AGUA FRIA RIVER SEDIMENT TRANSPORT STUDY

Carlos C. Carriaga, *Project Manager*
Larry W. Mays, *Principal Investigator*
Paul F. Ruff, *Co-Principal Investigator*

Sponsored by

Flood Control District of Maricopa County
2800 West Durango Street
Phoenix, Arizona 85009

DEPARTMENT OF CIVIL ENGINEERING

College of Engineering and Applied Sciences
Arizona State University
Tempe, Arizona 85287-5306

AGUA FRIA RIVER
SEDIMENT TRANSPORT STUDY

Carlos C. Carriaga, *Project Manager*
Larry W. Mays, *Principal Investigator*
Paul F. Ruff, *Co-Principal Investigator*

Sponsored by

Flood Control District of Maricopa County
2800 West Durango Street
Phoenix, Arizona 85009

Department of Civil Engineering
ARIZONA STATE UNIVERSITY
Tempe, Arizona 85287-5306
February 28, 1994

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF FIGURES (continued...)

LIST OF TABLES

LIST OF TABLES (continued...)

LIST OF TABLES (continued...)

LIST OF TABLES (continued...)

LIST OF TABLES (continued...)

LIST OF TABLES (continued...)

LIST OF TABLES (continued...)

INTRODUCTION

1.1 Purpose of Study

The project is aimed at developing sediment transport models capable of simulating the long-term stream bed profile behavior of the Agua Fria River using the U.S. Army Corps of Engineer's HEC-6 code. Long-term aggradation or degradation under the post-New Waddell Dam conditions are evaluated considering the existing, on-going, and proposed developments along and around the river vicinity. Results of the study can be used as a basis for the development of regulatory management practices for the Agua Fria River flood plain under the post-New Waddell Dam scenarios. The various models to be developed are described as follows:

Model I	Development of a model to evaluate the sediment transport under the existing condition with New Waddell Dam and the Arizona Canal Diversion Channel (ACDC) built;
Model II	Development of a future condition model using the existing condition model (Model I) to reflect the ultimate sand and gravel mining as permitted today; and,
Model III	Development of a future condition model by adding 1000-foot wide channel improvement along the Agua Fria River (wherever applicable) to Model II in order to evaluate the effect of mining sites on the proposed channel.

1.2 Authority for Study

In August, 1991, the Flood Control District of Maricopa County contracted with Arizona State University (ASU) to study the sedimentation processes along the Agua Fria River for a number of development scenarios along the river. The sedimentation study employed the use of the HEC-6 code developed by the **U.S. Army Corps of Engineers (1991).**

1.3 Coordination and Acknowledgments

The hydrologists and engineers from the Flood Control District of Maricopa County (Kofi Awumah, Carol Davis, Joon Hoong Kim, Besian Khatiblou, Tim Murphy, Jan Opstein, John Svechovsky, and Joe Tram) provided valuable advice and guidance towards completing this study.

The efforts put together by students in the Civil Engineering Department, ASU in the field collection, and laboratory analysis of sediment samples from the Agua Fria River provided a very significant contribution to the project. The modeling runs made by Hasan Mushtaq and Tom Shedden during the evaluation and selection process of sediment transport functions, and the help extended by David Boggs on the hydrologic analysis, plotting of gradation curves, compilation of data, and reviews of previous works on the Agua Fria River help bring the project to the defined goal.

Overall, the project could have not attained the level it had reached without the expertise provided by Dr. Michael McGee and Mr. William A. Thomas of the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, CA; and the guidance of Prof. Larry W. Mays and Prof. Paul F. Ruff of the Civil Engineering Department, ASU, who oversaw the project until its completion.

II THE AGUA FRIA RIVER

2.1 Scope of the Study

The study covers the 34-mile reach of the Agua Fria River. The downstream limit is the Gila River (designated as Mile 0.00) and the upstream limit is the existing Waddell Dam (designated as Mile 33.30). The watershed area of the river is estimated at about 2,340 mi^2 **(U.S. Army Corps of Engineers, 1968).**

2.2 Physical Characteristics

The Agua Fria River flows intermittently and begins in the Prescott National Forest within Yavapai County. The flows are stored at the New Waddell Dam [Mile 33.30] which impounds Lake Pleasant. The river meanders southwardly until its confluence with the Gila River.

2.2.1 River Geometry

The channel geometry of the entire 34-mile river reach was physically described using the 450 cross-sections developed for the floodplain study by **Jerry R. Jones & Assoc., Inc. (1989).** The cross-section data is comprised of paired coordinates of ground elevation and station that run laterally from the left flood plain (or overbank) then across the main channel and terminates at the end of the right flood plain. Considering the capability of the most recent version of HEC-6 code **(US Army Corps of Engineers, 1991)**, 96 cross-sections were selected to define the geometry and physical characteristics of the river. **Table 2.1** lists the selected cross-sections that were used based on the following criteria in the selection process:

(1) Cross-sections that have an extensive number of observation points.
(2) Cross-sections were selected or identified so that a fairly reasonable reach length was maintained. The following considerations were used: (i) about six to ten times the channel width for cross-sections other than those at bridge locations [see **Table 2.2** for the bridge locations along the river]; and, (ii) about one to five times the river width at bridge locations.
(3) Cross-sections that demonstrate consistency (e.g., current data were compared with those data obtained in the previous years by plotting their cross-sections).
(4) Cross-sections that may be under supercritical or critical conditions.
(5) Cross-sections where sediment data are available.
(6) Cross-sections which are considered to be of particular interest.

Table 2.1- The selected stations for the Agua Fria River

No.	Mile No.	Criteria Used	Approximate Location/Descriptions
1	0.160	6	Most downstream station
2	0.440	1	
3	0.730	1	
4	1.330	5,6	Broadway Road
5	1.710	1,5	About 0.5 mile south of Lower Buckeye Road
6	2.020	1	
7	2.600	5,6	Lower Buckeye Road
8	2.800	6	
9	3.270	5	About 0.5 mile south of Buckeye Road
10	3.400	4,6	
11	3.430	2	
12	3.729	2	
13	3.734	6	Buckeye Road Bridge, East bank levee starts
14	3.757	2	
15	3.767	6	South Pacific Railroad Bridge
16	4.094	4	
17	4.270	1,5	About 0.5 mile south of Van Buren Road
18	4.700	2	
19	4.754	5,6	Van Buren Road Bridge
20	4.790	4	
21	5.150	4	
22	5.290	5,6	Interstate 10 Bridge
23	5.380	2	
24	5.689	1,5,6	McDowell Road Bridge
25	5.750	5	
26	5.900	5	
27	6.430	5	About 0.50 mile south of Thomas Road
28	6.890	4	
29	6.990	5	
30	7.490	5	About 0.5 mile south of Indian School Road
31	8.000	6	Indian School Road Bridge
32	8.100	6	East bank levee ends
33	8.210	1	
34	9.130	5,6	Camelback Road Bridge
35	9.900	4,1	
36	10.530	1	
37	10.720	5	About 0.5 mile south of Glendale Avenue
38	11.010	1,2	
39	11.340	5,6	Glendale Avenue Bridge
40	11.520	4	
41	11.800	5	About 0.50 mile north of Glendale Avenue
42	12.380	4,5	Northern Avenue
43	13.330	5,6	Olive Avenue
44	13.810	2	
45	14.380	5	Peoria Avenue
46	14.850	4	
47	14.940	5	About 0.5 mile north of Peoria Avenue
48	15.320	1	

Table 2.1- The selected stations for the Agua Fria River (continued..)

No.	Mile No.	Criteria Used	Approximate Location/Descriptions
49	15.510	4	Cactus Road
50	15.980	5	About 0.5 mile north of Cactus Road
51	16.420	6	Grand Avenue Bridge
52	16.446	6	
53	16.450	5	San Fe Railroad Bridge
54	16.910	4	
55	17.380	1,2	
56	17.760	5	Greenway Road
57	18.240	4	
58	18.920	5,6	Bell Road Bridge
59	19.440	5	
60	19.890	5	
61	20.450	5	
62	20.920	2	
63	21.010	6	
64	21.420	1	
65	21.760	4,5	
66	22.320	5	
67	22.790	5	
68	23.350	5	Pinnacle Peak
69	23.890	5	About 0.50 mile south of Happy Valley Road
70	24.350	5	Happy Valley Road
71	24.540	4	
72	24.900	5	About 0.5 mile south of Jomax Road
73	25.370	6	
74	25.590	2	Jomax Road
75	25.860	4	
76	26.290	5	About 0.5 mile north of Jomax Road
77	26.730	4,5	
78	27.030	4	
79	27.680	5	Dixileta Drive
80	28.120	5	About 0.5 mile north of Dixileta Drive
81	28.670	5	Lone Mountain (About 1.0 mile south of CAP Canal)
82	29.040	5	About 0.5 mile south of CAP Canal
83	29.540	6	
84	29.611	4,6	Beardsley Canal Flume
85	29.800	5	CAP Canal
86	30.070	4	
87	30.260	5	About 0.5 mile north of CAP Canal
88	30.820	5	
89	31.390	5	About 0.5 mile north of Carefree Road
90	31.860	5	Cloud Road
91	32.430	5	About 0.5 mile south of Highway 74
92	32.860	4	
93	32.984	4,5,6	Highway 74 Bridge
94	32.998	4	
95	33.410	2	
96	33.820	6	Most upstream station

Table 2.2 - Bridge locations along the Agua Fria River

No.	Bridge Location	Mile Designation
1	Buckeye Road	Mile 3.734
2	South Pacific Railroad	Mile 3.767
3	Van Buren Road	Mile 4.754
4	Interstate 10 (I-10)	Mile 5.290
5	McDowell Road	Mile 5.689
6	Indian School Road	Mile 8.000
7	Camelback Road	Mile 9.130
8	Glendale Avenue	Mile 11.340
9	Olive Avenue	Mile 13.330
10	Grand Avenue	Mile 16.420
11	Santa Fe Railroad	Mile 16.450
12	Bell Road	Mile 18.920
13	Beardsley Canal Flume	Mile 29.611
14	Highway 74	Mile 32.984

2.2.2 Sediment Characteristics

Typical to alluvial rivers or streams, the characteristic description of the sediments at the Agua Fria River is generally coarser at the upstream river end and finer at the downstream end. This general description could be attributed to the movement of sediments in the form of wash-loads and finer aggregates that are transported downstream during flood events. Normally, sediment data are presented in size distribution plots called gradation curves. The sediment information compiled for the Agua Fria River are listed in **Table B-1** and their respective gradation curves are presented in **Appendix B.**

2.2.3 Hydrology

2.2.3.1 Flood Hydrographs - The 100-year hydrographs for the Agua Fria River at the confluence with the New River (Mile 9.87) were developed by **Water Resources Associates, Inc. (1986)**. Also the same study provided a 100-year hydrograph for the Arizona Canal Diversion Channel (ACDC) at the New River which is the major tributary of the Agua Fria river.

2.2.3.2 Flood Frequency - The flood insurance study for the Agua Fria River was conducted in 1988 of which a flood frequency curve was presented. The peak discharge-flood frequency relationships were provided by the U.S. Army Corps of Engineers (COE) **[Jerry R. Jones & Associates, Inc., 1989]**. The summary of discharges for 10- 25-, 50-, 100-, and 500-year discharges at various locations along the 34-mile river are tabulated in **Table 2.3.**

Table 2.3 - Design flood discharge at the Agua Fria River [Waddell Dam to Gila River for existing conditions]

Location Along the Agua Fria River	Peak Discharge (cfs) 10-yr	25-yr	50-yr	100-yr	500-yr
Inflow - Waddell Dam	60,000	90,000	110,000	135,000	190,000
Outflow-Waddell Dam [Mile 33.25]	60,000	90,000	110,000	135,000	182,000
Bell Road [Mile 18.91]	37,000	60,000	87,000	115,000	182,000
U/S New River Confluence [Mile 9.90]	30,000	48,000	66,000	90,000	177,000
D/S New River Confluence [Mile 9.81]	32,000	50,000	69,000	95,000	184,000
Camelback Road [Mile 9.375]	31,000	50,000	69,000	95,000	184,000
Indian School Road [Mile 8.03]	30,000	49,000	69,000	94,000	183,000
McDowell Road [Mile 6.34]	29,000	48,000	68,000	91,000	182,000
I-10 Freeway [Mile 5.39]	29,000	48,000	68,000	91,000	181,000
Avondale	28,000	47,000	67,000	90,000	179,000
Gila River Confluence [Mile 0.00]	27,000	47,000	67,000	89,000	179,000

[Source: U.S. Army Corps of Engineers, 1981]

2.2.3.3 Stage-Discharge Rating Data - Due to insufficiency of field data to relate water surface elevation with discharge at the most downstream control point of the river, a rating curve was generated using the slope-area method. **Appendix C** lists the stage-discharge rating data at the most downstream stations (i.e., stations 0.16, 0.25, 0.35, 0.44, and 0.54) determined from the use of the method. A number of energy gradients, S_e, were used to show that at some distance upstream [from the most downstream station 0.16], the water surface elevation converges [see **Tables C.1.2 - C.1.7**]. In addition, even when critical depths are assumed at the most downstream station [i.e. station 0.16], the same convergence behavior is expected at some distance upstream [see **Table C.1.1**]. These results of the analysis explain that only the reach below this station point, where the convergence occurs, will the sedimentation processes be inaccurately predicted.

Based on the evaluation of the most downstream station [i.e., Station 0.16] where the energy slope is small, a gradient slope, S_e, of 0.001 is assumed [see **Figure C.1.2**]. **Figure 2.1** shows the rating curve with a fitted relation expressed as,

$$WSE = 912.92 + 2.5237x10^{-4}Q - 2.8335x10^{-9}Q^2 + 1.2925x10^{-14}Q^3$$

where WSE is the water surface elevation in feet and Q is the flood discharge in cfs.

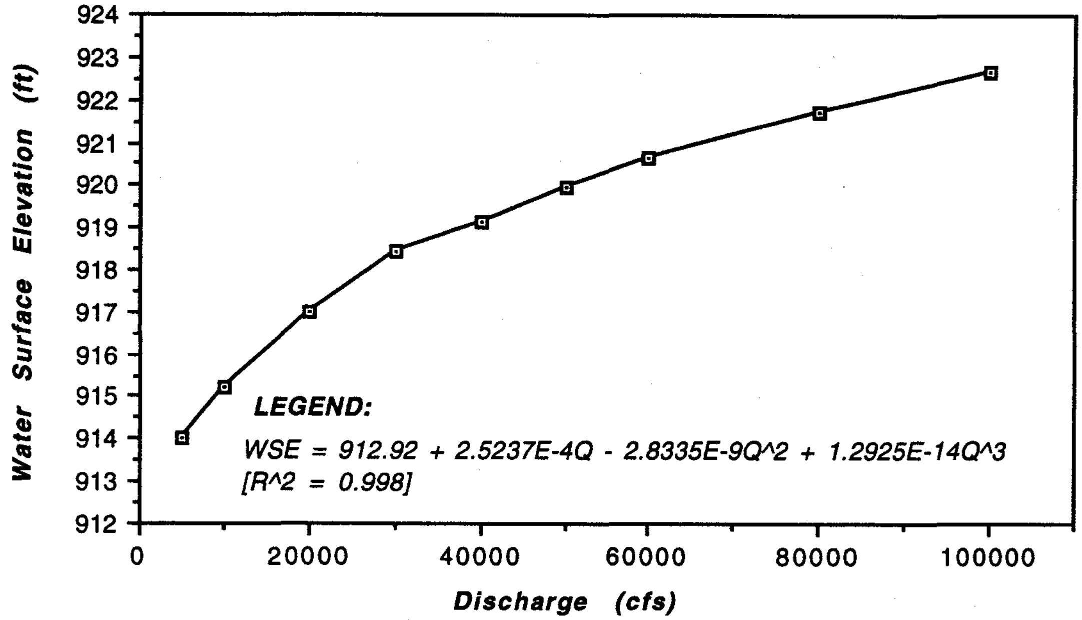

Fig. 2.1 - Rating curve at Station 0.16 obtained from slope-area method.

2.3 Structural Features

The discharges that flow through the Agua Fria River originate mostly from the existing Waddell Dam which impounds the Lake Pleasant. The physical data about the existing Waddell Dam are provided in **Table 2.4.** Currently, the existing dam regulates the flows for downstream use. In 1993, however, the New Waddell Dam which is being constructed at about one-fourth of a mile downstream of the existing dam, will regulate most of these discharges that serve downstream demands as well as those discharges that pass through the Agua Fria River.

Table 2.4 - Physical data of the existing Waddell Dam

Item	Description
Type of Dam	Concrete Multiple Arch
Height	176 feet
Crest Length	2,160 feet
Maximum Storage Capacity	157,600 acre-feet
Surface Area at Maximum Storage Capacity	3,760 acres

2.3.1 Existing Waddell Dam

The existing dam impounds as much as 157,600 acre-feet of water at Lake Pleasant with an equivalent water surface of about 3,760 acres (see **Table 2.4**). Completed in 1927, the dam was built initially for water supply. About two-thirds of the Agua Fria watershed is controlled by the said dam.

2.3.2 New Waddell Dam

The primary purpose of the New Waddell Dam is to store Colorado River water for Central Arizona Project (CAP) use. The dam will also store the runoffs from the upstream Agua Fria River, and provide incidental flood protection by controlling flood flows of the river. The New Waddell Dam which is located about one-fourth mile downstream of the existing Waddell Dam can store as much as 902,100 acre-feet of water. Furthermore, associated with the benefits mentioned above, the construction of the New Waddell Dam will provide additional advantages in flood plain management for the downstream Agua Fria River. These advantages are:

- (i) more sediments will be trapped due to larger storage and increased detention time for the sediments in the reservoir;
- (ii) the flood discharge will be significantly reduced;
- (iii) downstream sediment transport will be largely reduced due to controlled and more regulated releases; and,
- (iv) the 100-year flood peak at Camelback Road could be reduced from 95,000 cfs to 47,000 cfs.

In short, the New Waddell Dam will have the greatest impact from among the developments upstream of the Agua Fria River on controlling future flood peaks and subsequently, the channel morphology response. The relevant physical data of the New Waddell Dam are provided in **Table 2.5**

Table 2.5- Physical data of the New Waddell Dam

	Item	Description
A.	**Dam**	
	Type	*Rockfill Embankment*
	Height	*440 feet (300 feet above streambed)*
	Crest Elevation	*1,730 feet*
	Crest Length	*4,700 feet*
B.	**Spillway**	
	Type	*Ungated, free-overflow*
	Crest Length	*1,000 feet*
	Crest Elevation	*1,706.5 feet*
C.	**Reservoir**	
	Maximum Storage Capacity [Including Flood Space]	*902,100 acre-feet*
	Elevation at Maximum Storage Capacity	*1,706.5 feet*
	Surface Area at Maximum Storage Capacity	*10,340 acres*
	Conservation Storage Capacity	*816,000 acre-feet*
	(i) CAP Water	*658,400 acre-feet*
	(ii) MWD Replacement	*157,600 acre-feet*
	Minimum Pool	*40,500 acre-feet*
	Elevation at Maximum Conservation Storage	*1,702 feet*
	Surface Area at Maximum Conservation Storage	*9,970 acres*
D.	**Pumping-Generating Plant**	
	Number of Units	*8*
	Pump capacity	*3,000 cfs*
	Power Generation (Maximum)	*45 megawatts*
	Maximum Lift	*192 feet*
E.	**Waddell Canal**	
	Length	*4.9 Miles*
	Typical Cross-Section	*24 -foot bottom width, 82.5 to 88.5 feet wide at top of lining, lining height of 19.5 to 21.5 feet.*
	Lining Thickness	*4 inches*
	Capacity	*3000 cfs*

Note: CAP - Central Arizona Project; MWD - Maricopa Water District

III PREVIOUS STUDIES AND SCOPE OF THE CURRENT STUDY

3.1 Previous Studies and Reports

3.1.1 Hydraulic and Geomorphic Analysis of the Agua Fria River [by Simons, Li, & Assoc., Inc., May 1983]

This study covers a nine-mile reach of the Agua Fria River from the mouth of the New River to the confluence with the Gila River. Qualitative and engineering geomorphic analyses are presented, along with the results provided by QUASED - the sediment routing model developed by **Simons, Li & Associates, Inc. [SLA]** in 1981. A HEC-2 simulation was performed for the 100-year flood event. Stream reaches of aggradation and degradation are noted. Cross-sectional comparisons between 1973 and 1981 data were made. Recommendations for flood control projects were presented. Appended in the report are gradation data curves for sediments collected at 19 locations in the river and analyzed by Desert Earth Engineering **(Simons, Li & Assoc., Inc., 1983).**

3.1.2 Application of HEC-6 to Ephemeral Rivers of Arizona [by Dust, D. W., Bowers, M. T., and Ruff, P. F., January 1986]

The report details three case studies where the HEC-6 model was applied to Arizona streams: (i) the Agua Fria River between Jomax Road and Bell Road; (ii) the Salt River; and (iii) Rillito Creek. The report is intended as an aid to users of HEC-6 on Arizona ephemeral rivers, presenting some useful computer programs and strategies for collection and input of data, and in the calibration of model results against actual data using a program called STAP.

For the Agua Fria, three sets of HEC-6 hydrologic inputs were used: (i) 1964-79 data; (ii) 1964-83 data; and, (iii) 1979-1983 data. Some particularly useful observations for the Agua Fria include the designation of ineffective flow areas and hydraulic weighting factors in the HEC-6 input, and methodologies for estimating Manning's "n" for the main channel and overbanks. Inflowing sediment loads were generated using a dummy reach for five (5) different HEC-6 options for sediment load transport. The inflow hydrograph to the study reach was a release of record from Waddell Dam.

The report presents some useful information on HEC-6 computational stability when selecting discrete flow duration times at various flow rates. Stability tests were performed for Q = 4,000 cfs, 20,000 cfs, and 60,000 cfs. Absence of a rating curve at the downstream end of the study reach was compensated for by using HEC-6 default critical depth option to satisfy the downstream water surface elevation boundary requirements. The HEC-6 model results are inconclusive, but the "rigid bank" assumption for HEC-6 is indicated as a source of the discrepancies in actual and modeled stream cross-sectional geometries.

3.1.3 Agua Fria River Sedimentation Study to Determine the Effects of Gravel Mining Below Lower Buckeye Road [by Water Resources Associates, Inc., May 1986]

This report was prepared for Development Engineering, the operator for two sand and gravel mining companies - the Allied Sand & Rock and West Sand & Rock. These two companies proposed a large sand and gravel extraction operation in the Agua Fria River bed between Miles 1.0 and 2.5. The companies planned to excavate a 40-foot deep pit, approximately 3,000 feet in width across the river, for a length of 8,000 feet.

The study attempts to quantify changes in flood elevations and channel geometry likely to occur as a result of the proposed excavations. The report is intended to support the application of these mining companies to secure a permit from the Flood Control District of Maricopa County (FCDMC) to operate the sand and gravel mines. The study area includes only 3.5 miles of the Agua Fria River, immediately upstream from the confluence with the Gila River.

The data used by Water Resources Assoc., Inc. for the said study were the 1981-cross section data, the 100-year flood of 94,000 cfs, and a 10,000 cfs flow for channel slope-equilibrium analysis. The hydrograph for the 100-year flood (Waddell Dam spill) and a 29,000 cfs spill from the Arizona Canal Diversion Channel (ACDC) were prepared by the U.S. Army Corps of Engineers. Although the locations of sample sites are unspecified, a summary of sediment grain size distribution analyzed by **Force & Vann Inc.** is presented.

A HEC-2 backwater analysis was performed, and aerial photographs of stream channel location in 1936, 1975, late 1970's, and late 1980's along with 1957 USGS topographic quadrangles were used. The study attempted to quantify (i) local scour (using Armor Control, Neil, and Shen methods); (ii) regional scour (using the equilibrium-slope method with the Meyer-Peter-Muller bedload function and the Einstein integration for the suspended bedload); and (iii) head-cut migration at the upstream and downstream cuts (40-foot deep @ 10% slope).

The consultant predicts a 1,500-foot upstream headcut migration to a depth of 40 feet, and additional secondary regional and local scour upstream which threaten several structures. Downstream of the proposed excavation, headcut migration is predicted to extend only 340 feet, and to a depth of 5.5 feet. The consultants recommend armor, riprap and/or staircasing of the 40-ft faces, and maintenance of 200-foot wide buffers laterally to minimize chances of damage due to erosion.

3.1.4 Hydrology for the Evaluation of Flood Reduction by New Waddell Dam, Agua Fria River Below New Waddell Dam to the New River Confluence [by U.S. Army Corps of Engineers - Los Angeles District, September 1988]

This report analyzes the hydrology of the inflow to the New Waddell Dam reservoir and presents a "balanced" hydrograph routing through the reservoir. The outflow from the dam is evaluated under three potential operation schemes: (i) joint use [in which seasonal flood control space is provided between 1694 ft and 1702 ft, with full-time flood control space above elevation 1702 ft.]; (ii) no joint use [consisting of full-time water supply until elevation 1702 ft., and dedicated flood control from 1702 to 1706.5 ft.]; and (iii) full-time water supply [providing no flood control protection at all].

Discharge-frequency relationships are presented at four (4) locations between the dam and Agua Fria's confluence with the New River. They are: (1) below Waddell Dam; (2) at Bell Road; (3) at Grand Avenue; and, (4) above New River confluence. With the Waddell Dam, the 100-year flood peak will be reduced from 135,00 cfs (without the dam) to 10,000 cfs. Even with operation without flood control (full-time water supply), the 500-year flood release from Waddell to the Agua Fria River goes from 182,000 cfs (without the dam) to less than 70,000 cfs. Reservoir operations with storage reduces the 500-year peaks from 50,000 cfs (with the dam) to 30,000. The U.S. Army Corps of Engineers used a rainfall-runoff model to add local inflows to the discharge from Waddell Dam for hydrologic routing up to the confluence with the New River. The portion of the Agua Fria River between the New River and the confluence with the Gila River was not studied.

3.1.5 Flood Insurance Study (FIS): Agua Fria River, Maricopa County, Arizona [by Jerry R. Jones & Assoc., Inc., January 1989]

This report is the restudy of the 1988 Flood Insurance Study done by FEMA and was necessitated by modifications and construction in the floodplain. It considers the "Pre-Waddell Dam" hydrology, but incorporates new bridges constructed along the river and soil-cement levees constructed between Indian School and Broadway Roads. The restudy delineates the 100-year floodplain under the changed conditions. The report presents the 10, 50, 100, and 500-year flood discharges at Old Waddell Dam, and at seven downstream locations on the Agua Fria River. The report is most useful for the HEC-2 analysis, which produced in excess of 450 cross-sections of the river. The report contains references to other studies:

(i) U.S. Army Corps of Engineers, Los Angeles District, (1968), "Floodplain Information Study, Agua Fria River, Maricopa County, Arizona," Los Angeles, California.

(ii) U.S. Department of HUD, FIA, (1979), "Flood Insurance Study, Maricopa County, Arizona,", Washington, D.C., May 1979;
(iii) USGS, "Flood of February 1980 along the Agua Fria River, Maricopa County, Arizona," WRI Open File Rep. 80-767, Tucson, June 1980;
(iv) Simons, Li & Assoc., Inc., (1984), "Agua Fria Side-Drainage Analysis," Tucson, November 1984; and,
(v) Simons, Li & Assoc., Inc., (1985), "Agua Fria Control Project, Analysis of Side-Drainage Requirements, Buckeye Road to 1,500 feet South of Interstate 10," Tucson, January 1985.

3.1.6 Effects of In-Stream Mining on Channel Stability, *Executive Summary* [by Simons, Li & Assoc., Inc., June 1989]

This report addresses the issues of sand and gravel extraction in general and is applicable to desert alluvial streams, including: regulatory practices, structural hazards, economic value, social and environmental factors, statewide classification of streams in Arizona, review of study methodologies, mitigative measures, engineering parameters, long and short-term procedures, river response simulation procedures, case studies, justification for regulations on the industry, implementation plans, and needs for additional monitoring and data collection. The report provides a detailed description of the aggregate extraction activities in the Agua Fria River. Seven (7) "clusters" of mining are inventoried in the Agua Fria River between Buckeye Road and Camelback Road; and, additional five (5) "clusters" are located between the confluence of the New River and the confluence with the Gila River. Some basic data on the volumes excavated and aggradation/degradation measurements are presented for these reaches of the Agua Fria River.

A study was made in 1985 to develop strategies on the development of general input data and calibration of HEC-6 for ephemeral rivers in Arizona **[Dust, et al., 1986]**. The work also aimed at identifying potential limits on the capability of HEC-6 for such rivers. The study reach chosen for the Agua Fria River spanned about 6.52 miles located approximately seven (7) miles downstream of Waddell Dam. The north and south boundaries of the river reach were Jomax Road (Mile 26.60) and Bell Road (Mile 20.08), respectively, and consisted of 29 cross-sections. Due to the substantially inaccurate geometric data used, the results of the application of the HEC-6 Model to the Agua Fria River are inconclusive. The results suggested that the "rigid bank" assumption is a limiting factor in the application of HEC-6 to braided ephemeral rivers in Arizona.

Another study for the Agua Fria River was made to assess the hydraulic and geomorphic conditions and evaluate some proposed flood control projects along the study reach. The study reach was defined from the river's confluence with the New River (Mile 9.70) to the Gila River (Mile 0.0). The entire effort was geared to provide baseline information on hydraulic and sediment transport characteristics of the Agua Fria for future flood control projects **[Simons, Li and**

Associates, Inc., 1983]. Three levels of analysis were made which included the following: (i) qualitative geomorphic analysis; (ii) engineering geomorphic analysis; and, (iii) mathematical model simulation.

For the mathematical model simulation, the channel response of the Agua Fria River was made through QUASED **(Simons, Li and Assoc., Inc., 1981)** using the 1978-, 1979-, and 1980-floods. The 1973 cross-sections of the river obtained from the U.S. Army Corps of Engineers were used to simulate the pre-flood conditions while the 1981-cross-sections derived from 1981 topographic maps were used to approximate the post-flood conditions. The study concluded that QUASED satisfactorily predicted the aggradation and degradation trends for the 1978, 1979, and 1980 floods, and thus would give reasonable sedimentation predictions for the 100-year flood.

3.2 Scope of Work for the Present Study

The project is aimed at developing sediment transport models using the HEC-6 code to simulate the long-term stream bed profile response of the Agua Fria River based on different development scenarios. The sedimentation modeling covers the entire 34-mile reach of the Agua Fria River. The study reach has its upstream boundary located in the diversion outlet south of the New Waddell Dam and its downstream boundary at the Gila River confluence. Associated with the development of sediment transport model for the Agua Fria River was the training of personnel from the Flood Control District of Maricopa County on HEC-6 modeling.

The stage-by-stage incorporation of the development projects within the floodplain forms the basis of the modeling effort which, when evaluated, help identify and locate problem areas in the river. These problem areas are associated with the extent of degradation and aggradation as a result of the development projects considered. The components of the work scope are provided as follows:

(i) training
(ii) collection and review of available data;
(iii) data verification, acquisition, and validation;
(iv) sediment transport evaluation;
(v) coordination; and,
(vi) preparation of final report.

3.2.1 Training

The Civil Engineering Department performed training for the Flood Control District of Maricopa County personnel in the modeling:

(i) to simulate stream bed profile behavior;

(ii) to identify potential degradation/aggradation of stream beds;
(iii) to assess the natural dynamics of the river system;
(iv) to analyze the impacts of gravel mining; and,
(v) to identify flood risks due to sediment transport.

The training included the review of data coding, selection of pertinent data and information, and debugging process.

3.2.2 Collection and Review of Available Data

Data collection included the following information,

(i) geometric data - stream channel geometry from flood plain studies, aerial and ground photos, surveys and past sediment transport studies;
(ii) hydrologic and hydraulic data - historic flood, peak discharges from flood insurance studies for Agua Fria River, peak discharges for post-New Waddell Dam, rainfall data, and water surface profiles from HEC-2 runs of the Agua Fria River flood insurance study **(Jerry R. Jones & Assoc., Inc., 1989).**
(iii) sediment data - sediment gradation data, dredging and mining frequency, quantities and locations, and review of past sediment transport study reports;
(iv) site reconnaissance information - project site survey to observe the overall river and appropriate tributaries that aid in the calculation of sediment transport quantities; photographic documentation of sediment characteristics, inspection of flood control or drainage structures; and,
(v) field reconnaissance report that summarizes the site survey including photographs to document field sediment information. This report have been included in the Appendix (**see Appendix H**).

3.2.3 Data Verification and Acquisition

(i) collection of additional data required for the development of HEC-6 models. Data acquisition includes: geotechnical analysis; collection of sediment samples; and sieve analysis.
(ii) verification and validation of available geometric and sediment data, etc.

3.2.4 Sediment Transport Model Evaluation

(i) development of three (3) HEC-6 multi-profile models each for peak discharges of Q = 18,500 cfs, 32,000 cfs, 54,000 cfs, and 85,000 cfs which represent the 50-, 100-, 200-, and 500-year return period flood peaks of the post-New Waddell Dam. The development scenarios for these three (3) models are provided as follows:

Model I	Development of a model to evaluate the sediment transport under the existing condition with New Waddell Dam and the Arizona Canal Diversion Channel (ACDC) built;
Model II	Development of a future condition model using the existing condition model (Model I) to reflect the ultimate sand and gravel mining as permitted today;
Model III	Development of a future condition model by adding 1000-foot wide channel improvement along the Agua Fria River (wherever applicable) to Model II in order to evaluate the effect of mining sites on the proposed channel;

(ii) evaluation of the ten (10) sediment transport functions currently available in the most recent version of HEC-6 code; the functions will be tested to evaluate their validity for the Agua Fria River. In addition, sensitivity analyses of the various input parameters for the sediment transport functions, including Manning's roughness coefficient, will be performed.

(iii) development of all HEC-6 models from the available Agua Fria River HEC-2 model **(Jerry R. Jones & Assoc., Inc., 1989)** to calculate surface profiles, sediment transport capacity at each section, volume of material scoured or deposited between cross-sections, associated change in bed surface elevation, and the modification of cross-section geometry to appropriately reflect the scenarios considered and under each event;

(iv) preparation of a narrative report describing the modeling procedure, and assumptions made based upon the availability of sediment in the river system.

(v) comparison of the previous sediment studies within the study area and the results obtained by the HEC-6 model. Major differences will be addressed which will ultimately be discussed in the final report;

(vi) presentation of working maps and models during the course of the sediment transport modeling analysis for review by District staff at coordination meetings;

(vii) preparation of cross-section plots using a pen-plotter. The cross-sections will show water surface profiles, limits of movable bed, surface gradation for transport theory, gradation for scour calculations, and model invert. These plots in addition to the working maps, HEC-6 output, and HEC-6 inputs/outputs on diskettes are to be available at all reviews.

(viii) evaluation and analysis of the results of each modeling effort will be done separately; documentation of these results will be made separately and comparatively in the final report;

(ix) extent of the applicability of the study should be explained in the final report.

(x) final sediment transport maps will be based on the Agua Fria River floodplain maps;

(xi) tabulations which indicate the points of gradation, volume, depth, change of velocities, water surface elevations, and invert profiles will be presented in the final report.

3.2.5 Coordination

In addition to the training sessions, regular coordination meetings were held to discuss progress of work. Milestone coordination meetings were held at the completion of all major tasks. Prior to finalizing the sediment transport analysis, maps, reports, cross-section plots, HEC-6 output hard copies, and HEC-6 input/output files on diskettes were submitted to the Flood Control District for review and approval.

IV SELECTION OF SEDIMENT TRANSPORT FUNCTION

This section presents the preliminary study that covers the selection of an appropriate sediment transport function for the sedimentation modeling of the Agua Fria River. A 7.30-mile reach of the river was chosen for this preliminary study from which the performance of the ten (10) sediment transport functions available in HEC-6 code were evaluated.

Determination of inflowing sediment load was made for the various sediment transport functions because field data were not available. Further analyses were made to evaluate the sensitivity of the performance of selected sediment transport functions to the changes of hydraulic parameters in the model. In summary, this section of the report covers the following sub-sections: (i) development of input data; (ii) determination of inflowing sediment load; (iii) selection of sediment transport function; and, (iv) sensitivity analysis.

4.1 Development of Input Data

A river reach that has past and current geometric information is used for the preliminary study of the Agua Fria River. The difference between these two data logically comprises the channel changes to be simulated by using the HEC-6 code. Associated with these channel bed changes are the hydrologic events that have occurred during the period that had caused such changes to develop.

4.1.1 Location of River Reach

The north and south boundaries of the study reach are coincident with Jomax Road and Bell Road, respectively [see **Figure 4.1**]. Within the set limits, the ephemeral Agua Fria River is characterized by a wide flood plain in which braided channels meander through a relatively low relief and sparsely vegetated desert plain. Flow in the Agua Fria River is controlled by flood gates in Waddell Dam which impounds Lake Pleasant. This reservoir is located about seven miles north of the upstream limit of the study reach.

4.1.2 Modeling Data

The HEC-6 code requires three major data sets to be provided: (i) geometric and hydraulic data; (ii) sediment data; and, (iii) hydrologic data. The following information are used in the development of the input data for the study:

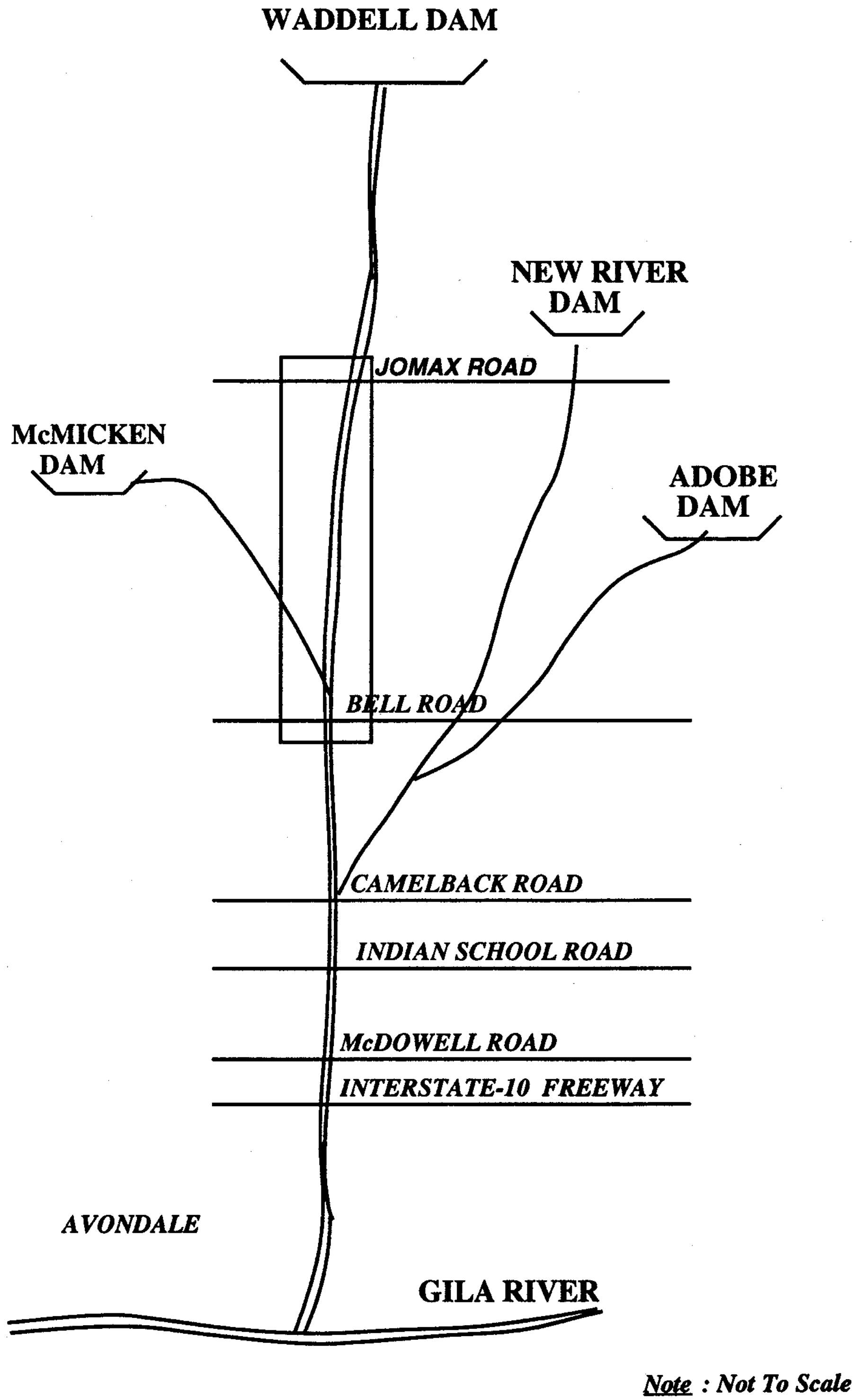

Figure 4.1 - River sketch of the Agua Fria River showing the location of the river reach.

