conditions some chum salmon were more successful negotiating the passage reach than others.

The data summarized in Table 3 are plotted on the criteria curves presented in Sautner et al. (1984) in Figures 3 and 4. Figure 3 corresponds to Criteria Curve I and shows data collected at passage reaches characterized by a uniform, unobstructed channel. Figure 4 corresponds to Criteria Curve II and shows data collected at passage reaches with a non-uniform, obstructed channel. The entire set of data collected at both types of passage reaches are plotted on Criteria Curve I in Figure 5.

The best visual fit of the data to the previous curves appeared to be for the plot of Criteria Curve I and the combined passage data. However, it was determined that additional revisions of Criteria Curve I were necessary to better represent the passage data. Specific field data were not available to support the sharp downward inflections in the 0-20 foot range of the original curve and field observations of chum salmon passage during 1984 did not support the original curve in this range. Therefore, the passage criteria for both successful and unsuccessful passage were revised based on a visual best fit of two straight lines to the plotted data points (Figure 6). These lines, referred to as "threshold limits," represent the threshold criteria for successful and unsuccessful passage of chum salmon in the middle Susitna River. The area between these lines represents the condition under which successful passage occurred with difficulty and exposure.

A comparison of the new passage threshold limits to the original Criteria Curve I is presented in Figure 7. The distribution breakdown of passage data within each passage category in relation to the revised passage criteria is presented in Figure 8.

Table 3. A summary of chum salmon passage data collected at passage reaches within slough and side channel study sites in the middle Susitna River during the 1984 open water season.

Thalweg Depth (Feet)	Passage[a] Depth (Feet)	Passage Reach Length (Feet)	Number of Observations for each Category of Salmon Passage: Successful Passage	Difficult Passage	Unsuccessful Passage	Channel Con- figuration	Substrate[b] Type
0.12	0.09	103			1	Uniform	SA/LG
0.18	0.13	62			6	Uniform	LG/SG
0.18	0.13	113			1	Non-uniform	RU/CO
0.19	0.14	62			1	Uniform	LG/SG
0.19	0.14	253			1	Non-uniform	LG/SG
0.20	0.15	38			1	Non-uniform	RU/LG
0.20	0.15	109			6	Non-uniform	RU/LG
0.22	0.16	88			1	Non-uniform	LG/RU
0.22	0.16	281			1	Non-uniform	CO/RU
0.25	0.18	263			1	Non-uniform	LG/RU
0.26	0.19	121			1	Non-uniform	BO/SI
0.26	0.19	121			1	Non-uniform	LG/SG
0.28	0.20	54		8	1	Non-uniform	LG/SG
0.29	0.21	59			1	Non-uniform	LG/SG
0.29	0.21	73			1	Non-uniform	BO/SI
0.29	0.21	95		1	1	Non-uniform	LG/SG
0.30	0.22	80		3	9	Uniform	LG/RU
0.30	0.22	85		2	2	Uniform	LG/RU
0.30	0.22	165			1	Non-uniform	SI/SA
0.31	0.23	148			4	Non-uniform	LG/RU
0.32	0.23	79		5	1	Uniform	LG/RU
0.32	0.23	526			1	Non-uniform	CO/RU
0.33	0.24	421			1	Uniform	LG/SA
0.34	0.25	38	1			Uniform	SA/LG
0.35	0.26	75		6	4	Non-uniform	CO/LG
0.36	0.26	35	1			Uniform	SA/SI
0.36	0.26	40		2		Uniform	LG/RU
0.37	0.27	58		1		Non-uniform	RU/LG
0.38	0.28	27		3		Uniform	LG/RU
0.38	0.28	156			1	Non-uniform	RU/CO
0.39	0.29	25			1	Non-uniform	RU/CO
0.39	0.29	75		2		Non-uniform	RU/LG
0.41	0.30	23		3	1	Non-uniform	RU/CO
0.41	0.30	65	1	2		Non-uniform	RU/LG
0.42	0.31	25			1	Non-uniform	RU/CO
0.44	0.32	38		1		Uniform	LG/RU
0.44	0.32	45		5	10	Non-uniform	SI/SA
0.45	0.33	35	1	3		Uniform	LG/RU
0.48	0.35	7	2			Uniform	RU/LG
0.50	0.37	19	2			Uniform	LG/SG
0.53	0.39	137		2		Non-uniform	CO/RU
0.54	0.40	33	5	1		Non-uniform	LG/SG
0.60	0.45	146		8		Non-uniform	CO/LG
0.62	0.46	0[c]	1			Non-uniform	RU/CO
0.68	0.51	0[c]	2			Non-uniform	CO/RU
0.69	0.51	0[c]	1			Non-uniform	LG/SG
0.70	0.52	0[c]	1			Non-uniform	CO/RU
0.74	0.55	0[c]	3			Non-uniform	LG/SG
0.76	0.57	0[c]	1			Non-uniform	CO/RU
0.81	0.60	0[c]	2			Non-uniform	LG/CO
		Totals	24	58	63		

a Passage depth values were calculated using the equation, $d_p=0.75d_t^{1.02}$, where d_p = passage depth, and d_t = thalweg depth.

b Abbreviations of substrate type defined in Methods Section (see Table 2).

c Passage reach length was not measured for this set of observations because water depth was clearly adequate for successful passage conditions.

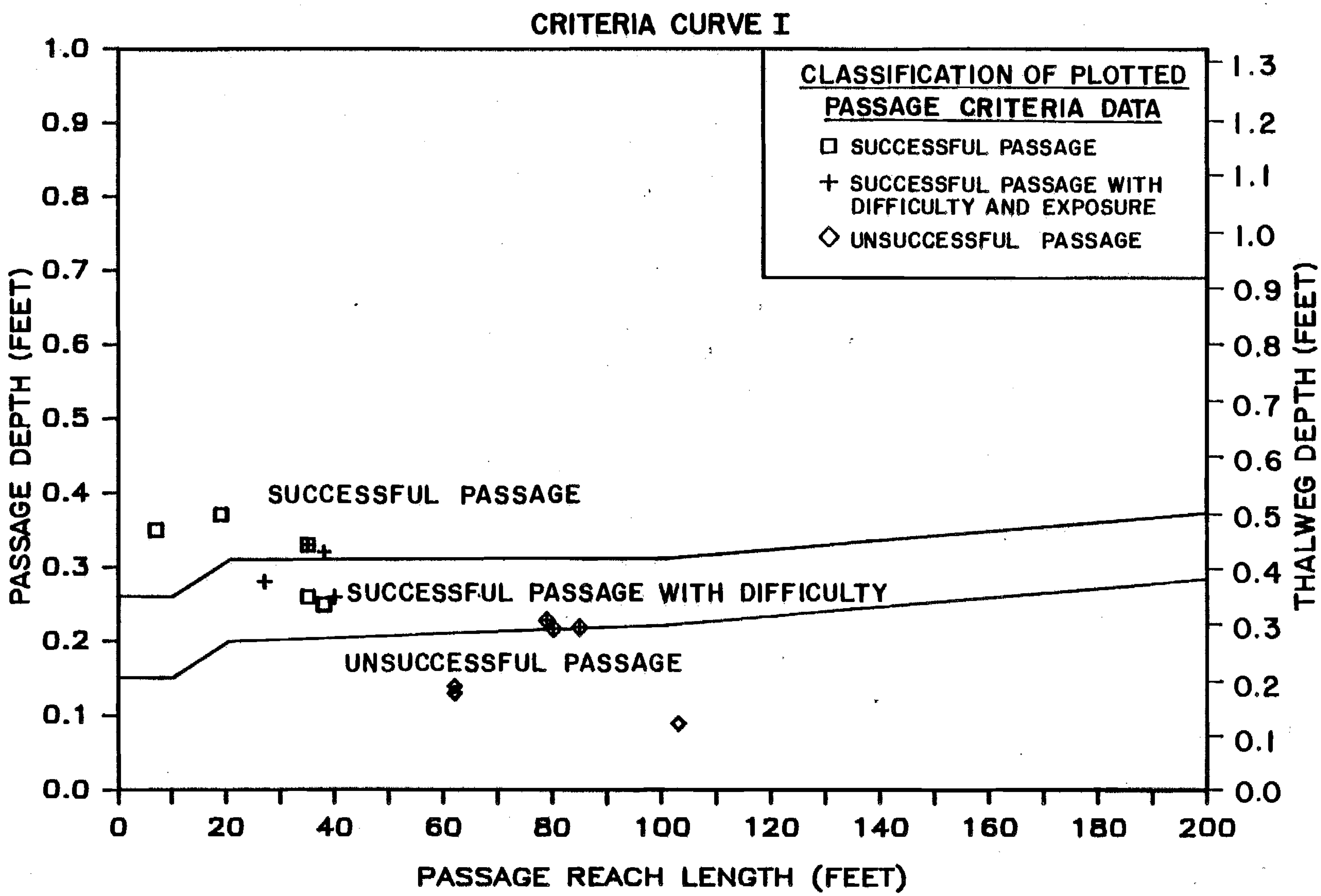

Figure 3. Chum salmon passage criteria collected at uniform passage reaches at selected slough and side channel sites plotted with Criteria Curve I.

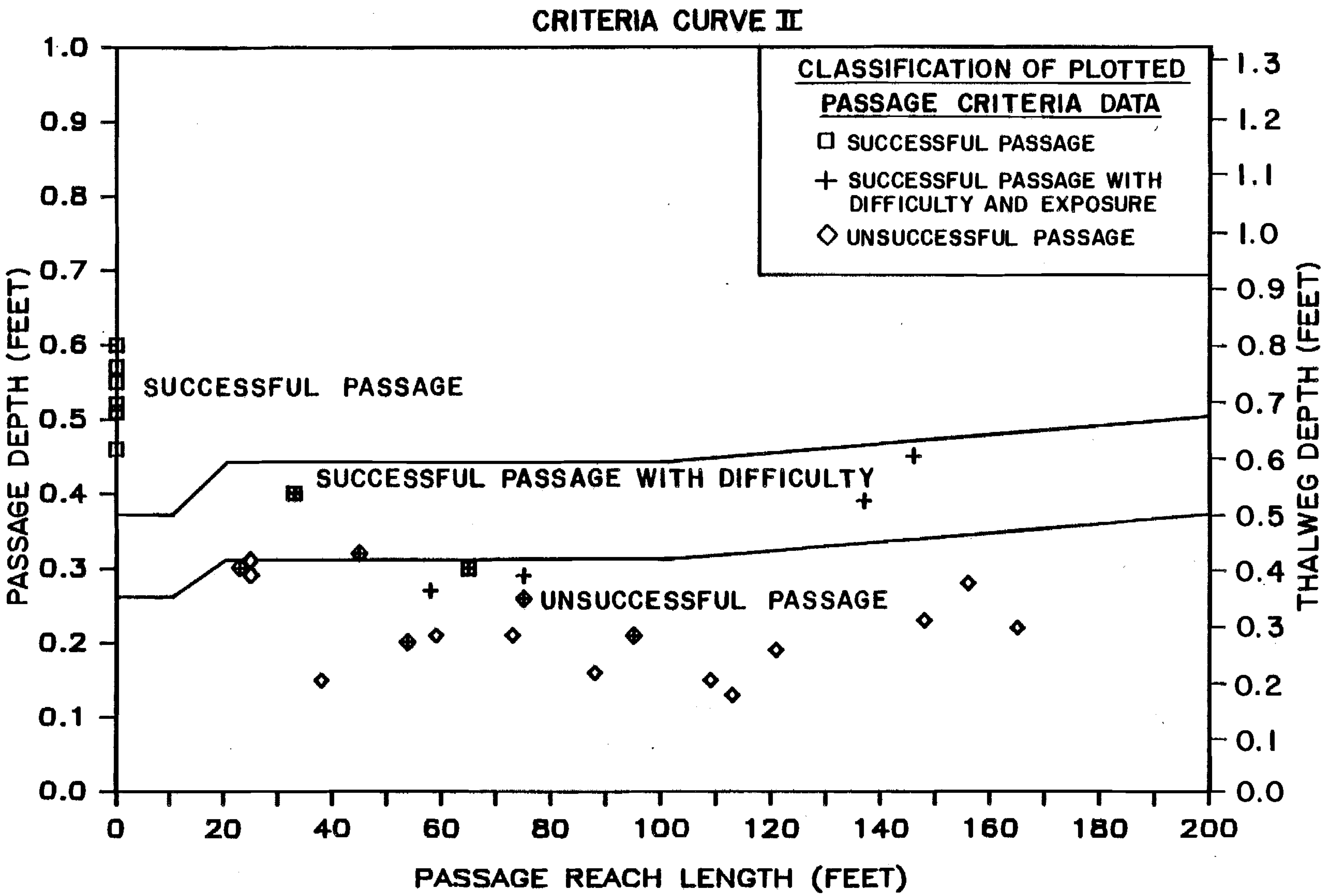

Figure 4. Chum salmon passage criteria collected at non-uniform passage reaches at selected slough and side channel sites plotted with Criteria Curve II.

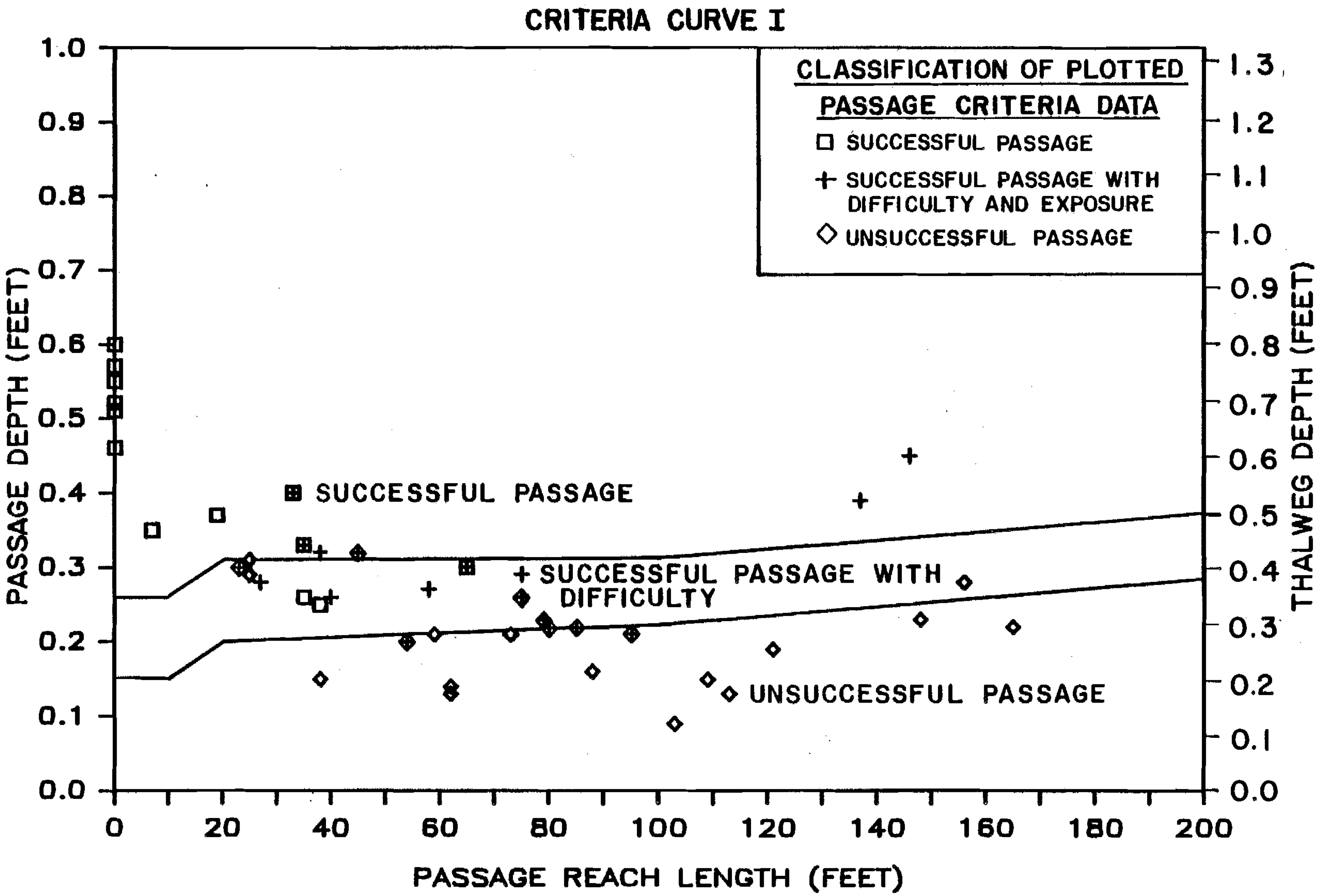

Figure 5. Chum salmon passage criteria collected at all passage reaches within selected slough and side channel sites plotted with Criteria Curve I.

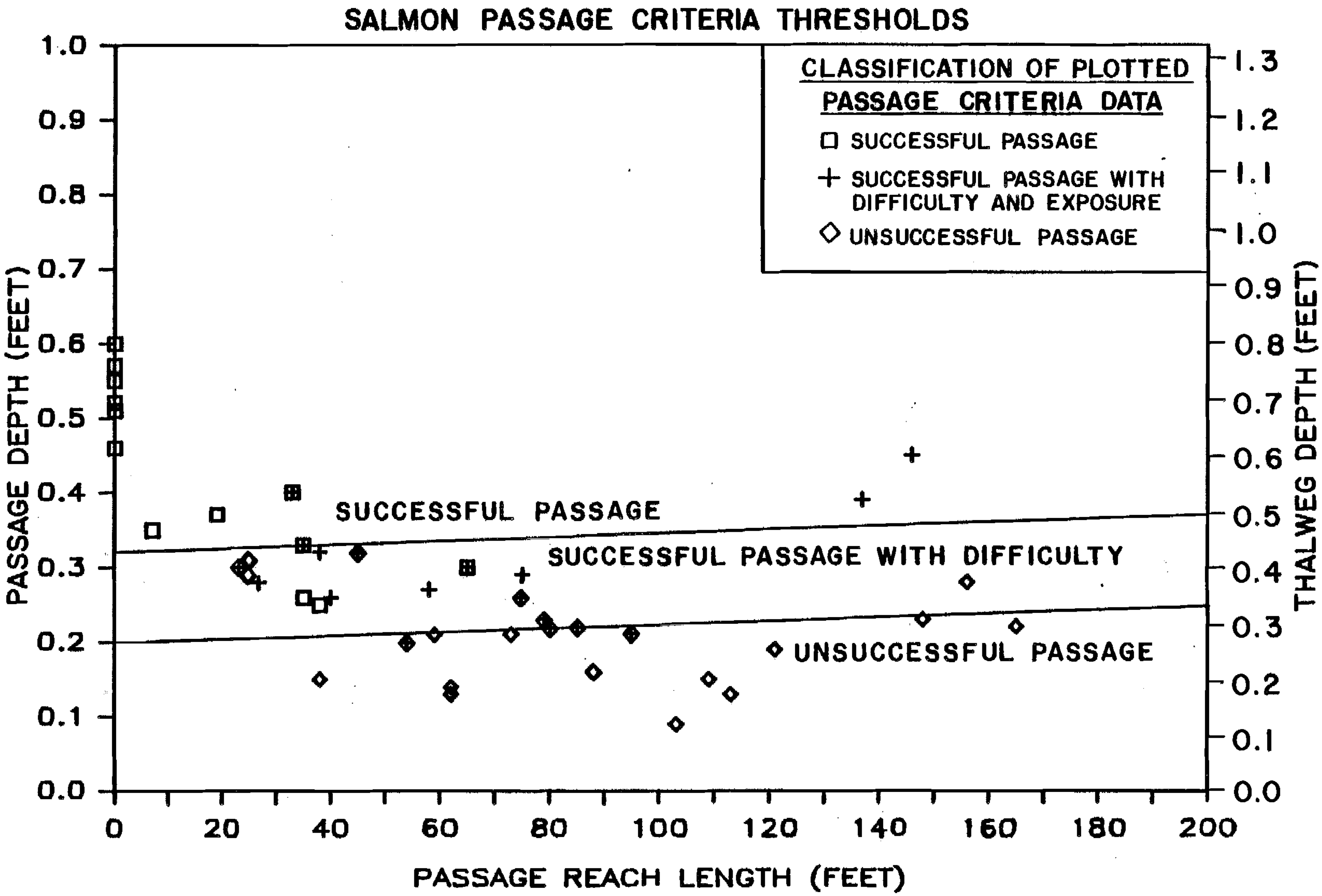

Figure 6. Revised passage criteria thresholds for successful and unsuccessful passage conditions of chum salmon within slough and side channels in the middle Susitna River.

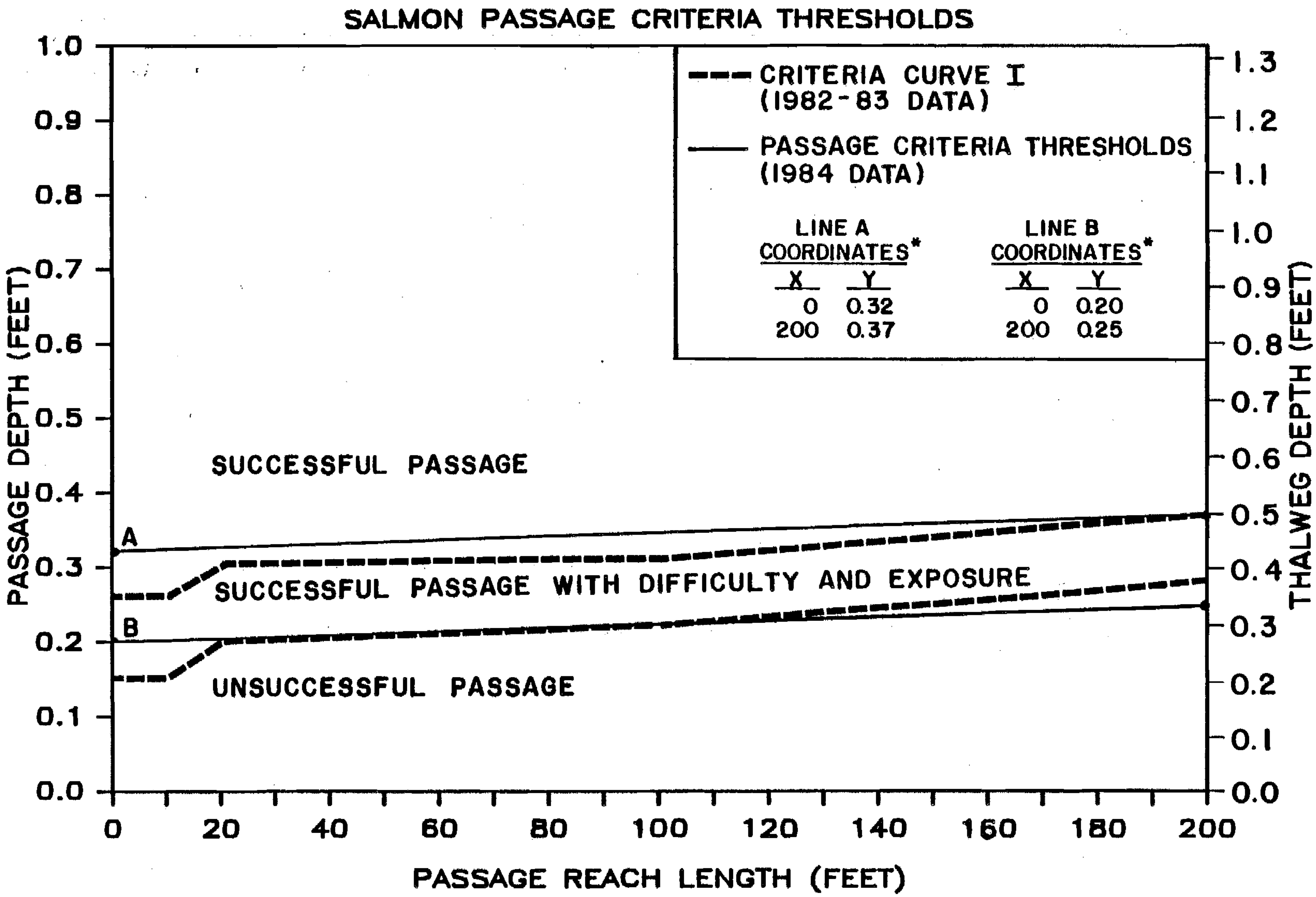

Figure 7. Comparison of revised passage criteria thresholds for successful and unsuccessful passage of chum salmon with Criteria Curve I. (*Line A and Line B coordinates represent passage depth values; the thalweg depth scale is presented for comparison purposes only.)

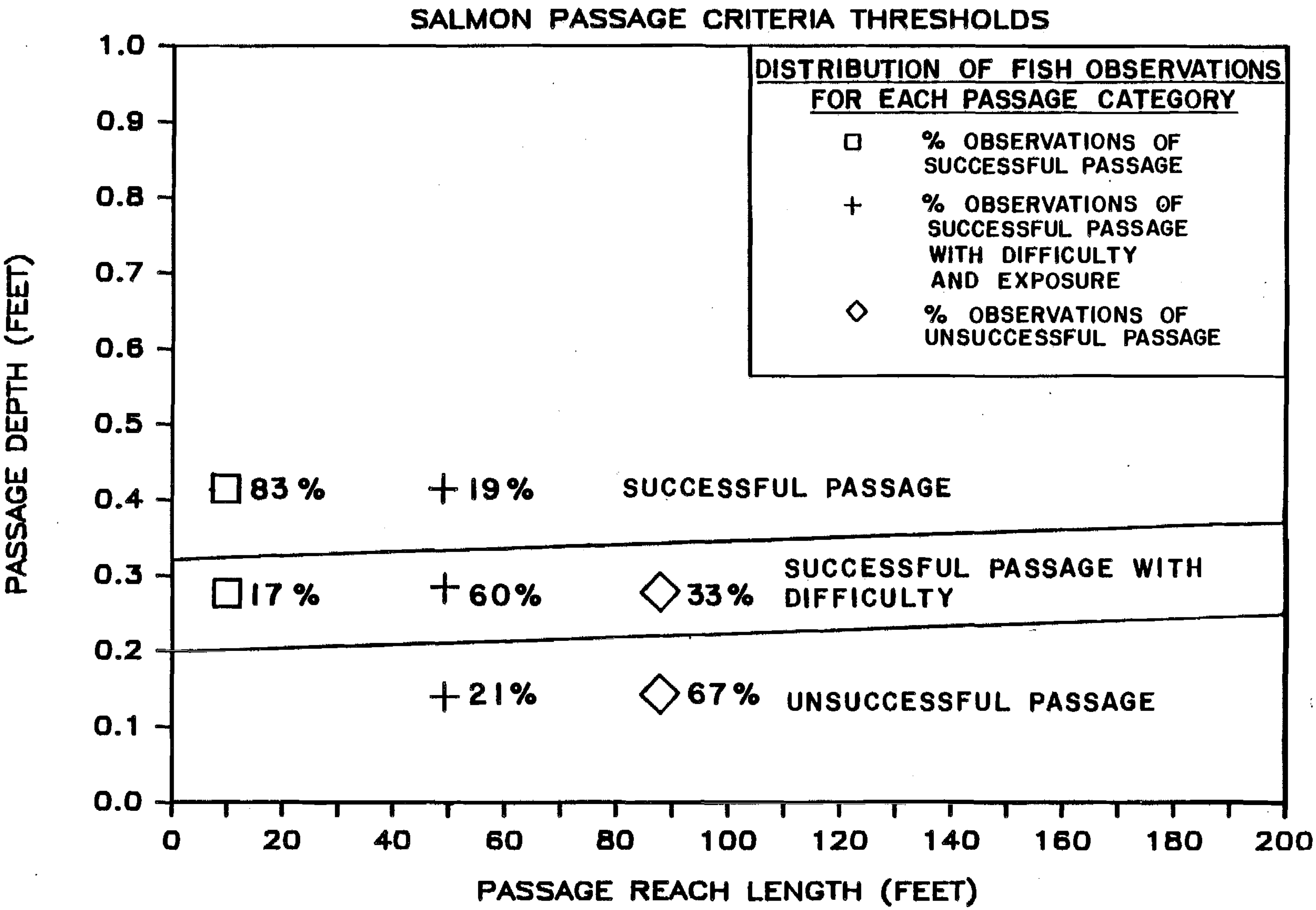

Figure 8. Percent distribution of chum salmon passage data for each category of passage in relation to the revised passage criteria thresholds.

3.2 Passage Reach Evaluations

A total of 85 passage reaches were identified within selected middle river slough and side channel study sites during the 1984 open water season (Table 4). Selected physical characteristics used to evaluate passage conditions at each of these passage reaches and cross references of these passage reaches to those previously identified in Sautner et al. (1984) are also included in Table 4.

Locations of identified passage reaches are presented on passage reach distribution maps and thalweg profiles of each study site in Appendices B and C, respectively. Summaries of additional hydraulic data collected during the 1984 open water season are presented in Appendix D (Cross Sectional Data) and Appendix E (Stage and Discharge Data).

3.2.1 Breaching and Backwater Analysis

Initial breaching and controlling mainstem discharges affecting passage reaches within study sites are summarized in Table 5. Mainstem discharges required to provide successful and unsuccessful salmon passage conditions from backwater effects at study sites are presented in Table 6. Percent exceedence values for controlling mainstem discharges and mainstem discharges required for successful passage conditions are included in Tables 5 and 6, respectively. Percent exceedence values were derived from a 35 year discharge record at Gold Creek (USGS gage #15292000) for the August 20 - September 20 salmon spawning period. The percent of total time values were taken from the flow duration curve, whereas, the percent of years frequency values indicate the relative number of years that the mean daily flow exceeded the indicated flow for at least one day during the period.

The exceedence frequency based on time reflects the average length of time in a period of record that the indicated flow is equalled or exceeded for the 32 days from August 20 to September 20 (including start and end dates). For example, at Passage Reach II in Slough 8A (Table 6), the exceedence frequency of 45 percent, which corresponds to a discharge of 16,000 cfs, would indicate that on the average, 14 days (45 percent of 32 days) would have daily discharges equal to or in excess of 16,000 cfs. The daily mainstem discharge exceedence curves for 10, 50 and 90 percent of the time are presented in Figure 9.

The exceedence frequency based on years reflects the number of years that the indicated flow is equalled or exceeded for at least one day during the study period. For the example above using 16,000 cfs, the exceedence frequency based on years is 94 percent. That is, 33 of 35 years had at least one day during the study period with a mean daily discharge equal to or greater than 16,000 cfs.

3.2.2 Local Flow Analysis

Estimates of local flow corresponding to successful and unsuccessful passage conditions at selected passage reaches within study sites are

Table 4. A summary of middle Susitna River passage reaches with selected physical characteristics which were identified during the 1984 open water season. A cross reference list to passage reaches defined in Sautner et al. (1984) is included.

Study Site (River Mile)	Passage Reach[a] 1984 Report	Passage Reach[a] 1985 Addendum	Mainstem Discharge (cfs)	Shallowest Depth (ft)[b] Thalweg	Shallowest Depth (ft)[b] Passage	Length[c] (ft)	Passage[d] Evaluation
Whiskers Creek	I	--	--	--	--	--	--
Slough (101.2)	II	I	7,380	0.25	0.18	35	Unsuccessful
	III	II	7,380	0.20	0.15	63	Unsuccessful
Mainstem 2	--	I	7,080	0.25	0.18	32	Unsuccessful
Side Channel	I	II	7,080	0.24	0.17	168	Unsuccessful
(114.4)	II	III	7,080	0.05	0.04	209	Unsuccessful
	IIIL	IVL	7,080	0.20	0.15	310	Unsuccessful
	IIIR	IVR	7,080	0.13	0.09	34	Unsuccessful
	IVR	VR	7,080	0.14	0.10	243	Unsuccessful
	VR	--	--	--	--	--	--
	VIR	VIR	7,080	0.21	0.15	84	Unsuccessful
	VIIR	VIIR	7,080	0.00	0.00	84	Unsuccessful
	VIIIR	VIIIR	7,080	0.12	0.09	318	Unsuccessful
Slough 8A	I	I	6,750	0.35	0.26	160	Successful/Difficult
(125.3)	II	II	6,780	0.18	0.13	229	Unsuccessful
	III	III	6,780	0.30	0.22	27	Successful/Difficult
	III	IV	6,780	0.15	0.11	116	Unsuccessful
	III	V	6,780	0.35	0.26	174	Successful/Difficult
	--	VIL	6,780	0.18	0.13	65	Unsuccessful
	IV	VIR	6,780	0.22	0.16	26	Unsuccessful
	V	VIIR	6,780	0.31	0.23	213	Unsuccessful
	VI	VIIIR	6,780	0.11	0.08	150	Unsuccessful
	VII	--	--	--	--	--	Unsuccessful
	VIII	IXR	6,780	0.13	0.09	136	Unsuccessful
	IX	XR	6,780	0.00	0.00	171	Unsuccessful
Slough 9	I	I	10,300	0.30	0.22	342	Unsuccessful
(128.3)	II	II	10,300	0.37	0.27	340	Successful/Difficult
	III	III	10,300	0.33	0.24	421	Unsuccessful
	IV	IV	10,300	0.36	0.26	35	Successful/Difficult
	V	V	10,300	0.44	0.32	219	Successful/Difficult

Table 4. (Continued).

Study Site (River Mile)	Passage Reach[a] 1984 Report	Passage Reach[a] 1985 Addendum	Mainstem Discharge (cfs)	Shallowest Depth (ft)[b] Thalweg	Shallowest Depth (ft)[b] Passage	Length[c] (ft)	Passage[d] Evaluation
				Physical Characteristics of Passage Reach			
Slough 9A (133.2)	--	I	6,600	0.19	0.14	74	Unsuccessful
	I	II	10,700	0.43	0.32	15	Successful/Difficult
	II	III	10,700	0.37	0.27	78	Successful/Difficult
	III	IV	10,700	0.38	0.28	27	Successful/Difficult
	III	V	10,700	0.35	0.26	54	Successful/Difficult
	IV	VI	10,700	0.33	0.24	54	Successful/Difficult
	V	VII	10,700	0.35	0.26	19	Successful/Difficult
	VI	VIII	10,700	0.32	0.23	223	Unsuccessful
	VII	--	--	--	--	--	--
	VIII	IX	10,700	0.38	0.28	22	Successful/Difficult
	IX	X	6,600	0.10	0.07	119	Unsuccessful
	X	XI	6,600	0.15	0.11	203	Unsuccessful
Side Channel 10 (133.8)	I	I	12,200	0.00	0.00	304	Unsuccessful
	II	II	12,200	0.00	0.00	365	Unsuccessful
	III	III	12,200	0.00	0.00	40	Unsuccessful
	IV	IV	12,200	0.00	0.00	35	Unsuccessful
	V	V	12,200	0.30	0.22	10	Successful/Difficult
	VI	VI	12,200	0.00	0.00	200	Unsuccessful
	VII	VII	12,200	0.00	0.00	263	Unsuccessful
Slough 11 (135.3)	I	I	9,890	0.29	0.21	189	Unsuccessful
	II	II	6,660	0.45	0.33	313	Successful/Difficult
	II	III	9,890	0.26	0.19	121	Unsuccessful
	III	IV	9,890	0.36	0.26	40	Successful/Difficult
	IV	V	9,890	0.30	0.22	85	Unsuccessful
	V	VI	9,890	0.39	0.29	75	Successful/Difficult
	V	VII	9,890	0.19	0.14	62	Unsuccessful
Upper Side Channel 11 (136.1)	I	--	--	--	--	--	--
	II	I	10,700	0.32	0.23	580	Unsuccessful
	III	II	10,700	0.00	0.00	880	Unsuccessful
Slough 19 (140.0)	--	I	5,400	0.17	0.12	47	Unsuccessful
	--	II	5,400	0.15	0.11	13	Unsuccessful
	--	III	5,400	0.33	0.24	18	Successful/Difficult
	--	IV	5,400	0.12	0.09	121	Unsuccessful
	--	V	5,400	0.13	0.09	44	Unsuccessful
	--	VI	5,400	0.30	0.22	63	Successful/Difficult
	--	VII	5,400	0.12	0.09	66	Unsuccessful
	--	VIII	5,400	0.00	0.00	126	Unsuccessful
	--	IX	5,400	0.00	0.00	108	Unsuccessful

Table 4. (Continued).

Study Site (River Mile)	Passage Reach[a] 1984 Report	Passage Reach[a] 1985 Addendum	Mainstem Discharge (cfs)	Shallowest Depth (ft)[b] Thalweg	Shallowest Depth (ft)[b] Passage	Length[c] (ft)	Passage[d] Evaluation
			Physical Characteristics of Passage Reach				
Slough 20 (140.1)	--	I	10,900	0.43	0.32	19	Successful/Difficult
	I	II	10,900	0.44	0.32	43	Successful/Difficult
	II	--	--	--	--	--	--
	III	III	10,900	0.30	0.22	20	Successful/Difficult
	IV	IV	10,900	0.42	0.31	43	Successful/Difficult
	V	V	10,900	0.36	0.26	31	Successful/Difficult
	VI	VI	5,400	0.00	0.00	383	Unsuccessful
Side Channel 21 (140.6)	I	I	5,600	0.33	0.24	55	Successful/Difficult
	II	II	5,600	0.32	0.23	29	Successful/Difficult
	III	--	--	--	--	--	--
	IV	III	5,600	0.36	0.26	63	Successful/Difficult
	V	IV	5,600	0.34	0.25	132	Successful/Difficult
	VI	V	10,600	0.41	0.30	62	Successful/Difficult
	VII	--	--	--	--	--	--
	VIII	VI	7,800	0.35	0.26	138	Successful/Difficult
	IX	--	--	--	--	--	--
	X	VII	7,800	0.25	0.18	800	Unsuccessful
	--	VIII	5,800	0.25	0.18	50	Unsuccessful
	--	IX	5,800	0.34	0.25	52	Successful/Difficult
Slough 21 (141.8)	I	I	10,900	0.30	0.22	256	Unsuccessful
	--	II	10,900	0.31	0.23	263	Unsuccessful
	IIL	IIIL	5,800	0.00	0.00	460	Unsuccessful
	IIR	IIIR	5,800	0.00	0.00	244	Unsuccessful
Slough 22 (144.3)	I	I	5,900	0.36	0.26	115	Successful/Difficult
	II	--	--	--	--	--	--
	III	II	5,900	0.32	0.23	76	Successful/Difficult
	IV	III	5,900	0.12	0.09	157	Unsuccessful

[a] Passage reaches located in left and right channels of site (facing upstream) are indicated as "L" and "R", respectively.

[b] Thalweg and passage depth values correspond to the shallowest measurements collected in the field at each passage reach.

[c] Length values correspond to the length of a passage at the specified shallowest depth as measured in the field.

[d] Evaluation of passage based on the revised passage criteria for the given set of passage reach conditions.

Table 5. A summary of initial breaching and controlling mainstem discharges affecting passage reaches within selected study sites in the middle Susitna River.

Study Site (River Mile)	Passage Reaches Affected	Breaching Analysis[a] Initial Breaching Discharge (cfs)	Controlling[b] Discharge (cfs)	Controlling Discharge Exceedence Frequency Percent Total Time[e]	Percent Total Years[f]
Whiskers Creek Slough (101.2)	I - II	22,000	23,000	16	69
Mainstem 2 Side Channel (114.4)	I - IVL	12,000	16,000	45	94
	IVR - VIIIR	23,000	25,000	10	57
Slough 8A (125.3)	I - VIL	27,000	27,000	7	46
	VIR - XR	33,000	33,000	2	11
Slough 9 (128.3)	I - V	16,000	19,000	29	77
Slough 9A (133.2)	I - XI	11,500	13,500[c]	60	97
Side Channel 10 (133.8)	I - VI	19,000	19,000	29	77
Slough 11 (135.3)	I - VII	42,000	42,000	1	9
Upper Side Channel 11 (136.1)	I - II	13,000	16,000	45	94
Slough 19 (140.0)	I - V	13,000[d]	13,000[d]	63	97
	VI - IX	Upland	Upland	--	--
Slough 20 (140.1)	I - VI	22,000	23,000	16	69
Side Channel 21 (140.6)	I - VII	9,200	12,000	71	97
	VIII - IX	18,000	24,000	13	66
Slough 21 (141.8)	I - IIIL	23,000	25,000	10	57
	IIIR	26,000	No Data	--	--
Slough 22 (144.3)	I - III	20,000	23,000	16	69

a Passage reach conditions are considered to be successful under controlling discharge conditions.

b Controlling mainstem discharge values where determined by the project hydraulic engineer using available hydraulic data.

c This mainstem discharge value is an estimate based on a mean increase of approximately 2,000 cfs over the initial breaching discharge.

d Corresponds to breaching of overflow channel #2 (Figure B-9) located at the mouth of Slough 19.

e Percentage of total time for a 35 year flow record that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

f Percentage of total years for a 35 year flow record that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

Table 6. Summary of mainstem discharges required to provide successful and unsuccessful salmon passage conditions from backwater effects at selected study sites in the middle Susitna River.

Study Site (River Mile)	Passage Reach[b]	Backwater Analysis[a] Unsuccessful Passage (cfs)	Successful Passage (cfs)	Successful Passage Exceedence Frequency Percent Total Time[c]	Percent Total Years[d]	Successful Passage WSEL (ft)	Staff Gage Used
Whiskers Creek Slough	I	e	e	--	--	365.54	101.2W1
(101.2)	II	e	e	--	--	366.00	--
Mainstem 2 Side Channel	I	8,600	9,200	87	97	474.12	114.4W6
(114.4)	II	11,800	12,500	67	97	474.89	114.4W6
	III	e	e	--	--	476.26	--
	IVL	e	e	--	--	476.33	--
	IVR	18,800	19,700	26	77	476.38	114.4S7
	VR	e	e	--	--	478.09	--
	VIR	e	e	--	--	477.82	--
	VIIR	e	e	--	--	478.97	--
	VIIIR	e	e	--	--	479.99	--
Slough 8A	I	7,200	7,700	94	97	561.04	125.3S1
(125.3)	II	14,600	16,000	45	94	562.49	125.3W5
	III	17,600	19,000	29	77	562.84	125.3W5
	IV	23,600	25,000	10	57	563.51	125.3W5
	V	e	e	--	--	564.00	--
	VIL	e	e	--	--	--	--
	VIR	e	e	--	--	566.74	--
	VIIR	e	e	--	--	568.84	--
	VIIIR	e	e	--	--	570.59	--
	IXR	e	e	--	--	572.34	--
	XR	e	e	--	--	574.24	--
Slough 9	I	10,900	11,600	74	97	590.04	128.3W3
(128.3)	II	e	e	--	--	592.24	--
	III	e	e	--	--	592.84	--
	IV	e	e	--	--	592.84	--
	V	e	e	--	--	593.19	--
Slough 9A	I	10,800	11,500	74	97	560.16	133.2S1
(133.2)	II	e	e	--	--	640.90	--
	III	e	e	--	--	642.22	--
	IV	e	e	--	--	642.79	--
	V	e	e	--	--	643.71	--
	VI	e	e	--	--	645.22	--
	VII	e	e	--	--	645.53	--
	VIII	e	e	--	--	646.74	--
	IX	e	e	--	--	647.57	--
	X	e	e	--	--	648.29	--
	XI	e	e	--	--	648.40	--

Table 6. (Continued).

Study Site (River Mile)	Passage Reach[b]	Backwater Analysis[a]: Unsuccessful Passage (cfs)	Successful Passage (cfs)	Successful Passage Exceedence Frequency: Percent Total Time[c]	Percent Total Years[d]	Successful Passage WSEL (ft)	Staff Gage Used
Side Channel 10	I	17,700	18,500	31	80	651.13	133.8W5
(133.8)	II	e	e	--	--	652.90	--
	III	e	e	--	--	653.11	--
	IV	e	e	--	--	653.55	--
	V	e	e	--	--	653.29	--
	VI	e	e	--	--	654.68	--
Slough 11	I	15,400	16,500	42	94	668.34	135.3W1
(135.3)	II	18,300	19,400	27	77	668.74	135.3W1
	III	32,000	33,400	2	11	670.44	135.3W1
	IV	38,800	40,300	1	9	671.19	135.3W1
	V	e	e	--	--	673.59	--
	VI	e	e	--	--	674.74	--
	VII	e	e	--	--	674.84	--
Upper Side Channel 11	I	e	e	--	--	680.94	136.2W3
(136.1)	II	e	e	--	--	682.17	--
Slough 19	I	e	e	--	--	718.23	140.04S
(140.0)	II	e	e	--	--	718.25	--
	III	e	e	--	--	718.08	--
	IV	e	e	--	--	719.30	--
	V	e	e	--	--	719.34	--
	VI	13,000	13,000	63	97	719.21	140.0S3
	VII	14,500	15,300	48	97	719.72	140.0S3
	VIII	18,100	19,000	29	77	720.39	140.0S3
	IX	24,800	25,600	8	54	721.49	140.0S3
Slough 20	I	12,300	13,200	62	97	723.81	140.1W4
(140.1)	II	20,000	21,100	22	77	725.01	140.1W4
	III	e	e	--	--	726.57	--
	IV	e	e	--	--	727.23	--
	V	e	e	--	--	727.64	--
	VI	e	e	--	--	728.20	--
Side Channel 21	I	7,100	7,800	94	97	731.49	140.6S8
(140.6)	II	9,700	10,300	82	97	732.09	140.6S8
	III	e	e	--	--	732.84	--
	IV	e	e	--	--	733.81	--
	V	e	e	--	--	736.99	--

Table 6. (Continued).

Study Site (River Mile)	Passage Reach[b]	Backwater Analysis[a]: Unsuccessful Passage (cfs)	Successful Passage (cfs)	Successful Passage Exceedence Frequency: Percent Total Time[c]	Percent Total Years[d]	Successful Passage WSEL (ft)	Staff Gage Used
Side Channel 21 (continued)	VI	e	e	--	--	737.94	--
(140.6)	VII	e	e	--	--	729.89	--
	VIII	e	e	--	--	744.09	--
	IX	e	e	--	--	744.54	--
Slough 21	I	e	e	--	--	744.29	142.0W5
(141.8)	II	e	e	--	--	745.39	--
	IIIL	e	e	--	--	748.59	--
	IIIR	e	e	--	--	749.49	--
Slough 22	I	16,000	17,800	35	89	780.01	144.3S7
(144.3)	II	21,900	22,700	17	69	780.55	144.3W3
	III	e	e	--	--	781.37	--

[a] This analysis assumes that local flows are negligible.

[b] Passage reaches located in left and right channels of sites (facing upstream) are indicated as "L" and "R", respectively.

[c] Percentage of total time for a 35 year flow record, that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

[d] Percentage of total years for a 35 year flow record that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

[e] Influence of backwater was not evaluated since breaching occurs at discharges lower than those required for providing backwater influence.

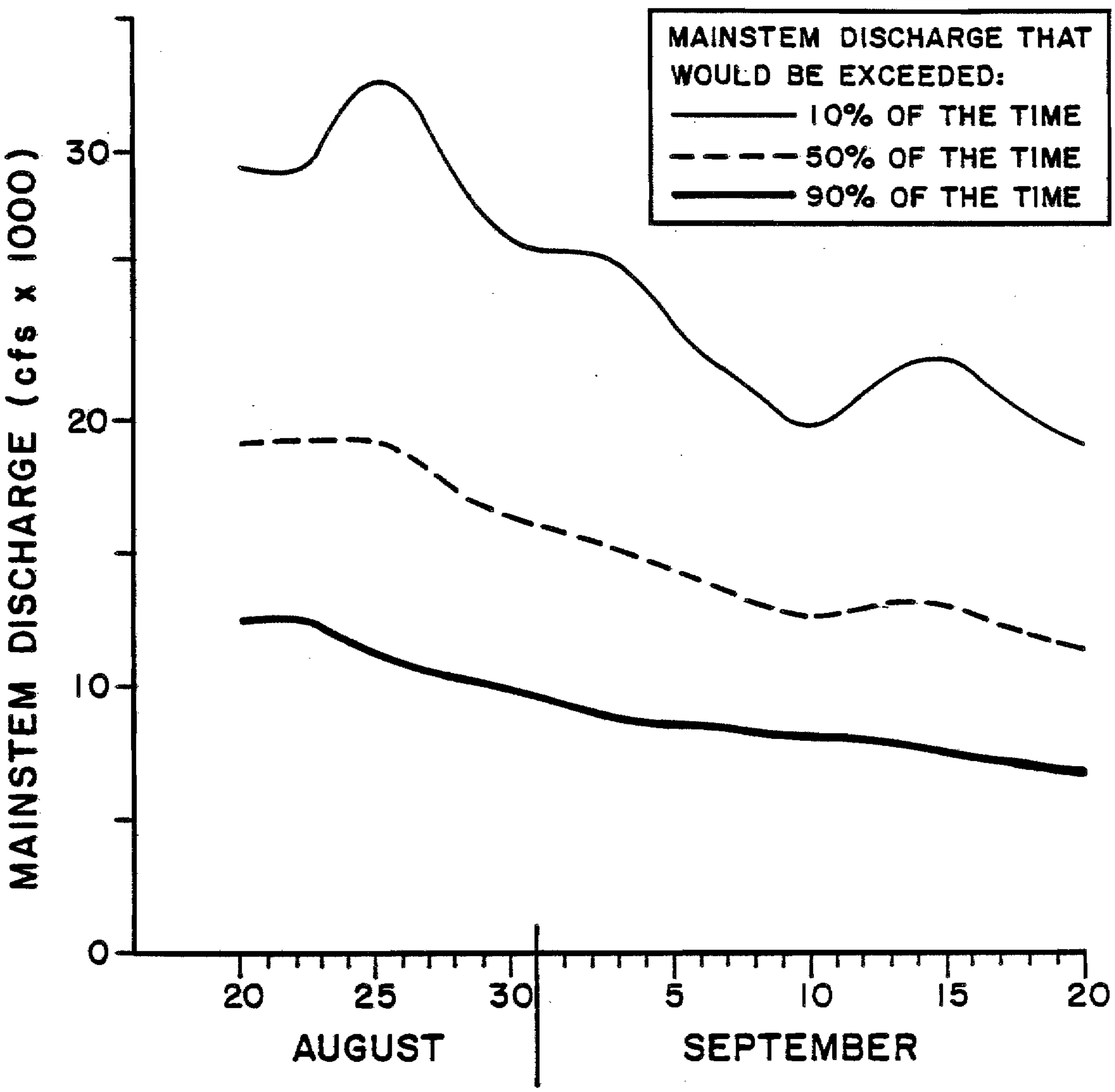

Figure 9. Daily mainstem discharge exceedence curves for the August 20 to September 20 salmon spawning period in the middle Susitna River under natural flow conditions. Exceedence curves were developed from 35 years of USGS discharge data at Gold Creek (Station No. 15292000) using methods described in Chapman (1982).

provided in Table 7. These estimates provide an indication of the quantity of local flow required for passage in the absence of the direct effects of mainstem influenced backwater and breaching. The required flows are very approximate, and should only be used to indicate the relative level of passage difficulty between sites.

Exceedence frequencies are provided at those sites for which a relationship between mainstem discharge and groundwater contributions to local flow have been established. Local flow in sloughs and side channels is comprised mainly of groundwater upwelling (driven largely by mainstem water levels) and runoff from precipitation events. The exceedence values reflect the percent of time that the passage condition is met or exceeded during the period from August 20 to September 20 as a result of precipitation events that generate local flows sufficient to supplement groundwater upwelling flow corresponding to a median mainstem discharge of 15,000 cfs for the period.

Since precipitation records illustrate that precipitation occurs only half of the time during this period, exceedence values range from zero to 50 percent. A zero percent frequency means that the amount of precipitation required to produce local flow to supplement groundwater generated flow corresponding to a median mainstem flow for the period is so large that it occurs very infrequently (e.g. 1 in 10 years). An intermediate exceedence frequency such as 22 percent indicates that the combination of groundwater generated flow corresponding to a mainstem discharge of 15,000 cfs and runoff from a precipitation event which is equalled or exceeded 22 percent of the time is sufficient to provide the required passage flow. An exceedence of 50 percent or greater indicates that the flow resulting from groundwater upwelling at a median mainstem discharge of 15,000 cfs is sufficient to provide the required flow for passage without precipitation input. The mainstem discharge and associated frequency that would be required for successful and unsuccessful passage conditions at passage reaches in Sloughs 8A, 9, and 11 in the absence of any precipitation input is given in Table 8.

Table 7. Summary of local flows required for successful and unsuccessful passage conditions and the frequencies of occurrence based on precipitation and groundwater contributions at median Susitna River discharge of 15,000 cfs during the August 20 to September 20 period.

Study Site (River Mile)	Passage Reach		Successful Conditions			Unsuccessful Conditions		
	Number	Length (ft)	Passage Depth (ft)	Local Flow (cfs)	Percent Exceedence	Passage Depth (ft)	Local Flow (cfs)	Percent Exceedence
Whiskers Creek (101.2)	I	34	0.33	14.0	a	0.21	6.0	a
	II	63	0.34	5.0	a	0.22	1.0	a
Mainstem II (114.4)	I	32	0.33	1.0	a	0.21	0.5	a
	II	168	0.36	5.0	a	0.24	1.0	a
	III	209	0.37	13.0	a	0.25	4.0	a
	IVL	310	0.37	4.0	a	0.25	1.0	a
	IVR	34	0.33	11.0	a	0.21	3.0	a
	VR	243	0.37	4.0	a	0.25	2.0	a
	VIR	84	0.34	2.0	a	0.22	0.8	a
	VIIR	84	0.34	7.0	a	0.22	3.0	a
	VIIIR	318	0.37	2.0	a	0.25	0.7	a
Slough 8A (125.9)	I	160	0.36	2.0	50	0.24	0.8	50
	II	229	0.37	5.0	14	0.25	2.0	33
	III	27	0.33	4.0	19	0.21	1.0	50
	IV	116	0.35	6.0	8	0.22	2.0	31
	V	174	0.36	6.0	7	0.24	2.0	30
	VIR	26	0.33	3.0	31	0.21	0.6	50
	VIIR	213	0.37	7.0	5	0.25	3.0	23
	VIIIR	150	0.35	11.0	5	0.23	3.0	20
	IXR	136	0.35	4.0	5	0.23	0.8	50
	XR	171	0.36	2.0	5	0.24	0.8	16
Slough 9 (128.3)	I	342	0.37	5.0	33	0.25	4.0	50
	II	340	0.37	6.0	17	0.25	3.0	50
	III	421	0.37	5.0	11	0.25	2.0	50
	IV	35	0.33	3.0	17	0.21	1.0	50
	V	219	0.37	0.9	8	0.25	0.9	37
Slough 9A (133.6)	I	74	0.34	9.0	22	0.22	4.0	50
	II	15	0.32	3.0	50	0.20	2.0	50
	III	78	0.34	4.0	50	0.22	2.0	50
	IV	27	0.33	4.0	22	0.21	2.0	50
	V	54	0.34	4.0	20	0.22	3.0	50
	VI	54	0.34	6.0	5	0.22	3.0	50
	VII	19	0.33	4.0	5	0.21	1.0	50
	VIII	223	0.37	9.0	5	0.25	3.0	7

Table 7 (Continued).

Study Site (River Mile)	Passage Reach Number	Passage Reach Length (ft)	Successful Conditions Passage Depth (ft)	Successful Conditions Local Flow (cfs)	Successful Conditions Percent Exceedence	Unsuccessful Conditions Passage Depth (ft)	Unsuccessful Conditions Local Flow (cfs)	Unsuccessful Conditions Percent Exceedence
Slough 9A (Continued)	IX	22	0.33	3.0	5	0.21	0.8	50
	X	119	0.35	2.0	8	0.23	0.6	50
	XI	203	0.37	9.0	5	0.25	3.0	5
Slough 11 (135.3)	I	189	0.37	4.0	5	0.25	1.0	50
	II	313	0.37	1.4	50	0.25	b	b
	III	121	0.35	9.0	5	0.23	3.0	5
	IV	40	0.33	3.0	5	0.21	1.0	50
	V	85	0.34	3.0	5	0.22	1.0	50
	VI	75	0.34	2.0	5	0.22	0.6	50
	VII	62	0.34	0.5	5	0.22	0.4	5
Upper Side Channel 11 (136.1)	I	580	0.37	8.0	50	0.25	2.0	50
	II	880	0.37	b	b	0.25	b	b
Sough 19 (140.0)	I	47	0.33	b	b	0.21	b	b
	II	13	0.32	b	b	0.20	b	b
	III	18	0.32	b	b	0.20	b	b
	IV	121	0.35	b	b	0.23	b	b
	V	44	0.33	b	b	0.21	b	b
	VI	63	0.34	2.0	a	0.22	0.6	a
	VII	66	0.34	2.0	a	0.22	0.7	a
	VIII	126	0.35	2.0	a	0.23	0.9	a
	IX	108	0.35	4.0	a	0.23	1.0	a
Slough 20 (140.1)	I	19	0.32	2.0	a	0.20	0.6	a
	II	43	0.33	2.0	a	0.21	0.5	a
	III	20	0.32	3.0	a	0.20	1.0	a
	IV	43	0.33	b	b	0.21	b	b
	V	31	0.33	b	b	0.21	b	b
	VI	383	0.37	10.0	a	0.25	4.0	a
Side Channel 21 (140.6)	I	55	0.34	5.0	50	0.22	2.0	50
	II	29	0.33	7.0	50	0.21	3.0	50
	III	63	0.34	7.0	50	0.22	3.0	50
	IV	132	0.35	4.0	24	0.23	1.0	50
	V	62	0.34	4.0	21	0.22	1.0	50
	VI	138	0.35	17.0	5	0.23	4.0	50
	VII	800	0.37	20.0	5	0.25	5.0	50
	VIII	50	0.33	7.0	5	0.21	2.0	50
	IX	52	0.34	5.0	9	0.22	2.0	50

Table 7 (Continued).

Study Site (River Mile)	Passage Reach		Successful Conditions			Unsuccessful Conditions		
	Number	Length (ft)	Passage Depth (ft)	Local Flow (cfs)	Percent Exceedence	Passage Depth (ft)	Local Flow (cfs)	Percent Exceedence
Slough 21 (141.8)	I	256	0.37	4.0	5	0.25	1.0	50
	II	263	0.37	2.0	50	0.25	0.4	50
	IIIR	244	0.37	3.0	5	0.25	0.8	50
	IIIL	460	0.37	b	5	0.25	b	5
Slough 22 (144.2)	I	115	0.35	3.0	a	0.23	1.0	a
	II	76	0.34	2.0	a	0.22	0.7	a
	III	157	0.36	4.0	a	0.24	2.0	a

[a] Frequencies not evaluated.

[b] No cross section data available.

Table 8. Frequencies of occurrence of local flows evaluated through the use of mainstem versus local flow relationships in Sloughs 8A, 9 and 11 excluding the effects of breaching and backwater.

Site	Passage Reach	Required Local Flow (cfs)		Required Mainstem Discharge (cfs)		Frequency of Occurrence (%)	
		Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful
Slough 8A	I	2.0	0.8	5,500	3,500	100	100
	II	5.0	2.0	60,000	25,000	0	10
	III	4.0	1.0	60,000	8,500	0	88
	IV	6.0	2.0	60,000	25,000	0	10
	V	6.0	2.0	60,000	31,500	0	6
	VIR	3.0	0.6	17,500	3,500	35	100
	VIIR	7.0	3.0	60,000	22,500	0	15
	VIIIR	11.0	3.0	60,000	26,000	0	9
	IXR	4.0	0.8	60,000	10,000	0	82
	XR	2.0	0.4	60,000	13,500	0	60
Slough 9	I	5.0	4.0	27,000	14,500	7	52
	II	6.0	3.0	58,000	8,000	0	90
	III	5.0	2.0	60,000	9,500	0	83
	IV	3.0	1.0	51,000	2,500	0	100
	V	2.0	0.8	60,000	19,500	0	25
Slough 11	I	4.0	1.0	34,000	7,500	4	93
	II	1.4	1.4	10,000	10,000	81	81
	III	9.0	3.0	60,000	28,000	0	7
	IV	3.0	1.0	44,000	10,500	1	79
	V	3.0	1.0	60,000	13,500	0	65
	VI	2.0	0.6	60,000	12,000	0	70
	VII	0.5	0.4	60,000	48,000	0	0

4.0 DISCUSSION

4.1 Salmon Passage Criteria

The analysis of the salmon passage data collected during the 1984 open water season resulted in revisions of the passage criteria curves developed from the 1982 and 1983 passage data (Sautner et al. 1984). The final product of the analysis was the development of a single set of salmon passage criteria thresholds for establishing successful and unsuccessful salmon passage conditions (Figure 7). In general, the same assumptions corresponding to the original criteria curves in Sautner et al. (1984) are applicable to the revised passage criteria thresholds. However, based on field observations of salmon passage, one of the important assumptions regarding the passage criteria required modification. This assumption was originally stated as follows:

> All passage reaches can be described as either uniform, straight channels with small substrate (less than or equal to 3 inches in diameter), or non-uniform braided channels with large substrate (greater than 3 inches in diameter).

Exceptions to this assumption were encountered at several passage reaches (e.g. Sloughs 20 and 21) during the past field season. Non-uniform channels were observed at passage reaches with predominantly small substrate, and passage reaches with predominantly large substrate and uniform channels were also encountered (Table 3). In these situations it was often very difficult to classify certain passage reaches under one of the original criteria curves. This required that the relative importance of channel configuration and substrate size be re-evaluated. Based on field observations, differences in channel configuration appeared to have a greater overall influence on water depths, and therefore on salmon passage conditions, than substrate size. Therefore, if substrate is disregarded as a factor in the salmon passage criteria analysis, the previous assumption can be rewritten as follows:

> All passage reaches can be described as either uniform, straight channels, or as non-uniform, braided channels.

This assumption indicates that passage reaches can still be classified into two categories which would theoretically require two separate sets of criteria curves as in Sautner et al. (1984). However, when length and depth data for both uniform and non-uniform passage reaches were plotted separately and together, there was no distinct evidence to indicate the requirement of two sets of criteria curves. The combined passage data (collected from both uniform and non-uniform channels) closely fit Criteria Curve I for uniform channels, whereas Criteria Curve II, for non-uniform channels, overestimates water depths required for successful passage. This was verified in the field when measuring lengths of passage reaches using the Criteria Curve II thalweg water depth of 0.67 feet. Passage reaches for which this depth value was used for establishing the upstream and downstream limits included water depths where fish did not appear to have any passage problems. A thalweg water depth of approximately 0.50 feet, which corresponds to

Criteria Curve I, appeared to be a more accurate indicator of the depth of water at which salmon first encounter passage difficulty.

Based on these reasons, and supported with field observations, it was determined that only a single set of passage criteria thresholds is necessary to accurately describe natural salmon passage conditions. Hence, the previous assumption was modified to read as follows:

> All passage reaches influence salmon passage conditions in a similar manner regardless of channel configuration and substrate size.

The salmon passage criteria thresholds developed in this addendum are similar to Criteria Curve I from Sautner et al. (1984), with some modifications based on the 1984 data. The most significant modification to the passage criteria involved the 0-20 feet range of the curves for both successful and unsuccessful passage. When the original criteria curves were developed in 1984, the sharp downward inflections in this range of the criteria curves were assumed to reflect an intuitive idea that salmon are able to swim through very shallow depths for short lengths. This adaptation was based solely on intuition and the professional judgement of several project personnel with various backgrounds. However, the salmon passage data collected during the 1984 field season were not sufficient to support the sharp, downward inflections in the 0-20 feet range of the original curves. General field observations of chum salmon passage also did not support this adaptation in the original curves. In addition, very few passage reaches identified during the 1984 field season had passage reach lengths that fit into the 0-20 feet range of the passage criteria. Thus, the original criteria curves were modified to reflect these field observations and additional data, resulting in the development of two straight lines, referred to as salmon passage criteria thresholds, which more accurately reflect salmon passage conditions.

The assumption that salmon are able to swim through shallower depths at shorter reach lengths may be falsely based on the well known ability of salmon to leap over obstacles such as waterfalls. However this ability is only characteristic with the physical and hydraulic features present at waterfalls (eg., plunge pool depths, water velocities). These conditions are not characteristic of passage reaches in sloughs and side channels of the middle Susitna River and thus there were no observations of salmon "jumping" over passage reaches of shorter reach lengths.

The salmon passage criteria thresholds developed in this addendum are represented by two straight lines which best fit the salmon passage data collected during 1984. Placement of the threshold lines for successful and unsuccessful salmon passage indicates that passage depth appears to be the critical physical factor affecting passage conditions. Passage reach length is not as critical in relation since passage depth increases only 0.05 feet over lengths up to 200 feet.

4.2 Passage Evaluations

During the 1984 open water field season, 85 passage reaches were identified at selected slough and side channel study sites of the middle Susitna River compared to 74 passage reaches previously identified in Sautner et al. (1984). The difference in the number of passage reaches is primarily related to the specific methods employed to identify passage reaches. In Sautner et al. (1984), passage reaches were identified strictly from surveyed thalweg profiles of each study site. However, the majority of these thalwegs were not surveyed for the purposes of analyzing salmon passage conditions. Thus, certain passage reaches within some study sites were not adequately defined on the thalweg profiles. In contrast, identification of passage reaches during the 1984 PVS were based on actual field observations. This method resulted in the identification of new passage reaches, the elimination of some previously identified passage reaches, and in some cases, the division of a single, previously identified passage reach into two separate passage reaches. In addition, Slough 19 was included as an additional study site to be evaluated for passage. Therefore, the methods employed in this addendum result in a more accurate and complete identification of passage reaches compared to the methods utilized in Sautner et al. (1984).

Mainstem discharge estimates resulting from the backwater and breaching analyses were also presented as percent exceedence frequencies based on time and years. Although these percent exceedence values are supposed to represent the entire period of interest, they may contain an inherent bias towards the first two weeks of the August 20 to September 20 salmon spawning period. An evaluation of the daily mainstem discharge exceedence curves for 10%, 50% and 90% of the time (Figure 9) indicates that the middle Susitna River discharge generally decreases through the period of interest. It is also apparent that higher discharges occur with greater frequency during the first half of the period of interest. Discharges generally decrease in the latter half of this period. The decreasing trend in mainstem discharge values is generally consistent during the entire period with few periodic spikes or peaks. Although the percent exceedence values presented in this addendum are for the entire August 20 to September 20 period, these values are more likely to occur during the first half of the salmon spawning period rather than the last half because this is the period when the higher discharges can be expected to be equalled or exceeded.

4.2.1 Mainstem Breaching

The mainstem Susitna River directly influences salmon passage conditions within a slough or side channel when the head of a site becomes breached. This event is significant, since after mainstem breaching has occurred all the passage reaches within a site are affected in a similar manner. The breaching analysis in this addendum provides a summary of the mainstem discharges which are required to breach selected study sites in the middle Susitna River. These results are essentially the same values that were reported in Sautner et al. (1984) with the addition of mainstem discharge estimates for Sloughs 9A and 19. Although two breaching discharges are presented for each study site, controlling discharge values are of primary importance since field observations have shown that successful salmon passage conditions exist at all passage reaches within a site when controlling mainstem breaching has occurred. Initial breaching discharges are only presented to provide an indication of when a study site is initially overtopped by mainstem water and may be considered to approximate the discharge representing the unsuccessful threshold value.

A review of the results of the breaching analysis (Table 5) indicates that the majority of study sites breach at relatively high mainstem discharges (19,000 to 42,000 cfs). This includes Sloughs 8A, 9, 11 and 21, which comprise a major portion of the primary spawning areas for chum salmon in the middle Susitna River. Under natural flow conditions, these relatively high mainstem discharges (19,000 to 42,000 cfs) are equalled or exceeded less than a third (29%-1%, respectively) of the total time for the period August 20 to September 20 (Table 5). These discharge values of 19,000 to 42,000 cfs also correspond to 77%-9%, respectively, of the total number of years in which the breaching discharge is equalled or exceeded at least once during the August 20 to September 20 period. However, the exceedence frequencies for the total number of years contains an inherent bias towards the first two weeks of the period of interest.

4.2.2 Mainstem Backwater

In addition to breaching effects, the mainstem Susitna River directly affects salmon passage in the mouth area of a slough or side channel by creating backwater pools. As mainstem discharge increases, the stage of the backwater pool progressively rises and inundates the lower portion of the site. This effect is important in regulating the passage of salmon into a slough or side channel spawning site at mainstem discharges less than those required for breaching.

The backwater analysis in this addendum presents a summary of the mainstem discharges which provide successful salmon passage conditions from backwater effects at selected study sites in the middle Susitna River. It is evident from the results that, in general, only the initial few passage reaches located in the mouth regions of study sites are inundated by backwater prior to breaching. However, at three sites (Whiskers Creek Slough, Upper Side Channel 11 and Slough 21), the influence of backwater on passage conditions is completely absent prior to breaching. In these cases, the effects of breaching and local flow become increasingly more critical in providing successful passage conditions.

A comparison of the results of the backwater analysis in this addendum to the results previously reported in Sautner et al. (1984) is presented in Table 9. It is evident from the comparison that the mainstem discharge values for successful passage conditions from both studies are in general agreement. The discharge values established in this addendum constitute a general increase of less than 1,000 cfs over values reported in Sautner et al. (1984). However in a few cases (eg., Passage Reach

Table 9. Comparison of the results of the backwater analysis presented in this addendum to the results previously reported in Sautner et al. (1984) for sloughs and side channels in the middle Susitna River.

Study Site (River Mile)	Passage Reach	Mainstem Discharges (cfs) Present Addendum Unsuccessful	Present Addendum Successful	Sautner et al. (1984) Unsuccessful	Sautner et al. (1984) Successful
Mainstem 2	I	8,600	9,200	a	a
Side Channel	II	11,800	12,500	11,500	12,200
(114.4)	IVR	18,800	19,700	18,400	19,200
Slough 8A	I	7,200	7,700	10,600	10,600
(125.3)	II	14,600	16,000	14,600	15,600
	III	17,600	19,000	a	a
	IV	23,600	25,000	a	a
Slough 9 (128.3)	I	10,900	11,600	12,200	12,200
Slough 9A (133.2)	I	10,800	11,500	a	a
Side Channel 10 (133.8)	I	17,700	18,500	17,400	18,200
Slough 11	I	15,400	16,500	15,200	16,200
(135.3)	II	18,300	19,400	a	a
	III	32,000	33,400	31,900	33,200
	IV	38,800	40,300	38,300	39,600
Slough 20	I	12,300	13,200	a	a
(140.1)	II	20,000	21,100	20,800	22,100
Side Channel 21	I	7,100	7,800	12,000	12,000
(140.6)	II	9,700	10,300	b	b
Slough 22	I	16,000	17,800	23,000	23,000
(144.3)	II	21,900	22,700	b	b

[a] This site not evaluated.

[b] Breaching occurs at mainstem discharges lower than those required for providing backwater influence.

I in Slough 8A), values differ more than 1,000 cfs for successful passage. These larger differences are due to better defined rating curves established during the 1984 field season which provide more accurate estimates of mainstem discharge.

Overall, discrepancies between the mainstem discharge values reported in both studies are a reflection of the revised passage criteria thresholds and their application in the backwater analysis. The methods which comprise the backwater analysis include the determination of the depth requirements for successful passage for a reach length of zero feet from the revised passage criteria thresholds. In this addendum, a passage depth of 0.32 feet corresponds to the zero reach length for successful salmon passage. In Sautner et al. (1984), the comparative passage depth from Criteria Curve I was 0.26 feet. Although the difference in the passage depth values is only 0.06 feet, it accounts for the general increase in mainstem discharge values reported in this addendum. In general, where discrepancies in the results of both studies occur, it should be noted that the results of this addendum are refinements of those reported earlier and are therefore considered more reliable.

4.2.3 Local Flow

Although the local flow analysis has been refined and expanded considerably from the analysis presented in Sautner et al. (1984), there is still a great deal of uncertainty associated with the estimated flows. The limited data available for the previous analysis resulted in a few general assumptions. Data were collected during the 1984 open water season to eliminate most of these assumptions and allow a more thorough analysis of the local flow required for passage in sloughs and side channels. The refined analysis improved the accuracy of the flow estimates, but still necessitated detailed assumptions. In addition, neither the groundwater distribution analysis nor the local flow frequency analysis were conducted for the passage evaluations presented in Sautner et al. (1984). These additional analyses and refinement of the methods used to evaluate local flows resulted in the following additional assumptions which are more specific and expanded from the assumptions presented in Sautner et al. (1984).

1. The surveyed cross section is representative of the most difficult passage conditions within the passage reach.

2. Local flow in passage reaches is composed of surface water runoff and groundwater contributions from inflow evenly distributed along the channel bed and inflow concentrated at upwelling sites.

3. The local flow distribution analysis evaluates flow at a passage reach which is representative of field conditions.

4. The percent groundwater values are constant at a site for all local flows and mainstem discharges.

5. The groundwater flows can be represented by local flows measured during a period of low rainfall.

6. Antecedent moisture conditions are invariable and have a negligible effect on surface water runoff.

7. The August precipitation duration curve at Talkeetna is applicable to the August 20 to September 20 salmon spawning period.

8. Precipitation at Talkeetna may be adjusted to represent rainfall conditions at sloughs and side channels of the middle river by using precipitation coefficients.

9. Basin areas contributed surface water in accordance with identified percent runoff factors. The factors are constant for all rainfall amounts.

10. Manning's Equation is applicable to the low flow and shallow depth conditions at passage reaches.

11. Manning's Equation can be calibrated at a known flow and corresponding water surface elevation; the calibrated equation may be applied to thalweg depths up to one foot.

12. Local flow in passage reaches is uniform; for uniform flow, the energy gradient is equal to the slope of the water surface.

13. The flow characteristics at a passage reach are governed by the maximum of the upstream and downstream water surface slopes at the cross section.

14. Manning's roughness coefficients are uniformly greater at the shallow depths associated with the passage analysis in comparison to the flood flow roughness values found in the literature (Chow 1959).

15. Flow excluded by flow computations using surveyed cross section data is a constant amount that is underpredicted at all depths.

Required local flow values for successful and unsuccessful salmon passage conditions presented in this addendum differ to varying degrees to previous values (Table 10). Variations between the addendum results and previous values may be partially explained by variations in the calibration of Manning's Equation. In Sautner et al. (1984) constant Manning's roughness coefficient was used at all passage reaches. In the addendum, a site-specific Manning's roughness coefficient reflected variations in passage reach substrate and channel uniformity. The energy gradient was approximated in the previous study from the water surface gradient evaluated over large reaches on the thalweg profile.

Table 10. Comparison of the results of the local flow analysis presented in this addendum to the results previously reported in Sautner et al. (1984) for sloughs and side channels in the middle Susitna River.

Study Site (River Mile)	Passage Reach	Local Flow (cfs) Present Addendum Unsuccessful	Present Addendum Successful	Sautner et al. (1984) Unsuccessful	Sautner et al. (1984) Successful
Whiskers Creek Slough (101.2)	I	6.0	14.0	8.0	16.0
Mainstem 2 Side Channel (114.4)	VR	2.0	4.0	3.0	5.0
	VIR	0.8	2.0	3.0	5.0
	VIIR	2.0	7.0	3.0	5.0
	VIIIR	0.7	2.0	3.0	5.0
Slough 8A (125.3)	I	0.8	2.0	1.0	2.0
	VIIR	3.0	7.0	3.0	5.0
	IXR	0.8	4.0	2.0	4.0
	XR	0.8	2.0	2.0	4.0
Slough 9 (128.3)	I	4.0	5.0	1.0	2.0
	II	3.0	6.0	1.0	1.0
	III	2.0	5.0	4.0	6.0
Slough 9A (133.2)	II	2.0	3.0	1.0	1.0
	III	2.0	4.0	2.0	3.0
	VI	3.0	6.0	0.5	1.0
	X	0.6	2.0	0.5	2.0
	XI	3.0	9.0	0.5	3.0
Slough 11 (135.3)	I	1.0	4.0	3.0	4.0
	IV	1.0	3.0	3.0	4.0
	V	1.0	3.0	5.0	8.0
Upper Side Channel 11 (136.1)	I	2.0	8.0	7.0	12.0
Slough 20 (140.1)	II	0.5	2.0	3.0	6.0
	III	1.0	3.0	3.0	6.0
Side Channel 21 (140.6)	II	3.0	7.0	4.0	8.0
	III	3.0	7.0	2.0	7.0
	IV	1.0	4.0	10.0	18.0
Slough 22 (144.3)	I	1.0	3.0	6.0	11.0
	III	2.0	4.0	1.0	2.0

In the addendum, the water surface gradient was predominantly obtained from field measurements of the water surface upstream and downstream from the cross-section. The cross-section database was previously much smaller; cross-sections were often unavailable within passage reaches and nearby cross-sections were used in the analysis. Cross-section data collected within passage reaches during the 1984 field season enlarged the database and permitted a more thorough analysis of local flows required for passage. Although still approximate, the required flows estimated in this addendum represent an improved estimate of the required local flows for passage.

4.3 Influence of Mainstem Discharge on Local Flow

The two principal sources of local flow in sloughs and side channels of the middle Susitna River are surface water runoff and groundwater upwelling. These sources of local flow are influenced by mainstem discharge and by precipitation events. Surface water runoff is a function of precipitation and basin characteristics, and is not influenced by fluctuations in mainstem discharge. Since precipitation in any amount falls roughly half of the time during the spawning period, surface runoff is generally periodic during this time. Most drainage areas contributing to sloughs and side channels are quite small and steep; thus surface runoff decreases substantially or stops soon after the precipitation stops. As a result of the intermittent nature of the surface runoff component of local flow, groundwater upwelling plays a major role in sustaining flow in sloughs and side channels during unbreached periods.

Groundwater upwelling during the spawning period originates from any of three sources: 1) shallow localized infiltration from the mainstem; 2) localized infiltration from precipitation events; or 3) regional groundwater transport in the down valley direction (AEIDC 1985). Of these three sources, only the first is directly influenced by short term fluctuations in mainstem stage. This localized source fluctuates rapidly in response to fluctuations in mainstem stage. This direct influence is demonstrated in a set of linear regression equations that relate the apparent groundwater component of slough flow to mainstem stage or mainstem discharge (e.g., H-E 1984, Beaver 1984, R&M 1984). The most recent version of these equations, developed as a function of mainstem stage (H-E 1985), were used in the frequency of occurrence analysis presented in Appendix A. Such relations have only been developed for Sloughs 8A, 9 and 11 and cannot be generalized for application to other sloughs and side channels. A relation has been developed for Slough 21 but is not applicable at mainstem discharges in the range considered in these passage analyses.

Another localized and fluctuating component of groundwater upwelling is that generated from precipitation events. This component generally enters from the valley wall side of the slough or side channel and is not all causally related to mainstem discharges. This component of groundwater upwelling is directly related to surface water runoff from precipitation. However, the response of infiltrating precipitation would be delayed in comparison with the rapid response of surface water runoff. The influence of this source of groundwater upwelling has not yet been quantified in general terms.

The regional groundwater transport component of groundwater upwelling provides the base flow in the slough or side channel. This component may fluctuate slightly on a seasonal time scale, but would remain fairly constant during the spawning period. The amount of local flow provided by this source depends upon the length and characteristics of the slough channel that intersects this source. Base flows in sloughs and side channels have not been quantified as a separate entity, but are incorporated in the local flow values resulting from the regression equations discussed above. The base flows are thought to be small in comparison to other groundwater components (H-E 1984).

4.4 Conclusions/Recommendations

The mainstem discharge and local flow values presented in this addendum differ in some cases with values previously reported in Sautner et al. (1984). In general, where discrepancies between the results of both studies occur, the results presented in this addendum are considered more reliable since they are based on refinements of both field and analytical methods. The critical discharge values which initially provide successful passage conditions at passge reaches through either backwater, breaching or local flow effects are summarized in Table 11.

The evaluation of salmon passage conditions presented in this report is based on the present hydraulic and morphologic characteristics of slough and side channel habitats. An important consideration that should be examined in future application of these data relates to physical changes that may occur within these habitats in the future. Changes in the natural sediment load of the Susitna River may result in aggradation or degradation of the streambed of slough or side channel habitats. Ice conditions may also result in changes in present channel morphology. Any changes in the present channel morphology may result in changes in the mainstem discharge and local flow values required for salmon passage as presented in this report. With these limitations in mind, the following conclusions were derived from this study.

1. All designated passage reaches influence salmon passage conditions in a similar manner regardless of channel configuration and substrate size.

2. The passage criteria data indicate that two separate sets of criteria curves are not required to describe passage requirements for chum salmon.

3. The thalweg depth threshold of 0.67 feet from Criteria Curve II is an overestimate of the water depth required for successful passage for chum salmon. A thalweg depth of 0.5 feet is a more accurate indicator of the depth at which salmon would first encounter passage difficulty.

Table 11. A summary of discharge values initially providing successful passage conditinos through either backwater, breaching or local flow effects at selected study sites in the middle Susitna River.

Study Site (River Mile)	Passage Reach[b]	Mainstem Discharge Required for Successful Passage[a]: Mainstem Discharge (cfs)	Source of Influence	Exceedence Frequency: Percent Total Time[c]	Percent Total Years[d]
Whiskers Creek Slough[e]	I	23,000	Breaching	16	69
(101.2)	II	23,000	Breaching	16	69
Mainstem 2 Side Channel[e]	I	9,200	Backwater	87	97
(114.4)	II	12,500	Backwater	67	97
	III	16,000	Breaching	45	94
	IVL	16,000	Breaching	45	94
	IVR	19,700	Backwater	26	77
	VR	25,000	Breaching	10	57
	VIR	25,000	Breaching	10	57
	VIIR	25,000	Breaching	10	57
	VIIIR	25,000	Breaching	10	57
Slough 8A	I	5,500	Local Flow	100	100
(125.3)	II	16,000	Backwater	45	94
	III	19,000	Backwater	29	77
	IV	25,000	Backwater	10	57
	V	27,000	Breaching	7	46
	VIL	27,000	Breaching	7	46
	VIR	17,500	Local Flow	35	89
	VIIR	33,000	Breaching	2	11
	VIIIR	33,000	Breaching	2	11
	IXR	33,000	Breaching	2	11
	XR	33,000	Breaching	2	11
Slough 9	I	11,600	Backwater	74	97
(128.3)	II	19,000	Breaching	29	77
	III	19,000	Breaching	29	77
	IV	19,000	Breaching	29	77
	V	19,000	Breaching	29	77
Slough 9A[e]	I	11,500	Backwater	74	97
(133.2)	II	13,500	Breaching	60	97
	III	13,500	Breaching	60	97
	IV	13,500	Breaching	60	97
	V	13,500	Breaching	60	97
	VI	13,500	Breaching	60	97
	VII	13,500	Breaching	60	97
	VIII	13,500	Breaching	60	97
	IX	13,500	Breaching	60	97
	X	13,500	Breaching	60	97
	XI	13,500	Breaching	60	97

Table 11 (Continued).

Study Site (River Mile)	Passage Reach[b]	Mainstem Discharge Required for Successful Passage[a]: Mainstem Discharge (cfs)	Source of Influence	Exceedence Frequency: Percent Total Time[c]	Exceedence Frequency: Percent Total Years[d]
Side Channel 10[e] (133.8)	I	18,500	Backwater	31	80
	II	19,000	Breaching	29	77
	III	19,000	Breaching	29	77
	IV	19,000	Breaching	29	77
	V	19,000	Breaching	29	77
	VI	19,000	Breaching	29	77
Slough 11 (135.3)	I	16,500	Backwater	42	94
	II	10,000	Local Flow	82	97
	III	33,400	Backwater	2	11
	IV	40,300	Backwater	1	9
	V	42,000	Breaching	1	9
	VI	42,000	Breaching	1	9
	VII	42,000	Breaching	1	9
Upper Side Channel 11[e] (136.1)	I	16,000	Breaching	45	94
	II	16,000	Breaching	45	94
Slough 19[e] (140.0)	I	13,000	Breaching	63	97
	II	13,000	Breaching	63	97
	III	13,000	Breaching	63	97
	IV	13,000	Breaching	63	97
	V	13,000	Breaching	63	97
	VI	13,000	Backwater	63	97
	VII	15,300	Backwater	48	97
	VIII	19,000	Backwater	29	77
	IX	25,600	Backwater	8	54
Slough 20[e] (140.1)	I	13,200	Backwater	62	97
	II	21,100	Backwater	22	77
	III	23,000	Breaching	16	69
	IV	23,000	Breaching	16	69
	V	23,000	Breaching	16	69
	VI	23,000	Breaching	16	69

Table 11 (Continued)

Study Site (River Mile)	Passage Reach[b]	Mainstem Discharge Required for Successful Passage[a]			
		Mainstem Discharge (cfs)	Source of Influence	Exceedence Frequency	
				Percent Total Time[c]	Percent Total Years[d]
Side Channel 21[e] (140.6)	I	7,800	Backwater	94	97
	II	10,300	Backwater	82	97
	III	12,000	Breaching	71	97
	IV	12,000	Breaching	71	97
	V	12,000	Breaching	71	97
	VI	12,000	Breaching	71	97
	VII	12,000	Breaching	71	97
	VIII	24,000	Breaching	13	66
	IX	24,000	Breaching	13	66
Slough 21[e] (141.8)	I	25,000	Breaching	10	57
	II	25,000	Breaching	10	57
	IIIL	25,000	Breaching	10	57
	IIIR	26,000	Breaching	-	-
Slough 22[e] (144.3)	I	17,800	Backwater	35	89
	II	22,700	Backwater	17	69
	III	23,000	Breaching	16	69

[a] Mainstem discharge values correspond to the lowest values resulting from a comparison of backwater, breaching and local flow effects unless otherwise noted.

[b] Passage reaches located in left and right channels of sites (facing upstream) are indicated as "L" and "R", respectively.

[c] Percentage of total time for a 35 year flow record that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

[d] Percentage of total years for a 35 year flow record that the indicated discharge is equalled or exceeded during the period 20 August - 20 September (USGS gage at Gold Creek, gage #15292000).

[e] Mainstem discharges related to local flow effects were not defined at this site and thus are not included in this comparison.

4. The revised salmon passage criteria are represented by two straight lines, referred to as threshold limits, which best fit the passage criteria data collected during 1984. The threshold limits represent the criteria for successful and unsuccessful passage of chum salmon in the middle reach of the Susitna River.

5. The distribution of fish passage field observations in relation to the threshold limits for successful and unsuccessful passage of chum salmon support the revision of the original criteria curves.

6. Field observations and passage data collected during 1984 do not support the downward inflection represented by the first 20 feet of the original criteria curves. Extensions of straight line threshold criteria for reach lengths greater than 20 feet continued through this 0 to 20 feet range in the revised passage criteria threshold limits.

7. Passage depth appears to be the critical physical factor affecting salmon passage. Based on the threshold limits for successful and unsuccessful passage of chum salmon, the required passage depth increases only slightly over passage reach lengths up to 200 feet and is assumed constant for lengths greater than 200 feet.

8. A total of 85 passage reaches were identified at selected slough and side channel study sites of the middle Susitna River based on field observations.

9. Breaching is important in providing successful passage conditions, but only at relatively high mainstem discharges at the majority of slough and side channel study sites in the Middle Susitna River.

10. Backwater is a dominant factor in providing successful passage conditions from the mainstem into some slough and side channel sites by inundating the lower most passage reaches in each site.

11. Local flow is influenced largely by mainstem discharge levels and by precipitation events.

12. Local flow is important in providing periodic conditions for successful passage and more frequent conditions for successful passage with difficulty and exposure at those sites infrequently receiving direct mainstem influence through breaching or backwater.

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8.0 APPENDICES

APPENDIX A

Supplement to Local Flow Methods

APPENDIX A

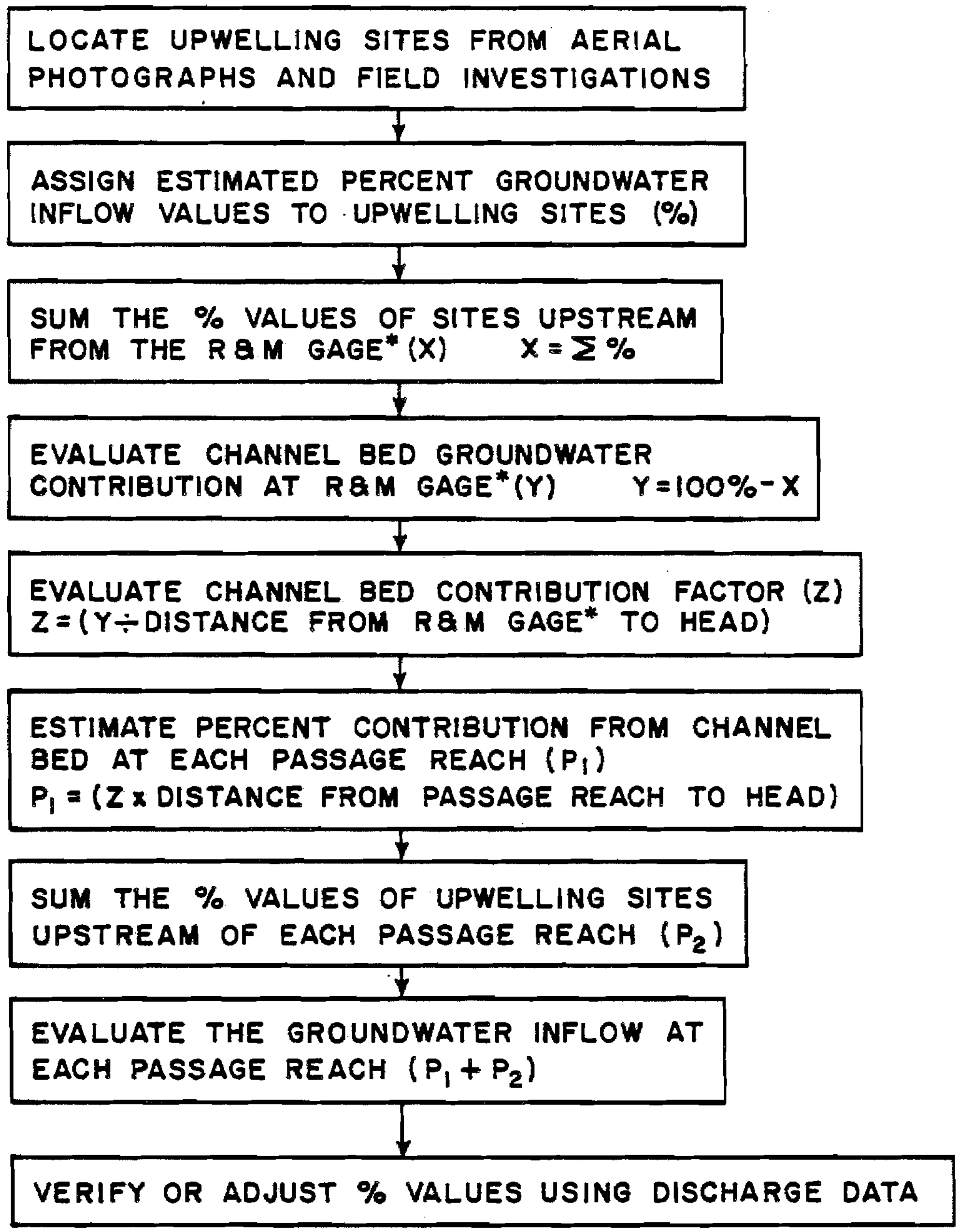
The general procedure for evaluating the required amount of local flow necessary for successful and unsuccessful passage and the frequency at which these required flows are expected to occur is described in Section 2.3.2.4. This appendix presents detailed methods for evaluating local flow distribution within a site, calibrating Manning's Equation, and evaluating the frequency of occurrence of local flows. All the methods presented are based on a number of assumptions; each analysis has some error associated with it which can compound as results from one analysis are used in another analysis. Consequently, the required flow estimates are very approximate and should only abe used as an index to the level of passage difficulty anticipated at the site.

Local Flow Distribution Analysis

At passage reaches where flow data were not collected, flows were estimated from flows measured elsewhere within the slough or side channel. The general procedure used to estimate the flow at a passage reach involved assigning a percent groundwater flow value to each passage reach relative to total flow at an R&M discharge gage or other reference, such as another passage reach. These percent groundwater flow values were assumed to be constant at all slough and mainstem flows. The flow at a specified passage reach may be estimated by multiplying the percent groundwater flow value at the passage reach by a flow measured elsewhere in the slough or side channel and adjusting this flow for tributary and surface water inflow.

The percent groundwater flow values at passage reaches are evaluated through the use of aerial photographs, on-site investigations and flow data measured at slough gages and passage reaches. Groundwater flow at a site is considered to be composed of both inflow evenly distributed along the channel bed and inflow concentrated at upwelling sites visible in aerial photographs or located during site investigations (R&M 1982). Appendix Figure A-1 illustrates the general procedure used to estimate the percent groundwater flow values. The upwelling sites were assigned percent groundwater flow values from field experience. At Sloughs 8A, 9, 11 and 21, the R&M discharge gage location was designated the 100 percent groundwater flow value. At sloughs and side channels lacking an R&M gage, the most downstream passage reach (Passage Reach I) was designated to be the reference point for 100 percent groundwater flow. The percent groundwater flow value at each passage reach was estimated by summing the percent groundwater flow values from (1) upwelling sites upstream of the passage reach and (2) the channel bed groundwater contribution.

Flow data available at various passage reaches on the same date or on a date with a similar mainstem discharge and antecedent precipitation were utilized to verify or adjust the percent groundwater flow values. Local flow data collected during the 1984 open water field season are presented in Appendix E (Appendix Table E2). The R&M discharge gages provided an additional source of flow data for comparison of the percent groundwater flow values. The evaluated percentage values at the passage reaches of the sloughs and side channels considered are presented in Appendix Table A-1.



* AT SLOUGHS AND SIDE CHANNELS WITHOUT R&M GAGES, PASSAGE REACH I WAS SUBSTITUTED FOR THE R&M GAGE.

Appendix Figure A-1. Illustration of the general procedure used in the local flow distribution analysis.

Appendix Table A-1. Percent groundwater flow values for sloughs and side channels.

Study Site	Passage Reach	Percent Groundwater Flow Values
Whiskers Creek Slough	I	100
	II	50
Mainstem 2 Side Channel	I	100
	II	90
	III	80
	IVL	40
	IVR	40
	VR	35
	VIR	30
	VIIR	25
	VIIIR	20
Slough 8A	I	228[a]
	II	71[a]
	III	71[a]
	IV	70[a]
	V	64
	VI	128
	VII	113
	VIII	104
	R&M Gage	100
	IX	50
	X	20
Slough 9	I	166
	II	152
	R&M Gage	100
	III	97
	IV	80
	V	30
Slough 9A	I	100
	II	79
	III	71
	IV	62
	V	59
	VI	54
	VII	44
	VIII	40
	IX	32
	X	30
	XI	24

Appendix Table A-1 (Continued).

Study Site	Passage Reach	Percent Groundwater Flow Values
Slough 11	I	120
	II	114
	III	102
	R&M Gage	100
	IV	78
	V	58
	VI	40
	VII	10
Slough 19	I	100
	II	90
	III	80
	IV	70
	V	55
	VI	50
	VII	20
	VIII	15
	IX	5
Slough 20	I	100
	II	80
	III	70
	IV	55
	V	45
	VI	15
Side Channel 21[b]	I	252
	II	249
	III	243
	IV	135[a]
	V	133[a]
	VI	214
	VII	179
	VIII	144
	IX	138
Slough 21	I	111
	R&M Gage	100
	II	93
	IIIR	36
	IIIL	26

Appendix Table A-1 (Continued).

Study Site	Passage Reach	Percent Groundwater Flow Values
Slough 22	I	100
	II	55
	III	35

[a] Passage reach is in one channel of a multi-channel reach of the study site.

[b] Percentages are referenced from the R&M gage located in Slough 21.

Calibration of Manning's Equation

The Manning Equation is assumed to be applicable to the low flow and shallow depth conditions in the passage reaches. The Manning Equation is an empirical relationship between channel flow (Q) and channel geometry:

$$Q = 1.486/n \; AR^{2/3}S^{1/2}$$

The energy gradient (S) is assumed to be represented by the water surface slope at the cross section, and the steeper of the upstream and downstream slopes is assumed to govern the passage reach flow characteristics. The channel hydraulic radius (R) and area (A) are calculated from the surveyed cross section. Manning's roughness coefficient (n) is assumed to be primarily a function of bed material size and channel uniformity. For application to the passage reaches, the roughness coefficient values are assumed to be uniformly greater at the shallow depths associated with the passage analysis in comparison to the normal and flood flow roughness coefficient values found in the literature (e.g. Chow 1959). The steps used to calibrate the Manning Equation at each passage reach are summarized below:

1. Obtain a surveyed cross section at the passage reach.

2. Measure the water surface elevation and collect corresponding local flow data.

3. Classify substrate and channel uniformity to evaluate the applicable range of roughness values (Appendix Table A-2).

4. Obtain the reach energy gradient from on-site water surface measurements or from thalweg water surface profiles (Quane et al. 1984).

5. Calibrate Manning's Equation by adjusting the roughness and gradient values.

The roughness coefficient and gradient values were adjusted during equation calibration to reflect site conditions, as represented by the measured water surface elevation and the local flow evaluated in the Local Flow Distribution analysis. The roughness coefficient value for a passage reach was varied within the appropriate range until the flow calculated with the Manning Equation approximated the measured flow. For passage reaches where the variations in roughness coefficient values did not yield an appropriate flow, the gradient values were adjusted. The average of minimum water surface slope was selected to represent the energy gradient if slopes from adjacent passage reaches were similar to the modified value. Alternatively, the slope of the reach was calculated from the thalweg water surface profile (Quane et al. 1984) and used when calculated and measured flow compared well.

At the few passage reaches lacking surveyed water surface elevations, Manning's Equation was calibrated by comparison with calibrated

Appendix Table A-2. Ranges of Manning's roughness coefficients as a function of substrate size and channel uniformity.

Substrate Material	Manning's Roughness Coefficient Uniform Channel (u)	Manning's Roughness Coefficient Non-uniform Channel (nu)
Sand/Silt (A)	Au 0.03 - 0.07	Anu 0.05 - 0.09
Sand/Silt and Gravel/Rubble/Cobble (B)	Bu 0.05 - 0.10	Bnu 0.07 - 0.12
Rubble/Cobble/Boulder (C)	Cu 0.06 - 0.12	Cnu 0.08 - 0.14

equations from adjacent and similar passage reaches. The passage reach energy gradient, substrate size and channel uniformity were used as indices of similarity.

At passage reaches with a wide, rocky, non-uniform cross section, a potentially significant proportion of local flow at the passage reach may be excluded by the flow computations using the surveyed cross section data. An example of such a cross section is Passage Reach I at Slough 9A (Appendix Figure D-22). Following the calibration of the Manning Equation with roughness coefficient and gradient values within reasonable limits, the Manning Equation at such sites calculated less flow at a passage reach than the estimated flow. The calculated flow was then subtracted from the measured flow to estimate the amount of passage reach flow that was excluded using the surveyed cross section. The excluded flow passes amongst the rocks in voids which are not surveyed using normal surveying techniques. The excluded flow was assumed to be a constant amount that would be underpredicted by the calibrated Manning Equation for all depths in the range considered for this study. To evaluate the total passage reach flow, the excluded flow was added to the flow calculated using the Manning Equation. Appendix Table A-3 lists the values selected for calibration and the excluded flow at affected passage reaches.

Frequency of Occurrence Analysis

The frequency of occurrence of local flows at passage reaches may be evaluated through the analysis of the flow contributions from groundwater and precipitation runoff. Appendix Table A-4 presents the local flows and their corresponding frequencies of occurrence. The general approach used to evaluate the frequency of occurrence corresponding to a specified local flow is described below:

1. Calculate the base flow for the period from August 20 to September 20 at the R&M gage using the mainstem versus slough discharge relationship. If a relationship has not been evaluated at the site, assume a base flow at Passage Reach I from the local flow data collected at known mainstem flows.

2. Evaluate the base flow at each passage reach by multiplying the base flow from Step 1 by the percent groundwater flow value obtained through the Local Flow Distribution analysis.

3. Evaluate the required surface water by subtracting the base flow from the estimated local flow required for successful passage.

4. Calculate the basin area upstream of the passage reach contributing surface runoff.

5. Calculate the precipitation necessary to yield the required surface water.

Appendix Table A-3. Values of Manning's roughness coefficient, energy gradient, and excluded flow for calibration of Manning's equation.

Study Site	Passage Reach	Substrate and Channel Uniformity Category[a]	Manning's Roughness Coefficient	Energy Gradient	Excluded Flow (cfs)
Whiskers Creek Slough	I	Bnu	0.11	0.00893	5.0
	II	Cu	0.06	0.00937	0.5
Mainstem 2 Side Channel	I	Bnu	0.12	0.00395	0
	II	Bnu	0.11	0.00615	0
	III	Cnu	0.13	0.01342	0
	IVL	Cnu	0.13	0.00235	0
	IVR	Cnu	0.13	0.02445	0
	VR	Cnu	0.13	0.02350	0
	VIR	Cu	0.08	0.00167	0
	VIIR	Cnu	0.13	0.00574[b]	0
	VIIIR	Bnu	0.11	0.00574	0
Slough 8A	I	Bnu	0.11	0.0015[c]	0
	II	Bu	0.08	0.0331	0
	III	Bnu	0.09	0.0331[b]	0
	IV	Bu	0.08	0.00742	0
	V	Bu	0.08	0.00742[b]	0
	VI	Cnu	0.12	0.0725	0
	VII	Cu	0.10	0.01179	0
	VIII	Bnu	0.09	0.0106	0.4
	IX	Cnu	0.12	0.0075	0.4
	X	Cnu	0.13	0.01826	0
Slough 9	I	Anu	0.05	0.00123	3.6
	II	Bnu	0.08	0.0107	0.8
	III	Bnu	0.09	0.000595	0.6
	IV	Bnu	0.09	0.00053	0.5
	V	Bnu	0.08	0.00053[b,d]	0
Slough 9A	I	Cnu	0.11	0.00403[b]	3.0
	II	Bnu	0.08	0.00403	1.9
	III	Bu	0.07	0.0188	0
	IV	Bu	0.07	0.0089	0.9
	V	Cnu	0.11	0.01818	0
	VI	Bnu	0.08	0.02286	2.3
	VII	Bnu	0.08	0.0118	0
	VIII	Cnu	0.14	0.00956	0
	IX	Cnu	0.11	0.0153	0
	X	Cnu	0.13	0.0056[d]	1.1
	XI	Bnu	0.08	0.01071	0

Appendix Table A-3 (Continued).

Study Site	Passage Reach	Substrate and Channel Uniformity Category[a]	Manning's Roughness Coefficient	Energy Gradient	Excluded Flow (cfs)
Slough 11	I	Cnu	0.12	0.00783[e]	0.7
	II	Bu	0.07	0.0064	0.4
	III	Bnu	0.08	0.0080	0
	IV	Cnu	0.11	0.01	0
	V	Cnu	0.10	0.00171[e]	0
	VI	Cnu	0.12	0.00913[d]	0
	VII	Cnu	0.11	0.00073[d]	0.4
Upper Side Channel 11	I	Cnu	0.11	0.0099	0.4
	II	Cnu	0.11	0.0177	0
Slough 19	I	Bu	f	f	f
	II	Bu	f	f	f
	III	Bnu	f	f	f
	IV	Bnu	f	f	f
	V	Bnu	f	f	f
	VI	Au	0.05	0.00778[b]	0
	VII	Bu	0.06	0.00778	0
	VIII	Au	0.05	0.00380	0
	IX	Bu	0.06	0.02	0
Slough 20	I	Cnu	0.14	0.0741[c]	0
	II	Bnu	0.11	0.0026[c]	0
	III	Bnu	0.11	0.0026[c]	0
	IV	Bnu	f	f	f
	V	Bnu	f	f	f
	VI	Bnu	0.11	0.016[c]	0
Side Channel 21	I	Bnu	0.08	0.009	0
	II	Bnu	0.07	0.015[b]	0.8
	III	Bnu	0.07	0.015[b]	1.2
	IV	Cnu	0.13	0.01519	0
	V	Cnu	0.13	0.01519[b]	0
	VI	Bnu	0.08	0.015[b]	1.2
	VII	Bnu	0.08	0.015[b]	0.8
	VIII	Bnu	0.07	0.02	0.8
	IX	Bnu	0.07	0.00902	0.8

Appendix Table A-3 (Continued).

Study Site	Passge Reach	Substrate and Channel Uniformity Category[a]	Manning's Roughness Coefficient	Energy Gradient	Excluded Flow (cfs)
Slough 21	I	Anu	0.07	0.00193	0
	II	Bu	0.06	0.00453	0
	IIIR	Cnu	0.10	0.00802	0
	IIIL	Cnu	0.10	0.00802	0
Slough 22	I	Cnu	0.13	0.02269	1.0
	II	Cnu	0.13	0.00833	0.5
	III	Cnu	0.13	0.01842	0.5

[a] Substrate and channel uniformity categories are taken from Table 3 in Section 2.3.2.4.

[b] Gradient from adjacent passage reach gradients.

[c] Gradient from entire thalweg reach.

[d] Average of upstream and downstream gradient.

[e] Minimum of upstream and downstream gradient.

[f] No cross section data available.

Appendix Table A-4. Frequency of occurrence of local flows for successful (S) and unsuccessful (US) passage for a baseflow correspoding to 15,000 cfs Susitna River discharge at Gold Creek and including precipitation values from August 20 to Septebmer 20.

Study Site	Passage Reach	Basin[a] Area	Percent Runoff	Base Flow (cfs) at 15,000 cfs	Required Local Flow (cfs)		Required Surface Water (cfs)		Required Site Precipitation (in)		Precipitation Coefficient	Required Talkeetna Precipitation (in)		Percent Exceedence	
					S	US	S	US	S	U		S	US	S	US
Slough 8A	I	2.21	65	4.6	2.0	0.8	0.0	0.0	0	0	1.30	0	0	> 50	> 50
	II	1.91	65	1.4	5.0	2.0	3.6	0.6	0.205	0.034	1.30	0.157	0.026	22	38
	III	1.88	65	1.4	4.0	1.0	2.6	0.0	0.153	0	1.30	0.118	0	24	> 50
	IV	1.79	65	1.4	6.0	2.0	4.6	0.6	0.298	0.039	1.30	0.229	0.030	16	37
	V	1.74	65	1.3	6.0	2.0	4.7	0.7	0.322	0.048	1.30	0.248	0.037	15	35
	VI	1.45	65	2.6	3.0	0.6	0.4	0.0	0.042	0	1.30	0.032	0	36	> 50
	VII	1.31	65	2.3	7.0	3.0	4.7	0.7	0.665	0.099	1.30	0.511	0.076	7	28
	VIII	1.28	65	2.1	11.0	3.0	8.9	0.9	1.359	0.137	1.30	1.045	0.105	2	25
	IX	1.01	10	1.0	4.0	0.8	3.0	0.0	1.043	0	1.30	0.802	0	4	> 50
	X	0.81	10	0.8	2.0	0.4	1.6	0.4	0.735	0.183	1.30	0.565	0.141	6	22
Slough 9	I	2.89	65	4.0	5.0	4.0	1.0	0.0	0.036	0	1.20	0.030	0	37	> 50
	II	2.04	65	3.6	6.0	3.0	2.4	0.0	0.182	0	1.20	0.152	0	22	> 50
	III	1.83	65	1.3	5.0	2.0	2.7	0.0	0.284	0	1.20	0.237	0	16	> 50
	IV	1.62	65	1.9	3.0	1.0	1.1	0.0	0.189	0	1.20	0.157	0	27	> 50
	V	1.52	10	0.7	2.0	0.8	1.3	0.1	0.318	0.024	1.20	0.265	0.020	14	40
Slough 9A	I	2.27	40	5.7	9.0	4.0	3.3	0.0	0.135	0	1.10	0.123	0	24	> 50
	II	2.27	40	4.5	3.0	2.0	0.0	0.0	0.0	0	1.10	0	0	> 50	> 50
	III	2.27	40	4.0	4.0	2.0	0.0	0.0	0.0	0	1.10	0	0	> 50	> 50
	IV	.35	40	3.5	4.0	2.0	0.5	0.0	0.133	0	1.10	C.121	0	24	> 50
	V	.35	40	3.4	4.0	3.0	0.6	0.0	0.159	0	1.10	0.144	0	22	> 50
	VI	.35	40	3.1	6.0	3.0	2.9	0.0	0.770	0	1.10	0.700	0	< 4	> 50
	VII	.21	40	2.5	4.0	1.0	1.5	0.0	0.664	0	1.10	0.604	0	< 6	> 50
	VIII	.17	40	2.3	9.0	3.0	6.7	0.7	3.664	0.383	1.10	3.330	0.348	0	11
	IX	.10	40	1.8	3.0	0.8	1.2	0.0	1.116	0	1.10	1.014	0	< 2	> 50
	X	.08	40	1.7	2.0	0.6	0.3	0.0	0.349	0	1.10	0.317	0	13	> 50
	XI	.02	40	1.4	9.0	3.0	7.6	1.6	35.331	7.438	1.10	32.119	6.762	0	0
Slough 11	I	0	10	2.2	4.0	1.0	1.8	0.0	d	d	1.07	d	d	< 5	> 50
	II	0	10	2.1	1.4	1.4	0.0	b	d	d	1.07	d	d	> 50	> 50
	III	0	10	1.8	9.0	3.0	7.2	1.2	d	d	1.07	d	d	< 5	< 5
	IV	0	10	1.4	3.0	1.0	1.6	0.0	d	d	1.07	d	d	< 5	> 50
	V	0	10	1.0	3.0	1.0	2.0	0.0	d	d	1.07	d	d	< 5	> 50
	VI	0	10	0.7	2.0	0.6	1.3	0.0	d	d	1.07	d	d	< 5	> 50
	VII	0	10	0.2	0.5	0.4	0.3	0.2	d	d	1.07	d	d	< 5	< 5

Appendix Table A-4 (Continued).

Study Site	Passage Reach	Basin[a] Area	Percent Runoff	Base Flow (cfs) at 15,000 cfs	Required Local Flow (cfs)		Required Surface Water (cfs)		Required Site Precipitation (in)		Precipitation Coefficient	Required Talkeetna Precipitation (in)		Percent Exceedence	
					S	US	S	US	S	U		S	US	S	US
Upper Side Channel 11	I	0	10	8.0[c]	8	2.0	0	0	d	d	1.07	d	d	>50	>50
	II	0	10	6.0[c]	b	b	b	b	d	d	1.07	d	d	e	e
Side Channel 21	I	5.03	65	7.6	5	2.0	0	0	0	0	1.07	0	0	>50	>50
	II	5.03	65	7.5	7	3.0	0	0	0	0	1.07	0	0	>50	>50
	III	5.03	65	7.3	7	3.0	0	0	0	0	1.07	0	0	>50	>50
	IV	0.84	40	3.3	4	1.0	0.7	0	0.122	0	1.07	0.122	0	24	>50
	V	0.70	40	3.3	4	1.0	0.7	0	0.166	0	1.07	0.166	0	21	>50
	VI	0.66	40	6.4	17	4.0	10.6	0	2.796	0	1.07	2.796	0	< 5	>50
	VII	0.64	40	5.4	20	5.0	14.6	0	4.082	0	1.07	4.082	0	0	>50
	VIII	0.61	40	4.3	7	2.0	3.7	0	0.830	0	1.07	0.830	0	0	>50
	IX	0.53	40	4.1	5	2.0	0.9	0	0.376	0	1.07	0.376	0	3	>50
Slough 21	I	0.41	10	3.3	4	1.0	0.7	0	0.635	0	1.07	0.635	0	< 5	>50
	II	0.32	10	2.8	2	0.4	0	0	0	0	1.07	0	0	>50	>50
	IIIL	0.16	10	0.8	3	0.8	2.2	0	5.114	0	1.07	5.114	0	5	>50
	IIIR	0.16	10	1.1	b	b	d	d	d	d	1.07	d	d	e	e

[a] Basin area evaluated from topographic maps from the United States Geological Survey (Scale 1:63,360), Talkeetna Mts C-6, D-1 and D-6.

[b] Cross section data not collected in field; required local flow cannot be evaluated.

[c] Local flow estimated from field observations.

[d] Precipitation does not yield a surface water contribution to local flow as no tributaries are located upstream of the passage reach and runoff infiltrates alluvium soil.

[e] Exceedence frequencies cannot be evaluated as local flow data are not available.

6. Use the Precipitation Duration Curve at Talkeétna for August (Appendix Figure A-2) and adjust the daily precipitation by the coefficients listed in Appendix Table A-5 to obtain the frequency of occurrence.

7. Repeat steps 3 through 6 using the local flow estimated for unsuccessful passage.

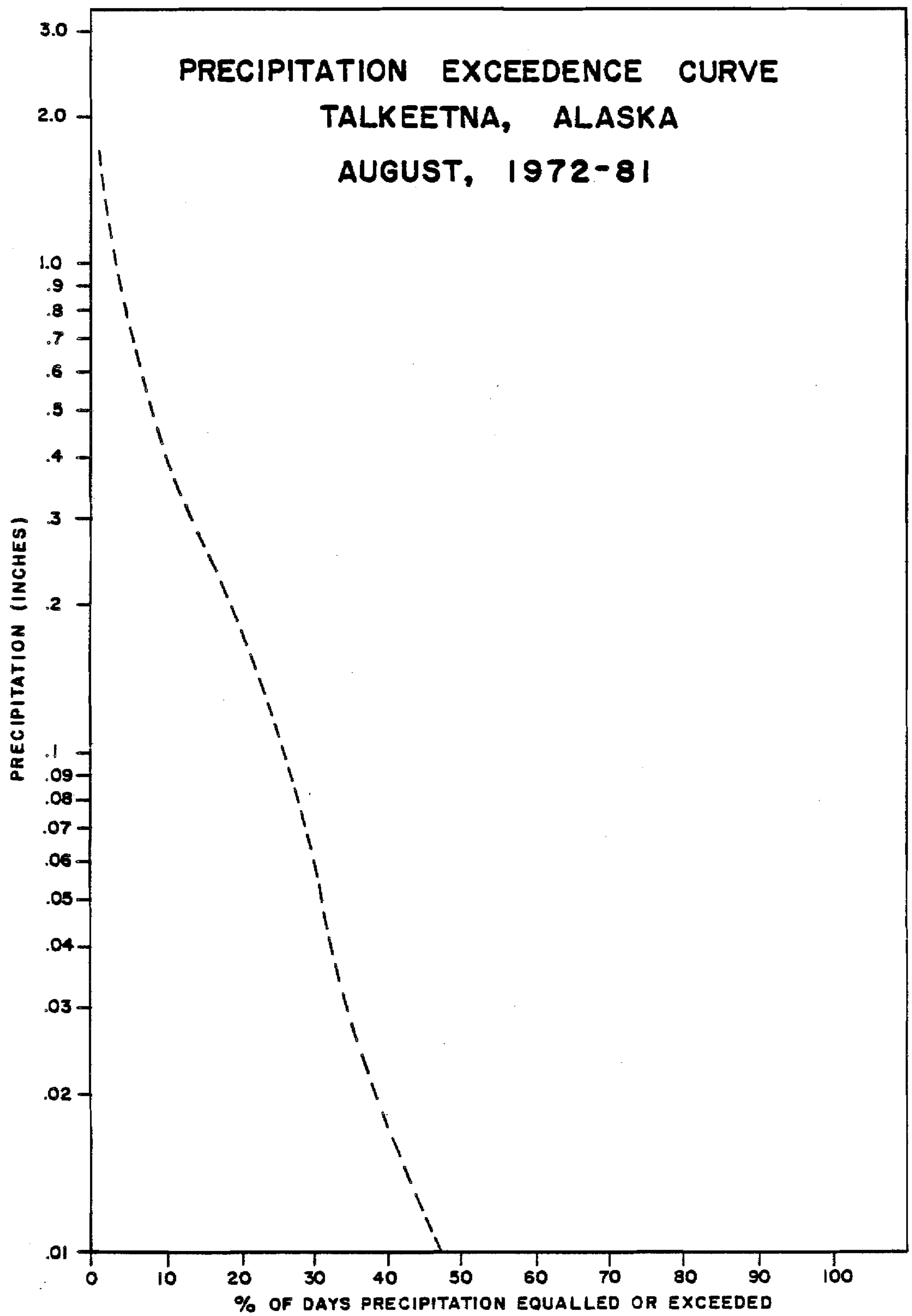
Base flows from groundwater contributions in the sloughs and side channels were evaluated at the average mainstem discharge during the period from August 20 to September 20. The average Susitna River discharge at Gold Creek for this period was estimated to be 15,000 cfs determined from the flow duration curve developed in Sautner et al. (1984). The slough versus mainstem stage relationships used to evaluate the base flows at Sloughs 8A, 9, and 11 (H-E 1985) are listed below:

$Q8A = -368.211 + 0.6356\ W_{sel}$ at RM 127.1
$Q9 = -171.8788 + 0.28892\ W_{sel}$ at RM 129.3
$Q11 = -335.39272 + 0.49209\ W_{sel}$ at RM 136.68.

Rating curves were used to estimate mainstem discharges at Gold Creek from water surface elevations at specific river miles (R&M 1985). At sloughs and side channels where local flow versus mainstem stage relationships have not been evaluated, base flows corresponding to a 15,000 cfs mainstem discharge at Gold Creek were estimated from local flow data. Slough flows, measured on dates when the mainstem discharge was 15,000 cfs, provided an estimate of base flows. Alternatively, local flows measured at the same site on different days were plotted and extrapolated to yield a base flow for a mainstem discharge of 15,000 cfs. Data collected during periods of high precipitation were excluded. Appendix Table A-6 lists the base flows evaluated at specific sites.

Precipitation events were assumed to contribute rainfall for 24 hours to permit comparison with the August Precipitation Duration Curve (R&M 1984a). The Precipitation Duration Curve (Appendix Figure A-2) was developed from daily precipitation records from 1972 to 1981. The August Precipitation Duration Curve was assumed to be applicable to the August 20 to September 20 period as the rainfall records for August and September appeared similar when compared. Talkeetna records were adjusted using precipitation coefficients for transfer of recorded data (R&M 1984b).

Antecedent moisture conditions were assumed invariable and a constant surface water runoff to precipitation percentage was selected for each passage reach. Variations in soil moisture prior to rainfall events may affect the amount of precipitation which becomes surface water runoff; in the precipitation frequency analysis, these variations were assumed negligible. For Sloughs 8A, 9, 11 and 21, the runoff to precipitation percentages reflected known topographic and soil conditions and were selected from runoff coefficients presented in the R&M Consultants Water Balance report (R&M 1984b). Sloughs and side channels with primarily alluvial soil watersheds were assigned a runoff coefficient of 10



Appendix Figure A-2. August Precipitation Duration Curve for the period 1972-1981 at the Talkeetna Weather Station (Adapted from H-E 1984).

Appendix Table A-5. Precipitation coefficients for determining precipitation values at selected sloughs using precipitation values recorded at the Talkeetna weather station (derived from R&M 1984).

Study Site	River Mile	Precipiation[a] Coefficient
Slough 8A	125.3	1.3
Slough 9	128.3	1.2
Slough 9A	133.2	1.1
Slough 11	135.3	1.07
Slough 21	141.8	1.0

[a] To obtain precipitation estimates for above sloughs, multiply precipitation at Talkeetna by the appropriate coefficient.

Appendix Table A-6. Base flows for a mainstem discharge at Gold Creek of 15,000 cfs.

Study Site	Local Flow (cfs)	Location of Local Flow Evaluation
Slough 8A	2.0	R&M Gage
Slough 9	2.4	R&M Gage
Slough 9A	5.7	PRI
Slough 11	1.8	R&M Gage
Side Channel and Slough 21	3.5	R&M Gage

percent. Steep slopes in the watershed would increase runoff; a runoff coefficient of 65 percent would be used in the precipitation analysis. For sloughs and side channels with watersheds encompassing both steep side slopes and alluvial materials, a runoff coefficient of 40 percent was selected. Appendix Table A-4 lists the runoff coefficients used at each site.

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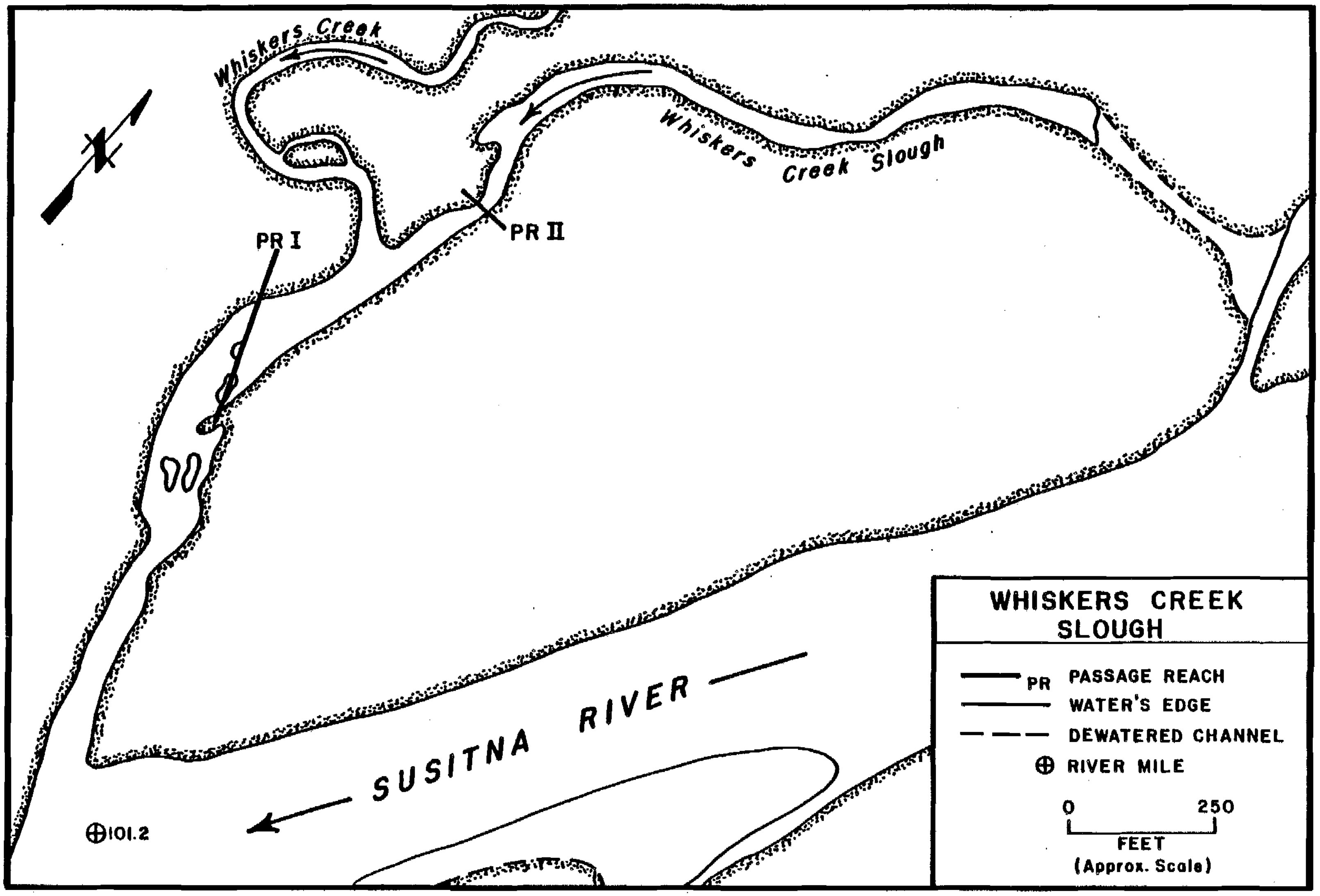
APPENDIX B

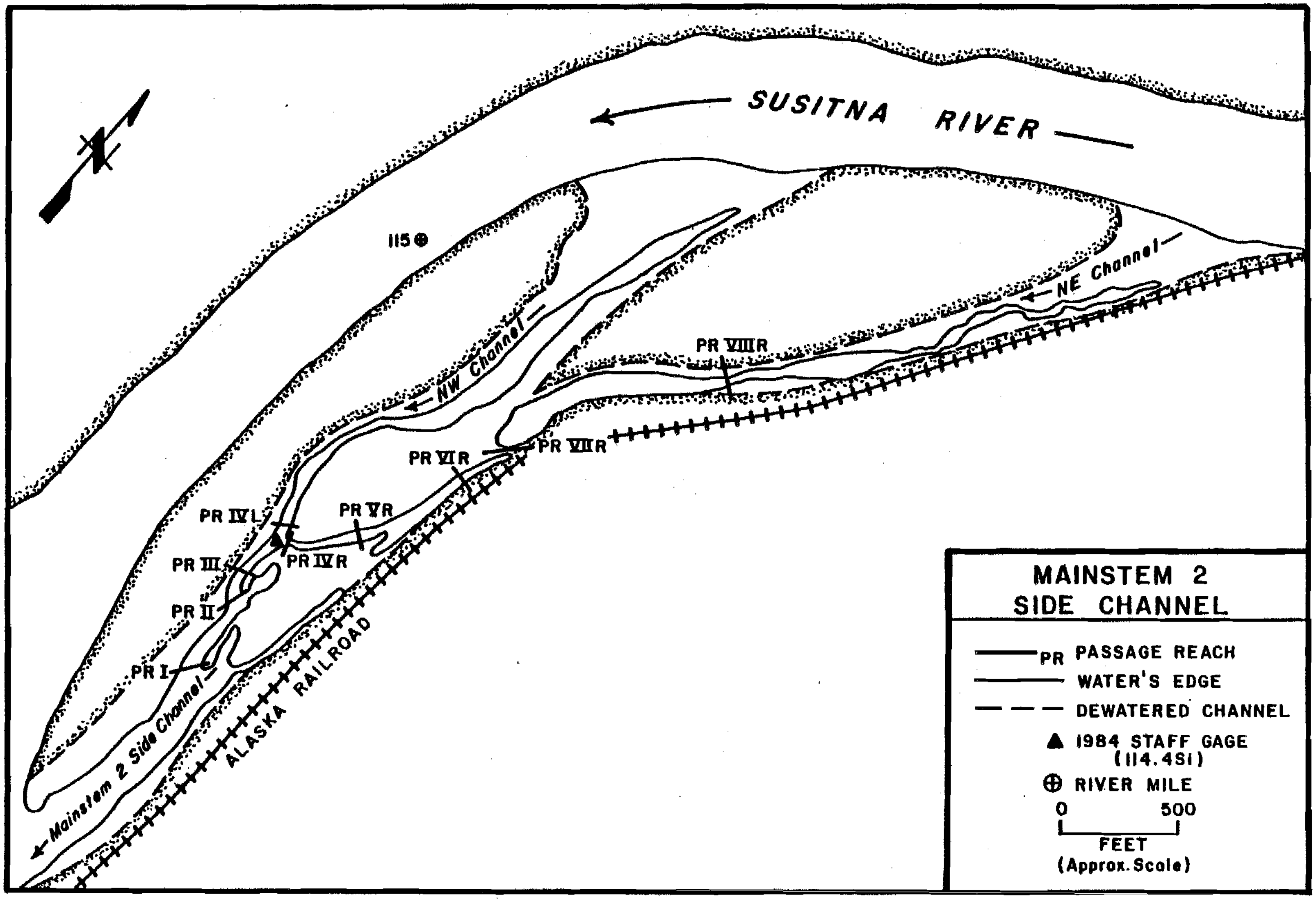
Passage Reach Distribution Maps

APPENDIX B: PASSAGE REACH DISTRIBUTION MAPS

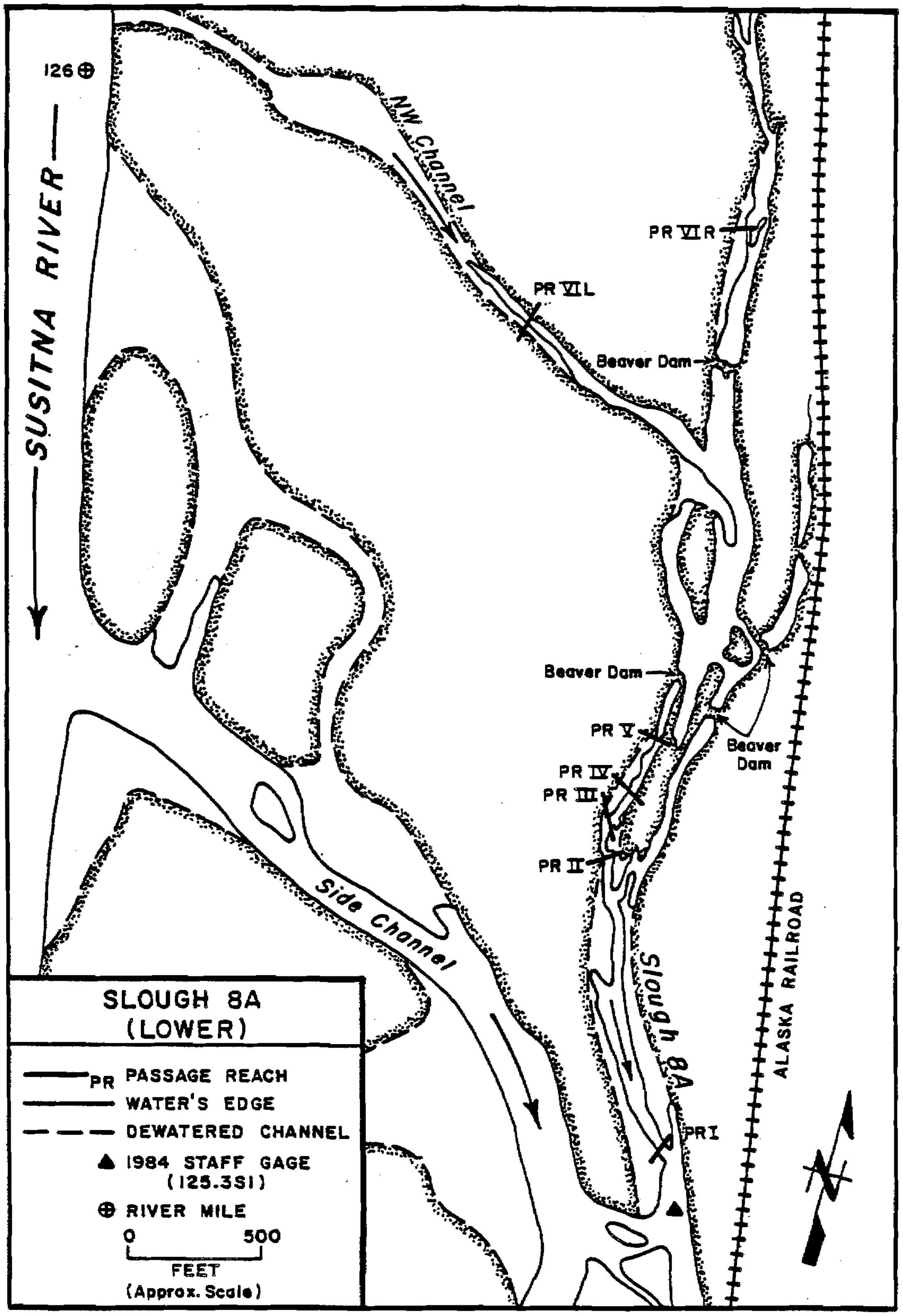
The maps compiled in this appendix show the locations of passage reaches at selected slough and side channel study sites of the middle Susitna River identified during the 1984 open water season (Appendix Figures B-1 to B-13). These maps have been revised from those appearing in Sautner et al. (1984) to show the wetted area of each site at unbreached flows. Locations of staff gages established in 1984 are designated on the appropriate site maps. These maps were derived from aerial photos of the middle Susitna River.



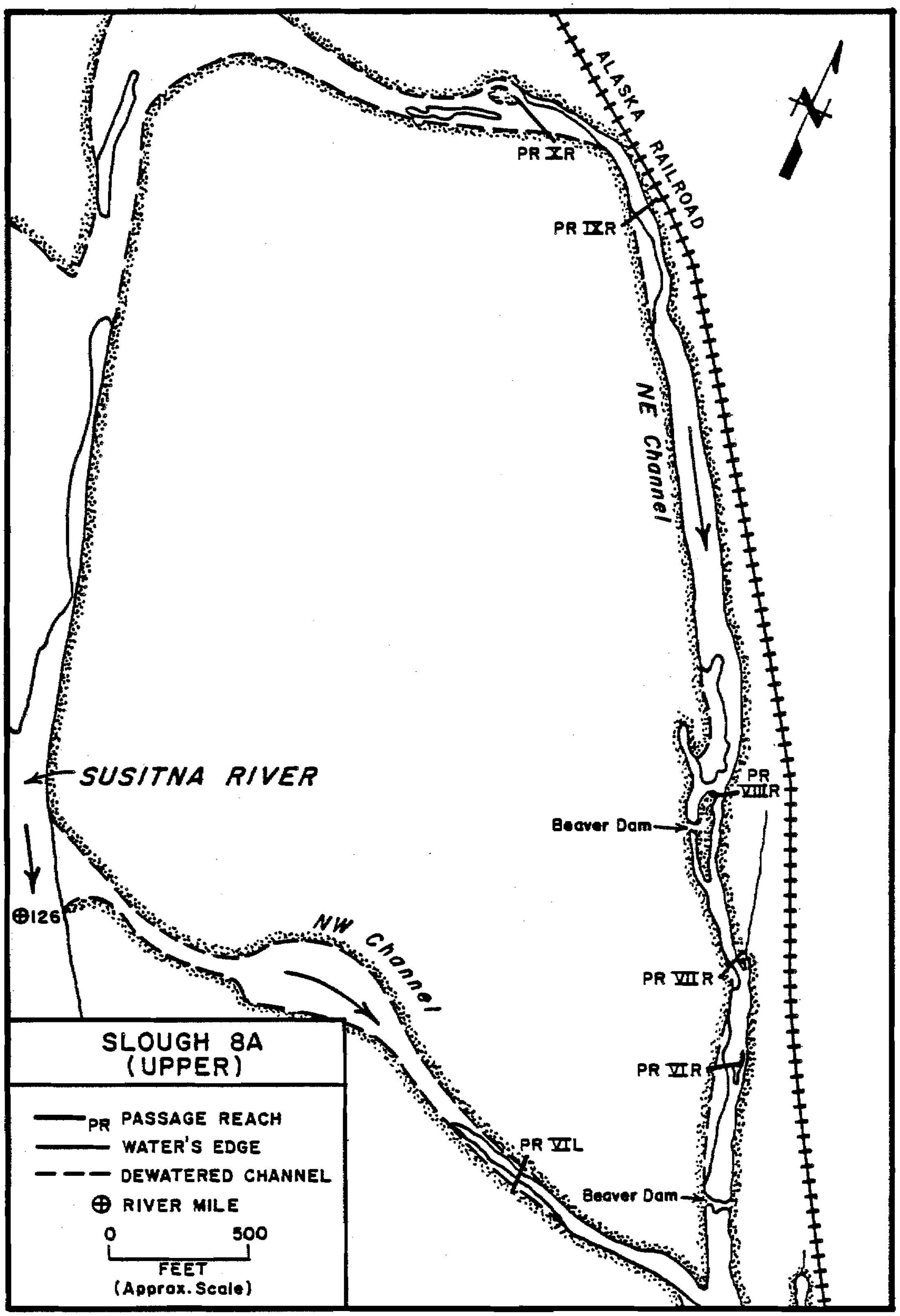
Appendix Figure B-1. Locations of passage reaches at Whiskers Creek Slough during the 1984 open water season.



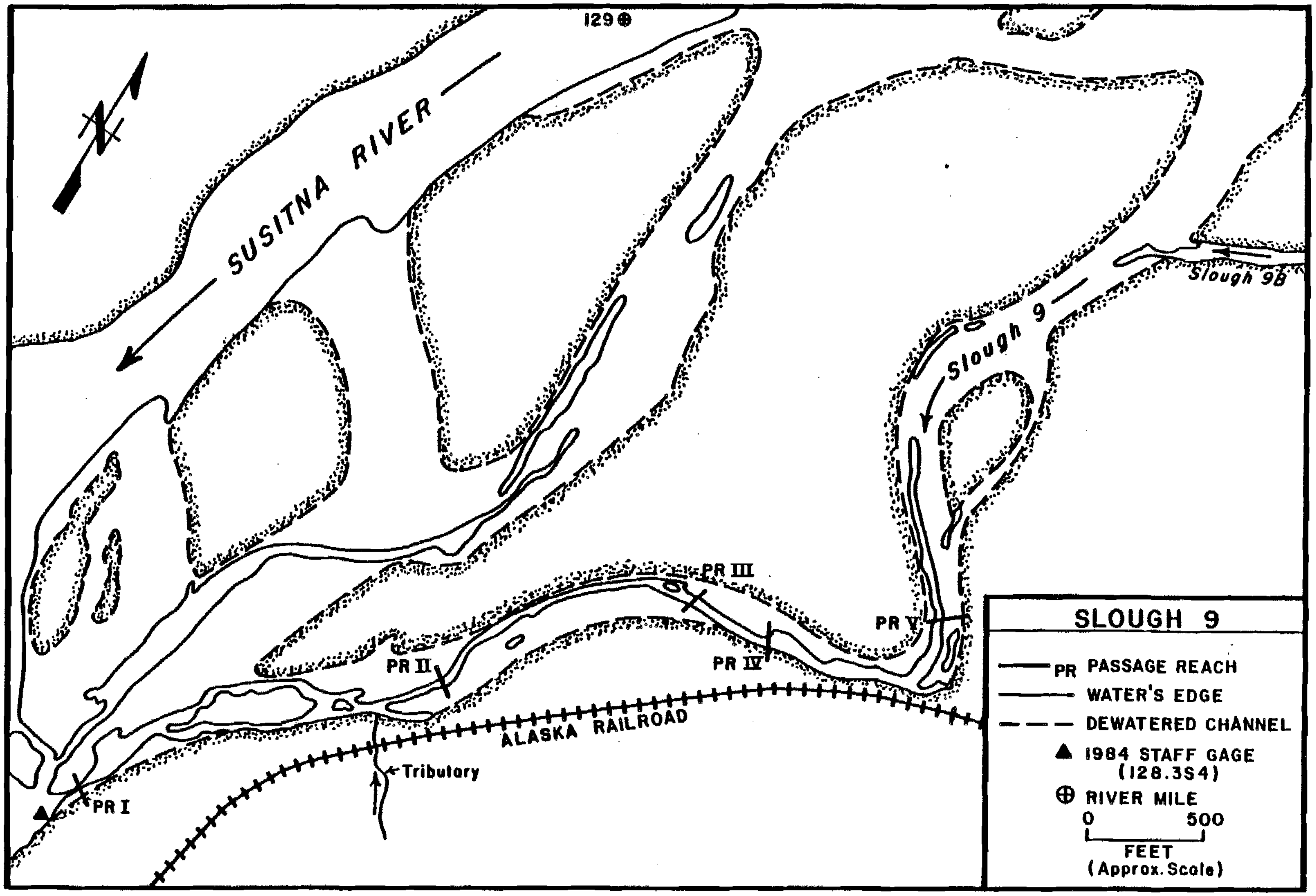
Appendix Figure B-2. Locations of passage reaches at Mainstem 2 Side Channel during the 1984 open water season.



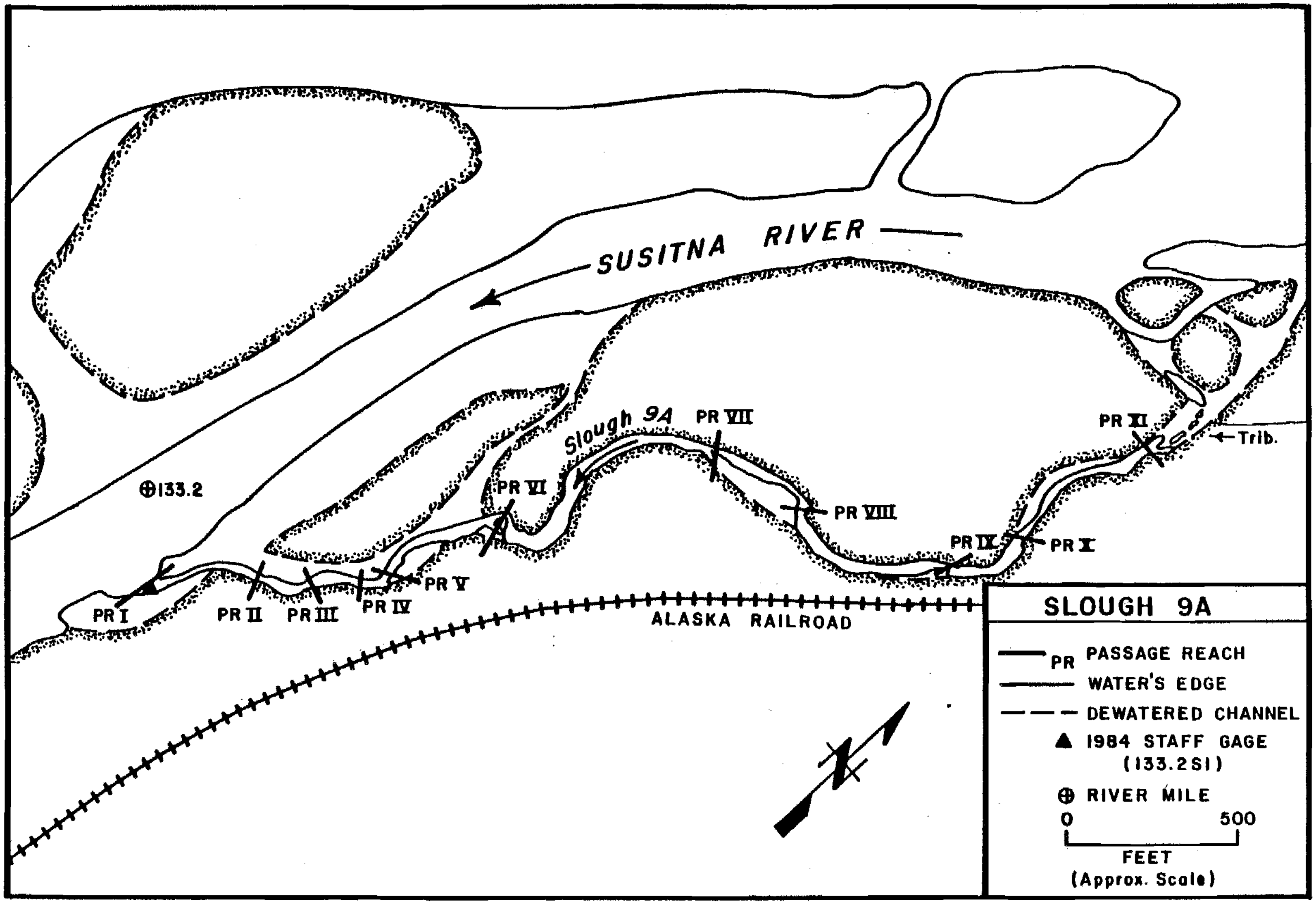
Appendix Figure B-3. Locations of passage reaches at Slough 8A (lower) during the 1984 open water season.