4.1.2.1 Geometric and Hydraulic Data

(i) <u>Cross-Section Data</u> - The geometric data of 1979 for the study reach is used as the original data set for the sediment transport selection study. The data was based on the floodplain delineation map drawn by **Yost and Gardner Engineers (1979)** covering the reach from Bell Road to Jomax Road which is about 7.30 miles long. The map has a contour interval of 4.0 feet and a scale of 1:400.

There are 39 cross-sections defined for the entire study reach and they are designated accordingly by their mileage number (see **Table 4.1**). As shown, adjustment on the mileage numbering has to be made to be consistent with the mileage numbering system that was used by the **Jerry R. Jones & Assoc., Inc.** in the 1989 flood insurance study of the Agua Fria River **[Jerry R. Jones & Associates, Inc., 1989]**.

Cross-section plots of 1979- and 1989-data for surveyed stations that are located close to one another are shown in **Figures 4.2 (a) - (f)**. All the plots shown reveal that the flood event that occurred in February 13-22, 1980, has generally, lowered the channel bed elevation.

(ii) <u>Channel Section Boundaries</u> - The river channel is comprised of three sections: left overbank (LOB), main channel, and right overbank (ROB). The significance of defining these section boundaries is to differentiate the main channel from the overbanks. **Table 4.1** defines the station boundaries that divide the left overbank, main channel, and right overbank sections.

(iii) <u>Thalweg Elevations</u> - The thalweg elevation data obtained from various locations along the study reach in 1979 **[Yost and Gardner Engineers, 1979]** and in 1989 **[Jerry Jones Associates, Inc., 1989]** are plotted in **Figures 4.3 (a, b, and c)**. Here, the entire study reach was divided into three segments in order to have a more distinctive comparison. These segments are defined as follows:

(i) First segment- downstream sub-reach [Mile 18.90 - Mile 21.09]
(ii) Second segment - middle sub-reach [Mile 21.24 - Mile 23.75]
(iii) Third segment - upstream sub-reach [Mile 23.62 - Mile 25.79]

Except for the most downstream segment i.e., first segment, **Figure 4.3(a)**, the bed changes occurring from 1979 to 1989, due to the Feb. 13-22 flood event are predominantly scouring. This indicates that scouring occured in the upper segments (i.e., second and third segments) and the scoured sediments upstream have been transported and deposited in the downstream segment resulting to the rise of bed profile.

Table 4.1 - Cross-sections covering the study reach from Bell Road to Jomax Road with the section boundaries.

Location	No.	Mileage Number	Adjusted Number	Section Boundaries LOB-Main	Section Boundaries Main-ROB
Bell Road	1	19.585	18.900	9770.00	10374.00
	2	19.620	18.940	8125.60	10352.70
	3	19.800	19.170	8584.10	10407.50
	4	20.000	19.350	7613.00	10077.50
	5	20.200	19.540	7397.30	10094.80
	6	20.400	19.720	7377.70	10594.90
	7	20.600	19.890	7975.10	10793.70
	8	20.800	20.080	8538.50	11071.70
	9	21.000	20.270	8252.40	11164.60
	10	21.200	20.450	7422.00	10304.00
	11	21.400	20.640	6482.60	10100.90
	12	21.600	20.830	7798.90	10284.10
	13	21.800	21.090	7997.20	10566.10
	14	22.000	21.240	8592.30	10201.40
	15	22.200	21.420	9030.20	10135.40
	16	22.280	21.590	9329.00	10276.70
	17	22.460	21.680	9514.50	10421.20
	18	22.600	21.760	9595.90	10818.10
	19	22.800	21.850	9752.50	11849.20
	20	23.000	22.130	9917.80	12406.60
	21	23.200	22.320	9550.40	12458.20
	22	23.400	22.600	9875.80	13445.90
	23	23.600	22.790	9929.10	13612.90
	24	23.850	22.980	9886.50	13112.70
	25	24.050	23.160	9945.60	13159.90
	26	24.250	23.350	9846.00	13075.40
	27	24.450	23.620	9882.50	12844.60
	28	24.650	23.800	9368.50	11313.10
	29	24.900	23.980	9094.80	11500.20
	30	25.100	24.170	9337.50	10940.00
	31	25.300	24.350	9599.40	10765.40
	32	25.450	24.450	9608.70	10908.40
	33	25.650	24.630	9731.80	10982.90
	34	25.900	24.900	9615.30	11329.60
	35	26.100	25.090	9850.30	10501.70
	36	26.300	25.370	9684.10	10554.90
	37	26.450	25.530	9724.70	10277.70
Jomax Road	38	26.600	25.590	9660.90	10744.80
	39	26.900	25.790	9535.40	10937.50

Source: HEC-2 Input Data File, Yost and Gardner Engineers, 1979.

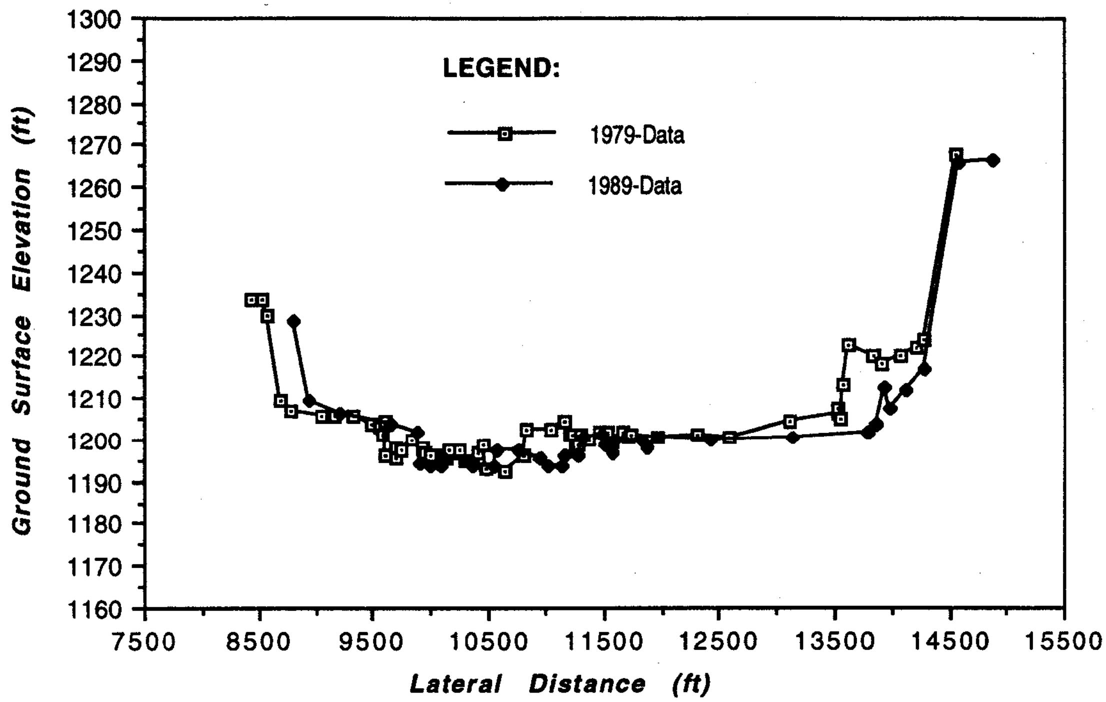

Figure 4.2 (a) - Cross-section plot of 1979- and 1989-data for Station 21.76

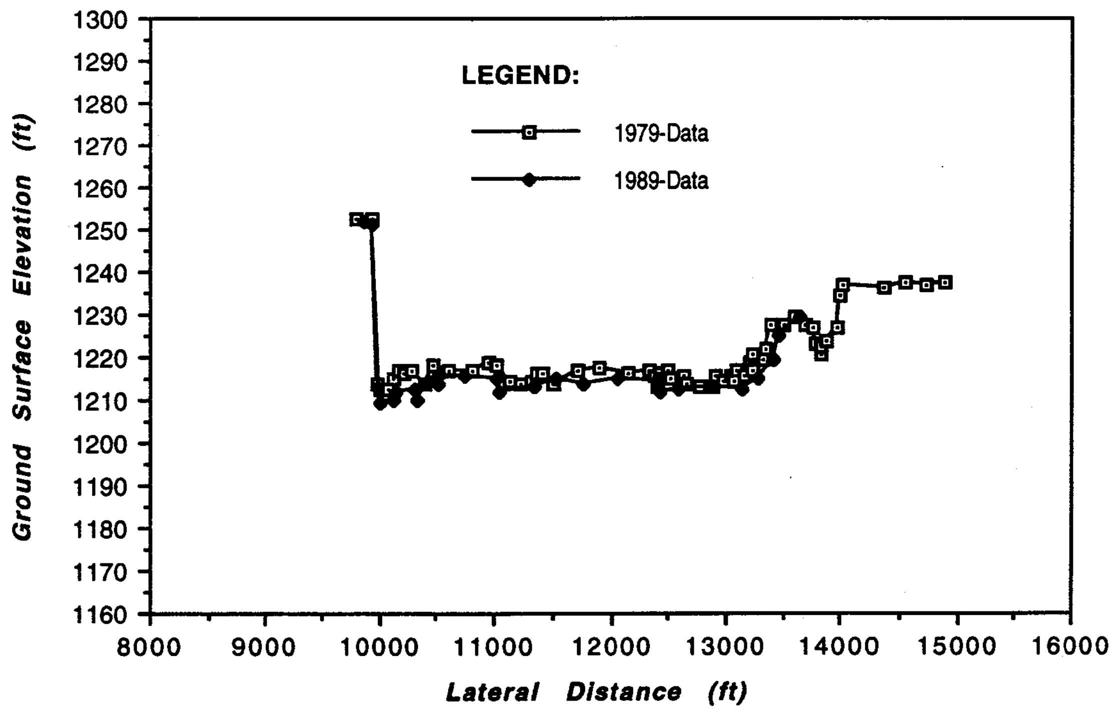

Figure 4.2 (b) - Cross-section plot of 1979- and 1989-data for Station 22.79

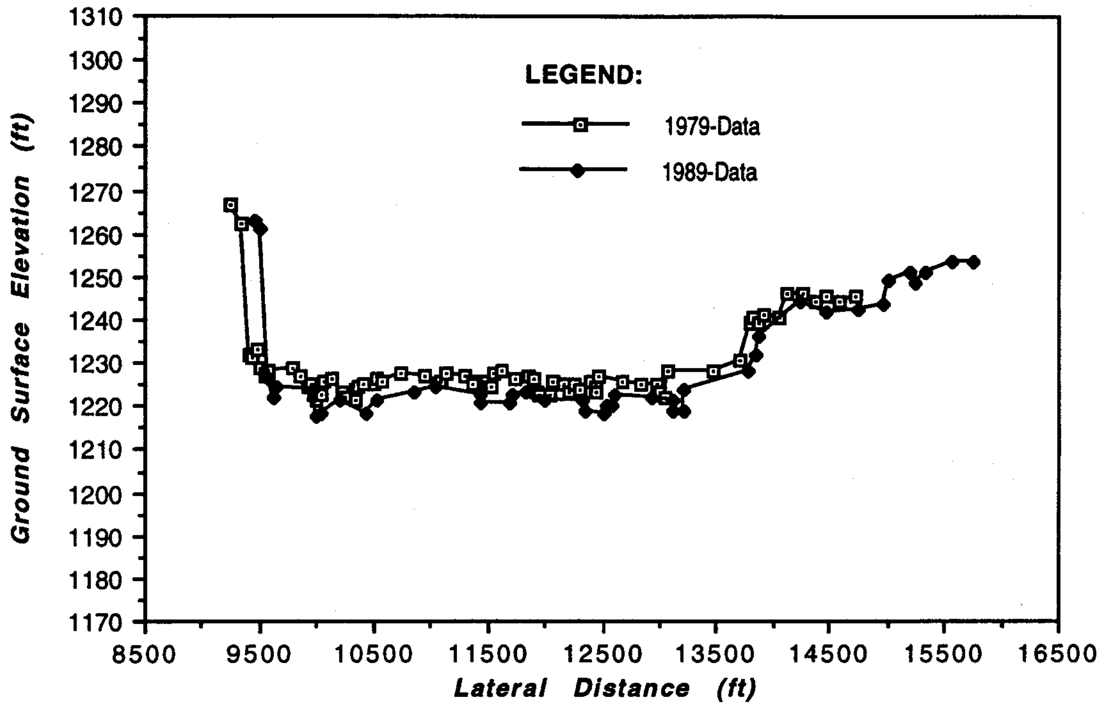

Figure 4.2 (c) - Cross-section plot of 1979- and 1989-data for Station 23.35

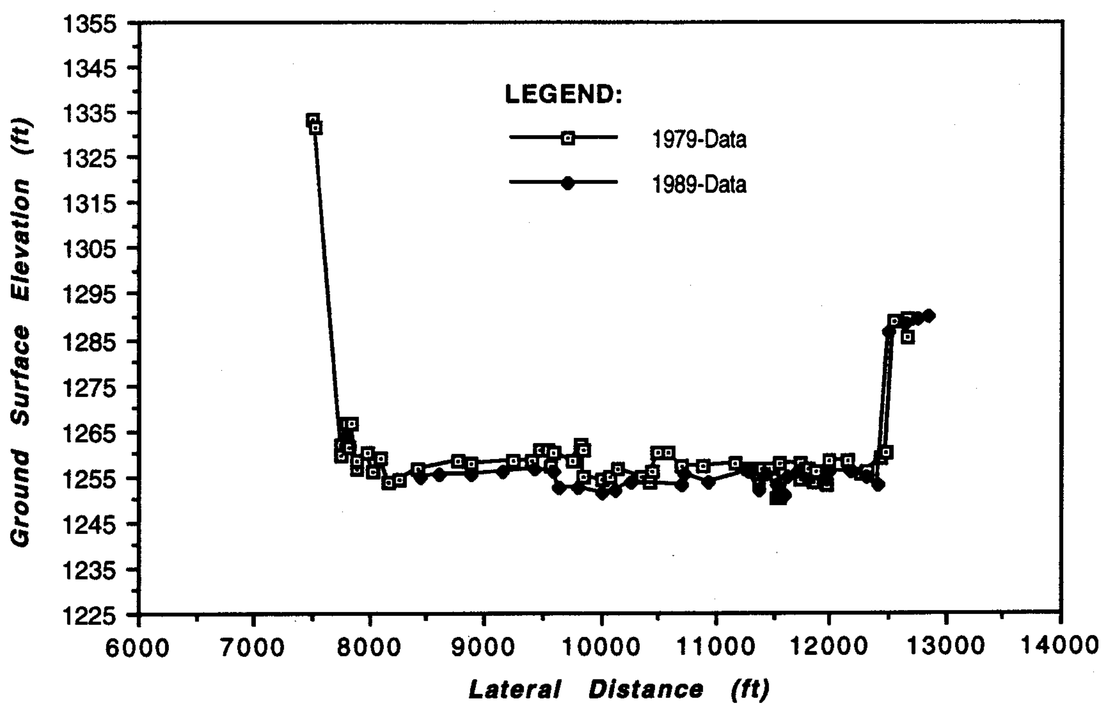

Figure 4.2 (d) - Cross-section plot of 1979- and 1989-data for Station 25.09

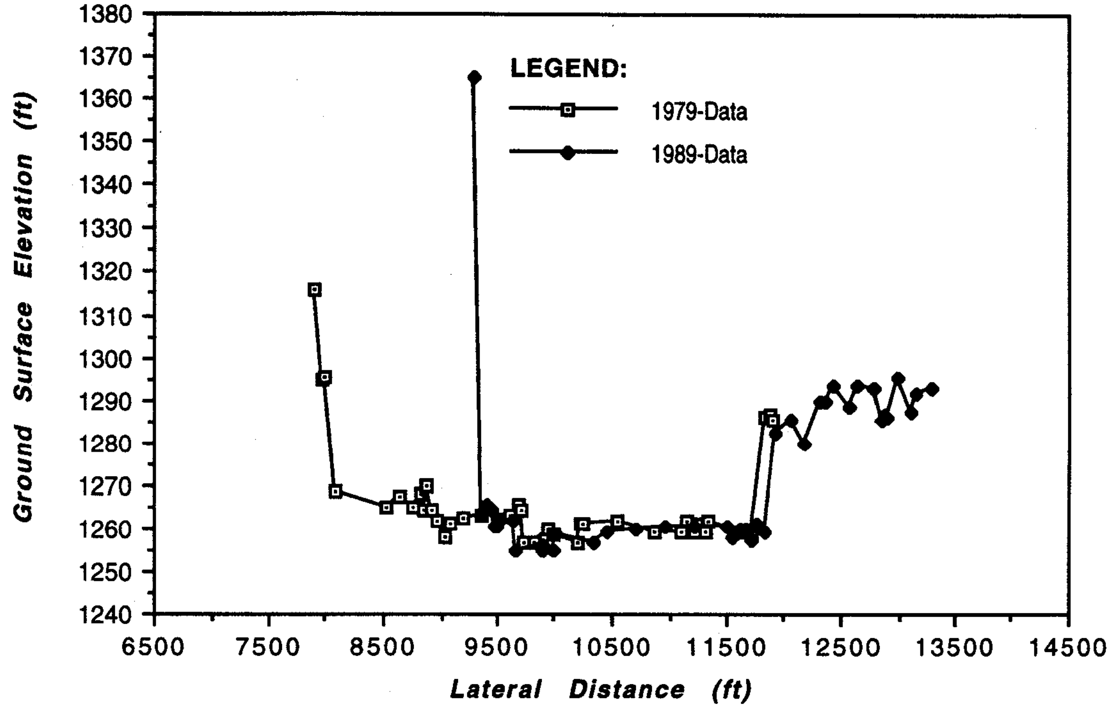

Figure 4.2 (e) - Cross-section plot of 1979- and 1989-data for Station 25.37

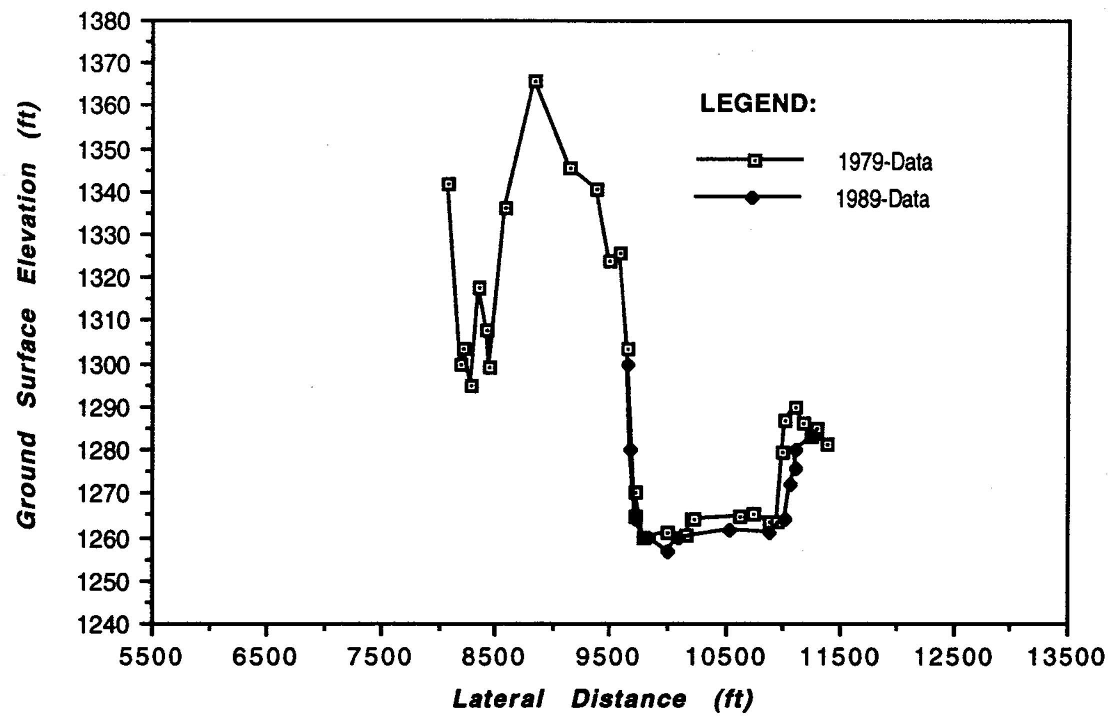

Figure 4.2 (f) - Cross-section plot of 1979- and 1989-data for Station 25.59.

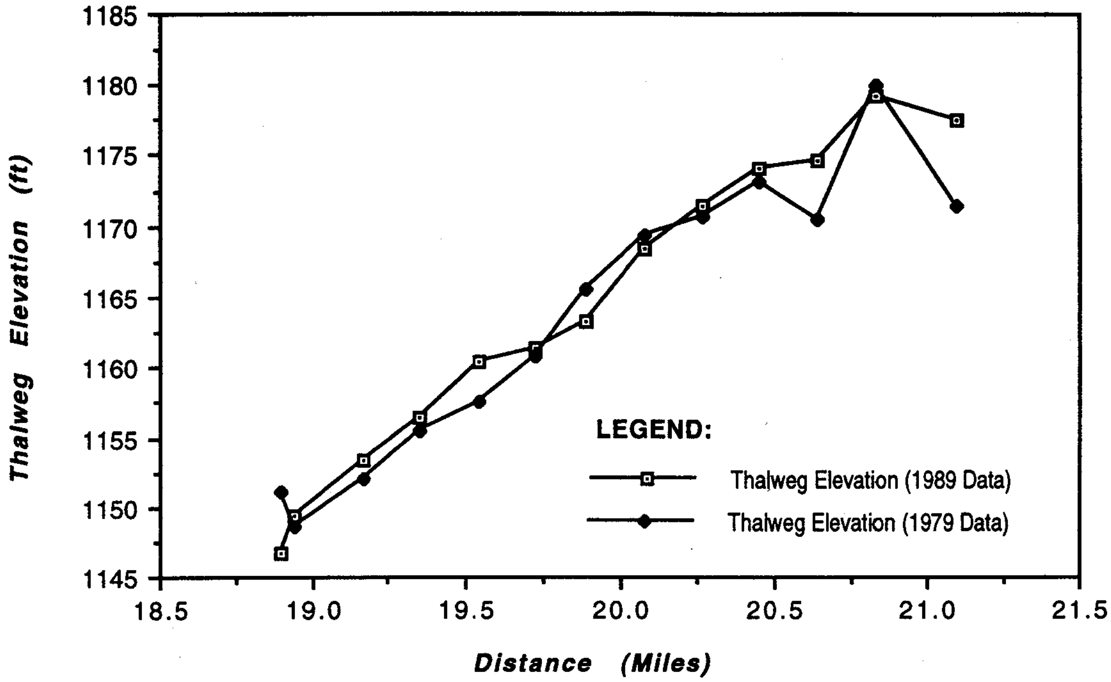

Figure 4.3 (a) - Thalweg elevations, 1979- and 1989-data [First segment]

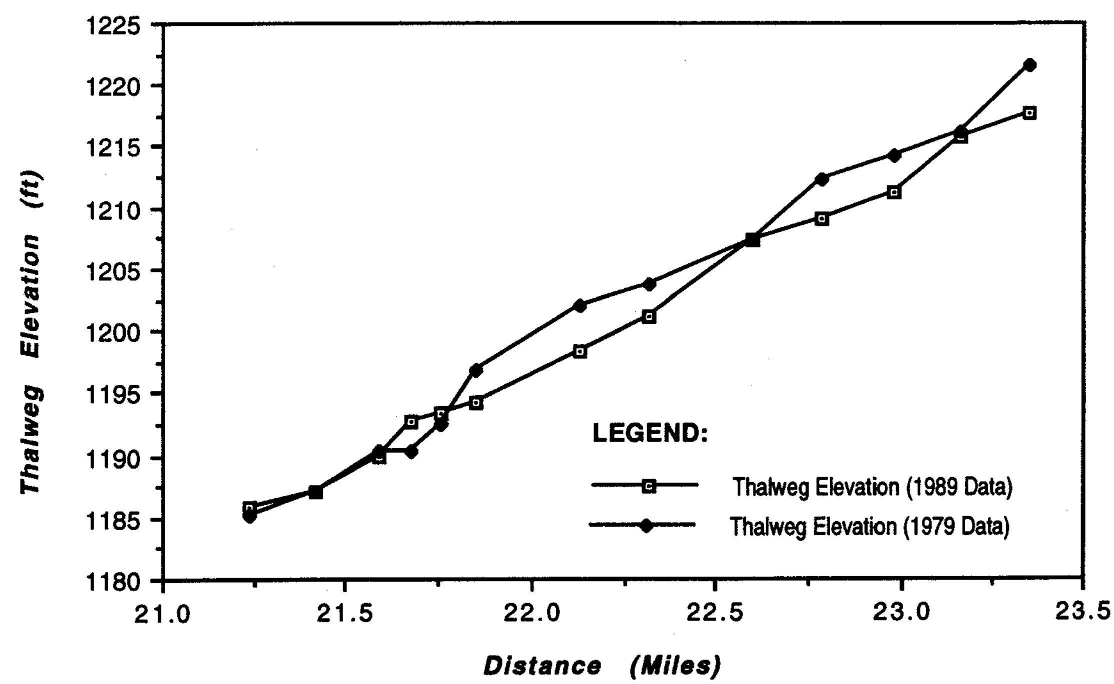

Figure 4.3 (b) - Thalweg elevations, 1979- and 1989-data [Second segment]

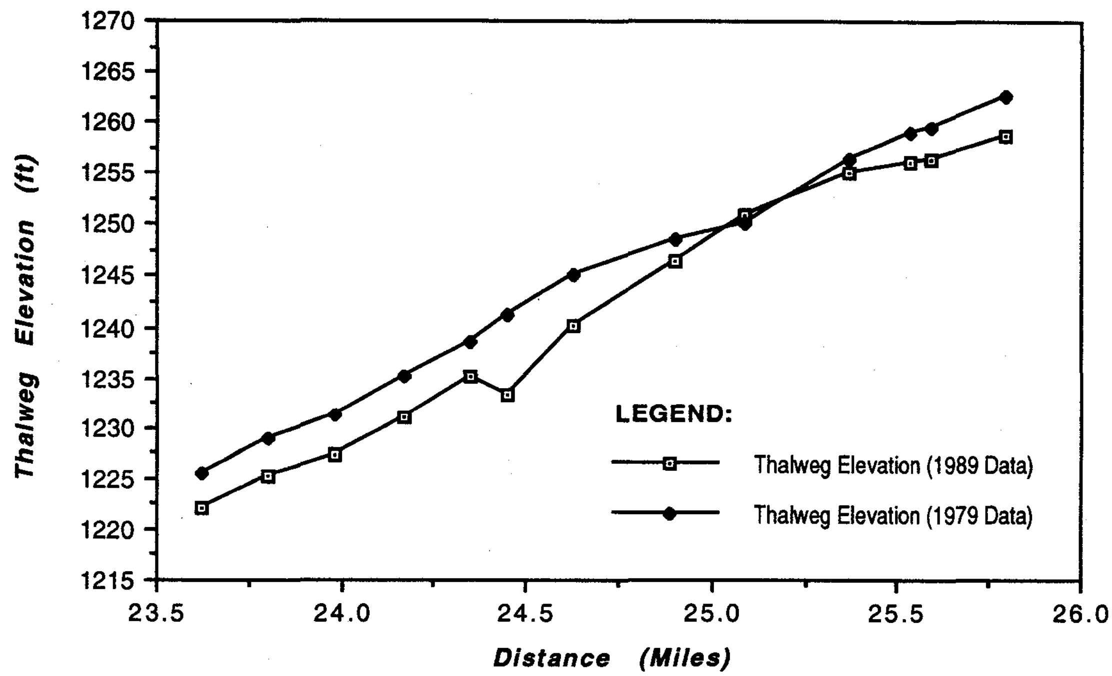

Figure 4.3 (c) - Thalweg elevations, 1979- and 1989-data [Third segment]

(iv) <u>Roughness Coefficients</u> - The roughness coefficient data along the study reach were derived from the NH cards of the **HEC-2** input data file used in the floodplain study of the Agua Fria River in 1979 **[Yost and Gardner Engineers, 1979]**.

Since the NH card provides the relationship between the lateral segments of the river cross-section and roughness coefficient 'n', a computer program was developed to determine the representative 'n' values for the left overbank (LOB), main channel, and the right overbank (ROB) to be used in the selection study. The representative roughness coefficients at various sections of the study reach are tabulated in **Table 4.2** and further plotted in **Figure 4.4**

(v) <u>Energy Loss Coefficients Due to Channel Contraction and Expansion</u> - The loss coefficients attributable to the contraction and expansion along the river channel are respectively, 0.1 and 0.3.

4.1.2.2 Hydrologic Data

(i) <u>Flood Data</u> - Only one flood event occurred between December 21, 1979 and January 29, 1989 - the respective dates when the delineation maps of the Agua Fria River were made. That flood event

Table 4.2 - Roughness coefficients derived from the NH card of 1979 data

Location	No.	Mileage No.	Left Overbank	Main Channel	Right Overbank
Bell Road	1	18.900	0.0400	0.0240	0.0397
	2	18.940	0.0400	0.0312	0.0250
	3	19.170	0.0394	0.0467	0.0250
	4	19.350	0.0400	0.0517	0.0250
	5	19.540	0.0400	0.0492	0.0250
	6	19.720	0.0400	0.0351	0.0600
	7	19.890	0.0400	0.0378	0.0600
	8	20.080	0.0404	0.0388	0.0400
	9	20.270	0.0404	0.0380	0.0350
	10	20.450	0.0405	0.0403	0.0350
	11	20.640	0.0403	0.0395	0.0350
	12	20.830	0.0406	0.0399	0.0500
	13	21.090	0.0406	0.0340	0.0800
	14	21.240	0.0412	0.0349	0.0800
	15	21.420	0.0396	0.0305	0.0732
	16	21.590	0.0299	0.0252	0.0762
	17	21.680	0.0498	0.0263	0.0576
	18	21.760	0.0500	0.0262	0.0525
	19	21.850	0.0500	0.0351	0.0495
	20	22.130	0.0250	0.0314	0.0500
	21	22.320	0.0250	0.0394	0.0500
	22	22.600	0.0250	0.0366	0.0500
	23	22.790	0.0250	0.0359	0.0500
	24	22.980	0.0250	0.0423	0.0500
	25	23.160	0.0400	0.0368	0.0500
	26	23.350	0.0400	0.0382	0.0500
	27	23.620	0.0500	0.0372	0.0500
	28	23.800	0.0500	0.0304	0.0478
	29	23.980	0.0500	0.0336	0.0500
	30	24.170	0.0744	0.0322	0.0250
	31	24.350	0.0728	0.0267	0.0250
	32	24.450	0.0729	0.0274	0.0250
	33	24.630	0.0708	0.0272	0.0500
	34	24.900	0.0500	0.0506	0.0500
	35	25.090	0.0500	0.0250	0.0625
	36	25.370	0.0500	0.0315	0.0670
	37	25.530	0.0500	0.0259	0.0800
Jomax Road	38	25.590	0.0250	0.0365	0.0800
	39	25.790	0.0250	0.0250	0.0800

Note: Derived from NH Card of the HEC-2 Input File **[Yost and Gardner Engineers. 1979]**

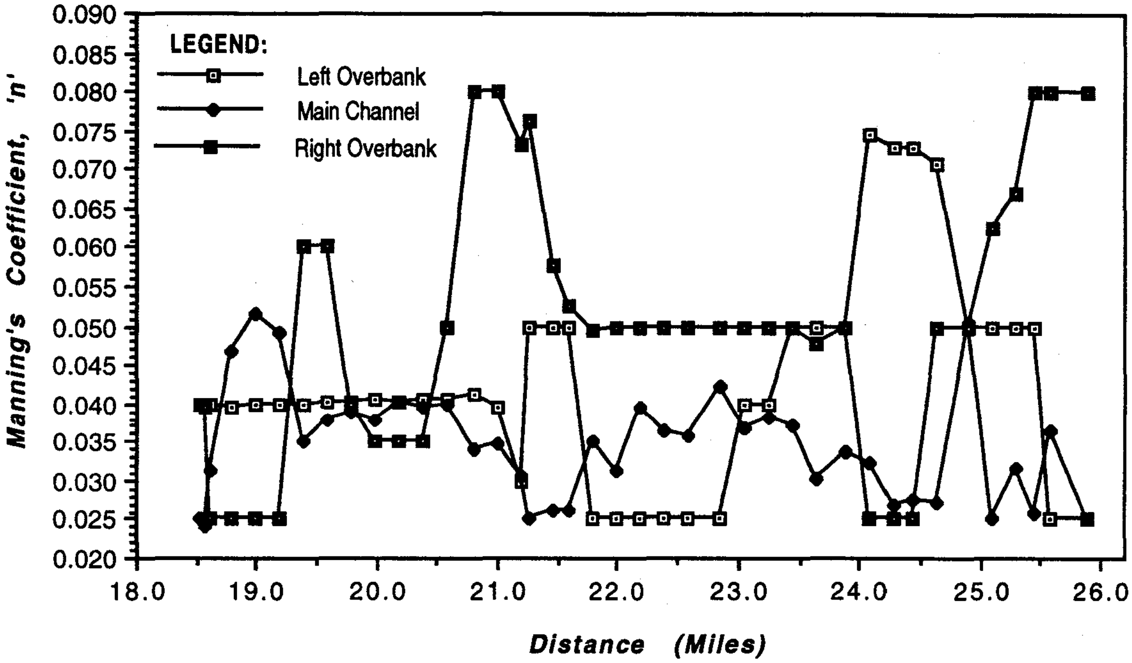

Figure 4.4 - Roughness coefficients at various locations of the study reach

was the reservoir releases made at the Waddell Dam in February 13-22, 1980, a period of about 8.79 days. The release hydrograph is shown in **Figure 4.5 (a).** The corresponding discretized hydrograph for the said flood event is shown in **Figure 4.5 (b).**

(ii) <u>Discharge Rating Data</u> - The discharge rating data at Bell Road is taken from the 1983 study of the same reach. The basis of this 1983 study is the 1979 data of the Agua Fria River - particularly the reach between Bell Road and Jomax Road **[Dust, Bowers, and Ruff, 1986]**. The rating data used in the 1983 study is shown in **Table 4.3** for Mile 19.00 whose derivation is based on critical depth analysis.

Since there are observed discrepancies between the GR data used by **Dust et al, (1986)** and the data used by **Yost & Gardner Engineers (1979)** in their respective studies of the Agua Fria River, the rating data at the most downstream reach was determined using the slope-area method suggested by **Hoggan (1989)**. This was done essentially to provide a more realistic input for the selection study and for the purpose of comparison. To derive the rating curve for the most downstream cross-section (Mile No. 18.90) at Bell Road using the slope-area method, an estimate of the starting water surface elevation must be specified.

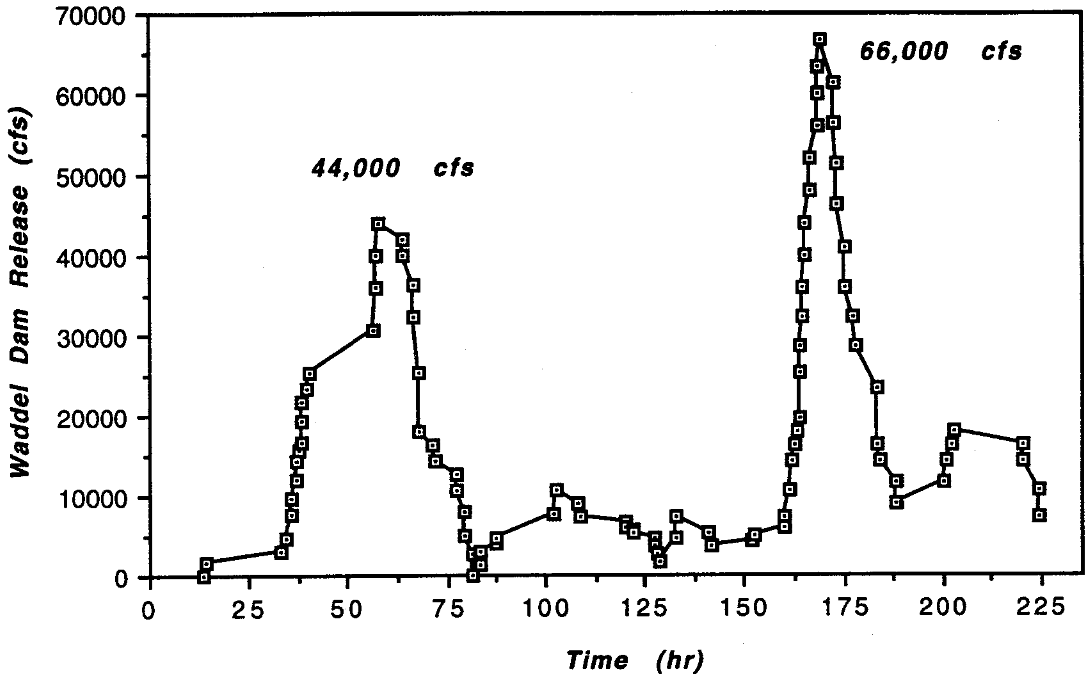

Figure 4.5 (a) - Release hydrograph from the Waddell Dam [Feb. 13-22, 1980]

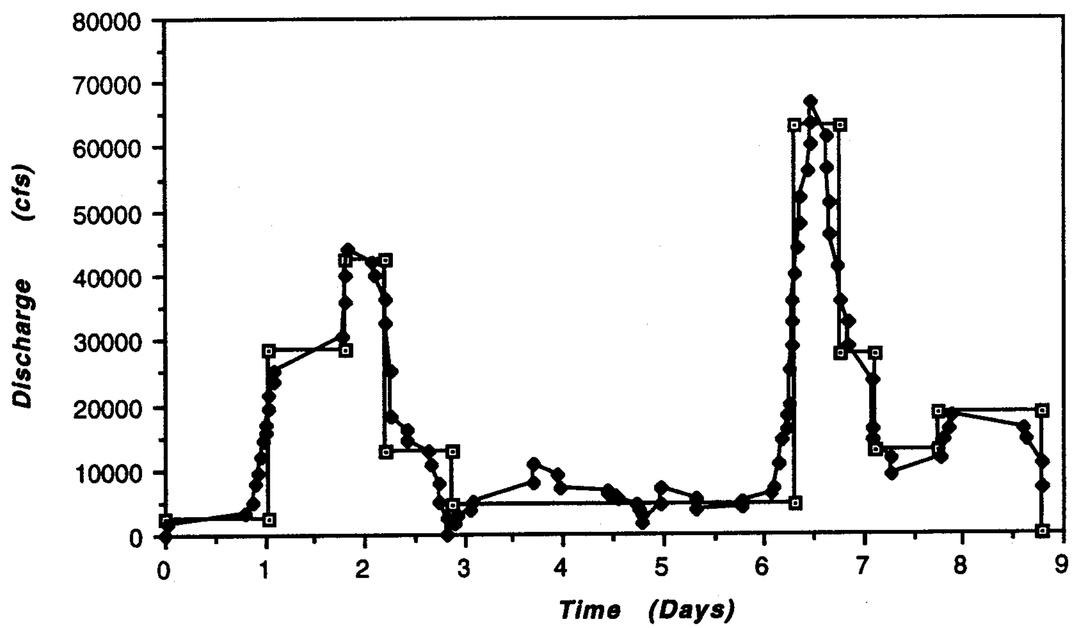

Figure 4.5 (b) - Discretized hydrograph of Feb. 13-22, 1980 releases [Number of time steps, N = 9]

Assuming that the flow is uniform, the procedure computes a discharge for these initial conditions and compares this computed discharge with the given discharge. If there is a significant difference, the estimated elevation is adjusted and the discharges are computed again. This procedure is repeated until the computed discharge and the given discharge are within a one-percent (1%) difference. The elevation, thus computed, is used as the starting water surface elevation **[Hoggan, 1989].** The results of employing this method is shown in **Table 4.4.** The rating data used by **Dust, et al., (1986)** and the rating data derived using the slope-area method are plotted in **Figure 4.6.**

Table 4.3 - Rating data at Section 19.00

N	Discharge,Q (cfs)	Water Surface Elev.,WSE (ft)
1	4000.00	1146.80
2	22000.00	1150.56
3	40000.00	1155.40
4	58000.00	1156.16
5	70000.00	1157.00

Note: From **Dust, Bowers and Ruff (1986).**
$WSE = 1145.3 + 3.2038 \times 10^{-4}Q - 2.2010 \times 10^{-9}Q^2$

Table 4.4 - Rating data at Section 18.900

N	Discharge,Q (cfs)	Water Surface Elev.,WSE (ft)
1	2,000.00	1152.10
2	7,000.00	1153.77
3	12,000.00	1154.93
4	17,000.00	1155.86
5	22,000.00	1156.59
6	27,000.00	1157.15
7	32,000.00	1157.57
8	37,000.00	1157.87
9	42,000.00	1158.11
10	47,000.00	1158.29
11	52,000.00	1158.46
12	57,000.00	1158.64
13	62,000.00	1158.87
14	67,000.00	1159.18
15	72,000.00	1159.59

Note: These values were generated using the 1979-data and the slope-area method suggested by **Hoggan (1989).**
$WSE = 1151.7 + 3.36911 \times 10^{-4}Q - 6.1161 \times 10^{-9}Q^2 + 4.11097 \times 10^{-14}Q^3$

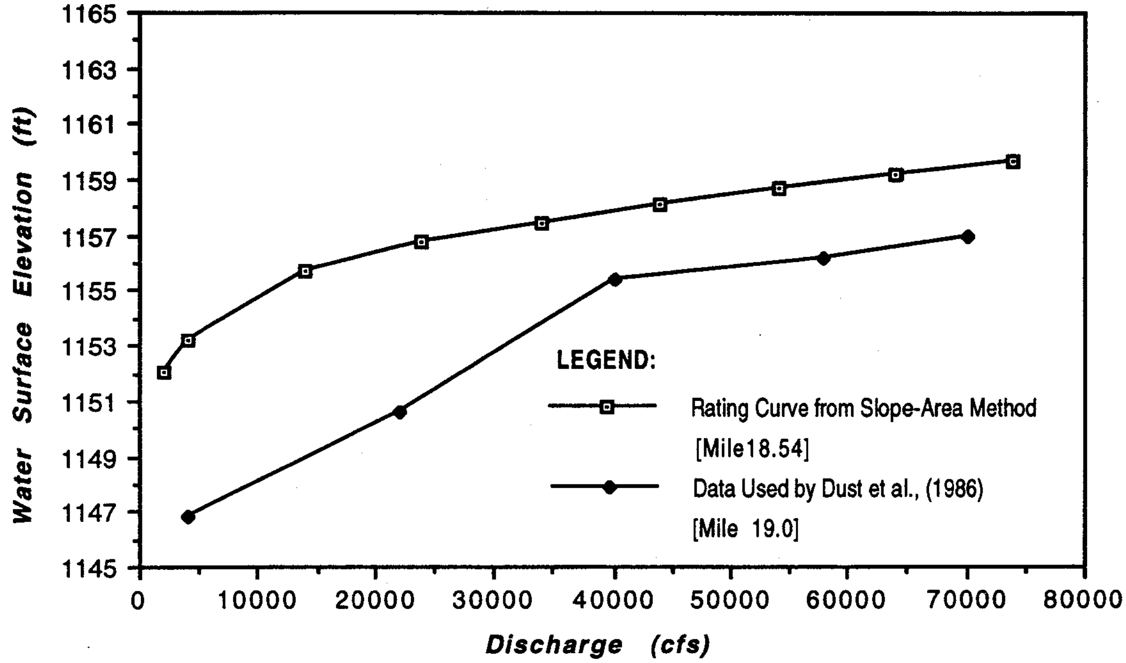

Figure 4.6 - Rating curves for the most downstream section of the study reach.

4.1.2.3 Sediment Data - The gradation data for the sediments along the study reach were obtained from the works of **Dust et. al, (1986).** There were three gradation types of sediments presented of which only two are presented in this report. They are classified as:

(i) *Type-1* data which is composed predominantly of sands with less than 6% gravel; and,

(ii) *Type-2* data which is described by a more uniform gradation with about 35% gravel.

These sediment data are presented in **Table 4.5** and their corresponding gradation curves are shown in **Figure 4.7.**

4.2 Determination of Inflowing Sediment Load

Inflowing sediment load data at the most upstream section of the river reach are non-existent. And since an assumption of zero inflowing sediment load is not physically realistic, generation of inflowing sediment load for the preliminary study is considered. **Dust et al., (1986)** has given a comprehensive outline on how inflowing sediment load can be generated.

Table 4.5 - Sediment data [Dust et al., 1986]

Classification	Size Range (mm)	Percentage (%) Type-1	Percentage (%) Type-2
Very Fine Sand	0.062- 0.125	3.500	0.200
Fine Sand	0.125- 0.250	4.500	0.400
Medium sand	0.250- 0.500	26.000	11.400
Coarse Sand	0.500- 1.000	41.000	19.000
Very Coarse Sand	1.000- 2.000	15.000	19.500
Very Fine Gravel	2.000- 4.000	5.500	12.000
Fine Gravel	4.000- 8.000	2.167	9.000
Medium Gravel	8.000- 16.000	2.333	9.200
Coarse Gravel	16.000- 32.000	0.000	10.300
Very Coarse Gravel	32.000- 64.000	0.000	9.000

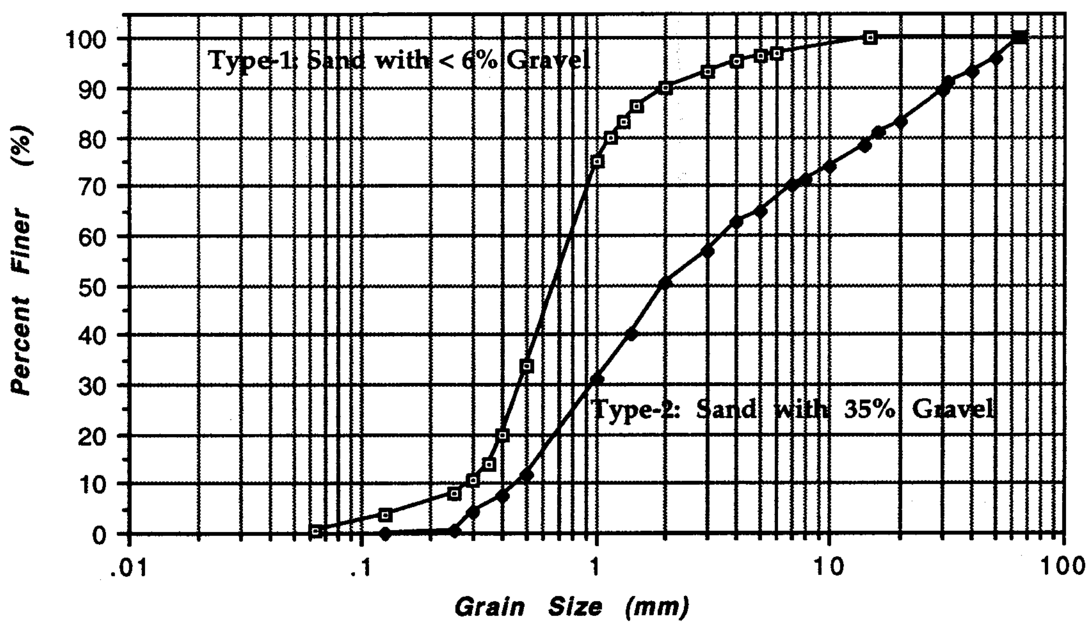

Figure 4.7 - Gradation curves for the sediments collected at the study reach

4.2.1 Data Requirements

The set of data required for the determination of inflowing sediment load include:

(i) <u>A complete set of geometric data</u> - This geometric data can be for the entire study reach or the 'upstream dummy reach', which is comprised of a number of sections whose geometric and sediment data are duplicates of the geometric and sediment data of the most upstream section.

This 'dummy reach' maintains a bed slope that is representative of the bed slope of the immediate downstream or upstream reach. It has been observed that either of these sets of geometric data can be used to generate satisfactory inflowing sediment data. However, it is more efficient to use the 'dummy reach' geometric data.

(ii) <u>A complete set of sediment data</u> - The sediment data for the study reach could be duplicates of the sediment data of the most upstream cross-section. For the L-records, the data are initially set to zero and the values are updated iteratively until satisfactory convergence is reached.

(iii) <u>Hydrologic data</u> - Three or more sets of hydrologic data are needed which include the lower and upper limits of discharge (e.g., the low-flow, bank-full flow, or the high-flow) expected in the river. In addition, the total duration of each of these sets of hydrologic data must be long enough to allow *'equilibrium transport rates'* to be computed. However, the individual time steps within the hydrologic data sets must be short enough to preserve 'computational stability'.

4.2.2 Procedures in the Determination of Inflowing Sediment

Given the above input data for **HEC-6**, the L-card data (i.e. the inflowing sediment data and the percentage of each sediment size) can be generated in the following manner,

Step (1) Execute **HEC-6** separately for the three or more sets of hydrologic data. The calculated sediment loads, for each reach increment and grain size, are listed in '*C' level output. If the "dummy reach" is used, select a reach increment located near the middle of the dummy reach and use the corresponding calculated transport rates as L-card value for the next set of **HEC-6** executions.

Similarly, select a reach increment that best resembles the river upstream of the study reach and use the calculated transport rates as L-card values for the next set of **HEC-6** executions, if the entire study reach is used.

Step (2) Repeat *Step (1)* until the calculated sediment discharges converge to the 'equilibrium' discharge for each grain size considered.

Step (3) *Steps (1)* and *(2)* need to be repeated for each transport relationship considered in the study.

The importance of the L-card data can be reduced by adding several 'dummy-sections' to the upstream end of the geometric data. These dummy sections/reaches can be copies of the most upstream cross-sections where the elevations and reach lengths of the duplicated cross-sections are adjusted to maintain the bed-slope. Dummy sections can also be the actual cross-sections upstream of the river study reach.

After the inflowing sediments are obtained for each sediment transport function, they are used in the model as upstream boundary conditions in simulating the sediment transport processes in the river. Using the flood events, the extent of degradation and aggradation in the study reach could be simulated. These simulated results from the model could be compared with the actual physical data (i.e, observed data). The sediment transport function that gives the closest agreement with the actual physical data will be selected as the most appropriate transport function to model the transport dynamics and sedimentation processes in the river.

4.2.3 Inflowing Sediment Loads

Ten (10) sediment transport functions have been evaluated in the determination of the inflowing sediment load associated with the four (4) flows considered (i.e., 4,000, 20,000, 45,000 and 67,000 cfs). Using the *Type-2* sediment data (see **Table 4.5** and **Figure 4.7**) throughout the 39 sections of the study reach, the generated inflowing sediment loads are listed in the ***Appendix B*** [see **Tables B.2-1** to **B.2-10]** which also list the amount of load for each grain class size considered.

The summary of these generated inflowing sediment loads corresponding to the four (4) discharge rates are listed in **Table 4.6**. As can be observed, a flow discharge of 4,000 cfs could generate a sediment load of about 11,301.1 tons/day using the Toffaleti formula or 38,274 tons/day using the Madden's modification (1963) formula. The grain sizes in ***Appendix B*** (i.e., VFS - very fine sand; FS - fine sand; MS - medium sand; CS - coarse sand; and VCS - very coarse sand, etc.) refer only to the sand and gravel size aggregates, as classified by the **U.S. Army Corps of Engineers [1991],** for the **HEC-6** code.

Table 4.6- Summary table of the Q-G_S [discharge-inflowing sediment load] relationship.

MTC No.	Sediment Transport Function	Sediment Load, G_S (tons/day) Q = 4000 cfs	Q = 20000 cfs	Q = 45000 cfs	Q = 60000 cfs
0,1	Toffaleti	11301.1	90264.2	145083.0	156146.0
3	Madden's (1963)	38274.0	278592.0	——	2200540.0
4	Yang's streampower	13900.2	110223.3	350663.1	604913.3
5	Duboys	61850.2	325068.1	704987.8	1058847.5
7	Ackers and White	16700.7	103099.7	318772.6	560082.5
8	Colby	4032.8	27873.2	66773.6	95300.3
9	Toffaleti/Schoklitsch	15642.6	115699.0	204395.7	245111.6
10	Meyer-Peter and Muller	10900.6	65493.9	175053.0	271187.9
12	Toffaleti/Meyer-Peter and Muller	21794.4	154974.0	319006.3	426247.1
13	Madden's (1985)	16351.0	88347.0	——	274768.0

4.3 Selection of Sediment Transport Function

4.3.1 Selection Process

As presented earlier, the current version of the **HEC-6** code offers ten (10) sediment transport functions for users to choose from. These functions (see **Table 4.7)** are used in the evaluation of the most appropriate sediment transport function for the sedimentation modeling of the Agua Fria River.

Table 4.7 - Sediment transport function options for HEC-6

MTC No.	Transport Function
0,1	Toffaleti
3	Madden's (1963) modifications of Laursen's formula (1958)
4	Yang's stream power function
5	Duboys
7	Ackers and White
8	Colby
9	Toffaleti and Schoklitsch
10	Meyer-Peter and Muller
12	Toffaleti and Meyer-Peter & Muller
13	Madden's (1985) modification of Laursen's formula (1958)

The procedure for the selection process of the most appropriate sediment transport function for the sedimentation modeling of the Agua Fria River can be briefly summarized as follows:

(i) Select a river reach of considerable length having good information on the following:

(a) <u>Geometric Data</u> - Topographical information before and after a flood event or series of flood events along the study reach. This is to assume that the flood or flood events play a vital role in affecting major morphological changes in the river.

(b) <u>Sediment Data</u> - Gradation data information for the sediments collected prior to the first flood events.

(c) <u>Hydrologic Data</u> - All flood data that had passed the river reach before the next topographical mapping is made.

(ii) Create a **HEC-6** input data file comprising of: (a) geometric data drawn from the first topographical mapping; (b) hydrologic data consisting of all flood events; and (c) sediment data comprising the gradation data.

(iii) Run **HEC-6** computer model using the different sediment transport formulas.

(iv) Compare the simulated thalweg elevations drawn from the **HEC-6** run results with the observed thalweg elevation data [observed from the topographic map].

(v) Select the sediment transport function that results in acceptable agreement with the observed thalweg elevations. If visual comparison among the sediment transport functions is difficult, a statistical evaluation of the total deviation and total squares of the deviation between the observed (i.e., 1989-thalweg elevation data) and simulated data will be considered.

Statistically, the most appropriate sediment transport function can be evaluated based on either one or both of the following two criteria considering the observed and the simulated results:

<u>Criterion I:</u> Minimum Sum of the Deviation

$$\text{Minimum DEV} = \sum_{i=1}^{N} \left| YOBS_i - YSIM_i \right|$$

<u>Criterion II:</u> *Minimum Sum of Squares of the Deviation*

$$\text{Minimum SSQ} = \sum_{i=1}^{N} \left| YOBS_i - YSIM_i \right|^2$$

where DEV is the absolute sum of the deviation; SSQ is the sum of squares of the deviation;$YOBS_i$ is the observed thalweg-elevation at station i; $YSIM_i$ is the simulated thalweg elevation at station i; N is the number of stations along the study reach; and, i is the station index number; $1 \le i \le N$.

4.3.2 Simulated Results

The simulation results involving the 10 sediment transport functions have been plotted for visual evaluation. In the presentation of the results, the three segments used earlier in comparing the thalweg elevations of the 1979- and 1989-data will be considered. This is to provide a more distinctive evaluation between the simulated results and the observed data. Again these three segments are defined as follows:

(i) First segment	*- downstream sub-reach*	*[Mile 18.90 - Mile 21.09]*
(ii) Second segment	*- middle sub-reach*	*[Mile 21.24 - Mile 23.75]*
(iii) Third segment	*- upstream sub-reach*	*[Mile 23.62 - Mile 25.79]*

For each segment, the simulated results from sediment transport functions are plotted against the 1989-thalweg elevation data in order to assess the most appropriate sediment transport function. The selection process using this approach is very difficult because in most cases the plots generated are close to one another; or in, some instances, the performance of some functions may be poor at some stations but show good results at other segments in the river reach.

Figures 4.8 (a), (b), and **(c)** show the plots of the simulated results using Toffaleti formula, Madden (1963) modification of Laursen's formula, and Yang's stream power function. Here, the simulated results obtained from the use of Madden's (1963) modification of Laursen's formula provides the best behavior among the three sediment transport formulas. Yang's streampower formula, however, behaves very closely to Madden's (1963) formula; in fact, it even outperforms the latter at some cross-sections. Here, the simulated bed elevations from the three sediment functions are generally lower in the first segment but are higher in the second and third segments of the reach.

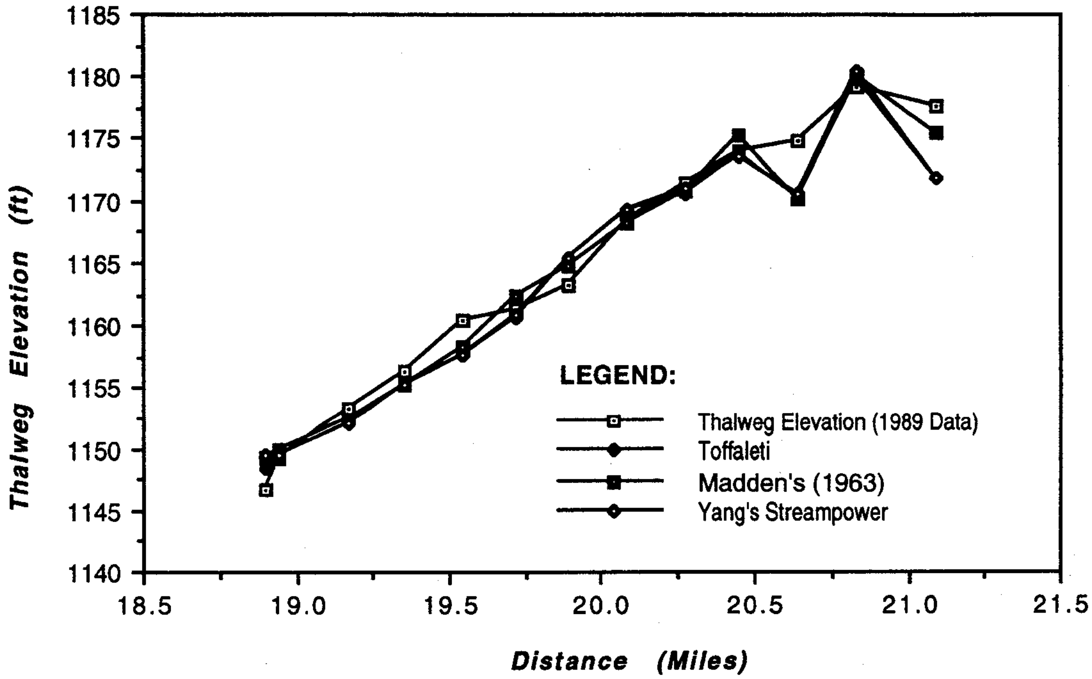

Figure 4.8 (a) - Plot of simulation results from three sediment transport formulas against the 1989-thalweg data [First segment].

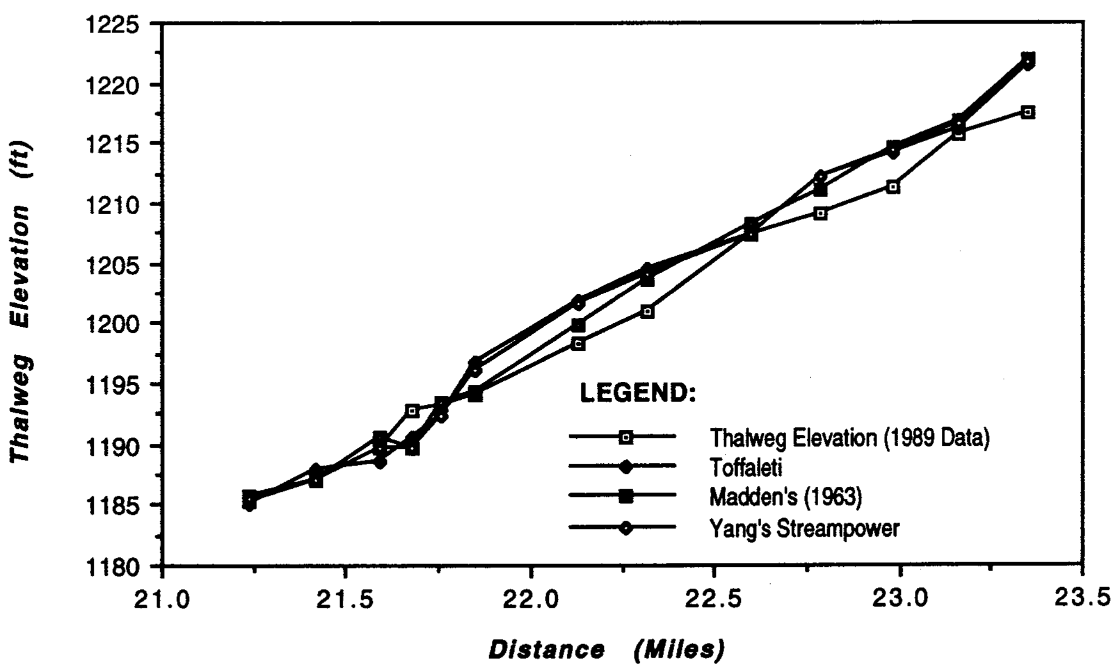

Figure 4.8 (b) - Plot of simulation results from three sediment transport formulas against the 1989-thalweg data [Second segment]

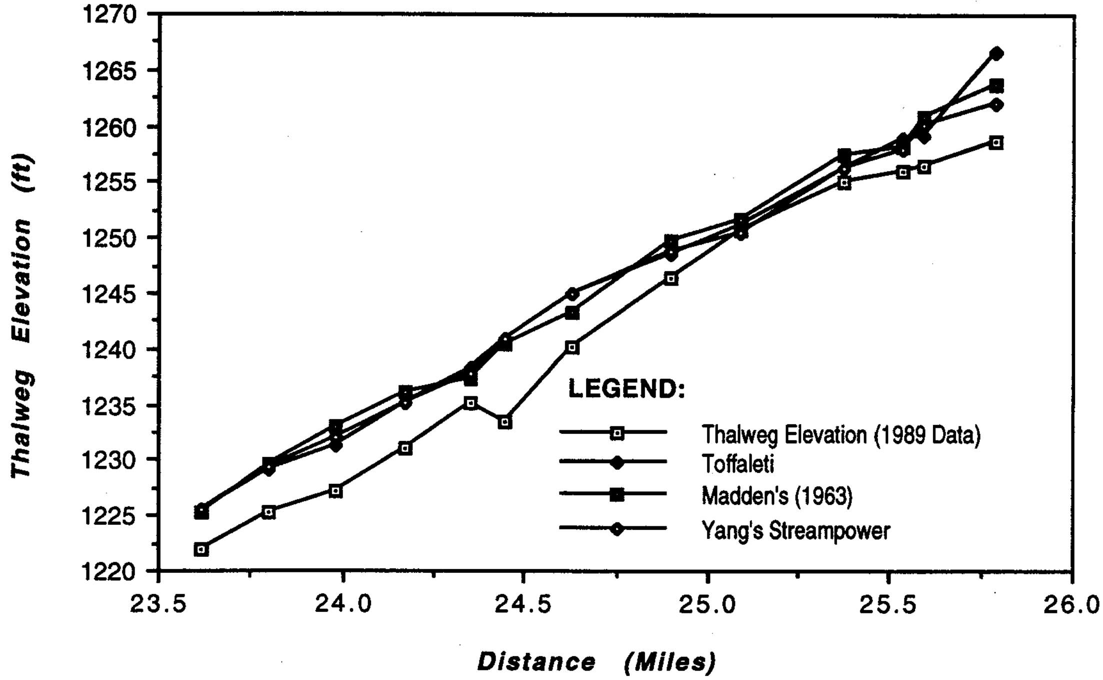

*Figure 4.8 (c) - **Plot of simulation results from three sediment transport formulas against the 1989-thalweg data** [Third segment]*

Figures 4.9 (a), (b) and **(c)** show the plot of the simulated results using Duboys, Ackers and White, and Colby formulas. Evaluation of the plots against the 1989-data thalweg elevation data shows superiority of Duboys over the other two functions.

Figures 4.10 (a), (b), and **(c)** show the plot of the simulated results using Toffaleti & Schoklitsch, Meyer-Peter & Muller, Toffaleti/Meyer-Peter and Muller, and the Madden's (1985) formulas. Analytical comparison using the two criteria as presented in **Section 4.3.1** provided the quantitative basis for the selection and evaluation processes.

4.3.3 Most Appropriate Sediment Transport Function

The purpose of conducting the preliminary analysis for the Agua Fria River is to select the most appropriate sediment transport function for the sedimentation modeling of the river. Two criteria were used for the quantitative evaluation in the selection process as previously defined in **Section 4.3.1.**

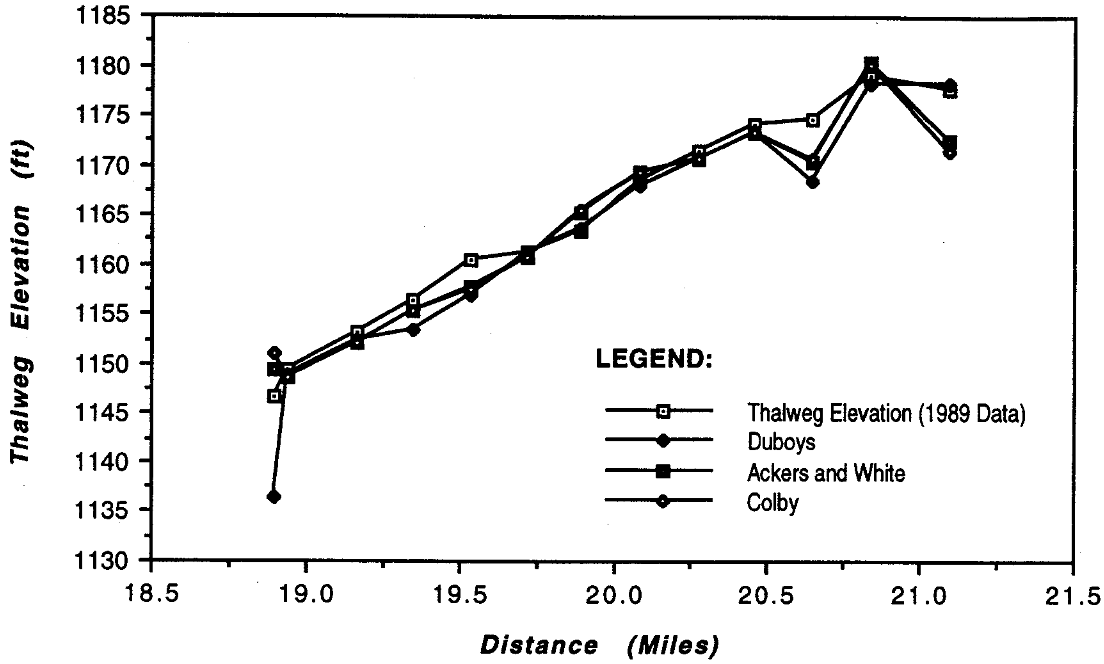

Figure 4.9 (a) - Plot of simulation results from three sediment transport formulas against the 1989-thalweg data [First segment]

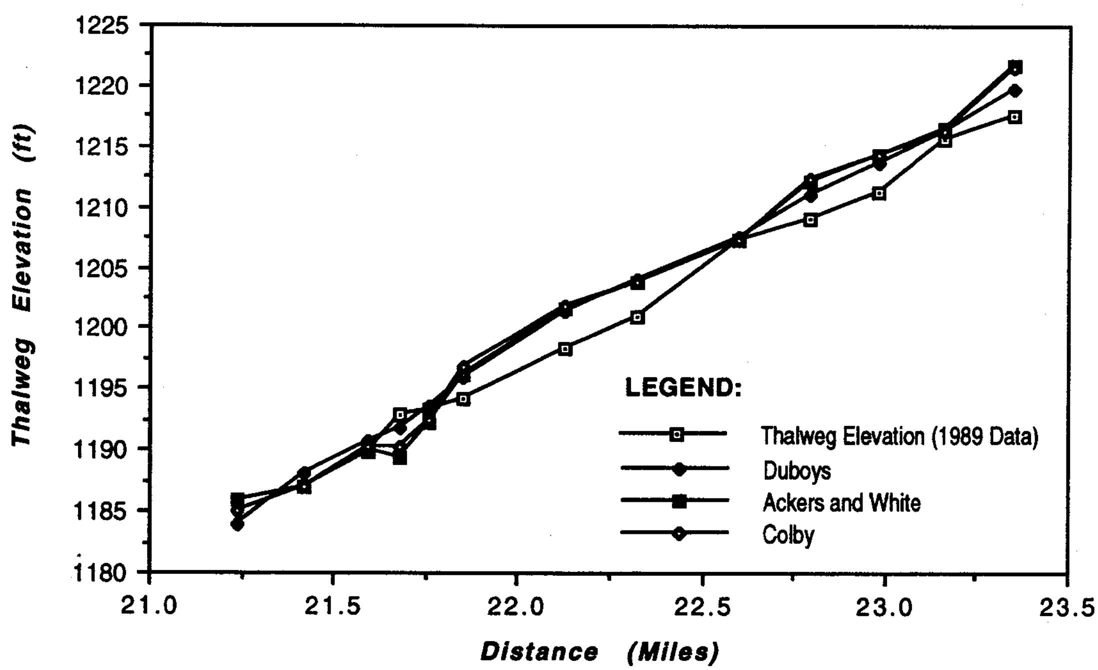

Figure 4.9 (b) - Plot of simulation results from three sediment transport formulas against the 1989-thalweg data [Second segment]

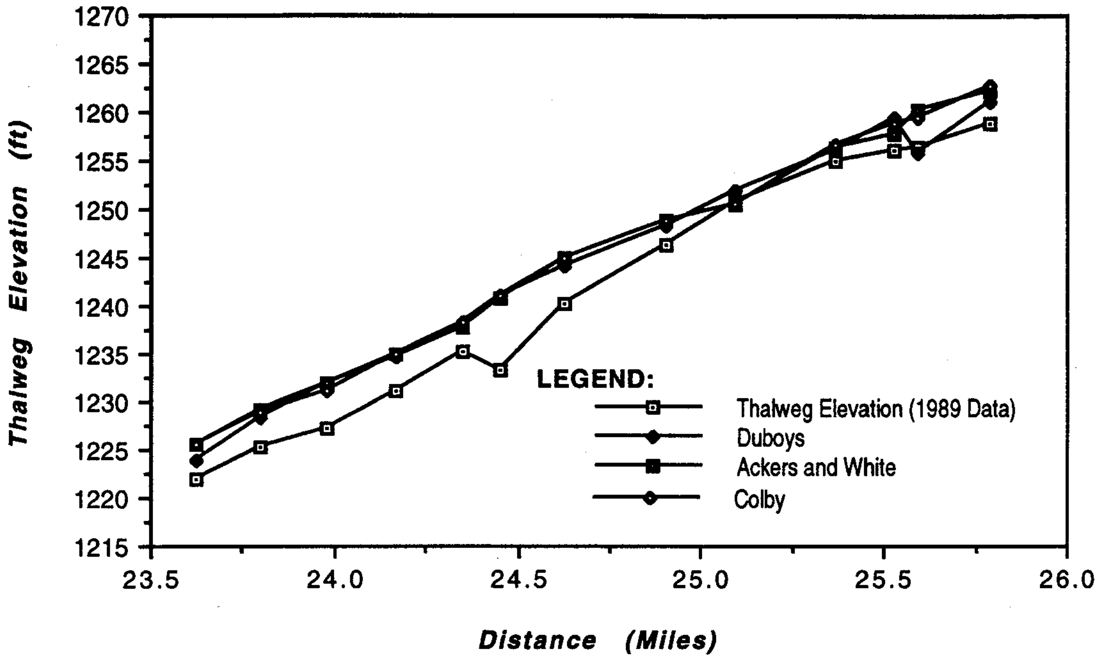

Figure 4.9 (c) - Plot of simulation results from three sediment transport formulas against the 1989-thalweg data [Third segment]

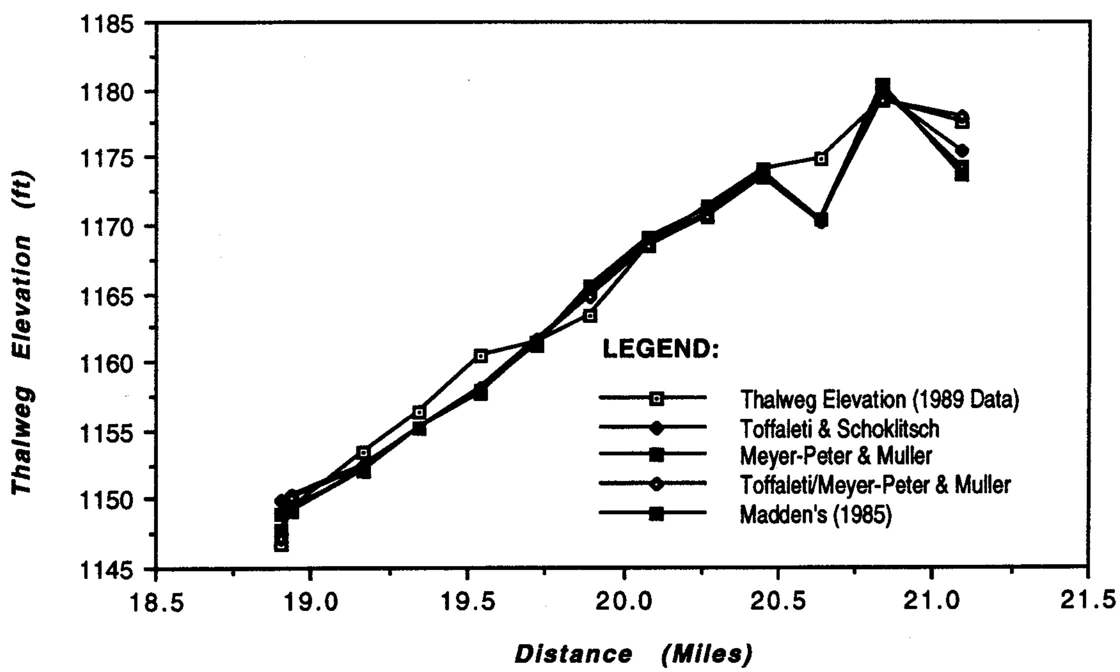

Figure 4.10 (a) - Plot of simulation results from four sediment transport formulas against the 1989-thalweg data [First segment]

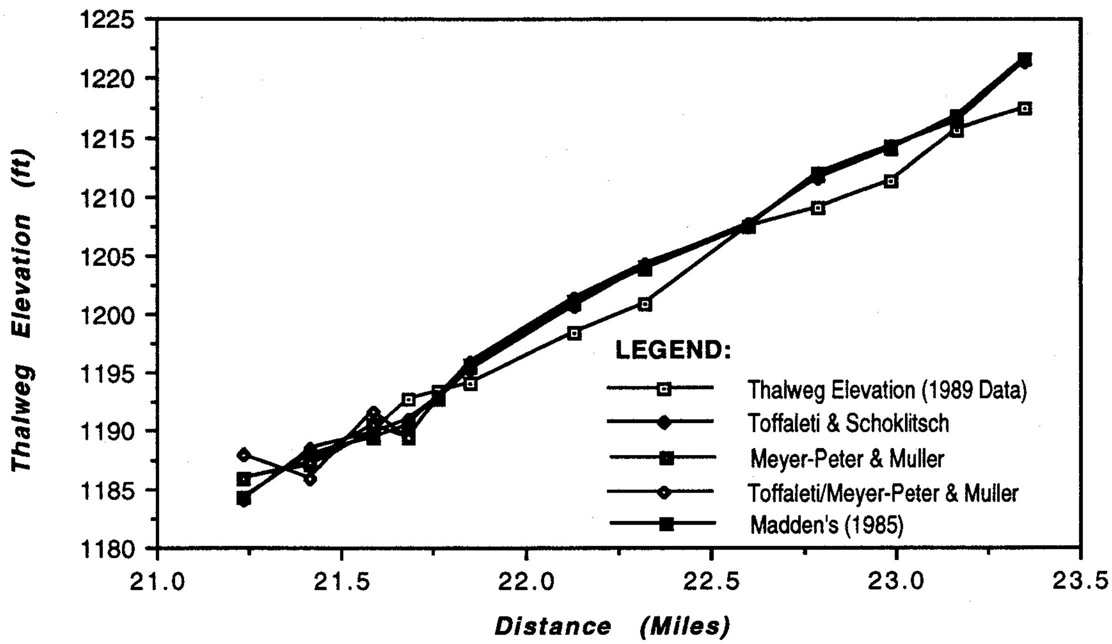

Figure 4.10 (b) - Plot of simulation results from four sediment transport formulas against the 1989-thalweg data [Second segment]

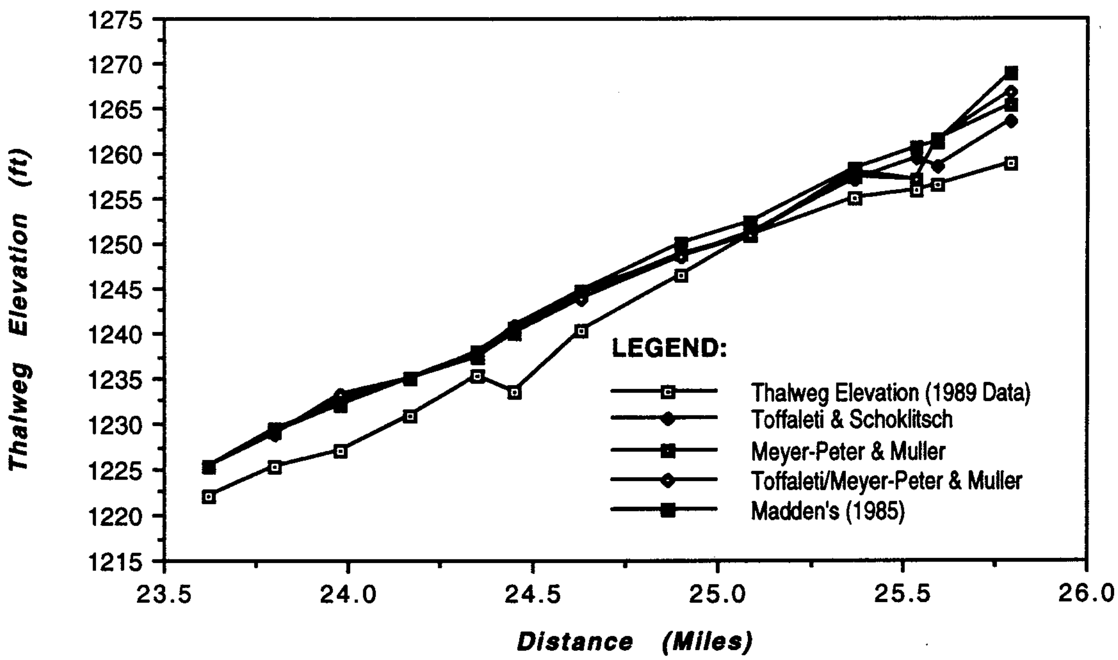

Figure 4.10(c) - Plot of simulation results from four sediment transport formulas against the 1989-thalweg data [Third segment]

From the simulated results in **Table 4.8,** Duboys formula seemed to be the most appropriate transport function based on criterion I (i.e., the least sum of deviations). However, the formula performed very inferior to almost all the sediment transport functions under criterion II (i.e., sum of the squares of the deviations) which explains that the function often brings about large deviation values.