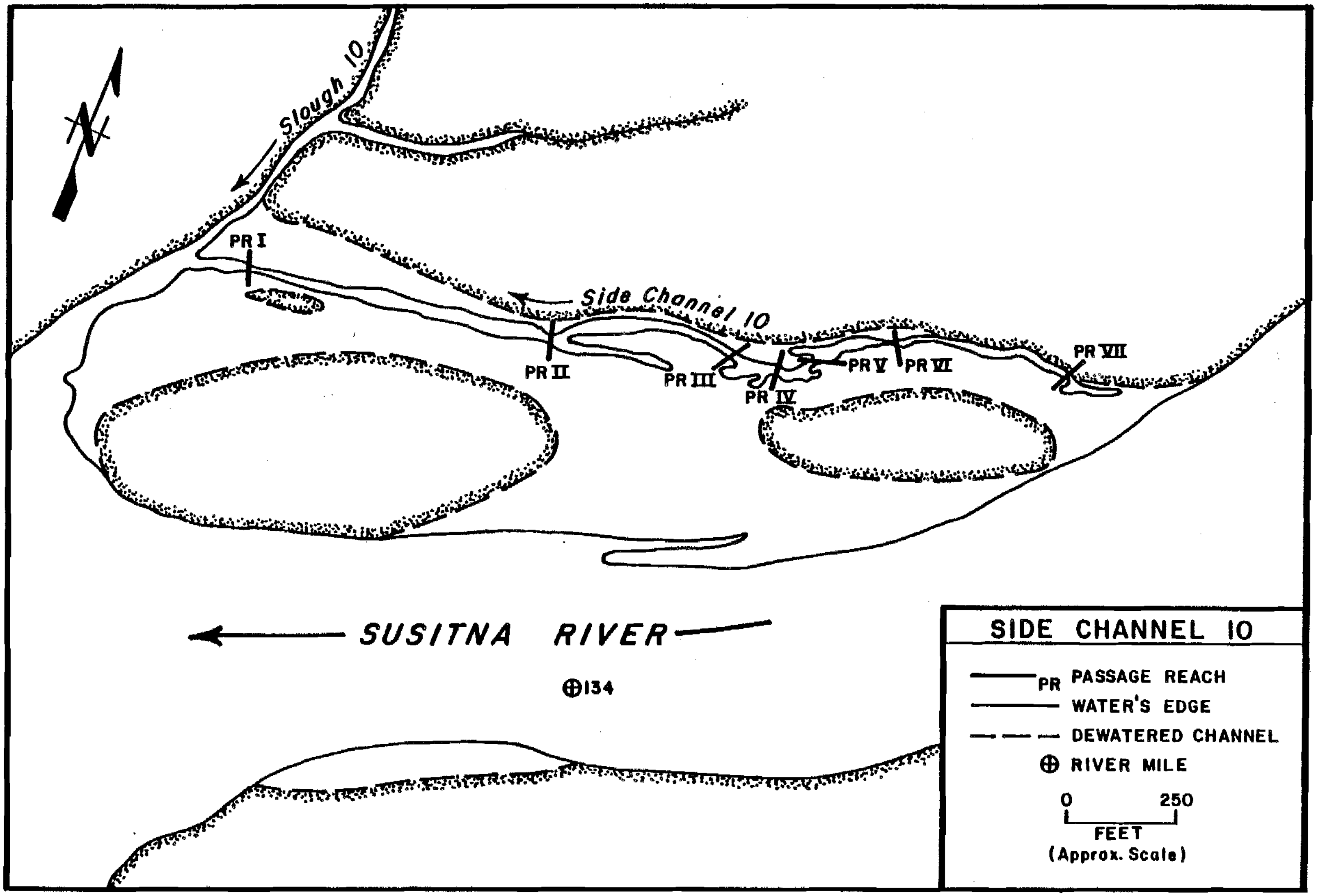
Appendix Figure B-4. Locations of passage reaches at Slough 8A (upper) during the 1984 open water season.



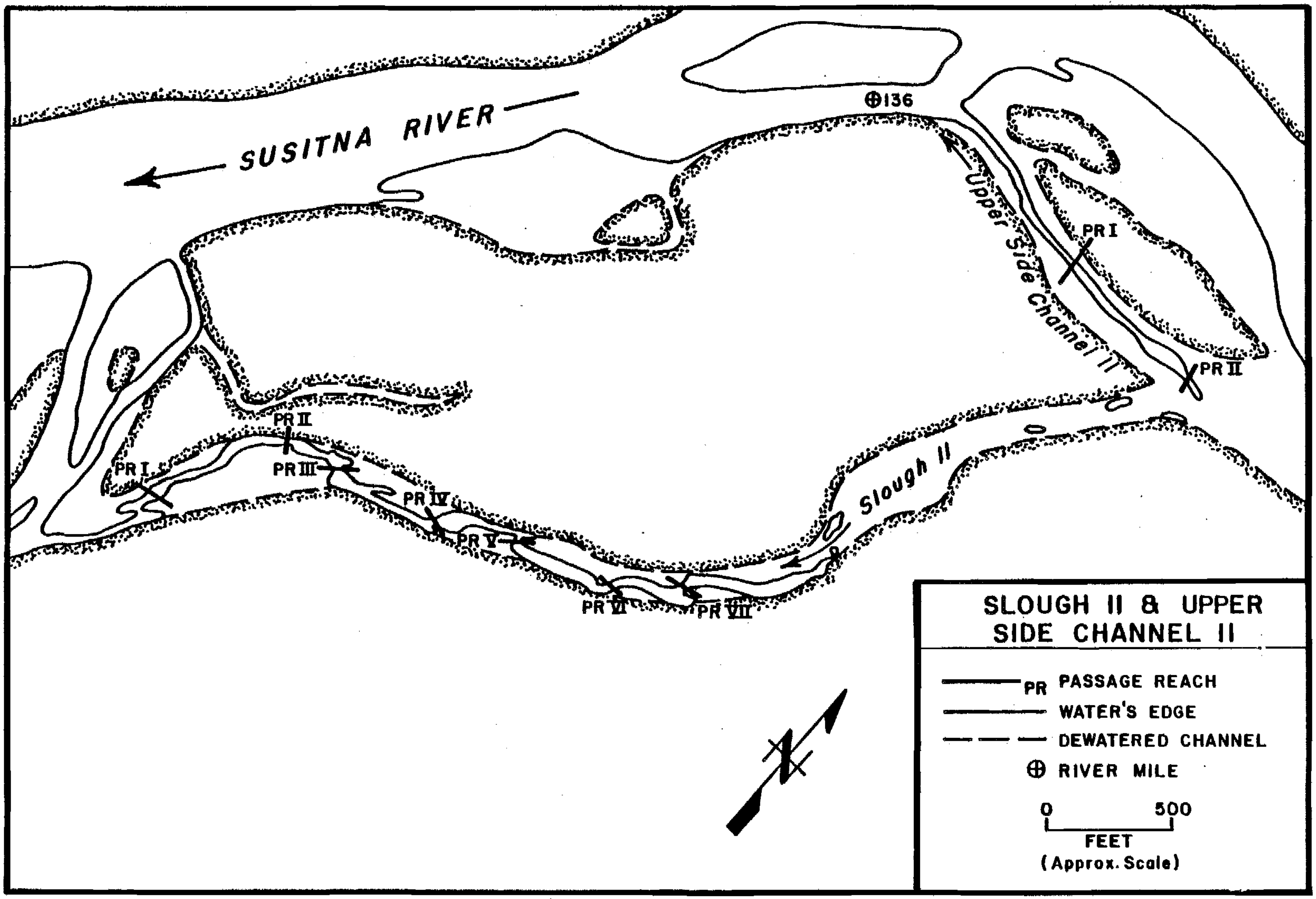
Appendix Figure B-5. Locations of passage reaches at Slough 9 during the 1984 open water season.



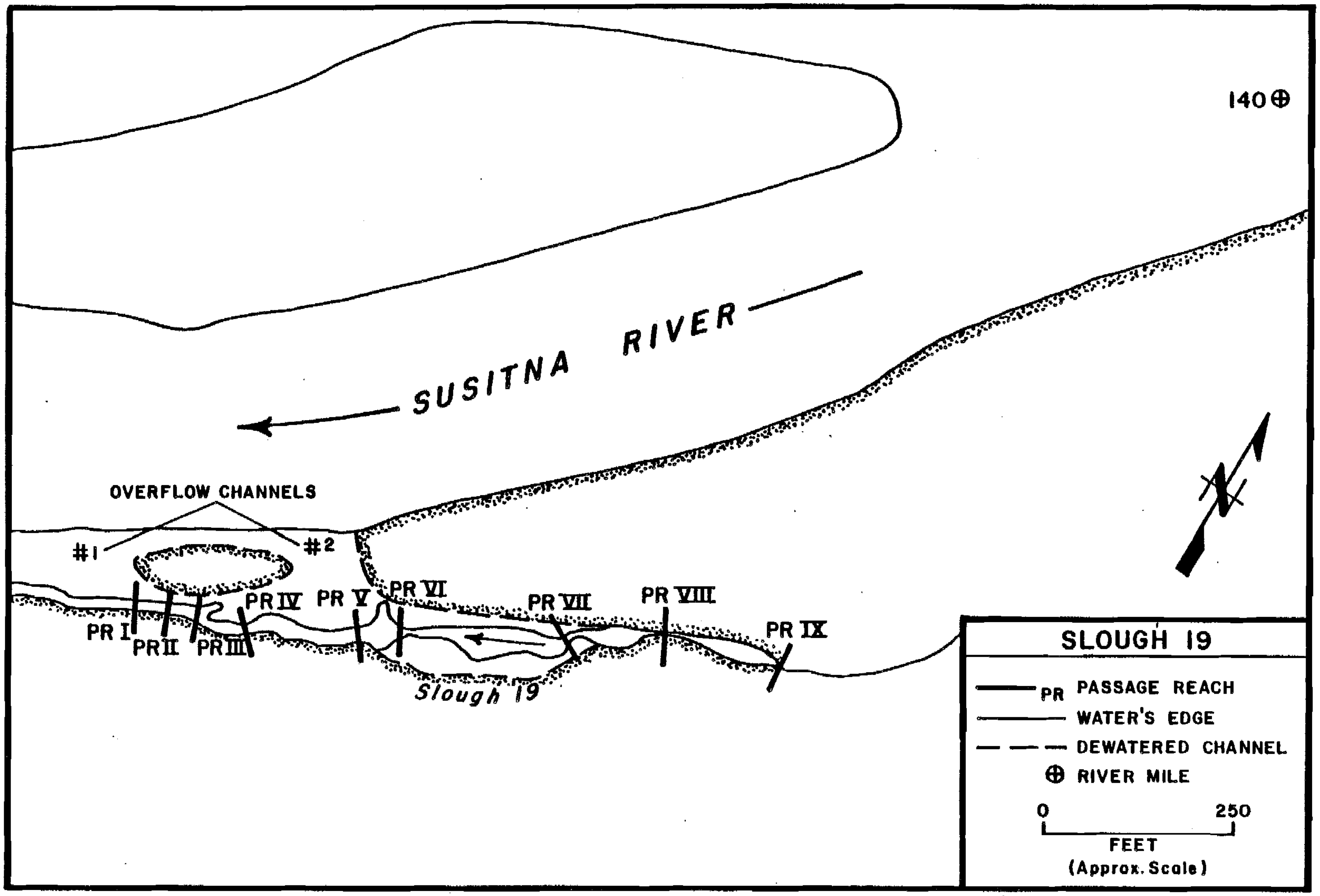
Appendix Figure B-6. Locations of passage reaches at Slough 9A during the 1984 open water season.



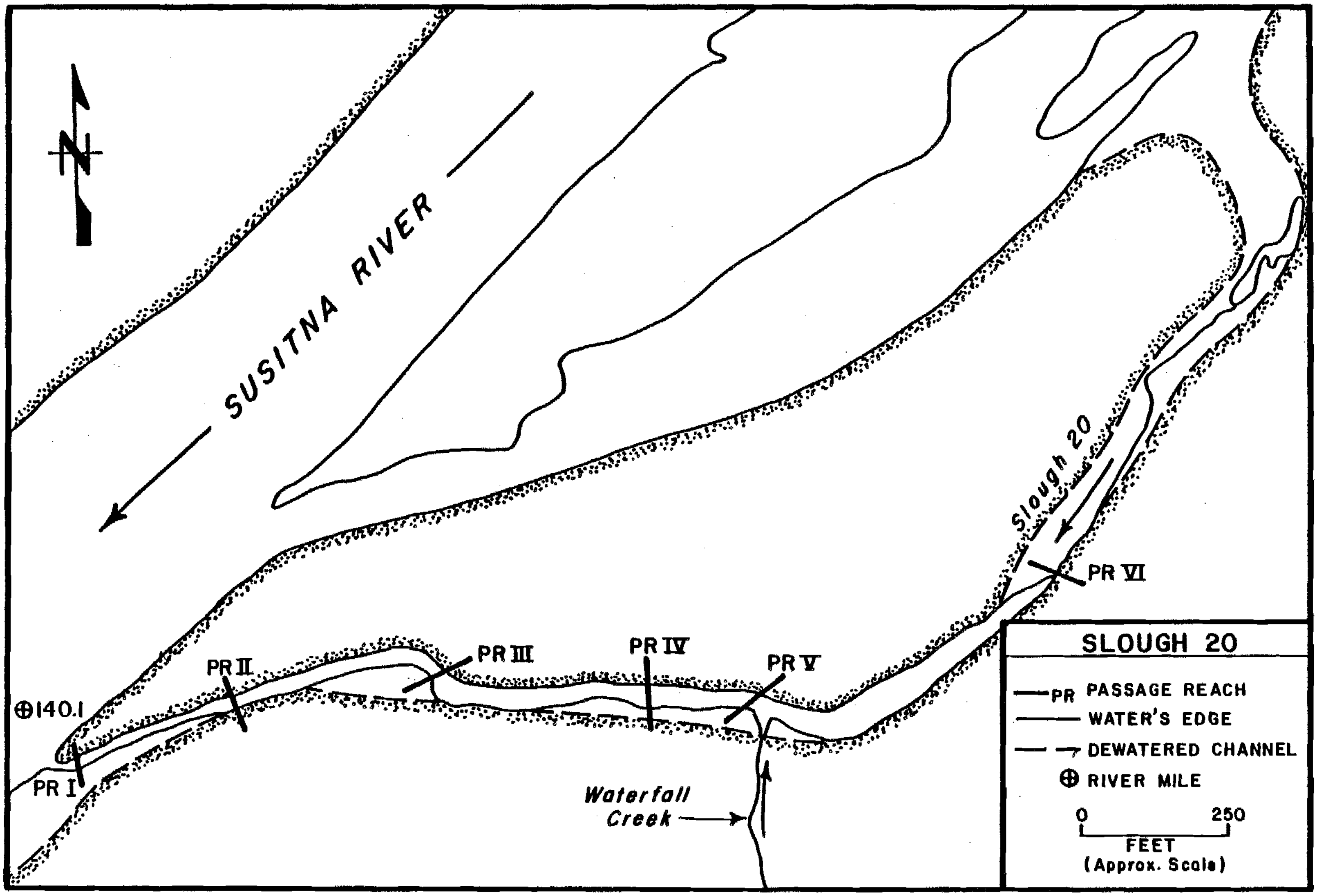
Appendix Figure B-7. Locations of passage reaches at Side Channel 10 as identified by the thalweg profile.



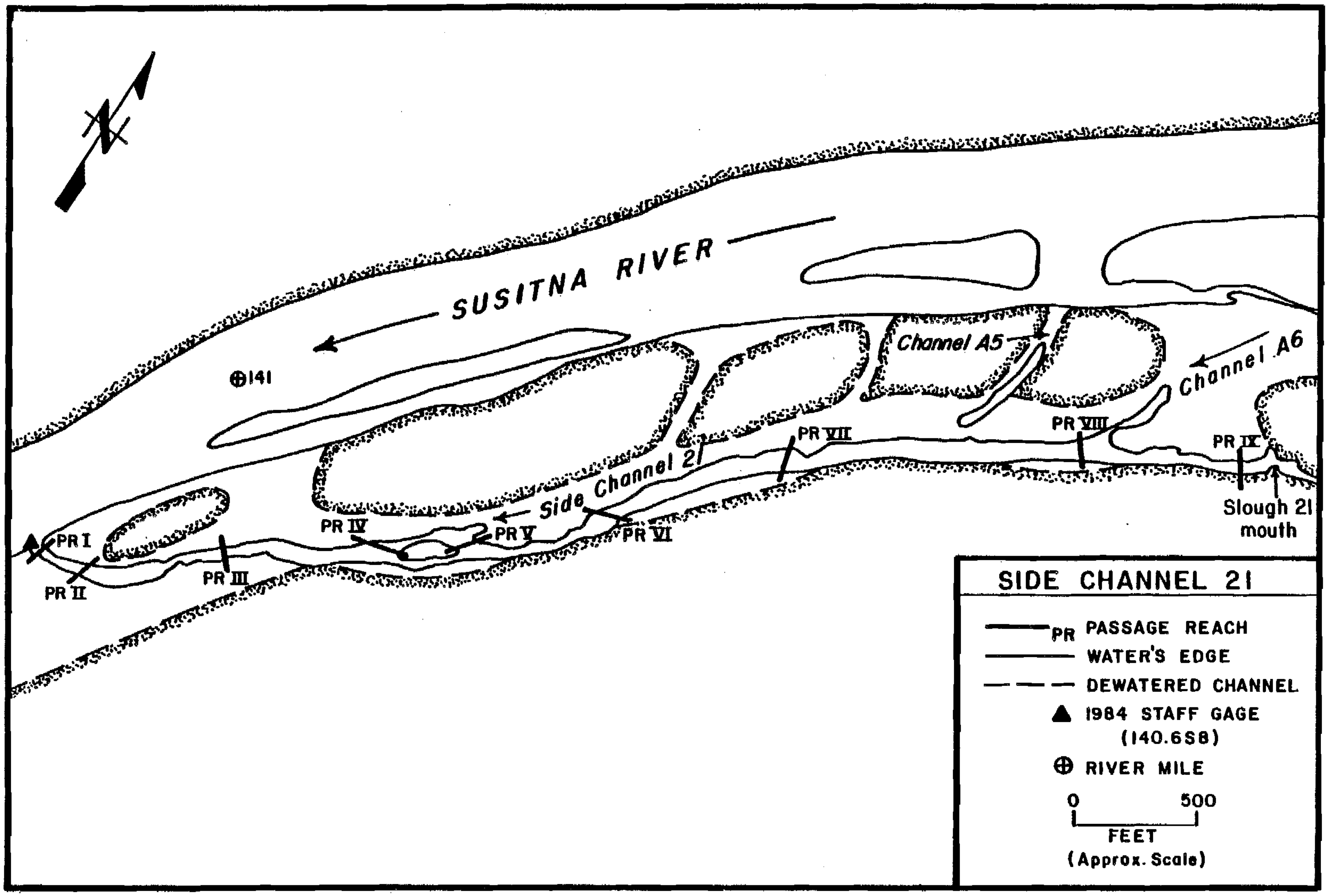
Appendix Figure B-8. Locations of passage reaches at Slough 11 and Upper Side Channel 11 during the 1984 open water season.



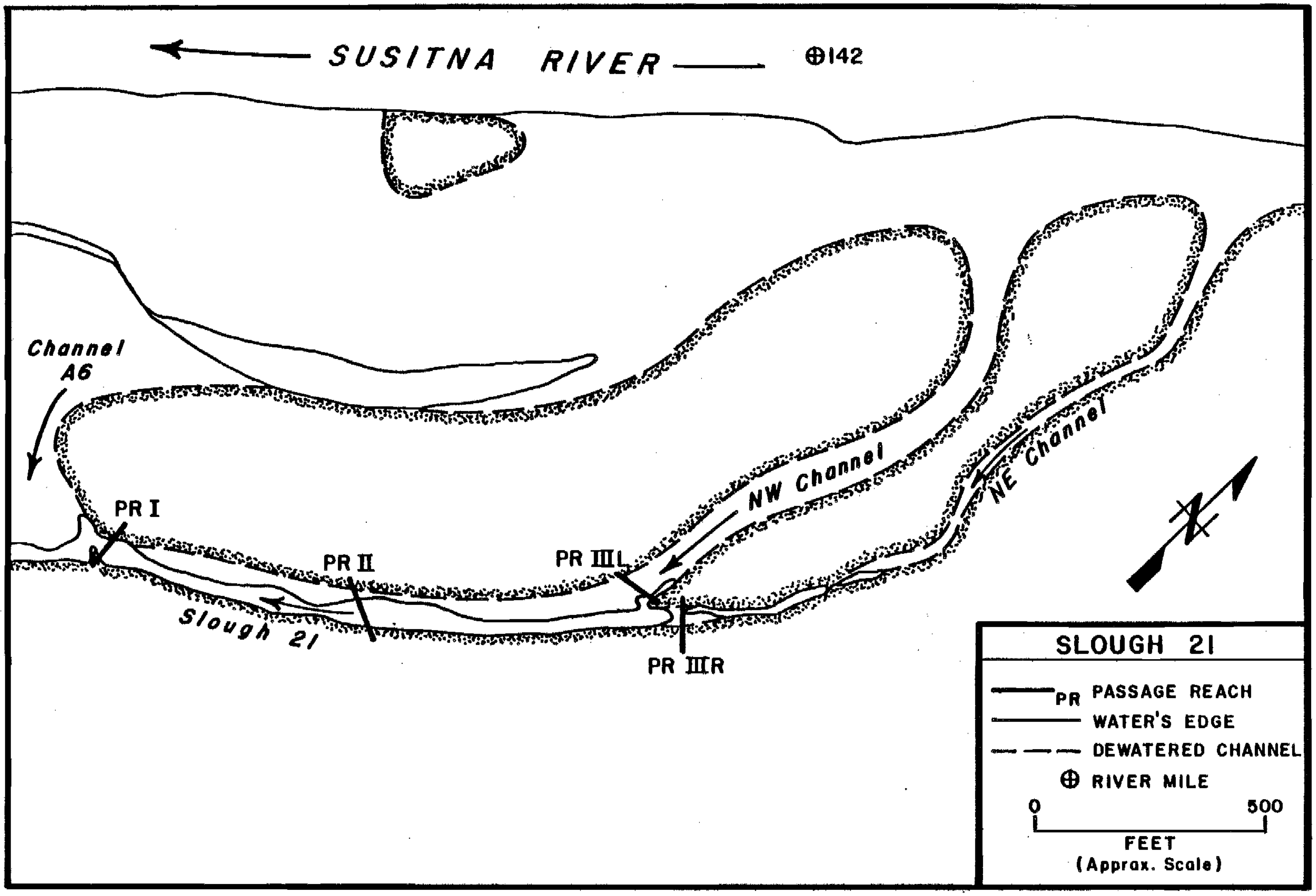
Appendix Figure B-9. Locations of passage reaches at Slough 19 during the 1984 open water season.



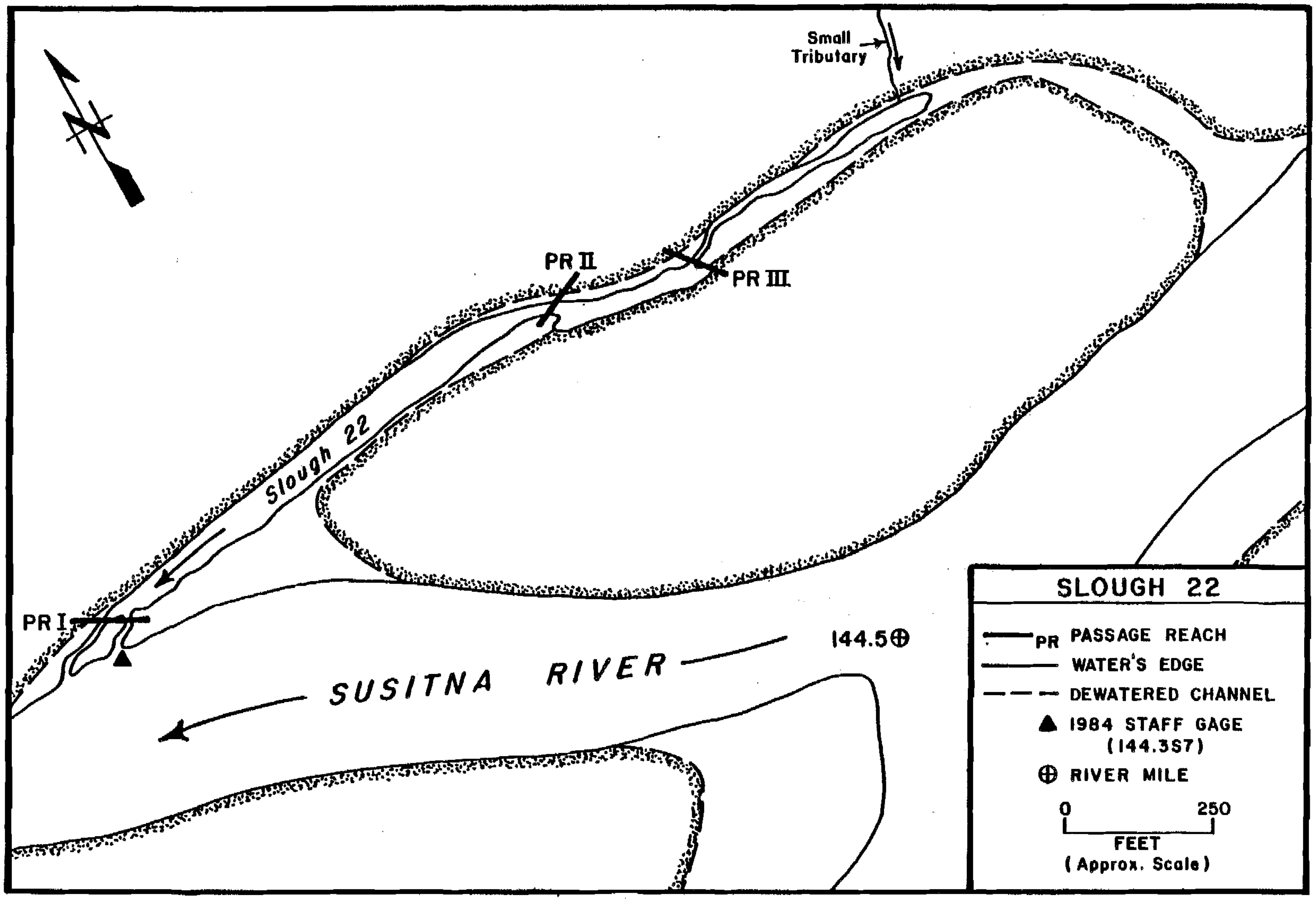
Appendix Figure B-10. Locations of passage reaches at Slough 20 during the 1984 open water season.



Appendix Figure B-11. Locations of passage reaches at Side Channel 21 during the 1984 open water season.



Appendix Figure B-12. Locations of passage reaches at Slough 21 during the 1984 open water season.



Appendix Figure B-13. Locations of passage reaches at Slough 22 during the 1984 open water season.

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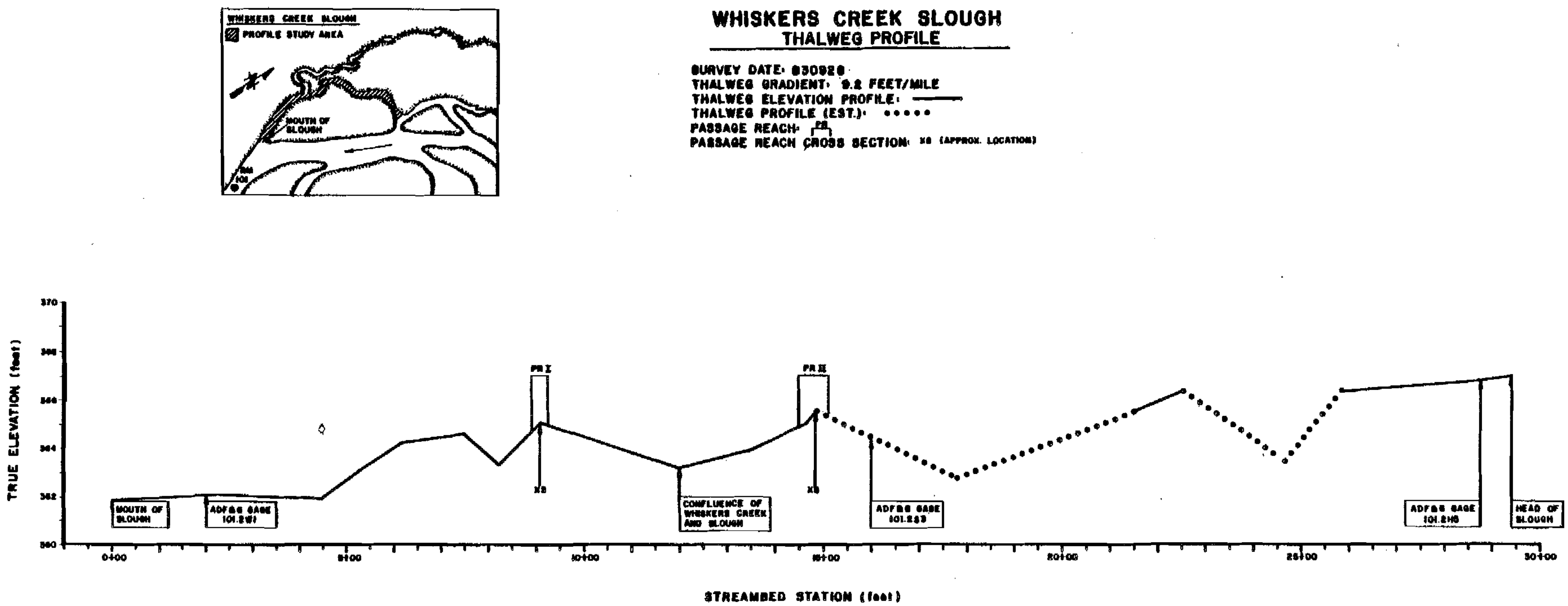
Sautner, J., L.J. Vining, and L.A. Rundquist. 1984. An evaluation of passage conditions for adult salmon in sloughs and side channels of the middle Susitna River. Chapter 6 in 1984 Report No. 3: Aquatic Habitat and Instream Flow Investigations (May-October 1983). Estes, C.C. and D.S. Vincent-Lang, eds. Alaska Department of Fish and Game Susitna Hydro Aquatic Studies. Anchorage, Alaska.

APPENDIX C

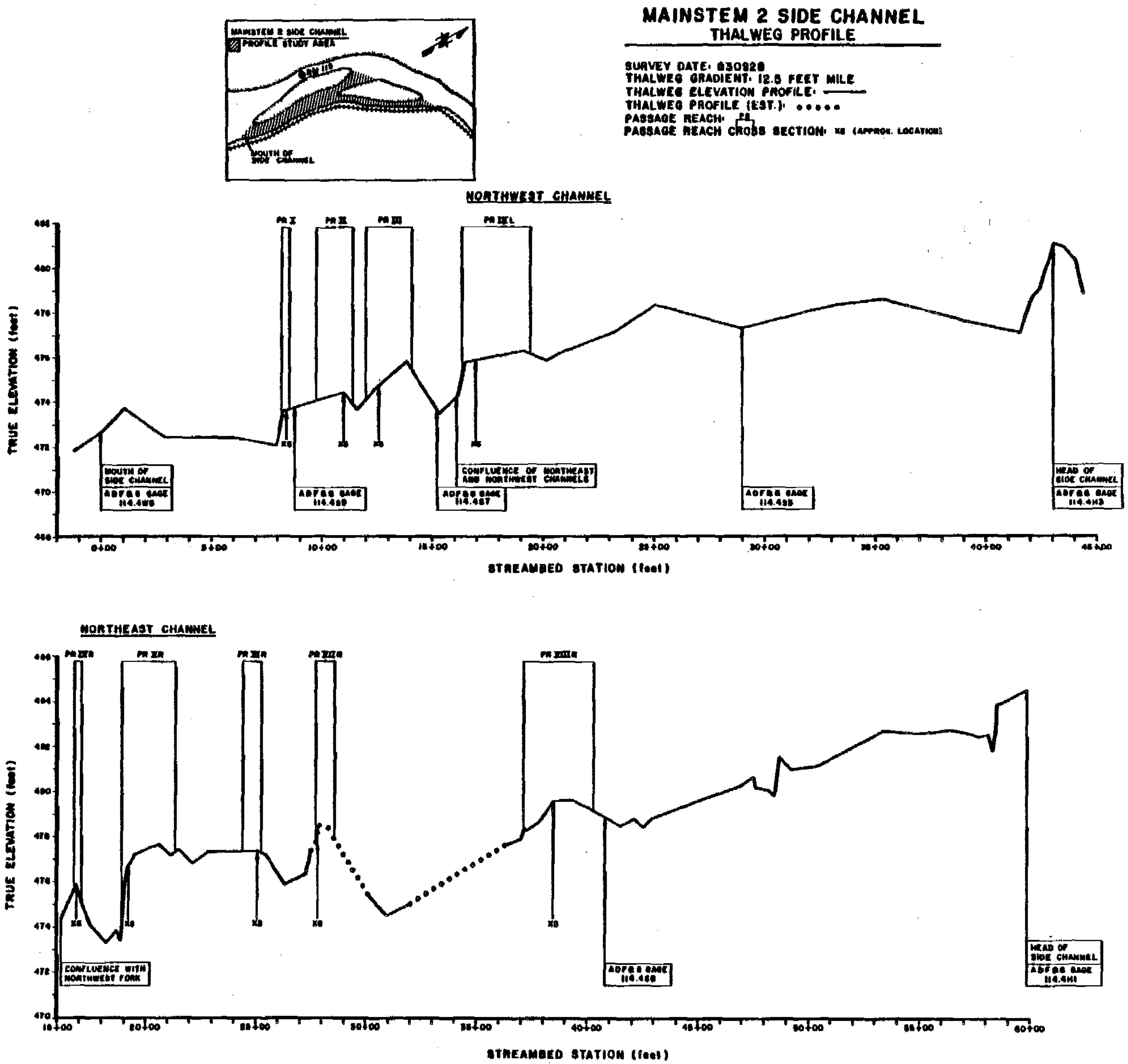
Thalweg Profiles of Passage Study Sites

APPENDIX C: THALWEG PROFILES OF PASSAGE STUDY SITES

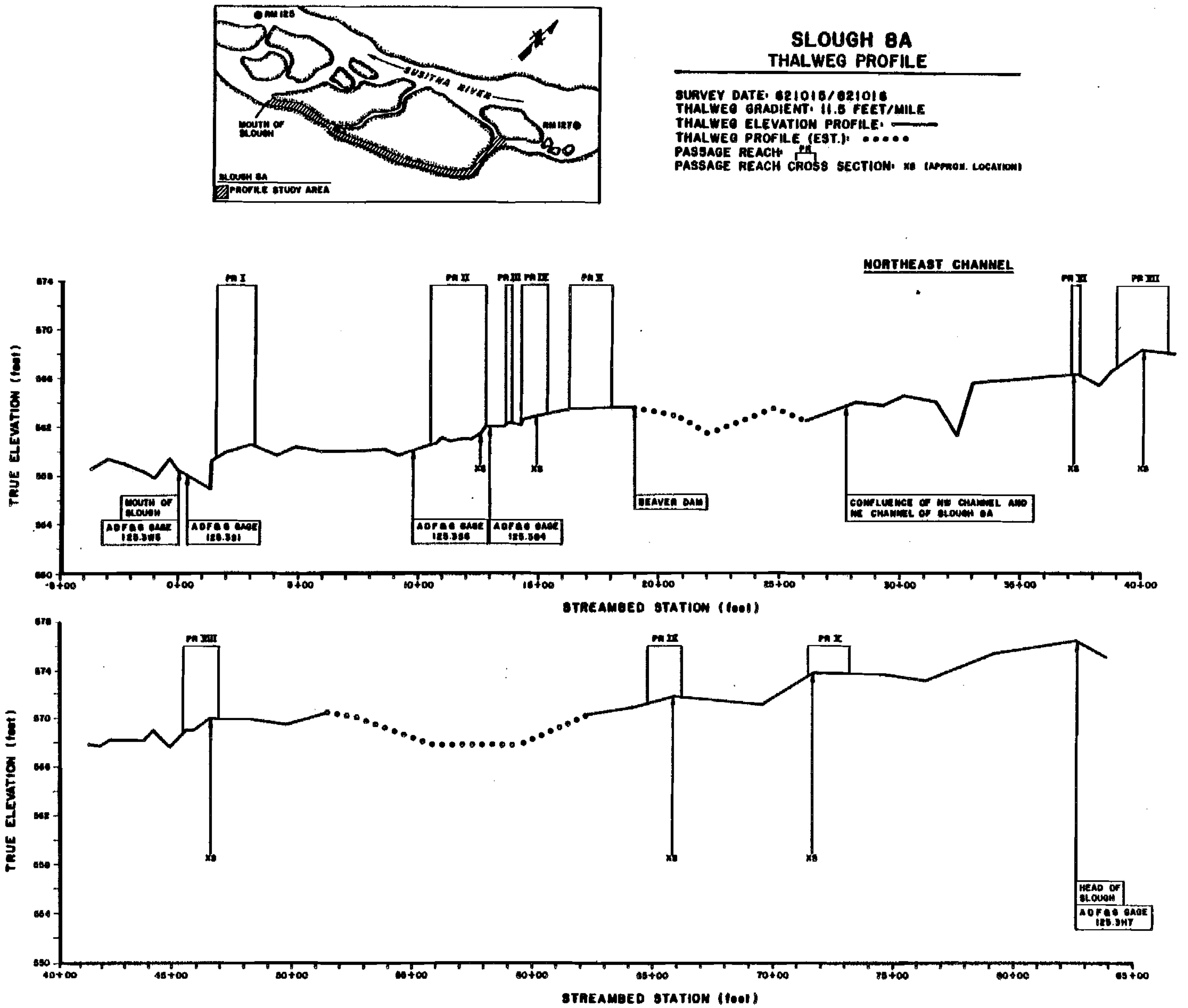
This appendix contains thalweg profiles of slough and side channel passage study sites illustrating passage reaches identified during the 1984 open water season (Appendix Figures C-1 to C-13). With the exception of Slough 19, these figures are revisions of thalweg profiles previously presented in Sautner et al. (1984). The Slough 19 thalweg, which was surveyed for the first time in 1984, is also presented here. Survey data used to complete the Slough 19 thalweg profile are summarized in Appendix Table C-1. Survey data for the other study sites are presented in Quane et al. (1984). These thalweg profiles are only intended to show approximate locations of passage reaches within each study site and due to their limited accuracy, should not be used for other, more detailed analyses.



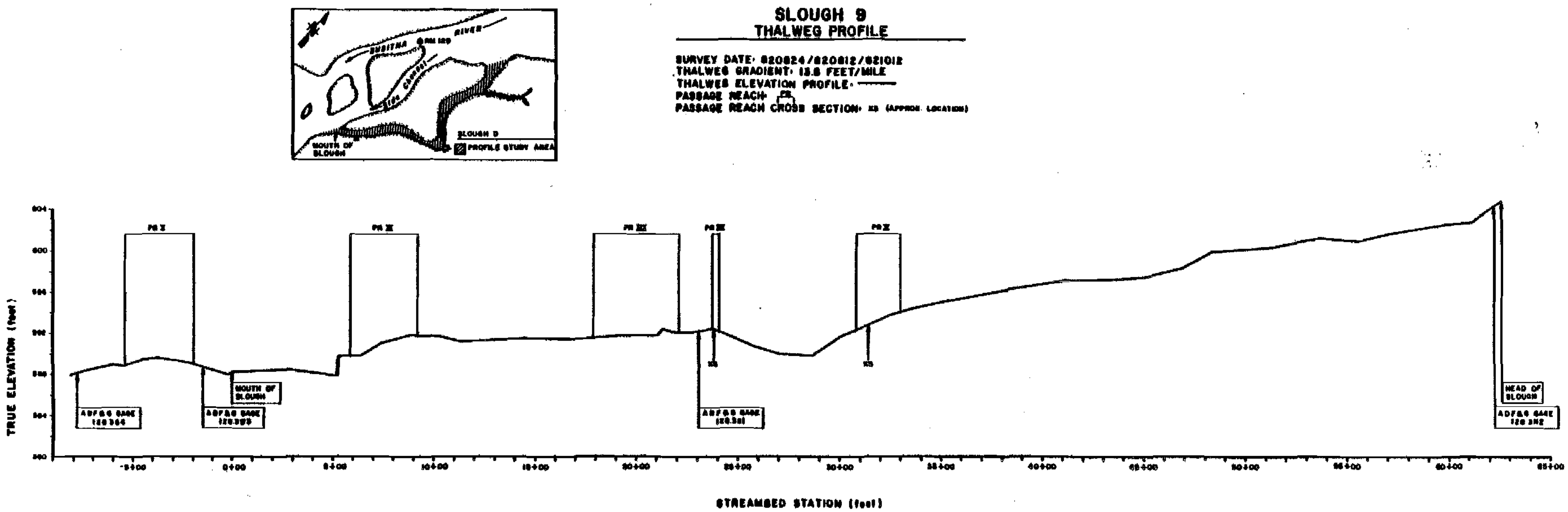
Appendix Figure C-1. Thalweg profile of Whiskers Creek Slough showing approximate locations of passage reaches.



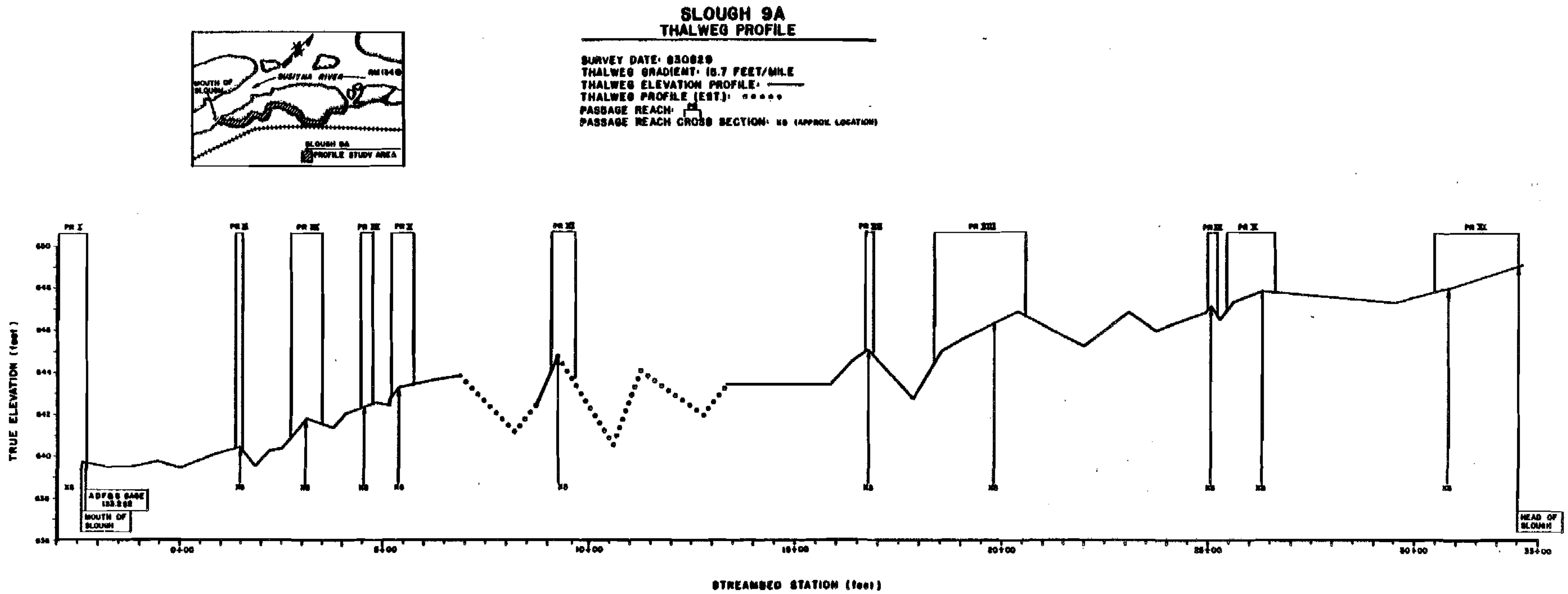
Appendix Figure C-2. Thalweg profile of Mainstem 2 Side Channel showing approximate locations of passage reaches.



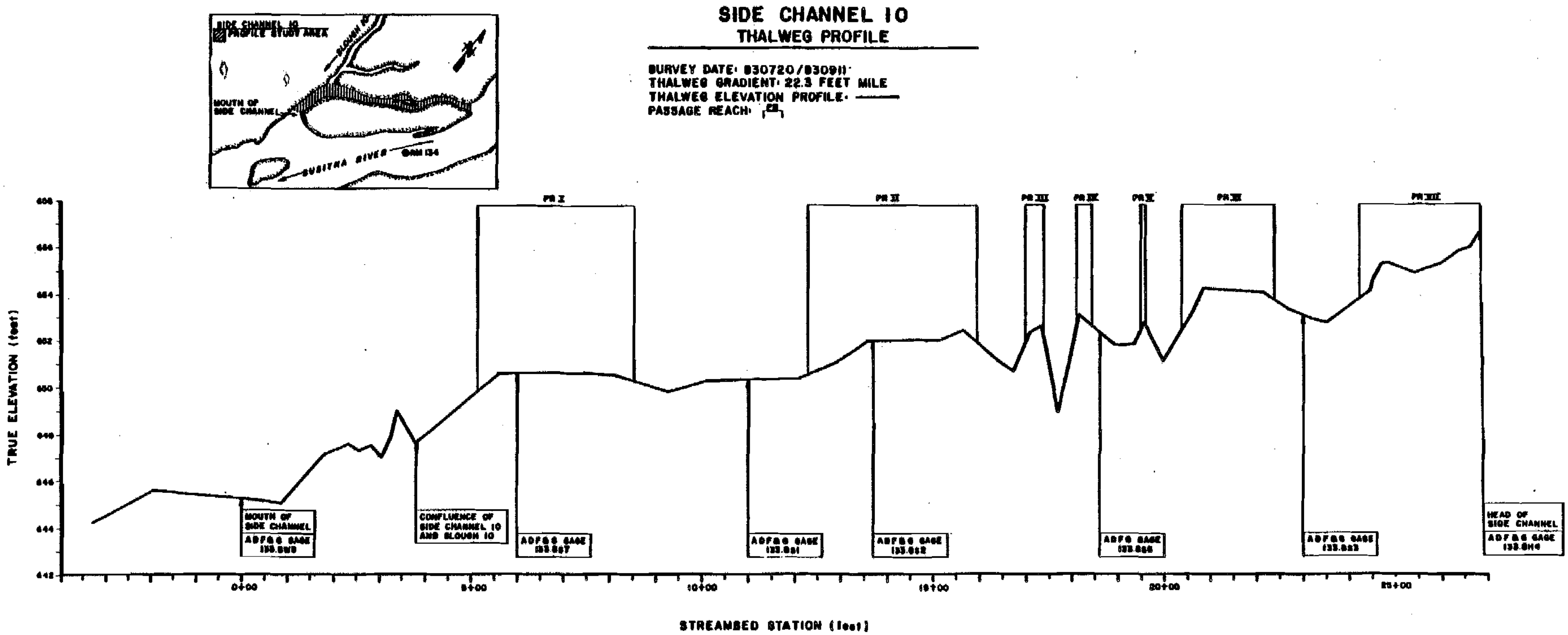
Appendix Figure C-3. Thalweg profile of Slough 8A showing approximate locations of passage reaches.



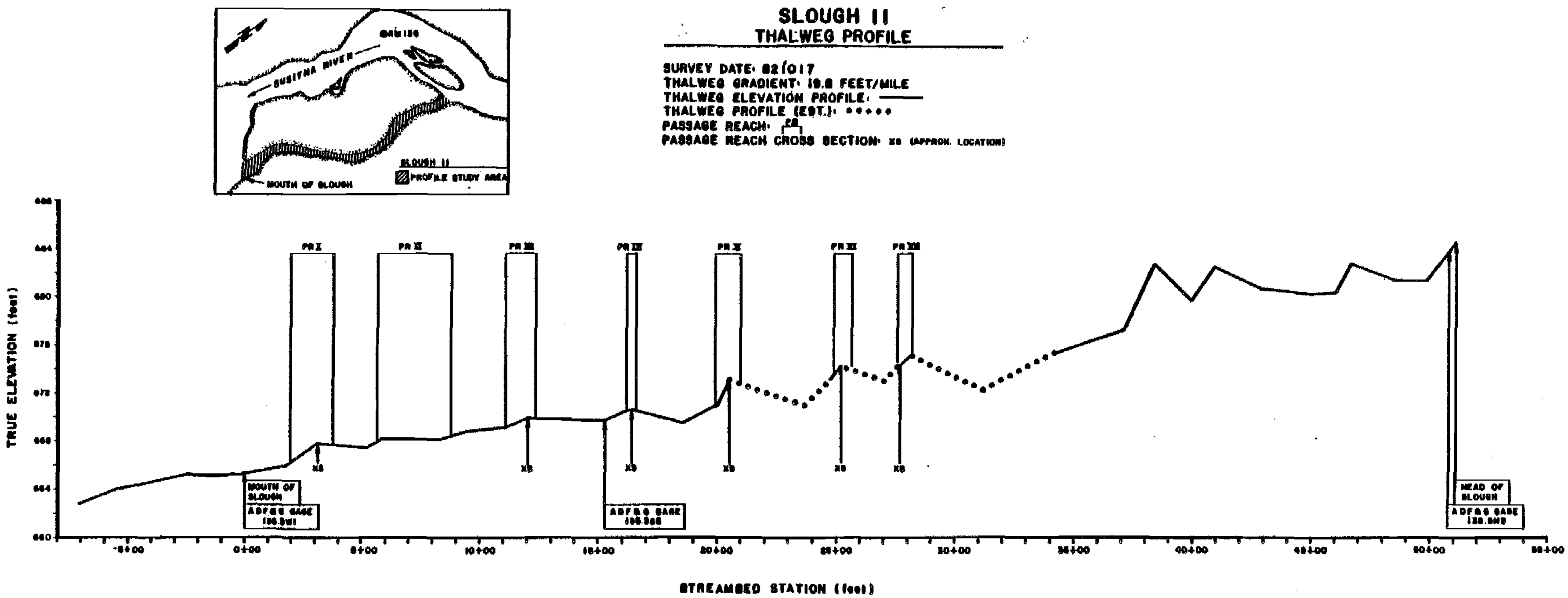
Appendix Figure C-4. Thalweg profile of Slough 9 showing approximate locations of passage reaches.



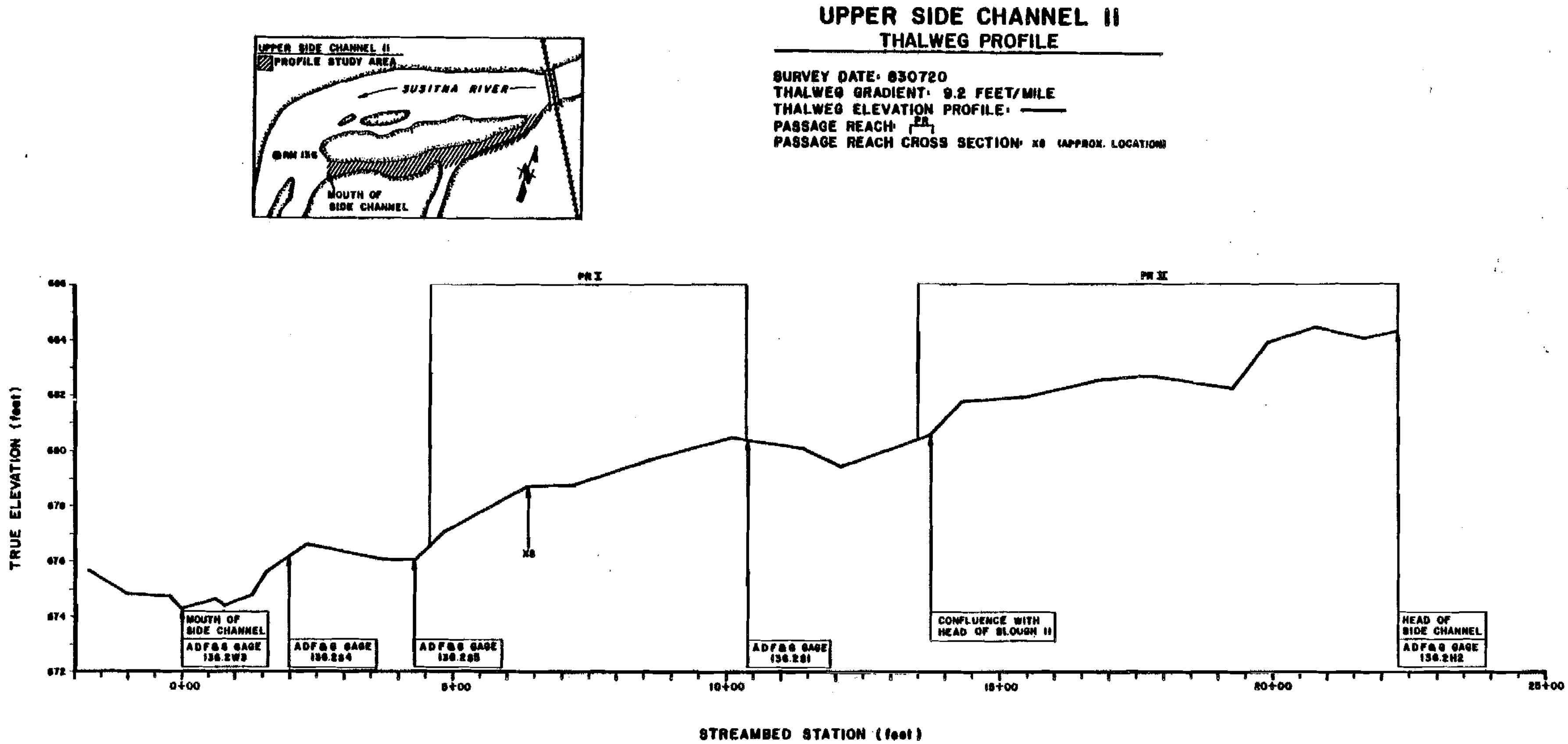
Appendix Figure C-5. Thalweg profile of Slough 9A showing approximate locations of passage reaches.



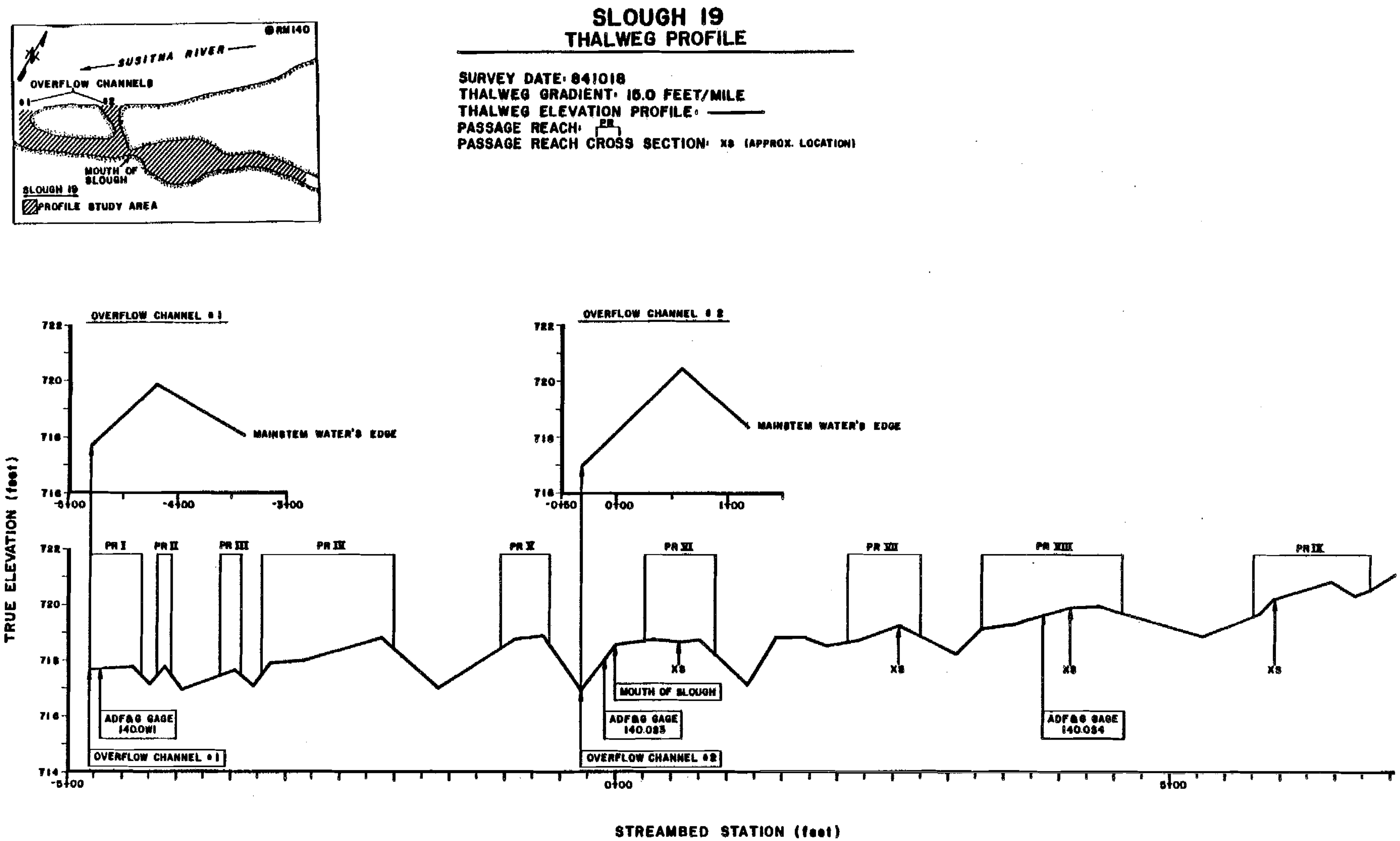
Appendix Figure C-6. Thalweg profile of Side Channel 10 showing approximate locations of passage reaches.



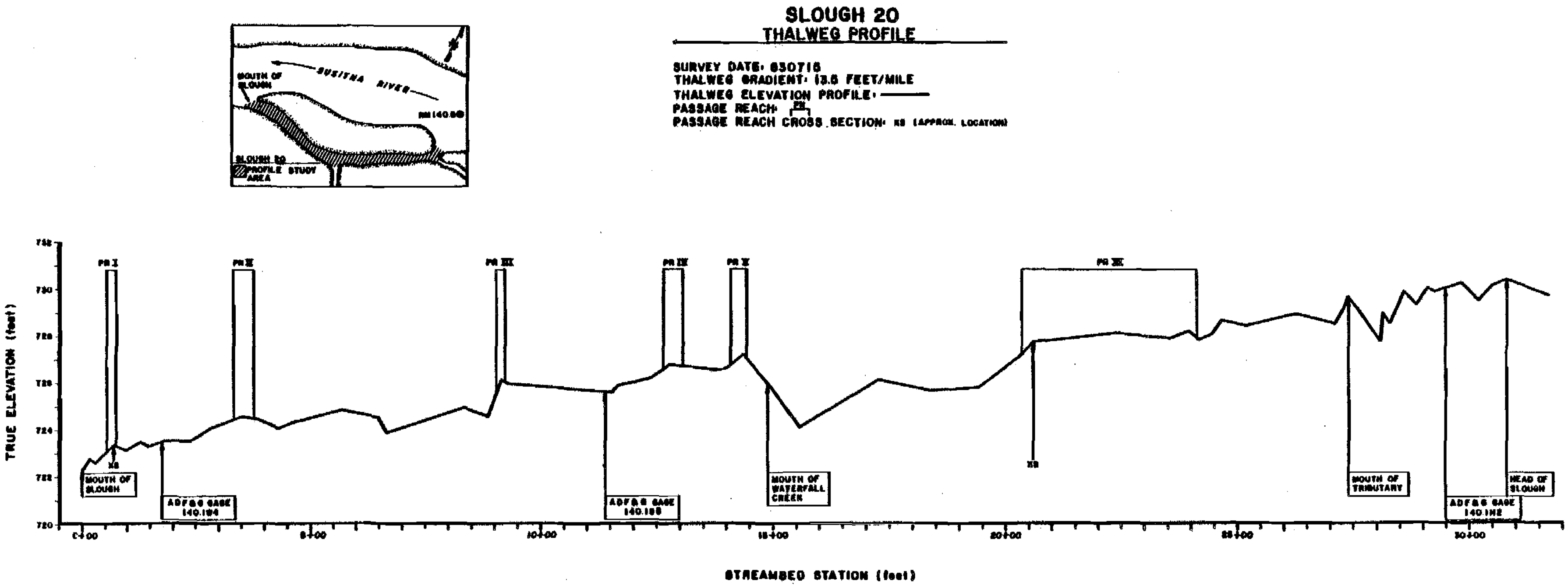
Appendix Figure C-7. Thalweg profile of Slough 11 showing approximate locations of passage reaches.



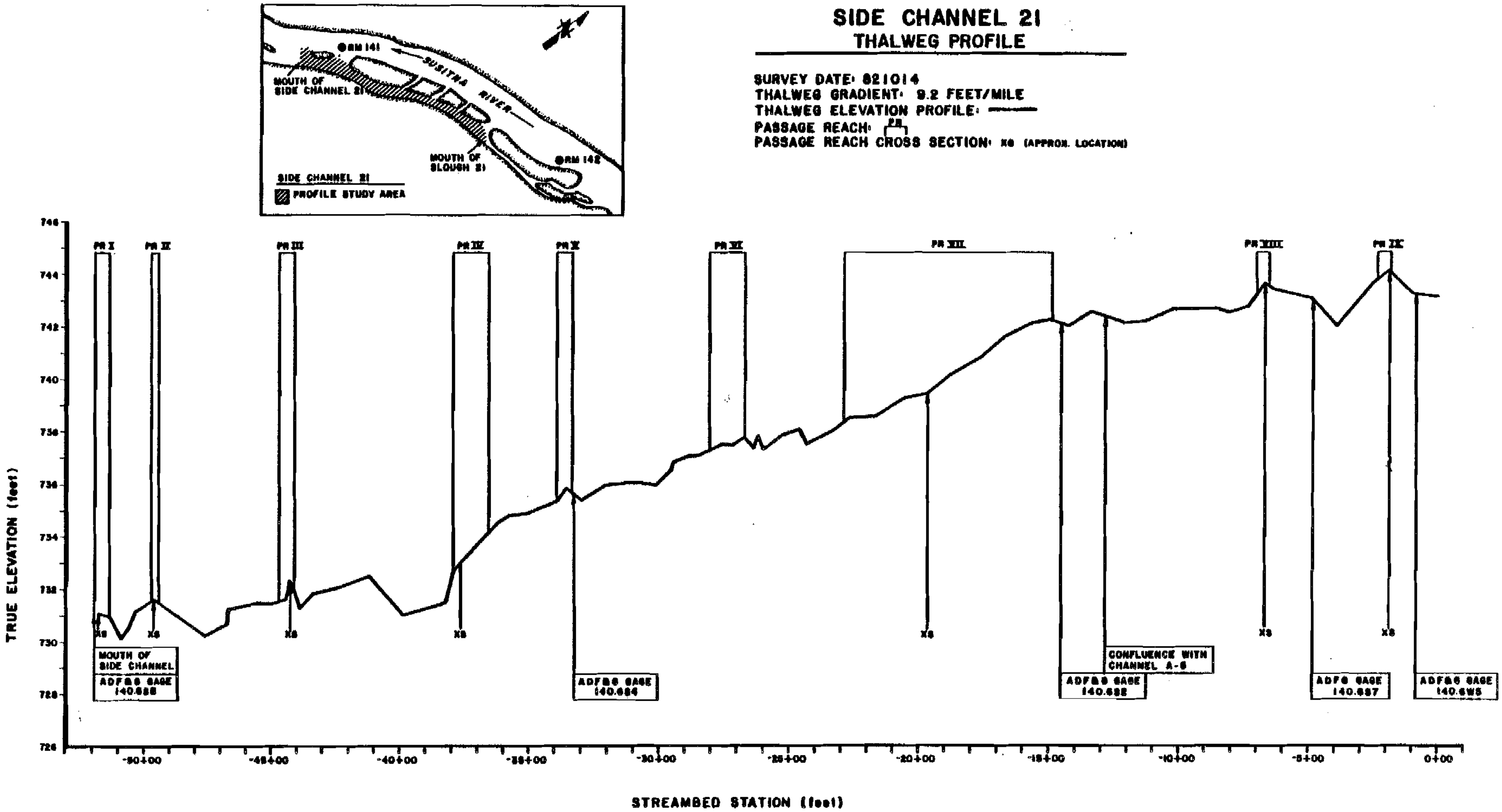
Appendix Figure C-8. Thalweg profile of Upper Side Channel 11 showing approximate locations of passage reaches.



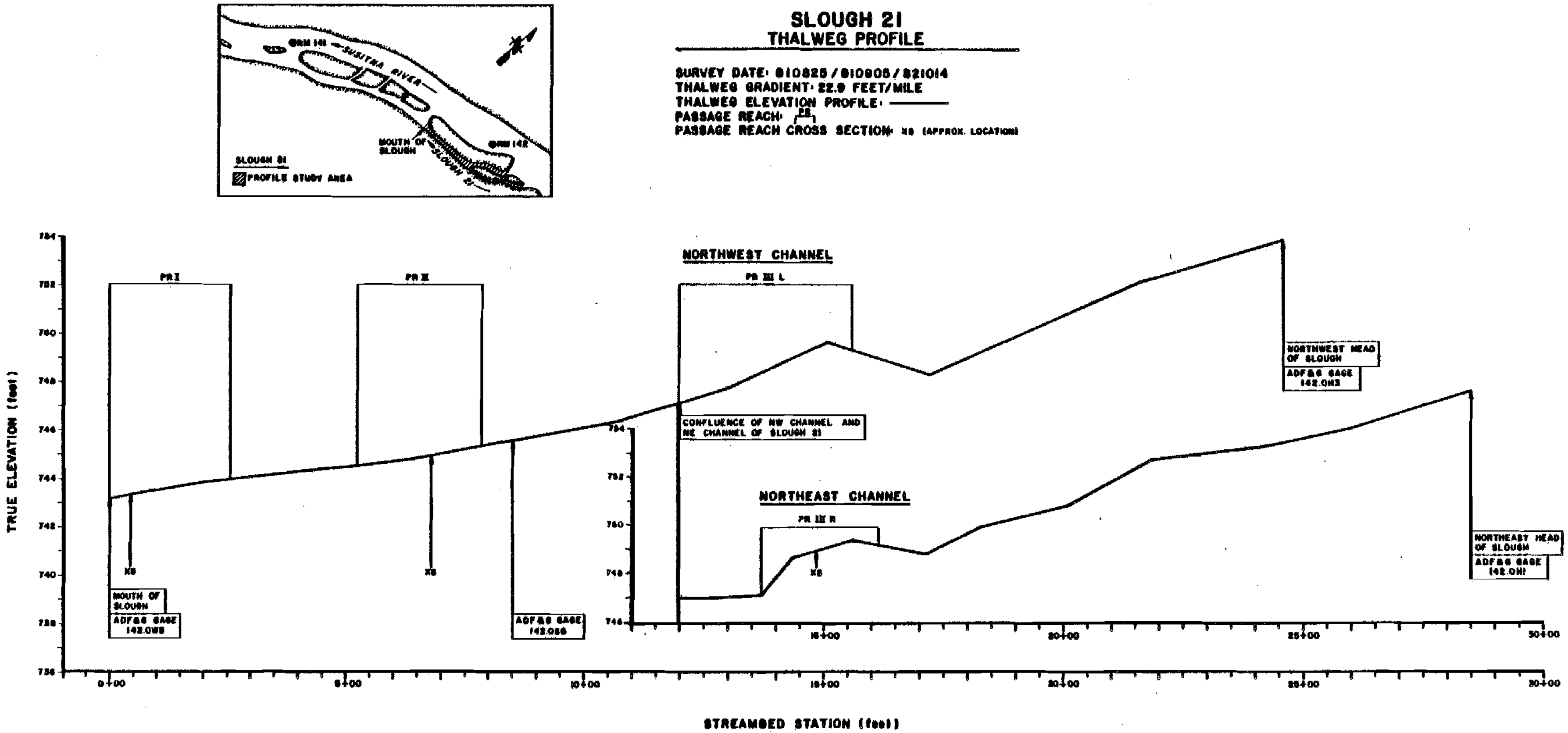
Appendix Figure C-9. Thalweg profile of Slough 19 showing approximate locations of passage reaches.



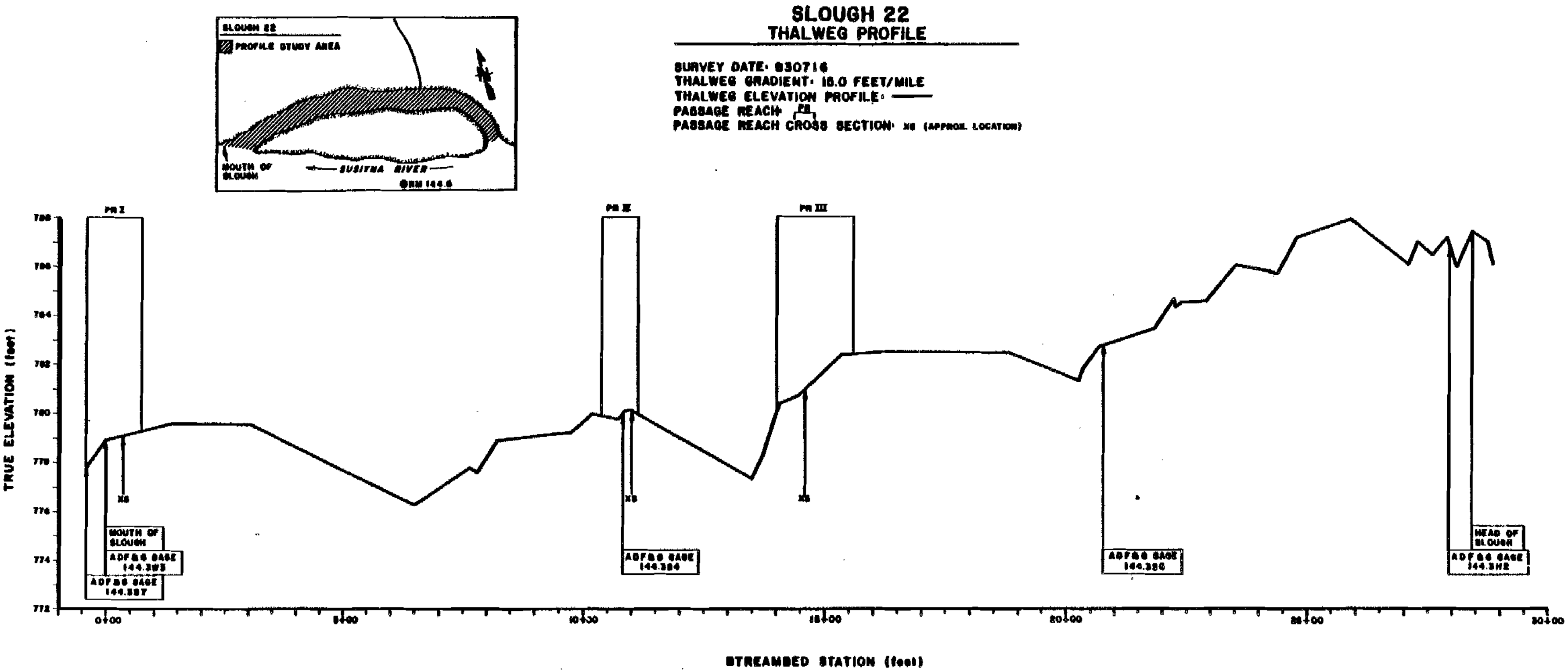
Appendix Figure C-10. Thalweg profile of Slough 20 showing approximate locations of passage reaches.



Appendix Figure C-11. Thalweg profile of Side Channel 21 showing approximate locations of passage reaches.



Appendix Figure C-12. Thalweg profile of Slough 21 showing approximate locations of passage reaches.



Appendix Figure C-13. Thalweg profile of Slough 22 showing approximate locations of passage reaches.

Appendix Table C-1. Summary of survey data collected for the thalweg profile of Slough 19 during the 1984 open water field season.

LOCATION OF THALWEG: Slough 19 (RM 140.0)
SITE FLOW: 0.1 cfs
USGS DISCHARGE: 5200 cfs

DATE: OCTOBER 18, 1984
TBM ID: ADF&G 140.0 RB 830914
Slough 19

Station (ft)	Thalweg Elevation (ft)	Water Depth (ft)	WSEL (ft)	Substrate[a] Code	Habitat Description
-4 + 79	717.70	0.20	717.90	SASI	Mid-Riffle
-4 + 40	717.79	0.17	717.96		Riffle/Pool
-4 + 24	717.16	0.80	717.96		Mid-Pool
-4 + 11	717.81	0.15	717.96	BOSI	Pool Constriction
-3 + 95	716.96	1.00	717.96	SISA	Mid-Pool
-3 + 46	717.64	0.33	717.97	SIBO	Pool Constriction
-3 + 29	717.09	0.89	717.98	SISA	Mid-Pool
-3 + 13	717.95	0.08	718.03	SISA	Pool/Riffle
-2 + 83	718.01	0.13	718.14	COSA	Mid-Riffle
-2 + 12	718.86	0.12	718.98	BOSA	Riffle/Pool
-1 + 60	717.06	1.90	718.96	SISA	Mid-Pool
-0 + 92	718.77	0.20	718.97		Pool/Riffle
-0 + 66	718.90	0.13	719.03	COSA	Riffle/Pool
-0 + 31	716.99	2.03	719.02	SISA	Mid-Pool
0 + 00	718.58	0.44	719.02	SISA	Mid-Pool, Mouth
0 + 36	718.80	0.22	719.02	SISA	Pool/Run
0 + 58	718.70	0.32	719.02	SISA	Mid-Run
0 + 76	718.77	0.27	719.04	SISA	Run/Pool
1 + 19	717.15	1.90	719.05	SISA	Mid-Pool
1 + 45	718.83	0.19	719.02	SISA	Pool/Run
1 + 70	718.84	0.21	719.05	SISA	Run/Pool
1 + 90	718.56	0.48	719.04	SISA	Mid-Pool
2 + 20	718.77	0.28	719.05	SISA	Pool/Riffle
2 + 56	719.28	0.09	719.37	BOCO	Riffle/Pool

Appendix Table C-1 (Continued).

Station (ft)	Thalweg Elevation (ft)	Water Depth (ft)	WSEL (ft)	Substrate[a] Code	Habitat Description
3 + 07	718.29	1.14	719.43	SISA	Mid-Pool
3 + 30	719.15	0.28	719.43	SISA	Pool/Riffle
3 + 60	719.31	0.13	719.44	SGSA	Mid-Riffle
3 + 69	719.47	0.01	719.48	LGSG	Mid-Riffle
4 + 11	719.89	DRY	719.89	LGSG	Mid-Riffle
4 + 35	719.95	ICE	719.95	SALG	Riffle/Pool
5 + 30	718.84	1.03	719.87	SISA	Mid-Pool
5 + 81	719.65	0.18	719.83	SA	Pool/Riffle
5 + 93	720.17	0.00	720.17	BOSI	Mid-Riffle
6 + 46	720.79	ICE	720.79	COBO	Riffle/Pool
6 + 67	720.30	0.35	720.65	CORU	Mid-Pool
6 + 81	720.48	ICE	720.65	CORU	Pool/Riffle
7 + 04	721.05	0.00	721.05	CORU	Riffle
Overflow Channel 1					
-4 + 79	717.70	0.20	717.90	SASI	Mid-Riffle
-4 + 20	719.89	DRY	719.89	CORU	High Point in Over-Flow Channel
-3 + 38	718.06	0.00	718.06	CORU	Mainstem Waters Edge
Overflow Channel 2					
-0 + 31	716.99	2.03	719.02	SISA	Mid-Pool
0 + 60	720.45	DRY	720.45	CORU	High Point in Overflow Channel
1 + 20	718.33	DRY	718.33	CORU	Mainstem Waters Edge

[a] Substrate code defined in Methods Section (see Table 2).

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Sautner, J., L.J. Vining, and L.A. Rundquist. 1984. An evaluation of passage conditions for adult salmon in sloughs and side channels of the middle Susitna River. Chapter 6 in 1984 Report No. 3: Aquatic Habitat and Instream Flow Investigations (May-October 1983). Estes, C.C. and D.S. Vincent-Lang, eds. Alaska Department of Fish and Game Susitna Hydro Aquatic Studies. Anchorage, Alaska.

APPENDIX D

Cross Sectional Data

APPENDIX D: CROSS SECTIONAL DATA

This appendix contains cross sectional data collected at passage reaches within selected slough and side channel study sites of the middle Susitna River. Survey data collected at selected passage reaches are summarized in Appendix Tables D-1 to D-58. Abbreviations of substrate type listed in these appendix tables are defined in Section 2.2.3 (Table 2) of this addendum. Appendix Figures D-1 to D-58 present these cross sectional data in graphic form. Relative water surface elevations upstream and downstream of selected passage reach cross sections are summarized in Appendix Table D-59.

Appendix Table D-1. Cross section profile of Passage Reach I in Whiskers Creek Slough, October 4,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.73		VEG	GB LB HEADPIN
7.00	99.21		VEG	
9.80	98.66	98.66	SISA	LWE
12.30	98.60	98.68	SIRU	
14.00	98.56	98.71	LGRU	
15.50	98.74	98.74	LGRU	
16.40	98.58	98.68	LGRU	
17.60	98.62	98.67	LGRU	
19.00	98.41	98.71	LGRU	
20.90	98.54	98.72	LGRU	
23.20	98.65	98.71	RULG	
26.00	98.69	98.69	RULG	
27.10	98.82	98.82	RULG	
28.20	98.66	98.71	LGRU	
30.80	98.56	98.71	LGRU	
32.60	98.69	98.69	RUCO	
34.60	98.72	98.72	RUCO	
38.00	98.72	98.72	RUCO	
39.20	98.89	98.89	RUCO	
41.70	98.75	98.79	RUCO	
43.00	98.59	98.82	RUCO	
44.40	98.56	98.81	RULG	
47.00	98.71	98.83	RULG	
50.20	98.70	98.83	LGCO	
52.50	98.75	98.84	LGCO	
54.70	98.66	98.84	LGCO	
56.40	98.72	98.84	LGCO	
59.30	98.55	98.81	LGCO	
61.20	98.70	98.81	LGCO	
65.70	98.82	98.82	LGCO	
68.40	98.87	98.87	LGCO	
70.50	98.79	98.84	LGCO	
72.00	98.69	98.85	LGCO	
76.30	98.77	98.85	LGCO	
78.50	98.76	98.83	LGCO	
81.40	98.54	98.79	LGCO	
83.00	98.69	98.78	LGCO	
86.40	98.56	98.67	LGCO	
87.10	98.83	98.83	LGCO	
90.50	98.75	98.75	LGCO	
95.50	98.79	98.79	LGCO	
98.60	98.71	98.77	LGCO	
100.50	98.61	98.77	LGCO	
102.70	98.81	98.81	COLG	RWE

Appendix Table D-1. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
108.60	99.10		COLG	
117.50	98.99		COLG	
123.00	98.83	98.83	COLG	LWE
126.50	98.78	98.83	LGRU	
131.00	98.73	98.82	LGRU	
133.80	98.80	98.81	LGRU	
138.00	98.66	98.81	LGRU	
140.00	98.61	98.77	LGRU	
142.20	98.59	98.78	LGRU	
144.00	98.52	98.77	LGRU	
147.00	98.54	98.78	LGRU	
149.60	98.60	98.75	LGRU	
153.00	98.77	98.77	LGRU	
156.00	98.59	98.67	LGRU	
161.40	98.76	98.76	LGCO	
167.00	98.71	98.71	RUCO	RWE
170.50	98.86		RUCO	
176.00	99.01		RUCO	
179.00	99.08		RUCO	
180.50	98.88	98.88	RUCO	LWE
183.50	98.81	98.88	RUCO	
185.80	98.77	98.88	LGRU	
187.00	98.94	98.94	LGRU	
190.50	98.77	98.88	LGRU	
195.00	98.84	98.88	LGRU	
199.00	98.87	98.87	LGRU	
202.50	98.79	98.79	LGRU	
205.50	98.70	98.79	LGRU	
207.00	98.65	98.79	LGRU	
208.10	98.79	98.79	LGSI	RWE
209.00	99.15		SISA	
211.50	99.43		SISA	
216.80	99.95		VEG	GB RB HEADPIN
216.80	100.19		VEG	RB HEADPIN

Appendix Table D-2. Cross section profile of Passage Reach II in Whiskers Creek Slough, October 4,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SIRU	LB HEADPIN
0.00	99.91		SIRU	GB LB HEADPIN
3.00	99.78		SIRU	
8.00	99.56		SIRU	
11.50	99.71		RUCO	
16.00	99.65		RUCO	
20.50	99.76		SIRU	
21.50	99.62		SIRU	
22.50	99.62		RULG	
23.00	99.39	99.39	RULG	LWE
25.10	99.44	99.44	RULG	
27.00	99.35	99.36	RULG	
29.40	99.26	99.35	RULG	
31.00	99.26	99.34	RULG	
33.00	99.27	99.38	RULG	
35.80	99.33	99.33	CORU	
38.00	99.33	99.33	RU	
42.00	99.24	99.25	RU	
43.40	99.26	99.26	RU	
44.60	99.25	99.25	RU	
45.50	98.96	99.15	LGRU	
45.90	99.01	99.17	LGRU	
47.00	99.06	99.15	RULG	
48.00	99.07	99.16	RULG	
48.50	99.30	99.30	RULG	
49.90	99.34	99.35	RULG	
52.00	99.28	99.31	RULG	
53.30	99.30	99.30	SILG	RWE
54.50	99.90		SILG	
56.70	100.74		VEG	GB RB HEADPIN
56.70	100.87		VEG	RB HEADPIN

Appendix Table D-3. Cross section profile of Passage Reach I in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SIRU	LB HEADPIN
0.00	99.89		SIRU	GB LB HEADPIN
5.00	99.69		SIRU	
12.40	99.59		SISA	
18.00	99.47		SISA	
20.40	99.63		SISA	
24.90	99.35		SISA	
28.00	99.64		SISA	
30.00	99.59		SISA	
32.40	99.24		SISA	
34.50	99.12		SISA	
35.10	98.94	98.94	SIRU	LWE
36.60	98.89	98.95	SIRU	
37.60	98.94	98.95	SIRU	
38.40	99.07	99.07	SIRU	
39.00	98.74	98.92	LGRU	
40.20	98.70	98.92	LGRU	
41.10	98.77	98.91	LGRU	
42.30	99.03	99.03	RUSA	
44.00	99.00	99.00	RULG	
45.00	98.82	98.91	RULG	
45.90	98.84	98.93	RULG	
46.70	98.68	98.93	RULG	
48.00	99.04	99.04	RULG	
49.00	98.86	98.90	RULG	
50.10	98.89	98.91	SARU	
51.30	98.91	98.91	SASI	RWE
53.50	99.11		SASI	
57.50	99.20		SASI	
58.70	99.30		SACO	
61.40	99.24		SACO	
64.00	99.46		SACO	GB RB HEADPIN
64.00	99.52		SACO	RB HEADPIN

Appendix Table D-4. Cross section profile of Passage Reach II in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		BOCO	LB HEADPIN
0.00	99.64		BOCO	GB LB HEADPIN
1.50	99.81		BOCO	
4.40	99.69		RUCO	
7.50	99.56		RUCO	
11.90	99.55		RUCO	
15.60	99.18		SIRU	
18.60	99.17		RUCO	
19.80	99.17		RUCO	
22.60	99.06		RUCO	
23.70	98.85	98.85	RUCO	LWE
25.60	99.09	99.09	RUCO	
26.50	98.71	98.81	SICO	
28.50	98.91	98.91	SICO	
29.10	98.75	98.81	SICO	
30.30	98.83	98.83	RULG	
32.40	98.92	98.92	RULG	
32.90	98.78	98.80	SIRU	
36.00	98.79	98.79	SIRU	
37.70	98.93	98.93	CORU	
40.00	98.60	98.76	CORU	
40.90	98.87	98.87	CORU	
42.00	98.66	98.77	CORU	
44.20	98.52	98.76	CORU	
45.50	98.82	98.82	CORU	
47.20	98.74	98.76	CORU	
47.80	98.80	98.80	CORU	
49.70	98.70	98.73	CORU	
51.90	98.61	98.75	CORU	
53.10	98.73	98.74	CORU	
54.70	98.78	98.78	CORU	
55.80	98.61	98.75	CORU	
58.60	98.83	98.83	RUCO	
61.00	98.80	98.80	RUCO	
64.20	98.74	98.74	RUCO	
65.40	98.59	98.74	RUCO	
67.00	98.64	98.74	RUCO	
68.20	98.75	98.75	CORU	
70.50	99.19	99.19	CORU	
71.50	98.82	98.82	CORU	
73.90	98.80	98.80	CORU	
74.80	98.76	98.76	CORU	RWE
76.10	98.99		CORU	
77.80	99.11		CORU	
81.50	99.08		CORU	

Appendix Table D-4. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
85.60	99.19		CORU	
91.50	99.23		CORU	
96.00	99.24		CORU	
99.80	99.29		CORU	GB RB HEADPIN
99.80	99.31		CORU	RB HEADPIN

Appendix Table D-5. Cross section profile of Passage Reach III in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGSG	LB HEADPIN
0.00	99.90		LGSG	GB LB HEADPIN
3.00	99.92		LGSG	
8.00	99.80		LGSG	
15.00	99.69		LGSG	
22.00	99.56		LGSG	
29.00	99.50		LGSG	
37.20	99.14		LGSG	
41.20	99.17		LGSG	
44.10	99.25		RUCO	
49.50	99.45		RUCO	
53.90	99.45		RUCO	
58.30	98.53		RUCO	
60.70	99.07	99.07	RUCO	LWE
62.50	99.37	99.37	RUCO	
64.30	99.00	99.01	RUCO	
66.40	99.02	99.02	RUCO	
69.40	99.02	99.02	RUCO	
70.80	99.00	99.00	RUCO	
73.80	99.05	99.05	RUCO	
76.50	98.82	98.82	RUCO	
82.10	98.95	98.95	RUCO	
87.30	98.97	98.97	RUCO	
88.80	99.07	99.07	RUCO	
90.40	98.90	98.90	RUCO	
91.00	98.81	98.83	RUCO	
92.30	99.03	99.03	RUCO	
95.50	99.06	99.06	RUCO	
101.70	98.90	98.95	RUCO	
103.50	98.91	98.95	RUCO	
105.50	98.95	98.95	RUCO	
109.40	99.01	99.01	RUCO	
115.20	99.00	99.00	RUCO	
119.60	98.99	98.99	RUCO	
121.00	98.85	98.88	RUCO	
123.10	99.01	99.01	RUCO	
125.70	98.83	98.84	RUCO	
127.80	98.88	98.90	RUCO	
128.50	99.17	99.17	RUCO	
131.30	99.10	99.10	RUCO	
134.40	99.30	99.30	RUCO	
135.50	99.13	99.14	RUCO	
139.50	99.11	99.16	RUCO	
140.90	99.16	99.16	RUCO	
144.50	99.41	99.41	RUCO	

Appendix Table D-5. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
146.50	99.33	99.34	RUCO	
149.00	99.66	99.66	COBO	
150.90	99.75	99.75	COBO	
151.70	99.43	99.44	COBO	
153.80	99.47	99.48	CORU	
154.40	99.50	99.50	CORU	RWE
154.90	99.66		CORU	
157.50	99.80		CORU	
160.90	99.83		CORU	
163.50	99.95		CORU	
167.90	99.92		CORU	
173.00	100.03		CORU	
177.60	100.08		CORU	GB RB HEADPIN
177.60	100.11			RB HEADPIN

Appendix Table D-6. Cross section profile of Passage Reach IVL in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SALG	LB HEADPIN
0.00	99.81		SALG	GB LB HEADPIN
5.80	99.17		SALG	
10.30	98.39		RUCO	
14.00	98.37		RUCO	
18.40	98.16		RUCO	
22.30	98.14		RUCO	
27.60	97.93		RUCO	
32.00	98.03		RUCO	
35.60	97.75		RUCO	
37.60	97.82		RUCO	
40.80	97.35		RUCO	
43.40	97.68		RUCO	
48.70	97.74		RUCO	
51.10	97.73		RUCO	
52.50	97.43	97.43	RUCO	LWE
54.20	97.44	97.44	RULG	
55.10	97.68	97.68	RULG	
58.90	97.72	97.72	RULG	
60.00	97.40	97.45	RULG	
61.60	97.53	97.53	RULG	
65.80	97.55	97.55	RULG	
68.40	97.42	97.45	RULG	
69.70	97.55	97.55	RULG	
75.00	97.48	97.48	LGRU	
78.00	97.51	97.51	LGRU	
82.20	97.49	97.49	LGRU	
86.10	97.48	97.48	LGRU	
88.50	97.58	97.58	LGRU	
90.00	97.44	97.44	LGRU	RWE
92.30	97.59		LGRU	
95.10	97.58		LGRU	
99.50	97.67		LGRU	
105.80	97.84		LGRU	
113.10	97.84		LGRU	
118.40	97.74		LGRU	
126.80	97.87		LGRU	
134.10	97.92		LGRU	
144.00	98.11		LGRU	
148.80	98.11		SGRU	
152.80	98.14		SARU	
157.50	98.28		SA	
163.50	98.78		SA	
166.50	98.87		SA	
170.50	99.57		SA	
173.30	99.89		SA	GB RB HEADPIN
173.30	100.00		SA	RB HEADPIN

Appendix Table D-7. Cross section profile of Passage Reach IVR in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGSG	LB HEADPIN
0.00	99.88		LGSG	GB LB HEADPIN
1.00	100.03		LGSG	
2.70	100.02		LGSG	
4.20	99.97		LGSG	
5.30	99.87	99.87	LGSG	LWE
6.50	99.76	99.83	LGSG	
7.30	99.78	99.87	LGSG	
8.00	99.87	99.87	LGSG	
8.90	99.79	99.86	LGCO	
10.00	99.96	99.96	LGCO	
11.60	99.87	99.87	LGCO	
12.50	100.10	100.10	LGCO	
15.50	99.85	99.85	LGCO	
17.00	99.97	99.97	LGCO	
19.70	99.93	99.93	CORU	
20.70	99.70	99.75	CORU	
22.00	99.90	99.90	CORU	
23.00	99.70	99.76	CORU	
24.50	99.76	99.78	CORU	
26.00	99.88	99.88	CORU	
27.50	99.78	99.78	CORU	
29.00	99.92	99.92	CORU	
30.30	99.77	99.78	CORU	
31.50	99.97	99.97	CORU	
32.80	99.79	99.79	CORU	
35.00	99.95	99.95	CORU	
36.00	99.78	99.83	CORU	
36.90	99.91	99.91	CORU	
37.60	99.72	99.85	CORU	
38.40	99.76	99.84	CORU	
39.40	99.90	99.90	CORU	
40.50	99.84	99.84	CORU	
41.80	100.04	100.04	CORU	
43.00	99.83	99.83	CORU	RWE
43.80	100.06		CORU	
45.60	99.84		CORU	
46.00	99.69		CORU	GB RB HEADPIN
46.00	99.75		CORU	RB HEADPIN
59.00	100.17		CORU	

Appendix Table D-8. Cross section profile of Passage Reach VR in Mainstem 2 Side Channel, October 5,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SA	LB HEADPIN
0.00	99.91		SA	GB LB HEADPIN
4.00	99.14		SA	
6.40	98.59		RULG	
8.80	98.19		RULG	
11.00	98.06		RULG	
13.10	97.94		RULG	
15.60	97.62		RULG	
17.20	97.66		RULG	
20.20	97.94		COLG	
23.40	97.80		COLG	
23.90	97.35	97.35	COLG	LWE
24.70	97.84	97.84	CORU	
26.50	97.30	97.33	CORU	
27.20	97.67	97.67	CORU	
28.50	97.17	97.31	CORU	
30.10	97.40	97.40	CORU	
32.00	97.44	97.44	CORU	
34.30	97.61	97.61	CORU	
35.80	97.16	97.25	CORU	
37.20	97.37	97.37	CORU	
39.20	97.27	97.29	CORU	
40.10	97.16	97.28	CORU	
42.20	97.17	97.29	CORU	
44.20	97.66	97.66	CORU	
45.20	97.28	97.28	CORU	RWE
45.70	97.57		CORU	
47.80	97.65		CORU	
49.70	97.60		CORU	
52.70	97.93		CORU	
56.90	98.13		CORU	
60.30	98.28		CORU	
63.70	98.45		CORU	
66.20	98.51		RUCO	GB RB HEADPIN
66.20	98.60		RUCO	RB HEADPIN

Appendix Table D-9. Cross section profile of Passage Reach VIR in Mainstem 2 Side Channel, October 5, 1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RULG	LB HEADPIN
0.00	99.92		RULG	GB LB HEADPIN
4.50	99.97		RULG	
7.00	99.63		RULG	
9.60	99.64		RULG	
12.00	99.44		RULG	
14.00	99.52		RULG	
15.50	99.24		RULG	
17.70	99.09	99.09	RULG	LWE
19.80	99.02	99.09	RULG	
21.50	99.09	99.09	RULG	
22.50	99.31	99.31	RULG	
23.80	99.02	99.09	RULG	
26.00	99.10	99.10	RULG	
27.00	99.23	99.23	RULG	
28.20	98.97	99.08	RULG	
30.60	99.00	99.08	RULG	
31.50	99.14	99.14	RULG	
33.80	99.09	99.09	RULG	
34.40	98.88	99.09	RULG	
35.90	98.99	99.09	RULG	
37.40	99.07	99.08	RULG	
39.00	99.23	99.23	RULG	
40.70	99.05	99.11	RULG	
43.20	99.00	99.09	RULG	
45.80	99.06	99.11	RULG	
47.00	99.11	99.11	RUCO	RWE
48.00	99.61		RUCO	
51.40	99.33		RUCO	
54.30	99.48		RUCO	
56.50	99.74		RUCO	
59.90	99.56		RUCO	GB RB HEADPIN
59.90	99.79		RUCO	RB HEADPIN

Appendix Table D-10. Cross section profile of Passage Reach VIIR in Mainstem 2 Side Channel, October 4,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RULG	LB HEADPIN
0.00	99.81		RULG	GB LB HEADPIN
4.10	99.99		RULG	
8.10	99.79		RULG	
10.30	99.89		RULG	
14.20	99.97		RULG	
19.60	99.59		RULG	
26.30	99.68		RULG	
29.40	99.67		RULG	
32.00	99.65		RULG	
34.50	99.50		RULG	
37.10	99.69		RULG	
41.30	99.49		RULG	
46.20	99.53		RULG	
49.30	99.60		RULG	
52.80	99.65		RULG	
56.50	99.55		RULG	
59.90	99.76		RULG	
63.60	99.53		RULG	
68.70	99.56		RULG	
72.00	99.85		RULG	
75.00	99.52	99.52	RULG	LWE OF POOL ABOVE PR
76.80	99.56	99.56	RULG	
80.10	99.33	99.33	RULG	
81.40	99.49	99.49	RULG	
83.80	99.32	99.32	RULG	
86.00	99.28	99.28	RULG	
89.10	99.53	99.53	RULG	
92.50	99.57	99.57	RULG	
95.80	99.65	99.65	RULG	
102.90	99.55	99.55	RULG	
106.60	99.72	99.72	RULG	
111.00	99.61	99.61	RULG	
114.10	99.58	99.58	RULG	
116.00	99.40	99.40	RULG	
117.80	99.51	99.51	RULG	
123.00	99.47	99.47	RULG	
125.50	99.40	99.40	RULG	
129.30	99.45	99.45	RULG	
132.10	99.61	99.61	RULG	
135.50	99.50	99.50	RULG	
139.50	99.59	99.59	RULG	
142.30	99.59	99.59	RULG	
145.40	99.72	99.72	RULG	
150.00	99.70	99.70	RULG	

Appendix Table D-10. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
154.30	99.73	99.73	RULG	
157.90	99.87	99.87	RULG	
161.10	99.94	99.94	RULG	
163.60	99.76	99.76	RULG	
164.80	99.72	99.72	RULG	RWE OF POOL ABOVE PR
167.60	100.04		SGRU	
169.20	99.80		RUSG	
171.60	99.91		RUSG	
173.40	100.23		SISA	
177.00	100.45		SISA	
182.00	100.77		SISA	
185.10	100.97		SISA	GB RB HEADPIN
185.10	101.07		SISA	RB HEADPIN

Appendix Table D-11. Cross section profile of Passage Reach VIIIR in Mainstem 2 Side Channel, Oct.4,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RULG	LB HEADPIN
0.00	99.87		RULG	GB LB HEADPIN
3.30	99.83		RULG	
6.00	100.16		RULG	
8.00	99.81		RULG	
10.80	99.60		RULG	
13.20	99.88		RULG	
15.70	99.60		RULG	
17.70	99.47		RULG	
19.20	99.34	99.34	RULG	LWE
21.00	99.34	99.34	RULG	
23.30	99.47	99.47	RULG	
24.80	99.62	99.62	RULG	
25.40	99.35	99.35	RULG	
26.20	99.34	99.34	RULG	
27.30	99.44	99.44	RULG	
28.20	99.28	99.33	RULG	
28.60	99.18	99.30	RULG	
29.50	99.28	99.32	RULG	
30.40	99.33	99.33	RULG	RWE
31.30	99.46		RULG	
33.50	99.52		RULG	
36.60	99.57		RULG	
38.00	99.87		RULG	
39.40	99.71		RULG	
41.20	100.06		RULG	
44.00	100.51		RULG	
45.30	100.10		RULG	
46.50	100.34		RULG	
47.30	100.27		RULG	GB RB HEADPIN
47.30	100.47		RULG	RB HEADPIN

Appendix Table D-12. Cross section profile of Passage Reach II in Slough 8A, October 6,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.86		SISA	GB LB HEADPIN
1.30	99.10		SISA	
2.20	98.24		SICO	
6.00	97.93		SICO	
8.70	97.92		SICO	
11.50	98.07		SICO	
15.30	98.20		CORU	
17.10	97.85		CORU	
19.60	97.65		RULG	
21.60	97.58		RULG	
23.20	97.31		RULG	
24.40	97.13		LGRU	
25.00	97.00	97.00	LGRU	LWE
25.90	96.90	96.96	LGRU	
27.10	96.79	96.97	LGRU	
28.20	96.98	96.98	LGRU	
30.00	97.03	97.03	LGRU	
30.50	96.84	96.98	LGRU	
30.90	96.82	96.96	LGRU	
32.50	97.06	97.06	RULG	
33.50	96.93	97.03	RULG	
34.90	97.01	97.03	RULG	
35.50	97.03	97.03	RULG	RWE
36.50	97.27		RULG	
37.40	97.48		RULG	
39.10	97.44		RULG	
41.00	97.39		RULG	
43.30	97.51		RULG	
44.80	97.36		SIRU	
46.10	97.73		SIRU	
48.20	98.04		SIRU	
51.40	98.26		SIRU	
55.50	98.57		SIRU	
60.90	99.22		SIRU	
65.60	99.81		SI	GB RB HEADPIN
65.60	99.98		SI	RB HEADPIN

Appendix Table D-13. Cross section profile of Passage Reach IV in Slough 8A, October 6,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RULG	LB HEADPIN
0.00	99.95		RULG	GB LB HEADPIN
1.00	99.99		RULG	
3.00	99.86		RULG	
4.00	99.48		RULG	
4.80	99.38		RULG	
5.80	99.07		RULG	
6.90	99.01	99.01	LGRU	LWE
8.10	98.98	99.00	LGRU	
9.40	98.93	99.01	LGRU	
10.10	99.05	99.05	LGRU	
11.20	98.95	99.00	LGRU	
12.00	98.99	99.00	LGRU	
13.30	98.95	99.00	LGRU	
14.40	98.89	98.99	LGRU	
16.10	98.90	98.98	LGRU	
17.50	98.89	98.99	LGRU	
18.50	98.84	98.99	LGRU	
19.30	99.01	99.01	LGRU	
20.70	98.96	98.96	RUCO	
22.00	99.02	99.02	RUCO	
23.90	99.10	99.10	RUCO	
25.00	98.94	99.02	RUCO	
26.00	99.01	99.01	RUCO	
27.10	99.18	99.18	RUCO	
28.10	99.01	99.02	LGRU	
29.70	99.10	99.10	LGRU	
32.00	99.02	99.02	LGRU	RWE
33.10	99.28		RUCO	
35.00	99.11		RUCO	
36.50	99.34		SIRU	
38.50	99.45		SISA	
41.60	100.48		SISA	GB RB HEADPIN
41.60	100.53		SISA	RB HEADPIN

Appendix Table D-14. Cross section profile of Passage Reach VIL in Slough 8A, October 6,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SI	LB HEADPIN
0.00	99.86		SI	GB LB HEADPIN
3.50	98.61		SISA	
6.00	97.98		RUSI	
8.90	97.79		RUCO	
10.80	97.59		RUCO	
12.00	97.52	97.52	RULG	LWE
13.10	97.61	97.61	RULG	
14.50	97.44	97.49	RULG	
15.10	97.55	97.55	RULG	
17.00	97.53	97.53	RULG	
18.70	97.60	97.60	LGSG	
20.40	97.59	97.59	LGSG	
21.80	97.69	97.69	LGSG	
23.60	97.84	97.84	LGSG	
24.70	97.65	97.65	LGSG	
25.80	97.60	97.65	LGSG	
27.40	97.65	97.66	LGSG	
29.50	97.63	97.64	LGSG	
30.00	97.70	97.70	LGSG	
32.30	97.61	97.61	LGSG	
33.20	97.51	97.54	LGSG	
34.00	97.64	97.64	LGSG	
35.00	97.44	97.49	LGSG	
35.60	97.51	97.51	LGSG	
36.20	97.39	97.48	LGSG	
37.00	97.30	97.48	LGSG	
37.80	97.41	97.48	LGSG	
38.50	97.58	97.58	LGCO	
39.20	97.42	97.46	LGCO	
40.30	97.47	97.47	LGCO	RWE
41.50	97.55		LGCO	
42.40	97.73		LGCO	
44.80	97.87		COLG	
48.60	97.84		LGRU	
51.30	98.02		LGRU	
54.30	98.00		RUCO	
57.80	98.30		RUCO	
62.00	98.25		SISA	
64.50	98.85		SISA	GB RB HEADPIN
64.50	98.92		SISA	RB HEADPIN

Appendix Table D-15. Cross section profile of Passage Reach VIR in Slough 8A, October 6,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RUCO	LB HEADPIN
0.00	99.87		RUCO	GB LB HEADPIN
1.50	99.88		RUCO	
2.80	99.68	99.68	RUCO	LWE
4.20	99.83	99.83	RUCO	
4.80	99.80	99.80	RUCO	
6.10	99.66	99.66	RUCO	
7.00	99.73	99.73	CORU	
7.50	99.33	99.52	CORU	
8.40	99.49	99.49	CORU	
9.90	99.41	99.41	CORU	
10.70	99.29	99.37	CORU	
12.20	99.13	99.35	CORU	
12.90	99.41	99.41	CORU	
13.60	99.07	99.38	CORU	
14.60	99.35	99.36	COBO	
15.80	99.30	99.36	COBO	
16.40	99.44	99.44	COBO	
17.30	99.36	99.36	COBO	
18.00	99.33	99.35	COBO	
18.50	99.45	99.45	COBO	
19.50	99.53	99.53	COBO	
21.20	99.55	99.55	COBO	
22.50	99.49	99.49	COBO	
24.20	99.45	99.45	RUCO	
25.20	99.58	99.58	RUCO	
25.60	99.23	99.42	RUCO	
26.00	99.41	99.42	RUCO	
26.90	99.59	99.59	CORU	
27.90	99.64	99.64	CORU	
28.70	99.81	99.81	CORU	
29.70	99.63	99.63	CORU	
30.10	99.50	99.50	CORU	RWE
30.40	99.72		CORU	
31.20	99.72		CORU	
31.80	99.99		SIBO	
34.00	99.92		SIBO	
36.70	99.88		SIBO	
38.40	99.83		SIBO	
39.50	99.72		RUCO	
40.50	100.02		VEG	
44.00	99.95		VEG	
45.60	99.94		VEG	GB RB HEADPIN
45.60	100.15		VEG	RB HEADPIN

Appendix Table D-16. Cross section profile of Passage Reach VIIR in Slough 8A, October 6,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.82		VEG	GB LB HEADPIN
1.00	99.72		VEG	
2.40	99.48		RUCO	
4.20	99.41		RULG	
6.00	99.38		RULG	
7.50	99.62		CORU	
8.70	99.57		CORU	
10.00	99.52		CORU	
11.00	99.63		CORU	
12.20	99.54		CORU	
13.30	99.50		CORU	
13.70	99.27	99.27	CORU	LWE
14.90	99.21	99.26	CORU	
16.40	99.17	99.25	CORU	
17.50	99.36	99.36	CORU	
18.70	99.04	99.24	RULG	
19.70	99.38	99.38	RULG	
20.60	99.08	99.25	RULG	
21.30	99.27	99.27	CORU	
22.40	99.13	99.23	CORU	
23.20	99.23	99.26	CORU	
24.70	99.04	99.23	CORU	
25.60	99.12	99.24	CORU	
26.30	99.18	99.23	CORU	
28.50	99.19	99.24	CORU	
30.00	99.32	99.32	CORU	
31.70	99.13	99.21	CORU	
32.80	99.31	99.31	CORU	
33.80	99.01	99.20	CORU	
34.70	99.12	99.21	CORU	
35.70	99.18	99.20	CORU	
36.20	99.01	99.20	CORU	
37.00	99.30	99.30	CORU	
38.50	99.13	99.18	CORU	
39.70	99.18	99.19	CORU	
40.50	99.17	99.18	CORU	RWE
41.50	99.34		CORU	
43.00	99.43		CORU	
45.10	99.36		CORU	
47.30	99.30		CORU	
49.00	99.29		RUCO	
51.50	99.42		RUCO	
53.00	99.65		COBO	
55.40	99.76		COBO	
57.40	99.82		COBO	
59.00	100.01		COBO	GB RB HEADPIN
59.00	100.18		COBO	RB HEADPIN

Appendix Table D-17. Cross section profile of Passage Reach VIIIR in Slough 8A, October 7,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SIRU	LB HEADPIN
0.00	99.80		SIRU	GB LB HEADPIN
2.50	99.93		SIRU	
3.80	99.56		SIRU	
6.00	99.51		SIRU	
7.50	99.74		SISA	
9.00	99.33		SISA	
10.50	99.31		SICO	
13.50	99.35		SICO	
14.00	99.49		SICO	
16.30	99.53		SICO	
18.00	99.39		COSI	
21.00	99.50		COSI	
22.00	99.52		COSI	
22.70	99.24	99.24	CORU	LWE
24.10	99.22	99.24	CORU	
25.10	99.34	99.34	CORU	
26.60	99.29	99.30	CORU	
27.70	99.33	99.36	CORU	
29.40	99.40	99.40	CORU	
30.50	99.63	99.63	CORU	
31.10	99.28	99.39	CORU	
32.00	99.34	99.35	CORU	
33.80	99.37	99.37	CORU	
35.20	99.29	99.39	CORU	
36.00	99.44	99.44	CORU	
37.30	99.49	99.49	CORU	
38.70	99.31	99.37	CORU	
41.00	99.48	99.48	CORU	
43.30	99.47	99.47	CORU	
45.00	99.52	99.52	CORU	
47.00	99.52	99.52	CORU	
48.40	99.42	99.45	CORU	
49.40	99.46	99.46	SICO	RWE
50.90	99.51		SICO	
52.60	99.65		SISA	
58.10	99.32		SICO	
60.40	99.51		SICO	
62.60	99.34		SISA	
65.00	99.54		SISA	
69.90	99.51		SISA	
73.50	99.70		SISA	
74.80	99.67		SISA	GB RB HEADPIN
74.80	99.89		SISA	RB HEADPIN

Appendix Table D-18. Cross section profile of Passage Reach IXR in Slough 8A, October 7,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SILG	LB HEADPIN
0.00	99.81		SILG	GB LB HEADPIN
1.60	99.59		LGSI	
4.70	99.64		SILG	
8.50	99.49		LGSG	
11.70	99.26		LGSG	
15.40	99.55		LGSG	
17.50	99.57		LGSG	
20.00	99.36		LGSG	
22.80	99.46		LGSG	
26.20	99.29		LGSG	
30.00	99.52		LGRU	
31.90	99.56		LGRU	
34.20	99.56		LGRU	
35.30	99.34	99.34	LGRU	LWE
37.00	99.37	99.37	LGRU	
38.00	99.32	99.34	LGRU	
39.00	99.46	99.46	LGRU	
40.70	99.35	99.35	LGRU	
41.90	99.43	99.43	LGRU	
43.70	99.46	99.46	LGRU	
45.10	99.28	99.35	RUCO	
49.00	99.32	99.34	RUCO	
50.30	99.48	99.48	RUCO	
53.20	99.34	99.35	RUCO	
57.30	99.42	99.42	RUCO	
59.20	99.49	99.49	RUCO	
62.00	99.35	99.35	RUCO	RWE
63.50	99.56		RUCO	
67.00	99.58		RUCO	
69.70	99.47		RUCO	
71.80	99.57		RUCO	
74.00	99.66		RUCO	
74.70	99.38	99.38	RUCO	LWE
76.80	99.56	99.56	RUCO	
78.50	99.47	99.47	RUCO	
81.60	99.32	99.37	RUCO	
83.20	99.38	99.39	RUCO	
84.30	99.53	99.53	RUCO	RWE
87.00	99.65		RUCO	
89.50	99.66		RUCO	
92.50	99.42		RUCO	
93.00	99.18	99.18	RUCO	LWE
94.10	99.36	99.36	RUCO	
95.10	99.05	99.18	RUCO	

Appendix Table D-18. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
96.10	99.18	99.19	RUCO	
98.00	99.19	99.19	RUCO	
98.70	99.18	99.18	SISA	RWE
100.00	99.73		SISA	
101.00	100.18		SISA	
101.90	100.51		SISA	GB RB HEADPIN
101.90	100.78		SISA	RB HEADPIN

Appendix Table D-19. Cross section profile of Passage Reach XR in Slough 8A, October 7,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RUCO	LB HEADPIN
0.00	99.83		RUCO	GB LB HEADPIN
1.00	99.87		RUCO	
2.00	100.01		RUCO	
4.90	100.04		RUCO	
6.40	99.79		RUCO	
7.90	99.73		RUCO	
9.20	99.66		RUCO	
10.90	99.79		RUCO	
14.50	99.82		RUCO	
16.70	99.67		RUCO	
18.50	99.51		RUCO	
19.50	99.47		RUCO	
21.50	99.53		RUCO	
22.60	99.28		RUCO	
23.90	99.57		RUCO	
25.60	99.79		RUCO	
26.70	99.89		RUCO	
28.70	100.12		COBO	
30.50	100.20		COBO	
32.50	100.10		COBO	
33.90	99.83		COBO	GB RB HEADPIN
33.90	100.01		COBO	RB HEADPIN

Appendix Table D-20. Cross section profile of Passage Reach IV in Slough 9, September 22,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.73		SISA	GB LB HEADPIN
2.50	99.07		SISA	
10.20	99.36		SISA	
42.00	99.51		SISA	
57.70	99.07		SISA	
62.70	99.30		SISA	
74.90	99.33		SISA	
91.30	98.98		SISA	
94.30	98.86	98.86	SISA	LWE
99.40	98.73	98.86	SISA	
104.80	98.74	98.87	SISA	
114.30	98.76	98.87	SISA	
122.00	98.85	98.85	SISA	
124.50	98.84	98.84	SISA	
126.60	98.69	98.86	SISA	
132.60	98.72	98.88	SISA	
138.00	98.57	98.87	SISA	
141.20	98.45	98.86	SISA	
145.80	98.57	98.87	SISA	
151.10	98.64	98.86	SISA	
153.50	98.62	98.87	SISA	
156.70	98.68	98.86	SISA	
160.80	98.65	98.86	SISA	
163.00	98.55	98.86	SISA	
165.30	98.52	98.86	SISA	
166.30	98.54	98.86	SISA	
168.00	98.69	98.86	SISA	
169.50	98.86	98.86	SISA	RWE
170.50	99.04		SISA	
173.20	100.49		SISA	
174.20	100.79		VEG	GB RB HEADPIN
174.20	101.10		VEG	RB HEADPIN

Appendix Table D-21. Cross section profile of Passage Reach V in Slough 9, September 22,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.84		SISA	GB LB HEADPIN
10.00	98.57		LGCO	
32.00	97.16		SILG	
49.00	95.74		SACO	
53.60	95.10		LGSG	
61.00	94.74		LGSG	
67.20	94.42		LGSG	
69.80	94.20		LGSG	
71.20	94.06	94.06	LGRU	LWE
73.20	93.94	94.07	LGRU	
74.40	93.83	94.07	LGRU	
76.20	93.86	94.08	LGRU	
76.50	94.01	94.07	LGRU	
77.20	93.82	94.05	LGRU	
78.30	93.72	94.08	LGRU	
78.50	94.29	94.32	LGRU	
79.10	93.73	94.09	LGRU	
79.90	93.66	94.09	LGRU	
81.00	93.66	94.08	LGRU	
81.40	93.91	94.11	LGRU	
81.90	93.72	94.10	LGRU	
82.80	93.77	94.09	RUCO	
83.70	93.90	94.08	RUCO	
84.00	94.05	94.09	RUCO	
84.50	93.94	94.09	RUCO	
85.50	94.09	94.09	RUCO	RWE
86.90	94.14		RUCO	
88.50	94.19		RUCO	
90.30	94.21		RUCO	
92.00	94.37		RUCO	
95.00	94.47		SIRU	
97.90	94.83		SIRU	
101.00	95.19		SIRU	
109.00	95.71		SISA	
119.00	95.74		SISA	
136.60	94.90	94.90	SILG	LWE SEEPAGE AREA
138.60	94.77	94.93	SILG	
140.20	94.83	94.92	SILG	
141.80	94.90	94.90	SISA	RWE SEEPAGE AREA
145.00	95.01		SISA	
150.50	95.17		SISA	
156.00	95.18		SISA	
161.00	96.14		SISA	
168.20	96.97		SISA	
173.20	97.50		SISA	GB RB HEADPIN
173.20	97.58		SISA	RB HEADPIN

Appendix Table D-22. Cross section profile of Passage Reach I in Slough 9A, October 8,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SARU	LB HEADPIN
0.00	99.81		SARU	GB LB HEADPIN
3.00	99.98		RUCO	
6.60	99.90		RUCO	
9.40	99.80		RUCO	
10.50	99.95		RUCO	
11.80	99.90		RUCO	
12.40	99.48	99.48	RUCO	LWE
13.00	99.57	99.57	RUCO	
14.50	99.74	99.74	RUCO	
15.80	99.76	99.76	RUCO	
16.70	99.39	99.48	RUCO	
18.70	99.71	99.71	RUCO	
20.50	99.64	99.64	RUCO	
22.40	99.50	99.50	RUCO	
24.30	99.61	99.61	RUCO	
25.90	99.57	99.57	RUCO	
26.50	99.44	99.50	RUCO	
27.70	99.62	99.62	RUCO	
29.60	99.76	99.76	RUCO	
31.00	99.66	99.66	RUCO	
32.10	99.39	99.49	RUCO	
33.20	99.53	99.53	RUCO	
35.00	99.62	99.62	RUCO	
37.30	99.46	99.46	RUCO	
39.20	99.67	99.67	RUCO	
42.50	99.63	99.63	RUCO	
43.80	99.35	99.41	RUCO	
45.60	99.38	99.42	RUCO	
47.80	99.50	99.50	RUCO	
48.70	99.68	99.68	RUCO	
52.00	99.52	99.52	RUCO	
54.50	99.53	99.53	RUCO	
57.20	99.55	99.55	RUCO	
61.00	99.62	99.62	RUCO	
62.20	99.28	99.47	RUCO	
63.00	99.59	99.59	RUCO	
64.40	99.48	99.49	RUCO	
67.00	99.51	99.51	RUCO	
69.40	99.59	99.59	RUCO	
71.10	99.56	99.56	RUCO	
74.00	99.47	99.47	RUCO	
76.10	99.39	99.44	RUCO	
77.50	99.60	99.60	RUCO	
80.20	99.53	99.53	RUCO	

Appendix Table D-22. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
82.20	99.48	99.49	RUCO	
84.50	99.53	99.53	RUCO	
88.00	99.55	99.55	RUCO	
89.50	99.48	99.49	RUCO	
92.50	99.42	99.49	RUCO	
94.50	99.49	99.49	RUCO	
97.70	99.48	99.48	RUCO	
99.10	99.53	99.53	RUCO	
101.20	99.59	99.59	RUCO	
104.00	99.48	99.48	RUCO	RWE
106.10	99.76		RUCO	
109.50	99.62		RUCO	
113.00	100.03		RUCO	
117.00	100.43		RUCO	
120.00	100.36		RUCO	
122.70	100.29		RUCO	GB RB HEADPIN
122.70	100.39		RUCO	RB HEADPIN

Appendix Table D-23. Cross section profile of Passage Reach II in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.93		SISA	GB LB HEADPIN
14.00	96.91		SISA	
22.60	96.63		SICO	
38.40	96.23		SICO	
45.00	93.62		SICO	
50.40	95.06		SISA	
52.50	94.96		SISA	
56.00	94.95		SISA	
61.30	95.18		SISA	
64.60	95.11		SISA	
66.10	94.98		SILG	
67.30	94.83	94.83	LGSG	LWE
68.30	94.76	94.84	LGSG	
69.50	94.64	94.84	LGSG	
71.30	94.55	94.84	LGSG	
73.40	94.51	94.85	LGSG	
74.20	94.56	94.84	LGSG	
75.40	94.47	94.85	LGSG	
78.00	94.42	94.83	LGSG	
78.80	94.56	94.82	LGSG	
81.00	94.63	94.83	LGSG	
81.80	94.54	94.82	LGSG	
82.80	94.76	94.84	LGRU	
83.60	94.83	94.83	LGRU	RWE
84.30	95.01		LGRU	
85.80	95.32		LGRU	
88.20	95.70		COLG	
91.60	96.46		COLG	
94.80	96.88		COLG	
100.00	97.37		SILG	
105.00	98.33		VEG	
108.50	99.30		VEG	
110.80	99.76		VEG	GB RB HEADPIN
110.80	100.00		VEG	RB HEADPIN

Appendix Table D-24. Cross section profile of Passage Reach III in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.87		SISA	GB LB HEADPIN
3.00	99.47		SISA	
14.40	97.30		SISA	
20.60	97.28		SISA	
30.80	97.26		SILG	
35.60	97.29		LGSI	
45.10	97.19		LGSI	
54.10	96.99		LGSG	
60.00	96.61		LGSG	
65.00	96.47		LGSG	
66.70	96.46	96.46	LGSG	LWE
67.50	96.33	96.33	LGSG	
68.50	96.23	96.33	LGSG	
69.50	96.19	96.32	LGSG	
70.00	96.38	96.38	LGSG	
70.40	96.17	96.33	LGSG	
71.90	96.15	96.33	LGSG	
73.10	96.00	96.32	LGSG	
74.00	95.95	96.32	LGSG	
74.90	95.96	96.36	LGSG	
76.00	96.01	96.35	LGSG	
77.40	96.09	96.33	LGSG	
78.20	96.00	96.28	LGSG	
79.80	95.89	96.28	LGSG	
81.00	95.96	96.26	LGRU	
82.00	96.17	96.27	LGRU	
82.50	96.26	96.26	LGRU	RWE
83.30	96.51		LGRU	
86.30	96.60		LGRU	
90.60	96.84		LGRU	
94.40	97.24		SIRU	
95.70	97.51		SISA	
107.00	98.49		SISA	
110.10	98.60		SISA	
114.30	99.46		SISA	GB RB HEADPIN
114.30	99.69		SISA	RB HEADPIN

Appendix Table D-25. Cross section profile of Passage Reach IV in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.87		SISA	GB LB HEADPIN
5.20	98.90		SISA	
7.60	98.59		SISA	
12.50	97.73		SILG	
16.30	97.71		LGSG	
24.00	97.01		LGSG	
28.20	96.92		LGSG	
31.30	96.81		LGSG	
34.60	96.47		LGSG	
35.70	96.34		LGSG	
38.00	96.30		LGSG	
38.80	96.16	96.16	LGSG	LWE
40.20	96.10	96.20	LGRU	
41.10	96.09	96.19	LGRU	
42.30	95.98	96.15	LGRU	
42.70	96.03	96.17	LGRU	
43.40	95.94	96.16	LGRU	
44.70	95.83	96.19	LGRU	
46.00	95.82	96.22	LGRU	
47.20	95.87	96.20	LGRU	
48.40	95.78	96.17	LGRU	
49.50	95.84	96.16	RUCO	
50.40	96.06	96.16	RUCO	
51.30	95.94	96.19	RUCO	
51.60	96.18	96.18	RUCO	
52.10	96.05	96.19	RUCO	
53.90	96.17	96.17	LGCO	RWE
55.20	96.21		LGCO	
56.30	96.34		LGCO	
60.00	96.56		LGCO	
65.20	96.97		RUCO	
69.50	97.29		LGCO	
75.20	97.77		SICO	
77.00	97.95		SICO	GB RB HEADPIN
77.00	98.12		SICO	RB HEADPIN

Appendix Table D-26. Cross section profile of Passage Reach V in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.82		VEG	GB LB HEADPIN
24.00	98.95		SILG	
29.10	98.83		LGSG	
47.20	98.19		LGRU	
57.40	97.87		LGRU	
68.20	97.69		LGRU	
71.00	97.46		LGRU	
74.30	97.50		LGRU	
77.70	97.43	97.43	LGRU	LWE
79.00	97.40	97.46	LGRU	
80.90	97.45	97.45	LGRU	
83.10	97.41	97.41	LGRU	
84.50	97.32	97.41	LGRU	
87.00	97.29	97.42	LGRU	
88.20	97.30	97.42	LGRU	
89.30	97.40	97.40	LGRU	
91.00	97.45	97.45	LGRU	
92.50	97.36	97.36	LGSG	
94.00	97.19	97.38	LGSG	
95.40	97.14	97.37	LGSG	
97.00	97.07	97.37	LGSG	
99.70	97.07	97.38	LGSG	
100.80	97.14	97.39	LGSG	
102.90	97.19	97.37	LGSG	
103.60	97.23	97.39	LGSG	
104.50	97.17	97.39	LGSG	
106.00	97.21	97.40	LGSG	
107.00	97.41	97.41	LGSG	
107.90	97.28	97.41	LGSG	
109.50	97.27	97.43	LGSG	
111.20	97.19	97.44	LGSG	
113.40	97.11	97.40	LGSG	
114.30	97.20	97.35	LGSG	
115.90	97.24	97.34	LGSG	
116.80	97.29	97.29	LGSG	
117.80	97.15	97.31	LGSG	
118.50	97.40	97.40	LGSG	
118.80	97.16	97.31	LGSG	
120.40	97.16	97.31	LGSG	
121.00	97.27	97.32	LGSG	
121.60	97.31	97.31	LGSG	RWE
122.50	97.37		LGSG	
123.90	97.41		LGSG	
126.40	97.57		LGSG	

Appendix Table D-26. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
129.40	97.63		LGSG	
135.00	97.62		LGSG	
139.40	97.36		LGSG	
143.00	97.43		LGCO	
146.10	97.25	97.25	LGCO	LWE SEEPAGE AREA
147.90	97.20	97.26	LGCO	
151.20	97.18	97.18	LGCO	
153.60	96.80	97.10	LGCO	
154.90	97.09	97.09	LGCO	
157.20	97.26	97.26	LGCO	
162.00	97.07	97.32	LGCO	
164.80	97.35	97.35	LGCO	RWE SEEPAGE AREA
165.40	97.42		LGCO	
167.00	97.60		CORU	GB RB HEADPIN
167.00	97.81		CORU	RB HEADPIN

Appendix Table D-27. Cross section profile of Passage Reach VI in Slough 9A, October 8,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		COLG	LB HEADPIN
0.00	99.82		COLG	GB LB HEADPIN
1.50	99.87		LGSG	
3.00	99.82		RUCO	
4.30	99.75		RUCO	
5.10	99.72		RUCO	
5.60	99.53	99.53	RUCO	LWE
6.60	99.55	99.55	RUCO	
7.80	99.48	99.54	RUCO	
8.50	99.50	99.55	RUCO	
9.00	99.52	99.53	RUCO	
9.70	99.38	99.54	RUCO	
10.50	99.28	99.54	RUCO	
11.40	99.47	99.56	RUCO	
12.20	99.41	99.54	RUCO	
12.50	99.60	99.60	BOCO	
13.40	99.52	99.54	BOCO	
14.30	99.53	99.53	BOCO	
14.80	99.58	99.58	BOCO	
15.80	99.49	99.50	BOCO	
16.70	99.59	99.59	BOCO	
18.80	99.65	99.65	BOCO	
19.00	99.68	99.68	BOCO	
20.20	99.62	99.62	BOCO	
22.00	99.80	99.80	BOCO	
23.30	99.57	99.57	COBO	RWE
23.50	99.74		COBO	
24.30	99.90		COBO	
25.30	99.80		COBO	
26.50	100.04		COBO	
29.50	100.00		RUCO	
32.00	100.06		RUCO	
34.00	100.30		RUCO	
36.00	100.17		RUCO	
37.80	100.36		RUCO	
40.30	100.29		RUCO	GB RB HEADPIN
40.30	100.42		RUCO	RB HEADPIN

Appendix Table D-28. Cross section profile of Passage Reach VII in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SICO	LB HEADPIN
0.00	99.76		SICO	GB LB HEADPIN
2.40	99.03		CORU	
5.50	98.45		CORU	
6.50	98.01	98.01	RULG	LWE
7.40	97.95	98.00	RULG	
8.50	97.83	98.04	RULG	
8.90	97.95	98.06	RULG	
10.00	97.71	98.05	LGRU	
10.80	97.77	98.09	LGRU	
11.80	97.84	98.12	LGRU	
12.80	97.90	98.10	LGRU	
13.70	98.11	98.11	LGRU	
14.00	97.89	98.10	LGRU	
15.00	97.94	98.06	LGRU	
16.10	97.87	98.07	LGRU	
16.80	97.97	98.12	LGRU	
17.60	97.87	98.12	LGRU	
19.00	97.88	98.08	LGRU	
20.40	98.10	98.10	LGRU	RWE
22.00	98.29		LGRU	
23.80	98.42		LGRU	
26.60	98.30		LGRU	
29.90	98.29		LGRU	
32.50	98.05		LGSA	
35.50	97.96	97.96	SALG	LWE SEEPAGE AREA
37.00	97.85	97.98	SALG	
38.10	97.96	97.96	SALG	RWE SEEPAGE AREA
44.20	98.21		SASI	
47.50	98.21		LGRU	
51.70	98.49		LGRU	
54.40	98.22	98.22	LGRU	LWE SEEPAGE AREA
55.10	98.16	98.23	LGRU	
57.30	98.24	98.24	SILG	RWE SEEPAGE AREA
59.00	98.47		SILG	
62.60	98.88		LGSG	
63.60	99.25		LGSG	GB RB HEADPIN
63.60	99.37		LGSG	RB HEADPIN

Appendix Table D-29. Cross section profile of Passage Reach VIII in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.86		VEG	GB LB HEADPIN
2.00	99.20		VEG	
4.50	94.65	95.00	SICO	LWE POOL BACKWATER
10.40	93.94	94.99	SICO	
14.90	94.72	94.93	SICO	
16.80	94.70	95.00	SILG	
20.90	94.98	94.98	LGSA	RWE POOL BACKWATER
23.20	95.21		LGSA	
28.70	95.42		SISA	
31.40	95.52		SISA	
33.00	95.39		LGRU	
35.40	95.57		LGRU	
37.20	95.38		LGRU	
40.10	95.42		LGRU	
41.50	95.36	95.36	LGRU	LWE
42.30	95.26	95.38	LGRU	
43.10	95.36	95.36	LGRU	
44.00	95.21	95.37	LGRU	
47.00	95.18	95.36	LGRU	
48.50	95.35	95.35	LGRU	
49.90	95.32	95.43	LGRU	
50.40	95.50	95.50	LGRU	
51.40	95.37	95.49	LGRU	
53.30	95.26	95.51	LGRU	
55.00	95.43	95.52	LGRU	
55.40	95.52	95.52	LGRU	
56.10	95.67	95.67	LGRU	
57.30	95.41	95.57	LGRU	
59.20	95.32	95.59	LGRU	
60.70	95.25	95.57	LGRU	
62.10	95.30	95.60	LGRU	
64.30	95.32	95.61	LGRU	
65.30	95.28	95.61	LGRU	
66.70	95.23	95.59	LGRU	
67.70	95.35	95.59	LGRU	
69.10	95.48	95.60	LGRU	
70.70	95.29	95.58	LGRU	
72.60	95.41	95.58	LGRU	
74.30	95.37	95.57	LGRU	
75.70	95.41	95.56	LGRU	
76.30	95.58	95.58	LGRU	
78.40	95.79	95.79	LGRU	
81.20	95.48	95.48	LGRU	
81.80	95.36	95.46	LGRU	

Appendix Table D-29. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
82.70	95.45	95.45	RULG	RWE
84.50	95.55		RULG	
89.80	95.58		RULG	
101.90	95.48		RULG	
106.80	95.92		RUCO	
115.60	95.81		RUCO	
130.30	96.02		RUCO	
133.30	95.75			LOG PILE
136.50	97.00			LOG PILE
140.70	99.72			LOG PILE
145.70	98.93			LOG PILE, GB RB HEADPIN
145.70	99.11			LOG PILE, RB HEADPIN

Appendix Table D-30. Cross section profile of Passage Reach IX in Slough 9A, September 23,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.87		SISA	GB LB HEADPIN
3.00	99.20		SISA	
7.10	99.03		SISA	
10.30	98.50		SILG	
16.10	98.17		LGSG	
22.70	97.98		LGSG	
27.00	97.75		LGSG	
28.40	97.64	97.64	LGSG	LWE
28.90	97.58	97.65	LGSG	
30.30	97.65	97.65	LGSG	
31.70	97.50	97.61	LGSG	
32.80	97.55	97.60	LGSG	
33.50	97.60	97.60	RULG	
34.50	97.78	97.78	RULG	
36.00	97.58	97.58	RULG	
36.80	97.52	97.57	RULG	
38.20	97.47	97.57	RULG	
39.90	97.56	97.56	RULG	
41.70	97.58	97.58	RULG	
43.00	97.58	97.58	RULG	
44.20	97.44	97.56	RULG	
45.00	97.33	97.55	RULG	
45.90	97.28	97.57	RULG	
46.40	97.37	97.56	RULG	
47.00	97.20	97.56	RULG	
47.70	97.33	97.55	RULG	
48.60	97.33	97.54	RULG	
49.80	97.43	97.59	RULG	
50.80	97.45	97.61	RULG	
51.70	97.51	97.60	RULG	
53.00	97.61	97.61	RULG	
54.30	97.65	97.65	RULG	
55.80	97.65	97.65	RULG	
57.40	97.54	97.65	RULG	
60.00	97.64	97.64	RULG	RWE
61.20	97.72		RULG	
64.60	97.98		RULG	
68.60	97.96		RULG	GB RB HEADPIN
68.60	98.10		RULG	RB HEADPIN

Appendix Table D-31. Cross section profile of Passage Reach X in Slough 9A, October 8,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.88		SISA	GB LB HEADPIN
2.00	99.50		LGSG	
3.90	99.44		LGSG	
4.80	100.01		LGSG	
5.90	99.33	99.33	LGSG	LWE
7.50	99.41	99.41	LGSG	
8.70	99.37	99.37	LGSG	
11.20	99.45	99.45	CORU	
12.60	99.21	99.31	CORU	
13.20	99.32	99.33	CORU	
14.20	99.16	99.26	CORU	
15.00	99.60	99.60	CORU	
16.50	99.31	99.31	CORU	
17.40	99.42	99.42	CORU	
19.70	99.33	99.33	CORU	
20.50	99.24	99.27	CORU	
20.90	99.44	99.44	CORU	
22.70	99.25	99.25	CORU	
25.00	99.27	99.27	CORU	
27.00	99.22	99.22	CORU	
28.00	99.35	99.35	CORU	
29.20	99.26	99.26	CORU	
29.90	99.08	99.14	CORU	
31.40	99.06	99.15	CORU	
32.30	99.15	99.15	CORU	
33.80	99.29	99.29	CORU	
35.90	99.30	99.30	CORU	
37.30	99.28	99.28	CORU	
39.40	99.45	99.45	CORU	
41.00	99.20	99.20	BOCO	RWE
42.00	99.51		BOCO	
44.50	99.45		BOCO	
47.00	99.34		BOCO	
48.50	99.64		BOCO	
51.40	99.39		BOCO	
53.10	99.47		BOCO	
54.00	99.88		BOCO	
55.50	98.95		SISA	
60.00	98.87		SISA	
65.50	99.19		SISA	
66.00	100.10		SISA	
67.00	100.47		SISA	GB RB HEADPIN
67.00	100.60		SISA	RB HEADPIN

Appendix Table D-32. Cross section profile of Passage Reach XI in Slough 9A, October 8,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SASG	LB HEADPIN
0.00	99.92		SASG	GB LB HEADPIN
2.50	99.92		SASG	
4.70	99.72		BOLG	
6.70	99.78		BOLG	
8.80	99.56		BOLG	
11.10	99.80		BOLG	
13.50	99.63		BOLG	
14.70	99.62		BOLG	
16.90	99.37		RULG	
17.70	99.45		RULG	
19.30	99.81		RULG	
20.80	99.38		RULG	
21.60	99.71		RULG	
23.60	99.16		RULG	
26.20	99.28		RULG	
28.30	99.22		RULG	
29.40	99.54		BOCO	
32.00	99.43		BOCO	
33.70	99.46		BOCO	
34.10	99.21	99.21	RUCO	LWE
35.00	99.28	99.28	RUCO	
36.00	99.07	99.20	RUCO	
36.60	99.25	99.25	RUCO	
38.00	99.26	99.26	RUCO	
38.70	99.08	99.21	LGRU	
39.40	99.05	99.20	LGRU	
40.30	99.10	99.20	LGRU	
40.70	99.26	99.26	LGRU	
42.30	99.35	99.35	COLG	
43.10	99.31	99.31	COLG	
44.70	99.42	99.42	COLG	
45.20	99.24	99.24	COLG	RWE
46.70	99.45		COLG	
48.90	99.43		RULG	
50.80	99.40		RULG	
52.60	99.47		RULG	
53.80	99.38		RULG	
56.00	99.45		RULG	
59.90	99.49		RULG	
63.00	99.54		RULG	
65.00	99.55		RULG	
67.10	99.37		RULG	
69.50	99.31		SISA	
72.50	99.42		SISA	
75.50	99.72		SISA	
77.20	100.15		SISA	GB RB HEADPIN
77.20	100.28		SISA	RB HEADPIN

Appendix Table D-33. Cross section profile of Passage Reach I in Slough 11, October 18,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SGLG	LB HEADPIN
0.00	99.77		SGLG	GB LB HEADPIN
8.00	98.69		SISA	
17.00	98.30		SISA	
20.60	98.21		SISG	
28.00	98.07		SILG	
30.30	97.96		SILG	
32.70	97.80	97.80	LGSG	LWE
34.40	97.64	97.80	LGSG	
35.30	97.71	97.81	LGSG	
36.30	97.62	97.81	LGSG	
37.90	97.74	97.76	LGSG	
39.60	97.81	97.81	LGSG	
41.00	97.95	97.95	LGSG	
42.70	97.98	97.98	LGSG	
44.90	97.99	97.99	LGSG	
45.30	97.93	97.93	LGSG	
47.50	97.77	97.91	LGSG	
48.30	97.84	97.90	LGSG	
50.00	97.72	97.91	LGSG	
51.80	97.57	97.57	LGSG	
53.00	98.03	98.03	LGSG	
56.50	98.10	98.10	LGSG	
59.30	98.07	98.07	LGSG	
63.50	97.55	97.55	LGSG	
65.00	97.49	97.58	LGSG	
66.70	97.37	97.57	LGSG	
68.80	97.55	97.64	LGSG	
71.00	97.65	97.65	LGSG	
72.80	97.55	97.68	LGSG	
74.50	97.46	97.64	LGSG	
76.80	97.66	97.71	LGSG	
79.80	97.68	97.71	SGSI	
85.00	97.71	97.71	SGSI	RWE
86.20	97.79		SGSI	
90.40	97.87		LGSG	
92.50	98.14		SGSI	
94.40	98.09		SGSI	GB RB HEADPIN
94.40	99.43		SGSI	RB HEADPIN

Appendix Table D-34. Cross section profile of Passage Reach III in Slough 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.87		VEG	GB LB HEADPIN
12.70	99.95		SILG	
23.00	99.86		SILG	
31.00	99.16		SILG	
33.30	98.79	98.79	LGSG	LWE
34.30	98.71	98.80	LGSG	
36.00	98.65	98.79	LGSG	
37.10	98.54	98.79	LGSG	
38.20	98.61	98.77	LGSG	
38.70	98.69	98.78	LGSG	
39.60	98.55	98.78	LGSG	
42.00	98.63	98.83	LGSG	
43.00	98.50	98.80	LGSG	
44.00	98.65	98.80	LGSG	
46.10	98.64	98.79	LGSG	
49.40	98.64	98.83	LGSG	
51.00	98.57	98.79	LGSG	
53.20	98.70	98.80	LGSG	
57.50	98.65	98.81	LGSG	
59.40	98.67	98.81	LGSG	
60.50	98.76	98.80	LGSG	
62.50	98.66	98.76	LGSG	
64.40	98.59	98.72	LGSG	
65.60	98.47	98.67	LGSG	
66.10	98.60	98.67	LGSG	
67.00	98.47	98.67	LGSG	
67.70	98.56	98.64	LGRU	
69.70	98.61	98.61	LGSG	RWE
71.80	99.19		LGSG	
74.70	98.91		LGSG	
75.70	98.78		LGSG	
78.00	98.66		LGSG	
81.80	98.85		LGSG	
90.80	98.87		RUSI	
100.00	98.93		RUSI	
103.60	99.09		RUSI	GB RB HEADPIN
103.60	99.26		RUSI	RB HEADPIN

Appendix Table D-35. Cross section profile of Passage Reach IV in Slough 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.74		VEG	GB LB HEADPIN
6.00	99.81		VEG	
9.90	99.71		SILG	
13.70	99.64	99.64	SILG	LWE
16.80	99.53	99.63	SILG	
18.30	99.36	99.64	LGRU	
19.80	99.27	99.67	LGRU	
21.50	99.28	99.65	LGRU	
22.90	99.39	99.62	LGRU	
24.50	99.50	99.68	SISG	
27.00	99.47	99.62	SISG	
29.40	99.55	99.65	SISG	
30.20	99.73	99.73	SISG	
30.80	99.59	99.69	LGSG	
31.90	99.62	99.68	LGSG	
32.50	99.75	99.75	LGSG	
33.20	99.58	99.70	LGSG	
35.30	99.60	99.72	LGRU	
38.00	99.62	99.72	LGRU	
39.70	99.72	99.72	LGRU	RWE
40.80	99.80		VEG	
43.00	99.92		VEG	
45.80	99.87		VEG	
50.40	99.83		VEG	GB RB HEADPIN
50.40	99.99		VEG	RB HEADPIN

Appendix Table D-36. Cross section profile of Passage Reach V in Slough 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGSG	LB HEADPIN
0.00	99.78		LGSG	GB LB HEADPIN
4.90	99.93		LGSG	
8.20	99.69		LGSG	
14.20	99.70		LGRU	
22.20	99.80		LGRU	
23.70	100.06		LGRU	
25.10	99.86	99.86	RULG	LWE
26.80	99.72	99.86	RULG	
27.70	99.87	99.87	RULG	
28.70	99.89	99.89	RULG	
29.40	99.78	99.88	RULG	
29.70	100.01	100.01	RULG	
30.50	99.89	99.89	RULG	
31.50	100.00	100.00	RULG	
32.50	99.75	99.75	RULG	
34.00	99.61	99.79	RUCO	
35.00	99.66	99.75	RUCO	
36.20	99.70	99.82	RUCO	
36.70	99.83	99.83	RUCO	
37.10	99.72	99.82	RUCO	
39.30	99.67	99.83	RUCO	
39.70	99.87	99.87	RUCO	
40.00	99.68	99.87	RUCO	
40.90	99.63	99.85	LGRU	
41.50	99.57	99.87	LGRU	
42.60	99.57	99.87	LGRU	
43.40	99.66	99.90	LGRU	
43.70	99.81	99.87	RUCO	
45.50	99.70	99.85	RUCO	
46.10	99.78	99.84	RUCO	
46.60	100.11	100.11	RUCO	
46.90	99.80	99.82	RUCO	
49.80	99.55	99.81	RUCO	
52.20	99.72	99.89	RUCO	
53.30	99.84	99.89	RUCO	
53.70	100.03	100.03	RUCO	
53.90	99.89	99.89	RUCO	
56.00	99.98	99.98	RUCO	
57.00	99.88	99.98	RUCO	
58.00	99.86	99.96	RUCO	
58.50	100.02	100.02	RUCO	
63.80	100.04	100.04	RUCO	
64.60	99.92	100.01	RUCO	
65.50	99.89	100.01	RUCO	