Table 4.8 - Evaluated values of the two criteria in the selection process

MTC No.	Sediment Transport Function	Sum of Deviation	Sum of Squares of Deviations
0,1	Toffaleti	96.06	372.61
3	Madden (1963)	88.61	317.49
4	Yang's Streampower	92.04	339.36
5	Duboys	86.86	364.31
7	Ackers and White	91.34	327.28
8	Colby	95.83	352.35
9	Toffaleti and Schoklitsch	87.20	299.79**
10	Meyer-Peter and Muller	88.04	324.29
12	Toffaleti and Meyer-Peter & Muller	88.42	337.68
13	Madden (1985)	102.28	439.28

Note: ** Toffaleti and Schoklitsch formula provided the most appropriate predictor for the transport dynamics of sediments at the study reach.

Toffaleti and Schoklitsch formula - the combined computational effort of Schoklitsch formula - that computes the bed load component - and the Toffaleti formula - that evaluates the rest of the sediment load components other than the bed load, offered the second best performance under Criterion I after Duboys. Under Criterion II, it excelled in performance over the rest of the functions evaluated.

This superior performance of the combined relations of Toffaleti and Schoklitsch formulas indicates its suitability for the sedimentation modeling of the Agua Fria River. In addition to the fact that it has the capability to describe very closely the complex sediment transport dynamics along the river reach, it also exhibited consistency. Associated with the summary results presented in **Table 4.8, Tables 4.9 (a)** and **(b)** list the station-by-station results generated by the ten (10) sediment transport functions in the analysis. The observed 1989-thalweg data were also included for purposes of comparison.

Table 4.9 (a) - Simulated results of the ten sediment transport functions

Station Number	Observed 1989-Data	Thalweg Elevation (ft) MTC=1	MTC=3	MTC=4	MTC=5	MTC=7
25.790	1258.80	1266.53	1263.87	1262.17	1261.21	1262.10
25.590	1256.50	1259.07	1260.77	1260.07	1255.93	1260.17
25.530	1256.00	1258.83	1258.26	1258.04	1259.41	1257.72
25.370	1255.00	1256.37	1257.40	1256.32	1256.22	1256.44
25.090	1250.80	1251.23	1251.70	1250.49	1251.87	1250.55
24.900	1246.50	1248.50	1249.74	1248.85	1248.38	1248.99
24.630	1240.20	1244.90	1243.27	1244.89	1244.23	1244.91
24.450	1233.40	1240.96	1240.42	1240.87	1241.01	1240.76
24.350	1235.20	1238.34	1237.29	1237.88	1237.77	1237.88
24.170	1231.00	1235.04	1236.03	1235.13	1234.75	1235.09
23.980	1227.20	1231.31	1232.95	1232.04	1231.84	1231.89
23.800	1225.20	1229.06	1229.59	1229.29	1228.46	1229.2
23.620	1222.00	1225.42	1225.30	1225.57	1224.02	1225.55
23.350	1217.60	1221.50	1221.95	1221.67	1219.82	1221.70
23.160	1215.70	1216.22	1216.81	1216.54	1216.16	1216.44
22.980	1211.30	1214.20	1214.58	1214.44	1213.74	1214.32
22.790	1209.10	1212.17	1211.07	1212.18	1210.94	1212.16
22.600	1207.40	1207.28	1208.32	1207.36	1207.63	1207.31
22.320	1201.00	1204.45	1203.67	1204.06	1203.98	1203.88
22.130	1198.40	1201.73	1199.87	1201.71	1201.31	1201.65
21.850	1194.20	1196.72	1194.33	1196.01	1196.00	1196.14
21.760	1193.30	1192.41	1193.43	1192.31	1193.59	1192.30
21.680	1192.80	1190.50	1189.71	1189.67	1191.76	1189.48
21.590	1189.80	1188.58	1190.61	1189.73	1190.78	1189.95
21.420	1187.00	1187.99	1187.15	1187.06	1188.00	1187.07
21.240	1185.80	1185.03	1185.40	1185.47	1183.86	1185.94
21.090	1177.60	1171.90	1175.43	1171.80	1178.27	1172.50
20.830	1179.20	1179.92	1180.06	1180.51	1178.27	1180.29
20.640	1174.80	1170.44	1170.25	1170.52	1168.62	1170.49
20.450	1174.10	1173.85	1175.40	1173.62	1173.43	1173.34
20.270	1171.40	1170.68	1170.79	1171.11	1170.63	1170.82
20.080	1168.50	1169.26	1168.20	1169.27	1167.93	1169.23
19.890	1163.30	1165.45	1164.75	1165.44	1163.67	1165.41
19.720	1161.40	1160.77	1162.29	1160.86	1161.28	1160.87
19.540	1160.40	1157.62	1158.22	1157.71	1156.99	1157.71
19.350	1156.40	1155.31	1155.22	1155.27	1153.37	1155.33
19.170	1153.30	1152.10	1152.48	1152.04	1152.38	1152.04
18.940	1149.30	1149.58	1149.86	1149.44	1148.87	1148.69
n=39 18.900	1146.70	1148.38	1149.17	1149.55	1136.48	1149.43
Sum of Deviation		96.06	88.61	92.04	86.86	91.34
Sum of Squares of Deviation		372.61	317.49	339.36	364.31	327.28

Where: MTC = 1, Toffaleti; MTC = 3, Madden's (1963); MTC = 4, Yang's Stream power function; MTC = 5 Duboys; and MTC = 7, Ackers and White.

Table 4.9 (b) - Simulated results of the ten sediment transport functions

Station Number	Observed 1989-Data	Thalweg Elevation (ft)				
		MTC=8	MTC=9	MTC=10.	MTC=12	MTC=13
25.790	1258.80	1262.68	1263.44	1265.20	1266.64	1268.95
25.590	1256.50	1259.55	1258.51	1261.50	1261.56	1261.29
25.530	1256.00	1259.02	1259.51	1257.14	1257.09	1260.61
25.370	1255.00	1256.55	1256.92	1257.31	1258.03	1258.22
25.090	1250.80	1250.42	1251.24	1250.82	1250.80	1252.43
24.900	1246.50	1248.90	1248.57	1248.91	1248.61	1249.91
24.630	1240.20	1245.02	1244.77	1244.42	1243.93	1244.84
24.450	1233.40	1241.02	1240.77	1240.05	1239.89	1240.70
24.350	1235.20	1238.42	1237.35	1237.44	1237.42	1237.89
24.170	1231.00	1235.12	1234.88	1234.92	1235.06	1235.14
23.980	1227.20	1231.12	1231.96	1232.55	1233.09	1232.05
23.800	1225.20	1228.99	1229.09	1229.11	1228.93	1229.43
23.620	1222.00	1225.53	1225.25	1225.18	1225.28	1225.33
23.350	1217.60	1221.61	1221.39	1221.60	1221.50	1221.54
23.160	1215.70	1216.27	1216.43	1211.84	1211.68	1212.05
22.600	1207.40	1207.27	1207.47	1207.53	1207.63	1207.44
22.320	1201.00	1203.75	1204.24	1203.93	1204.01	1203.98
22.130	1198.40	1201.82	1201.32	1201.13	1200.78	1200.81
21.850	1194.20	1196.82	1195.85	1195.56	1195.16	1195.70
21.760	1193.30	1192.42	1193.05	1192.77	1192.62	1193.01
21.680	1192.80	1190.22	1190.84	1189.39	1189.38	1190.39
21.590	1189.80	1190.32	1189.66	1190.48	1191.58	1189.24
21.420	1187.00	1187.02	1188.43	1187.29	1186.01	1187.85
21.240	1185.80	1185.12	1184.06	1185.97	1187.87	1184.35
21.090	1177.60	1171.60	1175.39	1174.35	1177.92	1173.66
20.830	1179.20	1180.20	1179.81	1179.93	1179.19	1180.23
20.640	1174.80	1170.60	1170.25	1170.37	1170.40	1170.36
20.450	1174.10	1173.34	1173.53	1173.55	1173.51	1173.96
20.270	1171.40	1170.84	1170.78	1170.58	1170.50	1171.06
20.080	1168.50	1169.34	1168.64	1168.90	1168.38	1169.01
19.890	1163.30	1165.52	1164.79	1165.12	1164.78	1165.43
19.720	1161.40	1160.76	1161.32	1161.42	1161.66	1161.10
19.540	1160.40	1157.62	1157.88	1157.77	1158.13	1157.89
19.350	1156.40	1155.41	1155.13	1155.09	1155.18	1155.24
19.170	1153.30	1152.07	1152.34	1152.02	1152.19	1152.12
18.940	1149.30	1148.52	1150.26	1149.14	1150.05	1149.39
18.900	1146.70	1150.92	1149.84	1147.77	1147.18	1148.99
Sum of Deviation		95.83	87.20	88.04	88.42	102.28
Sum of Squares of Deviation		352.35	299.79	324.29	337.68	439.28

Where: MTC = 8, Colby; MTC = 9, Toffaleti and Schoklitsch; MTC = 10, Meyer-Peter and Muller; MTC = 12, Toffaleti and Meyer-Peter and Muller; MTC = 13, Madden's (1985).

4.4 Sensitivity Analysis

Sensitivity analysis has been conducted to evaluate the model behavior against changes in the parameter values. The three parameters used in this analysis include: (i) the roughness coefficient; (ii) the inflowing sediment load; and, (iii) the sediment gradation. Only selected transport functions were used for the analysis to demonstrate their sensitivity with parameter changes.

4.4.1 Manning's Coefficient (n)

Four (4) sediment transport functions were used to evaluate their sensitivity against the changes in roughness coefficient values along the main channel of the study reach. These formulas include: Toffaleti and Schoklitsch, Meyer-Peter and Muller, Ackers and White, and Toffaleti/Meyer-Peter and Muller formulas.

(a) *Toffaleti and Schoklitsch Formula* - **Figures 4.11 (a), (b),** and **(c)** show the response of the model using Toffaleti and Schoklitsch function under four values of the roughness coefficient (n) [i.e., n = 0.02, 0.03, 0.04, and 0.05] while **Table 4.10a** lists the evaluated response. These evaluated responses in terms of the sum of deviation and sum of squares of deviation, indicate the insensitivity of the formula to changes in the values of roughness coefficients.

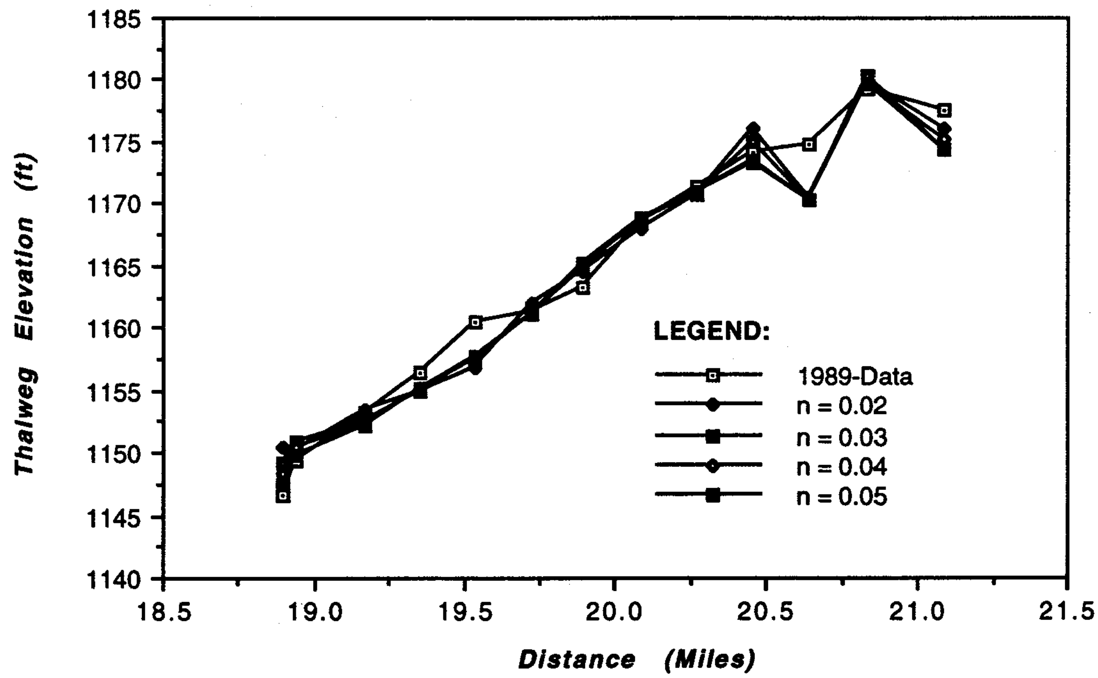

Figure 4.11 (a) - Model response to the change in roughness coefficient [Toffaleti and Schoklitsch Formula, First segment]

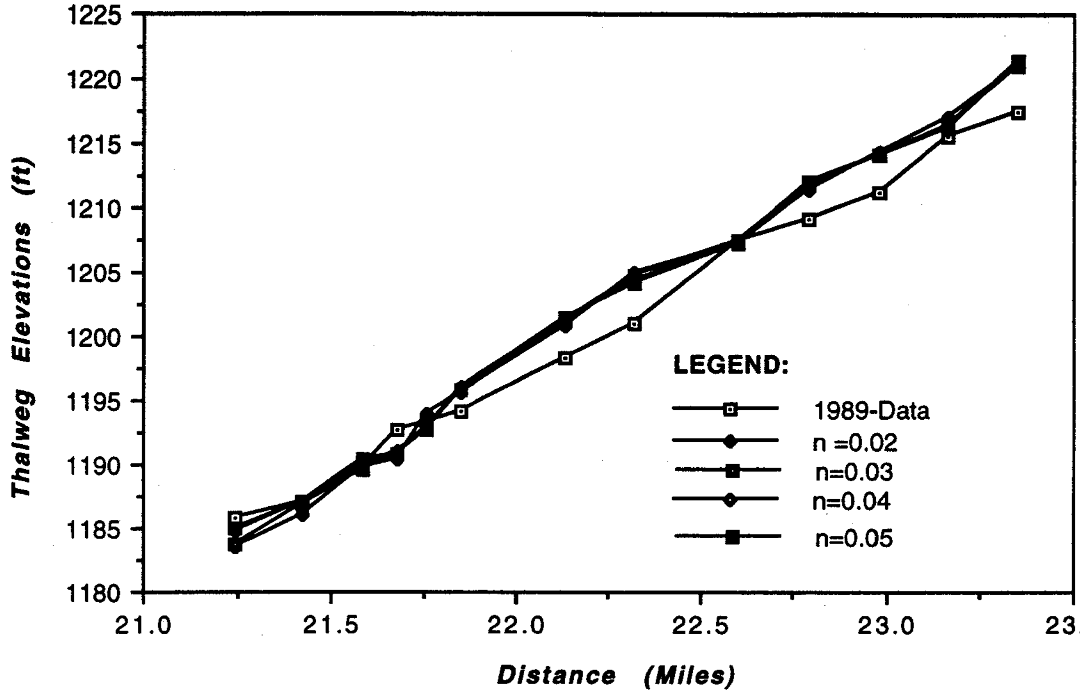

Figure 4.11 (b) - Model response to the change in roughness coefficient
[Toffaleti and Schoklitsch Formula, Second segment]

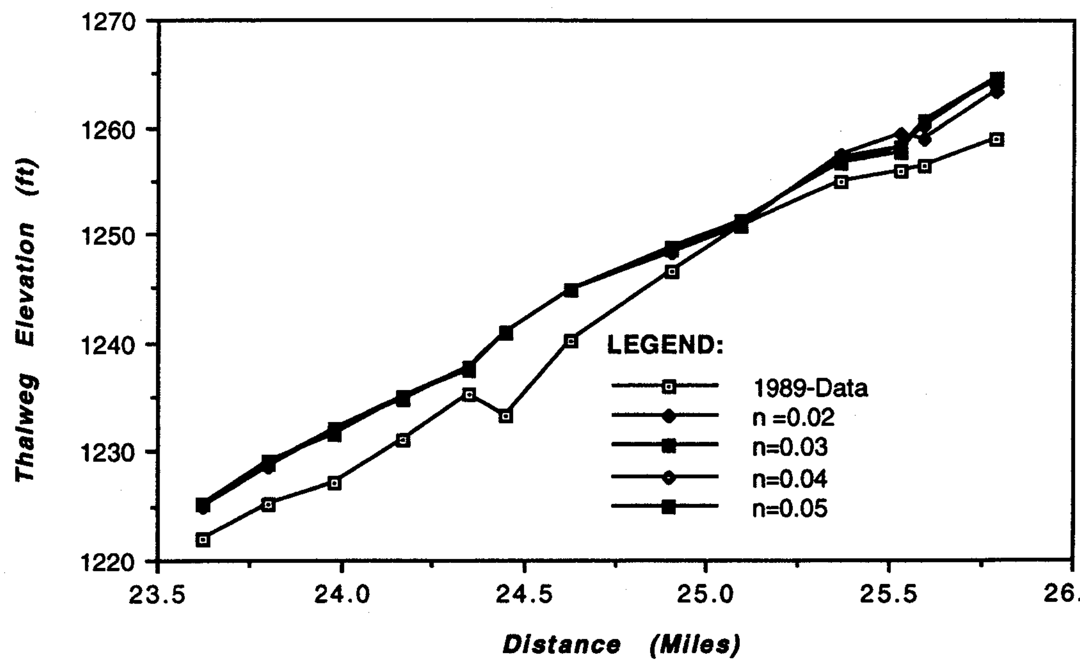

Figure 4.11 (c) - Model response to the change in roughness coefficient
[Toffaleti and Schoklitsch Formula, Third segment]

Table 4.10- Response of sediment transport functions on the change of roughness coefficient values

Roughness Coefficient 'n'	Sum of Deviation	Sum of Squares of Deviation
(a)	Toffaletti and Schoklitsch Formula	
n = 0.02	90.28	315.21
n = 0.03	89.71	316.48
n = 0.04	86.43	309.06
n = 0.05	87.10	317.17
(b)	Ackers and White Formula	
n = 0.02	83.08	293.06
n = 0.03	90.40	331.23
n = 0.04	94.36	353.61
n = 0.05	95.73	368.98
(c)	Meyer-Peter and Muller Formula	
n = 0.02	83.49	275.27
n = 0.03	88.45	334.03
n = 0.04	92.06	379.76
n = 0.05	93.52	405.16
(d)	Toffaleti/Meyer-Peter and Muller Formula	
n = 0.02	99.15	348.73
n = 0.03	93.80	372.33
n = 0.04	88.71	383.66
n = 0.05	94.86	443.77

(b) *Ackers and White Formula* - Similar work was done for the Ackers and White formula using four different values of the roughness coefficient, n. **Table 4.10b** lists the response of the model with these changes in the n-values. The sum of deviations and the sum of squares of the deviations were also evaluated for purposes of comparison. There is a slight sensitivity exhibited by the changes in roughness coefficient, n, on the performance of the Ackers and White formula as could be observed in **Figures 4.12** and **4.13**.

(c) *Meyer-Peter and Muller Formula* - **Table 4.10c** lists the response of the Meyer-Peter and Muller formula with changes in roughness coefficients. Similar to the Ackers and White formula, there is a pronounced sensitivity between the performance of Meyer-Peter and Muller formula and the roughness coefficient, n. The Meyer-Peter and Muller formula, however, is more sensitive

to the roughness coefficient, n, than the Ackers and White formula (see **Figures 4.12** and **4.13**).

(d) <u>*Toffaleti/Meyer-Peter and Muller Formula*</u> - **Table 4.10d** lists the response of the Toffaleti/Meyer-Peter and Muller formula with changes in roughness coefficient values. Based on the evaluated sum of deviation and sum of squares of deviation, the Toffaleti/Meyer-Peter and Muller formula does not follow a definite trend as the Ackers and White, and the Meyer-Peter and Muller formulas as could be verified in the evaluated sum of deviation in **Figure 4.12**.

(e) <u>*Summary*</u> - **Tables 4.10** tabulates the summary of the response of the four (4) sediment transport functions with changes in the roughness coefficient values. Based on the evaluated criteria [e.g., minimum sum of deviation and minimum sum of squares of deviation], it is observed that the Toffaleti and Schoklitsch formula is not sensitive to the changes of roughness coefficients along the main channel; while the other three functions are very sensitive (see **Figures 4.12** and **4.13**). Also, it is observed that the Toffaleti/Schoklitsch and the Toffaleti/Meyer-Peter and Muller formulas have demonstrated an uncharacteristic trend in terms of model performance as based on Criterion I. The two provided more stable channels at n = 0.04 than at other values (i.e., n = 0.02, n = 0.03, or n = 0.05).

4.4.2 Inflowing Sediment Load and Sediment Gradation Data

Sensitivity analysis was also done on the inflowing sediment load and sediment gradation data. In all of the previous analyses, *Type-2* sediment data have been used in the model. Here, Type-*1* data coupled with zero inflowing sediment load are used as part of the sensitivity analysis to evaluate the responses of the model. Three sediment transport functions were used to demonstrate how their performance are affected by the changes in the values of the above parameters. These functions include the Toffaleti and Schoklitsch, the Meyer-Peter and Muller, and the Ackers and White formulas.

(a) <u>*Toffaleti and Schoklitsch Formula*</u> - **Table 4.11a** lists the model response under Meyer-Peter and Muller formula to changes in sediment data and inflowing sediment load. It is observed that zero upstream boundary condition [i.e. inflowing sediment load is zero] provides better model response - a fact that is proven by lesser values of the sum of deviation and sum of squares of the deviation. These results show the sensitivity of sediment data and inflowing sediment in the use of the Toffaleti and Schoklitsch formula.

(b) <u>*Ackers and White Function*</u> - **Table 4.11b** lists the response of the Ackers and White formula to the changes in sediment data and inflowing sediment load. Similar to the Meyer-Peter and Muller formula, the Ackers and White function exhibits better performance when the inflowing sediment load is zero. This, likewise, shows that there is a significant sensitivity between these parameters and the performance of Ackers and White formula in the model.

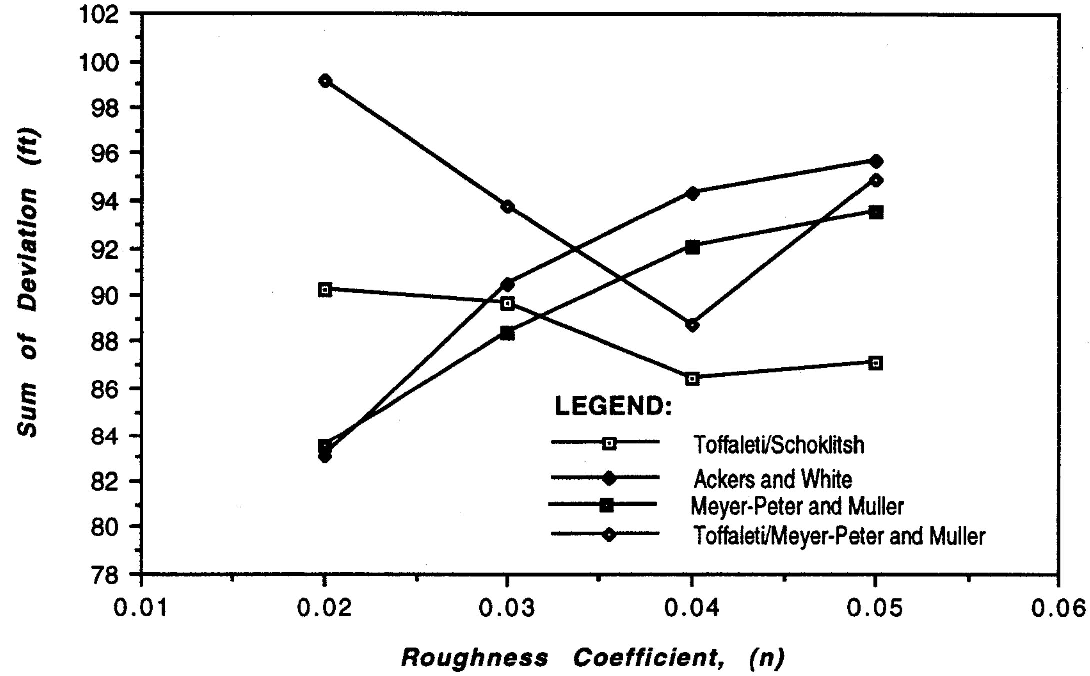

Figure 4.12 - Sum of deviation for four sediment transport functions

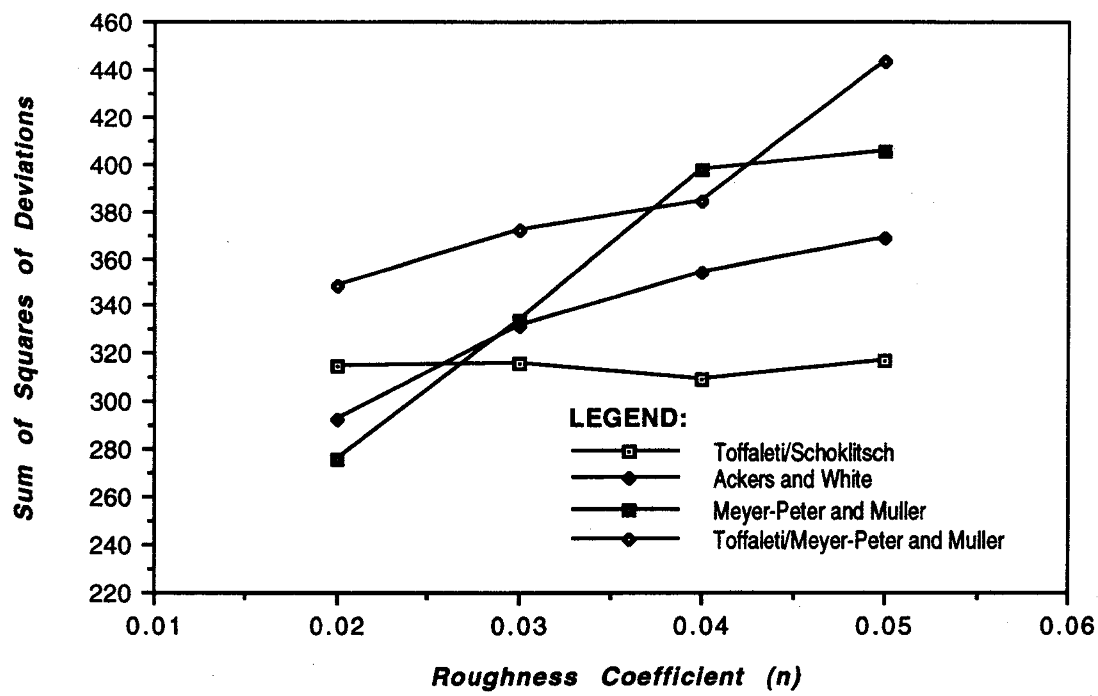

Figure 4.13- Sum of squares of deviation for four sediment transport functions

Table 4.11 - Response of sediment transport functions on the changes of inflowing sediment load and sediment data.

Sediment Data Classification*	Inflowing Sediment, Gs	Sum of Deviation	Sum of Squares of Deviations
(a)	Toffaleti and Schoklitsch Formula		
Type-1	Gs = 0.0	73.79	233.06
Type-2	Gs = 0.0	82.43	269.46
Type-2	Gs > 0.0**	87.20	299.79
(b)	Ackers and White Formula		
Type-1	Gs = 0.0	78.14	260.97
Type-2	Gs = 0.0	87.70	304.82
Type-2	Gs > 0.0**	91.34	327.28
(c)	Meyer-Peter and Muller Formula		
Type-1	G_s = 0.0	80.40	273.69
Type-2	G_s = 0.0	77.74	258.15
Type-2	G_s > 0.0**	88.04	324.29

Note: * Type-1 data is predominantly sandy with less than 6% gravel; Type-2 is graded uniformly with about 35% gravel.
** G_s is the generated inflowing sediment load.

(c) *__Meyer-Peter and Muller Formula__* - **Table 4.11c** lists the response of Yang's streampower function to the changes in inflowing sediment load and sediment data. Based on the evaluated sum of deviation (Criterion I) and sum of squares of deviation (Criterion II), the Meyer-Peter and Muller formula is sensitive to the parameters.

(d) *__Summary__* - All the three sediment transport functions analyzed exhibited significant sensitivity to the changes in inflowing sediment load and sediment gradation data. This is so because the dynamics of sediment transport along the river is governed principally by the sediment characteristics, particularly the sediment size. The degrees of sensitivity of the three sediment transport functions to the parameters, however, vary. Though, *Type-1* sediment data offer smaller mean grain size than the *Type-II* data, the behavior of the three transport functions are different.

Table 4.12 lists the response of the ten sediment transport functions to a zero inflowing sediment load while using the *Type*-2 gradation data in the entire study reach.

Table 4.12 - Summary table for the ten transport functions using zero inflowing sediment (G_s =0, Type-II data)

MTC No.	Sediment Transport Function	Sum of Deviation	Sum of Squares of Deviations
1	Toffaleti	90.93	318.62
3	Madden (1963)	75.35	242.00
4	Yang's Streampower	86.82	306.06
5	Duboys	75.28	294.59
7	Ackers and White	87.70	304.80
8	Colby	95.08	346.77
9	Toffaleti and Schoklitsch	82.43	269.46
10	Meyer-Peter and Muller	77.74	258.15
12	Toffaleti/Meyer-Peter and Muller	74.26	232.67
13	Madden (1985)	85.29	288.94

V MODELING DESCRIPTIONS

The sediment transport study for the Agua Fria River is aimed at using the **HEC-6** code to develop three models that describe different hydraulic scenarios associated with the existing, on-going, and proposed developments on and around the river. The three models are described in **Table 5.1.**

Table 5.1 - Scenarios of the different models to be developed for the Agua Fria River

Model	Modeling Scope
Model I	Develop a model to evaluate the sediment transport under the existing condition with New Waddell Dam and the Arizona Canal Diversion Channel (ACDC) built.
Model II	Develop a future condition model using the existing condition model (Model I) to reflect the ultimate sand and gravel mining as permitted today.
Model III	Develop a future condition model by adding a 1000-foot wide channel improvement along the Agua Fria River (wherever applicable) to Model II in order to evaluate the effect of the mining sites to the proposed channel.

5.1 Model I

5.1.1 Modeling Description

Model I evaluates the sediment transport under the existing condition at the Agua Fria River with the New Waddell Dam and the Arizona Canal Diversion Channel (ACDC) built.

5.1.2 Geometric Data

(i) River Geometry - The river geometry of the Agua Fria River is described by 96 cross-sections (see **Table A.1.1, Appendix A**) selected from the original 450 cross-sections provided by **Jerry R. Jones & Associates, Inc., (1989).** The basis of selecting 96 cross-sections for Model I is from the guidelines presented in **Section 2.2.1 [Chapter II].** Individual plots of the geometry for these selected cross-sections are presented in **Appendix A (Figs. A-1 to A-96)**

(ii) **Bridge-Crossings in the Agua Fria River** - There are 14 bridge crossings in the Agua Fria River (see **Table 2.2**). **Simons, Li and Assoc., Inc., (1983)** listed in their report some useful information on the bridge structures essential to the understanding of the hydraulic characteristics of these bridge crossings.

5.1.3 Sediment Data

The associated sediment data for the selected stations for Model I were from the field samples whose gradation curves are provided in **Appendix B.**

5.1.4 Hydrologic Data

Four hydrologic data under the post-New Waddell condition are used to run the three models developed. These data are for the 50-year, 100-year, 200- and 500-year peak releases from the New Waddell dam (see **Table 5.1.1**). Since the New River is the only significant tributary contributing to the main river, it is essential to consider the river's contribution to the flows at the Agua Fria River. The hydrologic study of the Agua Fria River in 1981 determined that a 100-year flood contribution of the New River during the 100-year flood at the Agua Fria River is about 5,000 cfs **[U.S. Army Corps of Engineers, Los Angeles, 1981]**. This peak discharge from the New River will be used for the four hydrographs [see **Tables C.2.1 to C.2.4, Appendix C]**. The duration of the hydrographs to be used is equivalent to the duration of the most recent 1980-flood event of about 8.7912 days.

Table 5.1.1 - Peak discharge from the New Waddell Dam

Return Period	Peak Discharges (cfs)
50 years	18,500.00
100 years	32,000.00
200 years	54,000.00
500 years	85,000.00

The above values were determined by the **US Army Corps of Engineers** based on the condition that the reservoir is full when the flood inflows occur. Since the hydrographs have not been completed during the modeling phases of the current study, a triangular-shape hydrograph was assumed with peaks occurring midway between the beginning and the ending of the flood event. Also, the hydrographs were discretized with discharge and time values computed according to the tabulated relations and values in **Table 5.1.2**. The attenuation of the flows at various locations along the river under the post-New Waddell Dam condition is presented in **Table C.3 [Appendix C]**. The values in this table were extracted from the behavior of the flow attenuation under the existing condition [i.e., pre-New Waddell Dam, see **Table 2.4, Chapter 2]**.

5.1.5 Model I Input Data Descriptions

5.1.5.1 Geometric and Hydraulic Data - The boundaries for the left and right overbanks (**X1** record) were modified from the HEC-2 input file used for the flood insurance study of the Agua Fria River (**Jerry R. Jones & Assoc., Inc., 1989**). The modifications were based on the plots made for the 96 stations (see **Figs. A-1** to **A-96**) which have aided in the redefinition of the boundaries (see **Table A.1.1, Appendix A**). Also, the **NH** data taken from the HEC-2 input file were used to define the **NC** record that assigns the channel roughness coefficients to the left overbank, right overbank, and main channels - based on the redefined overbank boundaries. The loss coefficients which account for the channel expansion and contraction losses are also included in the **NC** record. Further, the **HD** record was used to describe the extent of movable bed for each station and the depth of sediment reservoir storage available. The **X3** record was also used to define the extent of encroachment permitted in each station.

Between **Stations 9.13** and **9.90**, a **QT** record was inserted to indicate the presence of a tributary (i.e. New River) that contributes flow to the river.

Table 5.1.2 - Time duration and discharge relations in the development of hydrographs

n	Discharge Relation	Time Duration Relation	Equivalent Time Duration (days)	Cumulative Time (days)
1	0.00	-	0.000	0.000
2	0.25Q	t	1.850	1.850
3	0.50Q	0.75t	1.390	3.240
4	0.75Q	0.50t	0.925	4.165
5	1.00Q	0.25t	0.463	4.628
6	0.75Q	0.50t	0.925	5.553
7	0.50Q	0.75t	1.390	6.943
8	0.25Q	t	1.850	8.793
9	0.00	-	0.000	8.793

Where: Q is the peak discharge; t is the time duration associated with the lowest value of discharge.

5.1.5.2 Sediment Data - Since the Toffaleti and Schoklitsch formula (i.e., MTC No. 9, **I4** record) has been selected for the sedimentation modeling of the Agua Fria River, the inflowing sediment loads generated using Toffaleti and

Schoklitsch formula at Stations 33.82 - the most upstream station - was used (see **Table B-2-12, Appendix B**). These, in relation to the defined sets of discharges, are coded in the **L*** records (i.e. **LQ, LT,** and **LF**). The **I5** record is included to define a stability option in the sediment transport computation (see **Section 2.2.4, HEC-6: User's Manual (1991)**). Further, the **N** record was used to describe the sediment gradation information for each station based on the gradation curves presented in **Appendix B** (i.e., **Figs. B-1 to B-76**). Since the lone tributary (i.e., New River) is also expected to contribute some sediment inflows into the main river, the **$LOCAL** record is added, followed by the **L*** records which define the extent of sediment inflows.

5.1.5.3 Hydrologic data - The hydrologic data commences at **$HYD** record. Rating data (**$RATING** record followed by a set of **RC** record) which define the relationship between the discharge and the water surface elevation at the most downstream station (i.e., tail water surface elevation) are provided to specify the boundary condition for the backwater surface calculation.

Having this record included, an **R** record is not necessary to be included after each **Q** record. The two sets of discharge data in the **Q** record represent the discharge at the main river and the discharge at the tributary, respectively. The **T** record defines the water temperature and the presence of the record once in the first set of hydrologic data indicates that the water temperature is constant. The **X** and **W** records were used to define the time duration and the time step used for computational stability. Small time steps of $\Delta t = 0.1$ day were used to achieve that stability consideration as indicated in the ***Technical Document No. 13*** **(Thomas et. al., 1981)**.

Since four sets of hydrologic data were used representing return periods of 50, 100, 200, and 500 years, four input data files were created (i.e., *HEC6-M11, HEC6-M12, HEC6-M13, and HEC6-M14*).

5.2 Model II

5.2.1 Modeling Description

Model II is a future condition model using the existing condition (i.e., Model I) to reflect the ultimate sand and gravel mining as permitted today.

5.2.2 Description of Mining Sites Along the Agua Fria River

A number of mining sites are currently permitted along and around the Agua Fria River. The extent of bed modification as a result of sand and gravel mining undoubtedly, and will significantly, affect the sedimentation processes along the river. The extent of mining at the various sites have been incorporated in the geometry of the river in order to evaluate their ultimate hydraulic effects and to assess the associated sedimentation dynamics involved (see **Table 5.2.1**). Model II comprises this phase of the study in whose results could provide basis for decision making in terms of the extent of mining permission that could be allowed to gravel and sand mining companies.

Table 5.2.1 - Physical description of the mining developments

Mining Site Identification	Maximum Pit Depth (ft)	Dimensions Width (ft)	Dimensions Length (ft)	Mining Pit Bed Slope (ft/ft)
Site A	40.00	1270.	2700.	0.0020
Site B	15.00	640.	1960.	0.0020
Site C	30.00	1485.	5030.	0.0033
Site D	40.00	1300.	890.	0.0020
Site E	40.00	1555.	1960.	0.0020
Site F	40.00	1560.	1365.	0.0020
Site G	40.00	1750.	2765.	0.0030
Site H	40.00	1740.	6125.	0.0030

5.2.2.1 Site A - The geometry of the mining site [see **Figure 5.2.1**], could be represented by four (4) section stations as presented in **Table 5.2.2.** The section geometry information are based on the orientation of the mining site relative to the direction of flow. Some information about site A follows:

Owner: Salt River Pima Maricopa Indian Community
Location: Between Olive Avenue and Peoria Avenue
Maximum Pit Depth: 40 feet

Table 5.2.2 - Section stations for mining site A

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 13.810	0.00	1080.5	- 1735.00
Station 13.855	240.00	1081.0	- 1735.00
Station 14.380	2220.00	1085.4	- 1860.00
Station 14.412	240.00	1085.9	- 1860.00

Note: Bed slope is 0.002 ft/ft.

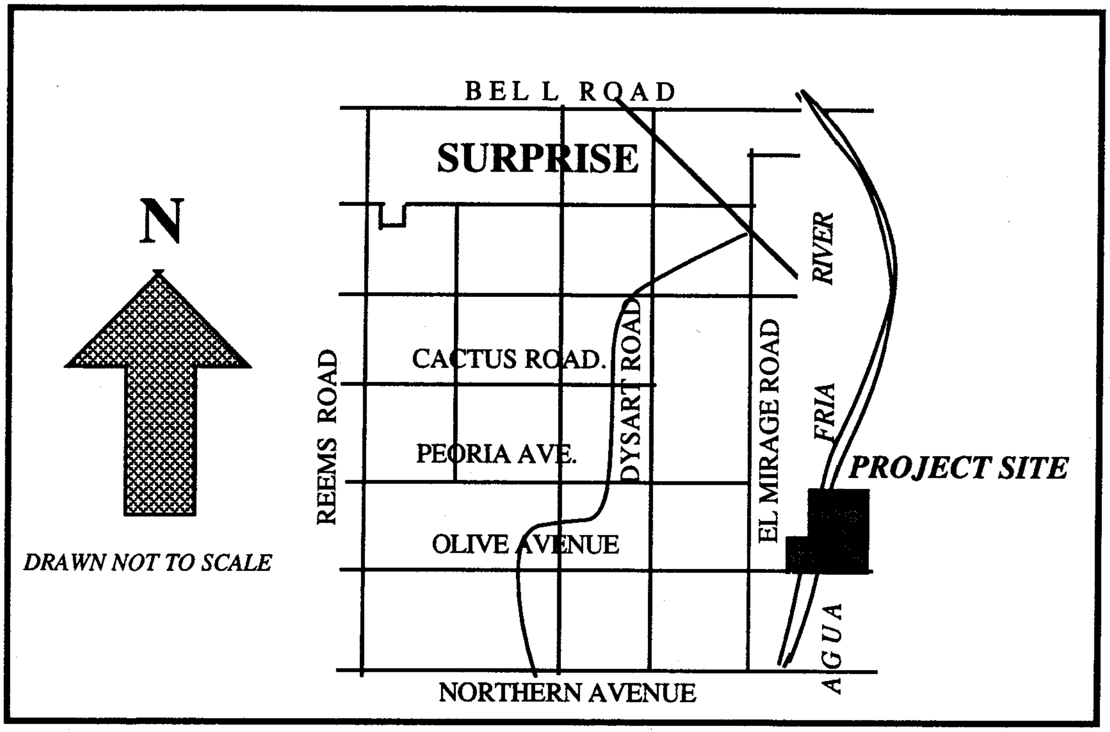

Figure 5.2.1 - Location map of the mining site A
[Owner: Salt River Pima Maricopa Indian Community]

(i) Geometric Data - The section geometry information of the above defined stations were derived from the development plan of the site made by **Barrett Consulting Group, Inc. (1987).** The bottom pit floor has a bed slope of 0.002 ft/ft.

(1) Station 13.810 - This section is the most downstream station of the mining site comprised of the existing ground surface data plus the specified revetment [Elevation: 1080.5 ft] that runs across the entire width of the property (see **Fig. D-A-1** and **Table D-A-1**). This station serves as the downstream boundary limit of the mining site.

(2) Station 13.855- The cross-section geometry for this station is shown in **Fig. D-A-2** and **Table D-A-2.**

(3) Station 14.380 - **Fig. D-A-3** and **Table D-A-3** present the cross-section geometry of the station.

(4) Station 14.412 - This is the most upstream station of mining site A which is comprised of the existing ground information plus the specified revetment (Elevation: 1085.9 ft) that covers the entire development area (see **Fig. D-A-4** and **Table D-A-4**).

(ii) Sediment Data - An 18-inch thick filter blanket at the drown-out chute and stilling basin is comprised of sediments with gradation specification as follows:

$$8.90 \text{ mm} \le D_{15} \le 16.00 \text{ mm}$$
$$13.30 \text{ mm} \le D_{50} \le 80.00 \text{ mm}$$
$$D_{85} \ge 71.10 \text{ mm}$$

A 42-inch thick revetment comprising of 21" stones is also provided which is laid over the 18-inch filter blanket. The riprap protection at the drown-out chute and top end armorment has the following gradation specification:

$$14.40 \text{ inches} \le D_{15} \le 21.20 \text{ inches}$$
$$21.20 \text{ inches} \le D_{50} \le 26.70 \text{ inches}$$
$$26.70 \text{ inches} \le D_{100} \le 36.20 \text{ inches}$$

(iii) Other Data - An 18-inch high berm [with 15-inch top width) is build along the western side of the mining site.

5.2.2.2 Site B - The mining site [see **Figure 5.2.2**] could be represented by five (5) section stations as defined in **Table 5.2.2.** The geometry of these stations were derived from the development map made by **Barrett Consulting Group, Inc. (1988)** for **Gravel Resources Company,** owner and operator of the mining site. Some information about site B are:

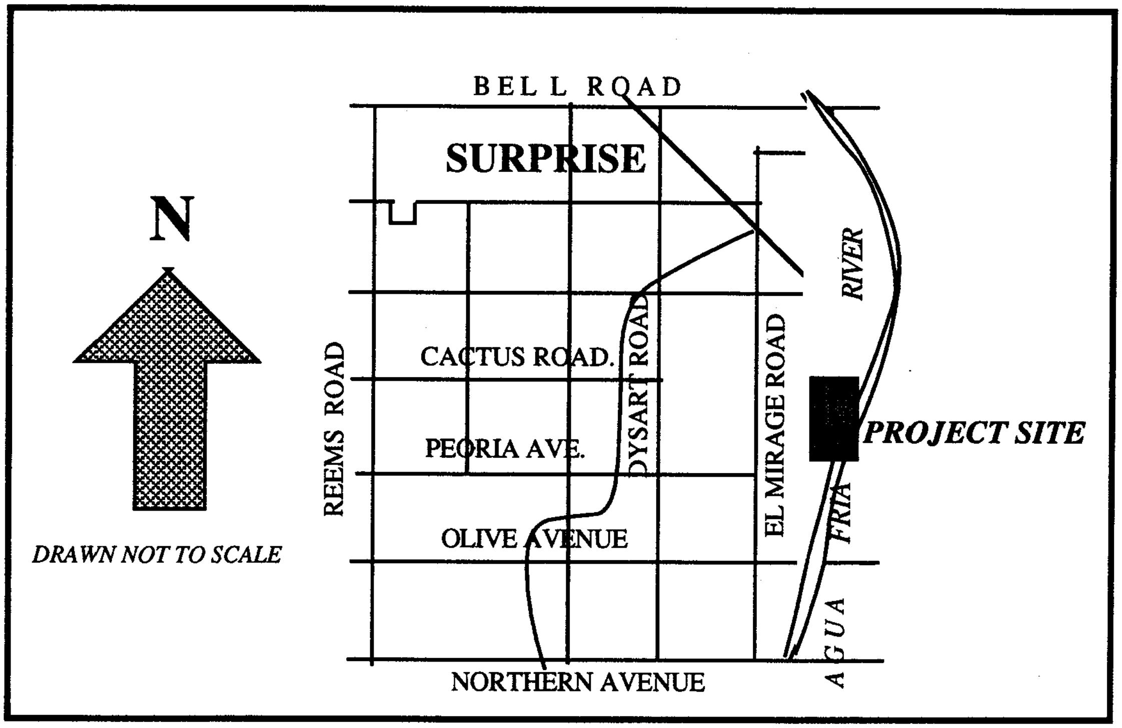

Figure 5.2.2 - Location map of the mining site B
[Owner: Gravel Resources Company]

Owner: Gravel Resources Company
Location: Between Peoria Avenue and Cactus Road
Maximum Pit Depth: 15 feet

Table 5.2.2 - Section stations for mining site B

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 14.932	0.00	1095.0	475.00
Station 14.940	45.00	1095.1	480.00
Station 15.063	650.00	1096.4	590.00
Station 15.303	1175.00	1098.8	540.00
Station 15.320	90.00	1099.0	540.00

Note: Bed slope is 0.002 ft/ft.

(i) **Geometric Data** - The section geometry of the above five (5) stations are described below. The top revetment elevation is designated at 1099.0 ft. at the most upstream station with a development slope of 0.002 ft/ft.

(1) Station 14.932 - This is the most downstream station for the mining site which is comprised of the existing field information plus the indicated 640-foot wide armorment provided in the plan [see **Fig. D-B-1** and **Fig. D-B-1**]. This station serves as the downstream boundary limit of the mining site B.

(2) Station 14.940 - The section geometry for this station is shown in **Fig. D-B-2** and **Table D-B-2.**

(3) Station 15.063 - The section geometry for this station is shown in **Fig. D-B-3** and **Table D-B-3.**

(4) Station 15.303 - **Fig. D-B-4** and **Table D-B-4** show the section geometry for this station derived from the development map of the mining site.

(5) Station 15.320 - The section geometry for this station is comprised of the existing ground information (see **Fig. D-B-5** and **Table D-B-5**). This section stations serves as the upstream boundary limit of the mining site B

(ii) Sediment Data - A 9" thick filter blanket is provided for the upstream drown out chute slope made up of sediments with gradation specification as follows:

$$3.18\text{ mm} \le D_{15} \le 3.20\text{ mm}$$
$$5.08\text{ mm} \le D_{50} \le 16.80\text{ mm}$$
$$D_{85} \ge 25.40\text{ mm}$$

An 18-inch rock-filled gabion marts laid over the 9-inch filter blanket is also provided for slope protection. Rock for mattresses shall be: D_0 = 4 inches; D_{15} = 5.0 inches; D_{50} = 8.0 inches; D_{85} = 10.0 inches; and, D_{90} = 12.0 inches.

5.2.2.3 Site C - The extent of development plan for mining site C could be represented by the ten (10) stations identified in **Table 5.2.3.** The site is comprised of two (2) mining pits. Some information about site C are:

Owner:	Agua Bell Land Development Company
Location:	Between Union Hills Drive and Beardsley Road
Maximum Pit Depth:	30 feet

Table 5.2.3 - Section stations for mining site C

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Pit No. 1:			
Station 19.944	0.00	1172.0	-1858.00
Station 19.953	45.00	1172.1	-1858.00
Station 20.240	1565.00	1177.3	-2090.00
Station 20.550	1650.00	1182.7	-1955.00
Station 20.563	70.00	1182.9	-1955.00
Pit No. 2:			
Station 20.577	70.00	1183.1	-1960.00
Station 20.640	373.00	1184.3	-2000.00
Station 20.657	90.00	1184.6	-1360.00
Station 20.920	1096.00	1188.2	-1010.00
Station 20.933	70.00	1188.4	-1010.00

Note: Bed slope is 0.0033 ft/ft.

(i) Geometric Data - The section geometry of the above defined stations were derived from the development and topographic map made by **WLB Group, Inc. (1987).** The plan provided a channel slope of 0.5% but this slope could not justify a good plan since the topographic slope of the area is only about 0.33%. A bed slope of 0.33% (= 0.0033 ft/ft) was adopted instead.

(1) Station 19.944 - This is the most downstream station of the mining site which comprise of the existing field data plus the armorment (Elevation: 1172.0 ft) over the whole development area (see **Fig. D-C-1** and **Table D-C-1**). This station serves as the downstream boundary limit for the said development site.

(2) Station 19.953 - The section geometry derived for this station is shown in **Fig. D-C-2** and **Table D-C-2.**

(3) Station 20.240 - The derived geometric information for this station is shown in **Fig. D-C-3** and **Table D-C-3.**

(4) Station 20.550- **Fig. D-C-4** and **Table D-C-4** show the derived geometric information for this station.

(5) Station 20.563 - The cross-section geometry for the station is comprised of the existing field information plus the armorment of 1306-foot wide (see **Fig. D-C-5 and Table D-C-5**). This station will serve as the transition station between the downstream and upstream mining pits.

(6) Station 20.577 - **Fig. D-C-6** and **Table D-C-6** show the derived cross-section geometry for this station.

(7) Station 20.640 - The cross-section geometry for the station is shown in **Fig. D-C-7 and Table D-C-7**.

(8) Station 20.657 - The cross-section geometry derived for the station is shown in **Fig. D-C-8** and **Table D-C-8.**

(9) Station 20.920 - **Fig. D-C-9** and **Table D-C-9** show the cross-section geometry of the station.

(10) Station 20.933 - The section geometry for this station is comprised of the existing field information plus the armorment (Elevation: 1188.40 ft) of 657-foot wide (see **Fig. D-C-10** and **Table D-C-10**). This station serves as the upstream boundary limit for the mining site.

(ii) Sediment Data - Riprap for bank protection is comprised of the following gradation specification as suggested by **WLB Group Inc. (1987)**: D_{15} = 0.19', D_{50} = 0.63', and D_{100} = 1.25'; where D_{100} rock should not be less than 2.0 times the size of the D_{50} rock and the D_{15} rock should not be less than 0.3 times the D_{50} rock. Further, the amount of rock smaller than the D_{15} size should not be greater than the available void space.

5.2.2.4 Site D - The mining site [see **Figure 5.2.3**] when fully developed could be represented by five (5) section stations as identified in **Table 5.2.4.**

Owner:	Finley Construction Corporation
Location:	Rose Garden and 115th Avenue
Maximum Pit Depth:	40 feet

Table 5.2.4 - Section stations for mining site D

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 21.657	0.00	1191.2	-1040.00
Station 21.680	120.00	1191.4	- 960.00
Station 21.760	460.00	1192.3	- 505.00
Station 21.773	70.00	1192.4	- 430.00
Station 21.818	240.00	1192.9	- 250.00

Note: Bed slope is 0.002 ft/ft.

(i) Geometric Data - The section geometry information for site D were derived from the development plan and topographic map drawn by **Barett Consulting Group, Inc., (1987)** for **Finley Construction Corporation.** The bed slope of the mining pit is given in the plan to be 0.002 ft/ft with the upstream armorment elevation of 1192.9 ft.

(1) Station 21.657 - This is the most downstream station for the mining site which comprised of the existing ground data obtained from the field (or topographic map). This station (see **Table D-D-1** for the modified elevation information and **Fig. D-D-1** for the cross-section plot) serves as the downstream boundary limit for the development site.

(2) Station 21.680 - The section geometry for the station is shown in **Fig. D-D-2** while the associated development data are listed in **Table D-D-2.**

(3) Station 21.760 - The section geometry of the station is shown in **Fig. D-D-3** and **Table D-D-3**

(4) Station 21.773 - **Fig. D-D-4** and **Table D-D-4** show the section information on the extent of development for the station.

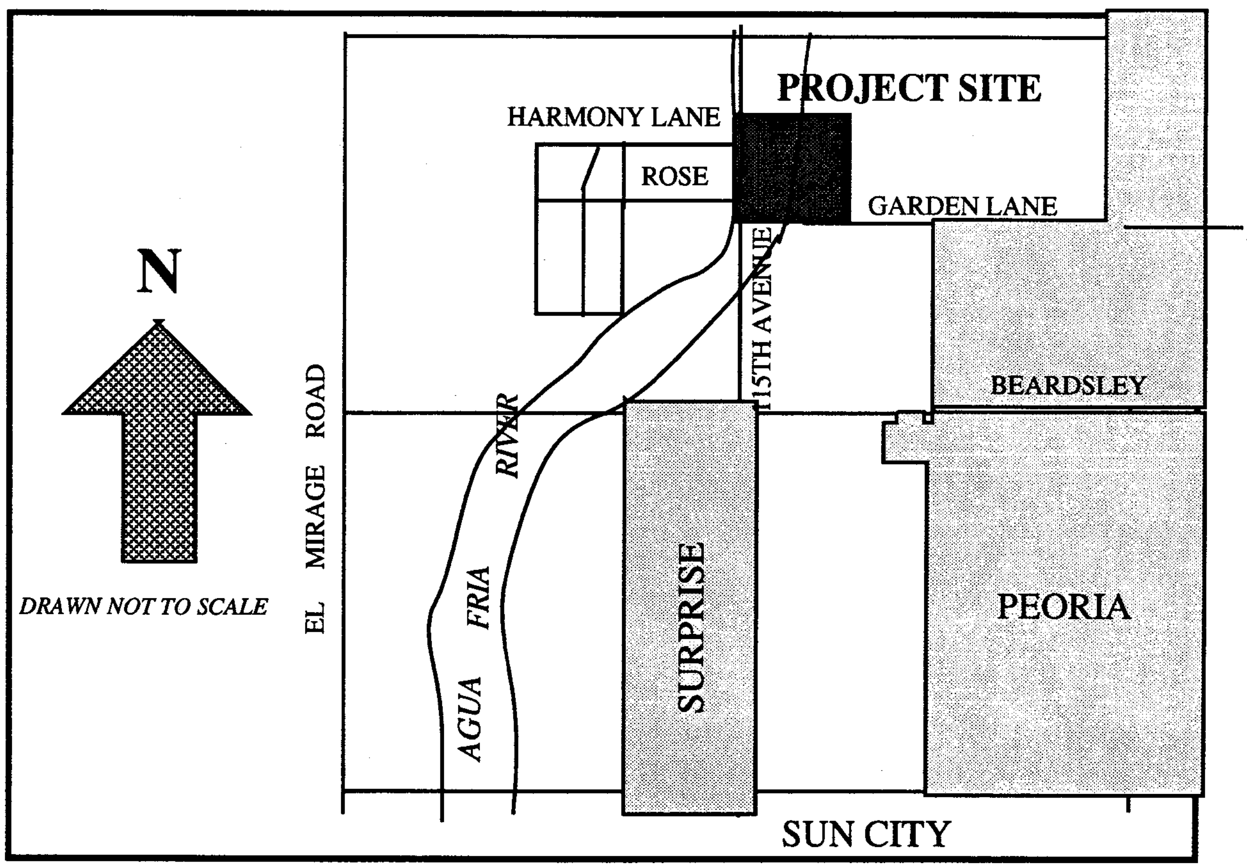

Figure 5.2.3 - Location map of the mining site D
[Owner: Finley Construction Corporation]

(5) Station 21.818 - The section geometry for the station is the existing ground information with the modified surface elevation at the site (see **Table D-D-5** and **Fig. D-D-5** for the cross-section plot). This station serves as the upstream boundary limit for the development site.

(ii) Sediment Data - For bank protection purposes, a 9-inch filter blanket along the drown-out chute and approach is provided overlaid with an 18-inch rock-filled gabion mattress **(Barrett Consulting Group, Inc., 1987)**. The filter blanket has the following gradation specification:

$$4.06 \text{ mm} \le D_{15} \le 16.00 \text{ mm}$$
$$5.08 \text{ mm} \le D_{50} \le 80.00 \text{ mm}$$
$$D_{85} \ge 32.51 \text{ mm}$$

For the 18-inch rock-filled mattress, the gradation specification is as follows: D_0 = 4"; D_{15} = 5", D_{50} = 8", D_{85} = 10", and D_{90} = 12".

5.2.2.5 Site E - The mining site [see **Figure 5.2.4**] is comprised of eight (8) stations that define the extent of the development [see **Table 5.2.5**]. The cross-section geometry information of these stations were determined from the plan made by **Barrett Consulting Group, Inc., (1987)** for **Ideal Rock Products**, the operator and owner of the mining site. Some information about site E are listed below:

Owner:	Ideal Rock Products
Location:	South of Deer Valley Drive
Maximum Pit Depth:	40 feet

Table 5.2.5 - Section stations for mining site E

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 21.500	0.00	1198.2	1615.00
Station 21.523	120.00	1198.4	1420.00
Station 21.657	710.00	1199.8	1735.00
Station 21.680	120.00	1200.0	1575.00
Station 21.760	460.00	1200.9	1625.00
Station 21.773	70.00	1201.0	1695.00
Station 21.818	240.00	1201.5	1930.00
Station 21.850	240.00	1202.0	2115.00

Note: Bed slope is 0.002 ft/ft.

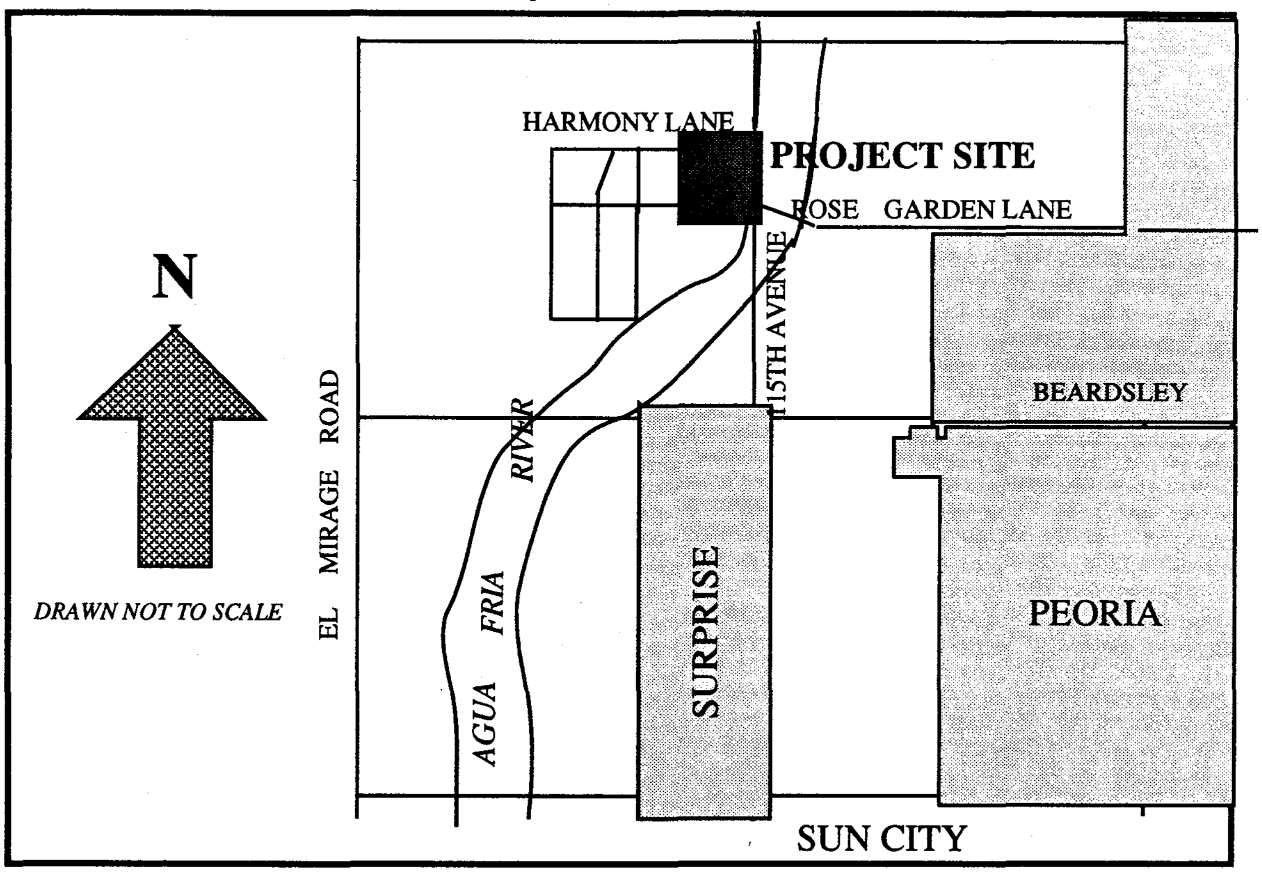

Fig. 5.2.4 - Location map of the mining site E
[Owner: Ideal Rock Products]

(i) Geometric Data - The information on the cross-section geometry of the above stations are provided as follows:

(1) Station 21.500 - This is the most downstream station for the mining site which comprised of the existing data from the field. This station is included together with the most downstream station in order to define the extent of the development for the mining site (see **Table D-E-1** for the modified elevation and **Fig. D-E-1** for the cross-section plot).

(2) Station 21.523 - **Table D-E-2** and **Fig. D-E-2** show the cross-section geometry information of the station.

(3) Station 21.657 - The information on the cross-section geometry for this station is shown in **Table D-E-3** and **Fig. D-E-3**.

(4) Station 21.680 - The information on the section geometry for the station is shown in **Table D-E-4** and **Fig. D-E-4.**

(5) Station 21.760 - The ground geometry information for the station are the existing field data (see **Table D-E-5** for the modified elevation and **Fig. D-E-5** for cross-section plot).

(6) Station 21.773 - The section geometry and modified elevation information for this station is shown in **Fig. D-E -6** and **Table D-E -6.**

(7) Station 21.818 - The section geometry and modified elevation information for this station are shown in **Fig. D-E -7** and **Table D-E -7.**

(8) Station 21.850 - **Fig. D-E-8** and **Table D-E-8** show the section geometry and the modified elevation information of this station. This station serves as the upstream boundary limit for the mining site.

(ii) Sediment Data - No information is provided in the plan.

5.2.2.6 Site F - The mining site (see **Figure 5.2.5**) could be described by four stations as shown **Table 5.2.6.** Some information abour site F are:

Owner:	Finley Construction Corporation
Location:	Deer Valley Drive and 115th Avenue
Maximum Pit Depth:	40 feet

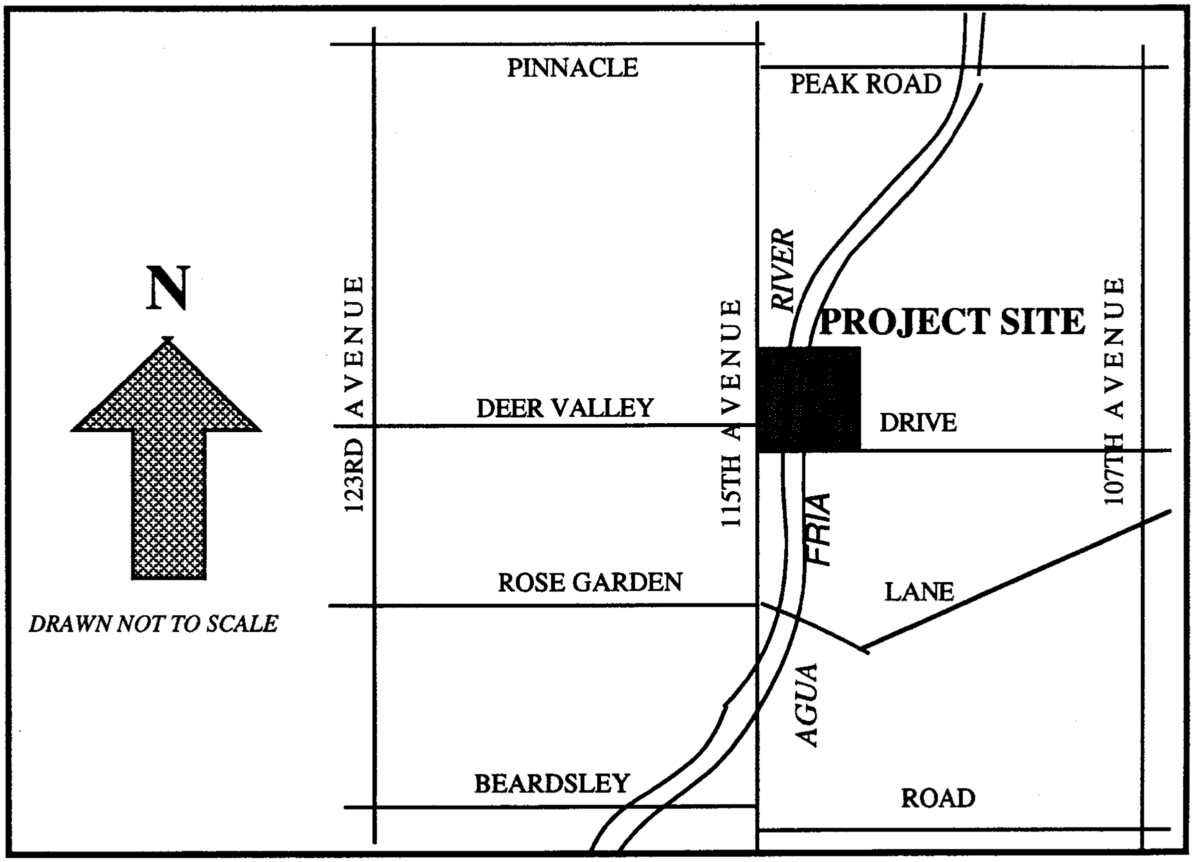

Fig. 5.2.5 - Location map of the mining site F
[Owner: Finley Construction Corporation]

Table 5.2.6 - Section stations for mining site F

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 22.107	0.00	1200.8	1170.00
Station 22.130	120.00	1201.0	1280.00
Station 22.320	1005.00	1203.0	1625.00
Station 22.365	240.00	1203.5	1700.00

Note: Bed slope is 0.002 ft/ft.

(i) Geometric Data - The geometric data presented are based on the site plan and topographic map made by **Barrett Consulting Group, Inc. (1987)** for the **Finley Construction Corporation** that operates the mining sites.

(1) Station 22.107 - This is the most downstream station for the mining site which comprises the existing field data (see **Table D-F-1** for the modified elevation and **Fig. D-F-1** for cross-section plot) obtained from the field survey. This station serves as the downstream boundary limit of the mining site. The incorporation of this station and the most upstream station allows a more realistic assessment on the extent of sedimentation processes involved resulting from the existence of the fully-operational mining pit.

(2) Station 22.130 - The derived cross-section geometry and modified elevation information for this station are shown in **Fig. D-F-2** and **Table D-F-2**

(3) Station 22.320 - The section geometry and modified elevation information are presented in **Fig. D-F-3** and **Table D-F-3.**

(4) Station 22.365 - The derived section geometry and elevation information for this station are shown in **Fig. D-F-4** and **Table D-F-4.**

(ii) Sediment Data - A 6-inch layer of 2-inch stone will be placed on top and along the edge of the levee adjacent to the drown-out chute approach. The 15-inch thick chute slope revetment is comprised of D_{50} = 8-inch stones laid over the 6" filter blanket **(Barrett Consulting Group, Inc., 1987)**. The filter blanket has the following gradation specification:

$$3.0 \text{ mm} \leq D_{15} \leq 3.80 \text{ mm}$$
$$4.4 \text{ mm} \leq D_{50} \leq 17.6 \text{ mm}$$
$$D_{85} > 30.0 \text{ mm}$$

For the riprap protection, the gradation specification is provided as follows:

$9.74 \text{ inches} \leq D_{100} \leq 12.7 \text{ inches}$
$7.43 \text{ inches} \leq D_{50} \leq 9.74 \text{ inches}$
$4.97 \text{ inches} \leq D_{15} \leq 7.43 \text{ inches}$

(iii) Other Data - An estimated 3-foot high and 5-foot top width levee is built in the south east corner of the mining site.

5.2.2.7 Site G -The mining site could be described by geometry information for six stations [see **Table 5.2.7**]. These geometry information could be extracted from the plan drawn by **Lemme Engineering Inc. (1987).** This mining site (site G) is the same mining site developed for **Lake End Sand and Gravel Corporation** (site H) but the development plan under this project covers only one mining pit which is mining pit no. 1 for site H. This mining site (site G), however, has a larger extraction pit area than the mining pit no. 1 of site H. The extraction pit is planned to have a 100-year storm slope bank protection (or riprap). Some information about site G are:

Owner: Blue Circle West
Location: North of Pinnacle Peak and South of Hatfield Road
Maximum Pit Depth: 40 feet

Table 5.2.7 - Section stations for mining site G

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 23.350	0.00	1221.0	- 435.00
Station 23.365	80.00	1221.2	- 410.00
Station 23.571	1085.00	1224.5	- 330.00
Station 23.694	650.00	1226.4	- 350.00
Station 23.851	830.00	1228.9	- 750.00
Station 23.874	120.00	1229.3	- 790.00

Note: Bed slope is 0.003 ft/ft.

(i) Geometric Data - The cross-section data for the stations identified were based on the topographic map and mining site plan provided by **Lemme Engineering Inc., (1987).** These information, particularly, the modifications prescribed on the channel bed based on the fully-developed mining site - are to be appended to the existing field data. Along the extraction pit, the planned bed slope is 0.00468 ft/ft. while the river slope (along the thalweg) is about 0.003 ft/ft. The inclusion of the plan in its entirety to the existing field data will comprise the field information that define the ultimate sand and gravel mining activities that are currently permitted.

(1) Station 23.350 - This is the most downstream station for the mining site which is comprised of the existing field data with modification provided for the bed elevation designated at 1221.0 ft. This ground surface elevation modification to the existing field data are presented in **Fig. D-G-1** and **Table D-G-1.**

(2) Station 23.365 - The cross-section geometry for this station is shown in **Fig. D-G-2** and **Table D-G-2.**

(3) Station 23.571 - The modification of cross-section geometry for this station is shown in **Fig. D-G-3** and tabulated in **Table D-G-3.**

(4) Station 23.694 - **Fig. D-G-4 and Table D-G-4** show the derived cross-section geometry information for the station.

(5) Station 23.851 - The modification of the section geometry for this station is shown in **Fig. D-G-5** and **Table D-G-5.**

(6) Station 23.874 - The cross-section geometry for this station is comprised of the existing field information but with armorment provided throughout the whole property area (Elevation: 1229.3 ft). These information are presented in **Fig. D-G-6** and **Table D-G-6**

(ii) Sediment Data - No data had been provided in the plan for the site development.

5.2.2.8 Site H - The site is comprised of three (3) mining locations arranged in the north-south fashion. When the site would be fully developed, the extent of the development could be defined by fourteen (14) section stations for **HEC-6**. Stations 13.350 to 23.874 define the section stations for the most downstream mining pit; stations 24.070 to 24.193 define the section stations for the middle mining pit; and stations 24.350 to 24.491 define the section stations for the most upstream mining pit [see **Table 5.2.8**]. Some information about mining site H are listed below:

Owner:	Lake End Sand and Gravel
Location:	North of Pinnacle Peak
Maximum Pit Depth:	40 feet

(i) Geometric Data - The section geometry information for the mining site are derived from the development plan and topographic map made by

For the riprap protection, the gradation specification is provided as follows:

9.74 inches $\leq D_{100} \leq$ 12.7 inches
7.43 inches $\leq D_{50} \leq$ 9.74 inches
4.97 inches $\leq D_{15} \leq$ 7.43 inches

(iii) Other Data - An estimated 3-foot high and 5-foot top width levee is built in the south east corner of the mining site.

5.2.2.7 Site G -The mining site could be described by geometry information for six stations [see **Table 5.2.7**]. These geometry information could be extracted from the plan drawn by **Lemme Engineering Inc. (1987).** This mining site (site G) is the same mining site developed for **Lake End Sand and Gravel Corporation** (site H) but the development plan under this project covers only one mining pit which is mining pit no. 1 for site H. This mining site (site G), however, has a larger extraction pit area than the mining pit no. 1 of site H. The extraction pit is planned to have a 100-year storm slope bank protection (or riprap). Some information about site G are:

Owner: Blue Circle West
Location: North of Pinnacle Peak and South of Hatfield Road
Maximum Pit Depth: 40 feet

Table 5.2.7 - Section stations for mining site G

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Station 23.350	0.00	1221.0	- 435.00
Station 23.365	80.00	1221.2	- 410.00
Station 23.571	1085.00	1224.5	- 330.00
Station 23.694	650.00	1226.4	- 350.00
Station 23.851	830.00	1228.9	- 750.00
Station 23.874	120.00	1229.3	- 790.00

Note: Bed slope is 0.003 ft/ft.

(i) Geometric Data - The cross-section data for the stations identified were based on the topographic map and mining site plan provided by **Lemme Engineering Inc., (1987).** These information, particularly, the modifications prescribed on the channel bed based on the fully-developed mining site - are to be appended to the existing field data. Along the extraction pit, the planned bed slope is 0.00468 ft/ft. while the river slope (along the thalweg) is about 0.003 ft/ft. The inclusion of the plan in its entirety to the existing field data will comprise the field information that define the ultimate sand and gravel mining activities that are currently permitted.

(1) Station 23.350 - This is the most downstream station for the mining site which is comprised of the existing field data with modification provided for the bed elevation designated at 1221.0 ft. This ground surface elevation modification to the existing field data are presented in **Fig. D-G-1** and **Table D-G-1.**

(2) Station 23.365 - The cross-section geometry for this station is shown in **Fig. D-G-2** and **Table D-G-2.**

(3) Station 23.571 - The modification of cross-section geometry for this station is shown in **Fig. D-G-3** and tabulated in **Table D-G-3.**

(4) Station 23.694 - **Fig. D-G-4 and Table D-G-4** show the derived cross-section geometry information for the station.

(5) Station 23.851 - The modification of the section geometry for this station is shown in **Fig. D-G-5** and **Table D-G-5.**

(6) Station 23.874 - The cross-section geometry for this station is comprised of the existing field information but with armorment provided throughout the whole property area (Elevation: 1229.3 ft). These information are presented in **Fig. D-G-6** and **Table D-G-6**

(ii) Sediment Data - No data had been provided in the plan for the site development.

5.2.2.8 Site H - The site is comprised of three (3) mining locations arranged in the north-south fashion. When the site would be fully developed, the extent of the development could be defined by fourteen (14) section stations for **HEC-6.** Stations 13.350 to 23.874 define the section stations for the most downstream mining pit; stations 24.070 to 24.193 define the section stations for the middle mining pit; and stations 24.350 to 24.491 define the section stations for the most upstream mining pit [see **Table 5.2.8**]. Some information about mining site H are listed below:

Owner:	Lake End Sand and Gravel
Location:	North of Pinnacle Peak
Maximum Pit Depth:	40 feet

(i) Geometric Data - The section geometry information for the mining site are derived from the development plan and topographic map made by

Lemme Engineering, Inc. (1986) for **Lake End Sand and Gravel Company**, the owner and the operator of the above mining pits.

Table 5.2.8 - Section stations for mining site H

Station Number	Distance Between Stations (ft)	Top Armorment Elevation (ft)	Dist. Between Thalweg and Property Line (ft)
Mining Pit No. 1:			
Station 23.350	0.00	1220.9	- 425.00
Station 23.365	80.00	1221.1	- 410.00
Station 23.571	1085.00	1224.4	- 330.00
Station 23.694	650.00	1226.4	- 425.00
Station 23.851	830.00	1228.9	- 745.00
Station 23.874	120.00	1229.3	- 790.00
Mining Pit No. 2:			
Station 24.070	1190.00	1232.9	- 935.00
Station 24.085	80.00	1233.1	- 965.00
Station 24.170	280.00	1233.9	-1030.00
Station 24.193	120.00	1234.3	-1030.00
Mining Pit No. 3:			
Station 24.350	945.00	1237.1	- 525.00
Station 24.365	80.00	1237.3	- 530.00
Station 24.468	545.00	1238.9	- 650.00
Station 24.491	120.00	1239.3	- 650.00

Note: **Bed slope for mining pits 1,2, and 3 is assumed to be 0.0030 ft/ft calculated from the actual channel bed slope.**

(1) Station 23.350 - This is the most downstream station for the mining site which comprises the existing ground data obtained from the field (or topographic map). This station serves as the downstream boundary limit for mining pit no. 1 (see **Table D-H-1** for the modified elevation and **Fig. D-H-1** for the cross-section plot).

(2) Station 23.365 - The cross-section geometry for the station is shown in **Fig. D-H-2** and **Table D-H-2.**

(3) Station 23.571 - The modifications of the section geometry for this station are shown in **Fig. D-H-3** and **Table D-H-3**

(4) Station 23.694 - The section geometry information for the station are shown in **Fig. D-H-4** and Table **D-H-4.**

(5) Station 23.851 - The section geometry information for this station are shown in **Fig. D-H-5** and **Table D-H-5.**

(6) Station 23.874 - The cross-section geometry for the station is comprised of the modified field ground data (see **Table D-H-6** for the modified elevation and **Fig. D-H-6** for the cross-section plot). This station marks the upstream boundary limit for mining pit no. 1.

(7) Station 24.070 - This station marks the most downstream station for mining pit no. 2. The section geometry of this station resembles the existing field data with modifications on the development site (see **Table D-H-7** for the modified elevation and **Fig. D-H-7** for cross-section plot).

(8) Station 24.085 - **Fig. D-H-8** and **Table D-H-8** provide the section modification of the geometry information for this station which is taken from the site development plan map **(Lemme Engineering, Inc., 1986).**

(9) Station 24.170 - The cross-section geometry and the modified elevation information for the development site for this station is shown in **Fig. D-H-9** and **Table D-H-9**.

(10) Station 24.193 - The geometric information for the station are the existing field data and the modified elevation (see **Table D-H-10** and **Fig. D-H-10**). This station is the most upstream station for mining pit no. 2 which marks the upstream boundary limit on the extent by which mining pit no. 2 would be developed.

(11) Station 24.350 - The section information for the station are the existing field data with the modification provided at the development site (see **Table D-H-11** for the modified elevation and **Fig. D-H-11** for cross-section plot). This station marks the most downstream station of mining pit no. 3.

(12) Station 24.365 - **Fig. D-H-12** and **Table D-H-12** show the cross-section geometry information of the station, which were determined from the site development plan map.

(13) Station 24.468 - The cross-section geometry of the pit for this station are presented in **Fig. D-H-13** and **Table D-H-13.**

(14) Station 24.491 - The section geometry of this station is comprised of the existing field data with site development modification (see **Table D-H-14** for the modified elevation and **Fig. D-H-14** for cross-section plot). This station marks the most upstream station for mining pit no. 3.