Appendix Table D-36. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
66.20	99.99	99.99	LGRU	RWE
67.20	100.09		LGRU	
69.70	100.16		LGRU	
75.00	100.16		LGRU	
81.00	100.20		LGRU	GB RB HEADPIN
81.00	99.89		LGRU	RB HEADPIN

Appendix Table D-37. Cross section profile of Passage Reach VI in Slough 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGCO	LB HEADPIN
0.00	99.70		LGCO	GB LB HEADPIN
11.80	99.16		LGCO	
21.70	98.87		LGRU	
24.30	98.77	98.77	LGRU	LWE
26.00	98.64	98.77	LGRU	
27.00	98.59	98.77	LGRU	
27.60	98.89	98.89	LGRU	
28.40	98.63	98.75	LGRU	
29.30	98.55	98.74	LGRU	
30.50	98.67	98.75	LGRU	
31.10	98.56	98.79	LGRU	
33.20	98.48	98.78	LGRU	
34.30	98.37	98.76	LGRU	
35.30	98.51	98.77	LGRU	
37.50	98.57	98.80	LGRU	
39.30	98.62	98.79	LGRU	
40.70	98.68	98.79	LGRU	
41.10	98.88	98.88	LGRU	
42.00	98.64	98.74	LGRU	
42.80	98.86	98.86	LGRU	
43.70	98.62	98.73	LGRU	
44.80	98.72	98.75	RULG	
45.60	98.60	98.70	RULG	
46.60	98.64	98.71	RULG	
47.30	98.70	98.70	RULG	RWE
48.20	98.83		RULG	
51.70	98.93		RULG	
54.30	98.85		RULG	
69.00	99.10		RULG	
82.80	98.79		VEG	
84.00	99.74		VEG	
85.10	99.80		VEG	GB RB HEADPIN
85.10	99.92		VEG	RB HEADPIN

Appendix Table D-38. Cross section profile of Passage Reach VII in Slough 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGRU	LB HEADPIN
0.00	99.77		LGRU	GB LB HEADPIN
2.40	99.68		LGRU	
9.60	99.14		LGRU	
12.90	98.17		LGRU	
16.90	98.93	98.93	LGSG	LWE
17.30	98.73	98.89	LGSG	
18.00	98.71	98.90	LGSG	
18.40	98.80	98.89	LGSG	
18.80	98.89	98.89	LGSG	
19.40	99.25	99.25	RUCO	
20.50	99.20	99.20	RUCO	
21.00	99.04	99.04	RUCO	
23.60	99.08	99.08	RUCO	
27.40	99.10	99.10	RUCO	
28.80	98.96	98.96	RUCO	
30.00	98.90	98.95	RUCO	
30.60	99.13	99.13	RUCO	
31.60	98.89	98.95	RUCO	
32.30	98.96	98.96	RUCO	
33.50	98.80	98.80	RUCO	
34.00	98.65	98.84	LGRU	
34.50	98.57	98.87	LGRU	
35.80	98.89	98.89	LGRU	RWE
36.40	99.22		RUCO	
37.50	99.07		RUCO	
41.90	99.30		LGCO	
49.50	99.42		LGCO	
53.00	99.25		LGCO	
64.00	99.63		LGCO	GB RB HEADPIN
64.00	99.76		LGCO	RB HEADPIN

Appendix Table D-39. Cross section profile of Passage Reach I in Upper Side Channel 11, September 21,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.76		VEG	GB LB HEADPIN
4.00	98.95		VEG	
10.00	98.39		SICO	
19.50	97.68		COBO	
24.20	97.66		COBO	
27.80	98.27		COBO	
38.00	97.52		COBO	
41.30	96.83	96.83	COBO	LWE
43.10	96.62	96.81	COBO	
45.50	96.60	96.81	COBO	
47.20	96.83	96.83	COBO	
48.40	96.88	96.88	RUCO	
51.60	96.66	96.66	RUCO	
53.70	96.47	96.66	RUCO	
55.50	96.66	96.66	RUCO	
56.00	96.99	96.99	RUCO	
58.60	96.69	96.69	RUCO	
59.80	96.50	96.69	RUCO	
60.80	96.69	96.69	RUCO	
61.70	96.96	96.96	RUCO	
63.30	96.69	96.69	RUCO	
64.50	96.56	96.68	RUCO	
66.90	96.48	96.66	RUCO	
68.80	96.45	96.67	RUCO	
69.00	96.69	96.69	RUCO	
70.30	96.54	96.68	RUCO	
71.80	96.77	96.77	RUCO	
72.10	96.50	96.67	RUCO	
74.00	96.33	96.67	RUCO	
76.30	96.31	96.68	RUCO	
78.00	96.57	96.67	RUCO	
79.40	96.44	96.65	RUCO	
80.30	96.33	96.65	RUCO	
81.90	96.30	96.66	RUCO	
83.40	96.50	96.64	RUCO	
84.50	96.65	96.65	RUCO	
85.80	96.45	96.67	RUCO	
87.70	96.38	96.68	RUCO	
88.20	96.25	96.66	RUCO	
89.50	96.42	96.66	RUCO	
91.00	96.47	96.66	RUCO	
91.30	96.69	96.69	RUCO	
91.80	96.51	96.66	RUCO	
95.50	96.62	96.62	RUCO	RWE

Appendix Table D-39. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
97.00	96.75	96.75	RUCO	SEEPAGE AREA
101.00	96.68	96.68	RUCO	
108.00	96.57	96.57	RUCO	
109.50	97.25	97.25	RUCO	
110.50	96.66	96.66	RUCO	
113.40	96.76	96.76	RUCO	
118.00	96.58	96.77	RUCO	
119.00	96.75	96.75	RUCO	
123.10	97.07	97.07	RUCO	
129.80	97.02	97.02	RUCO	
144.00	97.26	97.26	RUCO	
158.60	97.48	97.48	RUCO	
169.00	96.70	96.70	RUCO	SEEPAGE AREA
180.00	98.82		VEG	
183.40	99.43		VEG	GB RB HEADPIN
183.40	99.68		VEG	RB HEADPIN

Appendix Table D-40. Cross section profile of Passage Reach VI in Slough 19, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SASI	LB HEADPIN
0.00	99.90		SASI	GB LB HEADPIN
4.00	99.42		SASI	
6.00	99.26		SASI	
7.10	99.04	99.04	SASI	LWE
8.00	98.97	99.07	SASI	
9.00	98.88	99.06	SASI	
10.00	98.81	99.06	SASI	
10.80	98.76	99.06	SASI	
11.30	98.88	99.06	SASI	
12.10	99.07	99.07	SASI	RWE
13.00	99.36		SASI	
14.80	100.16		SISA	
16.00	100.36		VEG	GB RB HEADPIN
16.00	100.46		VEG	RB HEADPIN

Appendix Table D-41. Cross section profile of Passage Reach VII in Slough 19, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SASI	LB HEADPIN
0.00	99.87		SASI	GB LB HEADPIN
8.40	98.48		SASI	
11.80	98.35		SASI	
12.20	98.19	98.19	SASI	LWE
12.40	98.11	98.19	SASI	
12.80	98.36	98.36	SASI	
14.00	98.38	98.38	SASI	
15.20	98.25	98.25	SASI	
16.00	98.30	98.30	SASI	
17.60	98.21	98.21	SASI	
18.70	98.07	98.19	LGRU	
19.70	98.38	98.38	LGRU	
20.20	98.19	98.19	SABO	RWE
21.40	98.55		SASI	
28.60	98.78		SASI	
32.50	99.59		SASI	GB RB HEADPIN
32.50	99.68		SASI	RB HEADPIN

Appendix Table D-42. Cross section profile of Passage Reach VIII in Slough 19, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	98.84		SISA	GB LB HEADPIN
0.40	98.42		SISA	
2.00	98.32		SISA	
3.40	98.38		LGSA	
4.20	98.62		LGSA	
6.00	98.43		LGSA	
7.00	98.47		LGSG	
8.00	98.46		LGSG	
9.00	98.47		LGSG	
9.90	98.58		LGSG	
11.30	99.11		LGSG	GB RB HEADPIN
11.30	99.20		LGSG	RB HEADPIN

Appendix Table D-43. Cross section profile of Passage Reach IX in Slough 19, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		VEG	LB HEADPIN
0.00	99.55		VEG	GB LB HEADPIN
2.00	98.73		SISA	
6.00	98.38		SISA	
8.80	98.48		RUSA	
12.00	98.44		RUSA	
13.30	98.20		RUSA	
14.00	98.00		COSI	
14.50	98.12		COSI	
15.50	98.12		COSI	
16.50	98.27		COSI	
17.20	98.01		COSI	
18.00	98.09		COSI	
19.00	98.06		SISA	
19.80	98.26		SISA	
21.50	98.36		SISA	
22.70	98.58		SISA	GB RB HEADPIN
22.70	99.31		SISA	RB HEADPIN

Appendix Table D-44. Cross section profile of Passage Reach I in Slough 20, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.92		SISA	GB LB HEADPIN
3.00	99.14		BOSA	
3.60	99.45		BOSA	
4.70	98.65		BOSA	
6.20	98.46		CORU	
7.00	98.30		CORU	
7.60	98.09		LGSG	
8.50	98.29		LGSG	
10.20	98.29		LGSG	
11.10	98.34		LGSG	
12.80	98.27		LGSG	
14.60	98.41		LGSG	
16.00	98.55		LGSG	
18.20	98.72		LGSA	
20.00	99.11		SISA	
25.00	99.58		SASI	
48.00	100.41		SASI	
59.00	100.66		SASI	
64.50	101.70		SA	GB RB HEADPIN
64.50	101.77		SA	RB HEADPIN

Appendix Table D-45. Cross section profile of Passage Reach VI in Slough 20, October 17,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.84		SISA	GB LB HEADPIN
20.00	99.25		SISA	
34.00	98.88		SISA	
43.00	98.67		SALG	
50.00	98.41		SALG	
55.00	98.45		LGRU	
58.80	98.56		LGRU	
61.00	98.45		LGRU	
62.00	98.60		LGRU	
65.00	98.50		LGRU	
66.90	98.56		LGRU	
68.50	98.49		LGRU	
70.70	98.38		LGRU	
73.40	98.69		LGRU	
75.50	98.61		LGRU	
77.90	98.75		LGRU	
79.20	98.49		LGRU	
80.80	98.81		LGRU	
82.50	98.80		LGRU	
83.80	98.63		CORU	
85.30	98.48		CORU	
86.90	98.47		SARU	
88.50	98.41		SARU	
89.50	98.50		SA	
91.50	100.58		SASI	
92.30	100.70		VEG	GB RB HEADPIN
92.30	100.75		VEG	RB HEADPIN

Appendix Table D-46. Cross section profile of Passage Reach I in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		LGCO	LB HEADPIN
0.00	99.86		LGCO	GB LB HEADPIN
2.00	99.75		LGCO	
7.00	99.49		LGCO	
9.20	99.33	99.33	SARU	LWE
11.00	99.21	99.34	SARU	
12.40	99.02	99.33	SARU	
13.20	99.08	99.34	SASI	
15.00	99.12	99.34	SASI	
17.00	99.12	99.35	SASI	
19.00	99.04	99.34	SASI	
21.00	99.07	99.32	SASI	
23.00	99.20	99.33	SASI	
28.00	99.21	99.33	SASI	
30.50	99.40	99.40	SABO	
34.20	98.99	99.32	SABO	
36.10	99.22	99.31	SABO	
38.20	99.47	99.47	SABO	
40.20	99.57	99.57	SABO	
41.50	99.32	99.32	SABO	RWE
46.30	99.67		SABO	
48.00	100.31		BOSA	
49.50	99.97		BOSA	
51.50	100.77		BOSA	
55.90	100.63		BOSA	GB RB HEADPIN
55.90	100.72		BOSA	RB HEADPIN

Appendix Table D-47. Cross section profile of Passage Reach II in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SASI	LB HEADPIN
0.00	99.84		SASI	GB LB HEADPIN
3.30	99.40		SASI	
30.00	98.20		SASI	
49.00	97.82		SASI	
60.00	97.69		SASI	
63.00	97.57		SASI	
64.00	97.59		SASI	
64.10	97.45	97.45	LGSG	LWE
65.40	97.21	97.47	LGSG	
67.00	97.24	97.41	LGSG	
69.20	97.30	97.48	LGSG	
70.50	97.40	97.48	LGSG	
72.50	97.29	97.48	LGSG	
73.90	97.44	97.49	LGSG	
75.50	97.47	97.48	LGSG	
77.00	97.54	97.54	LGSG	
79.00	97.35	97.50	LGSG	
80.50	97.46	97.52	LGSG	
82.10	97.44	97.51	LGSG	
83.80	97.18	97.50	LGSG	
86.10	97.35	97.47	LGRU	
88.60	97.48	97.48	LGRU	
90.10	97.44	97.44	LGRU	RWE
91.10	97.64		LGRU	
94.00	97.61		LGRU	
98.90	97.83		LGRU	
104.50	97.75		LGSA	
111.50	97.88		LGSA	
120.80	98.04		SARU	GB RB HEADPIN
120.80	98.23		SARU	RB HEADPIN

Appendix Table D-48. Cross section profile of Passage Reach III in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.84		SISA	GB LB HEADPIN
2.00	99.21		SISA	
4.00	99.11		SALG	
5.80	98.97		LGSA	
6.50	98.84	98.84	LGSA	LWE
7.60	98.81	98.83	LGSA	
9.10	98.81	98.81	LGRU	
10.90	98.52	98.88	LGRU	
12.40	98.49	98.83	LGRU	
14.00	98.71	98.79	LGRU	
15.80	98.70	98.80	LGRU	
17.30	98.62	98.83	LGRU	
19.50	98.67	98.85	LGRU	
20.60	98.78	98.84	LGRU	
22.50	98.79	98.85	COSA	
25.50	98.79	98.86	COSA	
26.70	98.86	98.86	COSA	
28.00	98.77	98.85	COSA	
30.60	98.81	98.84	COSA	
33.30	99.03	99.03	COSA	
35.50	98.94	98.94	COSA	
38.10	98.77	98.77	COSA	
39.40	98.79	98.79	COSA	RWE
40.40	99.01		SACO	
41.70	99.11		SISA	GB RB HEADPIN
41.70	99.18		SASI	RB HEADPIN

Appendix Table D-49. Cross section profile of Passage Reach IV in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.85		SISA	GB LB HEADPIN
4.00	99.66		SARU	
10.20	99.57	99.57	LGSG	LWE
12.00	99.44	99.56	LGSG	
17.00	99.41	99.47	LGSG	
20.50	99.44	99.44	LGSG	
21.70	99.25	99.35	LGSG	
22.40	99.48	99.48	LGSG	
24.00	99.23	99.41	LGSG	
25.70	99.41	99.41	LGSG	
26.80	99.09	99.43	LGSG	
29.00	99.30	99.37	COLG	
31.00	99.27	99.35	COLG	
32.30	99.63	99.63	COLG	
35.20	99.56	99.56	COLG	
36.30	99.28	99.46	COLG	
38.30	99.66	99.66	COLG	
39.40	99.47	99.51	COLG	
42.00	99.61	99.61	COLG	
43.00	99.38	99.58	COLG	
44.00	99.63	99.63	COLG	
46.20	99.41	99.57	COLG	
48.00	99.64	99.64	COLG	
49.60	99.63	99.63	COLG	
51.10	99.69	99.69	COLG	
53.00	99.14	99.57	COLG	
54.00	99.57	99.57	COLG	
55.50	99.48	99.53	COLG	
56.50	99.19	99.52	COLG	
58.70	99.57	99.57	COLG	
60.90	99.36	99.60	COLG	
62.00	99.63	99.63	COLG	
64.00	99.70	99.70	COLG	
66.10	99.45	99.57	RULG	
67.20	99.77	99.77	RULG	
70.20	99.40	99.51	RULG	
71.70	99.52	99.52	RULG	RWE
73.00	99.56		RULG	GB RB HEADPIN
73.00	99.80		RULG	RB HEADPIN

Appendix Table D-50. Cross section profile of Passage Reach VII in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		RUSA	LB HEADPIN
0.00	99.95		RUSA	GB LB HEADPIN
5.50	99.95		RULG	
9.00	99.76		RULG	
13.70	99.96		RULG	
15.40	99.43	99.43	RULG	LWE
17.00	99.55	99.55	RUCO	
20.00	99.65	99.65	RUCO	
23.00	99.56	99.56	RUCO	
25.80	99.33	99.42	RUCO	
29.00	99.41	99.41	RUCO	
33.20	99.79	99.79	RUCO	
37.20	99.53	99.53	RUCO	
39.00	99.61	99.61	RUCO	
41.10	99.85	99.85	RUCO	
43.70	99.29	99.29	RUCO	
45.40	99.26	99.31	RUCO	
47.90	99.43	99.43	RUCO	
50.00	99.48	99.48	RUCO	
53.00	99.44	99.44	RUCO	
55.40	99.28	99.34	RUCO	
57.60	99.52	99.52	RUCO	
60.30	99.41	99.41	RUCO	
61.00	99.30	99.37	RUCO	
61.90	99.54	99.54	RUCO	
65.80	99.48	99.48	RUCO	
68.30	99.56	99.56	RUCO	
70.50	99.30	99.42	RUCO	
72.00	99.53	99.53	RUCO	
74.00	99.62	99.62	RUCO	
76.40	99.32	99.39	RUCO	
78.30	99.39	99.40	RUCO	
81.50	99.73	99.73	RUCO	
84.20	99.47	99.47	RUCO	
86.50	99.54	99.54	RUCO	
91.70	99.40	99.40	RUCO	
94.70	99.46	99.46	RUCO	
97.20	99.50	99.50	RUCO	
98.10	99.13	99.36	RUCO	
101.10	99.10	99.35	RUCO	
102.80	99.53	99.53	RUCO	
106.50	99.50	99.50	RUCO	
108.10	99.40	99.40	RUCO	
109.60	99.20	99.33	RUCO	
111.70	99.45	99.45	RUCO	

Appendix Table D-50. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
115.10	99.40	99.40	RUCO	
117.70	99.22	99.32	RUCO	
119.50	99.40	99.40	RUCO	
122.50	99.39	99.39	RUCO	
125.50	99.51	99.51	RUCO	
126.70	99.17	99.35	RUCO	
128.80	99.22	99.34	RUCO	
130.20	99.40	99.40	RUCO	
134.50	99.52	99.52	RUCO	
136.20	99.70	99.70	RUCO	
138.80	99.42	99.42	RUCO	
141.20	99.34	99.36	RUCO	
143.70	99.45	99.45	RUCO	
146.00	99.36	99.36	RUCO	RWE
147.00	99.76		RUCO	
153.00	99.80		BORU	
158.00	100.15		BORU	
164.50	100.72		BOSA	
171.00	102.10		BOSA	
178.50	101.57		SABO	
182.30	102.03		SABO	GB RB HEADPIN
182.30	102.67		SABO	RB HEADPIN

Appendix Table D-51. Cross section profile of Passage Reach VIII in Side Channel 21, October 15,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		BORU	LB HEADPIN
0.00	99.86		BORU	GB LB HEADPIN
3.00	100.01		BORU	
9.50	100.01		BOSI	
16.50	99.73		BOSI	
19.60	99.70		BOSI	
20.50	99.37	99.37	CORU	LWE
22.00	99.57	99.57	CORU	
23.30	99.37	99.37	CORU	
24.60	99.33	99.33	CORU	
25.50	99.43	99.43	CORU	
27.70	99.43	99.43	CORU	
31.00	99.71	99.71	CORU	
34.40	99.39	99.39	CORU	
36.00	99.12	99.12	CORU	
40.20	99.08	99.08	CORU	
42.00	98.82	98.94	CORU	
44.10	98.91	98.96	CORU	
45.00	99.31	99.31	CORU	
46.70	98.83	98.98	CORU	
48.30	99.11	99.11	CORU	
51.00	99.16	99.16	CORU	
52.10	98.91	98.96	CORU	
53.00	99.20	99.20	CORU	
56.00	99.70	99.70	BOCO	
60.60	99.74	99.74	BOCO	
67.50	99.67	99.67	BOCO	
70.50	99.28	99.28	BOCO	
74.00	100.05	100.05	BOCO	
77.00	99.43	99.43	BOCO	
79.70	99.24	99.24	BOCO	
81.10	98.91	99.12	BORU	
82.10	99.79	99.79	BORU	
84.30	99.56	99.56	BORU	
85.10	98.95	99.20	BORU	
86.90	99.48	99.48	BORU	
89.50	99.33	99.33	BORU	
92.50	99.47	99.47	BORU	
94.70	99.01	99.14	BORU	
97.00	99.32	99.32	BORU	
100.20	99.34	99.34	BORU	
102.00	99.38	99.38	BORU	
103.20	99.00	99.19	BORU	
105.50	99.27	99.27	BORU	
108.50	99.32	99.32	BORU	

Appendix Table D-51. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
110.20	99.41	99.41	BORU	
111.50	99.09	99.18	BORU	
113.50	99.28	99.28	BORU	
115.30	99.37	99.37	BORU	
116.50	99.10	99.18	BORU	
118.50	99.28	99.28	BORU	
119.50	99.19	99.19	COBO	RWE
120.00	99.45		COBO	
122.00	100.03		COBO	
125.00	99.73		COBO	
130.10	99.80		COBO	GB RB HEADPIN
130.10	99.90		COBO	RB HEADPIN

Appendix Table D-52. Cross section profile of Passage Reach IX in Side Channel 21, October 16,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.92		SISA	GB LB HEADPIN
10.00	99.29		SISA	
25.00	99.04		SISA	
37.60	98.32		SISA	
43.30	97.30		SISA	
57.00	97.34		SALG	
64.00	97.23		LGSA	
68.40	96.98		LGSA	
72.30	96.97		LGSA	
76.00	96.98		LGSA	
78.00	96.88		LGSA	
80.90	96.97		LGSA	
84.30	96.96		LGSA	
85.70	96.83	96.83	RUSA	LWE
88.00	96.86	96.86	RUSA	
89.50	96.74	96.83	RUSA	
90.80	96.95	96.95	RUSA	
92.80	96.92	96.92	RUSA	
94.40	96.80	96.80	RUSA	
95.30	96.83	96.83	RUSA	
96.60	96.46	96.80	LGSG	
98.00	96.61	96.81	LGSG	
100.10	96.59	96.81	LGSG	
101.20	96.88	96.88	LGSG	
101.80	96.58	96.81	LGSG	
104.00	96.64	96.82	LGSG	
105.70	96.92	96.92	BOSI	
107.90	96.87	96.87	BOSI	
109.50	97.00	97.00	BOSI	
111.80	96.82	96.82	BOSI	RWE
113.10	97.12		BOSI	
117.50	97.33		BOSI	
121.00	97.79		SISA	
127.50	102.47		SISA	GB RB HEADPIN
127.50	102.56		SISA	RB HEADPIN

Appendix Table D-53. Cross section profile of Passage Reach I in Slough 21, October 15,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.97		SISA	GB LB HEADPIN
1.00	99.76		SISA	
7.00	97.92		SISA	
13.00	97.10	97.10	SISA	LWE SEEPAGE AREA
25.40	96.67	96.81	SISA	
35.00	96.77	96.77	SISA	RWE SEEPAGE AREA
44.00	96.94		SISA	
57.50	96.91		SISA	
62.80	96.93		SISA	
63.40	96.74	96.74	SISA	LWE
65.00	96.63	96.72	SISA	
67.40	96.54	96.73	SISA	
69.50	96.49	96.70	SISA	
71.70	96.59	96.70	SISA	
74.80	96.53	96.72	SISA	
78.30	96.54	96.64	SISA	
78.90	96.43	96.73	SGSI	
80.70	96.47	96.73	SGSI	
81.60	96.64	96.69	SISA	
84.50	96.55	96.74	SISA	
86.00	96.45	96.73	SISA	
87.10	96.39	96.72	SASG	
88.00	96.32	96.72	SASG	
89.00	96.64	96.73	SISA	
90.20	96.68	96.69	SISA	RWE
90.80	97.21		SISA	
95.50	97.36		SISA	
101.50	97.03		SISA	
108.50	97.05		SISA	
118.00	102.94		VEG	GB RB HEADPIN
118.00	102.97		VEG	RB HEADPIN

Appendix Table D-54. Cross section profile of Passage Reach II in Slough 21, October 15,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.92		SISA	GB LB HEADPIN
1.80	99.34		SISA	
2.70	98.77		SISA	
4.50	98.93		SISA	
8.40	98.77		SABO	
9.80	98.54		SABO	
11.50	98.62		SISA	
14.30	98.76		SISA	
16.80	98.65		SABO	
18.80	98.81		SABO	
21.20	98.66		SABO	
22.10	98.30	98.30	SIBO	LWE
24.50	98.29	98.29	BOLG	
26.40	98.38	98.38	BOLG	
28.00	98.62	98.62	BOLG	
28.80	98.24	98.27	BOLG	
29.90	98.17	98.27	BOLG	
31.00	98.20	98.27	BOLG	
31.50	99.00	99.00	BOLG	
33.20	98.55	98.55	BOLG	
33.80	98.09	98.28	BOLG	
34.60	98.06	98.28	COLG	
35.60	98.38	98.38	COLG	
36.50	98.27	98.28	COLG	
39.00	98.38	98.38	COLG	
39.80	98.18	98.28	COLG	
41.00	98.04	98.27	COLG	
42.10	98.43	98.43	COLG	
43.40	98.35	98.35	COLG	
44.80	98.39	98.39	COLG	
46.50	98.47	98.47	COLG	
47.20	98.10	98.28	COLG	
49.40	98.02	98.28	COLG	
50.50	97.76	98.30	COLG	
51.50	98.14	98.29	COLG	
53.70	98.24	98.29	COLG	
55.60	98.35	98.35	COLG	
57.40	98.28	98.29	COLG	
59.00	98.30	98.30	COLG	RWE
60.00	98.76		COLG	
61.30	98.53		COLG	
63.00	98.44		COLG	
65.00	98.65		COLG	
66.60	98.24		SGCO	

Appendix Table D-54. Continued.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
68.70	98.20		SISA	
70.70	99.06		SISA	
71.40	99.56		SISA	GB RB HEADPIN
71.40	99.68		SISA	RB HEADPIN

Appendix Table D-55. Cross section profile of Passage Reach IIIR in Slough 21, October 15,1984.

STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.74		SISA	GB LB HEADPIN
2.00	99.63		SISA	
3.20	99.25		SISA	
5.00	99.01		SASG	
7.00	98.93		LGSG	
10.00	98.95		LGSG	
12.00	98.72		LGRU	
14.20	99.01		LGRU	
16.20	98.69		LGRU	
18.20	98.81		LGRU	
20.00	98.53		SGSA	
22.00	98.60		SGSA	
24.00	98.65		SISA	
25.60	99.12		SISA	
27.00	98.84		SGLG	
29.00	98.93		SGLG	
31.00	98.94		SGLG	
33.00	99.08		SGLG	
34.70	99.07		SASG	
36.00	99.63		SISA	GB RB HEADPIN
36.00	99.75		SISA	RB HEADPIN

Appendix Table D-56. Cross section profile of Passage Reach I in Slough 22, October 14,1984.

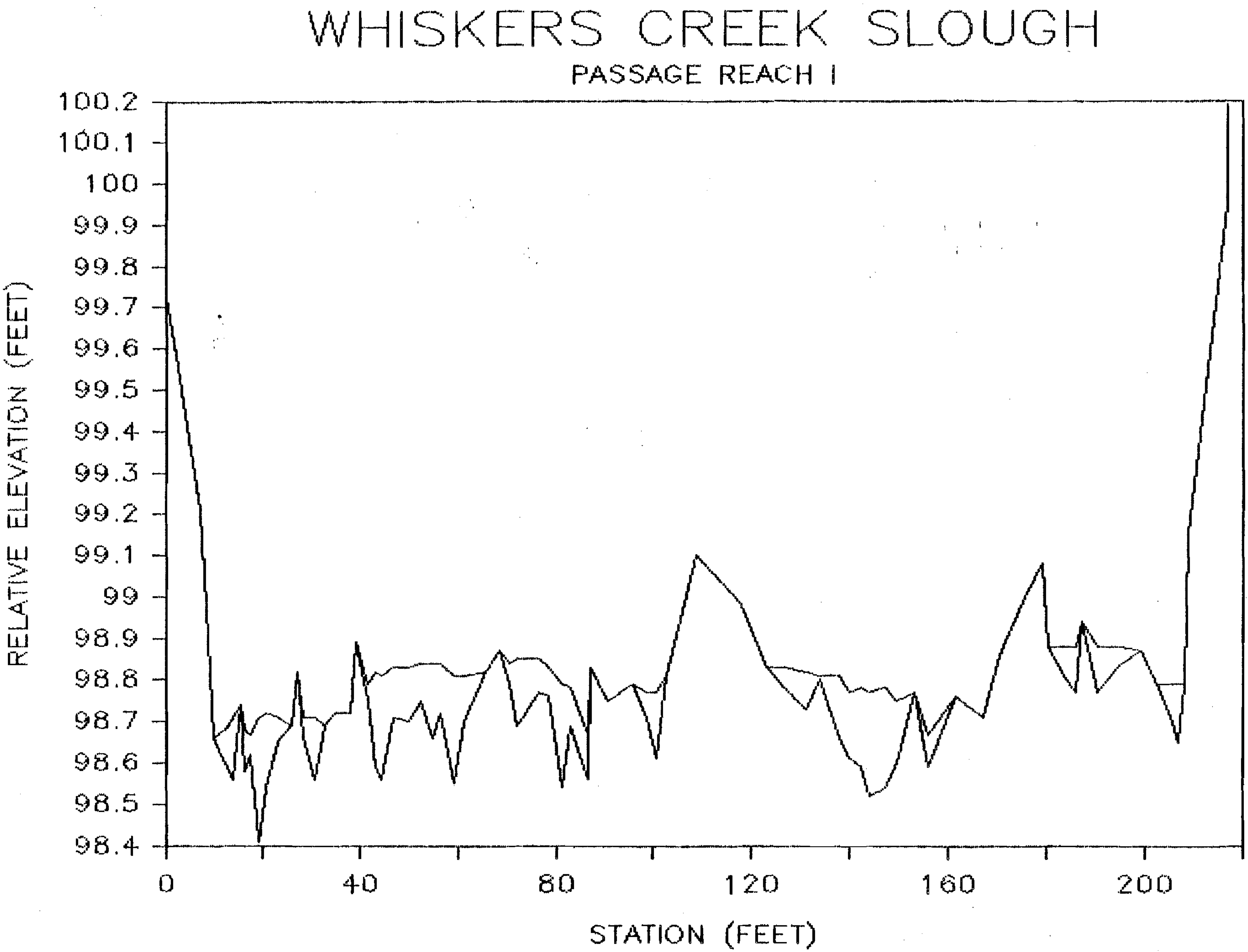
STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		COBO	LB HEADPIN
0.00	98.72		COBO	GB LB HEADPIN
3.70	98.82		COBO	
5.90	98.51		COBO	
9.00	98.32		COBO	
10.00	98.39		COBO	
11.40	98.40		COBO	
12.00	98.16	98.16	CORU	LWE
13.60	98.07	98.15	CORU	
14.50	98.29	98.29	CORU	
16.00	98.15	98.15	CORU	
17.80	98.24	98.24	CORU	
19.10	97.80	98.16	CORU	
19.60	98.20	98.20	CORU	
21.00	97.97	98.16	CORU	
22.00	98.30	98.30	BOCO	
24.30	98.22	98.22	BOCO	
26.00	98.07	98.15	BOCO	
27.30	98.15	98.15	BOCO	RWE
28.50	98.36		BOCO	
31.60	98.41		BOCO	
35.50	98.67		CORU	
38.00	98.47		CORU	
42.00	98.77		CORU	
43.70	98.44		CORU	
45.00	98.75		BOCO	
48.00	98.95		BOCO	
52.00	98.88		BOCO	
55.50	98.86		BOCO	
58.30	98.79		CORU	
61.00	98.56		CORU	
64.20	98.46		CORU	
66.50	98.47		CORU	
68.00	98.55		CORU	
69.70	98.49		CORU	
71.90	98.32		CORU	
72.70	98.01		CORU	
73.50	98.10	98.10	BOCO	LWE
74.00	98.25	98.25	BOCO	
74.50	97.95	97.95	BOCO	
75.50	98.23	98.23	BOCO	
75.50	97.75	97.75	BOCO	
76.50	98.14	98.14	BOCO	RWE
78.10	98.31		BOCO	
80.10	98.24		BOCO	
82.50	98.39		BORU	GB RB HEADPIN
82.50	99.54		BORU	RB HEADPIN

Appendix Table D-57. Cross section profile of Passage Reach II in Slough 22, October 14,1984.

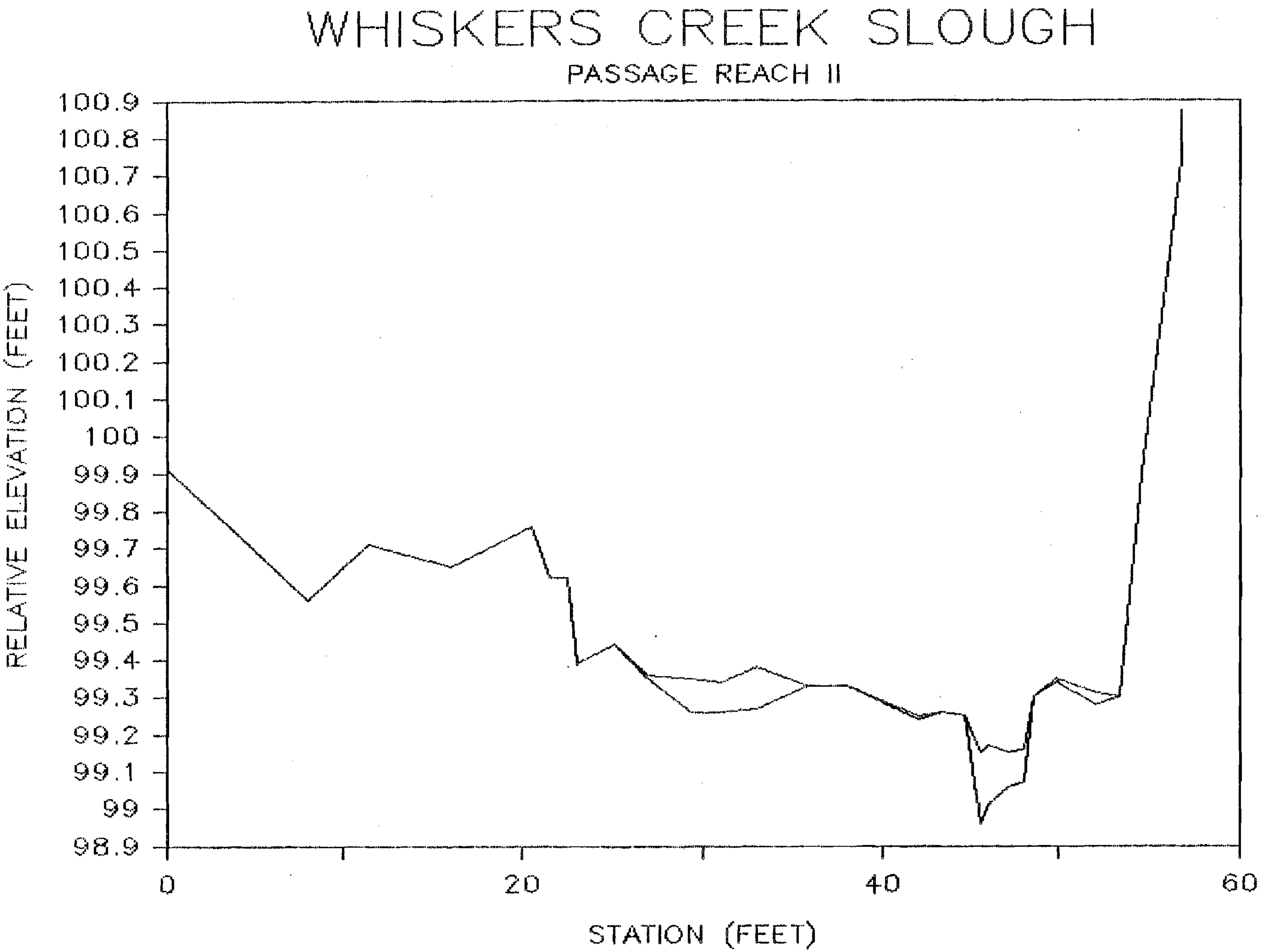
STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.92		SISA	GB LB HEADPIN
3.10	99.25		SISA	
5.10	98.40		SISA	
7.30	98.27		SISA	
8.00	97.86		SISA	
9.40	98.15		SIBO	
10.60	97.78	97.78	SIBO	LWE
11.00	97.79	97.80	SIBO	
12.60	97.73	97.78	SIBO	
13.20	97.81	97.81	SIBO	
14.40	97.99	97.99	SIBO	
15.90	97.80	97.80	SIBO	
18.00	97.97	97.97	SIBO	
18.90	97.71	97.79	SIBO	
20.00	97.99	97.99	SIBO	
20.50	97.54	97.79	RUCO	
21.30	97.45	97.77	RUCO	
22.00	97.85	97.85	RUCO	
25.30	97.80	97.80	RUCO	
26.80	98.06	98.06	RUCO	
27.80	97.66	97.75	RUCO	
28.70	97.51	97.74	RUCO	
30.30	98.07	98.07	BOCO	
33.50	97.98	97.98	BOCO	
36.90	97.87	97.87	BOCO	
38.50	97.78	97.83	BOCO	
39.50	97.84	97.84	BOCO	RWE
41.10	98.06		BOCO	
44.20	98.34		BOCO	
48.00	98.11		BOCO	
50.00	98.29		BOCO	
54.40	98.37		BOCO	
58.30	98.12		BOCO	
64.60	98.17		BOCO	
67.70	98.13		BOCO	
71.20	98.26		BOCO	
76.50	98.69		BOCO	
94.50	98.48		BOCO	
108.50	98.53		BOCO	
115.50	98.77		BOCO	
127.70	98.28		SICO	
132.50	98.55		SISA	
136.70	100.28		SISA	GB RB HEADPIN
136.70	100.42		SISA	RB HEADPIN

Appendix Table D-58. Cross section profile of Passage Reach III in Slough 22, October 14,1984.

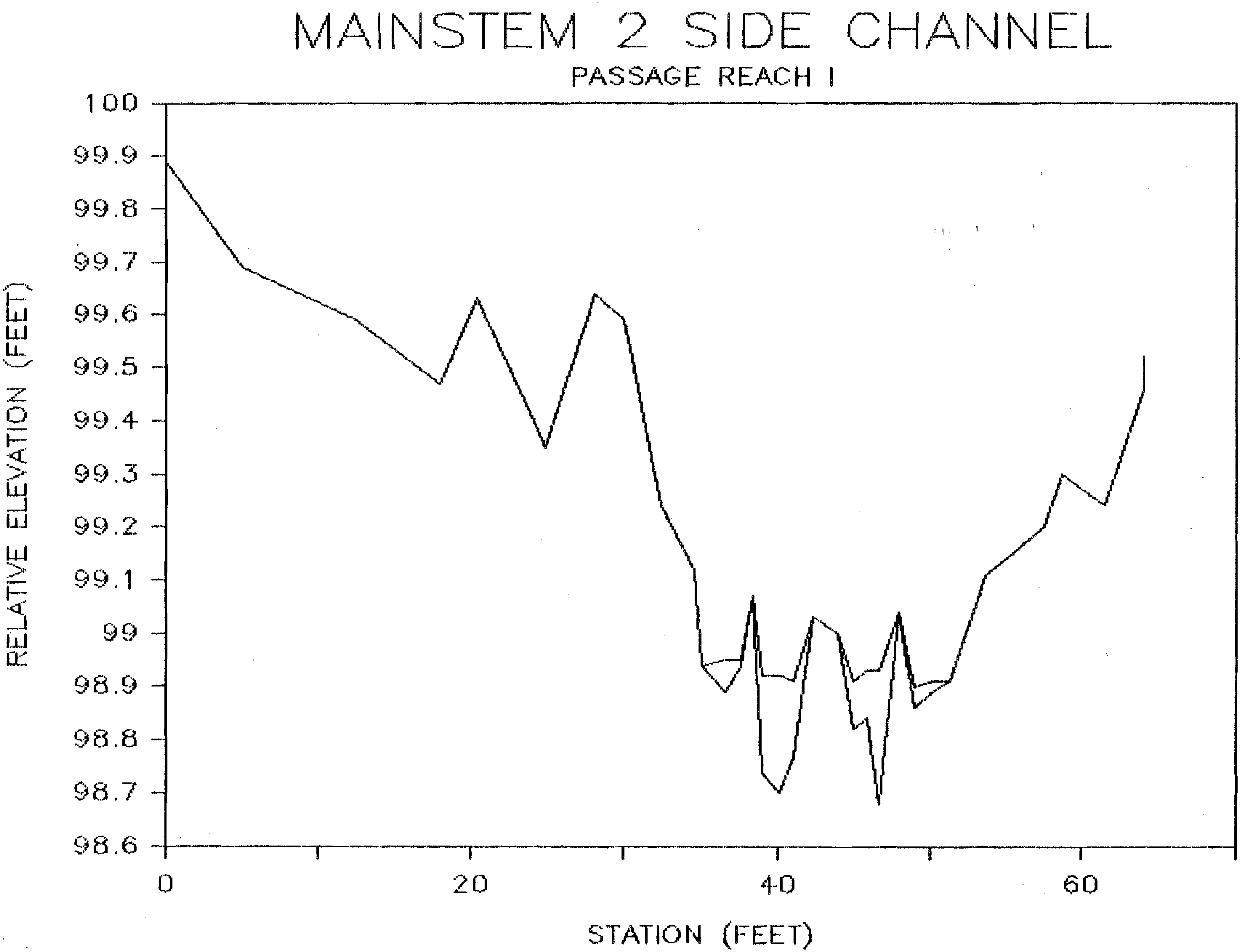
STATION (ft)	RELATIVE ELEVATION (ft)	WSEL (ft)	SUBSTRATE	COMMENTS
0.00	100.00		SISA	LB HEADPIN
0.00	99.89		SISA	GB LB HEADPIN
4.30	99.30		SIBO	
9.00	98.91		COBO	
13.00	98.85		COBO	
15.90	98.55	98.55	COBO	LWE
17.50	98.50	98.62	LGRU	
17.80	98.51	98.60	LGRU	
18.80	98.74	98.74	BOCO	
19.70	98.80	98.80	BOCO	
20.60	98.51	98.63	BOCO	
21.60	98.66	98.66	COBO	
22.60	98.69	98.69	COBO	
24.20	98.58	98.68	COBO	
25.70	98.68	98.68	RUCO	
26.50	98.64	98.70	RUCO	
27.10	98.70	98.70	RUCO	RWE
28.40	98.98		RUSA	
28.90	98.97		RUSA	GB RB HEADPIN
28.90	99.35		RUSA	RB HEADPIN



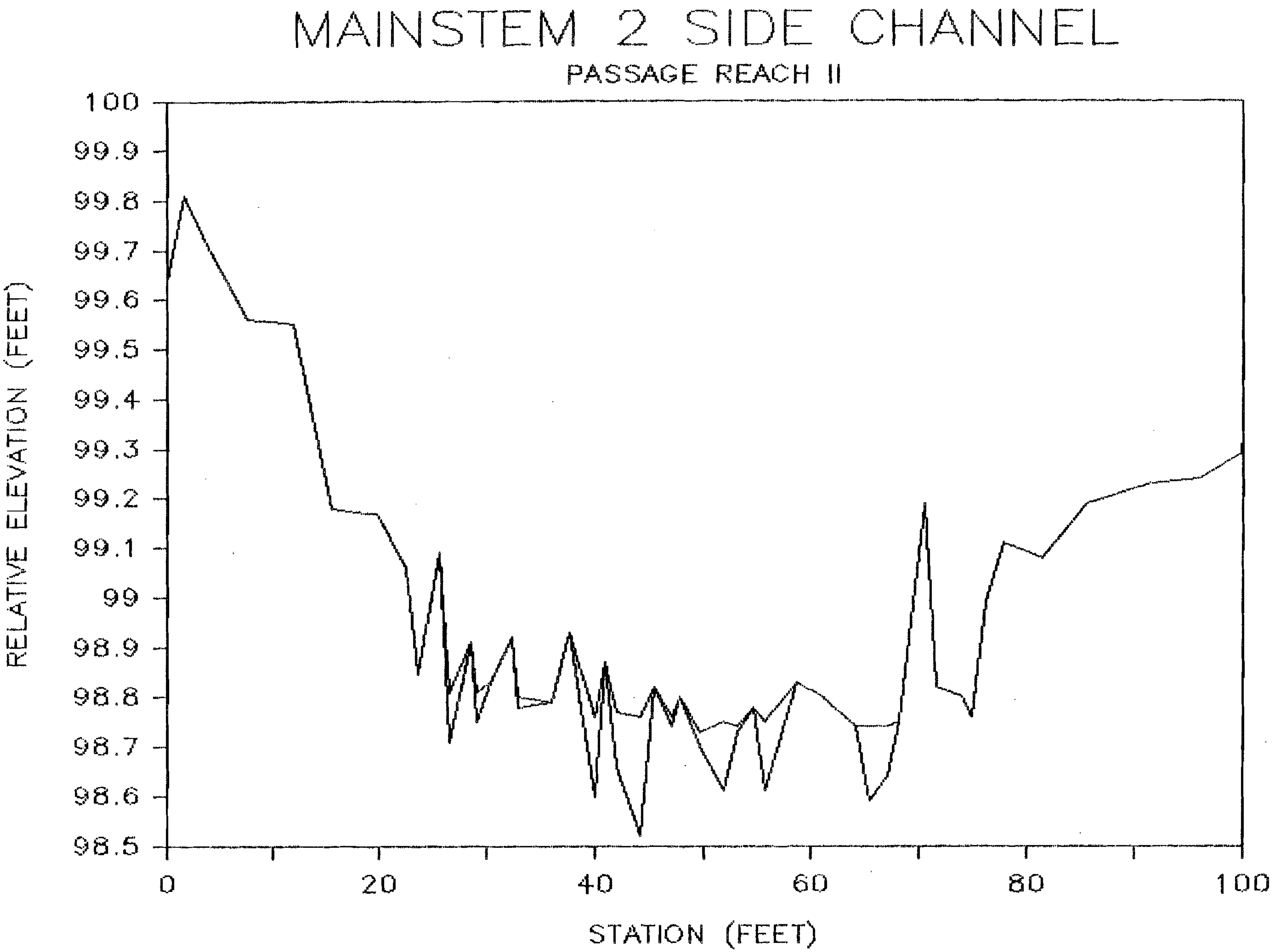
Appendix Figure D-1. Cross sectional profile of Passage Reach I in Whiskers Creek Slough, October 4,1984.



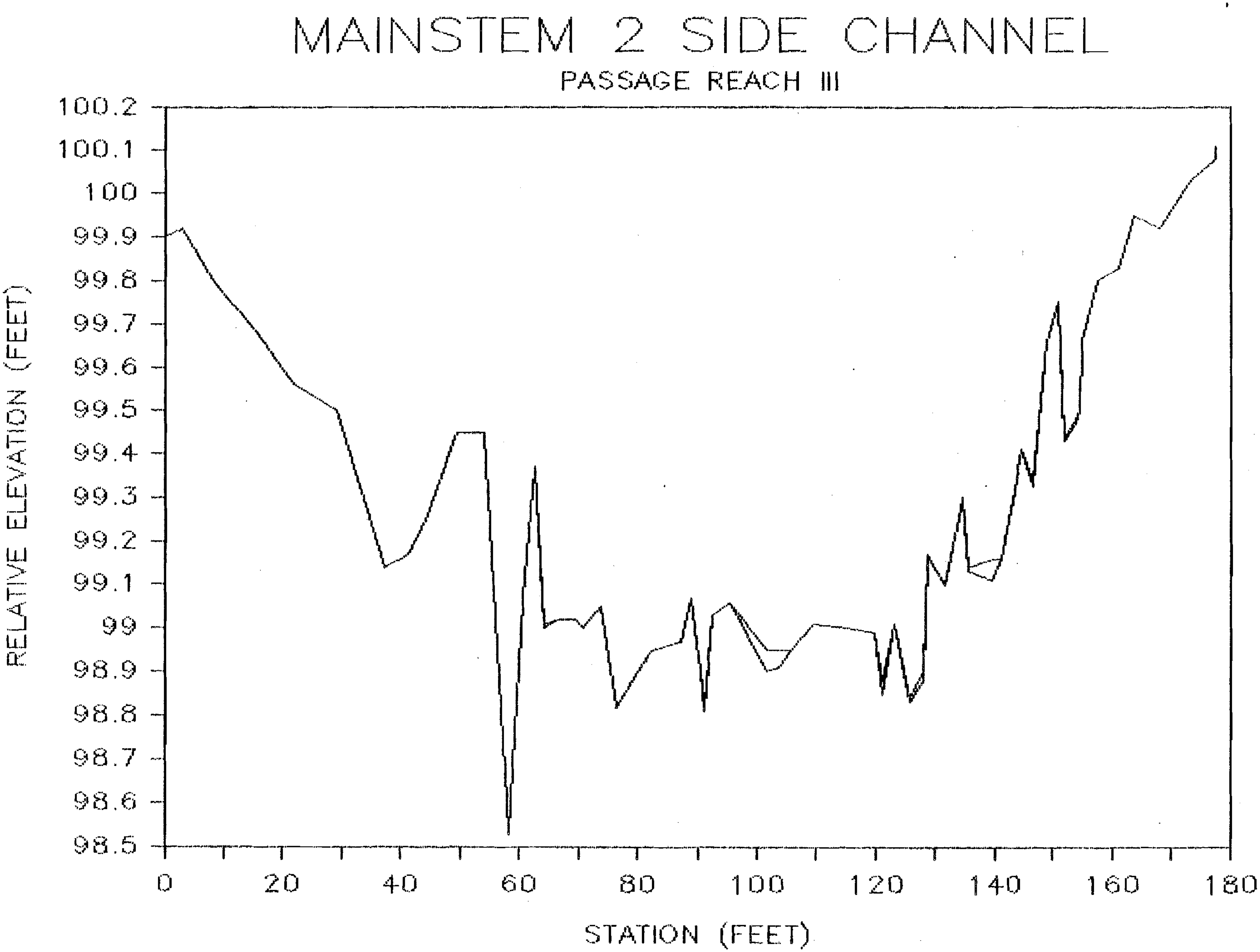
Appendix Figure D-2. Cross sectional profile of Passage Reach II in Whiskers Creek Slough, October 4,1984.



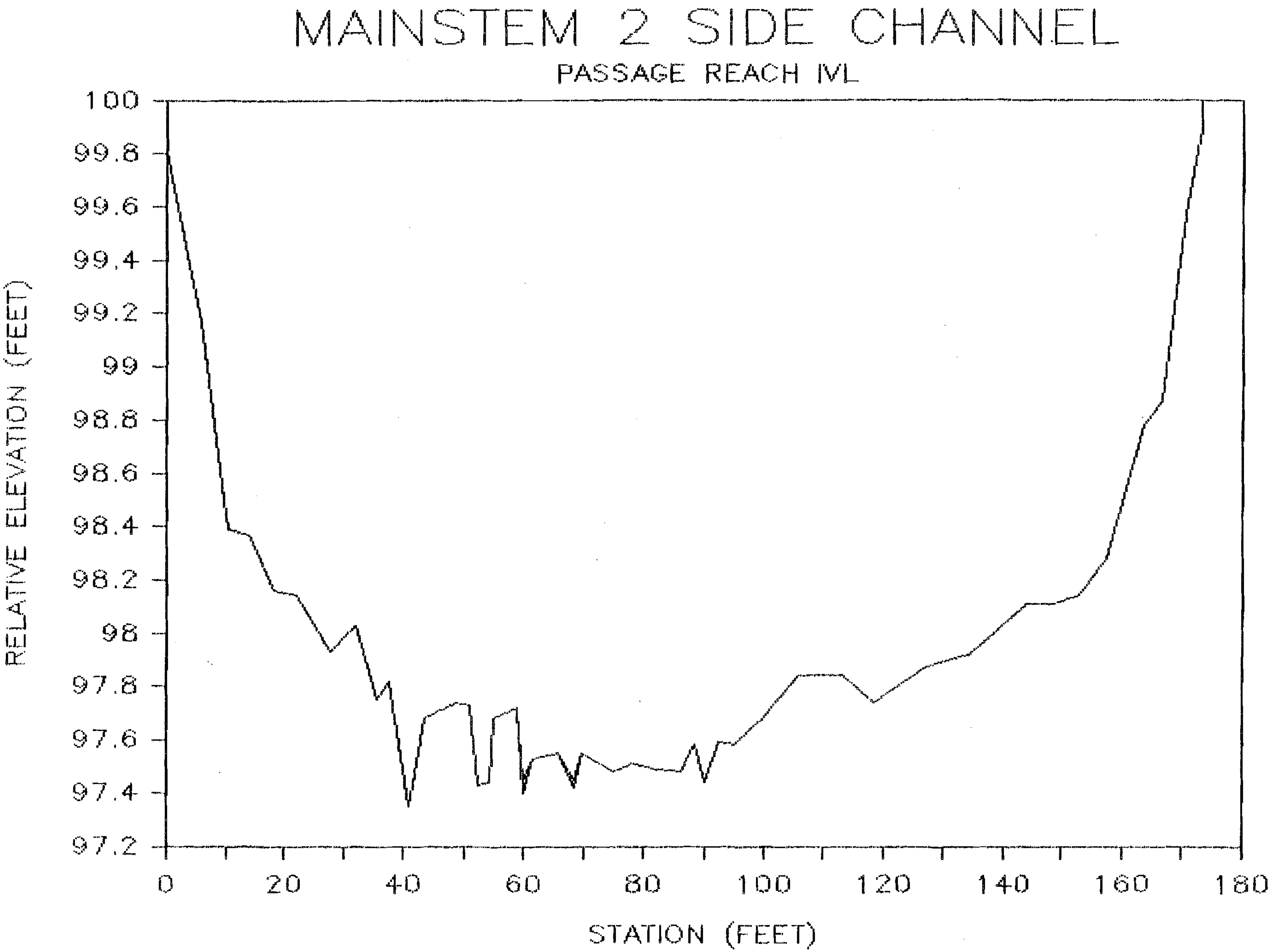
Appendix Figure D-3. Cross sectional profile of Passage Reach I in Mainstem 2 Side Channel, October 5,1984.



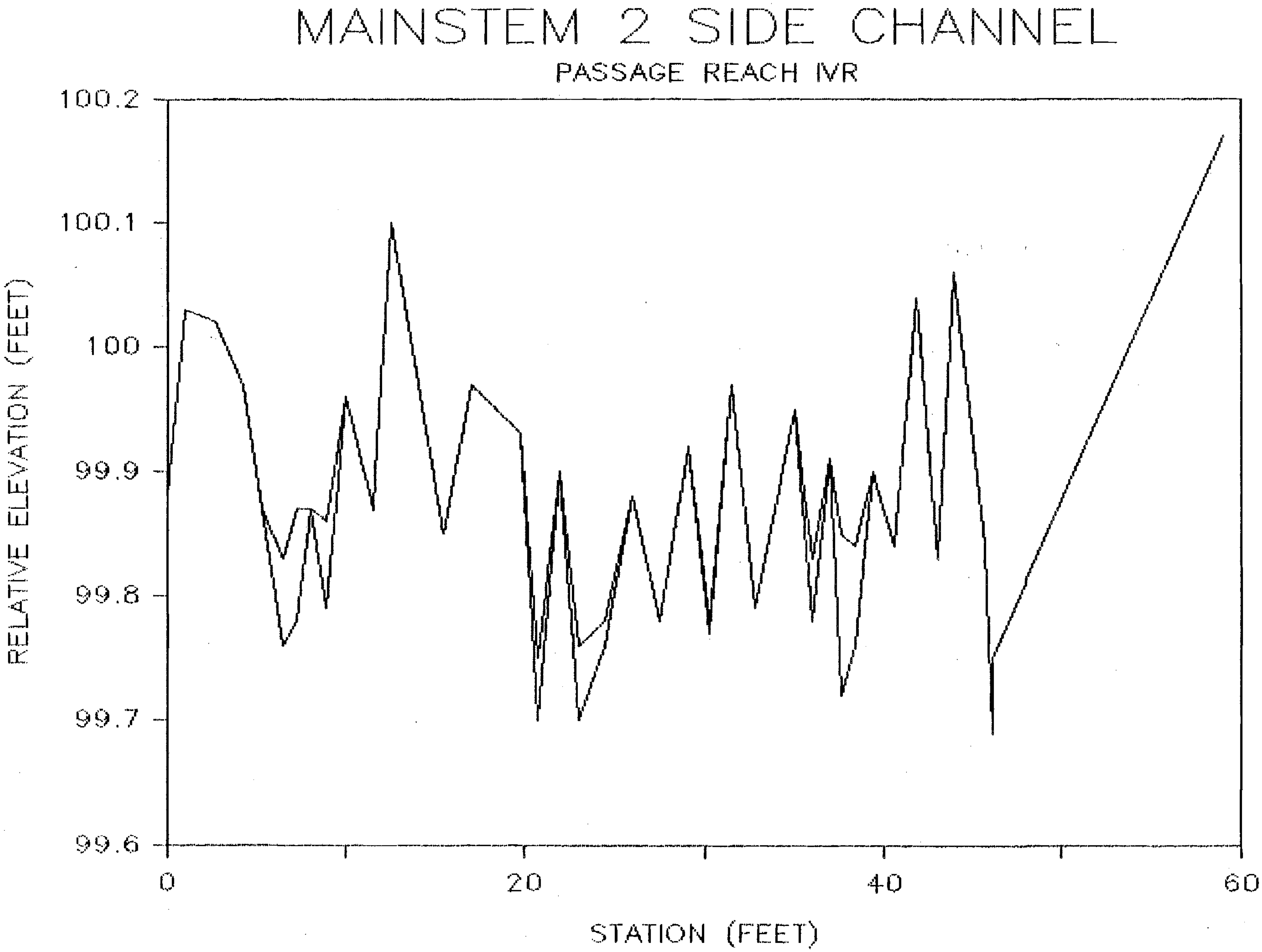
Appendix Figure D-4. Cross sectional profile of Passage Reach II in Mainstem 2 Side Channel, October 5,1984.



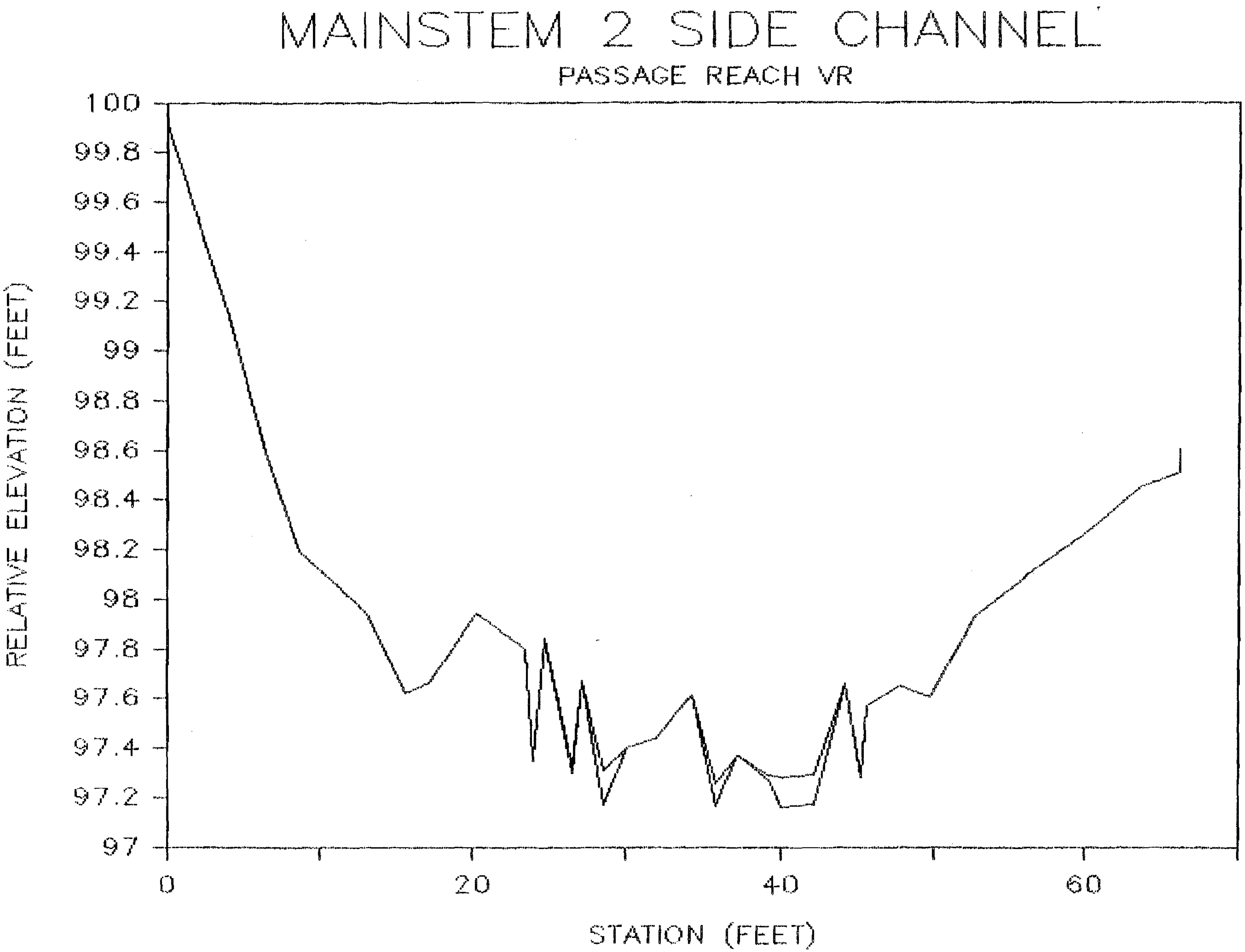
Appendix Figure D-5. Cross sectional profile of Passage Reach III in Mainstem 2 Side Channel, October 5,1984.



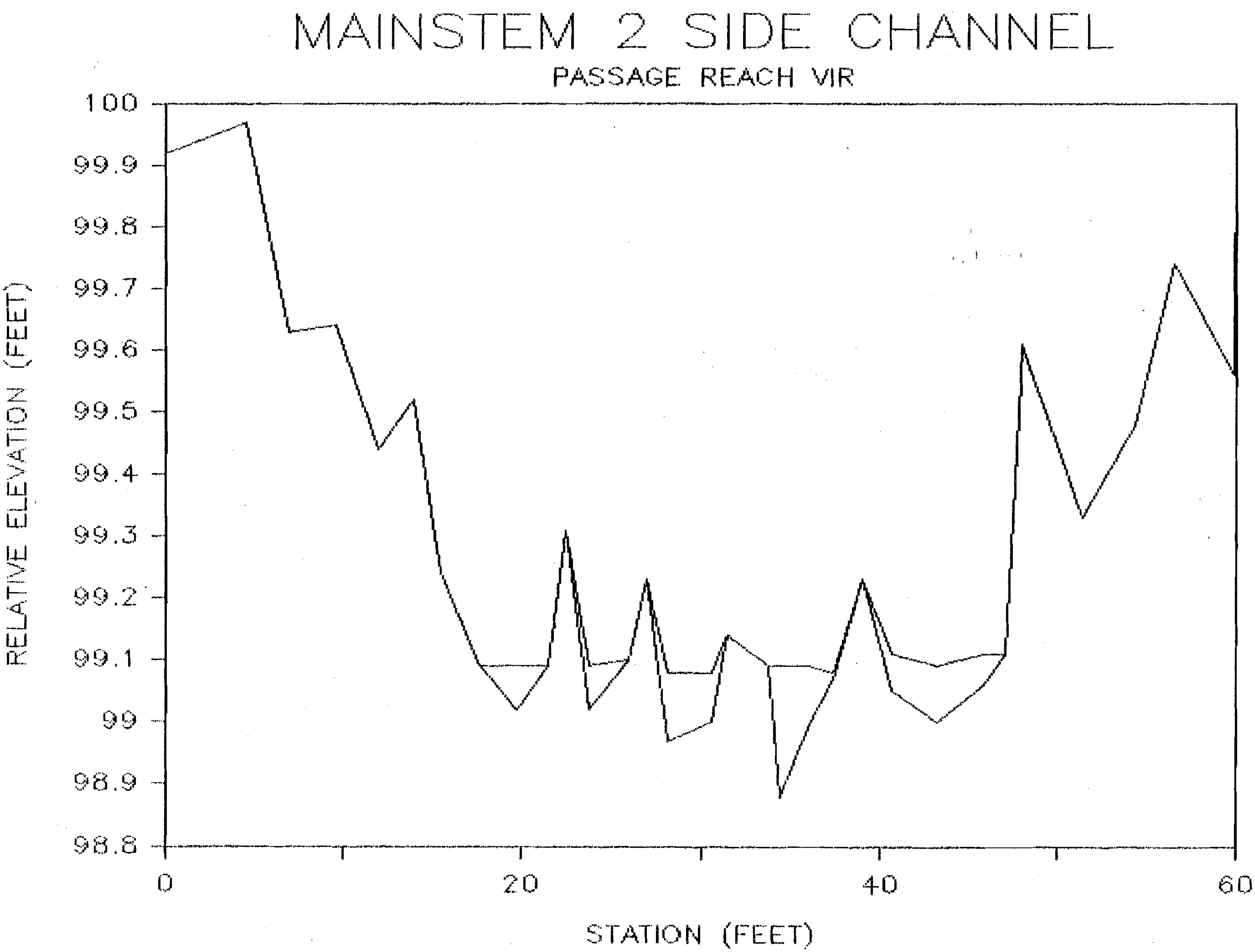
Appendix Figure D-6. Cross sectional profile of Passage Reach IVL in Mainstem 2 Side Channel, October 5,1984.



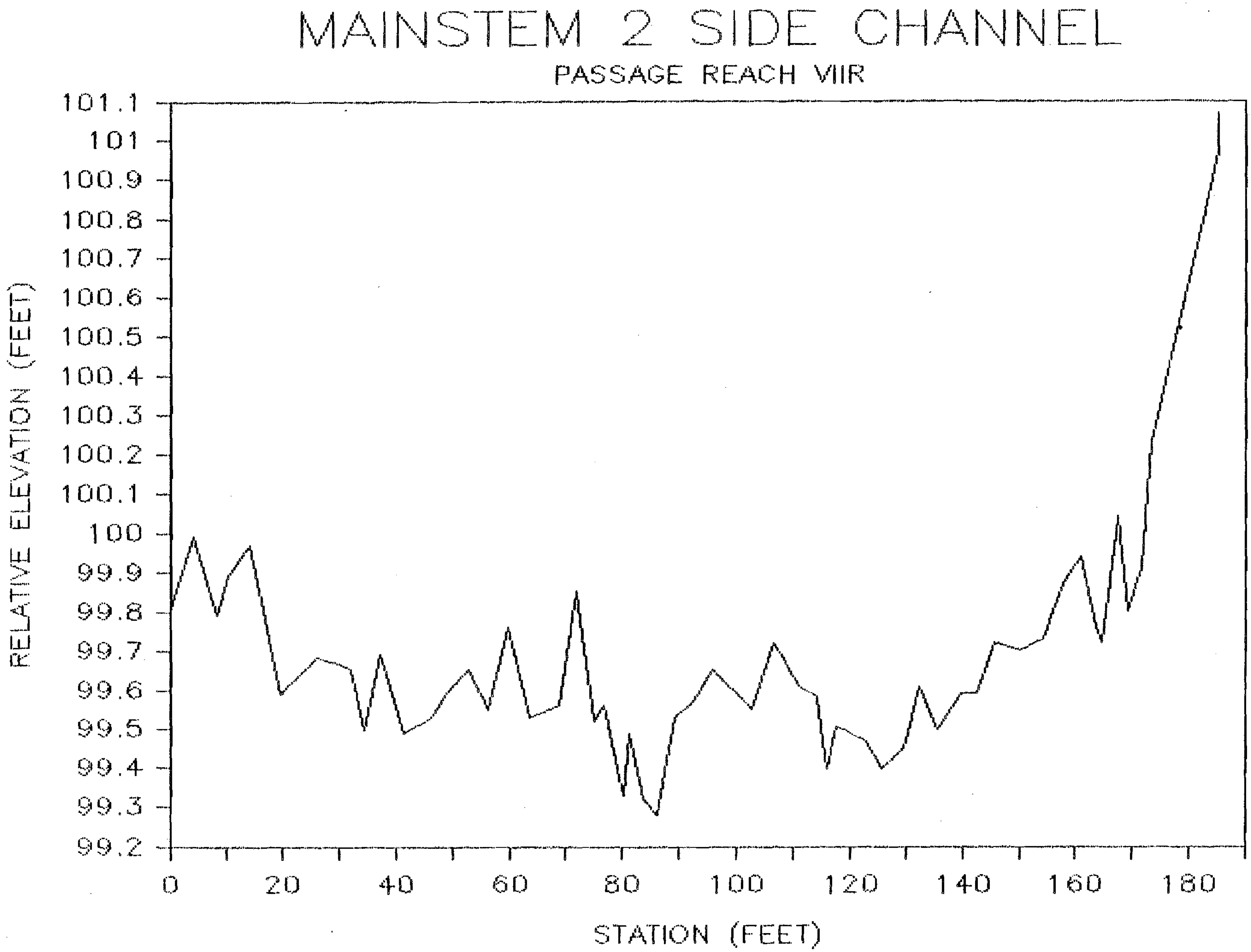
Appendix Figure D-7. Cross sectional profile of Passage Reach IVR in Mainstem 2 Side Channel, October 5,1984.