(ii) Sediment Data - No sediment data were presented in the site plan by **Lemme Engineering, Inc. (1986).**

5.2.3 Model II Input Data Descriptions

Under Model II, eight mining site locations are incorporated into the original model (Model I), i.e., mining sites A, B, C, D, E, F, G, and H. The geometry information for the stations of these mining sites were taken from the development maps provided by the developers and owners of the mining sites. From the eight mining sites identified, however, mining site G which is to be operated by ***Blue Circle West Company*** forms a part of a larger mining site (Site H) which is to be operated by ***Lake End Sand and Gravel Company.*** Thus, two sets of data are developed for Model II, each set comprising a number of mining sites as follows:

Table 5.2.10 - Composition of mining sites for two Model II data sets

	Model Set	Mining Site Composition
(i)	Model IIA	Sites A, B, C, D, E, F, and G
(ii)	Model IIB	Sites A, B, C, D, E, F, and H

Model IIA will have 37 stations added into the original model (i.e. Model I) which has 96 stations and Model IIB, on the other hand, will have additional 45 stations.

5.2.3.1 Geometric and Hydraulic Data - The original information on the geometry and hydraulics of original Model I are retained for Model II. For the additional stations associated with the mining sites, the geometry information of some of the stations were generated from the nearby stations with consideration on the channel slope of the river. The location of the left and right overbank boundaries are redefined to accommodate the location of the mining sites.

Some hydraulic information for the mining site locations are listed in **Table A.1.2** (see **Appendix A**). From the tabulated data, the location of the left and right overbank boundaries (encoded in the **X1** record) are defined. The roughness coefficient values associated with the left overbank, right overbank and main channels are specified in the **NC** record with the loss coefficient values for channel expansion and contraction. The use of the **HD** record that defines the depth of sediment storage that is subject for transport is necessary which is also used to specify the extent of movable bed in each station. The specification of movable bed limit for each station underscores the importance of declaring specifically the mining site locations to be shielded from further degradation and allow other sections in the station to be scoured. This means that the **HD** record could specify the limit of movable bed as presented in **Table A.1.2.** Conversely, however, aggradation or deposition actions are allowed to occur anywhere. The definition of reach lengths for the mining site stations in **X1** record has taken into consideration a regular shape of mining pits; thus, reach length values are maintained for the left overbank, right overbank and main channels.

5.2.3.2 Sediment Data - The sediment information for the original model (i.e., Model I) are retained for Model II. Although large sediment aggregates are specified for the mining sites, field gradation data (for **N** record) for the mining stations are needed for the movable section of the channel.

5.2.3.3 Hydrologic Data - The hydrologic data used in Model I are used for Model II. Under Model II, however, four data files are developed for each Model II data set, i.e., ***H6-M21A, H6-M22A, H6-M23A, and H6-M24A*** for Model IIA, and ***H6-M21B, H6-M22B, H6-M23B,*** and ***H6-M24B*** for Model IIB.

5.3 Model III

5.3.1 Modeling Description

Model III is the future condition model by adding a 1000-foot wide channel improvement along the Agua Fria River (where applicable), to Model II to evaluate the effects of sand and gravel mining on the proposed channel.

5.3.2 Rationale of Channelization

Improvement channels of 1000-foot wide are proposed at various locations along the Agua Fria River for the following reasons:

(i) to widen constricted (or narrow) channels that permit or cause critical or supercritical flows along the existing channels;

(ii) to shorten (or narrow down) existing channels for the flows to be concentrated along a defined route; and

(iii) to contain the flow where flood easily encroaches into low-lying plains.

The second objective [(ii) above] permits reclamation of areas occupied by the river for other purposes. Narrowing of channel geometry, however, requires channel dredging.

5.3.3 Location of Improvement Channels

The existing levee along the Agua Fria River stretches from Station 1.87 to Station 8.34 along the west bank and from Station 3.76 to Station 8.100 along the east bank of the river. A break at the east bank levee is made between stations

5.48 and 5.54 to accommodate a small tributary. A proposed 1000-ft wide levee is being considered for the two stretches defined in **Table 5.3.1.**

The stretch from Station 8.10 to Station 13.33 is comprised of low-lying plains where the river banks are not defined. An improvement channel will certainly contain the flow at a defined route and protect the flood plains from flood encroachment. This stretch of channelization terminates at Station 13.33 because a mining site is located at some distance upstream. At the mining site, however, channel improvement will not be proposed. The existing west bank terminates at Station 8.34. However, if a uniform 1000-foot wide channel improvement is made, the existing channel must be modified.

Table 5.3.1 - Channel Improvement Location

	Channel Improvement	Coverage of Channelization From	To	Total Levee Length (ft)
(i)	Channel Improvement I	Station 8.10	Station 13.33	25120.00
(ii)	Channel Improvement II	Station 16.45	Station 19.89	18170.00

Similarly, the stretch from Station 16.45 (immediately after Grand Avenue) to Station 19.89 requires channelization to protect the flood plain from flood encroachment since the flood plains on both banks are residential areas. The channelization terminates at Station 19.89 because a number of mining sites are located upstream.

Beyond these upstream mining sites, channelization is optional because the river has much more defined banks and the relatively high-lying flood plains are not residential areas. Except around the vicinity of the Jomax Road (Station 25.59 (approximately) the flood plains upstream are not flood-proned.

5.3.3.1 <u>Channel Improvement-I</u> - **Table 5.3.2** lists the stations covered by this channelization. **Tables E-I-1** to **E-I-14** define the channel improvement geometries of the 14 stations.

5.3.3.2 <u>Channel Improvement-II</u> - **Table 5.3.3** lists the Stations covered under this channelization. **Tables E-II-1** to **E-II-8** define the channel improvement geometries of the eight (8) stations.

5.3.4 Model III Input Data Descriptions

5.3.4.1 Geometric and Hydraulic Data - A 20-foot high flood levee is considered for the 1000-ft wide improvement channels indicated in **Table 5.3.1.** The geometry information for the stations that describe such improvements are

Table 5.3.2 - Stations Covered Under Channel Improvement I

No. (1)	Station No (2)	Reach Length (ft) (3)	Bed Slope[b] (ft/ft) (4)	Thalweg Elev. (ft) (5)	Corrected Bed Elev. (ft) (6)	Levee[c] Elev. (ft) (7)	Distance[d] (ft) (8)
1	8.10	-	-	1000.10	1000.10	1020.10	- 526.00
2	8.21	600.00	0.00283	1001.80	1001.80	1021.80	- 526.00
3	8.73	2640.00	0.00379	1011.80	1009.30	1029.30	- 526.00
4	9.13[a]	2090.00	0.00211	1016.20	1015.20	1035.20	- 526.00
5	9.90	3950.00	0.00235	1025.50	1026.50	1046.50	- 526.00
6	10.53	3330.00	0.00174	1031.30	1035.90	1055.90	- 526.00
7	10.72	1010.00	0.00277	1034.10	1038.80	1058.80	- 526.00
8	11.01	1430.00	0.00091	1035.40	1042.80	1062.80	0.00
9	11.34[a]	1680.00	0.00351	1041.30	1047.60	1067.60	- 905.00
10	11.52	980.00	0.00112	1042.40	1050.40	1070.40	- 935.00
11	11.80	1415.00	0.00466	1049.00	1054.40	1074.40	- 819.00
12	12.38	925.00	0.00465	1053.30	1057.00	1077.00	- 750.00
13	12.84	2485.00	0.00382	1062.80	1064.10	1084.10	- 844.00
14	13.33[a]	2585.00	0.00337	1071.50	1071.50	1091.50	- 526.00

Note: [a] Bridge locations.
[b] Based on thalweg elevations; average bed slope is 0.00284 ft/ft;
[c] A levee height of 20.0 ft is provided above the corrected bed elevation.
[d] Distance between the existing thalweg location and the proposed channel site.

Table 5.3.3 - Stations Covered Under Channel Improvement II

No. (1)	Station No (2)	Reach Length (ft) (3)	Bed Slope[b] (ft/ft) (4)	Thalweg Elev. (ft) (5)	Corrected Bed Elev. (ft) (6)	Levee[c] Elev. (ft) (7)	Distance[d] (ft) (8)
1	16.45[a]	-	-	1110.00	1110.00	1130.00	- 231.00
2	16.91	2440.00	0.00189	1114.60	1117.10	1137.10	- 242.00
3	17.38	2455.00	0.00289	1121.70	1124.30	1144.30	- 729.00
4	17.76	1980.00	0.00318	1128.00	1130.10	1150.10	- 705.00
5	18.24	2525.00	0.00305	1135.70	1137.50	1157.50	- 209.00
6	18.92[a]	3595.00	0.00376	1149.20	1148.00	1168.00	- 475.00
7	19.44	2800.00	0.00279	1157.00	1156.20	1176.20	- 912.00
8	19.89	2375.00	0.00265	1163.30	1163.30	1183.30	- 526.00

Note: [a] Bridge locations.
[b] Based on thalweg elevations; average bed slope is 0.00293 ft/ft;
[c] A levee height of 20.0 ft is provided above the corrected bed elevation.
[d] Distance between the existing thalweg location and the proposed channel site.

shown in **Figs. E.I-1** to **E.I-14** (see also **Tables E.I-1** to **E.I-14, Appendix E**) for Channel Improvement I; and **Figs. E.II-1** to **E.II-8** (see also **Tables E.II-1** to **E-II-8, Appendix E**) for Channel Improvement II. The channel lay-outs are based on the average bed gradient of the river. Such improvements along the river permits the necessity of redefining the location of the left and right over bank boundaries as listed in **Table A.1.3. (see Appendix A)** for the **X1** record of each station. Roughness coefficient values of 0.04, 0.03, and 0.04 are made for the left over bank, main, and right over bank channels, respectively, for the **NC** record, while the movable bed of 1000-foot wide is defined in the **HD** record by specifying the left and right station boundary limits.

5.3.4.2 Sediment Data - Similar to the previous two models (i.e., Model I and II), gradation information collected from the field were used for the **N** records of the Channel Improvement stations (see **Tables B-1** to **B-76** and **Figs. B-1** to **B-76, Appendix B**).

5.3.4.3 Hydrologic Data - The same four sets of hydrologic data defining 50, 100, 200, and 500 years of return periods are used for Model III. These data files are, respectively, ***HEC6-M31, HEC6-M32, HEC6-M33,*** and ***HEC6-M34.***

VI RESULTS AND ANALYSIS

6.1 Selection of Sediment Transport Function

Prior to the development of the three (3) models that describe and incorporate the on-going and future improvements along the Agua Fria River, preliminary efforts were made to select the sediment transport function that best describes the sediment transport dynamics in the river. This necessitated the determination of inflowing sediment load that enters the most upstream station of the study reach [i.e., Jomax Road]. A set of inflowing sediment load is generated for each sediment transport function associated with different discharge values. **Tables B.3-1** to **B.3-12** list the water discharge - sediment discharge relations for different sediment transport functions which have been used in the evaluation of the most appropriate sediment transport function for the Agua Fria River.

In the selection process of the sediment transport function, the ten (10) transport functions available in the current version of HEC-6 code were evaluated. **Table 6.1** lists the result of the analysis showing the two evaluated criteria in the selection process. As shown, the formula provided by the combination of the Toffaleti and Schoklitsch relations gave the best predictor of transport dynamics along the reach studied.

Table 6.1- Statistical analyses between the simulated and observed data

MTC No.	Sediment Transport Function	Sum of Deviation	Sum of Squares of Deviations
0,1	Toffaleti	96.06	372.61
3	Madden (1963)	88.61	317.49
4	Yang's Streampower	92.04	339.36
5	Duboys	86.86	364.31
7	Ackers and White	91.34	327.28
8	Colby	95.83	352.35
9	Toffaleti and Schoklitsch	87.20	299.79**
10	Meyer-Peter and Muller	88.04	324.29
12	Toffaleti and Meyer-Peter & Muller	88.42	337.68
13	Madden (1985)	102.28	439.28

Note: ** Toffaleti and Schoklitsch formula provided the most appropriate predictor for the transport dynamics of sediments at the study reach.

The combination of the Toffaleti and Schoklitsch formulas for the sedimentation modeling of the Agua Fria River explains the use of the Schoklitsch formula in computing the bed load portion of the sediment movement, while the Toffaleti formula accounts for the rest of the sediment loads, other than the bed load. This manner of calculation is attributed from the fact that the Toffaleti formula was designed to compute the total load based on sediment sizes that range from 0.01 to 4.00 mm. The Schoklitsch formula, on the other hand, were established to evaluate the bed sediment load for sediment sizes ranging from 0.3 to 5.0 mm (see **Table 6.2**). Since the Schoklitsch formula covers a broader range of larger sediment sizes in the sediment movement computation, the bed load is effectively handled by it.

6.2 Inflowing Sediment Loads for the Modeling of the Agua Fria River

In the consideration of the entire Agua Fria River as the study reach, determination of inflowing sediment loads at the most upstream station (i.e. Station 33.82) is vital. Also, since the New River serves as a tributary to the Agua Fria River, inflowing sediment load data must be determined at the tributary mouth (i.e. Station 9.13). These data are listed in **Tables B.3-11** and **B.3-12 (in Appendix B).**

6.3 Modeling Results

Four (4) hydrologic scenarios were used in running all the models (i.e. Models I, II, and III). These hydrologic scenarios were based on peak flows for return periods of 50,100, 200, and 500 years when the New Waddel Dam is operational. Also, an expected constant contribution from the New River is considered for different return periods. Four (4) hydrographs associated with the four (4) return periods having a duration of about 8.793 days [i.e. equivalent to the Feb. 13-22, 1980 flood duration] are presented in **Appendix C [see Tables C.2.1- C.2.4].**

6.3.1 Model I Results

(a) <u>River Bed Changes</u> - **Table G.1.1** (see **Appendix G)** lists the station-to-station bed profile changes associated with the four (4) hydrographs used in running Model I. The accumulated volume of sediment aggregates entering and leaving the river are summarized in **Table G.1.2** (see **Appendix G).** For the 50-year hydrograph, a -480% trap efficiency is computed. Trap efficiency is determined by the following relations: (Inflow-Outflow)*100/Inflow. The negative sign indicates that more sediment aggregates are leaving the river than those that are entering (through Stations 33.820 and 9.130). Similar river responses are observed for the 100-, 200-, and 500-year hydrographs, which have trap efficiencies of -363%, -273%, and -185%. These numbers indicate that the bed along the entire river permits more scouring than depostion.

Table 6.2 - Basic information on the development and use of common sediment transport functions

Function Name	*Type*	*Sediment Size Range (mm)*	*Depth Range*	*Developed from*	*Comments*
Ackers/White	Total Load	0.04 - 2.5	-	Flume Data	Provides good description of movement for lightweight sediments in laboratory flumes and natural rivers.
Colby	Total Load	0.10 - 0.8	0.1 - 10 ft	Flume & Stream Data	Temperature at 60 °F. The function is recommended for sand rivers with depth less than 10 feet. Effective at velocity range of 1 to 10 fps.
Duboys	Bed Load	0.01 - 4.0	-	Small Flumes	The formula is not applicable for sand bed streams that carry suspended load.
Engelund/ Hansen	Total Load	Sizes in excess of 0.15 mm	-	Large Flume Data	Appears to satisfactorily predict sediment discharge in sand bed rivers.
Laursen	Total Load	0.01- 4.08	-	Flume Data	Intended to be applied only to natural sediments with specific gravity of 2.65. It is adaptable for shallow rivers with fine sand and coarse silt.
Meyer-Peter/ Muller	Bed Load	0.40-30.0	1 to 1.20 m	Flume Data	Not valid for flows with appreciable suspended loads. The function was calibrated for coarse sands and gravels. It is recommended for rivers when the bed material is coarser than 5 mm.
Schoklitsch	Bed Load	0.30 - 5.0	-	Small Flume Data	It is a bed load formula which should not be applied to sand bed streams which carry considerable bed sediments in suspension.
Shields	Bed Load	1.7 - 2.50	-	Flume Data	The sediments used in the experiments were coarse and the shear velocities were low. Almost all the sediments moved were bed load.
Toffaleti	Total Load	0.062 - 16	-	Stream Data	The bed load portion may be calculated using any bed load function; for example, Schoklitsch, or Meyer-Peter and Muller. The function should not be used for lightweight and coarser materials. It is adaptable for large sand bed rivers and for materials with specific gravity of 2.65.
Yang's Streampower Function	Total Load	0.015 - 1.71	-	Stream Data	The function is effective for sediments with specific gravity of 2.65. Yang's sand formula is adaptable for sand bed laboratory flumes and natural rivers - wash load excluded. Yang's gravel formula is adaptable for gravel transportation when bed material is between 2 and 10 mm.

(b) <u>Sedimentation at Bridge Locations</u> - Because channel widths at bridge locations are often constricted, bed sediment movements are active around the area due to the increased velocity of flow. Extensive bed degradation is often the result of such increased velocity brought about by reduced channels. Constricted channels at bridge locations are normally lined by concrete or armored with large rocks because the site is always proned to excessive scouring. The use of large rocks for bed protection at such locations is always important for energy dissipation and to shield the channel bed from scouring. The channel under the Buckeye Road bridge and South Pacific Railroad bridge are very much proned to scouring. However, the channel has been lined with large cobbles and rocks to protect the bed from excessive scouring. In the development of the input data for HEC-6, two (2) ways have been made for the channel:

(i) A zero depth of sediment reservoir is specified for the stations that define the channel geometry around the Buckeye Road and South Pacific Railroad (i.e. Stations 3.767, 3.757, 3.734, and 3.729). This information is specified in the **HD** record; and,

(ii) The sediment data defined in the **N record** for the stations were given large size aggregates.

Specification of a zero depth of sediment reservoir renders the bed immovable at the area and thus, the bed would not be subjected to any scouring. In summary, **Table 6.3** lists the expected behavior of channel beds at various bridge locations in the Agua Fria River:

Table 6.3 - Net Bed Response at Bridge Locations, Model I

	Bridge Locations	Station	Sedimentation Process
(1)	Buckeye Road	3.734	Aggradation
(2)	South Pacific Railroad	3.767	Neither
(3)	Van Buren Road	4.754	Aggradation
(4)	Interstate 10	5.290	Degradation
(5)	McDowell Road	5.689	Degradation
(6)	Indian School Road	8.000	Aggradation
(7)	Camelback Road	9.130	Degradation
(8)	Glendale Avenue	11.340	Aggradation*
(9)	Olive Road	13.330	Degradation**
(10)	Grand Avenue	16.420	Aggradation
(11)	Santa Fe Railroad	16.450	Degradation
(12)	Bell Road	18.920	Degradation
(13)	Beardsley Canal Flume	29.611	Degradation
(14)	Highway 74	32.984	Degradation

Note: * This station is degraded under the 500-year hydrograph.
** This station is aggraded under the 500-year hydrograph.

Two other locations along the river exhibited too much scouring. One is at the most upstream stations of the Agua Fria River (i.e. Stations 33.820, 33.410, 32.998, and 32.984) and the other location is at the Grand Avenue area (i.e., Stations 16.910, 16.450, 16.446, and 16.420). Apparently, these stations have constricted channels permitting more scouring along the channel because of higher flow velocities created. Specifically for the upstream location, the stations that are subjected to very severe degradation include the station that corresponds to the Highway 74 bridge (i.e. Station 32.984) and the immediate upstream station (i.e. Station 32.998). At the Grand Avenue area, very serious degradation has been observed at Stations 16.910, 16.450 (i.e. Sta Fe Railroad bridge), and 16.446. Though the channel at Grand Avenue bridge (Station 16.420) is also constricted, degradation was not possible due to a more constricted channel stations located upstream particularly Stations 16.450 and 16.446.

In summary, it is observed that after a series of degradation are encountered upstream, aggradation process occurs at the immediate station or stations downstream which is permitted by the relatively enlarged channel and the much reduced flow velocity conditions. Such conditions allow the deposition of the sediment aggregates carried and transported by the stream from the upstream constricted channels.

6.3.2 Model II Results

Two river scenarios were considered and analyzed under Model II: Model IIA and Model IIB (see **Section 5.2, Chapter V**). The discussions under Model II are based on the results obtained from Model IIB which covers a more extensive mining development than Model IIA.

(a) River Bed Changes - **Table G.2.1 (Appendix G)** lists the extent of bed changes for Model II associated with the four hydrographs used. The incorporation of the eight (8) mining sites along the river predictably exhibited more dynamic response along the river in terms of aggradation and degradation. In terms of accumulated volume of sediment aggregates entering and leaving the river, the trap efficiencies computed for 50-, 100-, 200-, and 500-year return periods are respectively: -414%, -305%, -241%, and -167%. The negative sign for the trap efficiencies indicates that more scouring is permitted along the stream than deposition although the mining pit locations are being aggraded extensively up to the available pit depth. Mining pit depths allowed at these mining locations range from 15.0 feet to 40.0 feet.

(b) Sedimentation at Bridge Locations - **Table 6.4** summarizes the net channel bed response at various bridge locations in the Agua Fria River:

The sedimentation response at various bridge locations under Model II is closely in agreement with the results of Model I (see **Table 6.3**). Although excessive sedimentation is occurring at mining site locations and at their immediate upstream and downstream stations, the mining developments have not significantly affected the pattern of sedimentation response at various bridge locations in the river.

(c) Sedimentation at Mining Site Locations - In general for all the mining sites, serious head-cutting is encountered at the upstream station which migrates upstream and downstream (i.e. the immediate upstream and downstream stations). At the mining pit, however, the bed is aggraded in proportion to the magnitude of flows passing through the channel. The source of the sediment aggregates being deposited at the mining pits is from the scoured sediments associated with the head-cutting operations upstream of the mining pit.

(d) Summary - Since most of the mining pits are situated at the river channel with few pits situated directly across the river thalweg, definition of ineffective flow areas at the mining site locations was not considered. This means that all the channel area under water was considered the effective flow area which is used in all the hydraulic computations for the mining site stations.

Table 6.4 - Net Bed Response at Bridge Locations, Model II

	Bridge Locations	Station	Sedimentation Process
(1)	Buckeye Road	3.734	Aggradation
(2)	South Pacific Railroad	3.767	Neither
(3)	Van Buren Road	4.754	Aggradation
(4)	Interstate 10	5.290	Degradation
(5)	McDowell Road	5.689	Degradation*
(6)	Indian School Road	8.000	Aggradation
(7)	Camelback Road	9.130	Degradation
(8)	Glendale Avenue	11.340	Aggradation**
(9)	Olive Road	13.330	Degradation
(10)	Grand Avenue	16.420	Aggradation
(11)	Santa Fe Railroad	16.450	Degradation
(12)	Bell Road	18.920	Degradation
(13)	Beardsley Canal Flume	29.611	Degradation
(14)	Highway 74	32.984	Degradation

Note: * This station is aggraded under the 500-year hydrograph.
** This station is degraded under the 500-year hydrograph.

6.3.3 Model III Results

Two channel improvements comprised of a 1000-foot wide channel that runs along two selected reaches of the river (i.e., Channel Improvement I with a reach length of about 5.1 miles, and Channel Improvement II with a reach length of about 3.4 miles) were made to assess the impact of channelization on the extent of sedimentation in the river. Also, the combined impact brought about by the channelization development and the mining activities at the Agua Fria River on sedimentation was evaluated.

(a) River Bed Changes - **Table G.3.1** (see **Appendix G**) lists the extent of bed changes for Model III. The sedimentation dynamics for the entire river is more controlled with channelization development introduced than without it (i.e. Model II scenario). This indicates that with the 1000-foot wide channelization projects introduced at two selected reaches along the river, the sediment movement is kept to a minimum at the sites indicated while the movement of sediments are concentrated largely at the mining locations. The trap efficiencies associated with the four hydrographs are -416%, -309%, -231%, and -168% (see **Table G.3.2, Appendix G**).

(b) Sedimentation at Bridge Locations - **Table 6.5** summarizes the channel behavior at bridge locations. Similar to the responses that have been exhibited by the channel in Models I and II, serious degradation are encountered at the most upstream stations (i.e. Highway 74 area), and at the Grand Avenue area, and mild scouring Station 5.29 (i.e. Interstate 10).

(c) Sedimentation at Mining Site Locations - Excessive head-cutting occurs at the most upstream station of each of the mining pits . This head-cutting affects the immediate upstream station which seriously degrades the bed. The removed aggregates from the stations are carried downstream by the stream and deposited at the mining pit. Also slight head-cutting occurs at the most downstream station at the mining site as the river bed gradient is restored to its normal slope.

In general, the extent of sedimentation at mining site locations above the channelization developments (i.e., channel improvements I and II) are the same for Models II and III. The extent of bed sedimentation for Mining site B, which is situated at the immediate downstream of Channel Improvement II, is different from the results of Model II. The difference lies on the channel expansion from channelization site to the mining site location. Mining Site A, which is located downstream of Mining site B, has behaved similarly as in the simulated results of Model II.

(d) Sedimentation at Channel Improvement Reaches - Along the 5.1-mile reach that stretches from Station 8.10 to Station 13.33 that defines Channel Improvement I, a stable channel bed is observed. This indicates that due to a more uniform flow brought about by 1000-foot wide channelization development, the transport dynamics of sediments along the channel was kept to a minimum. The extent of bed sedimentation along the channel, however, becomes significant with the passage of higher flows.

Similarly, along the 3.4-mile reach that stretches from Station 16.450 to Station 19.890 that defines Channel Improvement II, a stable channel is observed. However, the sudden narrowing of the channel at the most upstream station

Table 6.5 - Net Bed Response at Bridge Locations, Model III

	Bridge Locations	Station	Sedimentation Process
(1)	Buckeye Road	3.734	Aggradation
(2)	South Pacific Railroad	3.767	Neither
(3)	Van Buren Road	4.754	Aggradation
(4)	Interstate 10	5.290	Degradation
(5)	McDowell Road	5.689	Degradation
(6)	Indian School Road	8.000	Aggradation
(7)	Camelback Road	9.130	Degradation
(8)	Glendale Avenue	11.340	Degradation
(9)	Olive Road	13.330	Degradation
(10)	Grand Avenue	16.420	Aggradation
(11)	Santa Fe Railroad	16.450	Degradation*
(12)	Bell Road	18.920	Degradation/Aggradation**
(13)	Beardsley Canal Flume	29.611	Degradation
(14)	Highway 74	32.984	Degradation

Note: * Degradation occurs for the 50- and 100-year hydrographs.
** Aggradation occurs for the 200- and 500-year hydrographs.

(i.e., Station 19.890) has resulted in significant bed degradation. Downstream of the 3.4-mile reach, the river bed exhibited some degree of degradation because the channel is further constricted or reduced at a bridge location site (i.e., Santa Fe Railroad bridge).

6.4 Comparison with Previous Studies

A study of the Agua Fria River in 1986 - particularly the reach between Jomax Road and Bell Road - resulted in Yang's streampower and Shield's functions as the more 'appropriate' sediment transport functions applicable for the Agua Fria study **[Dust, et al., 1986]**. In an earlier study, however, **Dust (1982)** had used the Engelund-Hansen relationship in the sedimentation modeling of the Agua Fria River. It is the high transport rates of the Engelund-Hansen formula that motivated its use for the said study.

A hydraulic and geomorphic analysis of the Agua Fria River conducted by **Simons, Li & Associates, Inc.**, in 1983 employed the Meyer-Peter and Muller bed load function in combination with the Einstein integration of the suspended bed-material load to estimate the sediment transport capacity in the river. The justification presented by **Simons, Li & Associates, Inc. (1983)** in using these equations is due to their apparent success in modeling other rivers having similar bed characteristics as the Agua Fria River.

Another sedimentation study conducted by **Water Resources Associates, Inc., (1986)** for the Agua Fria River - particularly aimed at determining the effects of gravel mining below the Lower Buckeye Road - had used the Meyer-Peter and Muller formula to estimate the bed load and the Einstein integration of the suspended bed material load to estimate the suspended load. However, there were no basis presented to merit or justify the use of these functions in the study.

The library of the most recent version of **HEC-6** code does not, however, include Engelund-Hansen, Einstein, and Shield's relations among the sediment transport function options. It is, therefore, not possible to evaluate the performance of these three relations against the 'overall best' function - combination of Toffaleti and Schoklitsch formulas as the most appropriate descriptor of the sediment transport dynamics for the modeling of the Agua Fria River. In summary, the previous studies conducted for the Agua Fria River are listed in **Table 6.6.**

Table 6.6 - Current and previous sedimentation studies of the Agua Fria River

Author (Year)	Study Reach/Length	Sediment Transport Function/Code
(1) David Dust (1982)	Bell Road-Jomax Road (Mile 18.925 to Mile 25.59) Reach length = 6.7 miles;	Engelund-Hansen formula using HEC-6 code **(HEC, 1977)**
(2) Simons, Li & Assoc., Inc, (1983)	Gila Confluence -Glendale Avenue (Mile 0.00 to Mile 11.4); Reach length = 11.4 miles	Meyer-Peter and Muller for bed load computation and Einstein Integration for suspended load computation using QUASED code **(Simons, & Li, Inc., 1981);**
(3) Water Resources Assoc., Inc. (1986)	Gila Confluence to Buckeye Road (Mile 0.00 to Mile 3.734); Reach length = 3.734 miles.	Meyer-Peter and Muller for bed load computation and Einstein Integration suspended load computation. **
(4) Dust, et. al. (1986)	Bell Road-Jomax Road (Mile 18.925 to Mile 25.59)	Yang's streampower and Shield's function using HEC-6 code **(HEC, 1977);**
(5) This Study (1993)	Gila Confluence to New Waddell Dam (Mile 0.00 to Mile 33.82); Reach length = 34.00 miles;	Toffaleti and Schoklitsch formula using HEC-6 code **(HEC, 1991);**

Note: ** The study used three methods: (i) local scour was estimated using armor control method, Neil method, and Shen method; (ii) regional method scour was computed by equilibrium slope method; and (iii) head-cut migration was estimated using a simplified routing scheme.

VII CONCLUSIONS AND RECOMMENDATIONS

7.1 Selection of Sediment Transport Function

(1) The sediment transport relation provided by the Toffaleti and Schoklitsch formulas [MTC No. 9] described very closely the transport dynamics of sediment movements along the study reach from Bell Road to Jomax Road. The function has provided the most stable channel among the ten (10) sediment transport functions tested in relation to the observed thalweg elevations [i.e., 1989-data]. The good performance of the function in closely predicting the sediment movements along the study reach merits its consideration for the sedimentation modeling of the entire Agua Fria River.

(2) The selection of the most appropriate sediment transport function for the Agua Fria River is more extensive under this current study than in previous studies conducted. It is extensive because all the sediment transport function options in the most recent version of the HEC-6 code **(US Army Corps of Engineers, 1991)** were used in the selection process.

(3) The performance of the Duboys formula (MTC No. 5) gave the least deviation (criterion I) among the ten (10) sediment transport functions evaluated (see **Table 6.1**); however, the formula exhibited very poor performance under criterion II which indicates that Duboys gave excellent predictions at some stations while also giving very poor predictions at other stations.

(4) The sediment transport relation provided by the Meyer-Peter and Muller formula (MTC No. 10) offers a good alternative to the Toffaleti and Schoklitsch formula for the modeling of the Agua Fria River. This conclusion is based on the performance of the Meyer-Peter and Muller formula from the two criteria used in the selection process (see **Table 6.1**). Also, this transport function had been used twice in past sedimentation studies of the Agua Fria River which listed in **Table 6.6**. These studies were conducted by **Simons, Li and Assoc., Inc. (1983)** and **Water Resources Assoc., Inc. (1986)**. Because of the above reasons, there is a good level of confidence to use the Meyer-Peter & Muller formula as the most appropriate alternative for Toffaleti and Schoklitsch formula.

7.2 Previous Sedimentation Modeling Studies for Agua Fria River

(5) Previous sedimentation studies of the Agua Fria River have employed other sediment transport functions to model the sediment transport dynamics along the river. These transport functions include: Yang's stream power function (**Dust et al, 1986**), Shield's formula (**Dust et al, 1986**), Meyer-Peter and Muller (**Simons, Li & Assoc., Inc., 1983; Water Resources Assoc., Inc.,**

1986), Engelund and Hansen (**David Dust, 1982**), and the Einstein integration method (**Simons, Li & Assoc., Inc., 1983; Water Resources Assoc., Inc., 1986**). In summary, these studies are listed in **Table 6.5.** Because the river reaches considered under these different studies were not located in the same sites, and because of the apparent inconsistency of the hydraulic characteristics along the river, selection of sediment transport functions were made based on the most significant factor considered at the time of modeling.

7.3 Sensitivity Analysis

(6) The selected transport function for modeling of the Agua Fria River (i.e., Toffaleti and Schoklitsch formula) is not very sensitive to the changes in the Manning's roughness coefficient, n. This demonstrates that the value of 'n' is not a critical parameter in the use of the Toffaleti and Schoklitsch formula for the modeling of the Agua Fria River. Other functions tested (i.e., Ackers and White, Meyer-Peter and Muller, and Toffaleti/Meyer-Peter and Muller formulas), however, have shown pronounced sensitivity to Manning's 'n'. From the four (4) transport functions analyzed, Toffaleti/Meyer-Peter and Muller formula exhibited the greatest sensitivity to Manning's coefficient 'n'.

(7) Realistically, as expected, all the sediment transport functions tested exhibited significant sensitivity to the inflowing sediment load and sediment gradation data.

7.4 Model I

(8) Pronounced degradation is observed at the most upstream stations (i.e. Stations 33.820, 33.410, 32.998, and 32.984) for all the four (4) sets of hydrologic data used. The cross-section geometry of these stations are relatively constricted permitting significant degradation or scouring at these sites. Station 32.984, which defines the cross-section geometry of the Highway 74 bridge and which exhibited the worst degradation among the four stations, needs armorment for bed protection purposes. Another potential measure to effectively reduce the large degradation encountered at the bridge site and its vicinity is through channelization or widening of the channel. This would permit a much reduced flow velocity, and consequently, a more uniform flow condition and a stable channel.

(9) Another site which is extensively degraded is at the Grand Avenue area (i.e., Stations 16.910, 16.450, and 16.446) where two adjacent bridges are situated about 25 feet apart. These bridges are the Santa Fe Railroad bridge (Station 16.450) and Grand Avenue bridge (Station 16.420). Measures that could be adopted to reduce the serious degradation at the area include: (i) the widening of the river channel; and/or, (ii) the armorment of the channel bed particularly at the bridge locations by the use of large boulders as streambed protection.

(10) A channel location that was found to be the most stable part of the Agua Fria River is at the Buckeye Road area (i.e., Stations 4.094, 3.767, 3.734, and 3.729) where two bridge crossings are located. These two bridges are the Buckeye Road bridge (Station 3.734) and the South Pacific Railroad bridge (Station 3.767). The river bed at these bridge areas are very stable because of the large boulders that armored the channel which shield the channel bed from degradation. The immediate downstream station (i.e., Station 3.43), however, has exhibited some serious degradation as a result of the energy being dissipated at that station brought about by the high flow velocities created upstream associated with the constricted channel.

(11) Conversely, the channel bed at the Van Buren Road bridge (i.e., Station 4.754) has aggraded significantly and the aggradation will increase with higher flows. The aggregates deposited at the site are transported from the immediate upstream stations that include the bridge station of Interstate 10 which exhibited significant channel bed degradation.

(12) The bed profile at other locations are not substantially changed except at Station 11.01 where increasing aggradation is observed with higher flows. Improvement of the channel along the braided areas by dredging or by channelization helps improve the hydraulic condition of the channel, thereby, reducing the aggradation process. For this station, the significant increase in the channel width has contributed tremendously to the aggradation process. This could be explained by the reduction of flow velocity along the channel and thus, the sediments being carried by the flow find their way to settle and be deposited.

(13) In general, the entire river reach is degraded more than it is aggraded based on the trap efficiencies evaluated in **Table G.1.2 (Appendix G)**. This indicates that higher flows will permit more aggradation than degradation along the Agua Fria River.

(14) In summary, Model I, which accommodates the features of the existing conditions at the Agua Fria River, could be used in further studying the river response with the following notes on data changes:

(a) Geometric Data - updated versions of the geometric data specially at specific stations or locations of interest to the modeler should replace the ones that are currently used in the model.

(b) Sediment Data - more current information of the sediment characteristics at the specific area or station should be used to replace the ones that are in the model to meet the ever-changing aggregate size and characteristics in the river. The sediment reservoir depth must be known so that the extent of potential degradation could be specified in order to come up with a more realistic simulated result. Special consideration must be made on the gradation data collected from the field from 1980 to 1990 to be possibly replaced with the most recent gradation information.

(c) Hydrologic Data - Since the hydrographs that have been used in the current study were based on the flood of February 18-22, 1980, a more realistic hydrograph based on any recent hydrologic study of the Agua Fria River watershed should be used for a more realistic output.

7.5 Model II

(15) The three (3) bridge locations identified to have serious cases of degradation under Model I are carried over in the simulation results of Model II. These sites are further described as follows:

Site 1 - This site is comprised of the most upstream stations of the river reach (i.e., Stations 33.82, 33.41, 32.998, and 32.984) which are in the vicinity of the Highway 74 road bridge..

Site 2 - The site is comprised of the stations at the Grand Avenue area where two adjacent bridge crossings (i.e., Stations 16.910, 16.45, and 16.446) are situated;

Site 3 - This site is comprised of the stations around Interstate 10 (i.e. Stations 5.38 and 5.29).

(16) The stations where substantial aggradation (or deposition) occurs are predominantly located at mining sites. Since the mining sites are not protected from degradation, both deposition and scouring are observed. Head-cutting at the most upstream station of the mining site is normally observed at these mining locations. This head-cutting phenomenon does not only concentrate at the said upstream station but it does migrate further to the immediate upstream stations, producing a large volume of aggregates that could be potentially deposited at the downstream stations. All the mining sites have exhibited substantial aggradation and they are described as follows:

Site A - This mining site includes Stations 14.412, 14.388, 13.855 and 13.810. Large deposition occurs at higher flows with extensive head-cutting at the most upstream station. Head-cutting migration is observed in the upstream and downstream boundaries of the mining site ;

Site B - This mining site includes Stations 15.320, 15.303, 14.940, and 14.932. A serious case of degradation occurs at the immediate downstream station (i.e. Station 14.850) because the station is the only buffer station between mining sites A and B;

Site C - This mining site covers two mining pits and the geometry information are provided by Stations 20.993, 20.920, 20.657, 20.640, 20.577, 20.563, 20.550, 20.240, 19.953, and 19.944. The immediate station upstream of site C (i.e., Station 19.89) shows a serious case of head-cut migration. Overall, the mining pits are observed to degrade more than they are aggraded.

Site D - The mining site is comprised of Stations 21.818, 21.773, 21.760, 21.680, and 21.657. No serious aggradation is encountered at the site because of the presence of mining site E which is laterally situated alongside site D.

Site E - This mining site includes the Stations of 21.850, 21.818, 21.773, 21.760, 21.680, 21.657, 21.523, and 21.500. No pronounced aggradation process is observed for similar reason as stated in site D.

Site F - This mining site is comprised of Stations 22.365, 22.320, 22.130, and 22.107. Serious aggradation occurs at higher flows in this site, while at the same time serious head-cutting occurs at the most upstream and downstream stations (i.e. Stations 22.365 and 22.107, respectively),

Site G - This mining site is comprised of Stations 23.874, 23.851, 23.694, 23.571, 23.365, and 23.350. Pronounced aggradation occurs at all flows with head-cutting at both the most upstream and downstream stations of the mining site.

Site H - The mining site is comprised of three (3) mining pits with 14 stations (i.e., Stations 24.491, 24.468, 24.365, 24.350, 24.193, 24.170, 24.085, 24.070, 23.874, 23.851, 23.694, 23.571, 23.365, and 23.350). All the mining pits have aggraded seriously for all the flows considered. A serious head-cut migration is observed at the immediate upstream station of mining site H (i.e., Station 24.540).

(17) The significant observation under Model II is the increased volume of aggradation evaluated in the river - specifically at the mining site locations. This could be explained by the reduced accumulated volume of sediment outflows evaluated under Model II as listed in **Table G.2.2** (see **Appendix G**) as compared with the accumulated value of sediment outflows for Model I (see **Table G.1.2., Appendix G**). This indicates that there is an extensive bed movement along the river as a consequence of the mining activities along the river. Such bed movements, however, are concentrated in the mining sites and their vicinity.

(18) The location of all the mining sites are at the river channel (see **Appendix D**) with one site (i.e., Site D) situated across the river thalweg. Serious bed degradation and severe head-cutting and migration are often the result of

the mining pits that are situated at the river channel. Relocation of these mining sites away from the river channel in order to avoid interference with the natural flow of water should be considered.