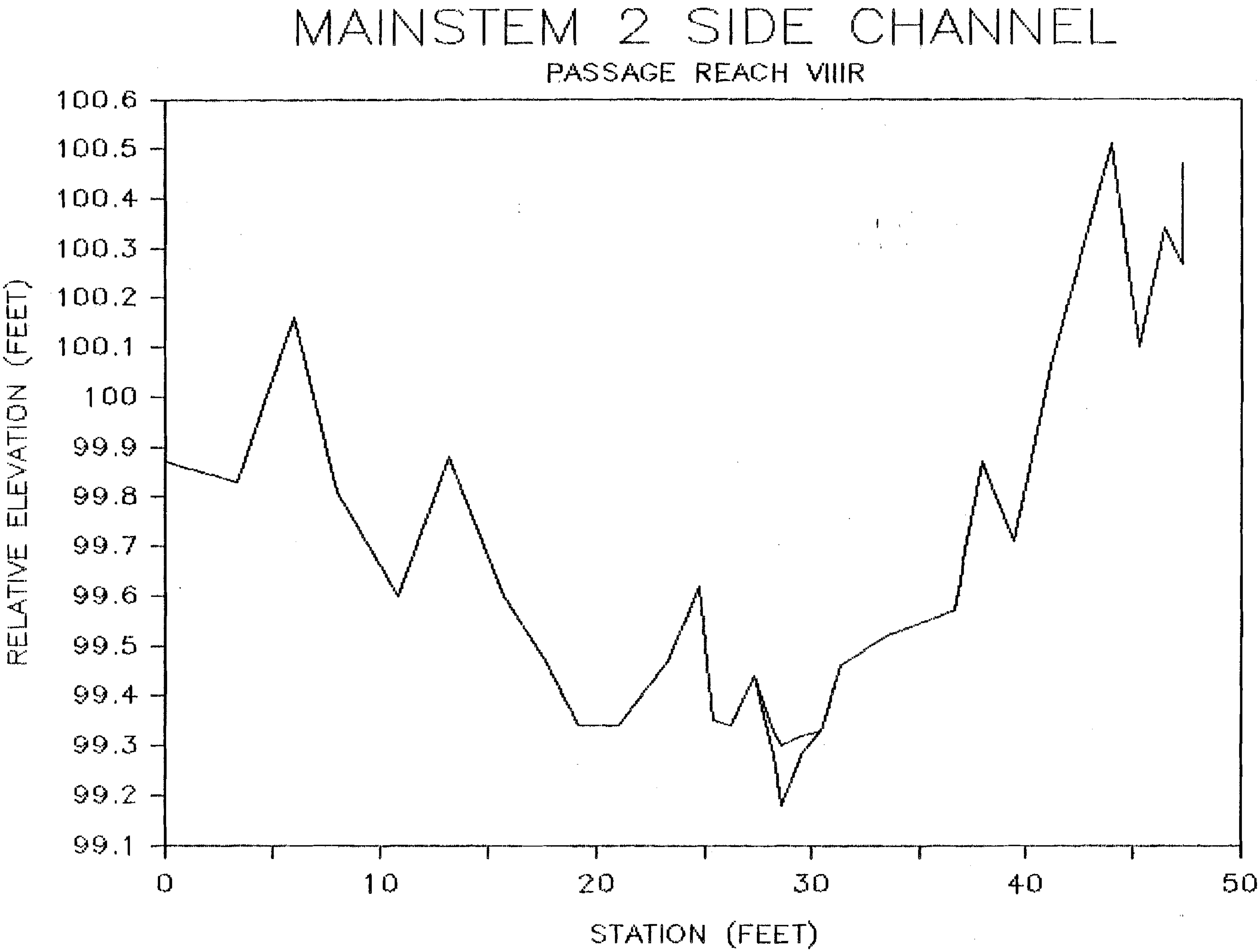
Appendix Figure D-8. Cross sectional profile of Passage Reach VR in Mainstem 2 Side Channel, October 5,1984.



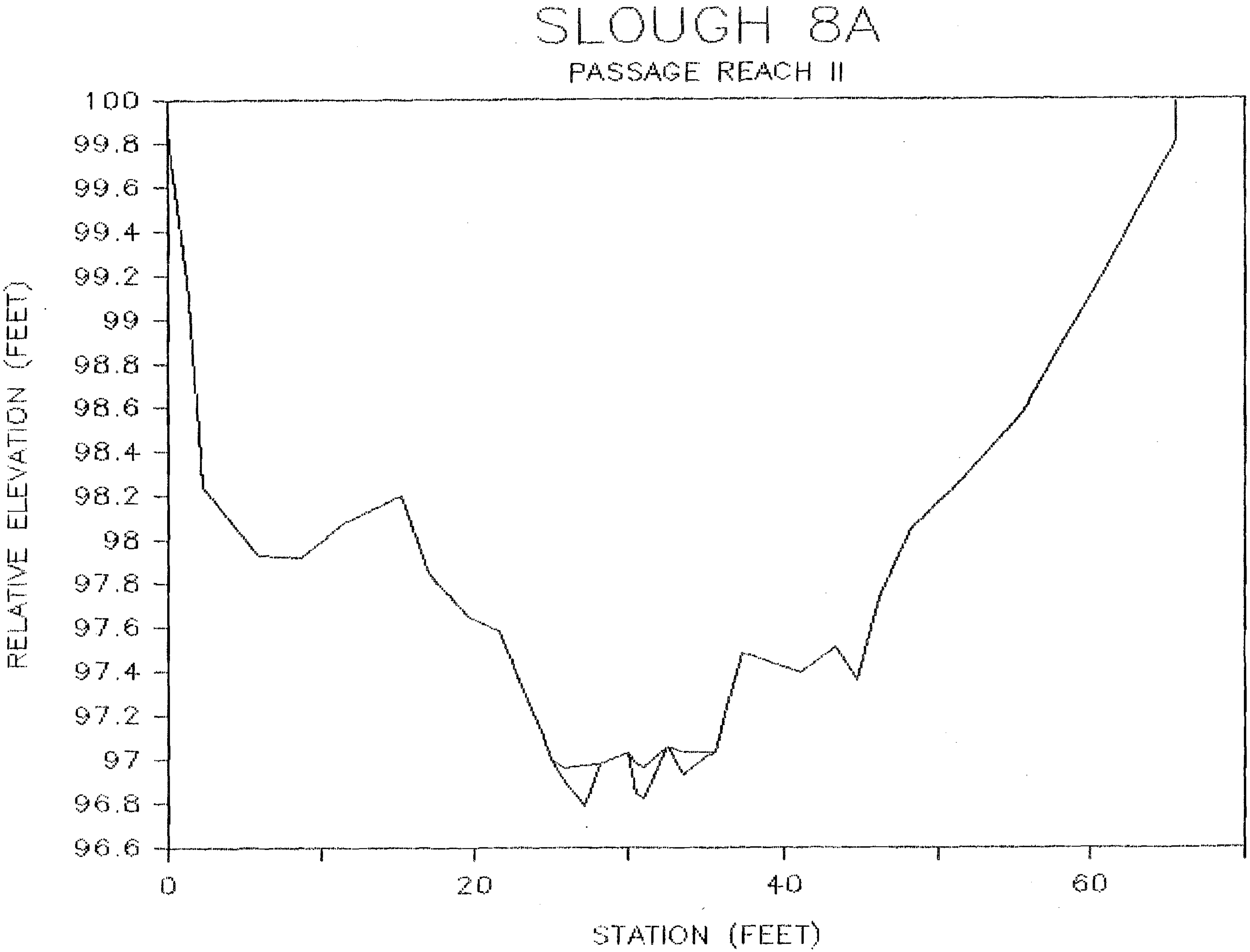
Appendix Figure D-9. Cross sectional profile of Passage Reach VIR in Mainstem 2 Side Channel, October 5,1984.



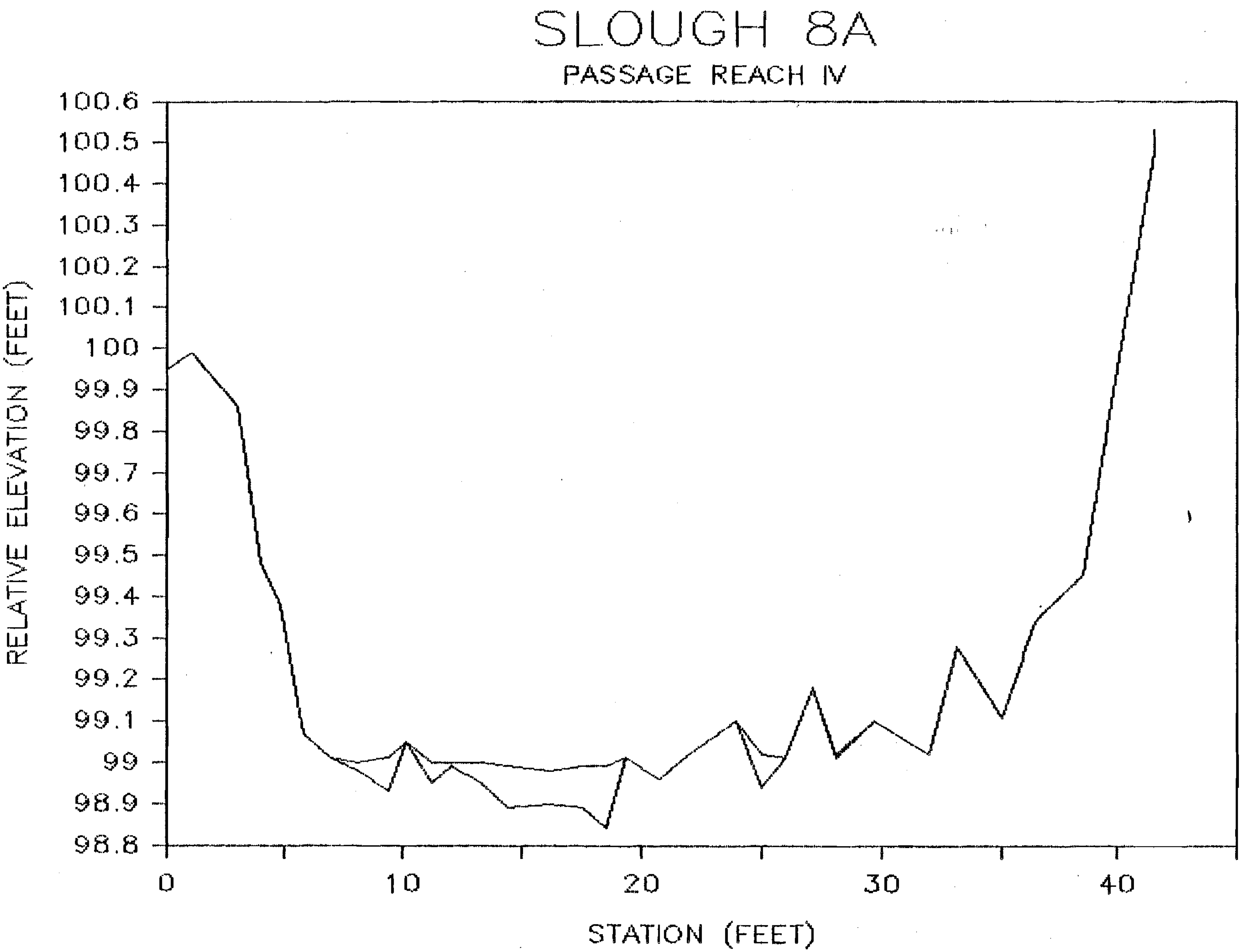
Appendix Figure D-10. Cross sectional profile of Passage Reach VIIR in Mainstem 2 Side Channel, October 4,1984.



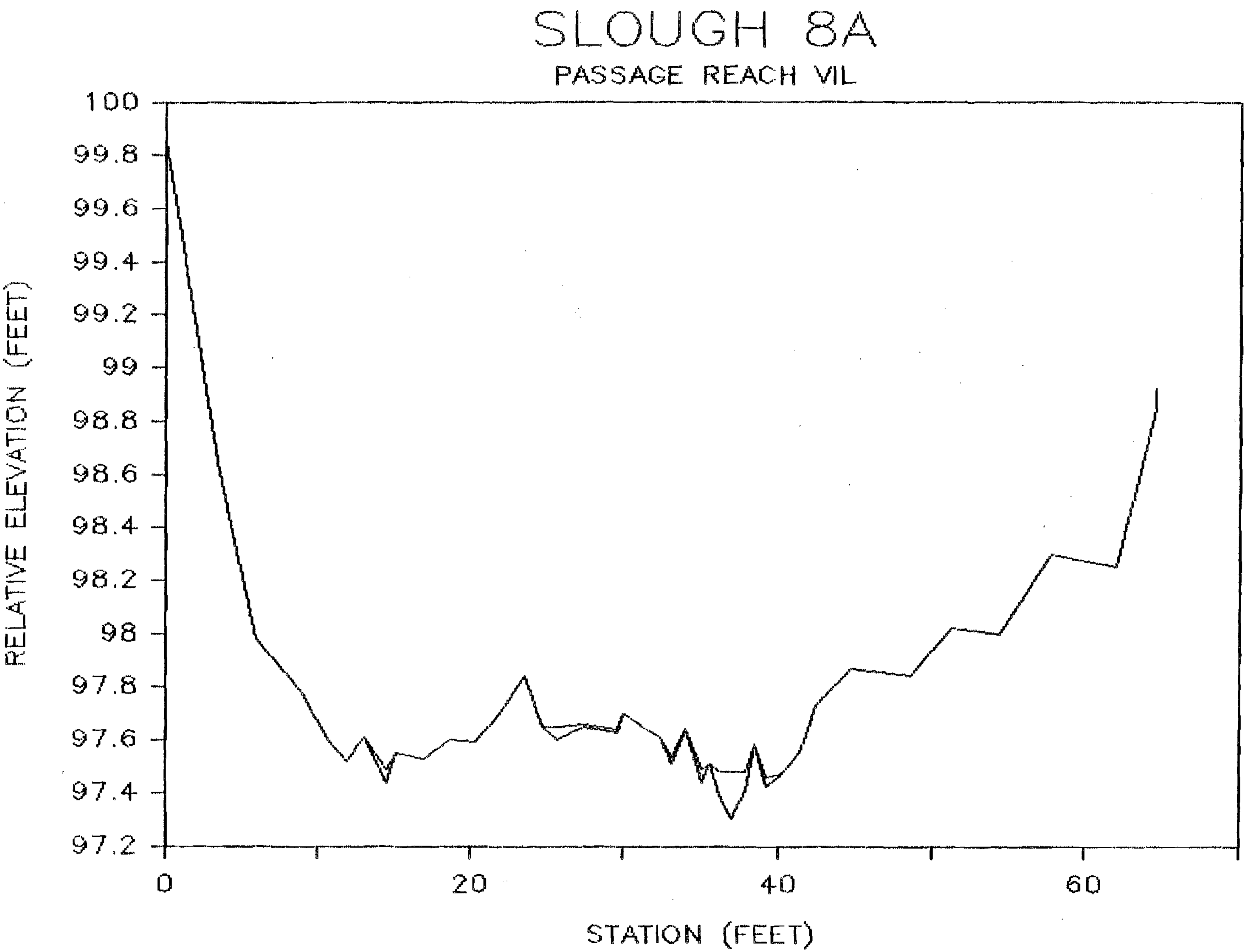
Appendix Figure D-11. Cross sectional profile of Passage Reach VIIIR in Mainstem 2 Side Channel, October 4,1984.



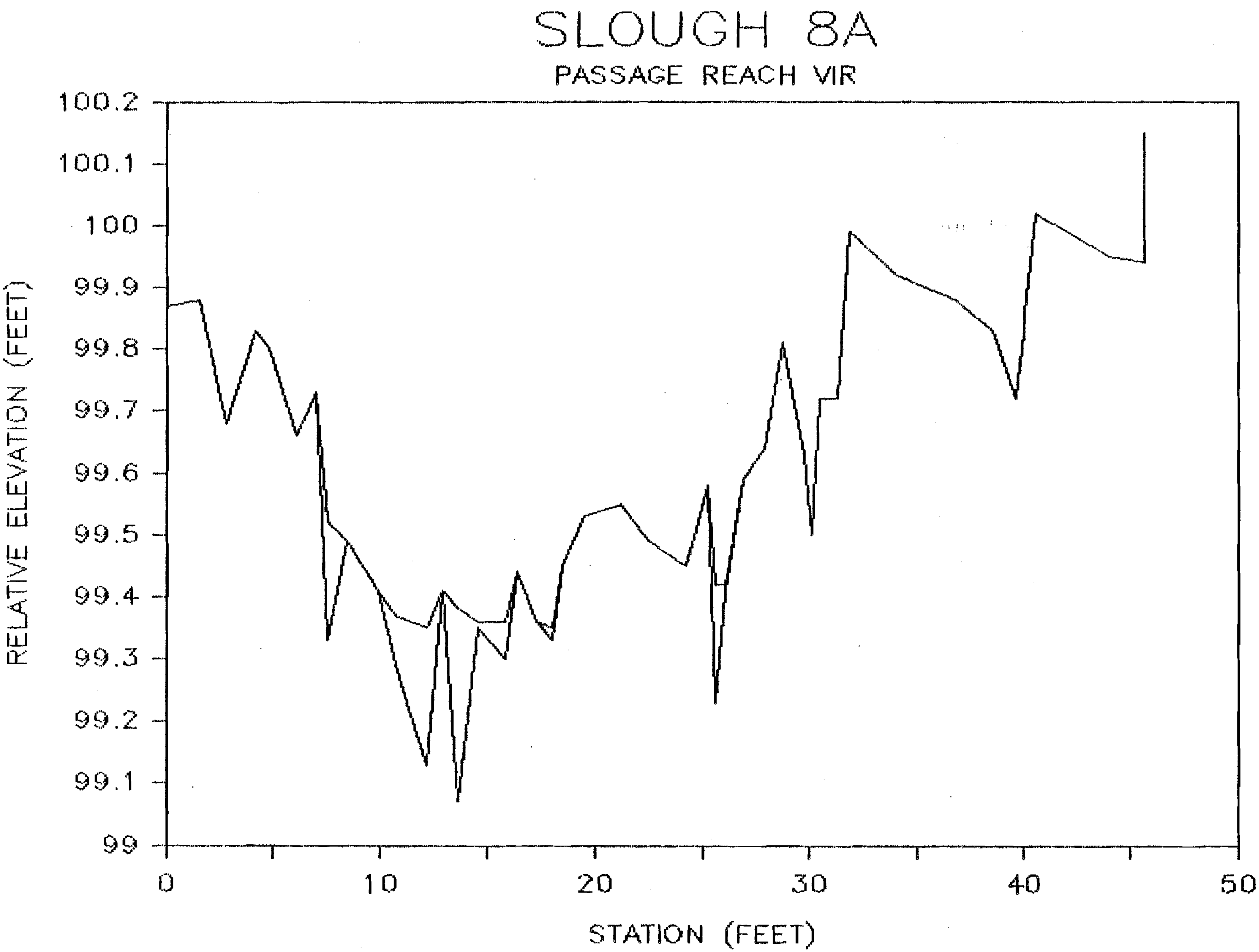
Appendix Figure D-12. Cross sectional profile of Passage Reach II in Slough 8A, October 6,1984.



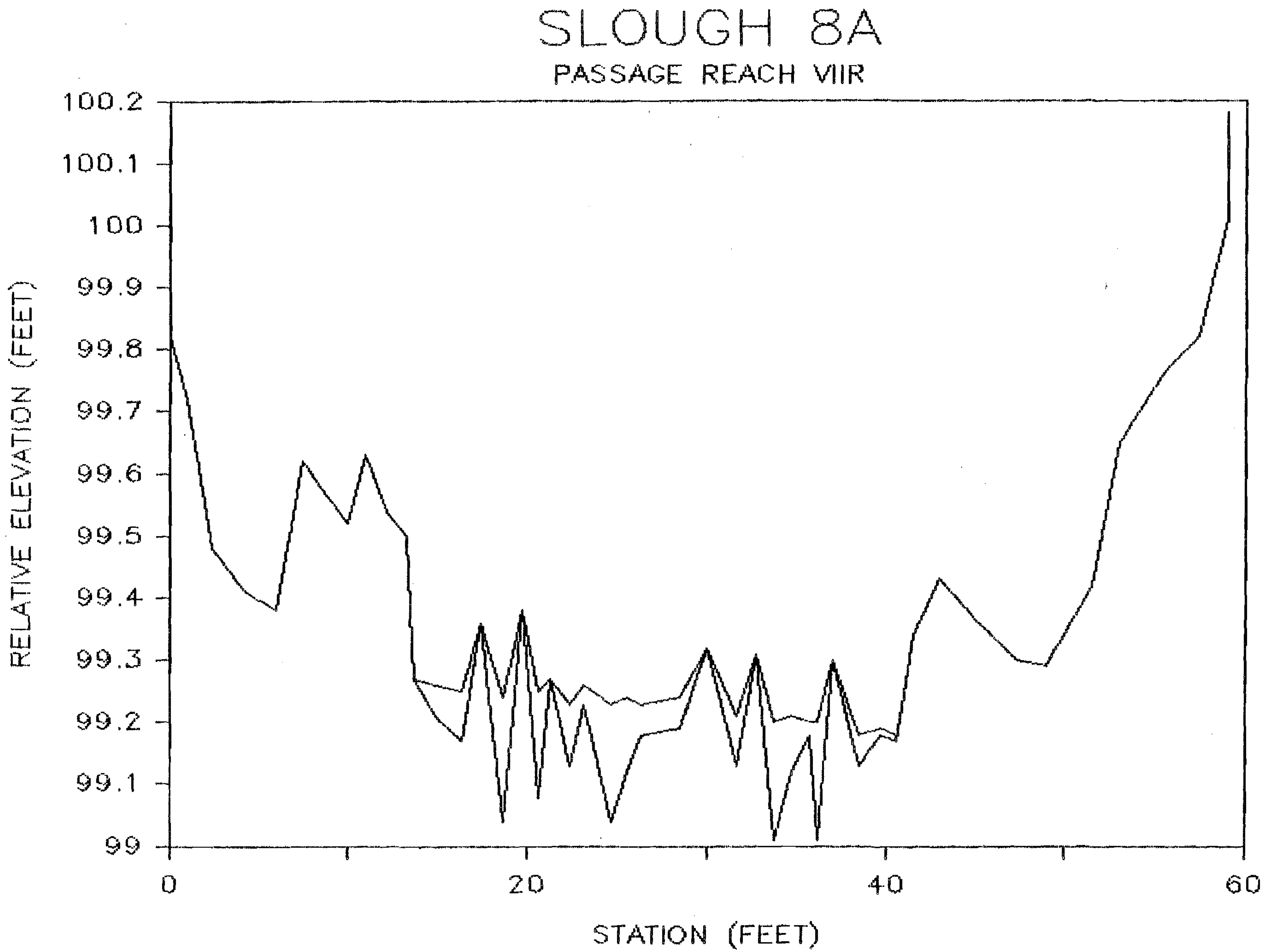
Appendix Figure D-13. Cross sectional profile of Passage Reach IV in Slough 8A, October 6,1984.



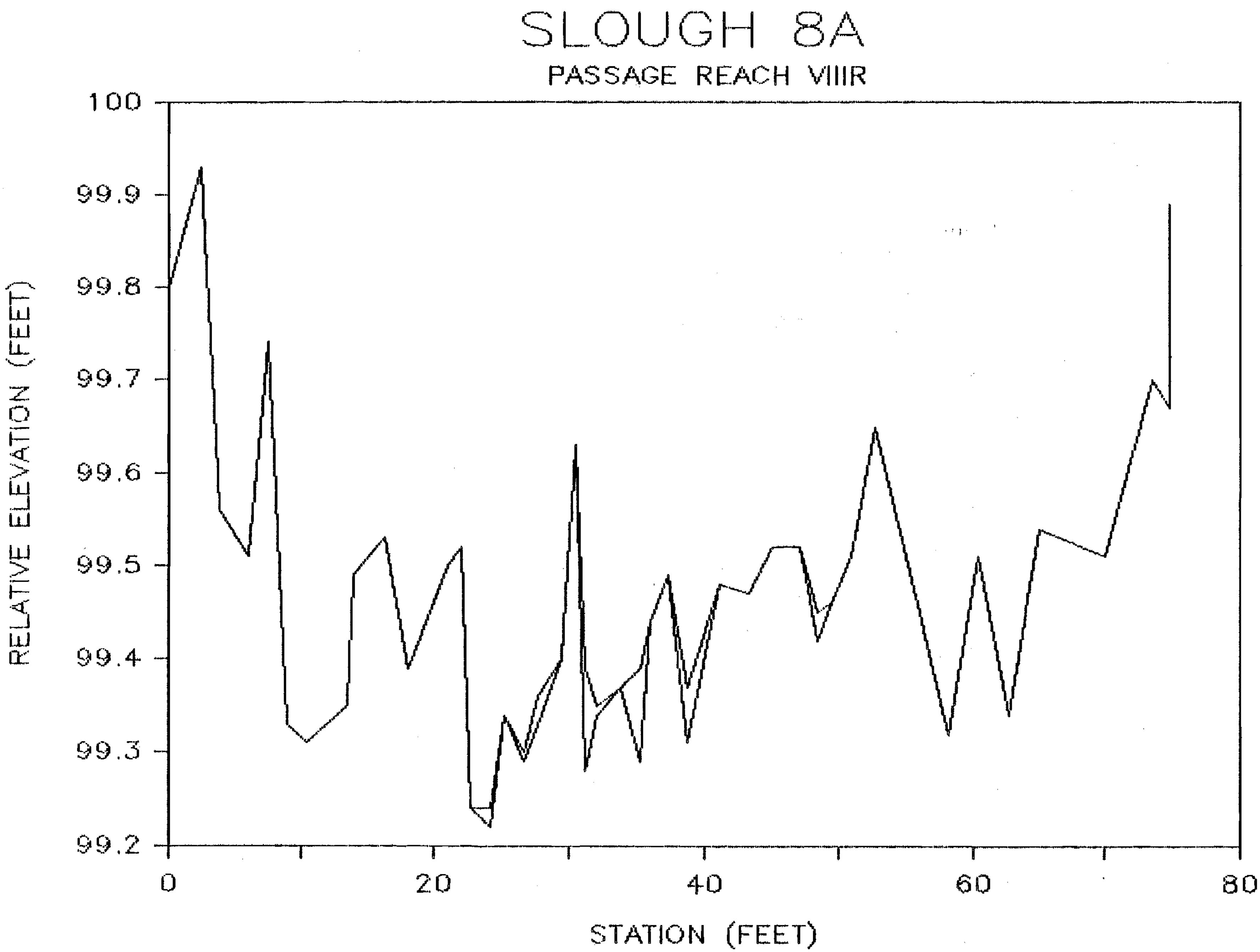
Appendix Figure D-14. Cross sectional profile of Passage Reach VIL in Slough 8A, October 6,1984.



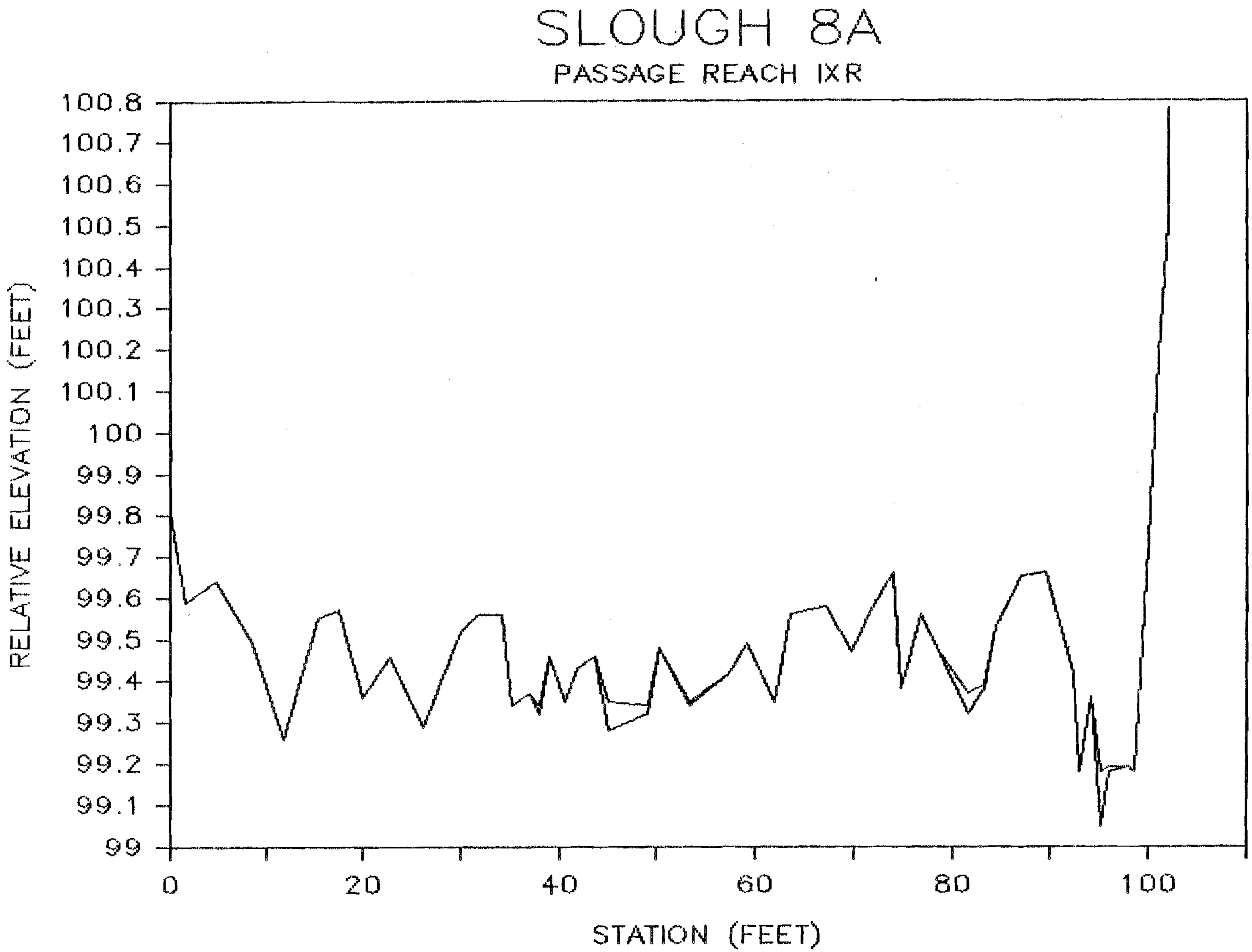
Appendix Figure D-15. Cross sectional profile of Passage Reach VIR in Slough 8A, October 6,1984.



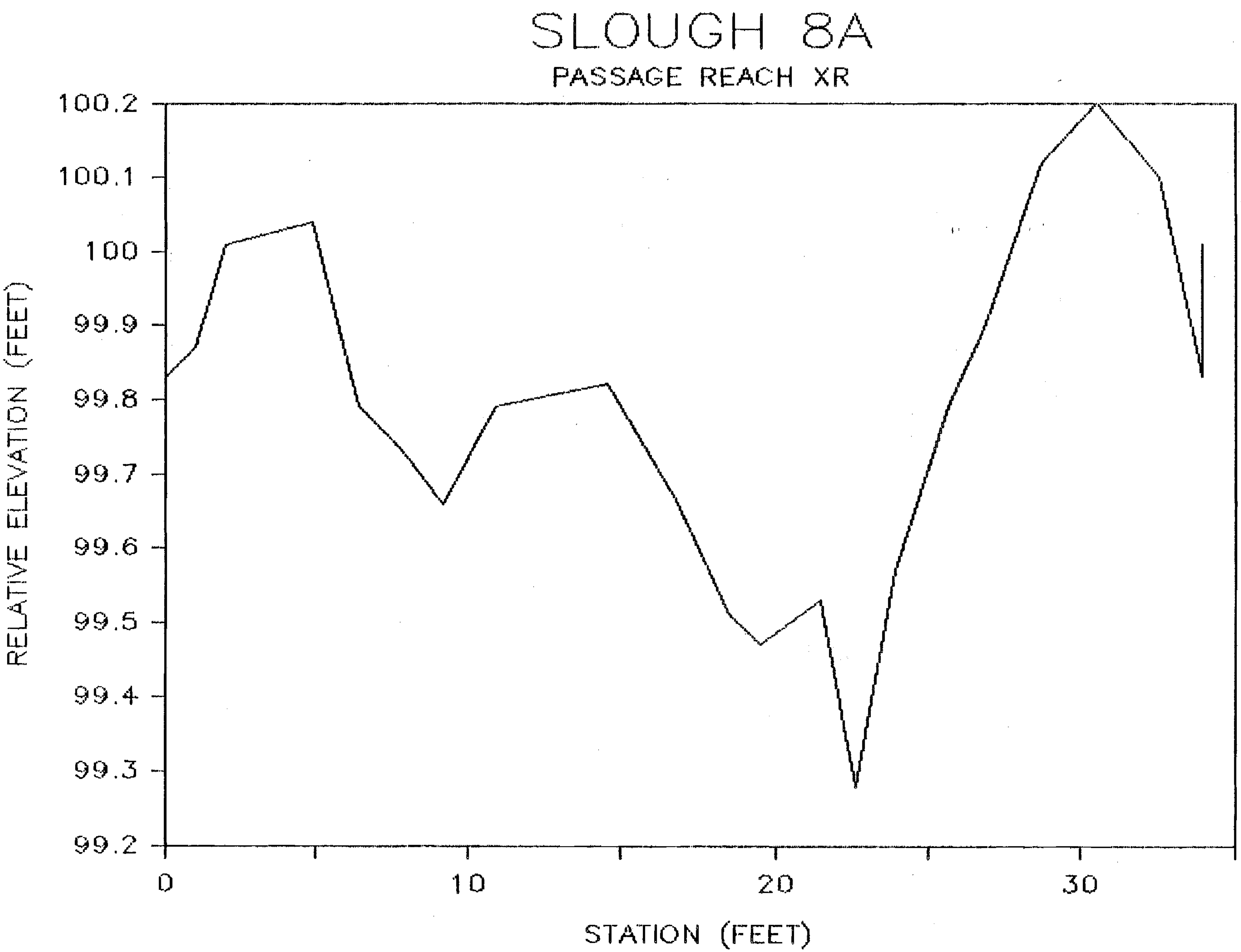
Appendix Figure D-16. Cross sectional profile of Passage Reach VIIR in Slough 8A, October 6,1984.



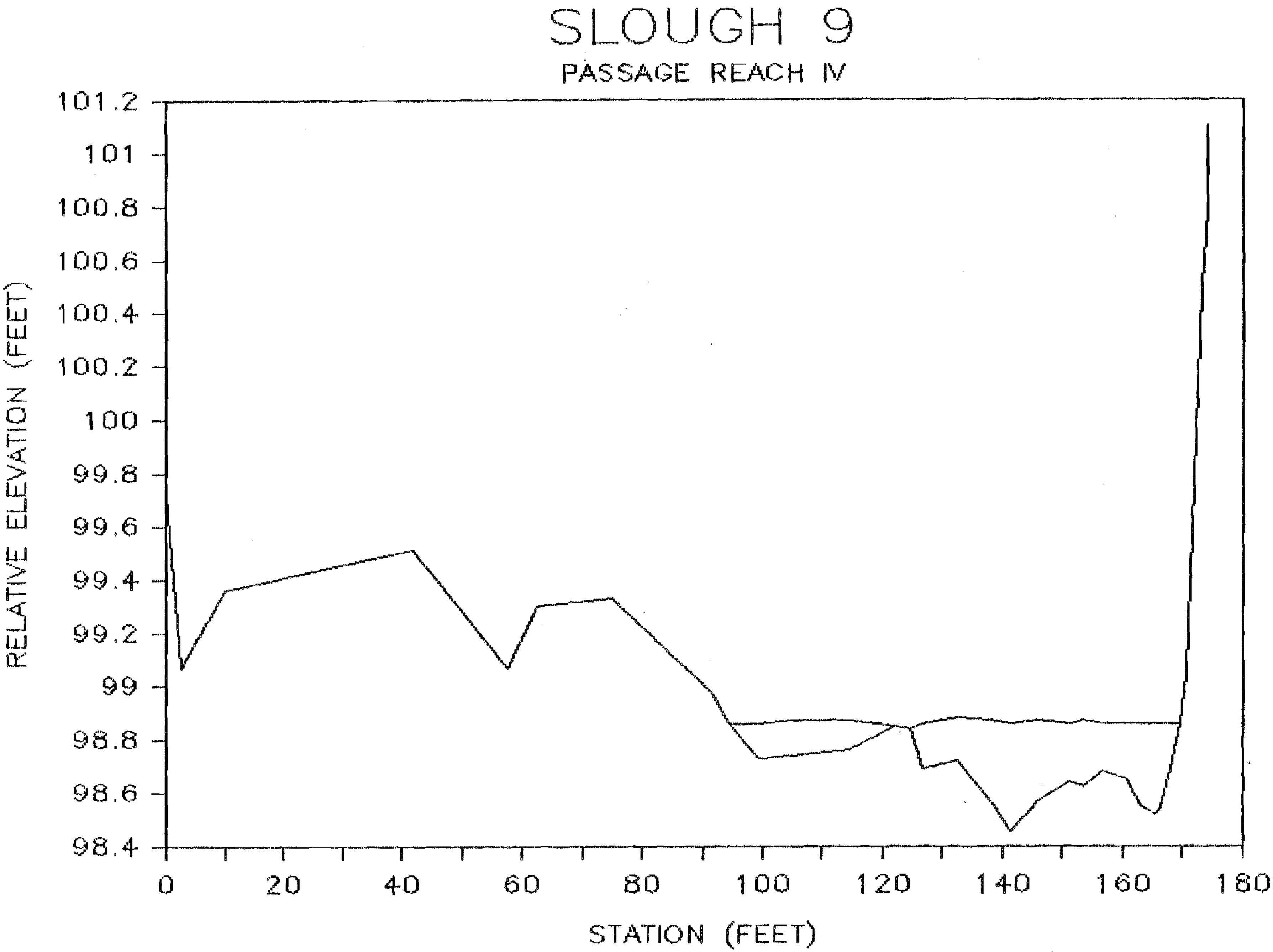
Appendix Figure D-17. Cross sectional profile of Passage Reach VIIIR in Slough 8A, October 7,1984.



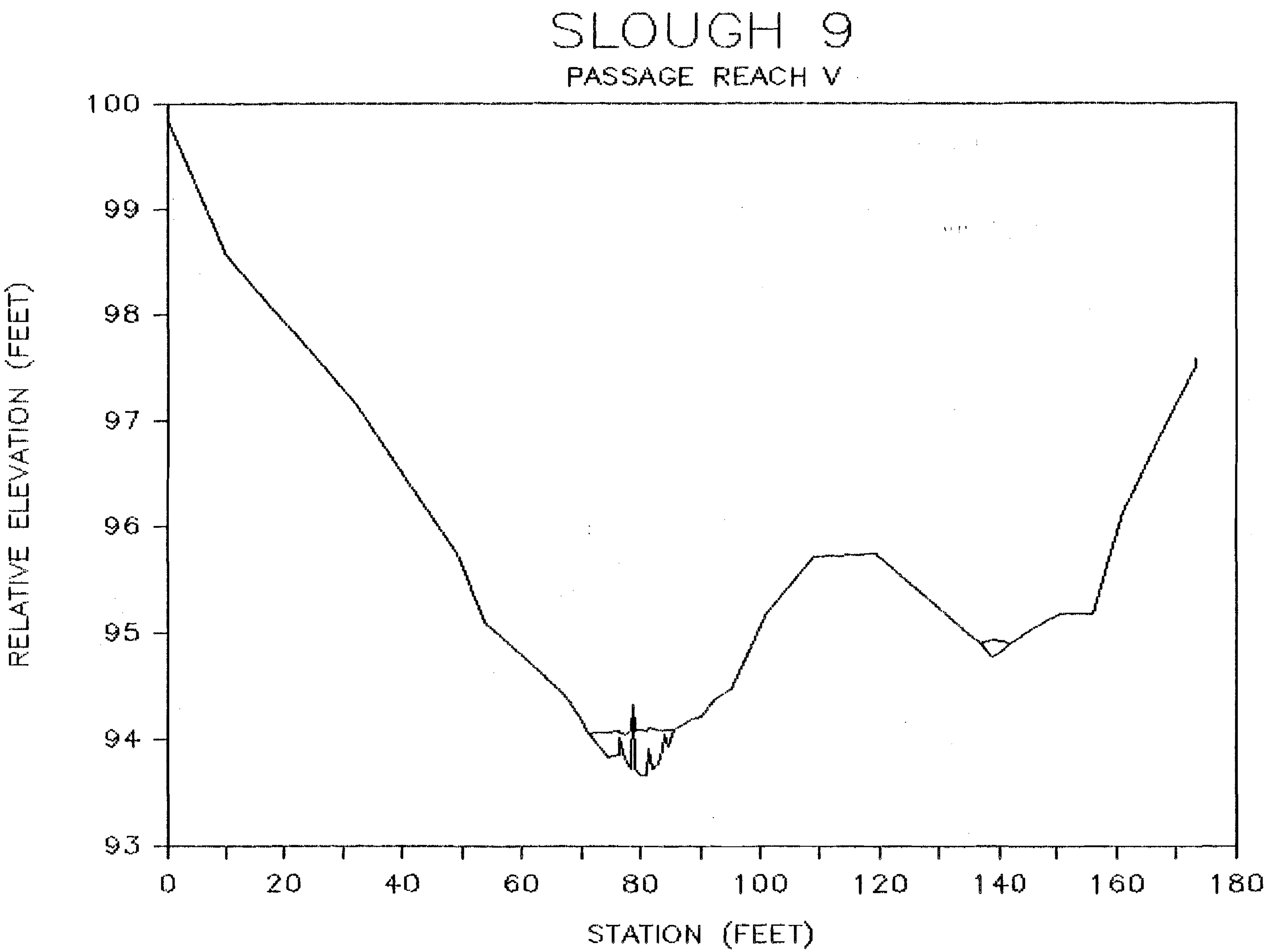
Appendix Figure D-18. Cross sectional profile of Passage Reach IXR in Slough 8A, October 7,1984.



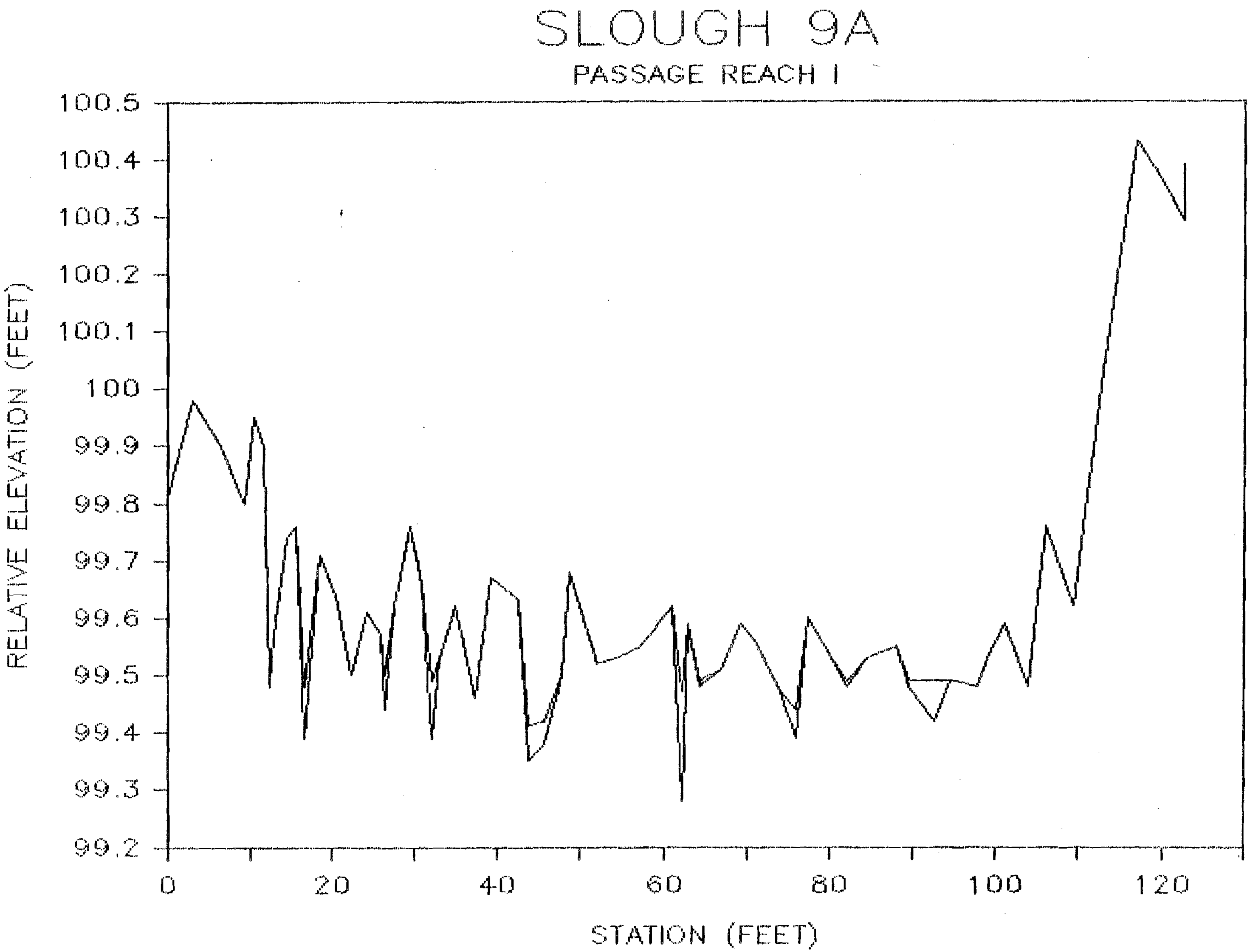
Appendix Figure D-19. Cross sectional profile of Passage Reach XR in Slough 8A, October 7,1984.



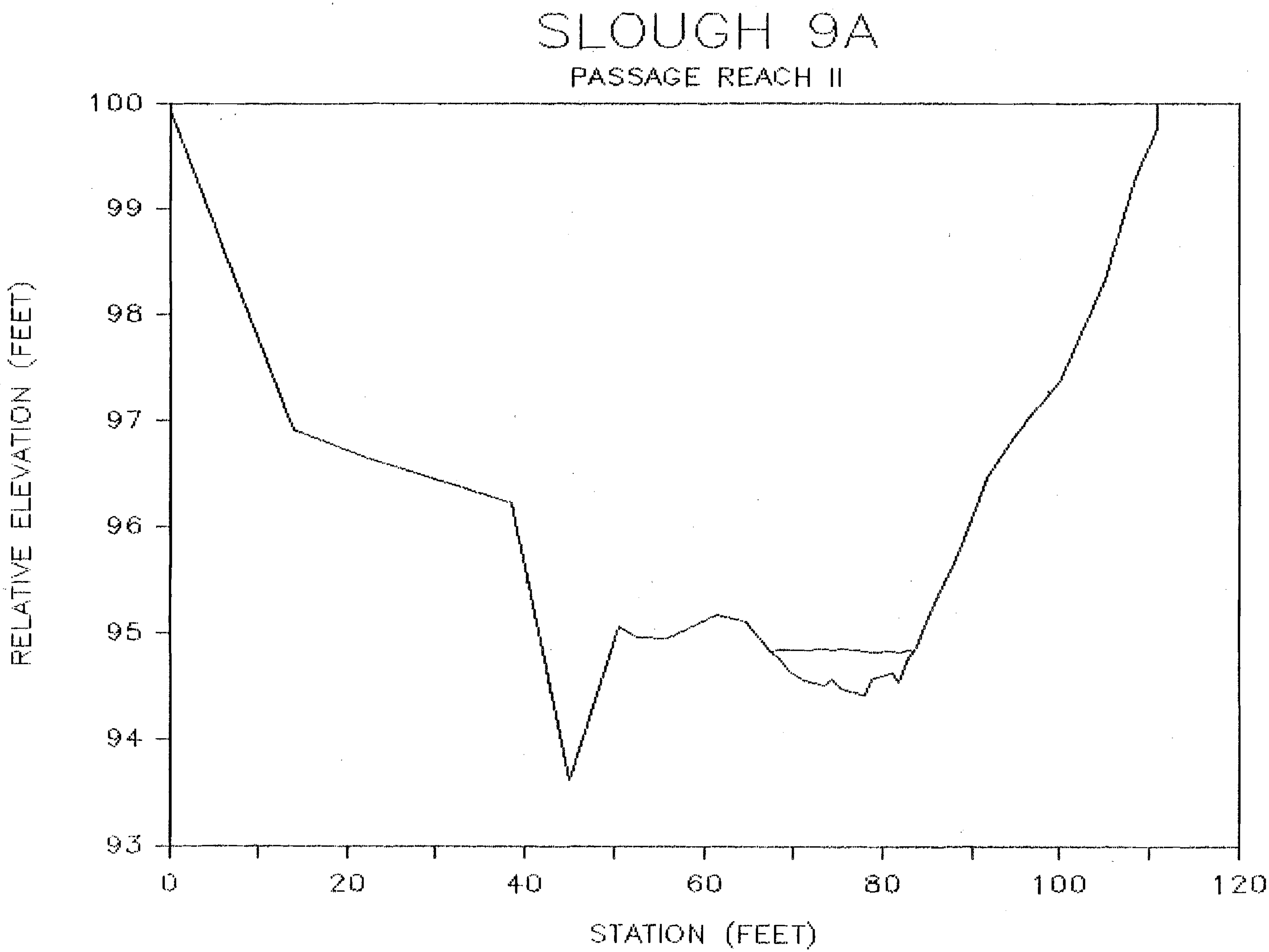
Appendix Figure D-20. Cross sectional profile of Passage Reach IV in Slough 9, September 22,1984.



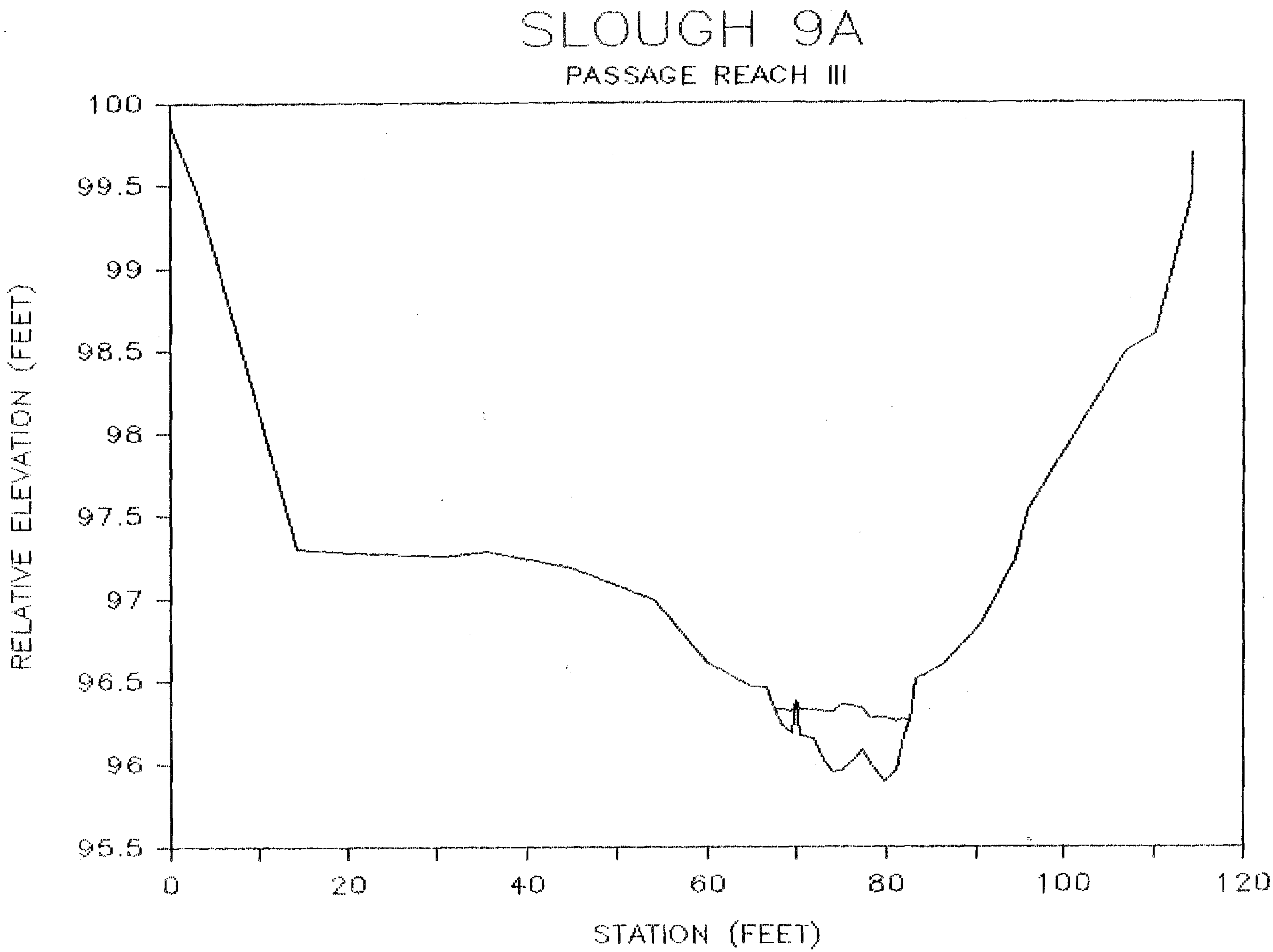
Appendix Figure D-21. Cross sectional profile of Passage Reach V in Slough 9, September 22, 1984.



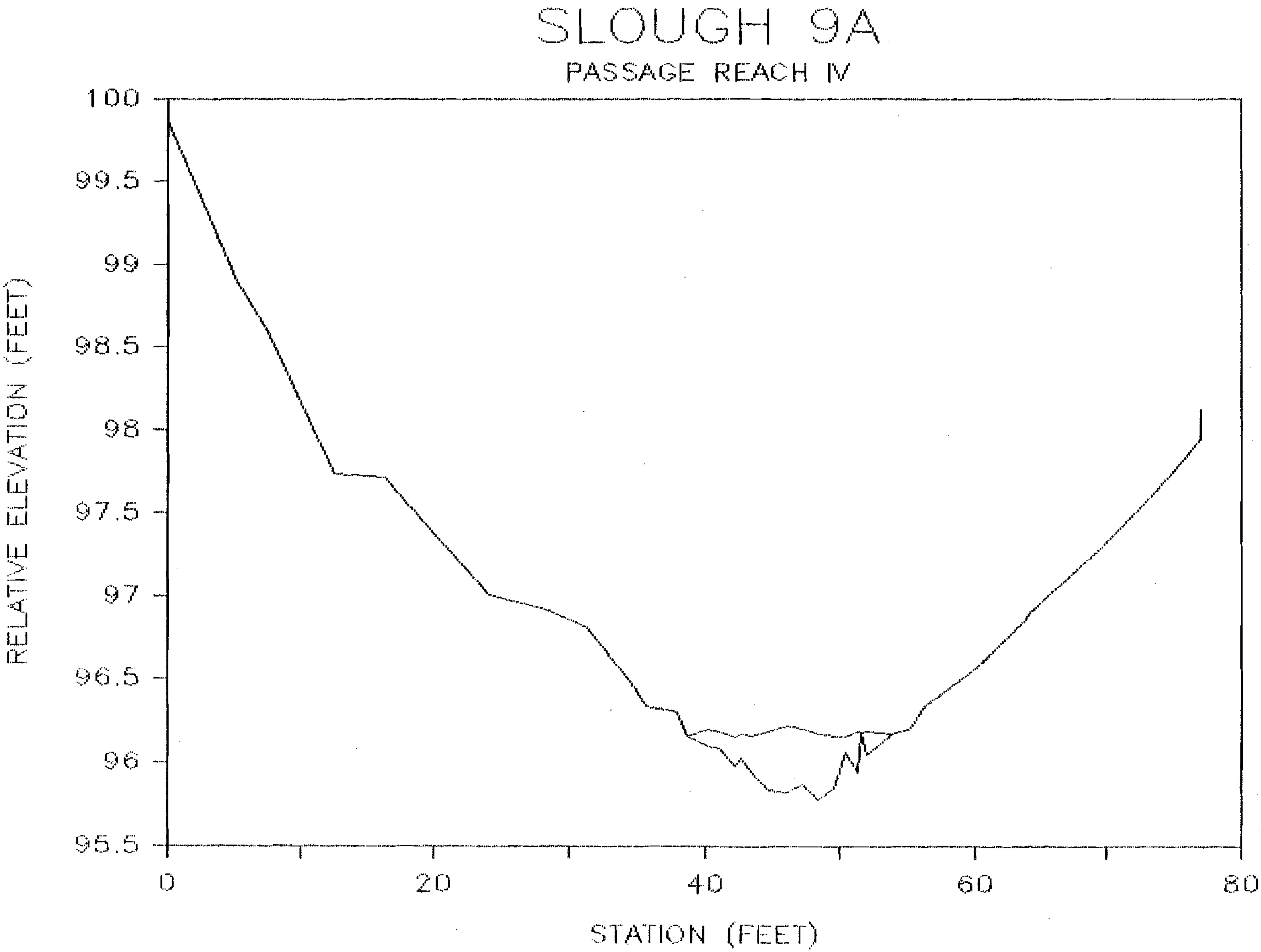
Appendix Figure D-22. Cross sectional profile of Passage Reach I in Slough 9A, October 8,1984.



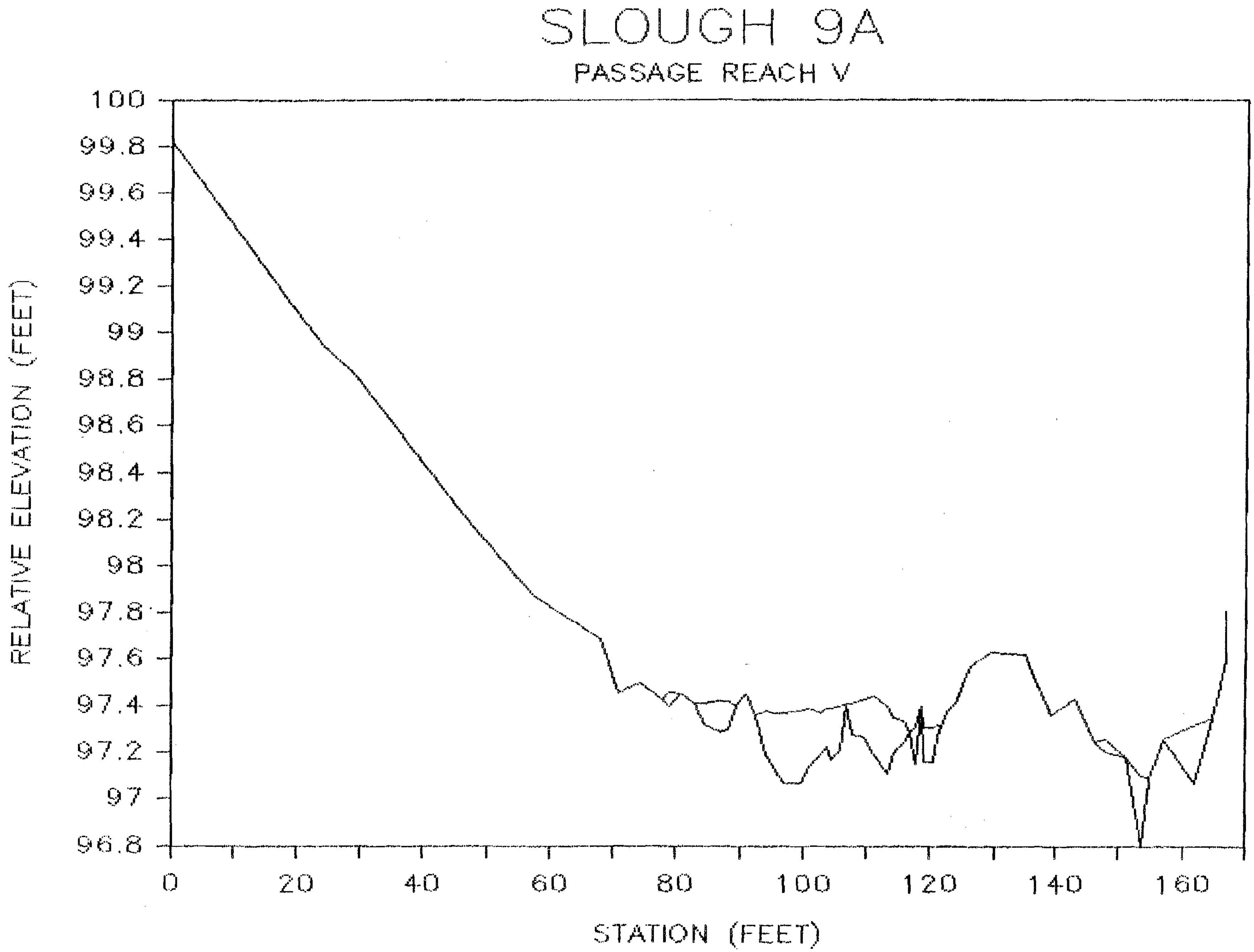
Appendix Figure D-23. Cross sectional profile of Passage Reach II in Slough 9A, September 23,1984.



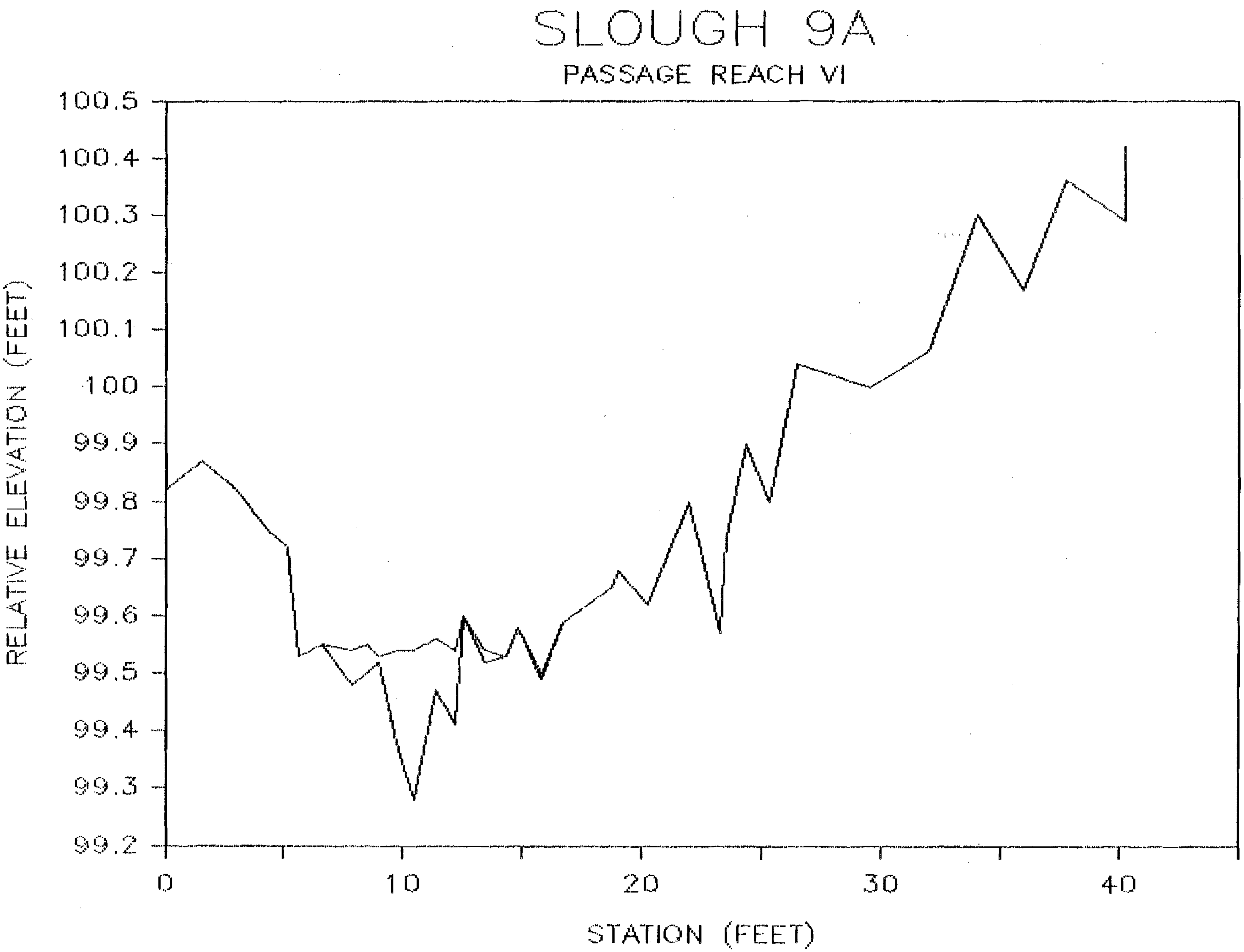
Appendix Figure D-24. Cross sectional profile of Passage Reach III in Slough 9A, September 23,1984.



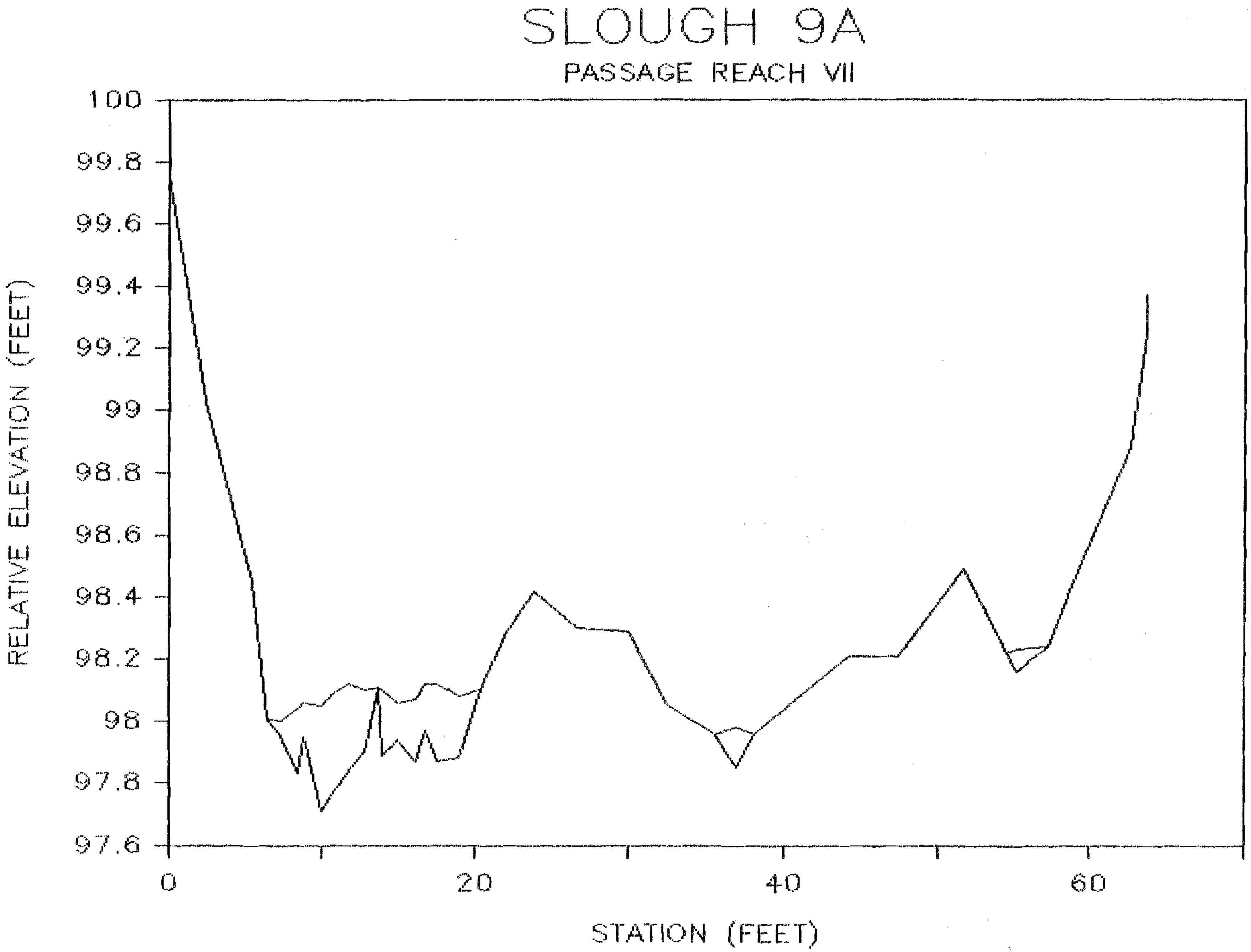
Appendix Figure D-25. Cross sectional profile of Passage Reach IV in Slough 9A, September 23,1984.



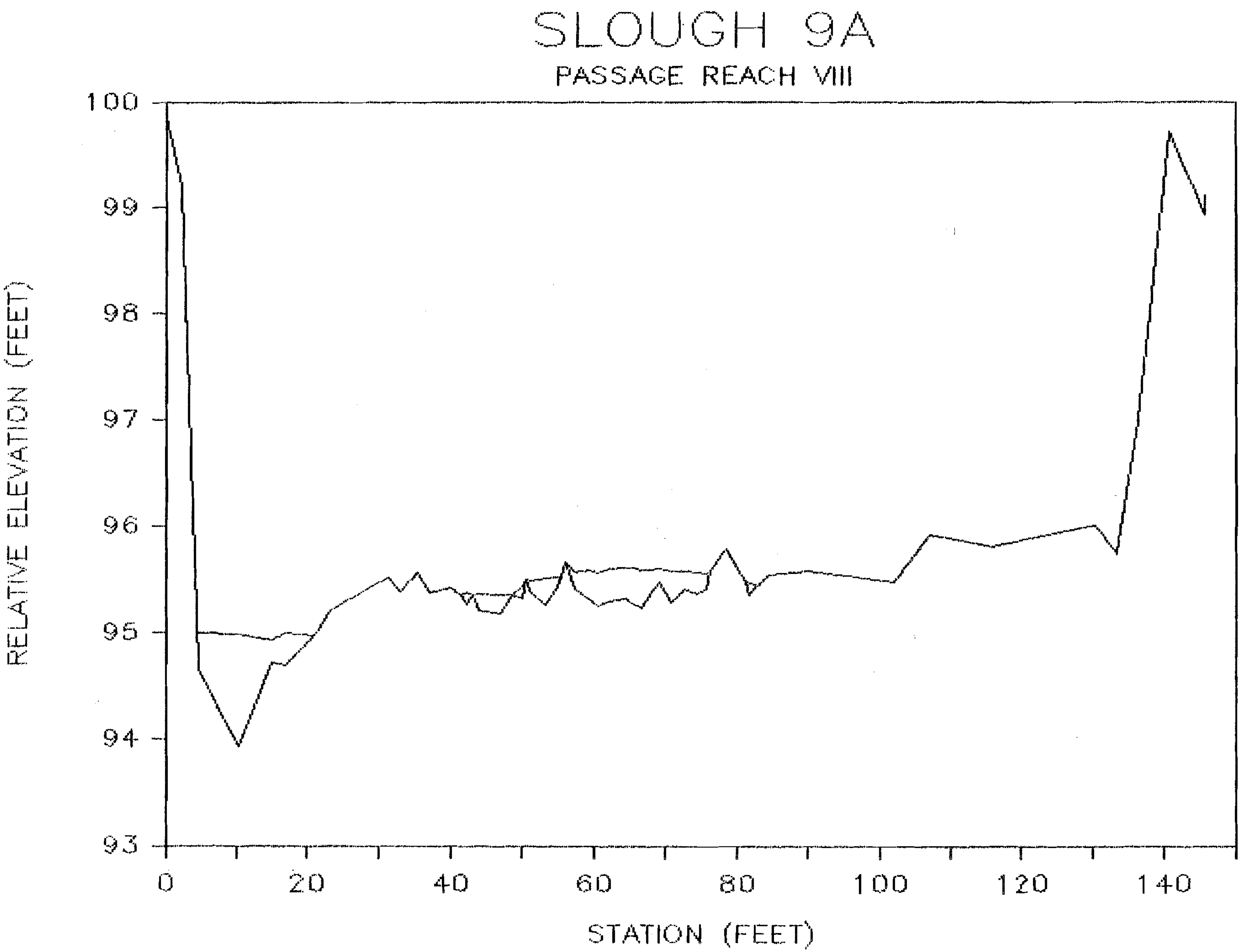
Appendix Figure D-26. Cross sectional profile of Passage Reach V in Slough 9A, September 23,1984.



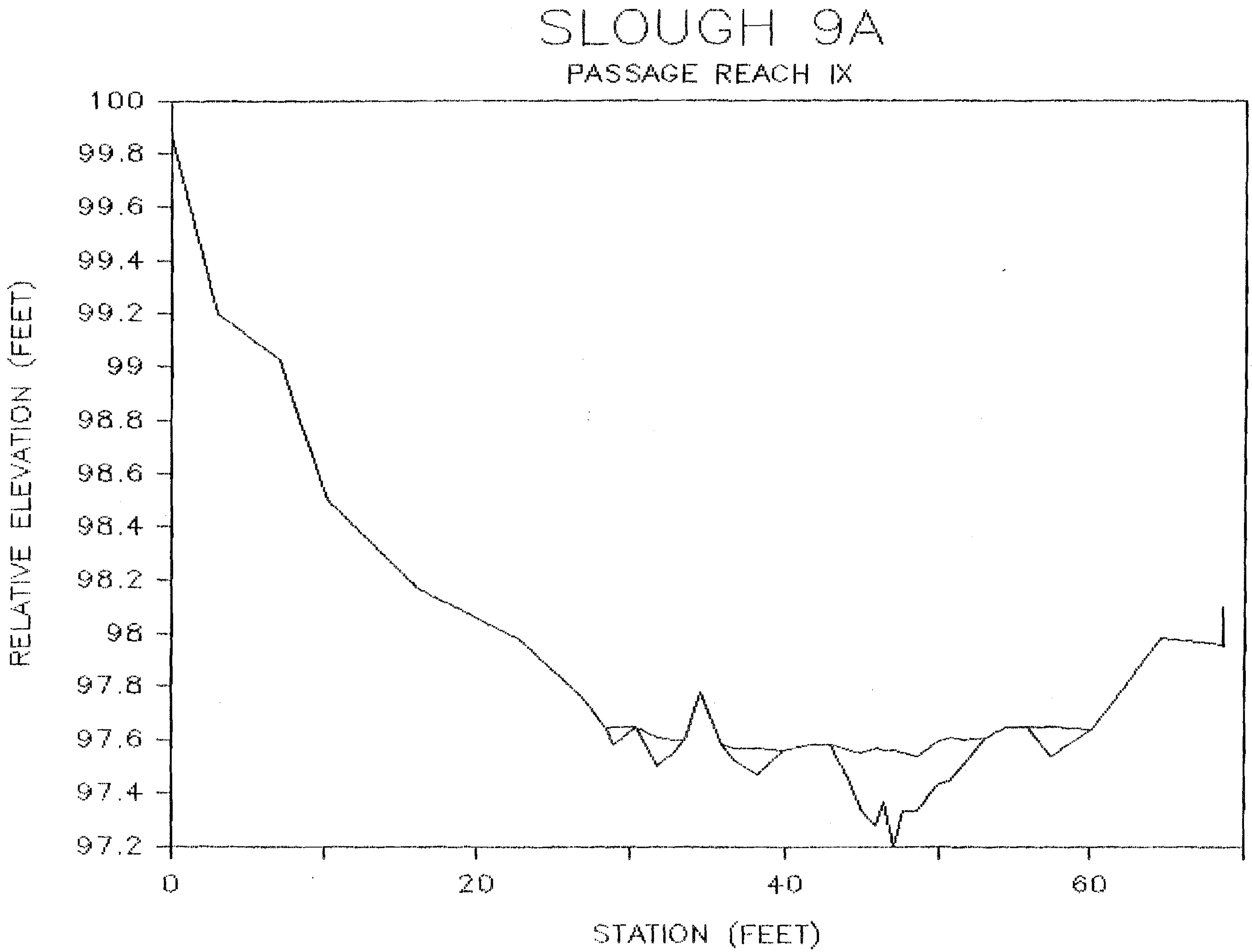
Appendix Figure D-27. Cross sectional profile of Passage Reach VI in Slough 9A, October 8,1984.



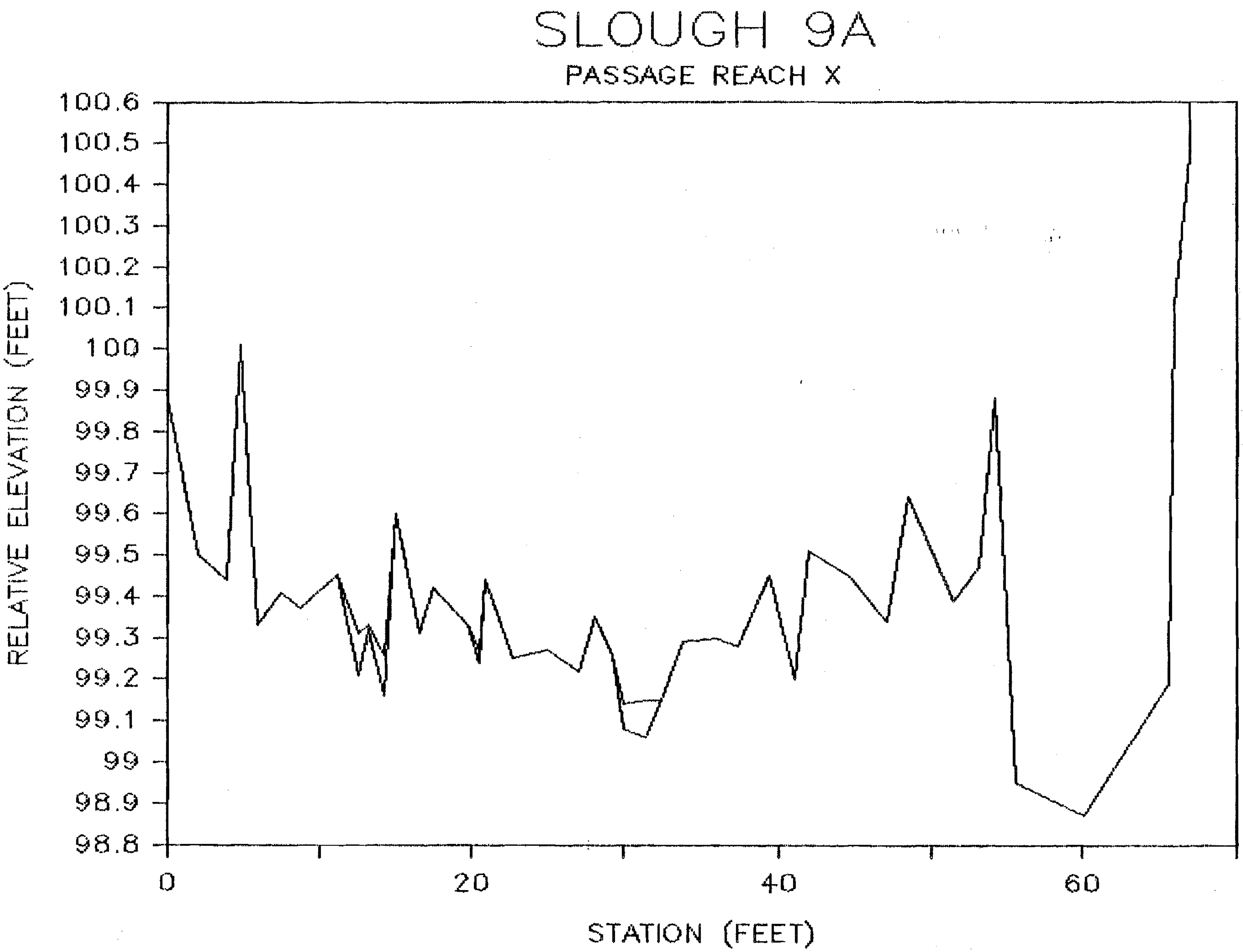
Appendix Figure D-28. Cross sectional profile of Passage Reach VII in Slough 9A, September 23,1984.



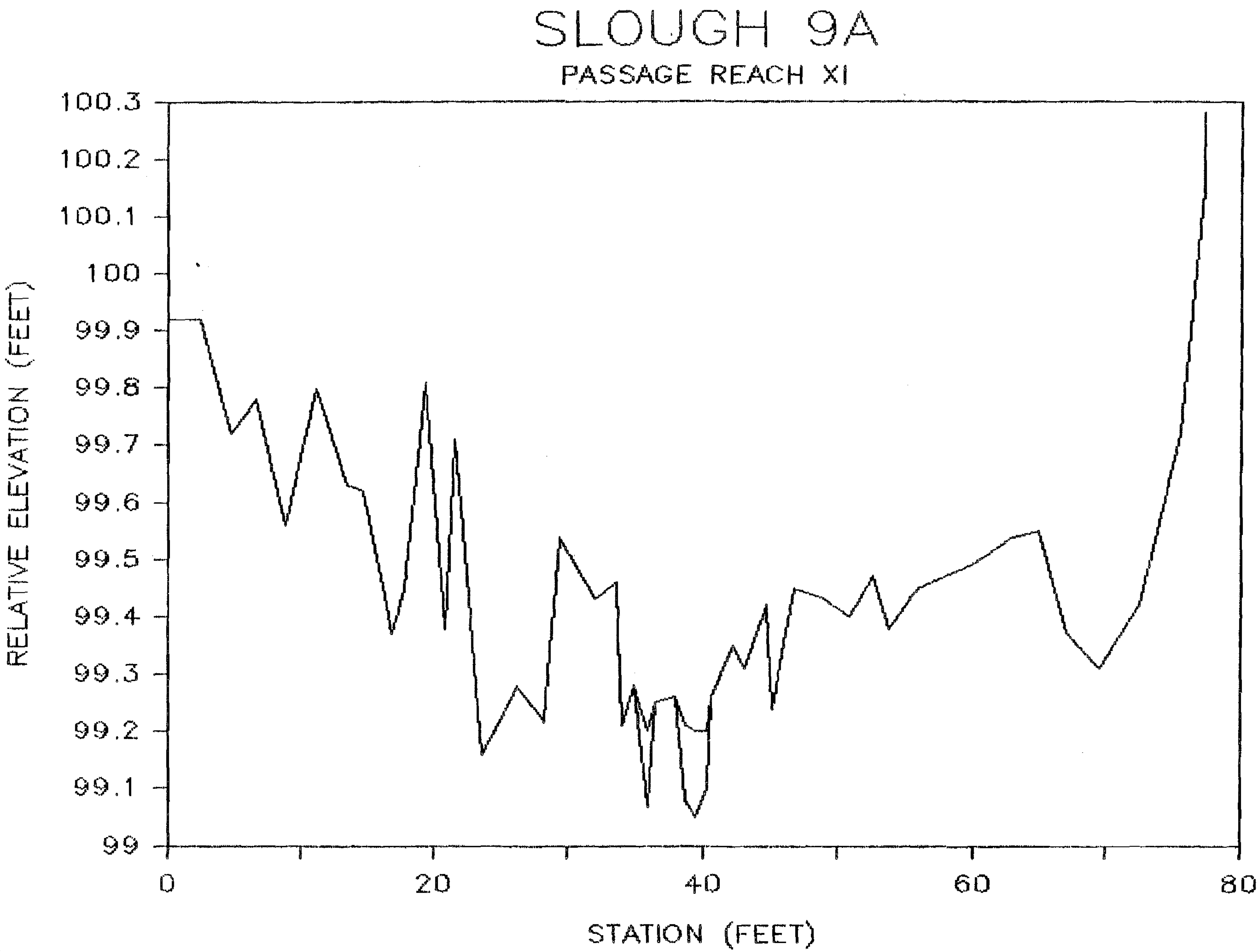
Appendix Figure D-29. Cross sectional profile of Passage Reach VIII in Slough 9A, September 23,1984.



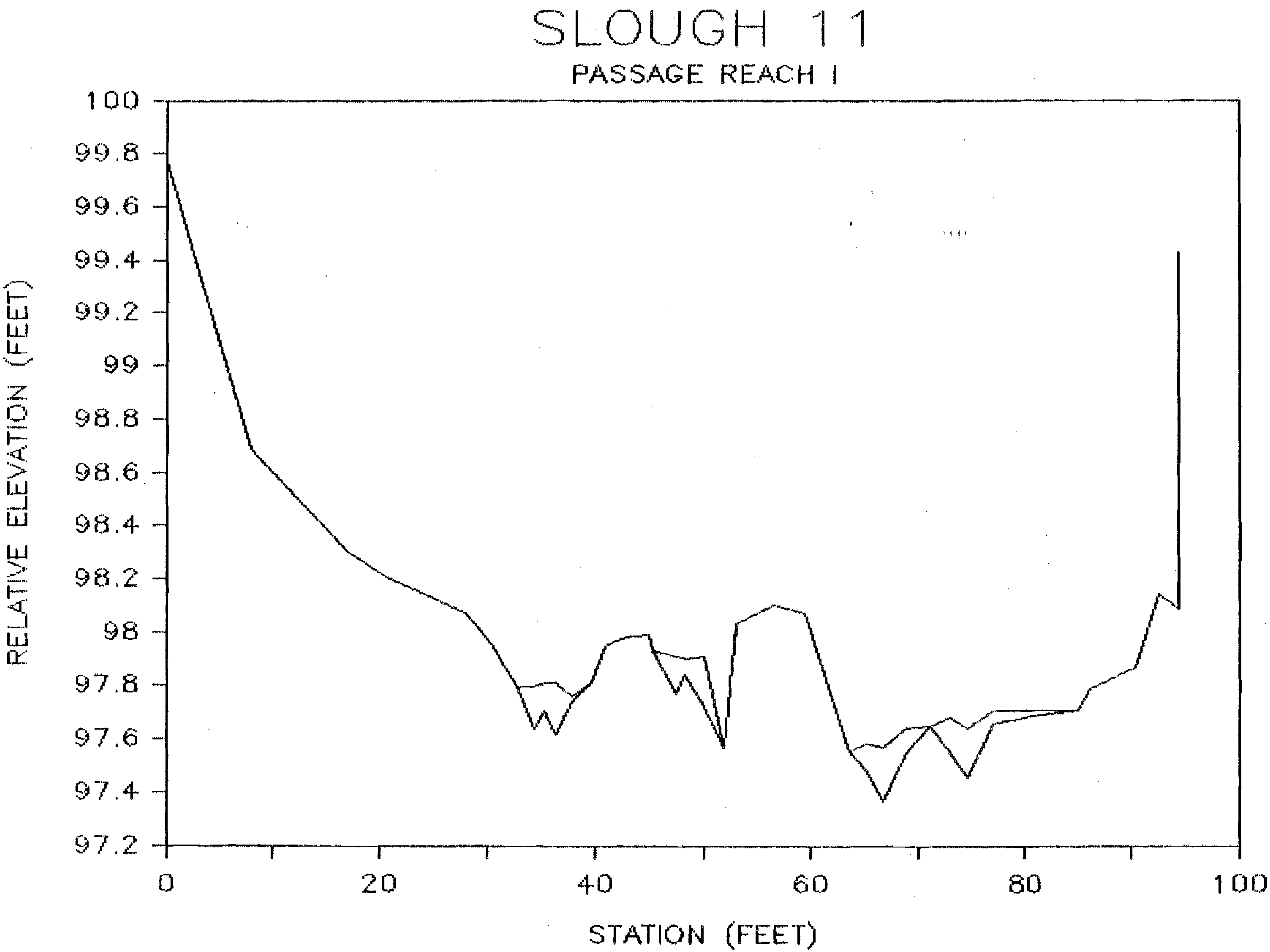
Appendix Figure D-30. Cross sectional profile of Passage Reach IX in Slough 9A, September 23,1984.



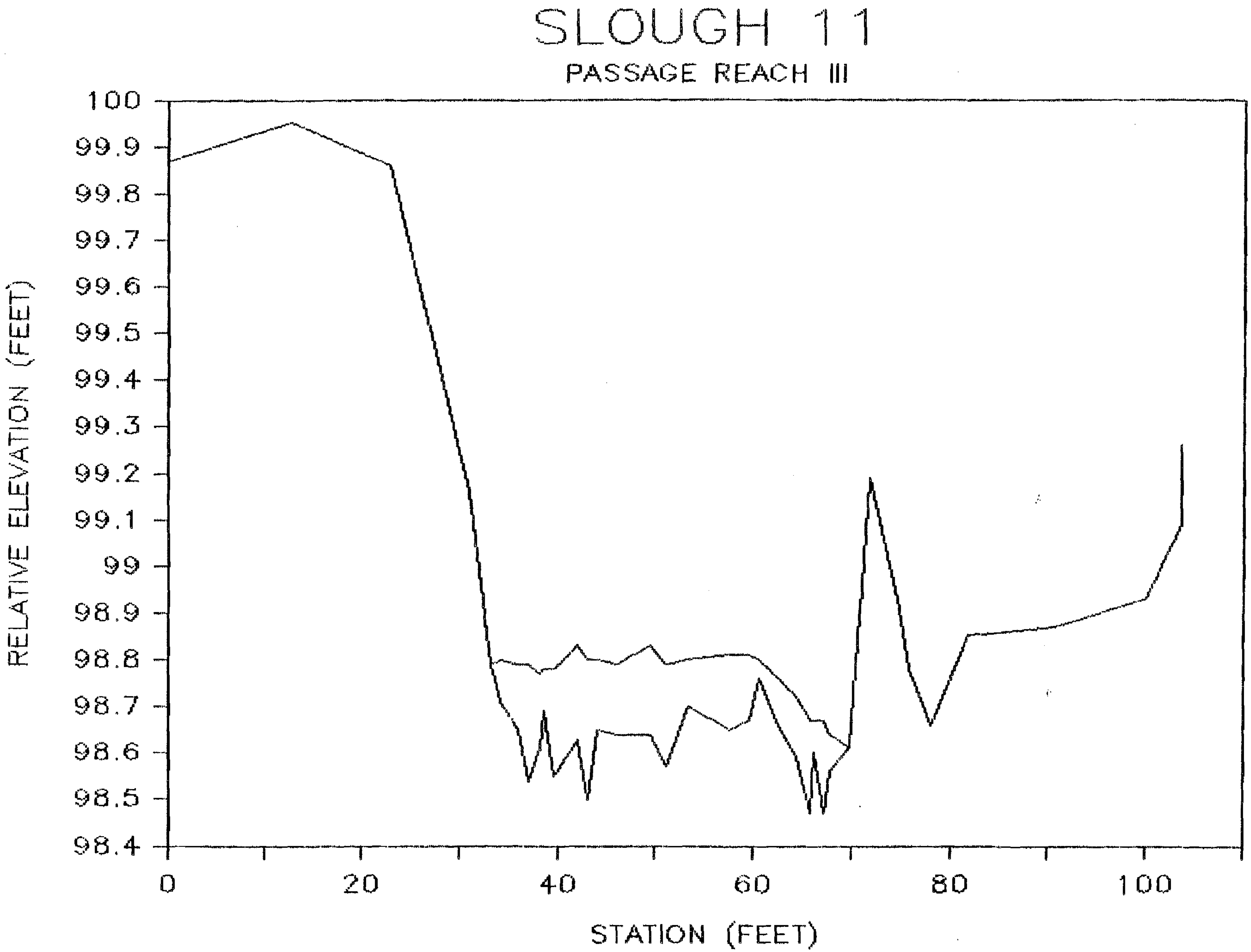
Appendix Figure D-31. Cross sectional profile of Passage Reach X in Slough 9A, October 8,1984.



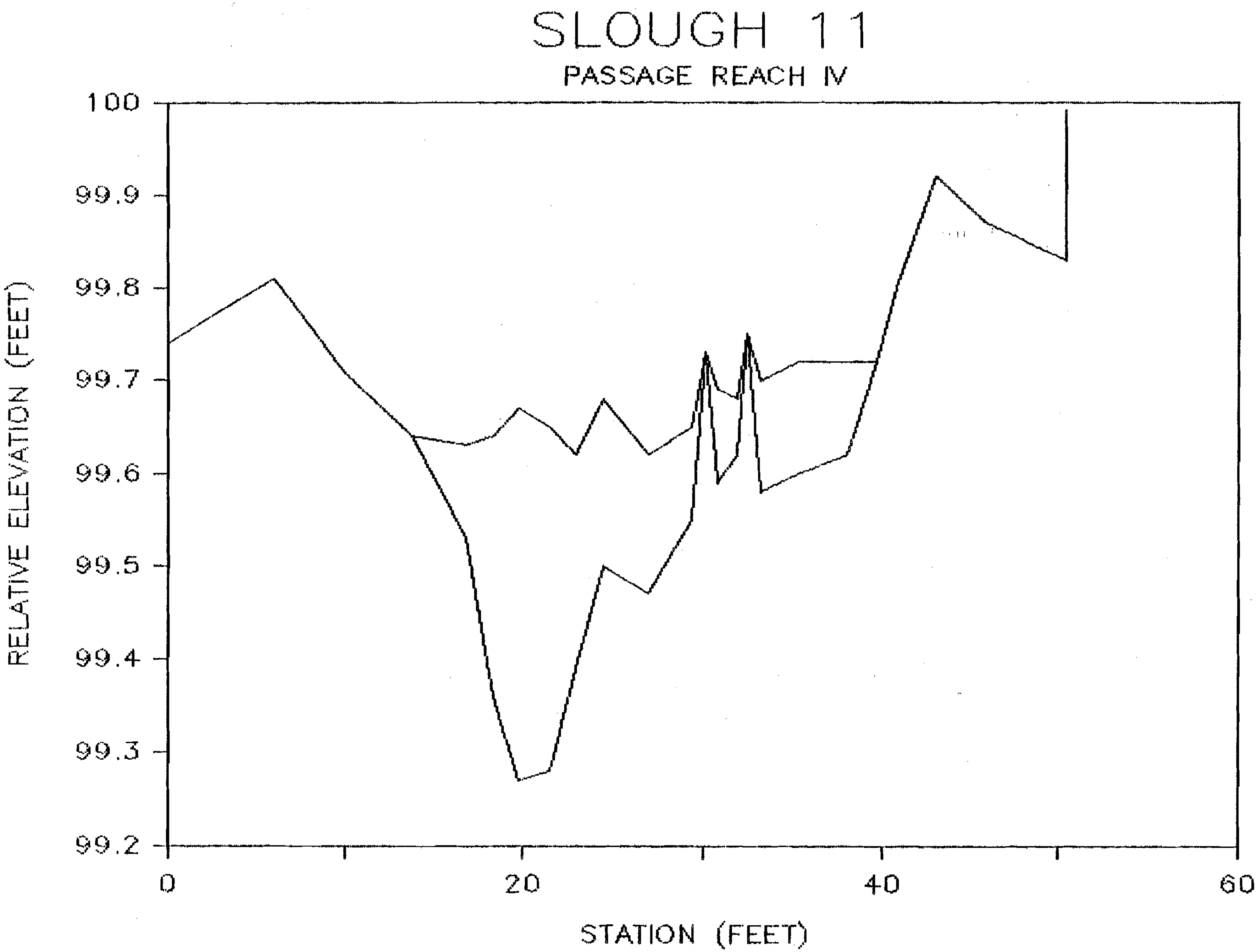
Appendix Figure D-32. Cross sectional profile of Passage Reach XI in Slough 9A, October 8,1984.



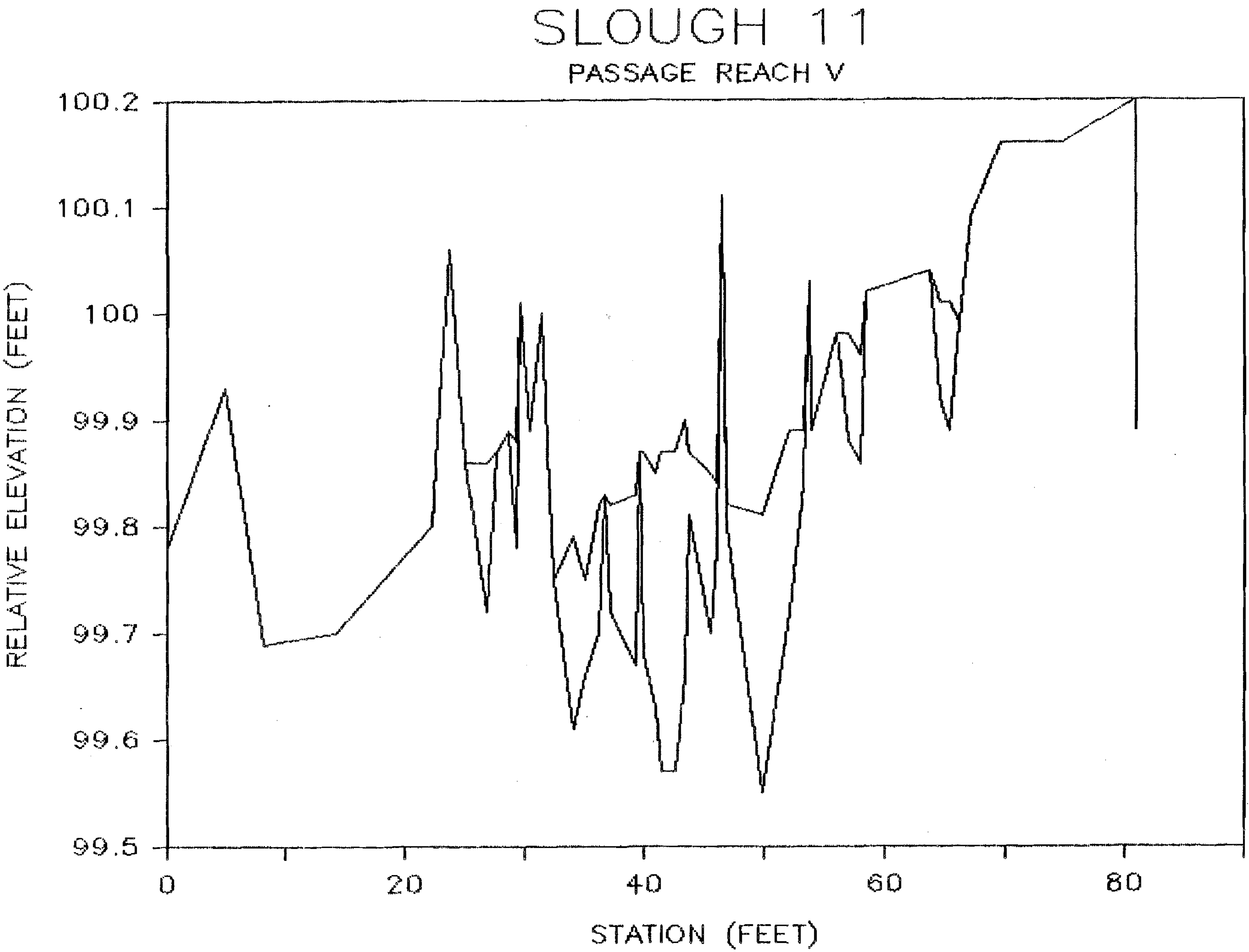
Appendix Figure D-33. Cross sectional profile of Passage Reach I in Slough 11, October 18, 1984.



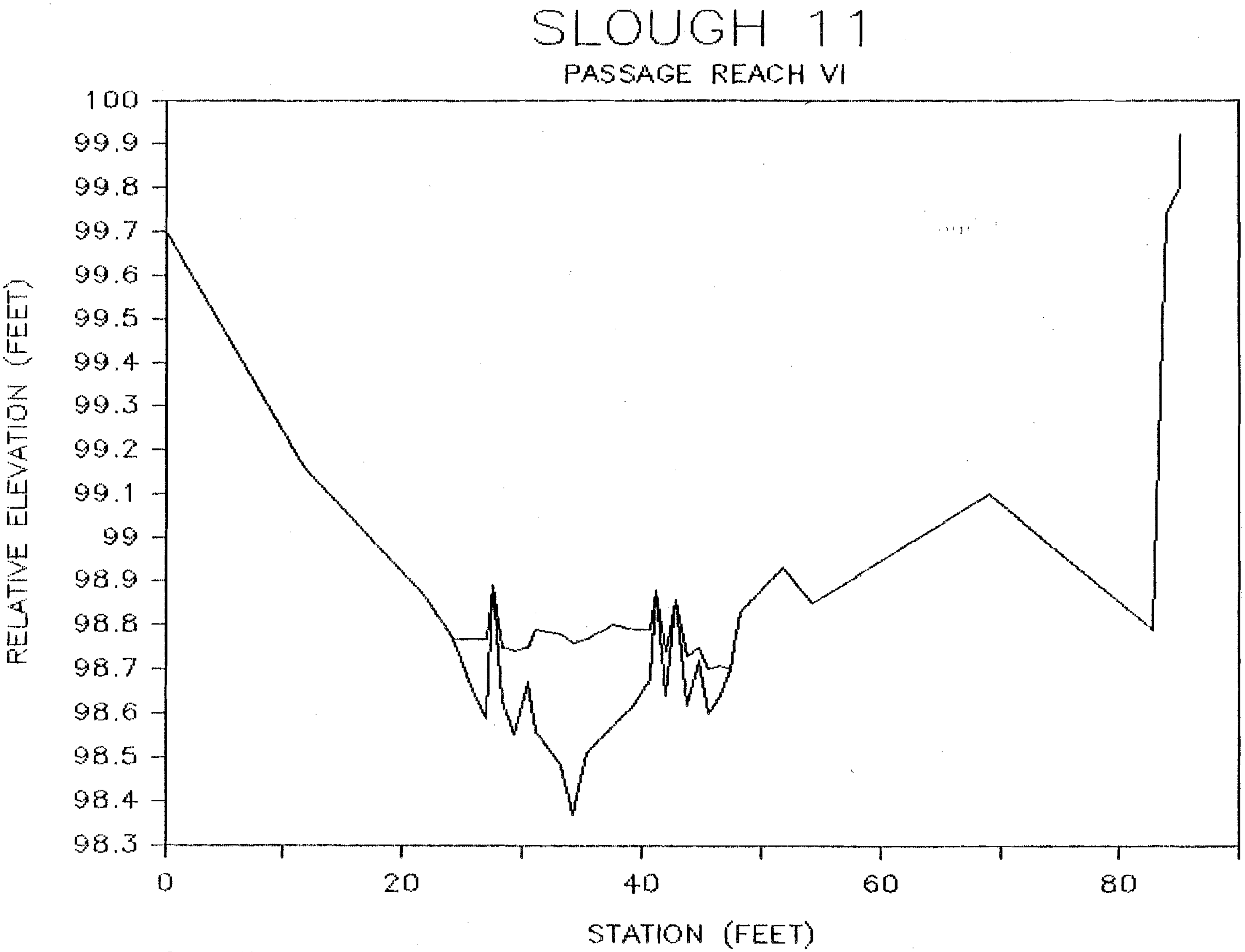
Appendix Figure D-34. Cross sectional profile of Passage Reach III in Slough 11, September 21,1984.



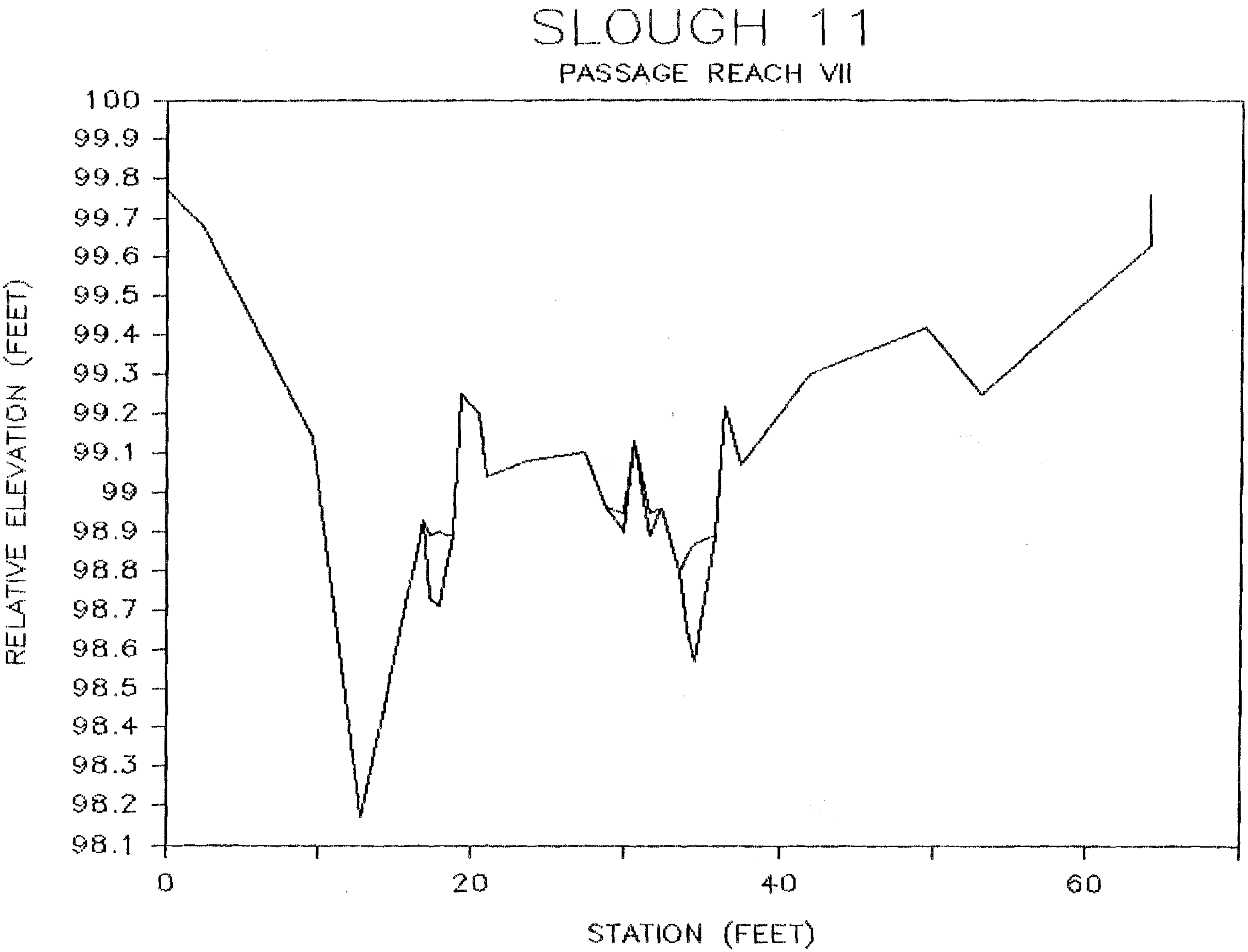
Appendix Figure D-35. Cross sectional profile of Passage Reach IV in Slough 11, September 21,1984.



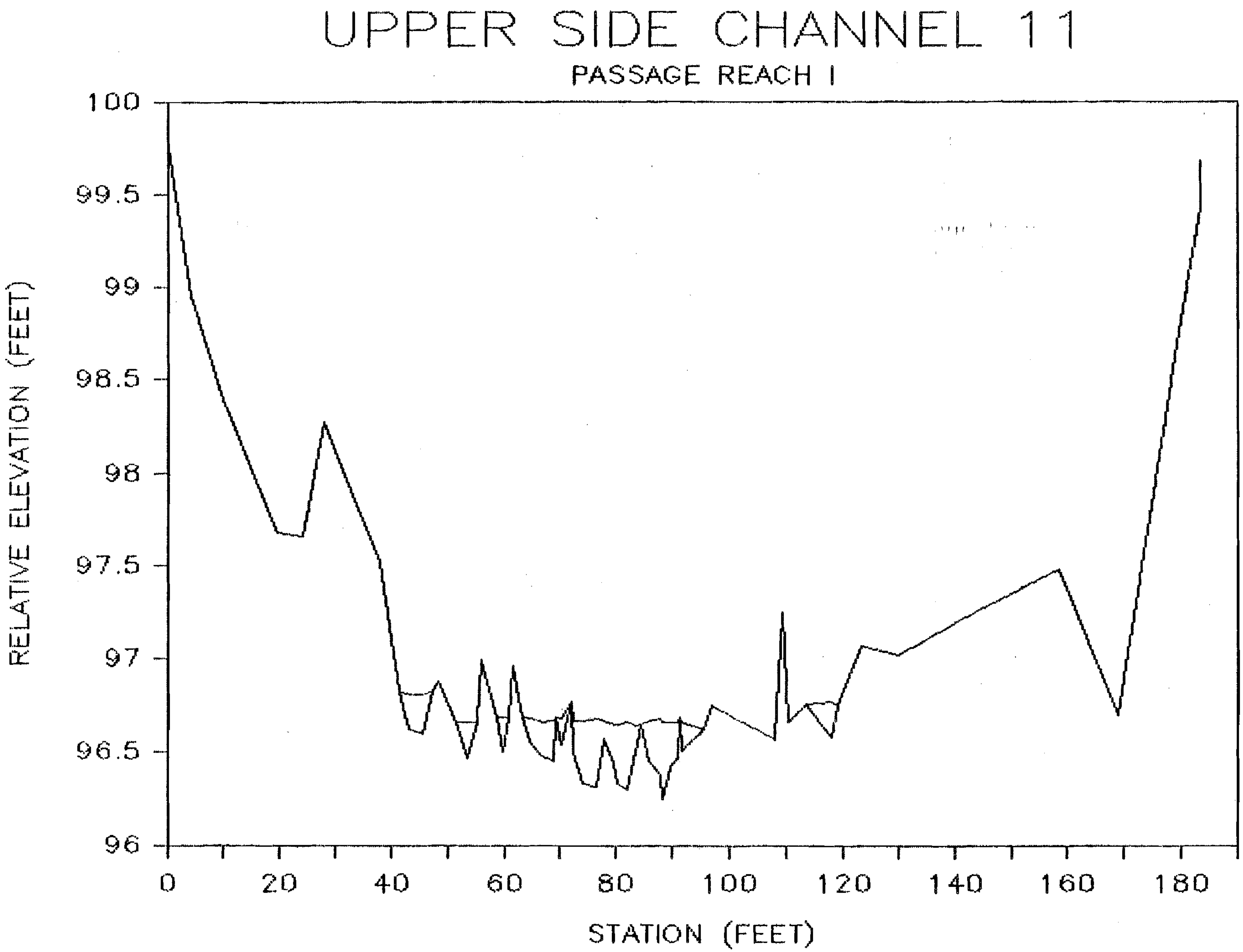
Appendix Figure D-36. Cross sectional profile of Passage Reach V in Slough 11, September 21,1984.



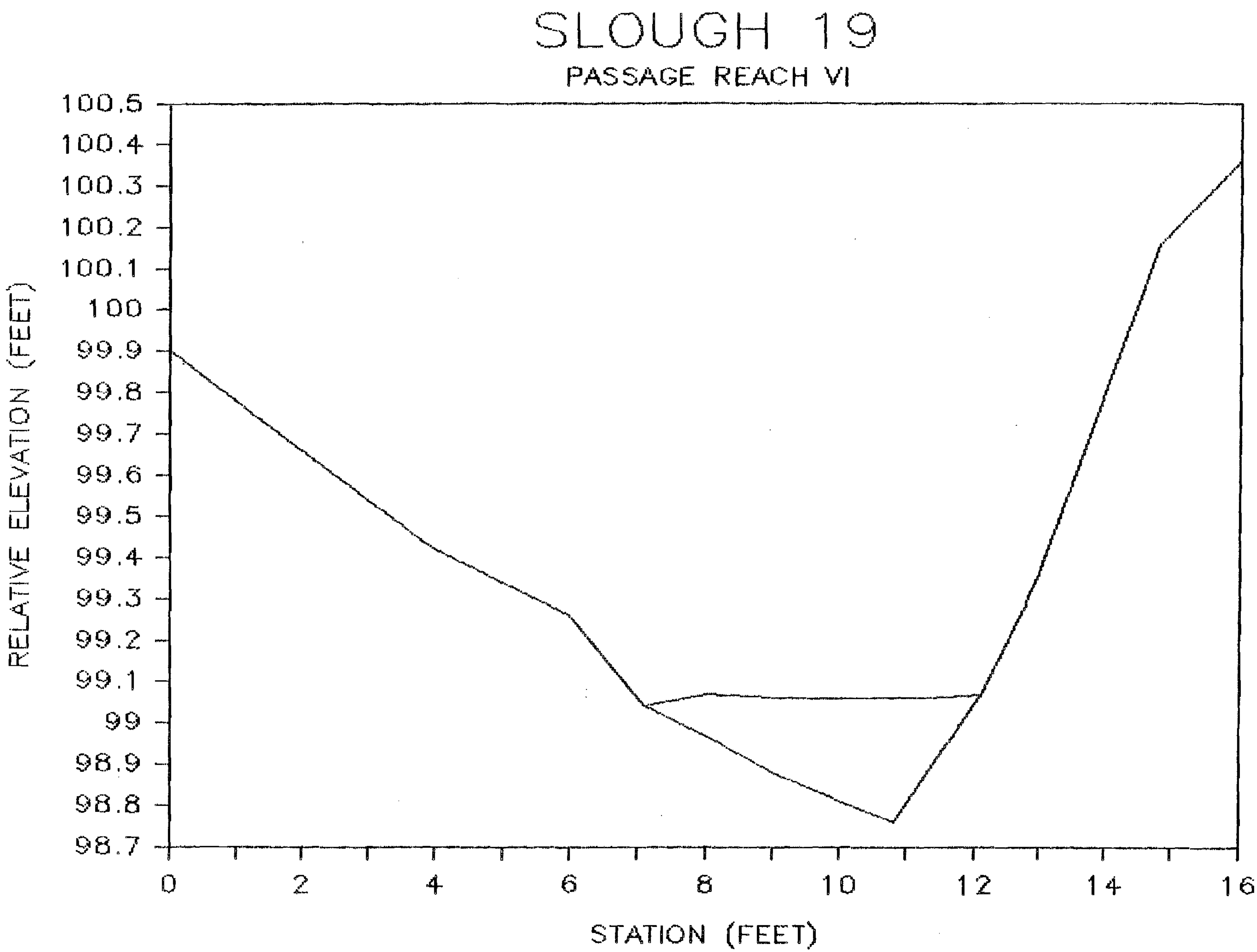
Appendix Figure D-37. Cross sectional profile of Passage Reach VI in Slough 11, September 21,1984.



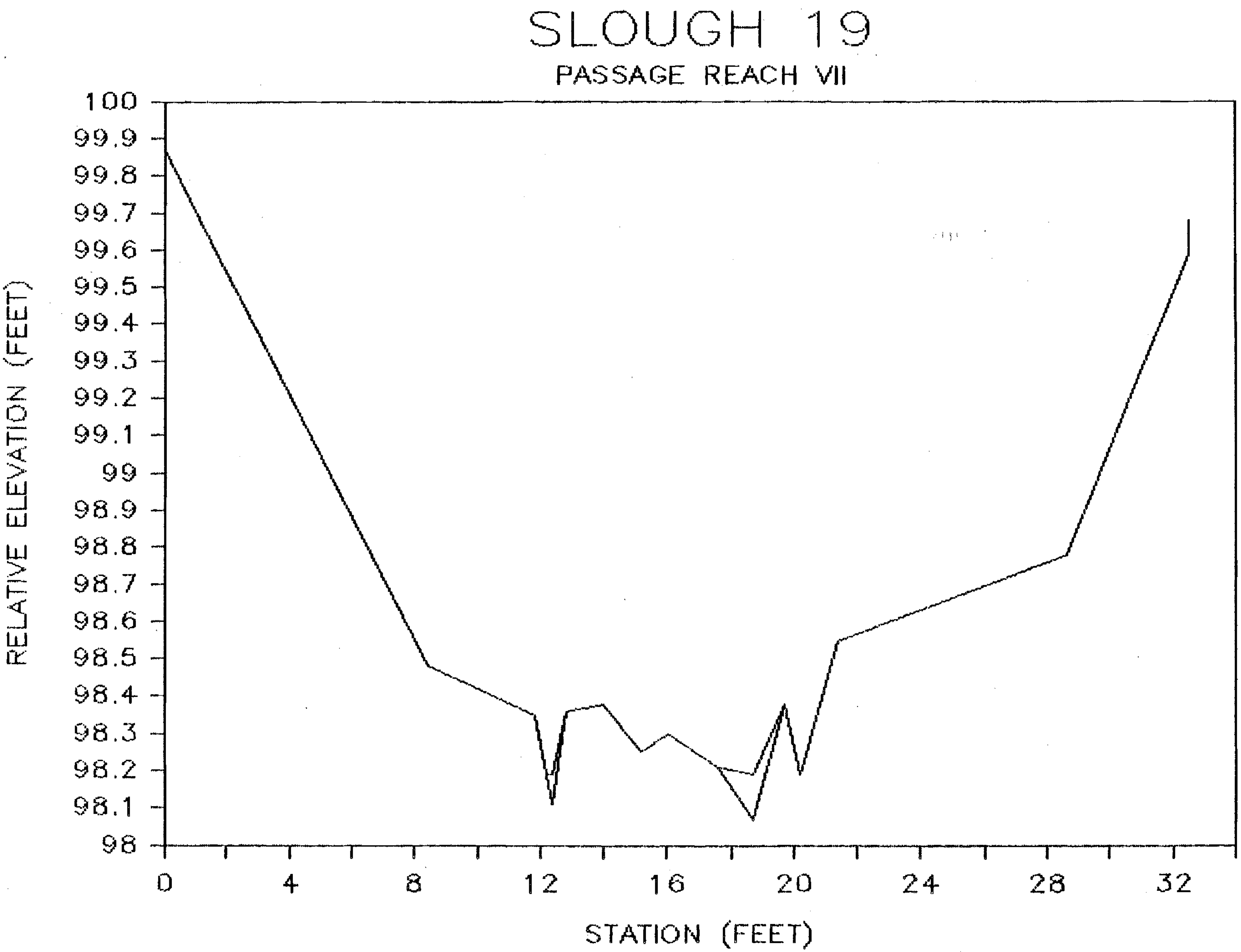
Appendix Figure D-38. Cross sectional profile of Passage Reach VII in Slough 11, September 21,1984.



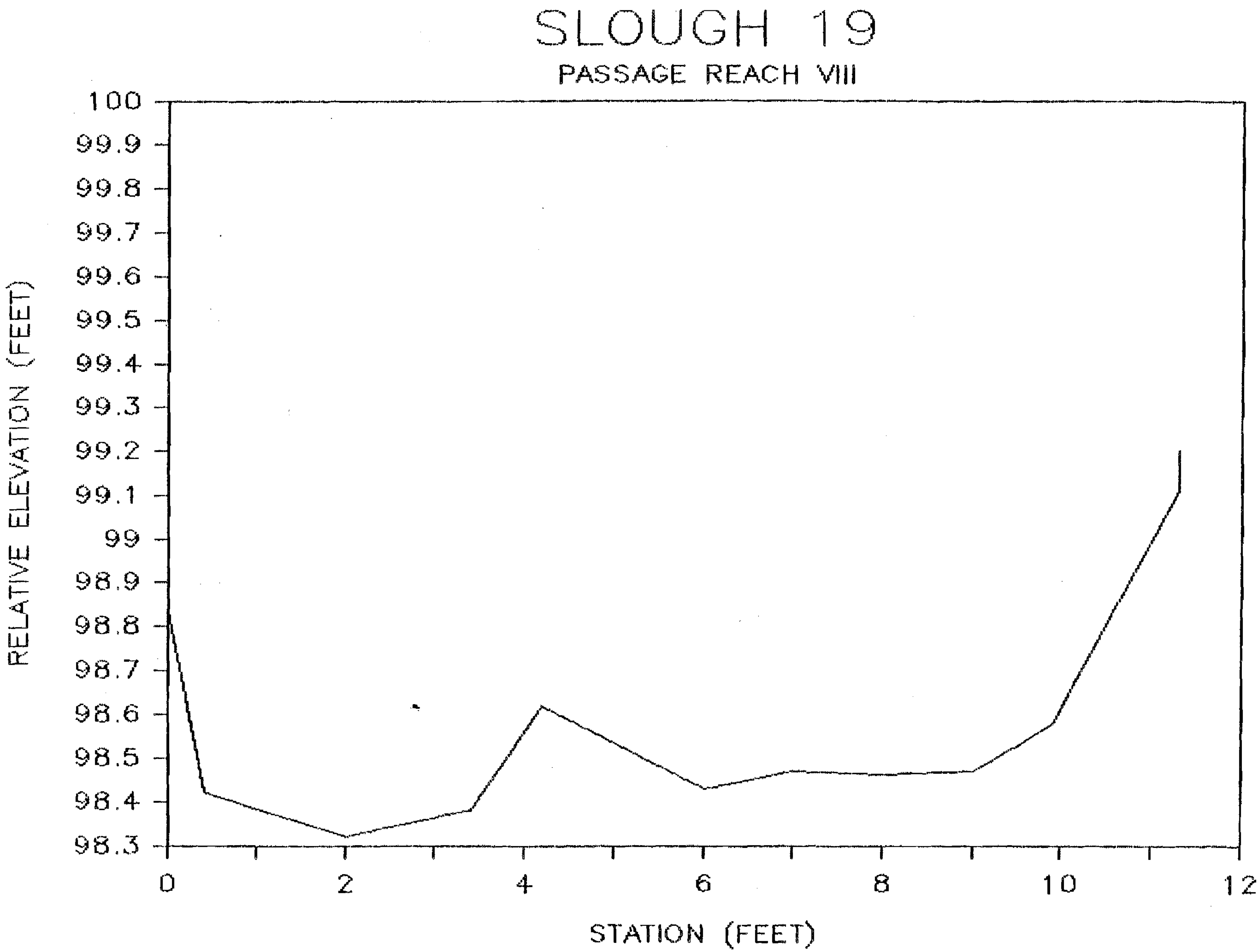
Appendix Figure D-39. Cross sectional profile of Passage Reach I in Upper Side Channel 11, September 21,1984.



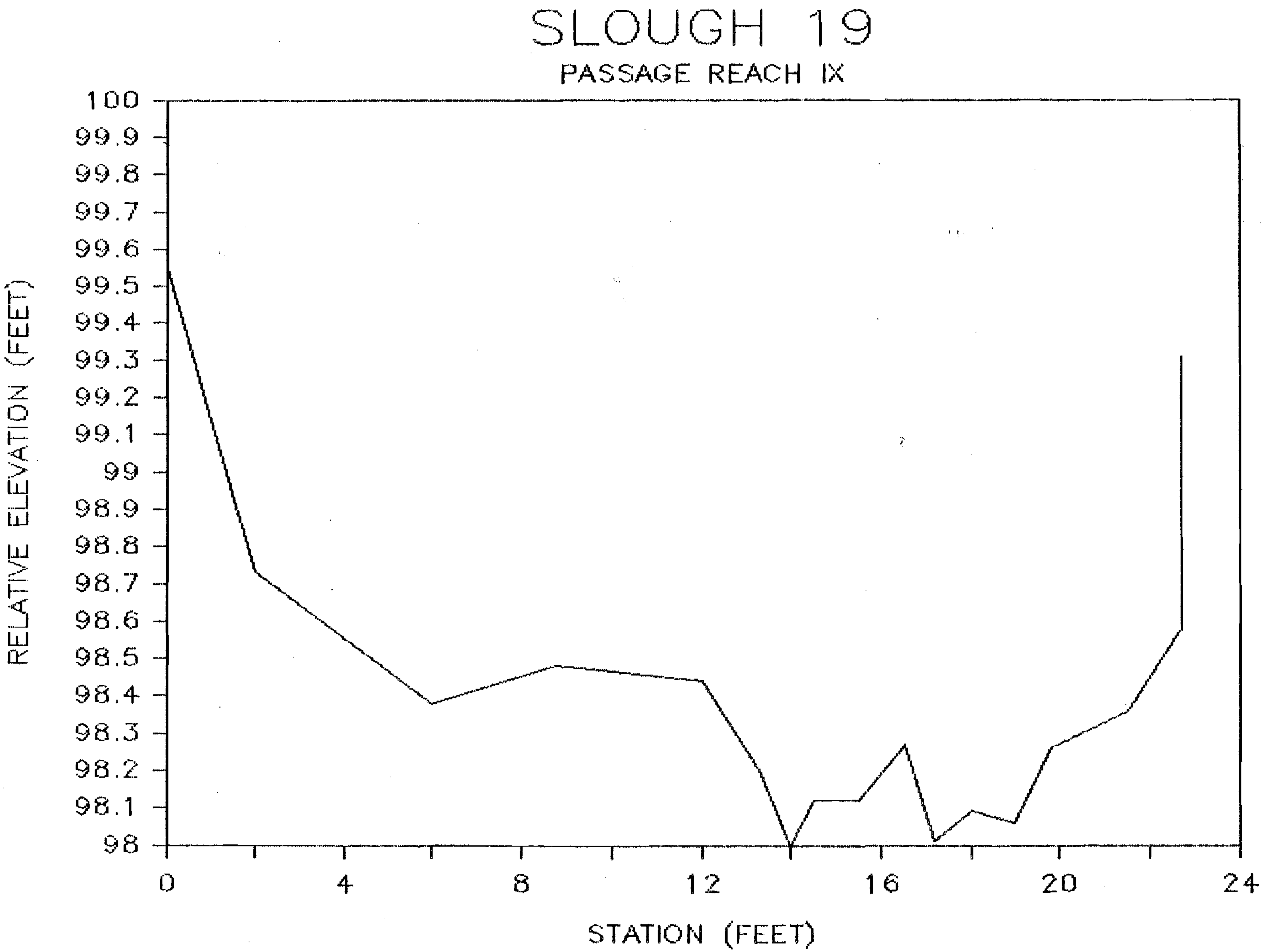
Appendix Figure D-40. Cross sectional profile of Passage Reach VI in Slough 19, October 17,1984.



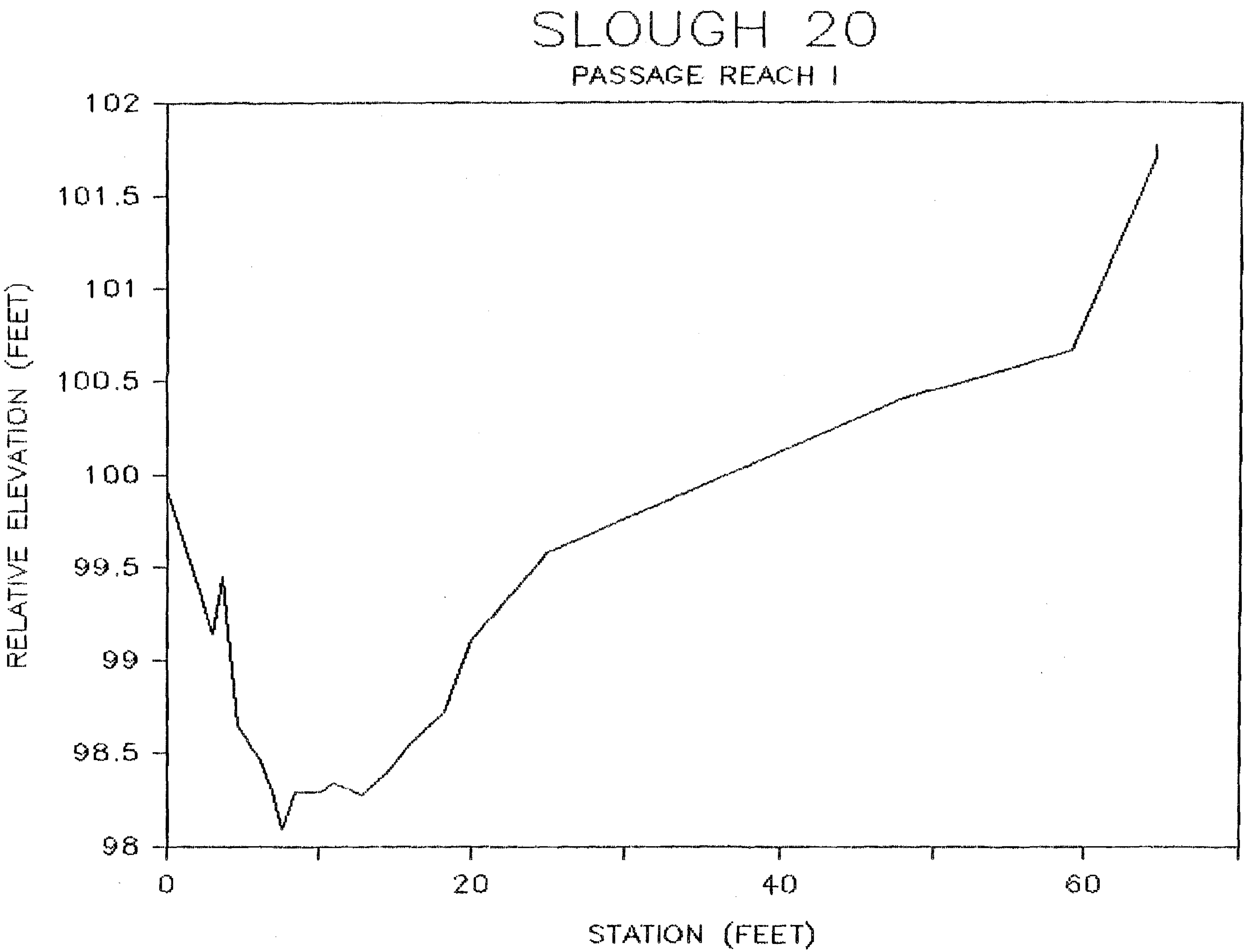
Appendix Figure D-41. Cross sectional profile of Passage Reach VII in Slough 19, October 17,1984.



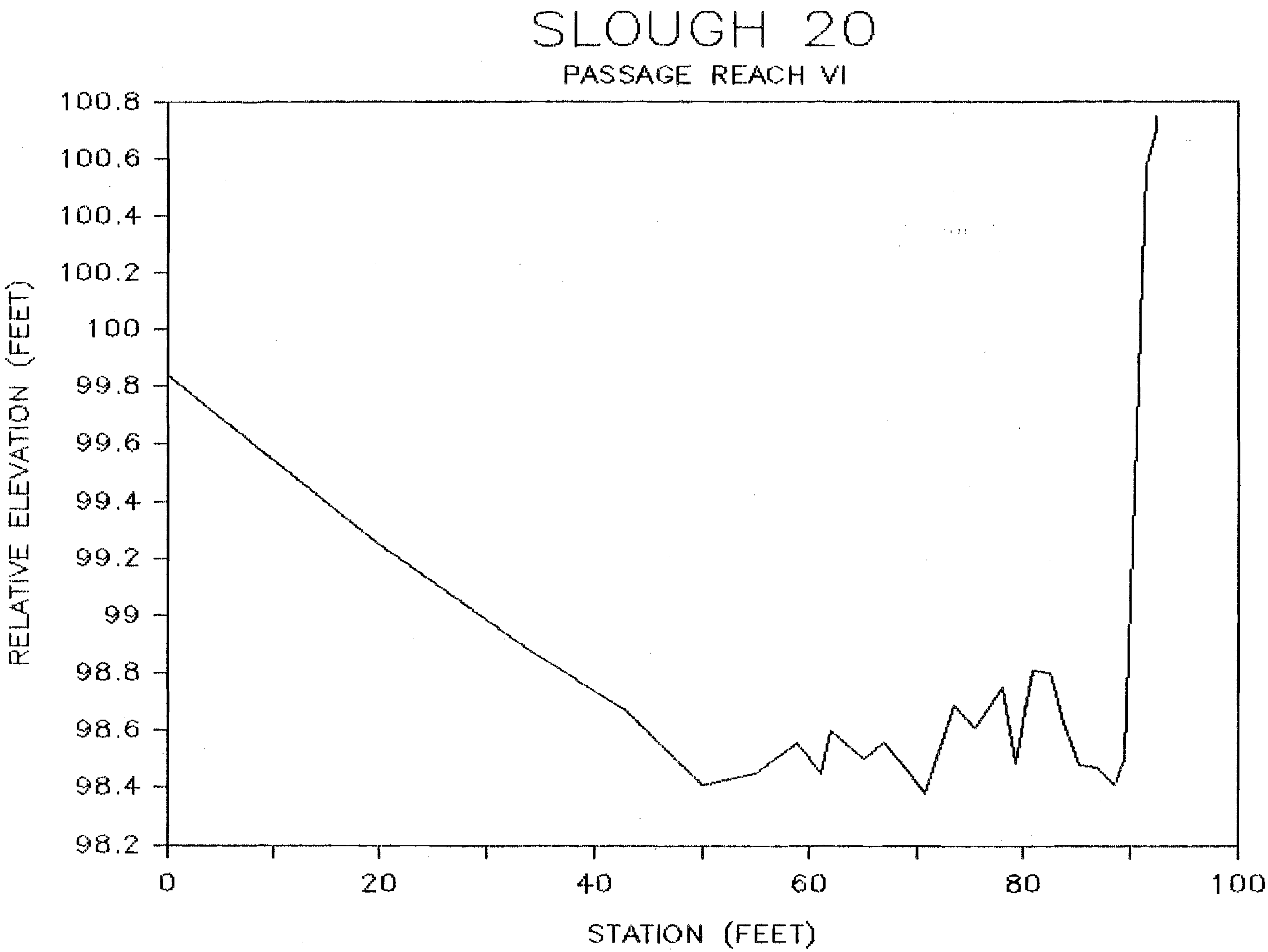
Appendix Figure D-42. Cross sectional profile of Passage Reach VIII in Slough 19, October 17,1984.



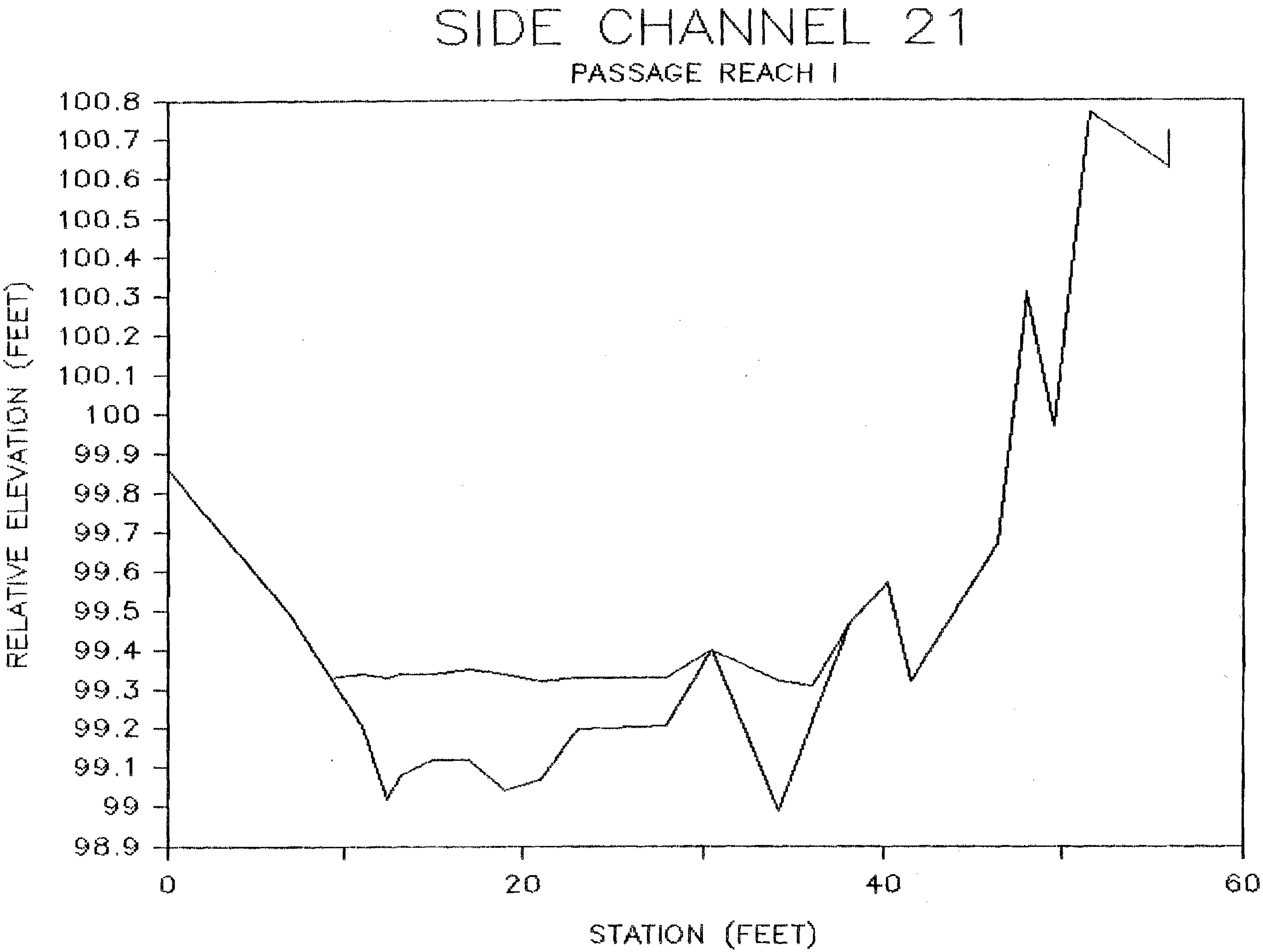
Appendix Figure D-43. Cross sectional profile of Passage Reach IX in Slough 19, October 17,1984.



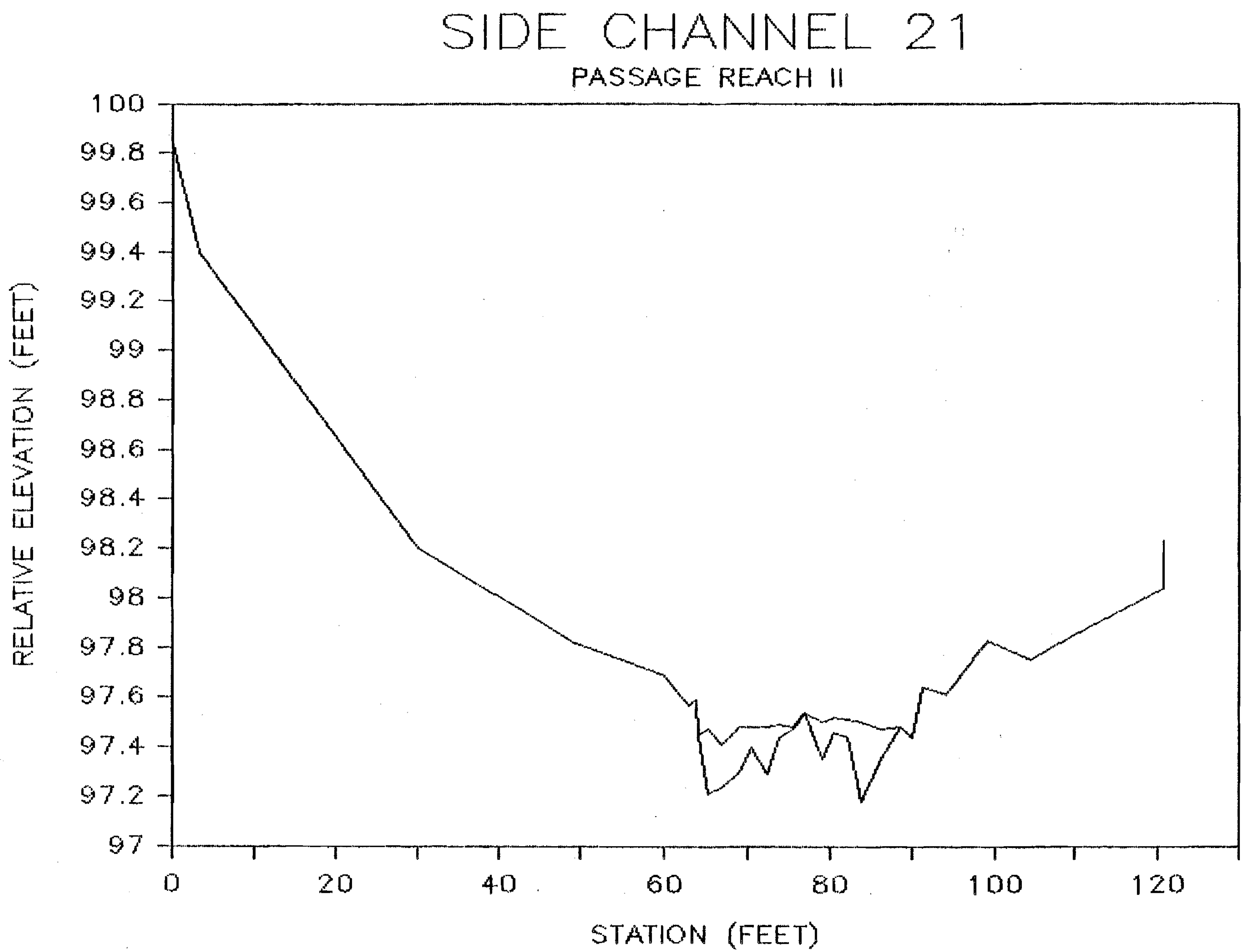
Appendix Figure D-44. Cross sectional profile of Passage Reach I in Slough 20, October 17,1984.