(19) Model II could be used to evaluate future mining operations along the river. Before permits are granted to mining companies, Model II could be used to simulate the extent of bed sedimentation at the site. Here, the model could be modified to accommodate any mining site plans (e.g., bed armorment, levee protection, etc.) which could be secured from mining operators. Also, various scenarios could be evaluated and analyzed through Model II with the aim of selecting the best possible site plan that could provide the most stable channel possible.

(20) The incorporation of mining sites to Model I has not significantly effected the bed channel behavior at bridge locations. This indicates that the adverse affects of mining locations on the extent of sedimentation along the river channel are very local in scope. This indicates that only the sites and the nearby upstream and downstream stations are adversely affected by the various mining site developments.

7.6 Model III

(21) The incorporation of two channel improvements along the Agua Fria River create a more uniform flow condition at the two reaches covered by the channelization developments. This has permitted less sediment movement except at the most upstream and downstream stations of Channel Improvement II where the channel constriction has permitted higher flow velocities, and consequently, bed degradation. For Channel Improvement I, bed degradation is observed at the upstream boundary station as the channel undergoes some transition from the natural channel to the 1000-foot wide channel provided for the channelization. The remaining stations exhibited a stable channel due to the similar reason indicated for Channel Improvement II.

(22) The impact created by channel improvements to Model II has slightly increased the mobility and transport dynamics of sediment aggregates along the channel as proven by a slight increase of accumulated volume of sediment outflows. (compare **Tables G.2.2.** with **G.3.2, Appendix G**). The trap efficiency for the entire river decreases with the increasing magnitude of flows passing the river.

(23) Under Model III, the channel bed response at bridge locations on the extent of sedimentation are in close agreement with Models I and II. This indicates that the channelization developments do not adversely affect the bed sedimentation at bridge locations. This observation is also true to Stations 8.00 and 16.45 (i.e., stations representing Indian School Road bridge and Santa Fe Railroad bridge), which are situated immediately downstream of the two channel improvements, Channel Improvements I and II.

(24) Model III is a useful tool in the study of other channelization possibilities or developments at the Agua Fria River in order to assess the extent of bed changes along the entire river in response to different flow hydrographs considered. Such evaluations provide opportunities to assess and select a project or a combination of development projects that gives stable and satisfactory channel response.

7.7 HEC-6 Model Limitations

Some of the limitations of HEC-6 recognized in the modeling efforts for Agua Fria River are provided as follows:

(25) The rigid bank assumption of the HEC-6 code minimally limits the modeling of the Agua Fria River along the reach between Stations 8.34 and 1.87 (a 6.5-mile stretch from Indian School Road bridge to the Lower Buckeye Road where bank levees are built at both sides of the river for flood protection).

(26) The consideration of sediment aggregates greater than 64 mm are not handled by HEC-6. Very little information has been reported in the literature on these sediment sizes. Though aggregates greater than 64 mm could be found along the streams of Agua Fria River, their consideration in the modeling was neglected by the code. This is not a serious limitation on the model, however.

(27) The entire movable bed portion of the cross-sections are assumed to aggrade or degrade uniformly in HEC-6.

(28) Since HEC-6 is not suitable for rapidly changing flow conditions, this assumption affects the simulated results of Model II where mining pits as deep as 40 feet are considered. The extent of mining pit development may permit rapid changes in the flow condition along the stream because of the bed modification necessary to define the geometry information of mining sites.

(29) Since HEC-6 is a one-dimensional model with no provision for simulating the development of meanders or specifying a lateral distribution of the sediment transport rate across the channel section, lateral channel migration (a phenomenon that most likely occurs at mining pits) or bank erosion are not considered.

7.8 Critical Aspects for Floodplain Management

(30) With the changes of the bed profile as simulated by the HEC-6 code, locations of extreme degradation and aggradation along the river could be identified. The impact of such bed changes in the river and in the floodplain should be studied and further investigated. For example, the results from the

model simulations could aid in the identification of critical locations along the river so that preventive measures could be made against the excessive or serious occurrence of bed sedimentation. Such measures include:

(i) channelization of the river to widen channels that are narrow; and, to provide a much-defined channel especially for braided and undefined channels;

(ii) relocation of mining activities from the water course in the river due to the head-cutting actions that both migrate upstream and downstream from the mining pits and due to the significant impact mining activities produced on the flow behavior and pattern that enhances bed sedimentation and bank erosion;

(iii) provision of flood levees along critical areas to protect the floodplain; and,

(iv) armorment of the river bed with large rocks to prevent excessive bed degradation because uncontrolled bed degradation along the river reduces the effectiveness of in-stream structures like bridge piers, and threatens the existence of underground utility lines like gas, sewer and water distribution lines.

7.9 Applicability and Appropriateness of the Models

(31) Model I is applicable in evaluating the bed response of the river to various hydrologic inputs. A hydrologic study, is therefore, necessary for the Agua Fria watershed in order to consider the most representative hydrograph in the model, such as the 50-year or 100-year hydrograph.

(32) Models II and III are the models developed for scenarios when mining sites are operational with and without the channel improvement projects (i.e., Channel Improvements I and II). The current version of the HEC-6 code is limited in the handling of flow conditions resulting from significant river bed modification like mining pits; however, the results do provide good qualitative information that are helpful in engineering analysis. The upcoming new version of the HEC-6 code will most likely better accommodate such limitations. Also, Model III which covers both the channel improvement and the mining developments at the Agua Fria River provide good qualitative engineering information.

(33) Further, the current model input needs regular updating to accommodate the changes along the river. For example, some of the sediment information used in the models (i.e., Models I, II, and III) were data that have been collected and analyzed in early 80's. As much as possible, the most current field information on both the geometric and sediment data must be

accommodated in all the models for more reliable assessments of the model outputs.

(34) In general for all the models (i.e., Models I, II and III), short period simulation involving one event or a one-week period provide good qualitative results. Longer simulation periods provide better information on the sedimentation processes that will most likely occur along the river. This is because the HEC-6 code was designed to simulate long-term trends of scour and/or deposition in a stream channel that might result from modifying the frequency and duration of the water discharge and/or stage or from modifying the channel geometry, e.g., encroaching in the flood plains **(US Army Corps of Engineers, 1991).**

VIII REFERENCES

Arizona State University [ASU] (1992), Gradation Analysis of Sediment Samples Collected at Various Locations in the Agua Fria River, Conducted by the Civil Engineering Department, ASU, January-February, 1992.

ABC Sand & Rock Co. (1991), A Laboratory Report for Three Sediment Data *[Courtesy of the Maricopa Flood Control District].*

Barrett Consulting Group, Inc. (1987), Development plan map of the mining site to be operated by Salt River Pima Maricopa Indian Community, Project No. 72500, Drawn on September 21, 1987.

Barrett Consulting Group, Inc. (1987), Development plan map of the mining site to be operated by Finley Construction Corporation.

Barrett Consulting Group, Inc. (1987), Development plan map of the mining site to be operated by Ideal Rock Products, Project No. 73200, Drawn on November 10, 1987.

Barrett Consulting Group, Inc. (1987), Development plan map of the mining site to be operated by Finley Construction Corporation, Project No. 72001, Drawn on December 28, 1987.

Barrett Consulting Group, Inc. (1988), Development plan map of the mining site to be operated by Gravel Resources Company, Project No. 72200, Drawn on January 21, 1988.

Dust, D. W. (1982), Data Development, HEC-6 Computations, and Analysis of the Results for the Agua Fria River - Arizona, submitted to Prof. Paul Ruff as a course requirement, Civil Engineering Department, Arizona State University, August 1982 (unpublished).

Dust, David W. (1983), Computer Modeling of Bull Creek with HEC-6, ***A Final Report,***, submitted to the Environmental Resources Engineering Faculty, Humboldt State University, May, 1983, pp.44.

Dust, D.W., M.T. Bowers, and P. F. Ruff (1986), Application of HEC-6 to Ephemeral Rivers of Arizona, ***Report Number: FHWA/AZ86/214,*** Prepared for Arizona Department of Transportation, January 1986, pp.159.

Hoggan, D. H. (1989), Computer-Assisted Floodplain Hydrology and Hydraulics, McGraw-Hill Publishing Company, New York, USA.

Jerry R. Jones & Associates, Inc. (1989), Agua Fria River Flood Insurance Study, Contract FCD 87-2, JJA Job No. 286-080.01, Prepared for Flood Control District of Maricopa County, January, 1989, pp. 40.

Lemme Engineering, Inc. (1986), Site plan and development map for the mining site to be operated by Lake End Sand and Gravel Company, Drawn on November, 1986.

Lemme Engineering, Inc. (1987), Development plan map of the mining site to be operated by Blue Circle West, drawn on December, 1987.

Ryan, K. (1991), Sediment Sample Gradation Study of a Selected Site in the Agua Fria River Bed., A Report, Submitted as a Requirement for CEE 590, Civil Engineering Department, Arizona State University, June, 1991.

Sergent, Hauskin & Beckwith [SHB] (1980), A Compilation of Test Borings Taken at Various Bridge Locations in the Agua Fria River, *[Courtesy of the Maricopa Flood Control District]*.

Sergent, Hauskin & Beckwith [SHB] (1991), A Compilation of Test Borings Taken at the Agua Fria River Between Indian School and Camelback Roads, *[Courtesy of the Maricopa Flood Control District]*.

Simons, Li & Assoc., Inc. (1983), Hydraulic and Geomorphic Analysis of the Agua Fria River, Proj. No. AZ-MC-05. A Report submitted to the Flood Control District of Maricopa County, Arizona, May 16, 1983.

Stevens, Jr., H. H. and C. T. Yang (1989), Summary and Use of Selected Fluvial Sediment-Discharge Formulas, Water Resources Investigations Report No. 89-4026, U.S. Geological Survey, Denver, Colorado, USA.

Thomas, W. A., Gee, D. M., and McArthur, R. C. (1981), Training Document No. 13, "Guidelines for Calibration and Application of Computer Program HEC-6", Hydrologic Engineering Center, Davis, California, February, 1981.

United Metro (UM) (1986), A Laboratory Report of Sediment Data Obtained at Mining Site, *[Courtesy of the Maricopa Flood Control District]*.

U.S. Army Corps of Engineers (1968), Flood Plain Information Study, Agua Fria River, Maricopa County, Arizona, *Report* by U.S. Army Corps of Engineers - Los Angeles District, California, March 1968.

U.S. Army Corps of Engineers (1977), HEC-6: Scour and Deposition in Rivers and Reservoirs, User's Manual, U.S. Army Corps of Engineers, 1977.

U.S. Army Corps of Engineers (1990), HEC-6: Scour and Deposition in Rivers and Reservoirs, ***User's Manual***, Hydrologic Engineering Center, Davis, California, U.S.A., September, 1990.

U.S. Army Corps of Engineers (1991), HEC-6: Scour and Deposition in Rivers and Reservoirs, ***User's Manual***, June 1991 Release.

Water Resources Associates, Inc. (1986), Agua Fria River Sedimentation Study, submitted to Development Engineering, Phoenix, Arizona, May 30, 1986.

Yost and Gardner Engineers (1979), Floodplain Delineation Map of Agua Fria River from Bell Road to Jomax Road, Job No. 5483, Prepared for Flood Control Distric of Maricopa County, Drawn on Dec. 21, 1979.

APPENDIX A - River Geometry and Hydraulic Data

A.1 - Hydraulic Data

Table A-1 - Hydraulic Data for the 92 Selected Stations (Model I)

No.	Mile No.	Roughness Coefficient LOB	Main	ROB	Boundary Left	Right	Reach Length (ft)	Thalweg Elev. (ft)
1	0.160	0.070	0.044	0.040	8000.0	12725.0	465.	908.30
2	0.440	0.033	0.039	0.040	8029.0	10420.0	1485.	912.80
3	0.730	0.034	0.042	0.040	8340.0	12394.0	1510.	916.90
4	1.330	0.040	0.043	0.042	8038.0	10456.0	3385.	925.50
5	1.710	0.041	0.035	0.040	9091.0	10284.4	2480.	928.20
6	2.020	0.041	0.035	0.035	8839.4	10077.3	1965.	932.70
7	2.600	0.045	0.036	0.031	9437.4	10851.6	3320.	939.60
8	2.800	0.045	0.035	0.030	8817.0	11222.0	1000.	942.00
9	3.270	0.045	0.035	0.030	9692.6	11130.5	2505.	944.50
10	3.400	0.045	0.035	0.030	9760.9	10928.5	685.	945.10
11	3.430	0.045	0.035	0.030	9654.5	10873.4	165.	946.00
12	3.729	0.045	0.035	0.030	9420.0	10603.0	1580.	952.20
13	3.734	0.045	0.035	0.030	9400.9.	10599.3	25.	952.30
14	3.757	0.045	0.035	0.030	9425.0	10555.0	120.	951.20
15	3.767	0.045	0.035	0.030	9428.1	10572.0	50.	952.90
16	4.094	0.040	0.025	0.045	9440.0	10578.0	1765.	958.30
17	4.270	0.040	0.025	0.045	9449.0	10588.0	925.	957.10
18	4.700	0.040	0.025	0.045	9451.0	10579.0	2250.	959.10
19	4.754	0.040	0.025	0.045	9402.5	10572.4	225.	960.30
20	4.790	0.040	0.025	0.045	9440.0	10590.0	277.	961.10
21	5.150	0.040	0.025	0.045	9291.0	10713.0	1873.	967.40
22	5.290	0.040	0.022	0.040	9250.8	10672.4	775.	971.50
23	5.380	0.040	0.025	0.040	9266.0	10656.0	465.	971.40
24	5.689	0.040	0.022	0.040	9371.3	10553.8	1620.	973.85
25	5.750	0.040	0.025	0.040	9426.0	10579.0	370.	973.70
26	5.900	0.040	0.025	0.040	9429.0	10561.0	950.	975.40
27	6.430	0.040	0.025	0.040	9452.0	10537.0	2855.	981.00
28	6.890	0.040	0.025	0.040	9439.0	10577.0	2345.	989.40
29	6.990	0.040	0.025	0.040	9400.0	10559.0	550.	990.20
30	7.490	0.040	0.025	0.040	9509.0	10525.0	2595.	995.20
31	8.000	0.022	0.022	0.022	9235.5	10725.0	2685.	999.20
32	8.100	0.040	0.025	0.040	9350.0	10883.0	535.	1000.10
33	8.210	0.040	0.025	0.040	9461.0	10989.0	600.	1001.80
34	9.130	0.022	0.022	0.022	9137.5	10860.0	4730.	1016.20
35	9.900	0.000	0.025	0.000	9296.0	10257.0	3950.	1025.50
36	10.530	0.040	0.030	0.040	9141.0	10087.0	3330.	1031.30
37	10.720	0.040	0.030	0.040	9360 0	10386.0	1010.	1034.10
38	11.010	0.045	0.059	0.045	8515.0	10287.0	1430.	1035.40
39	11.340	0.045	0.035	0.055	9573.0	10178.0	1680.	1041.30
40	11.520	0.045	0.035	0.055	9873.0	10117.0	980.	1042.40
41	11.800	0.045	0.035	0.055	8224.0	10302.0	1415.	1049.00
42	12.380	0.045	0.035	0.055	9379.0	10302.0	2885.	1053.30
43	13.330	0.045	0.035	0.055	9251.1	10758.5	5070.	1071.50
44	13.810	0.045	0.035	0.040	9250.0	10525.0	2575.	1075.70
45	14.380	0.045	0.035	0.040	8210.0	10691.0	2965.	1084.40
46	14.850	0.045	0.035	0.040	9106.0	10454.0	2430.	1090.50
47	14.940	0.045	0.035	0.040	9140.0	10772.0	470.	1091.00
48	15.320	0.045	0.035	0.040	9681.0	11762.0	1950.	1093.50
49	15.510	0.040	0.030	0.040	9756.0	11854.0	985.	1097.30

Table A-1 - Hydraulic Data for the Selected Stations (continued...)

No.	Mile No.	Roughness Coefficient LOB	Main	ROB	Boundary Left	Right	Reach Length(ft)	Thalweg Elev. (ft)
49	15.510	0.040	0.030	0.040	9756.0	11854.0	985.	1097.30
50	15.980	0.045	0.035	0.040	9825.0	10836.0	2395.	1103.90
51	16.420	0.045	0.035	0.040	9776.8	10225.4	2215.	1108.70
52	16.446	0.045	0.035	0.040	9768.4	10241.0	95.	1110.00
53	16.450	0.045	0.035	0.040	9768.0	10241.0	20.	1110.00
54	16.910	0.045	0.035	0.040	9758.0	10178.0	2440.	1114.60
55	17.380	0.045	0.035	0.040	9233.0	10670.0	2455.	1121.70
56	17.760	0.045	0.035	0.040	8819.0	10431.0	1980.	1128.00
57	18.240	0.045	0.035	0.040	8972.0	10927.0	2525.	1135.70
58	18.920	0.045	0.035	0.040	9447.5	10577.0	3595.	1149.20
59	19.440	0.040	0.030	0.040	7491.0	10174.0	2800.	1157.00
60	19.890	0.040	0.030	0.040	8142.0	10997.0	2375.	1163.30
61	20.450	0.040	0.030	0.040	8070.0	10526.0	2955.	1174.10
62	20.920	0.040	0.030	0.040	7924.0	10707.0	2490.	1179.50
63	21.010	0.040	0.030	0.040	8125.0	10446.0	430.	1179.30
64	21.420	0.040	0.030	0.040	9359.0	10853.0	2165.	1187.00
65	21.760	0.040	0.030	0.040	9887.0	11304.0	1815.	1193.30
66	22.320	0.040	0.030	0.040	9946.0	12625.0	2940.	1201.00
67	22.790	0.040	0.030	0.040	9941.0	13467.0	2510.	1209.10
68	23.350	0.040	0.030	0.038	9967.0	13219.0	2930.	1217.60
69	23.890	0.039	0.030	0.035	9324.0	11071.0	2860.	1227.60
70	24.35	0.040	0.030	0.034	7939.0	10201.0	2445.	1235.20
71	24.540	0.030	0.030	0.031	9240.0	10227.0	980.	1238.30
72	24.900	0.030	0.030	0.030	9334.0	11529.0	1905.	1246.50
73	25.370	0.040	0.030	0.040	9459.0	11916.0	2485.	1255.00
74	25.590	0.040	0.030	0.035	9685.0	11070.0	1125.	1256.50
75	25.860	0.040	0.030	0.040	8220.0	11215.0	1455.	1260.00
76	26.290	0.041	0.033	0.041	8722.0	11227.0	2240.	1271.60
77	26.730	0.041	0.033	0.041	9720.0	11263.0	2330.	1279.80
78	27.030	0.048	0.035	0.043	9679.0	10553.0	1590.	1281.20
79	27.680	0.041	0.033	0.041	8224.0	10125.0	3430.	1294.70
80	28.120	0.041	0.033	0.041	9108.0	10107.0	2355.	1304.60
81	28.670	0.041	0.033	0.041	9950.0	11203.0	2885.	1311.50
82	29.040	0.042	0.035	0.042	9808.0	10638.0	1975.	1317.20
83	29.540	0.042	0.035	0.042	9198.0	10150.0	2640.	1326.70
84	29.610	0.042	0.035	0.042	9052.0	10244.0	375.	1328.90
85	29.800	0.042	0.035	0.042	9347.0	10610.0	1400.	1327.70
86	30.070	0.042	0.035	0.042	9604.0	10306.0	1420.	1334.00
87	30.260	0.042	0.035	0.042	9711.0	10643.0	1005.	1338.90
88	30.820	0.043	0.045	0.043	9865.0	11244.0	2960.	1345.20
89	31.390	0.043	0.037	0.043	9470.0	10633.0	2970.	1354.70
90	31.860	0.043	0.037	0.043	9490.0	10321.0	2505.	1362.00
91	32.430	0.043	0.040	0.052	9438.0	10437.0	2980.	1363.80
92	32.860	0.049	0.042	0.049	9719.0	10564.0	2295.	1374.90
93	32.984	0.047	0.032	0.055	9750.0	10150.0	648.	1378.40
94	32.998	0.047	0.032	0.055	9762.0	10164.0	72.	1381.40
95	33.410	0.060	0.050	0.050	9750.0	10687.0	2170.	1386.90
96	33.820	0.060	0.050	0.050	9565.0	10600.0	2175.	1387.40