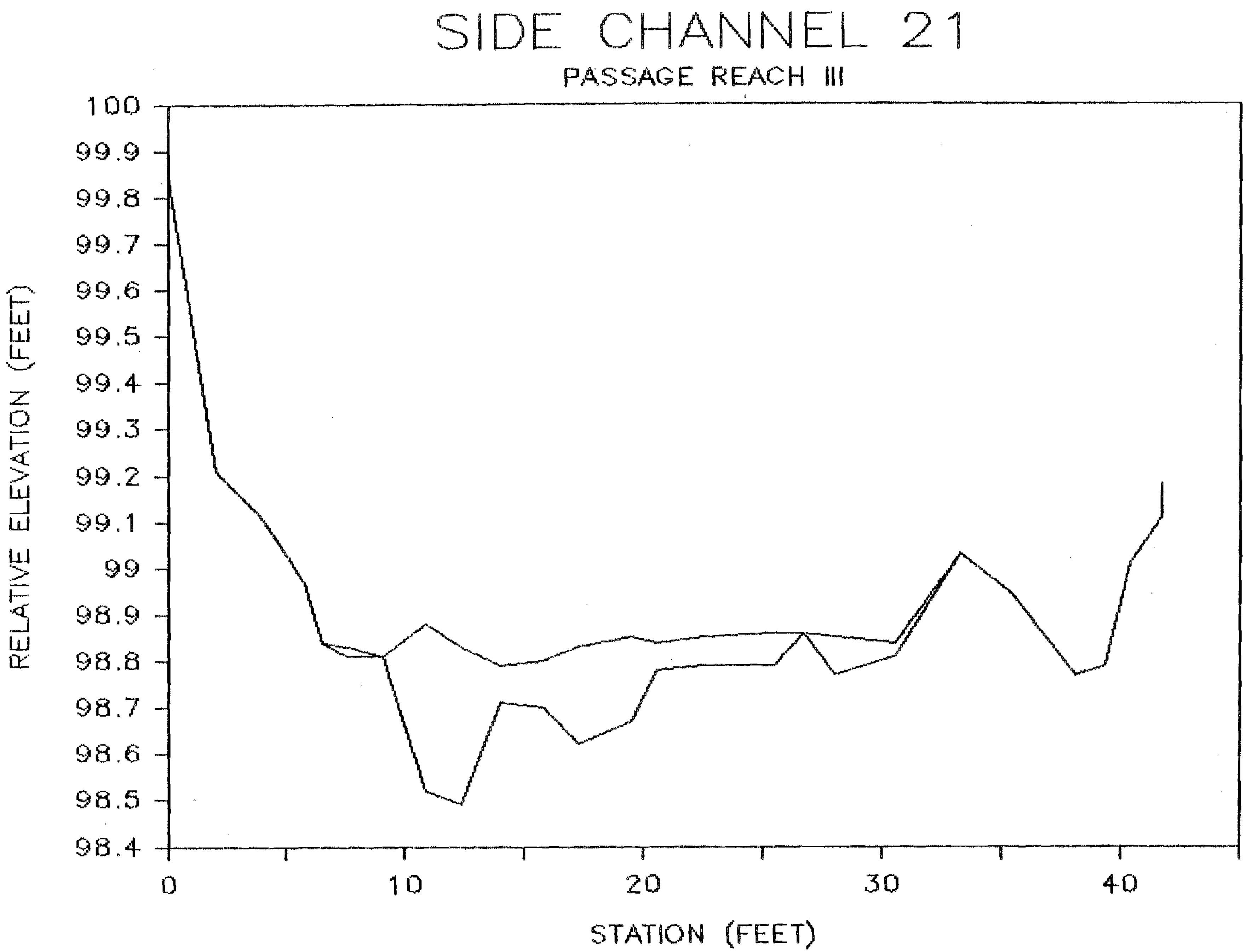
Appendix Figure D-45. Cross sectional profile of Passage Reach VI in Slough 20, October 17,1984.



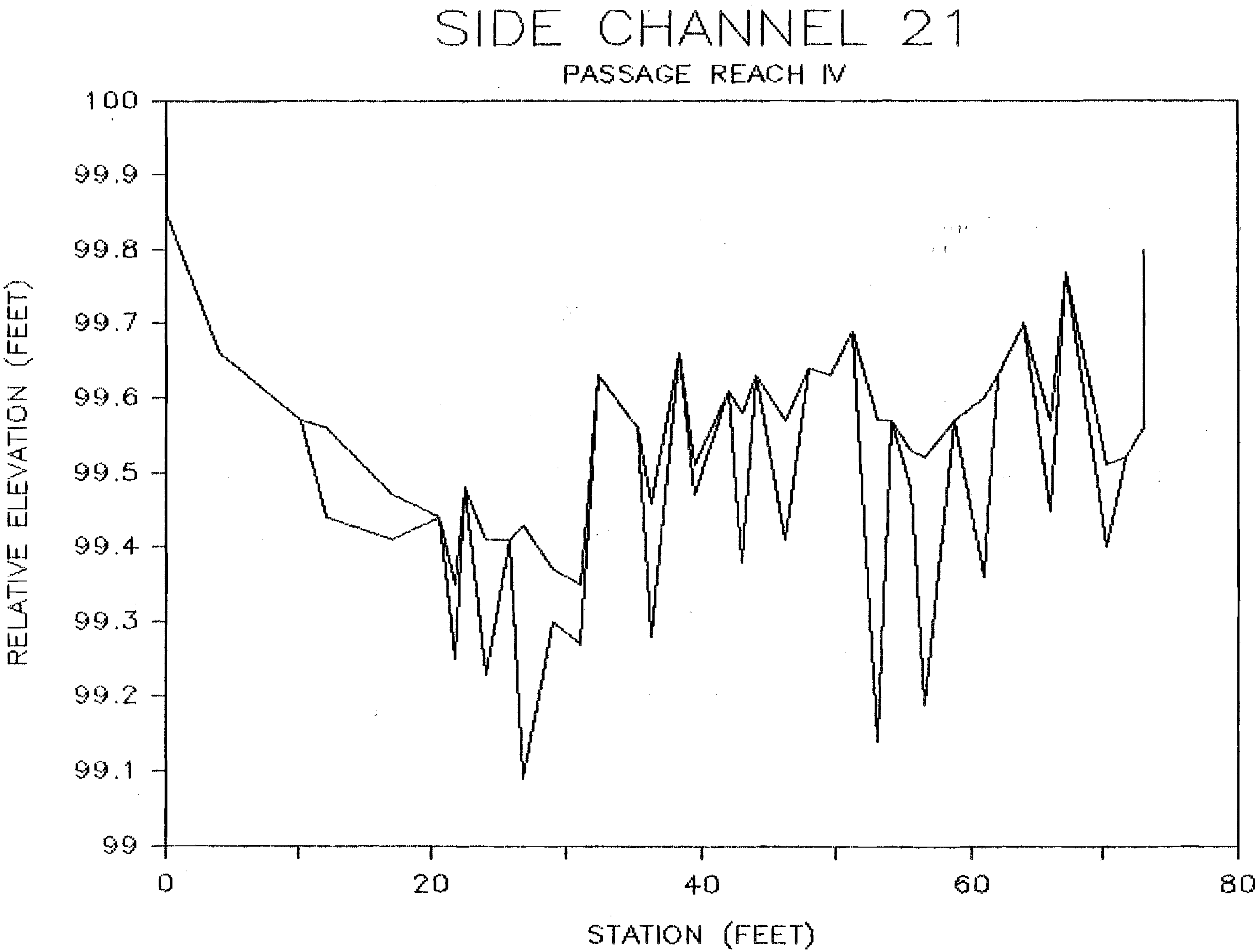
Appendix Figure D-46. Cross sectional profile of Passage Reach I in Side Channel 21, October 16,1984.



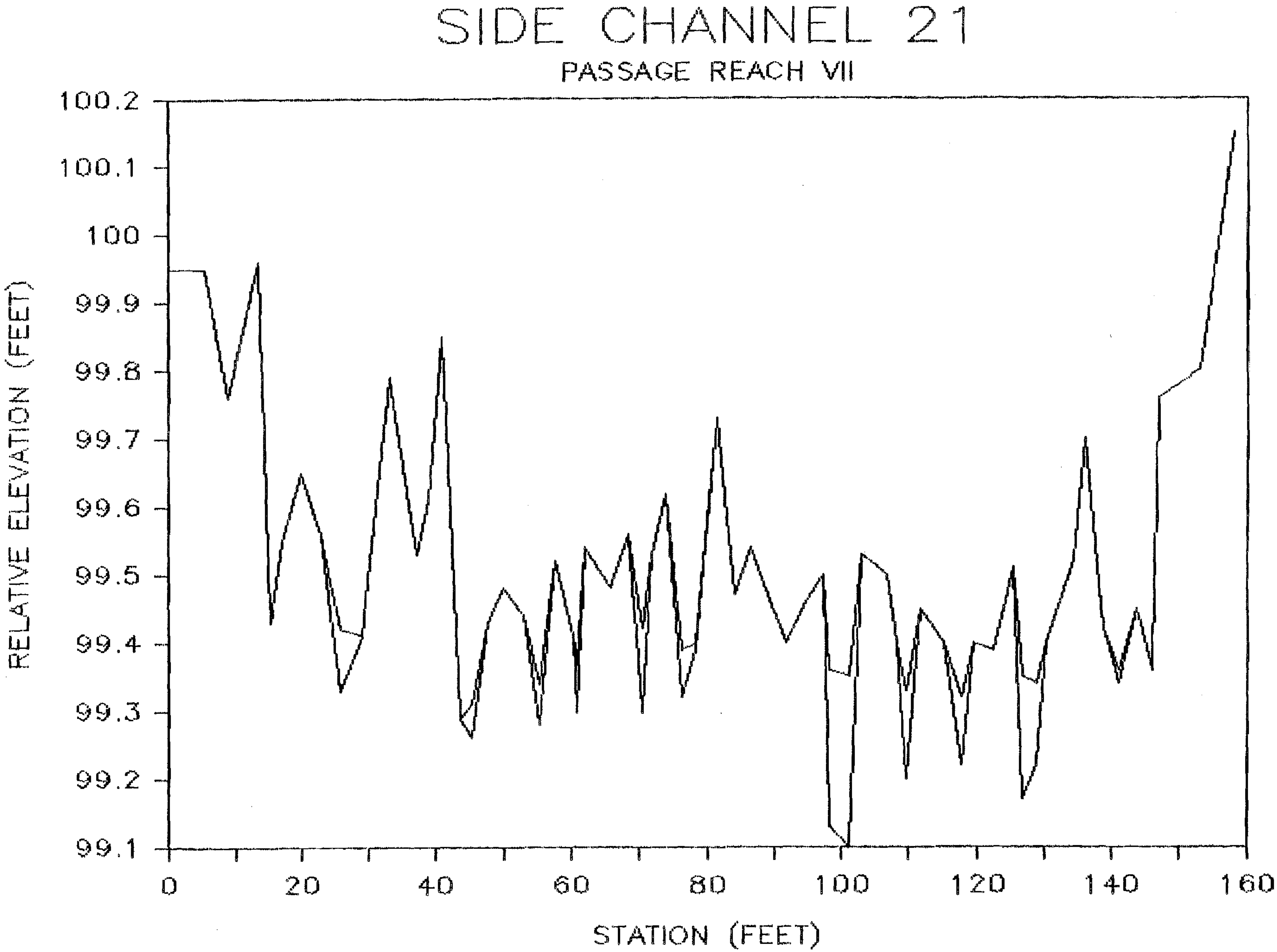
Appendix Figure D-47. Cross sectional profile of Passage Reach II in Side Channel 21, October 16,1984.



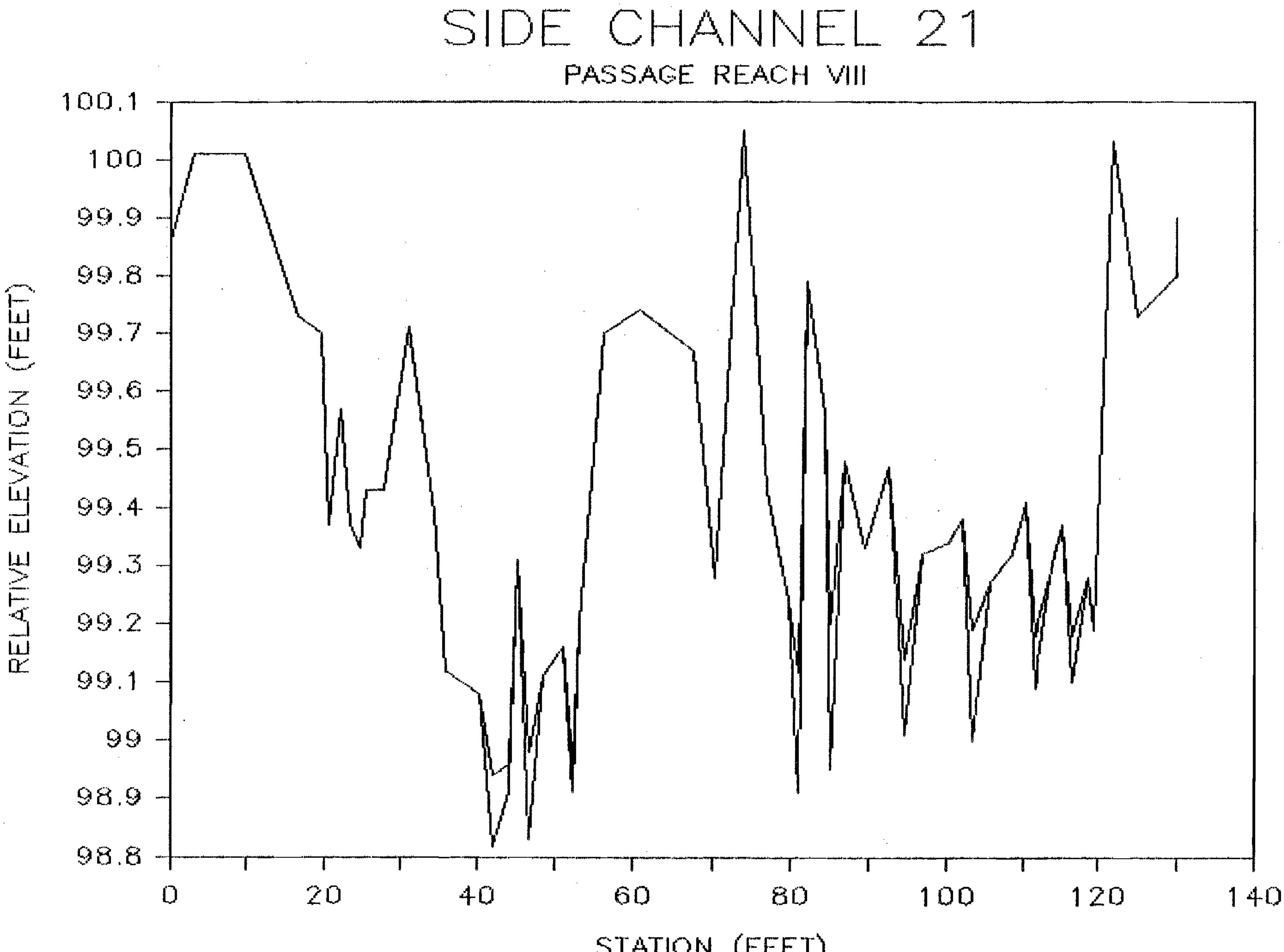
Appendix Figure D-48. Cross sectional profile of Passage Reach III in Side Channel 21, October 16,1984.



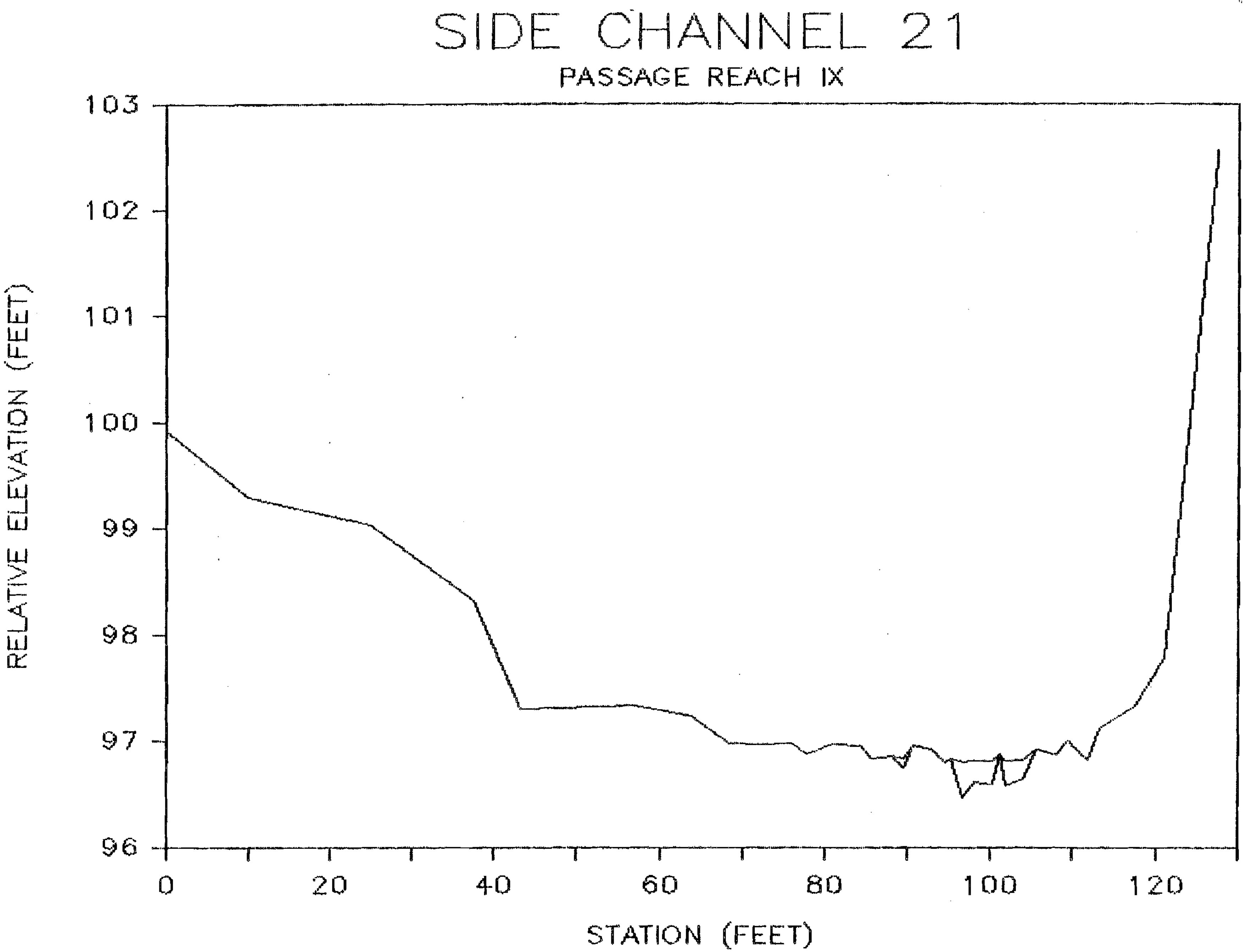
Appendix Figure D-49. Cross sectional profile of Passage Reach IV in Side Channel 21, October 16,1984.



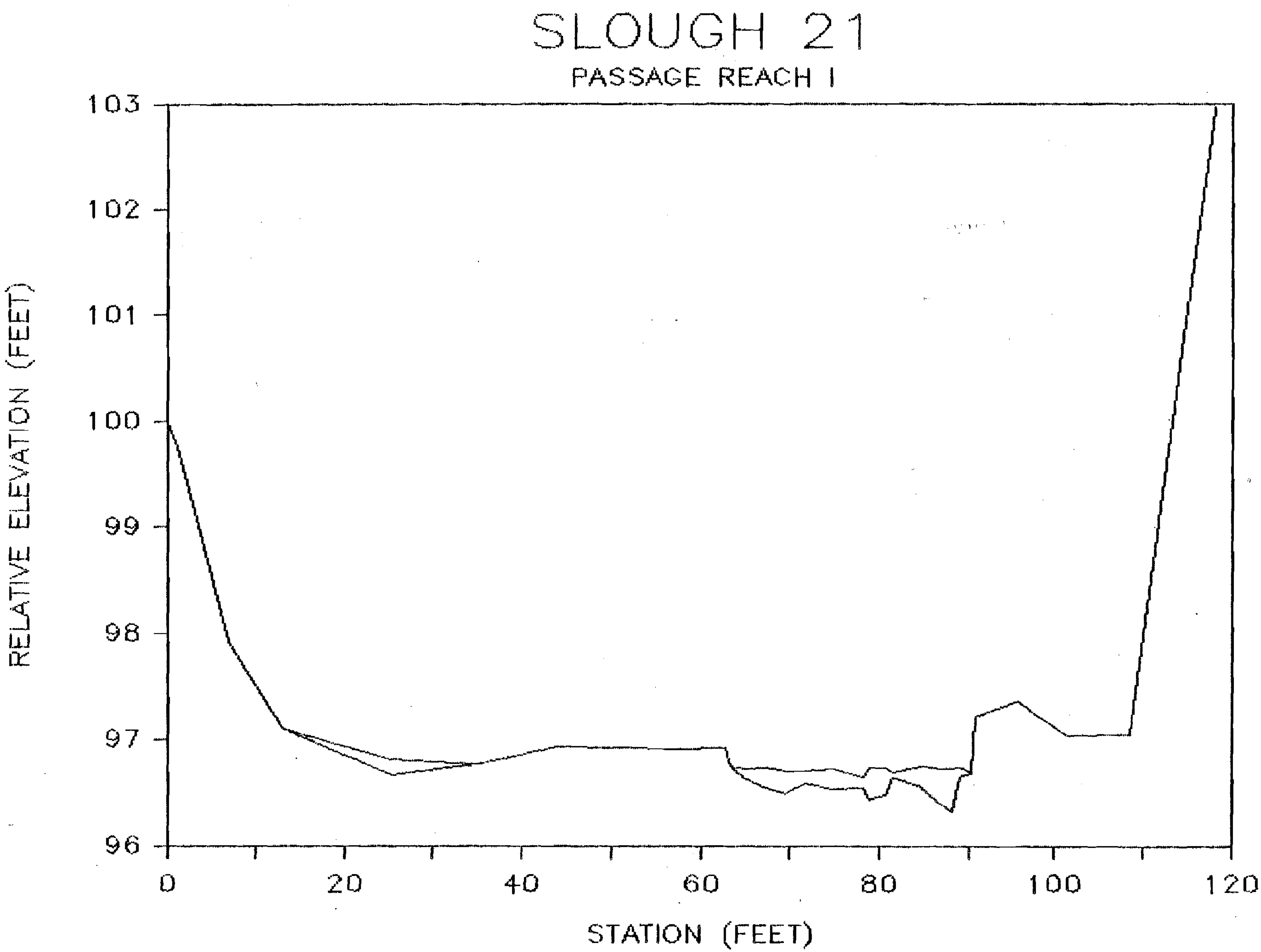
Appendix Figure D-50. Cross sectional profile of Passage Reach VII in Side Channel 21, October 15,1984.



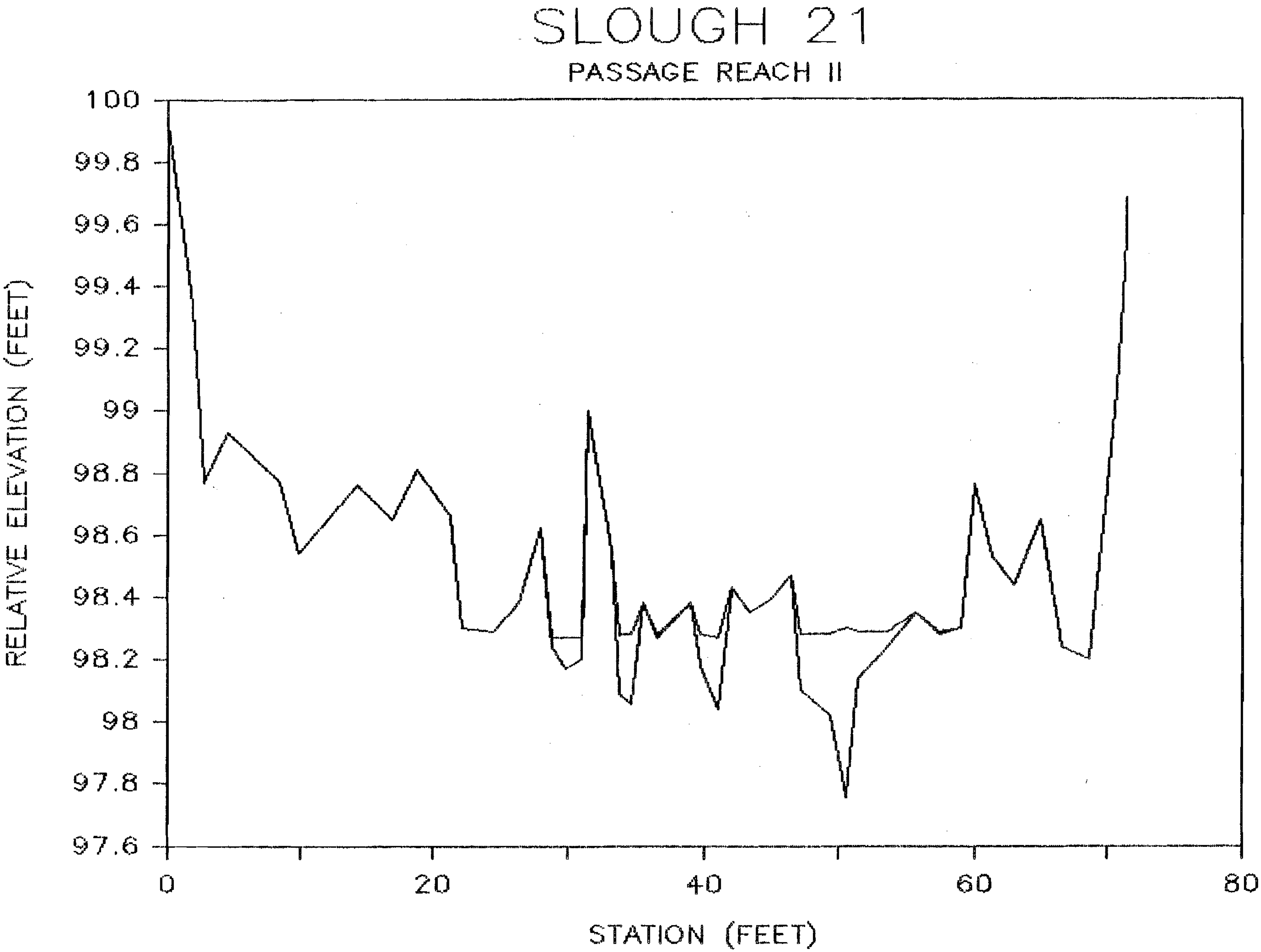
Appendix Figure D-51. Cross sectional profile of Passage Reach VIII in Side Channel 21, October 15,1984.



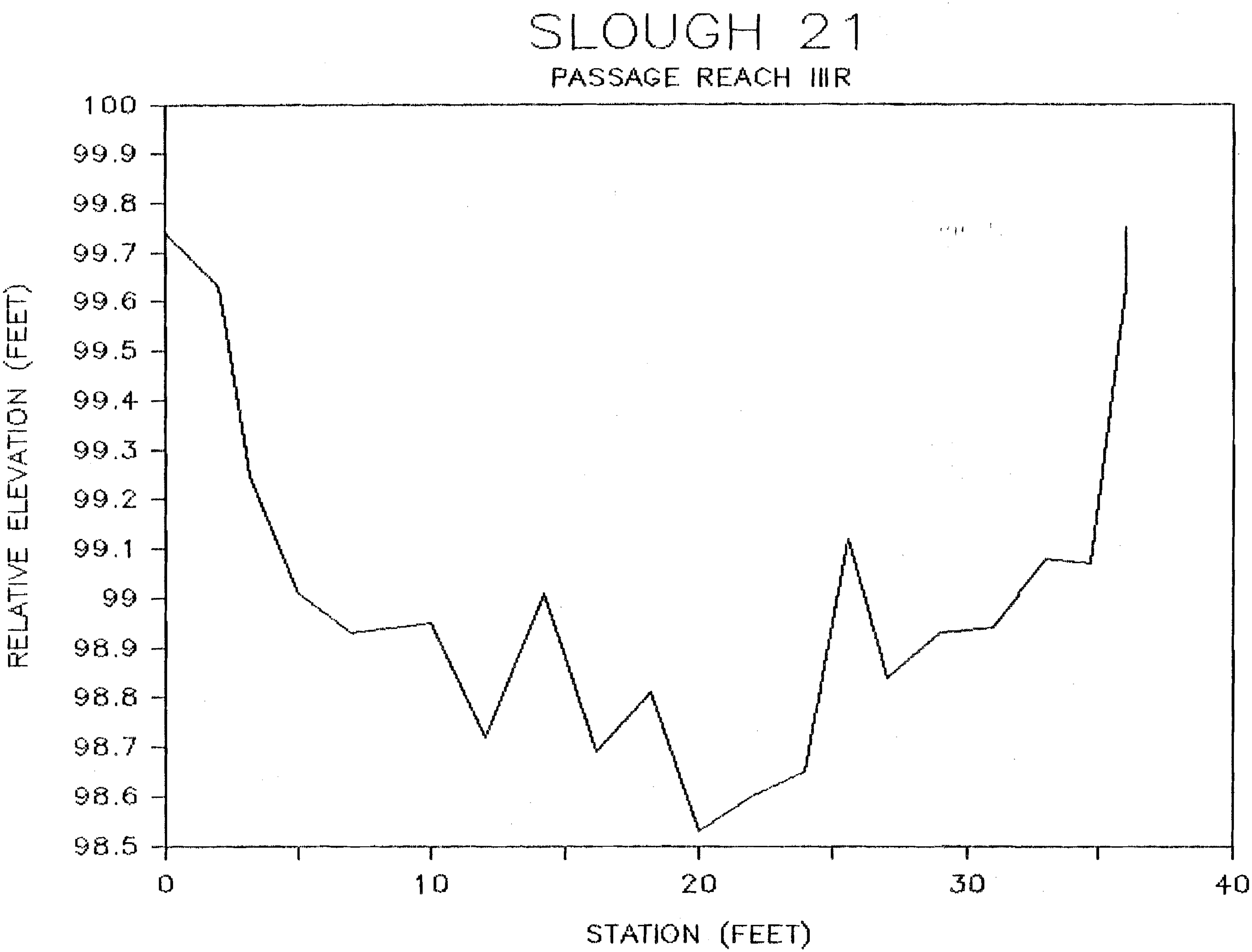
Appendix Figure D-52. Cross sectional profile of Passage Reach IX in Side Channel 21, October 15,1984.



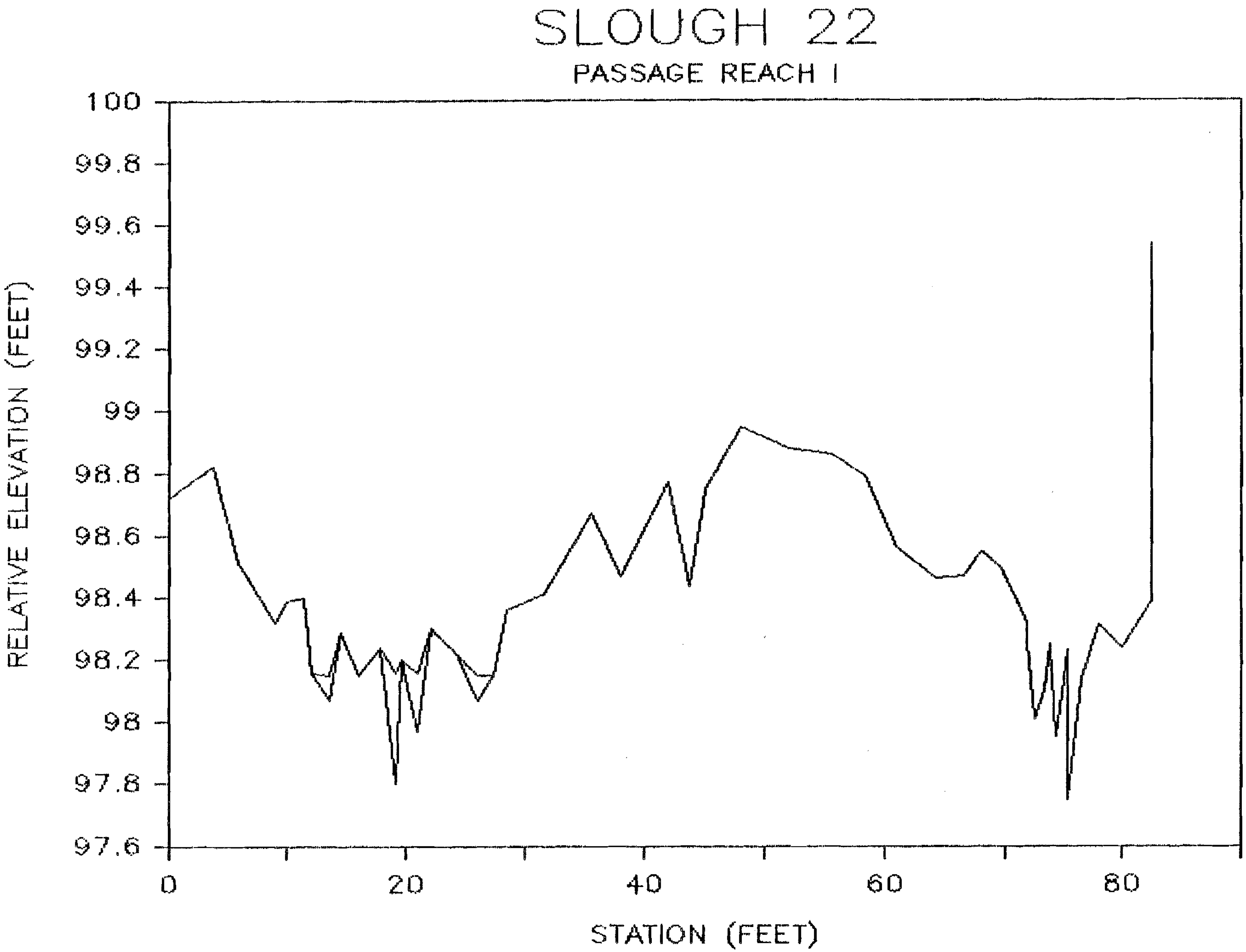
Appendix Figure D-53. Cross sectional profile of Passage Reach I in Slough 21, October 15,1984.



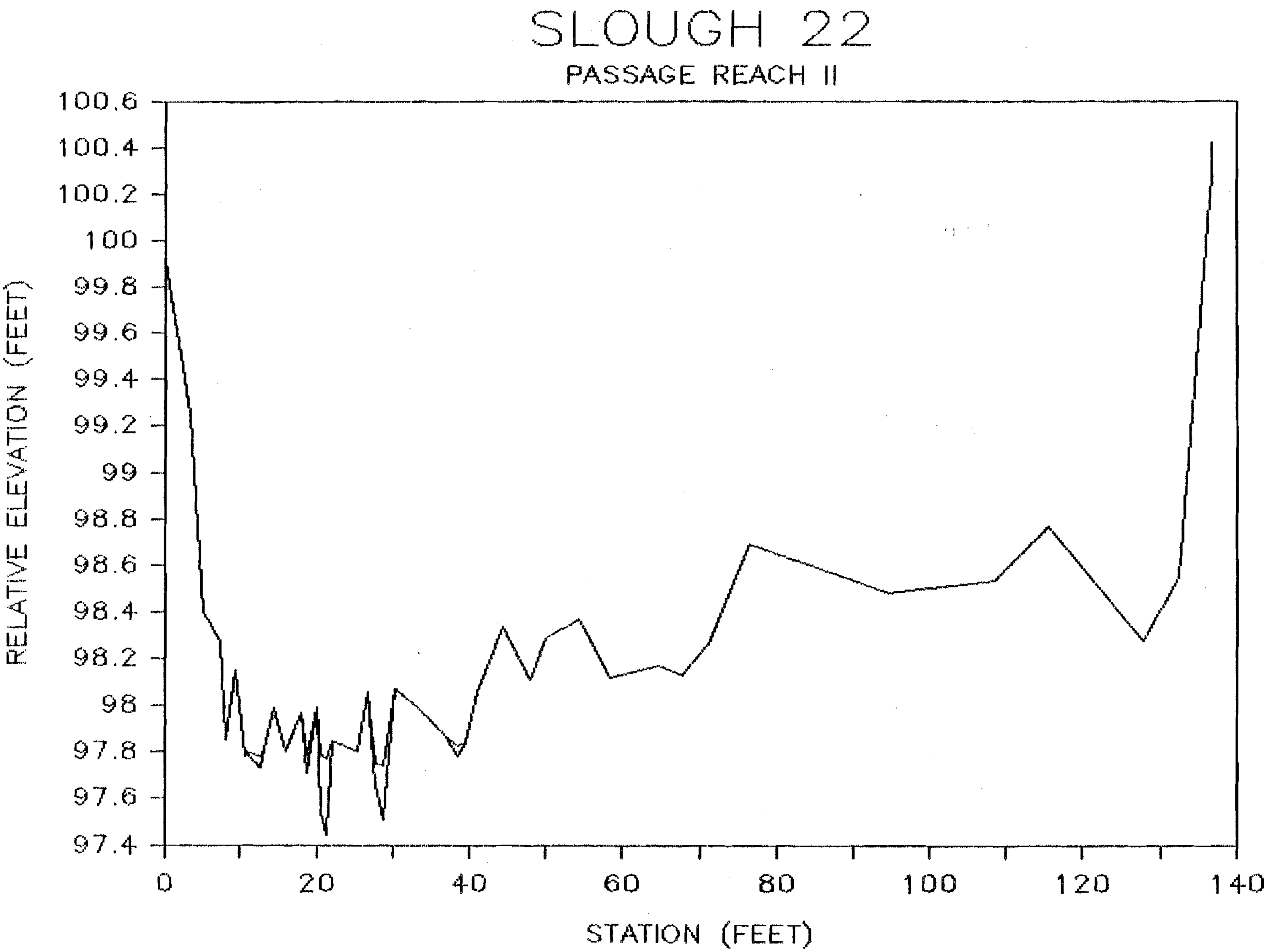
Appendix Figure D-54. Cross sectional profile of Passage Reach II in Slough 21, October 15,1984.



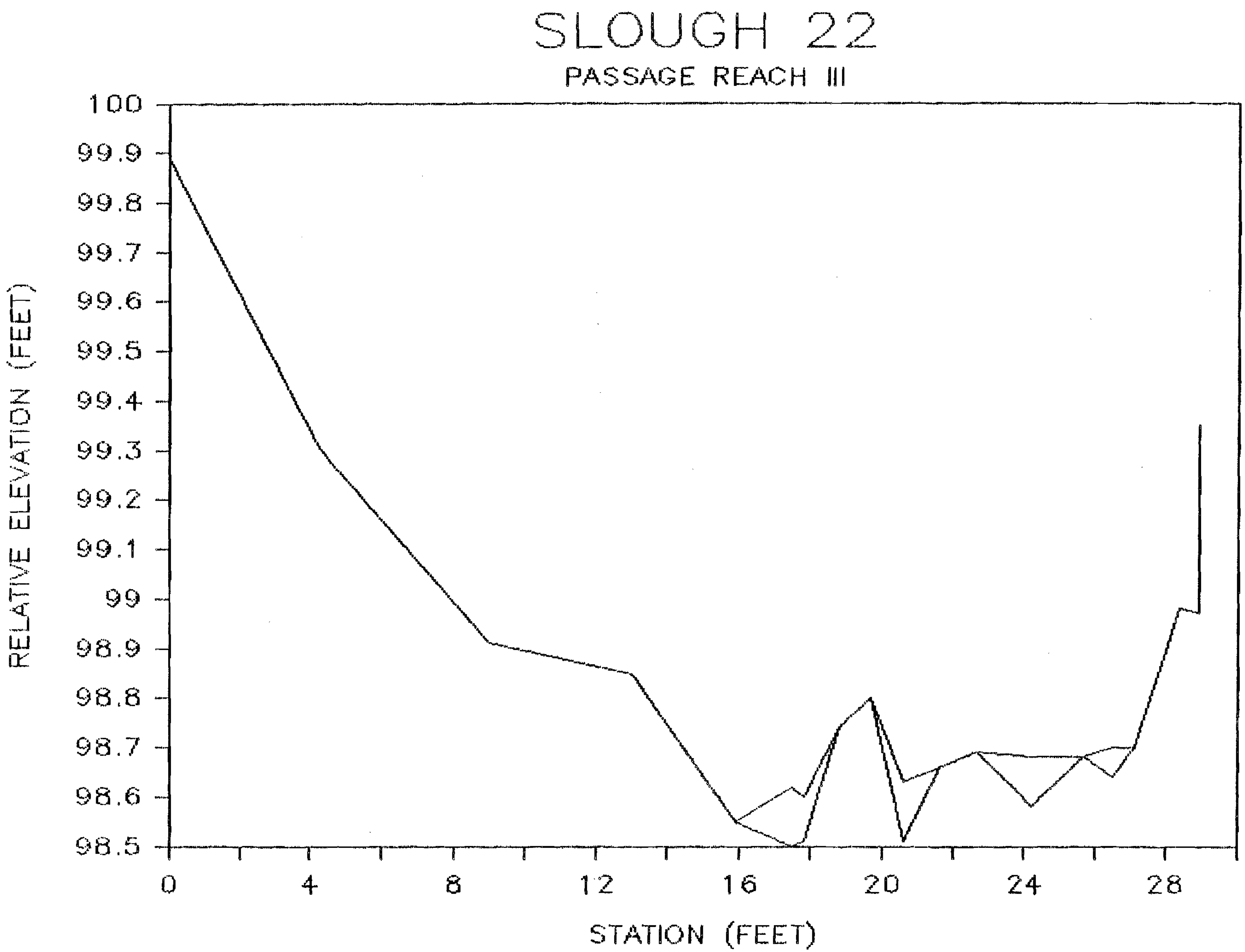
Appendix Figure D-55. Cross sectional profile of Passage Reach IIIR in Slough 21, October 15,1984.



Appendix Figure D-56. Cross sectional profile of Passage Reach I in Slough 22, October 14,1984.



Appendix Figure D-57. Cross sectional profile of Passage Reach II in Slough 22, October 14,1984.



Appendix Figure D-58. Cross sectional profile of Passage Reach III in Slough 22, October 14,1984.

Appendix Table D-59. Summary of lengths and relative water surface elevations upstream and downstream of selected passage reach cross sections collected during the 1984 open water field season.

Site (River Mile)	Passage Reach	Date	Upstream[a] Length (ft)	Upstream[a] Relative WSEL (ft)	Downstream[a] Length (ft)	Downstream[a] Relative WSEL (ft)
Whiskers Creek Slough	I	841004	21	98.89	4	98.60
(101.2)	II	841004	28	99.47	24	99.12
Mainstem 2 Side Channel	I	841005	13	98.97	19	98.85
(114.4)	II	841005	42	98.82	126	98.03
	III	841005	149	100.00	60	98.48
	IVL	841005	244	97.74	66	97.28
	IVR	841005	25	99.93	9	99.63
	VR	841005	213	98.31	30	96.61
	VIR	841005	18	99.13	66	99.08
	VIIR	841004	76	99.10	8	98.56
	VIIIR	841004	182	100.38	136	98.70
Slough 8A	II	841006	21	97.71	208	96.23
(125.3)	IV	841006	52	99.13	64	98.54
	VIL	841006	52	99.79	13	97.42
	VIR	841006	22	99.69	4	99.30
	VIIR	841006	104	99.49	109	97.94
	VIIIR	841007	33	99.63	117	98.11
	IXR	841007	32	99.47	104	98.50
	XR	841007	148	100.63	23	98.76
Slough 9A	I	841008	14	99.51	60	98.36
(133.2)	VI	841008	35	100.35	13	99.39
	X	841008	30	4.95	89	4.39
	XI	841008	168	99.85	35	98.85
Slough 11 (135.3)	I	841018	30	97.99	56	96.64
Slough 19	VI	841017	31	99.05	--	--
(140.0)	VII	841017	21	98.20	45	97.84
	VIII	841017	47	98.32	79	97.89
	IX	841017	88	98.38	20	97.63
Side Channel 21	I	841016	41	99.43	14	94.27
(140.6)	II	841016	22	97.57	7	97.43
	III	841016	18	98.92	45	98.41
	IV	841016	106	100.31	26	99.15
	VIII	841015	20	99.32	30	98.84
	IX	841015	6	96.83	46	96.41
Slough 21	I	841015	88	96.86	75	96.57
(142.0)	II	841015	92	98.37	161	97.57
	IIIR	841015	128	98.86	116	97.37
Slough 22	I	841014	37	98.29	78	96.35
(144.3)	II	841014	12	97.91	64	97.68
	III	841014	97	99.79	60	97.52

[a] Upstream and downstream lengths and relative WSELs were collected simultaneously with the respective cross sectional surveys.

APPENDIX E

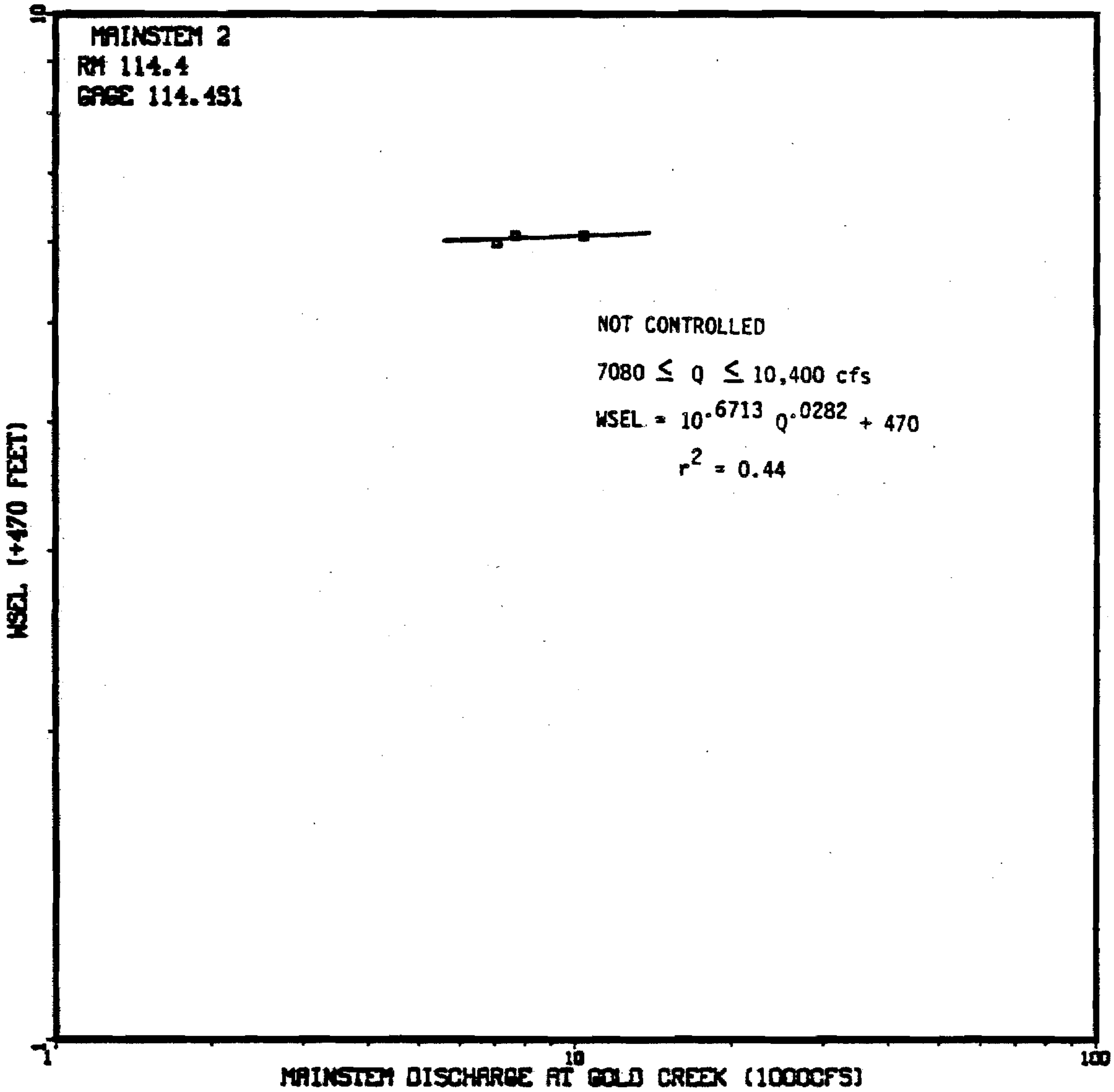
Stage and Discharge Data

APPENDIX E: STAGE AND DISCHARGE DATA

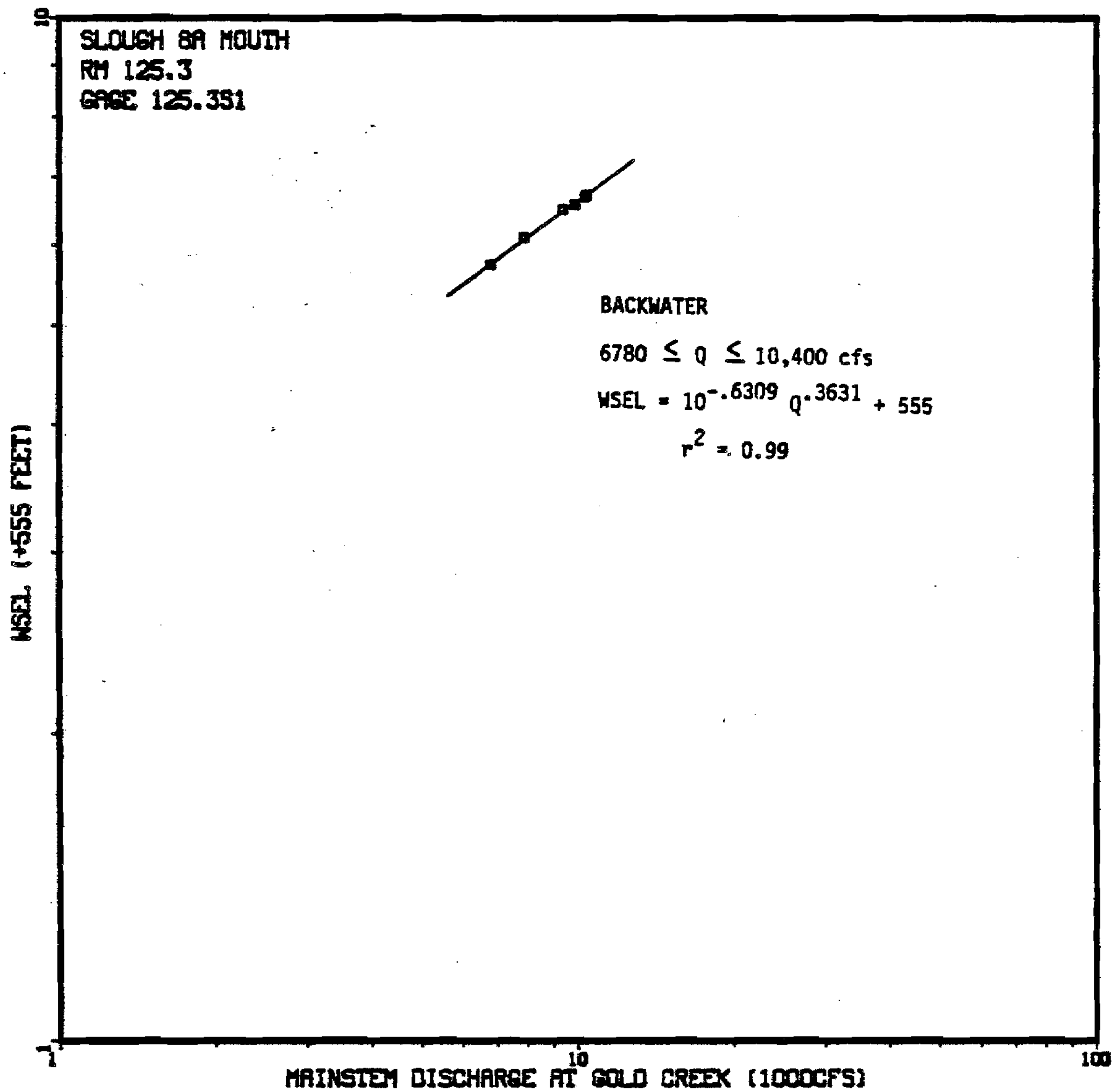
This appendix contains stage and discharge data collected at selected slough and side channel passage study sites in the middle Susitna River. Appendix Table E-1 is a summary of the stage data collected during the 1984 open water season. The rating curves developed for these stage data are presented in Appendix Figures E-1 to E-6. A summary of local flow measurements collected at selected passage study sites is given in Appendix Table E-2.

Appendix Table E-1. Comparison of water surface elevations to the mean daily mainstem discharge (cfs) obtained at the USGS gaging station at Gold Creek (USGS 15292000) during the 1984 open water season.

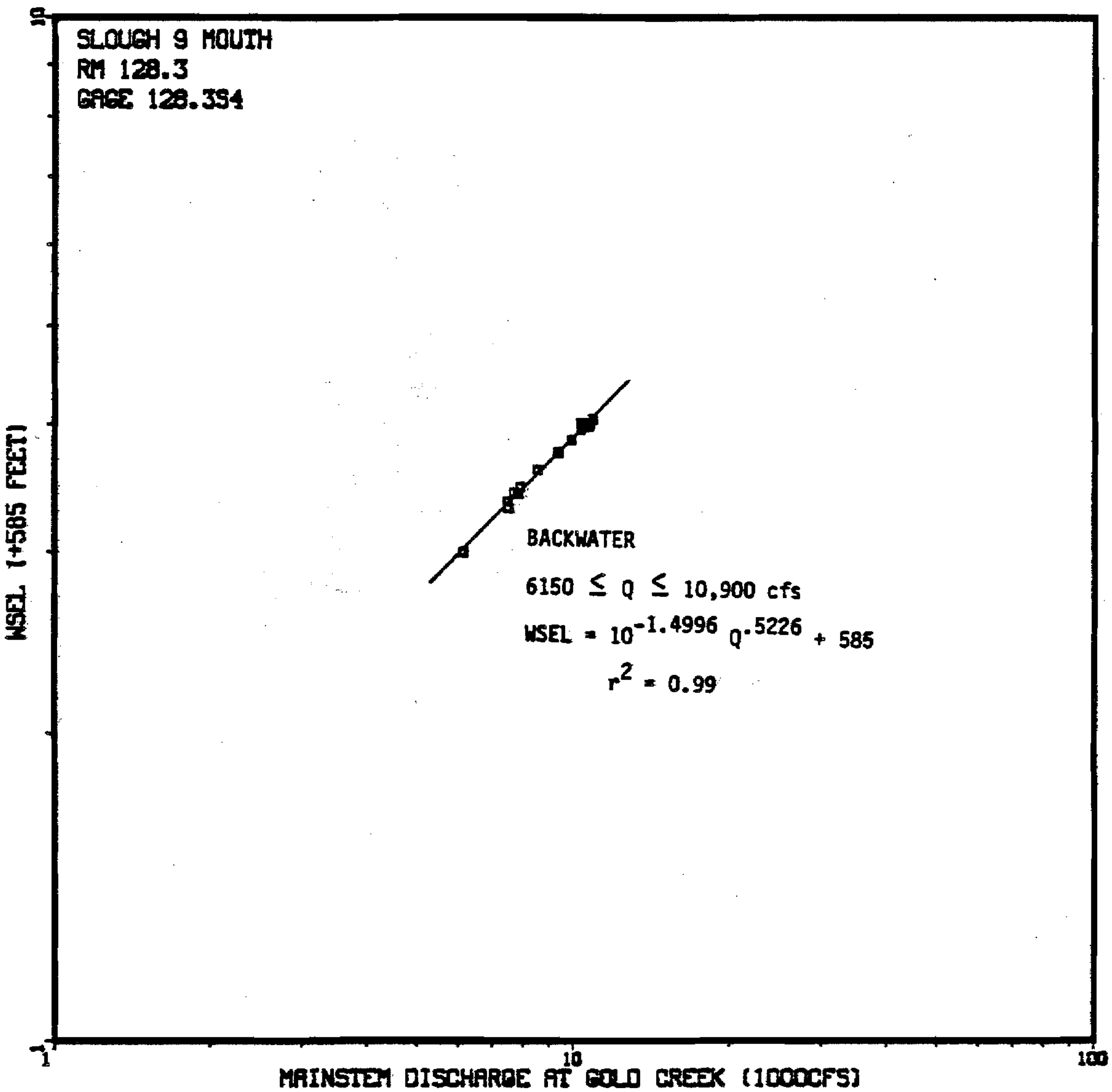
Location	Date	Time	WSEL (ft)	Discharge (cfs)
Mainstem 2	841005	1145	475.99	7,080
(114.4S1 at RM 114.4)	840926	1330	476.08	7,680
	840920	1355	476.08	10,400
Slough 8A Mouth	841006	1128	560.74	6,780
(125.3S1 at RM 125.3)	840925	1500	561.11	7,890
	840919	1520	561.51	9,390
	840910	1609	561.58	9,890
	840922	1415	561.70	10,300
	840920	1630	561.72	10,400
Slough 9 Mouth	841013	1230	588.00	6,150
(128.3S4 at RM 128.3)	840927	1030	588.36	7,470
	840930	1030	588.31	7,500
	840926	0950	588.43	7,680
	841001	1000	588.42	7,830
	840925	1525	588.47	7,890
	840915	1330	588.61	8,520
	840911	1020	588.75	9,330
	840911	1513	588.76	9,330
	840910	1803	588.86	9,890
	840906	1454	588.95	10,300
	840922	1000	589.01	10,300
	840920	1645	589.01	10,400
	840909	1050	589.01	10,600
	840907	1015	588.98	10,700
	840908	0945	589.05	10,900
Slough 9A Mouth	841008	1010	639.69	6,810
(133.2S1 at RM 133.2)	841003	1643	639.71	7,680
	840925	1610	639.72	7,890
	840923	1020	639.74	9,010
	840911	1018	639.75	9,330
	840919	1600	639.78	9,390
	840910	1821	639.79	9,890
	840922	1550	639.87	10,300
	840920	1715	639.96	10,400
	840907	1020	639.96	10,700
	840907	1505	640.00	10,700
Side Channel 21 Mouth	840924	1730	731.61	8,290
(140.6S8 at RM 140.6)	840910	0950	731.96	9,890
	840909	1650	732.13	10,600
	840909	1110	732.14	10,600
	840921	0930	732.39	11,400
Slough 22 Mouth	841001	1335	778.92	7,830
(144.3S7 at RM 144.3)	840924	1345	778.89	8,290
	840908	1515	779.26	10,900
	840921	0945	779.40	11,400



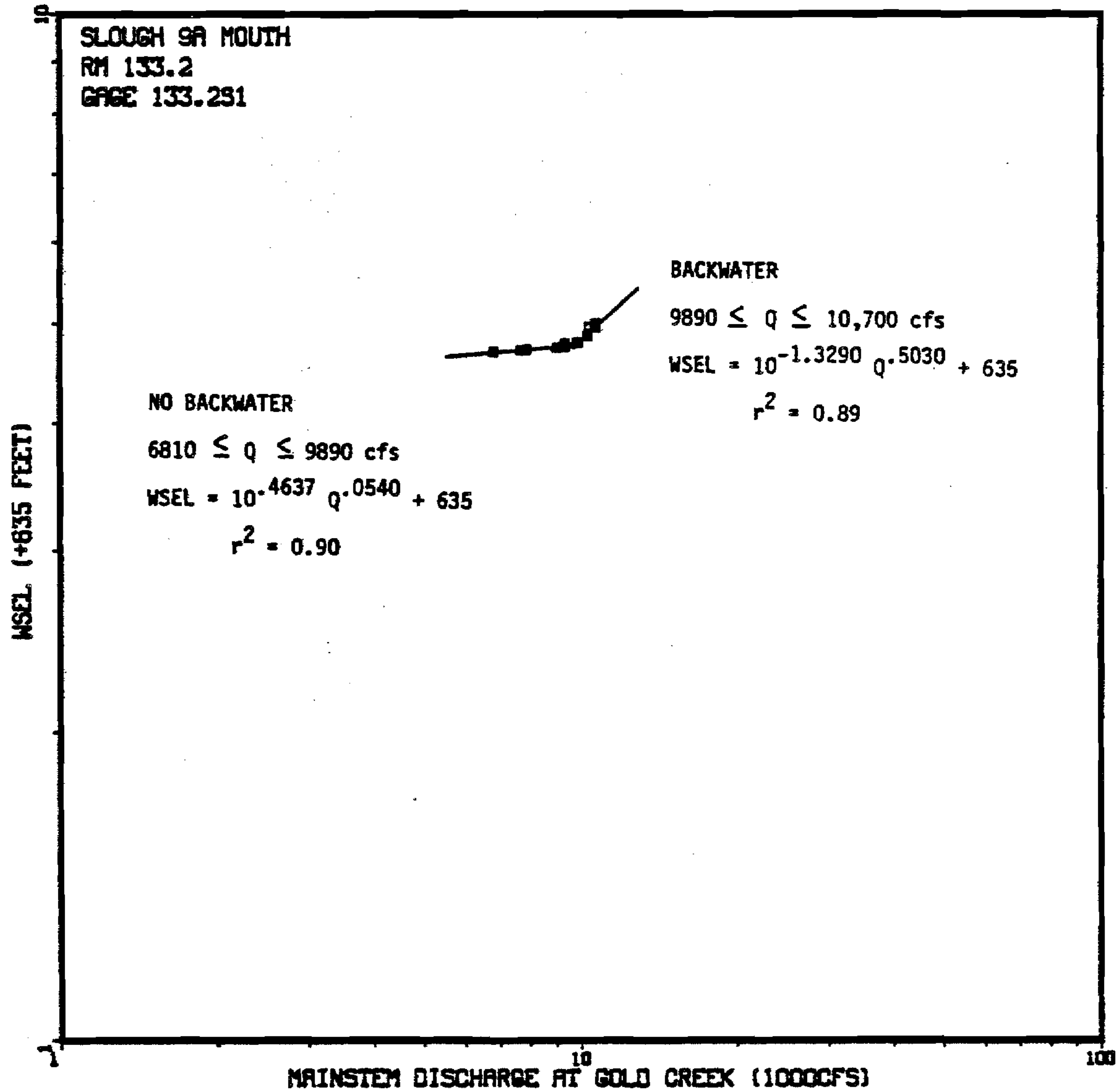
Appendix Figure E-1. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Mainstem 2 Side Channel.



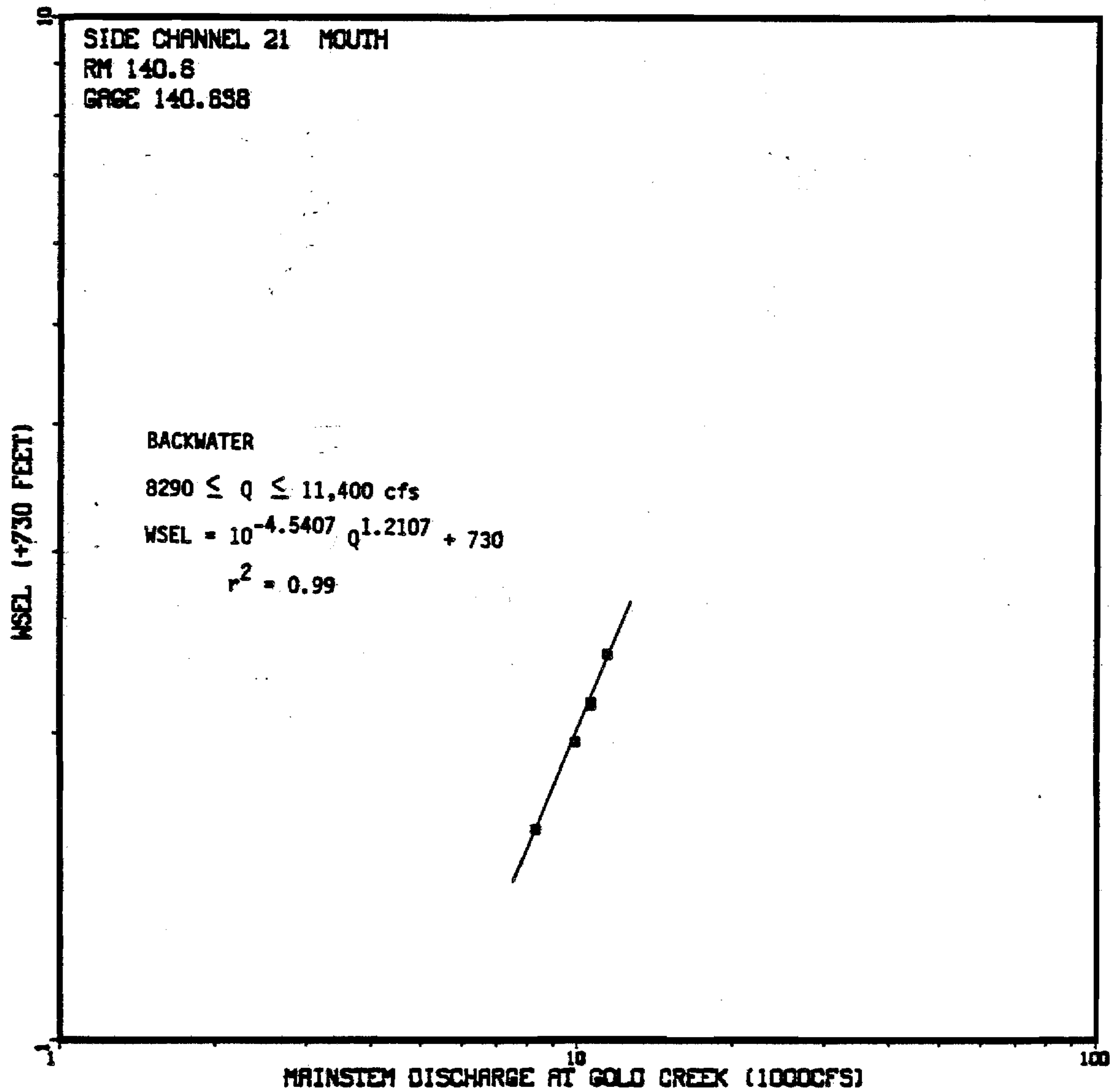
Appendix Figure E-2. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Slough 8A mouth.



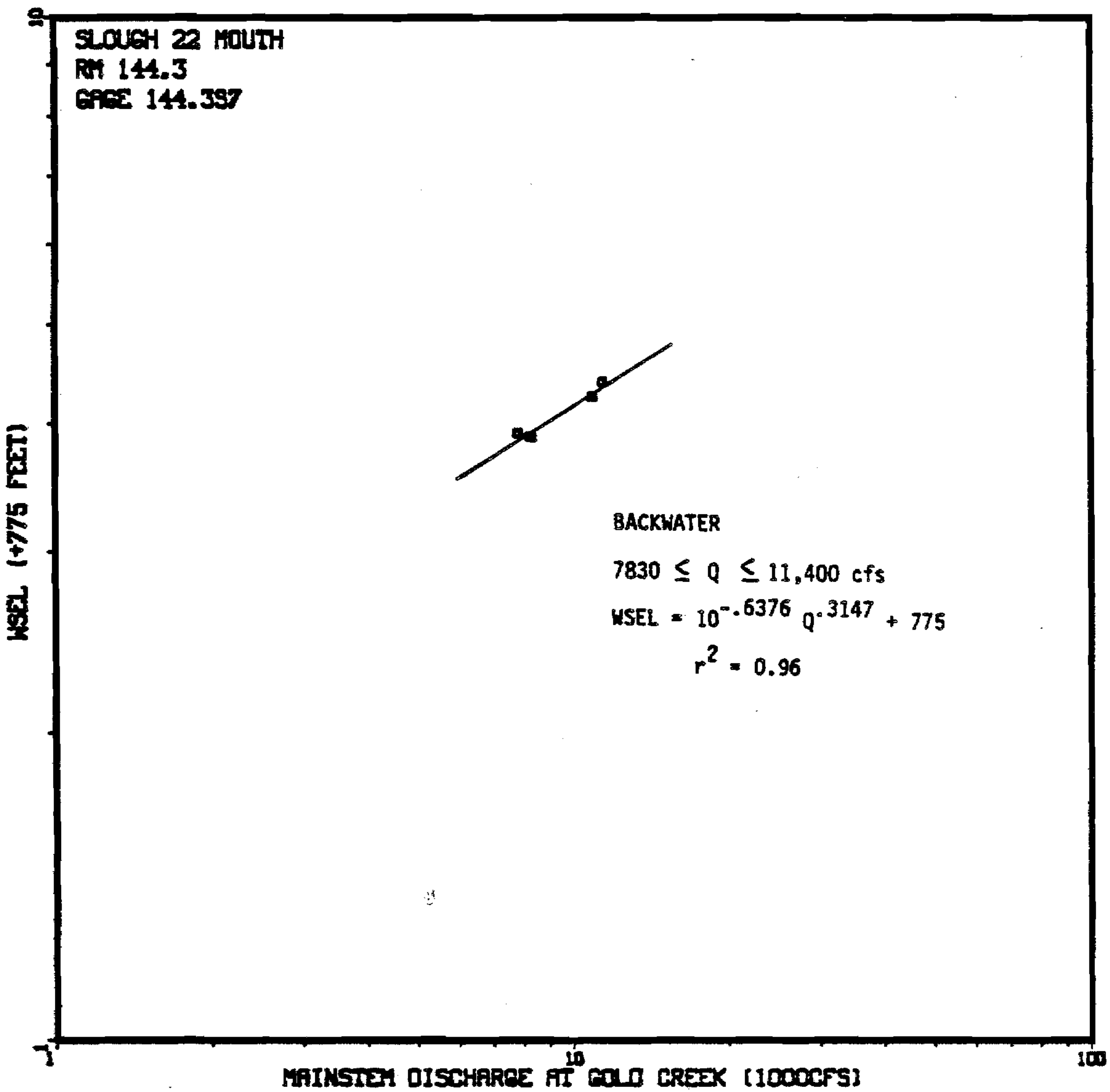
Appendix Figure E-3. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Slough 9 mouth.



Appendix Figure E-4. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Slough 9A mouth.



Appendix Figure E-5. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Side Channel 21 mouth.



Appendix Figure E-6. Mainstem discharge (Provisional USGS 1984) versus the water surface elevation at Slough 22 mouth.

Appendix Table E-2. Comparison of local flow measurements collected at selected slough, side channel and tributary study sites in the middle Susitna River to the mean daily mainstem discharge at Gold Creek (USGS 15292000) during the 1984 open water season.

Location	Date	Time	Measured Flow (cfs)	Mainstem Discharge (cfs)
Whiskers Creek Slough (Downstream of PR I)	841004	1245	11.0	7,380
Whiskers Creek (Upstream of Slough Confluence)	841004	1320	8.1	7,380
Mainstem 2 Side Channel (PR I)	841005	1530	0.5	7,080
Slough 8A (PR VIIR)	841007	1420	0.7	6,630
(PR IV)	841007	1610	0.4	6,630
Slough 9 (PR II)	840911	1550	2.9	9,330
(PR V)	840911	1645	1.1	9,330
Slough 9A (PR II)	840911	1030	4.0	9,330
	841008	1420	2.7	6,600
(PR V)	840911	1150	3.2	9,330
(PR VII)	840911	1350	2.3	9,330
	841008	1510	1.4	6,600
Slough 11 (PR III)	840826	1005	4.3	31,700
(PR IV)	840826	1115	3.1	31,700
(PR VI)	840826	1220	2.1	31,700
Slough 19 (PR VI)	841017	1515	0.1	5,400
Side Channel 21 (PR IX)	841015	1325	2.0	5,800
(PR III)	841016	1630	4.5	5,600
Slough 21 (Upstream of PR I)	841015	1430	1.6	5,800
Slough 22 (PR II)	841014	1610	0.7	6,090