A.2 Plots of Cross-Sections

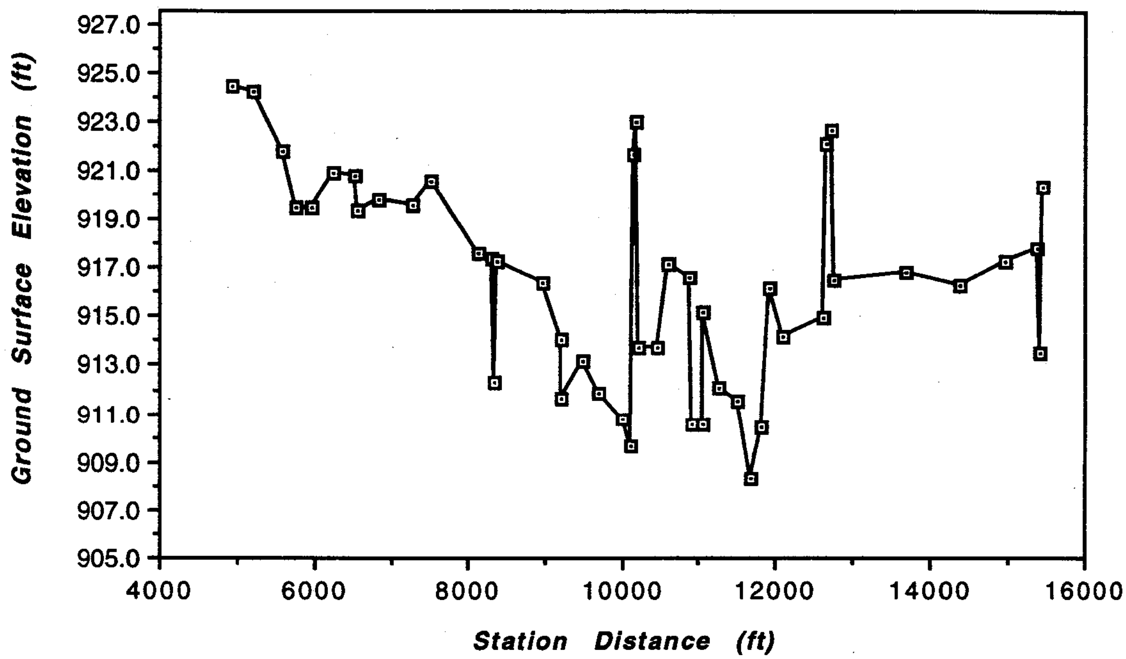

Fig. A-1 - Cross-section plot of Station No. 0.160

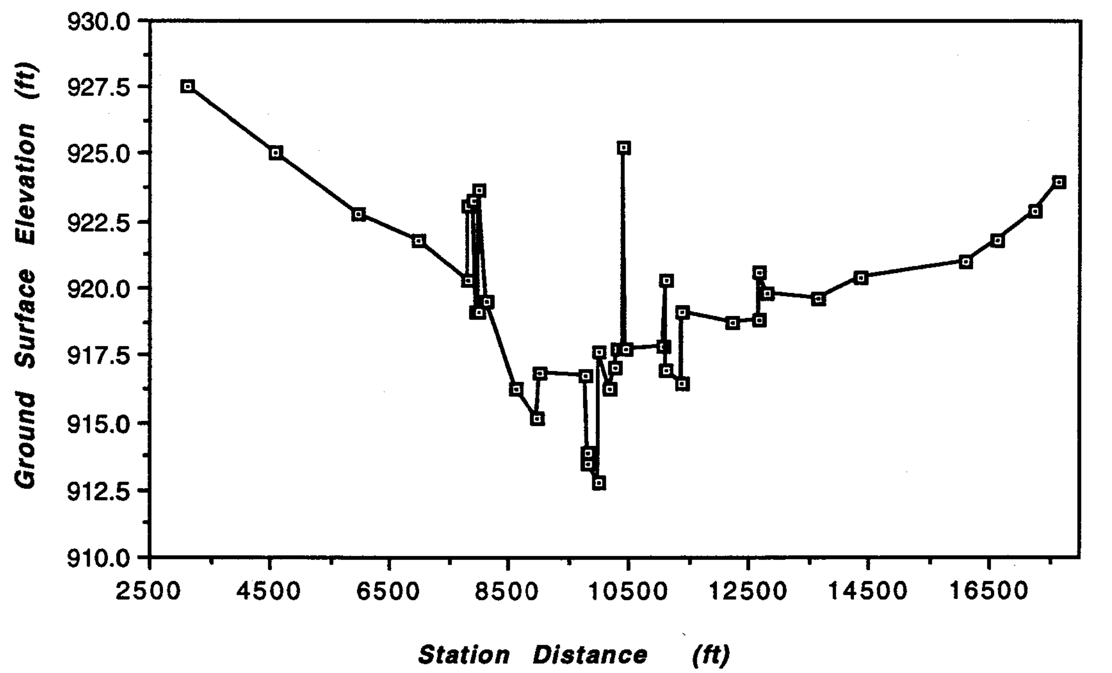

Fig. A-2 - Cross-section plot of Station No. 0.440

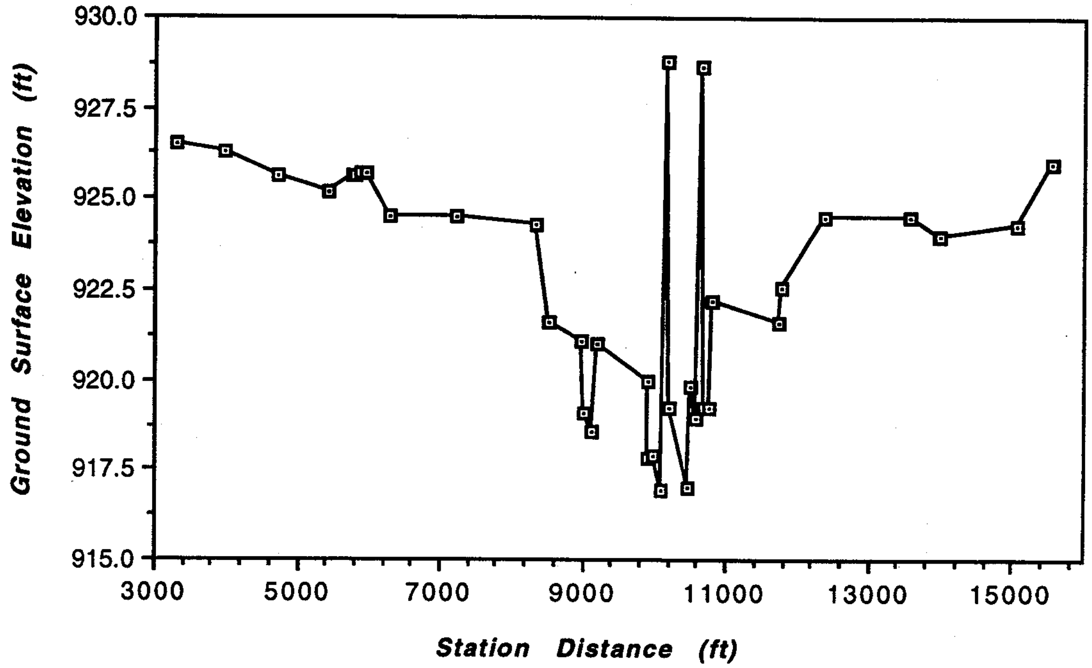

Fig. A-3 - Cross-section plot of Station No. 0.730

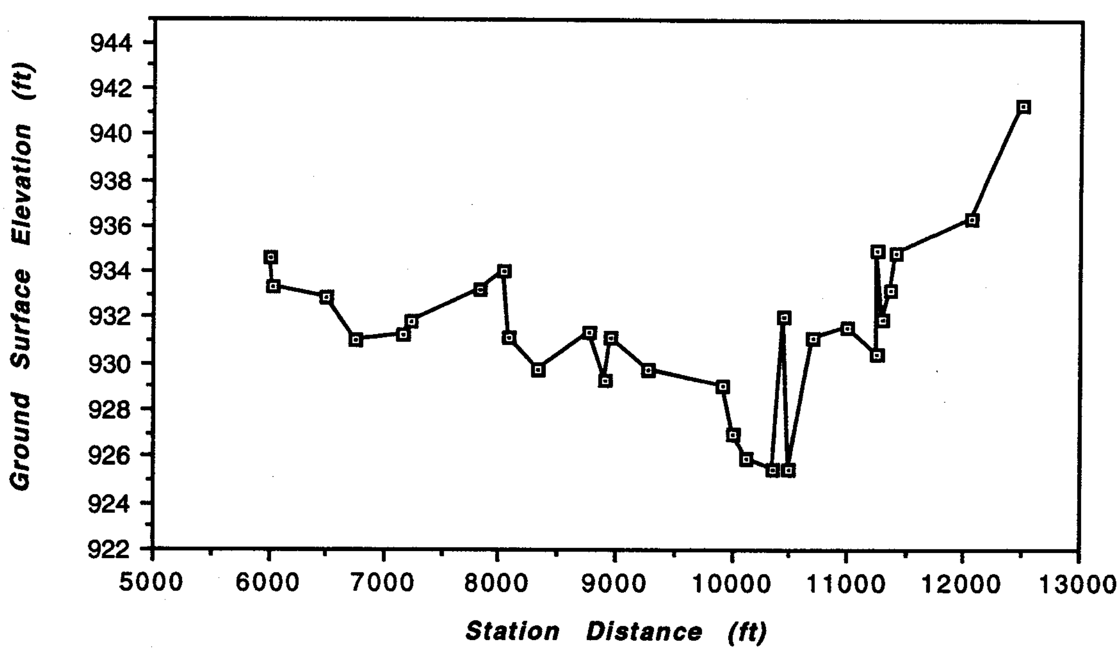

Fig. A-4 - Cross-section plot of Station No. 1.330

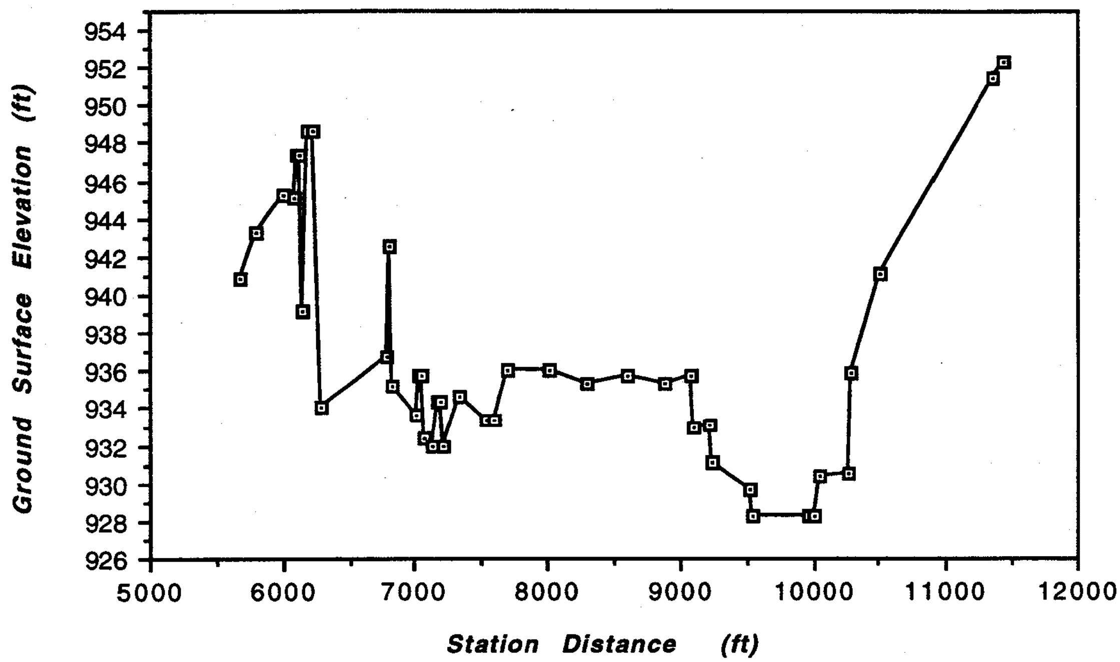

Fig. A-5 - Cross-section plot of Station No. 1.710

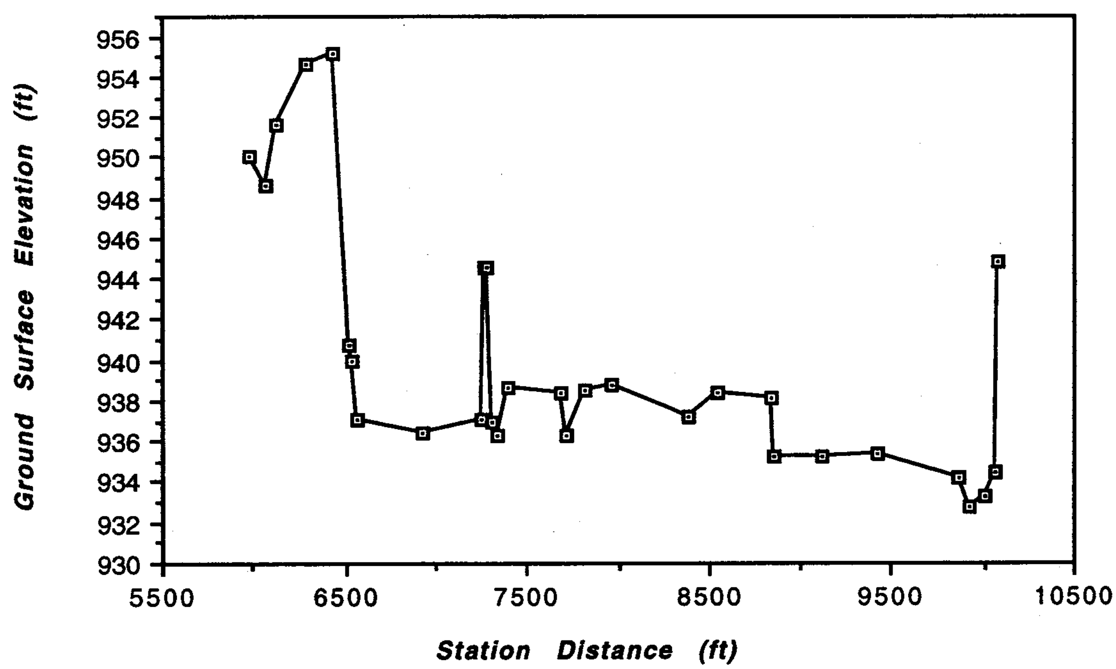

Fig. A-6 - Cross-section plot of Station No. 2.020

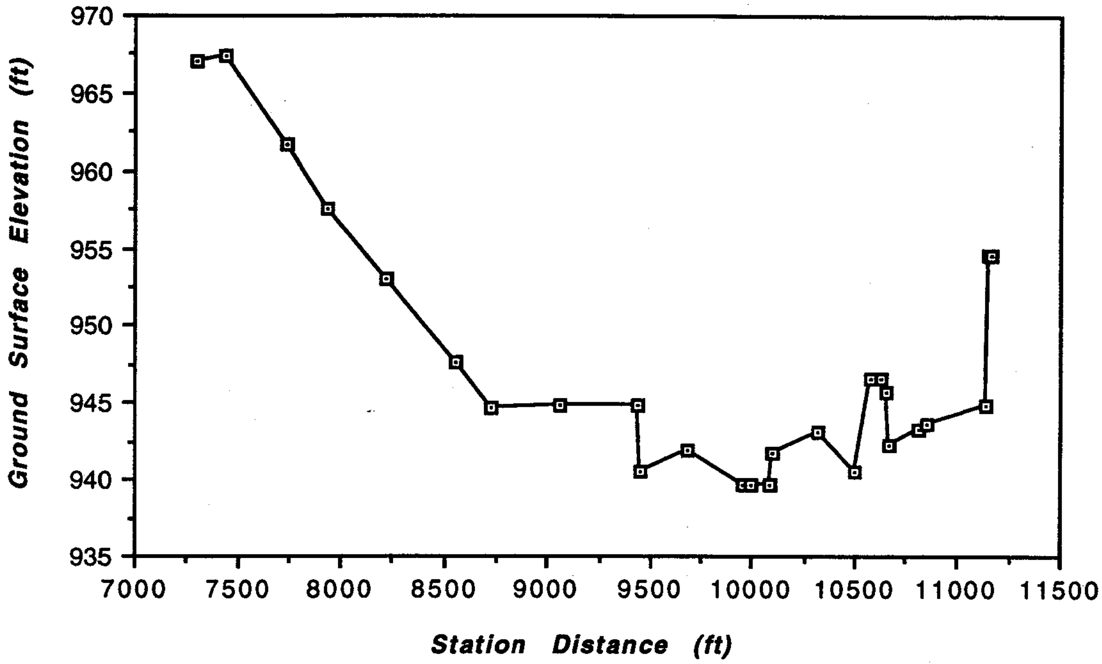

Fig. A-7 - Cross-section plot of Station No. 2.600

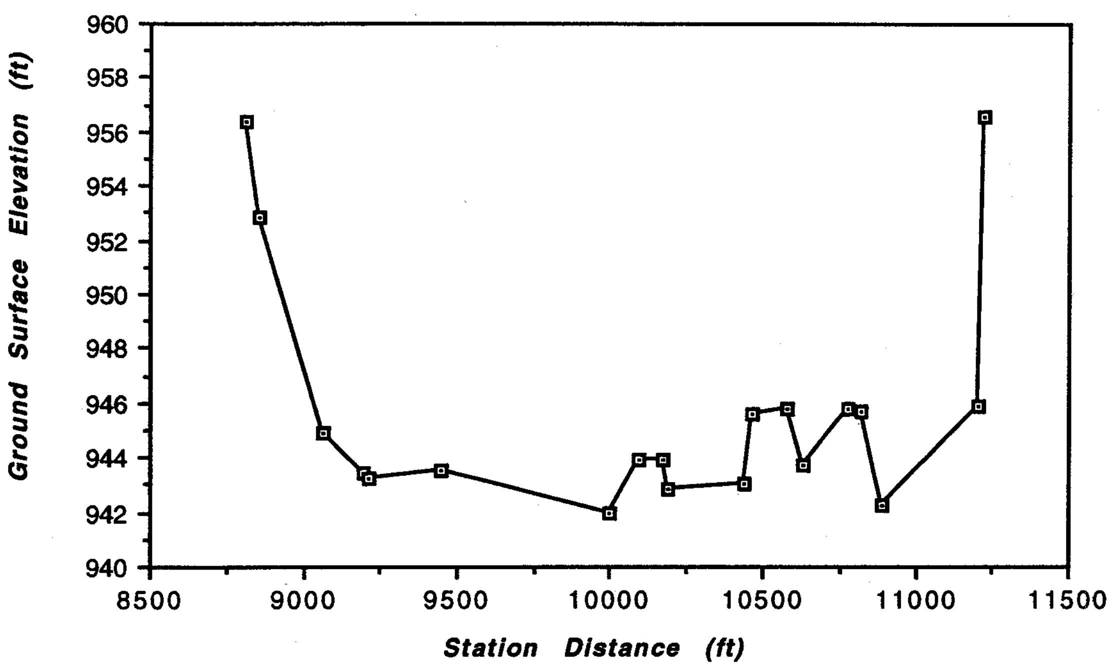

Fig. A-8 - Cross-section plot of Station No. 2.800

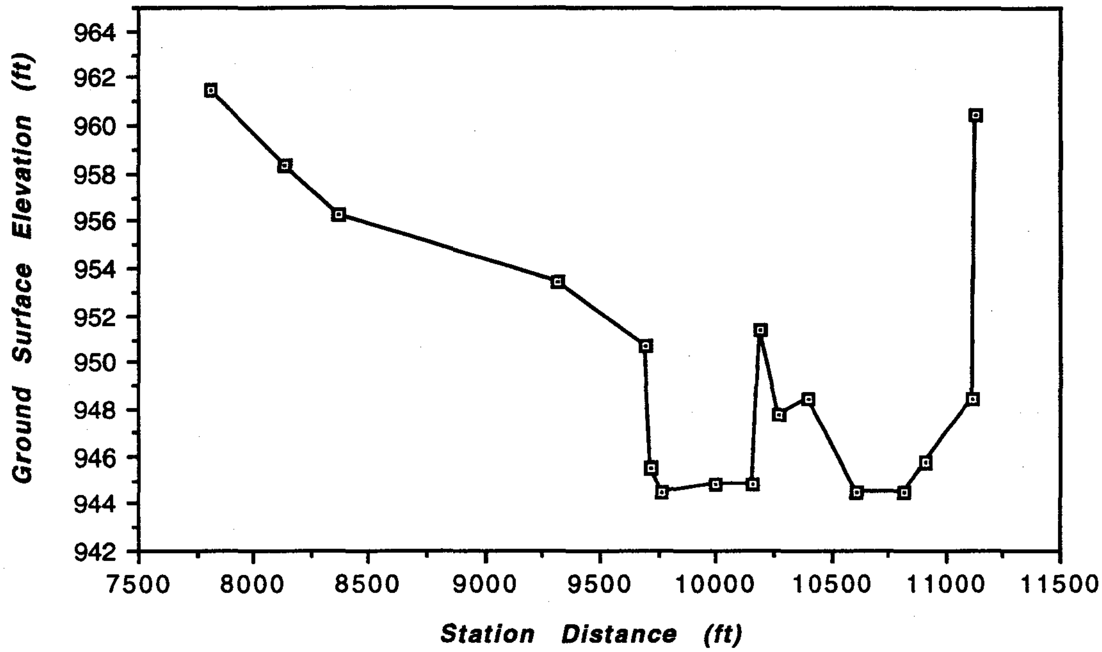

Fig. A-9 - Cross-section plot of Station No. 3.270

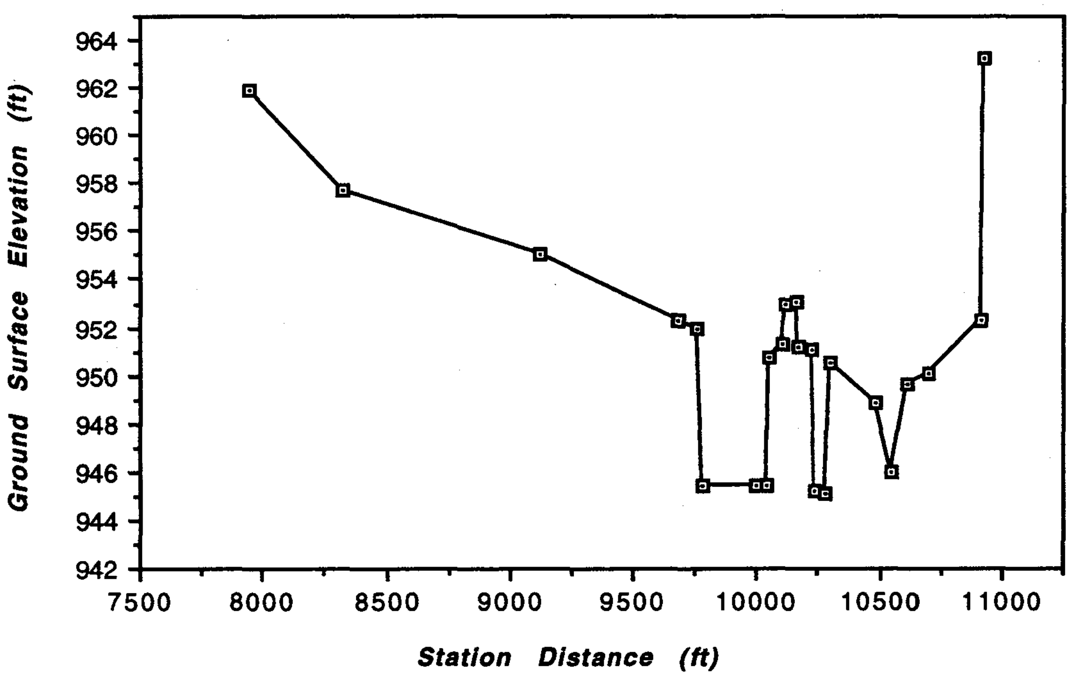

Fig. A-10 - Cross-section plot of Station No. 3.400

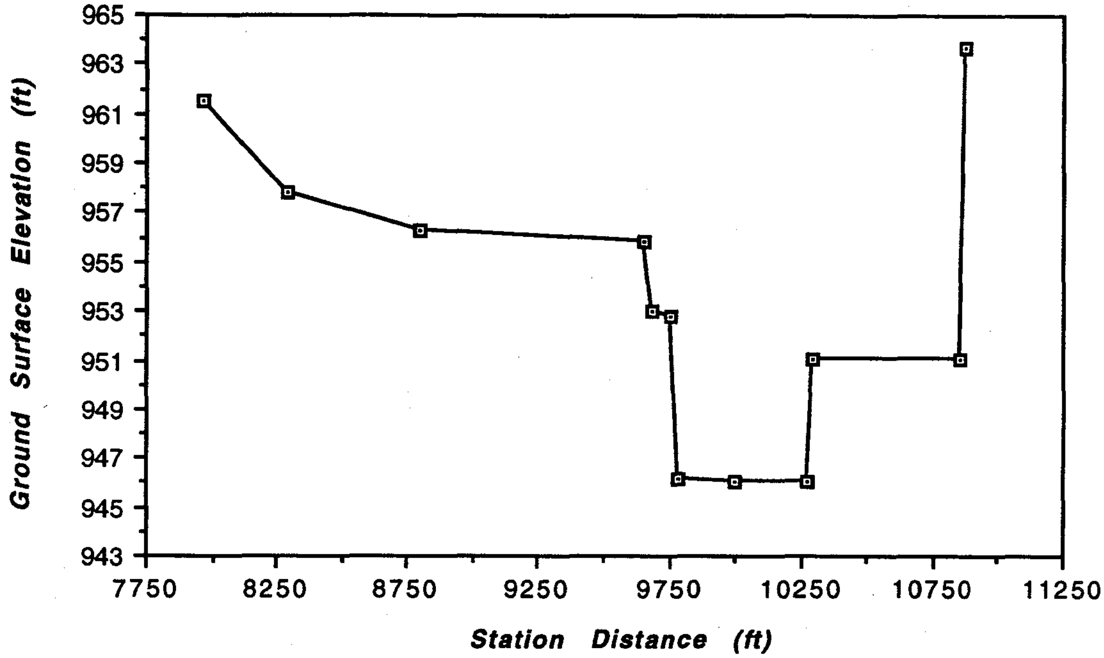

Fig. A-11 - Cross-section plot of Station No. 3.430

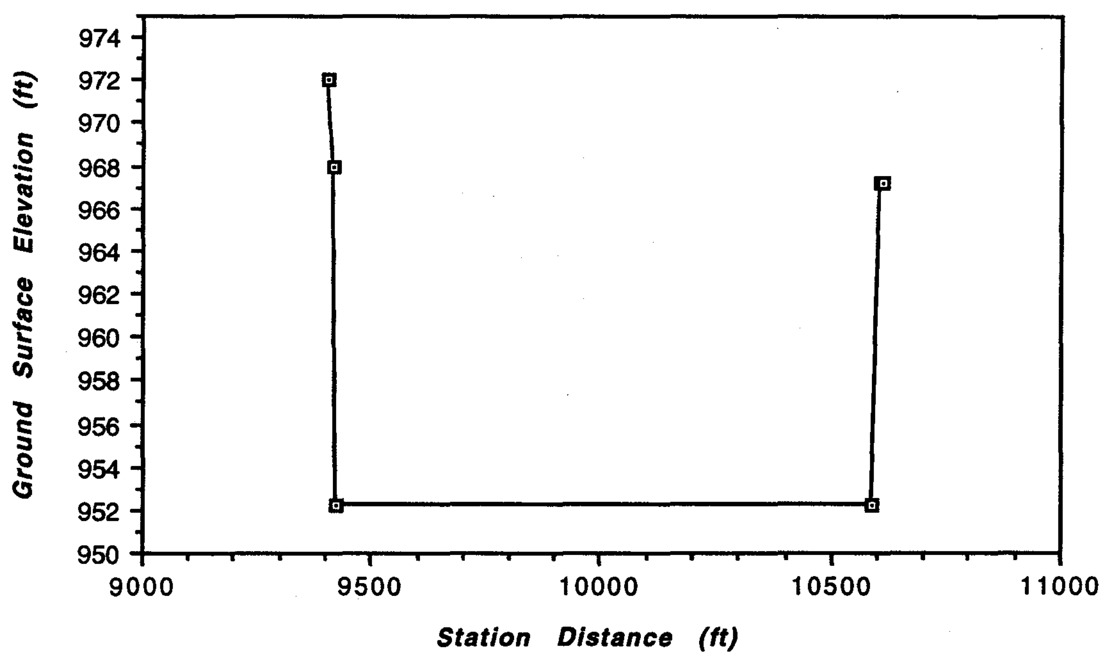

Fig. A-12 - Cross-section plot of Station No. 3.729

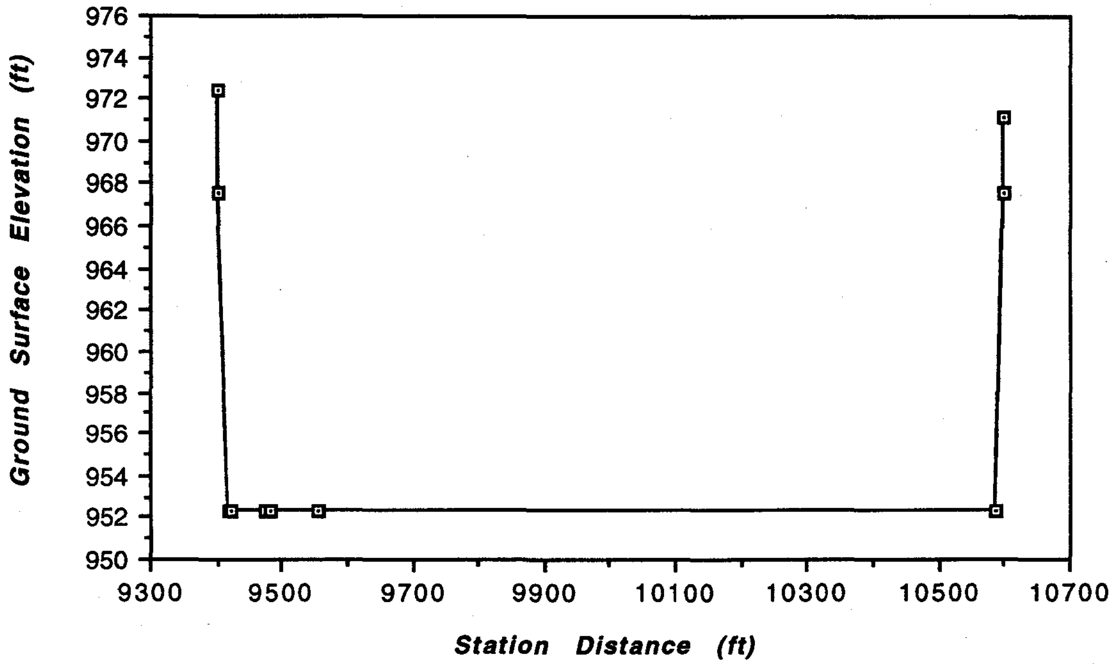

Fig. A-13 - Cross-section plot of Station No. 3.734

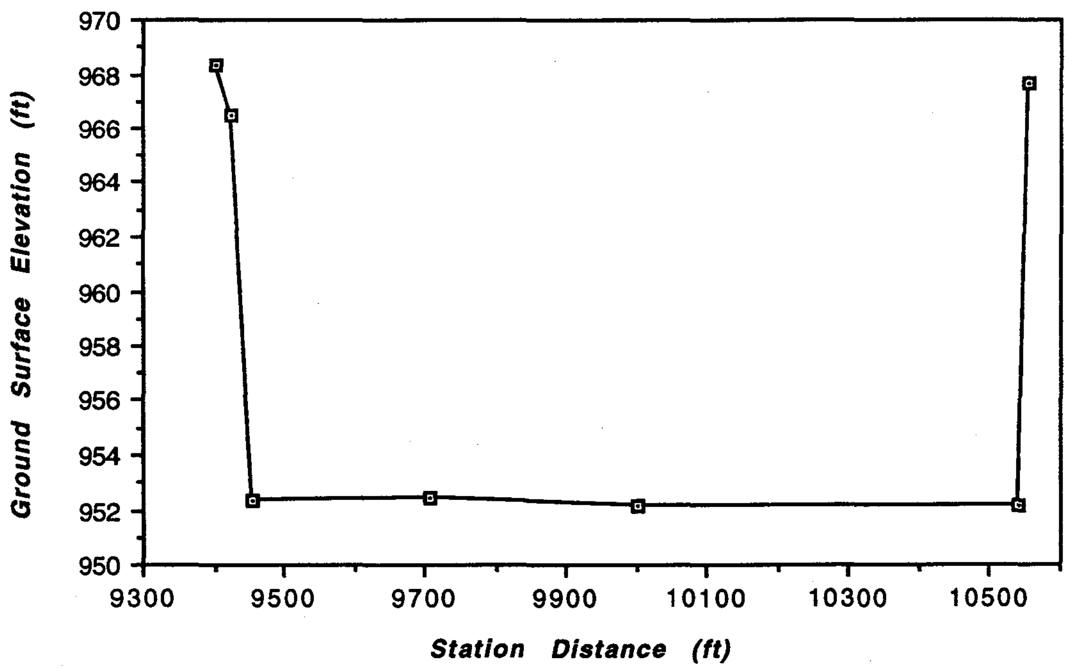

Fig. A-14- Cross-section plot of Station No. 3.757

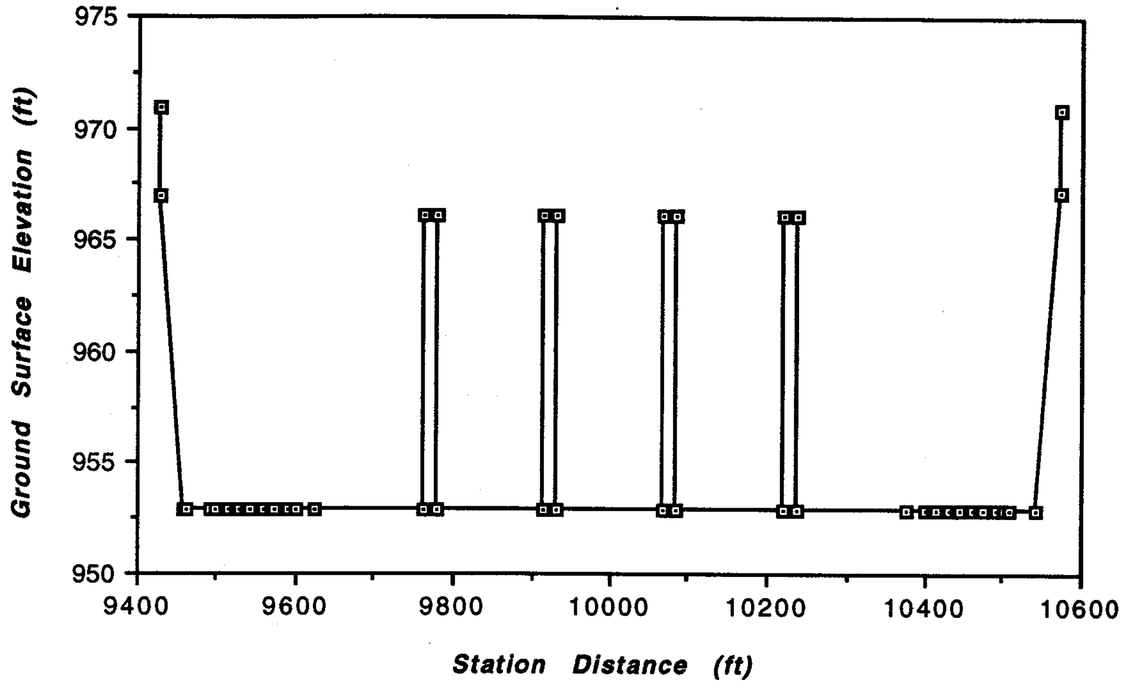

Fig. A-15 - Cross-section plot of Station No. 3.767

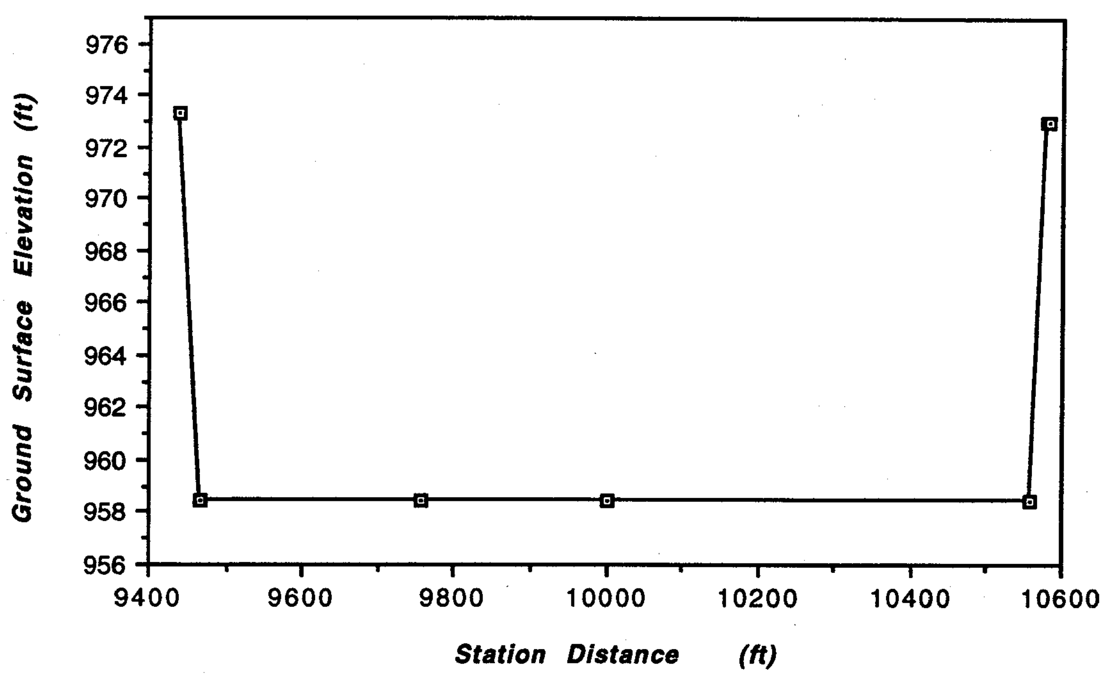

Fig. A-16- Cross-section plot of Station No. 4.094

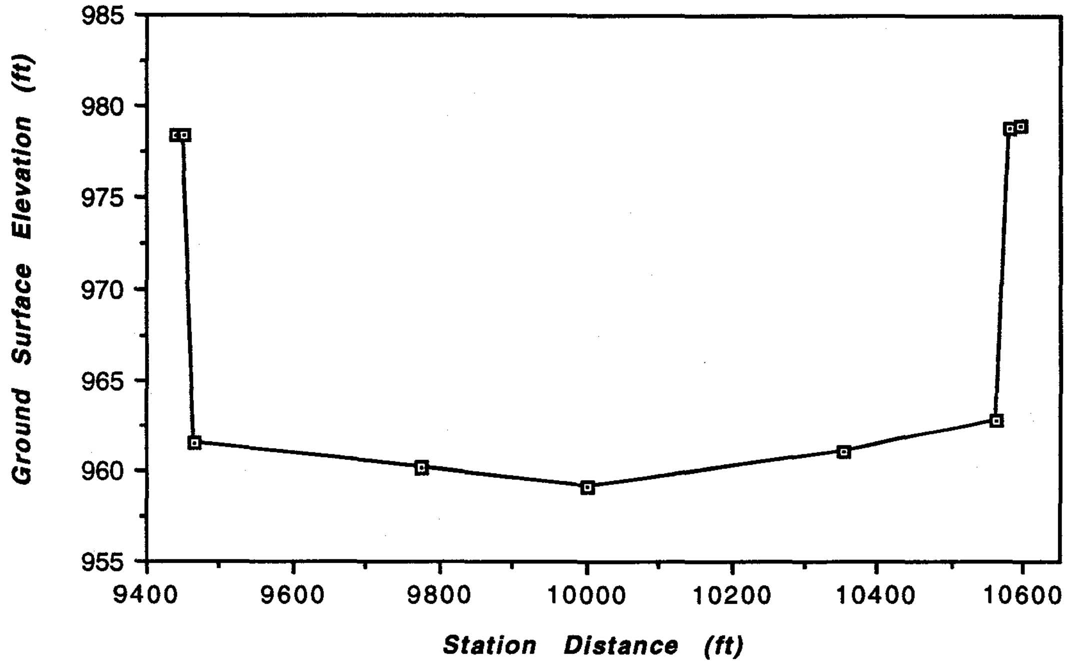

Fig. A-17 - Cross-section plot of Station No. 4.270

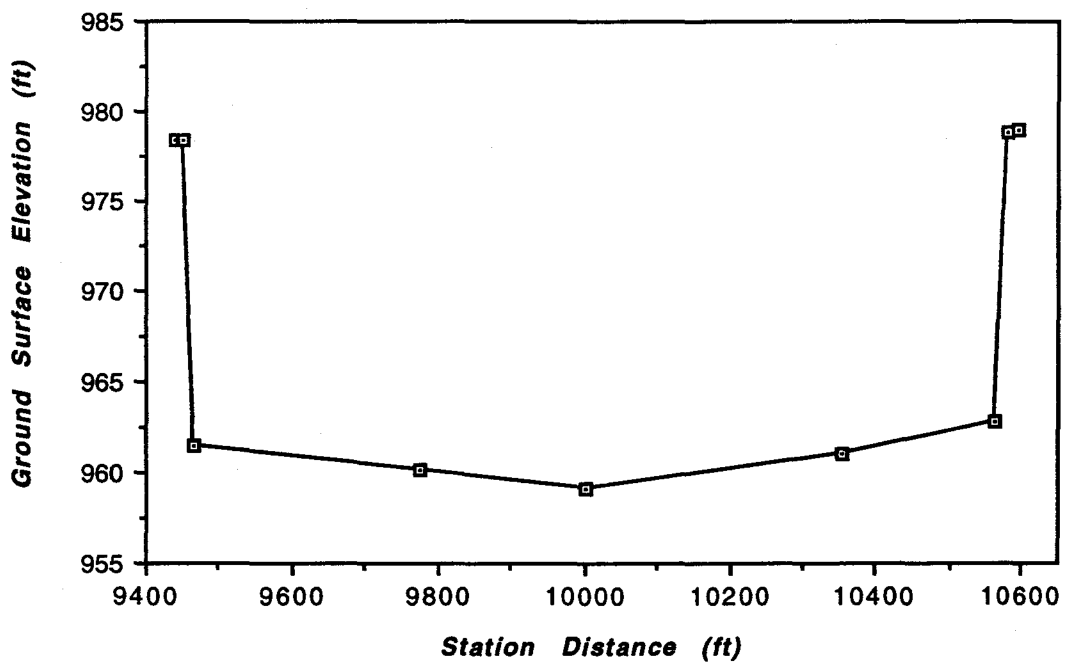

Fig. A-18 - Cross-section plot of Station No. 4.700

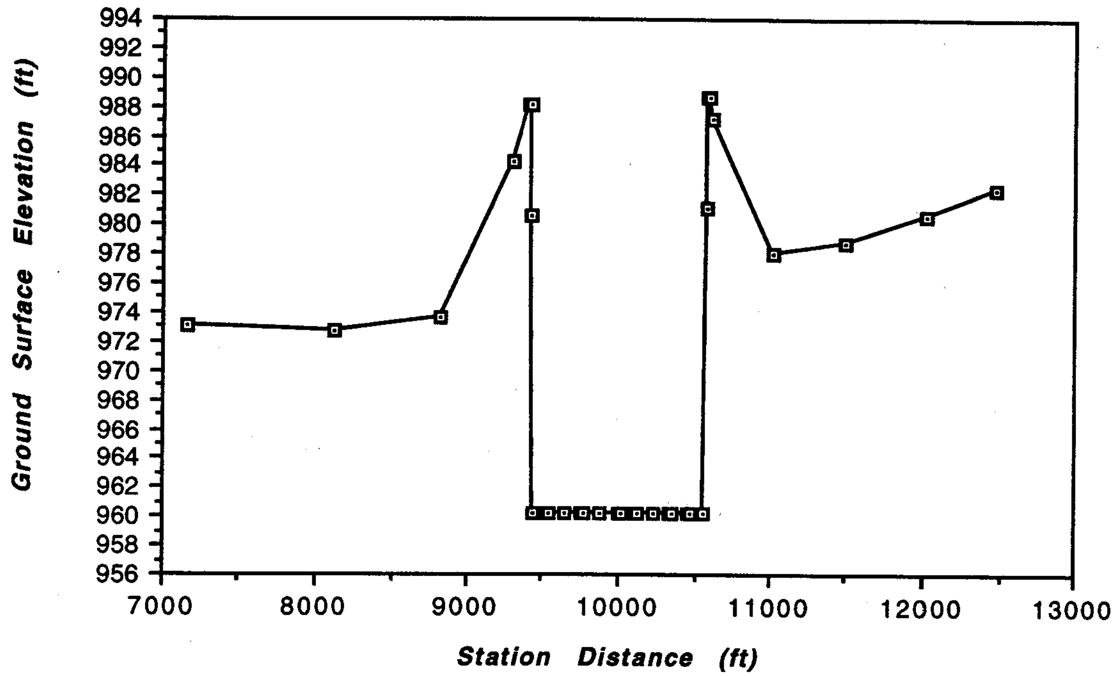

Fig. A-19 - Cross-section plot of Station No. 4.754

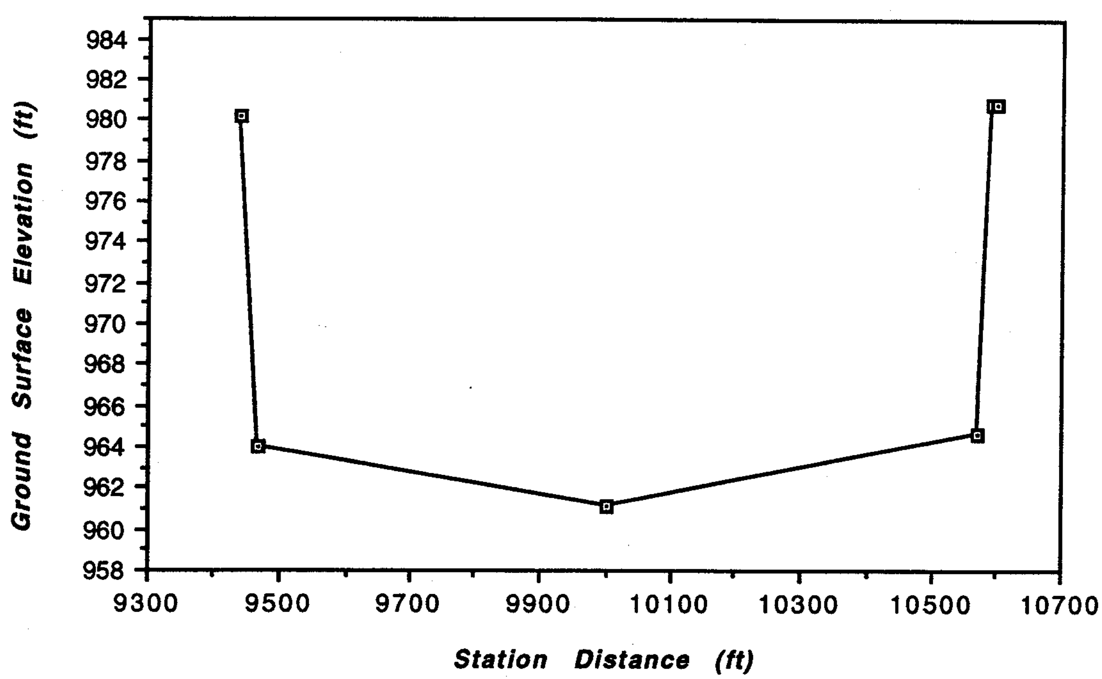

Fig. A-20 - Cross-section plot of Station No. 4.790

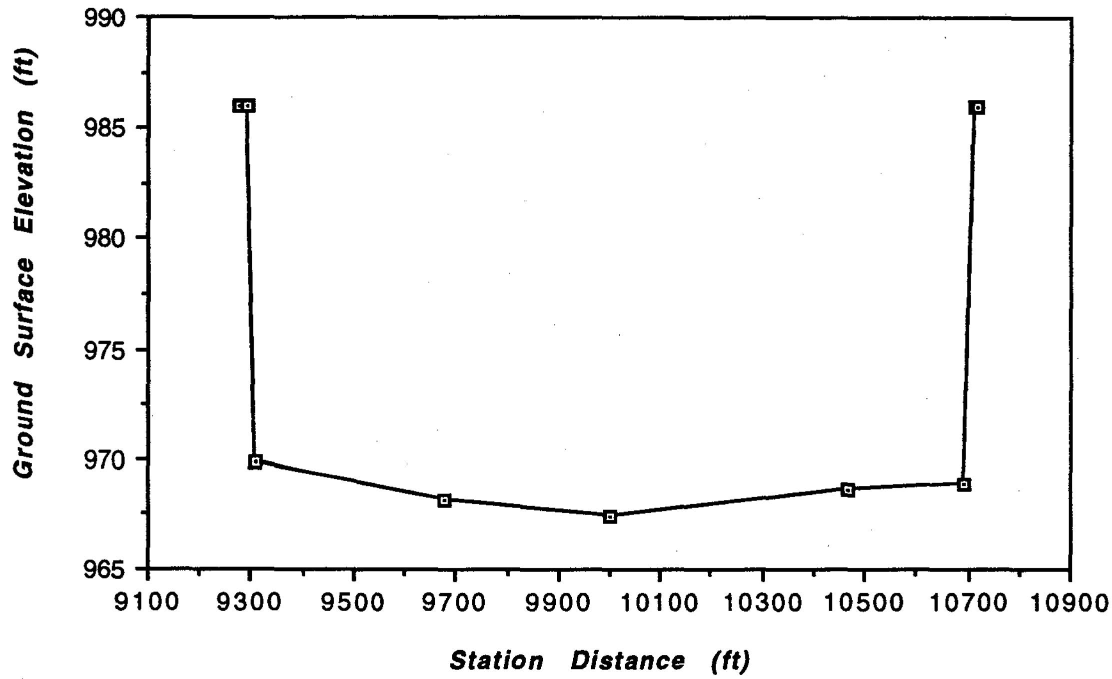

Fig. A-21 - Cross-section plot of Station No. 5.150

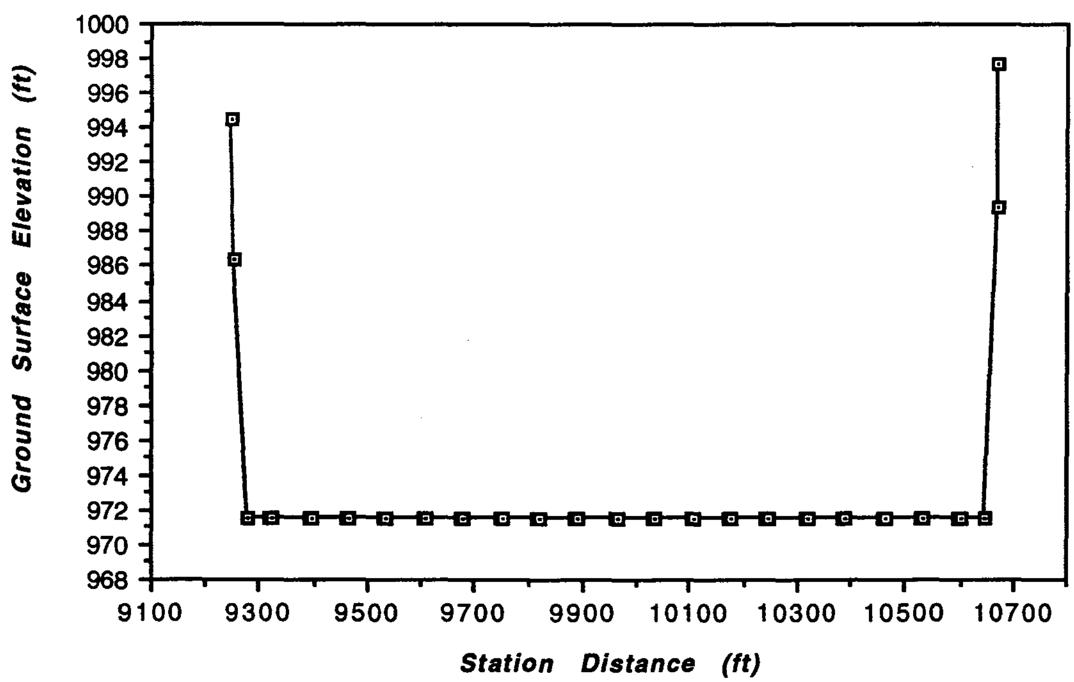

Fig. A-22 - Cross-section plot of Station No. 5.290

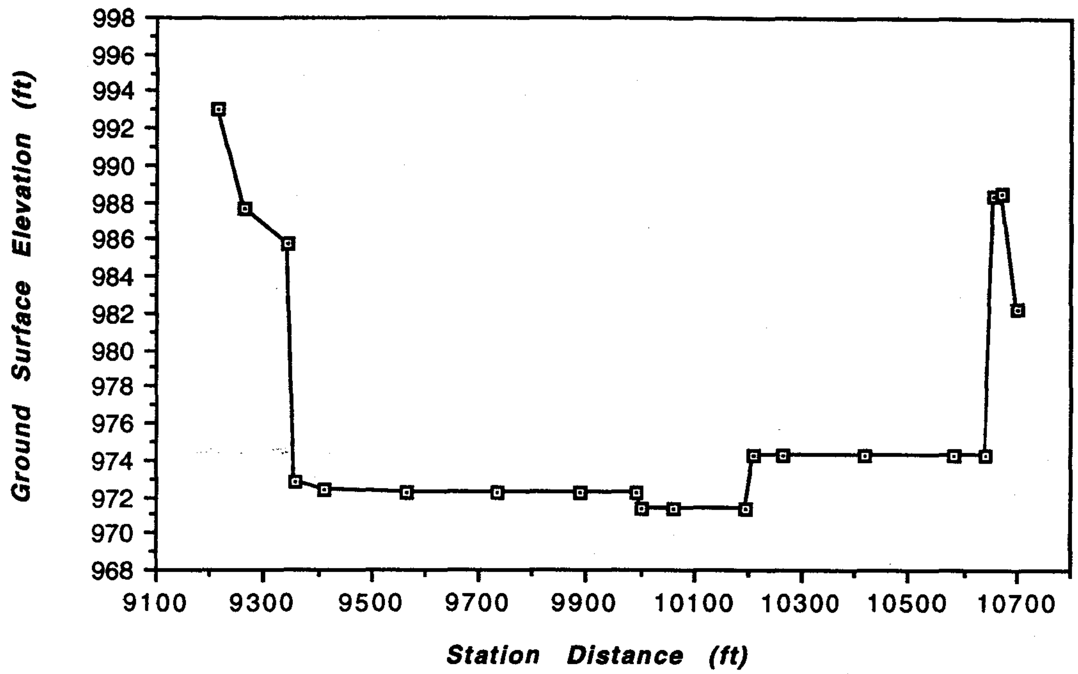

Fig. A-23 - Cross-section plot of Station No. 5.380

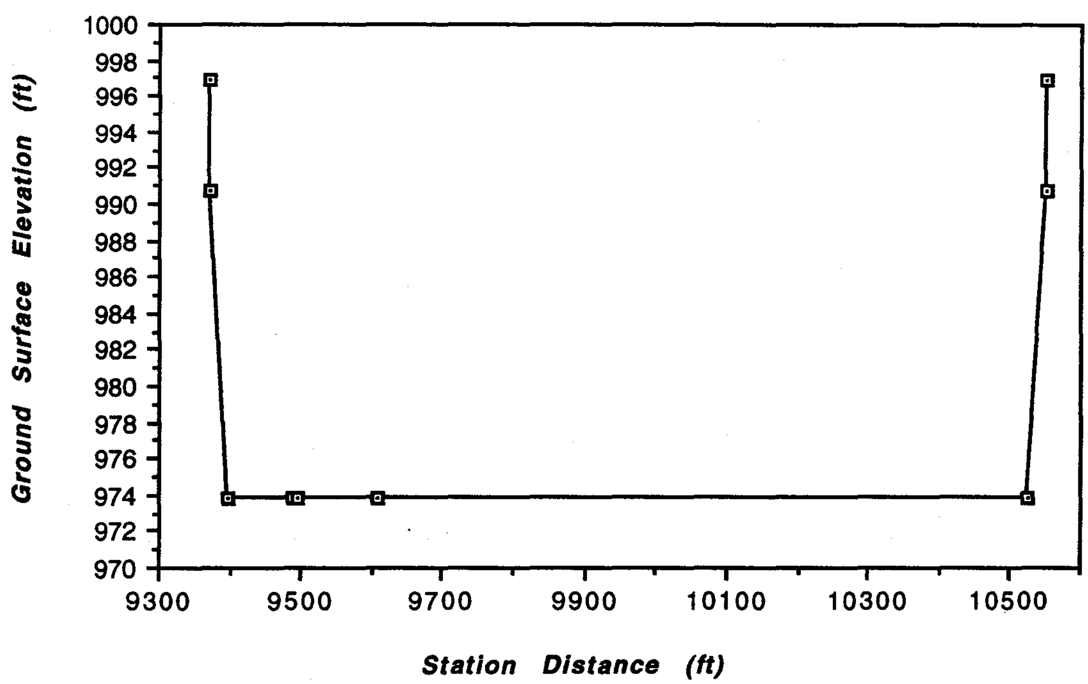

Fig. A-24 - Cross-section plot of Station No. 5.689

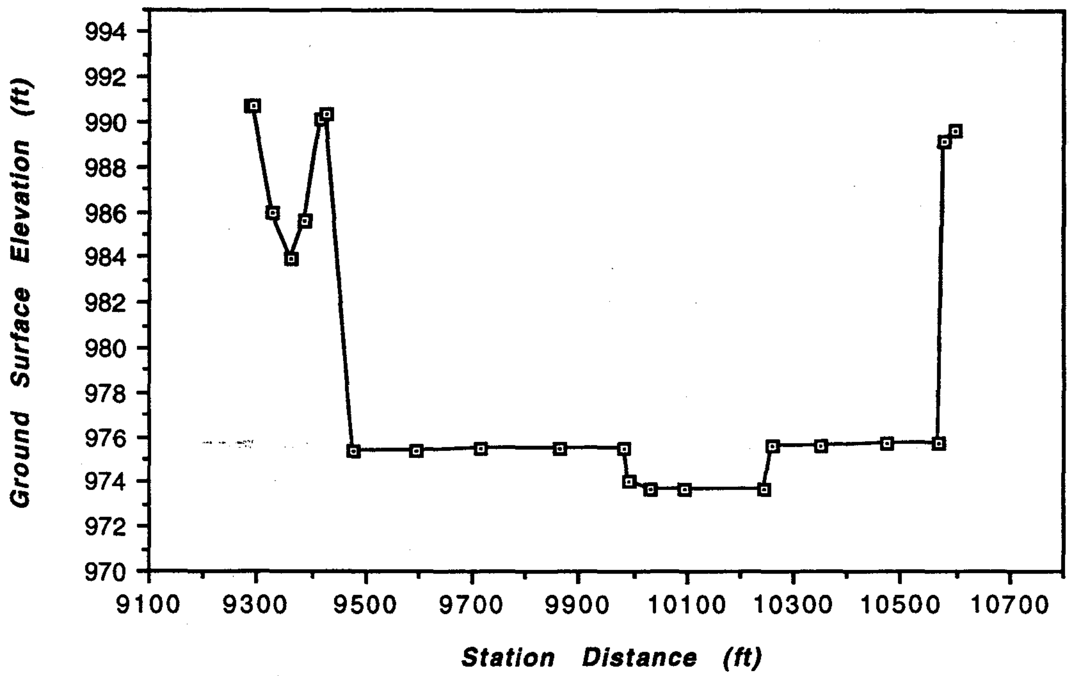

Fig. A-25 - Cross-section plot of Station No. 5.750

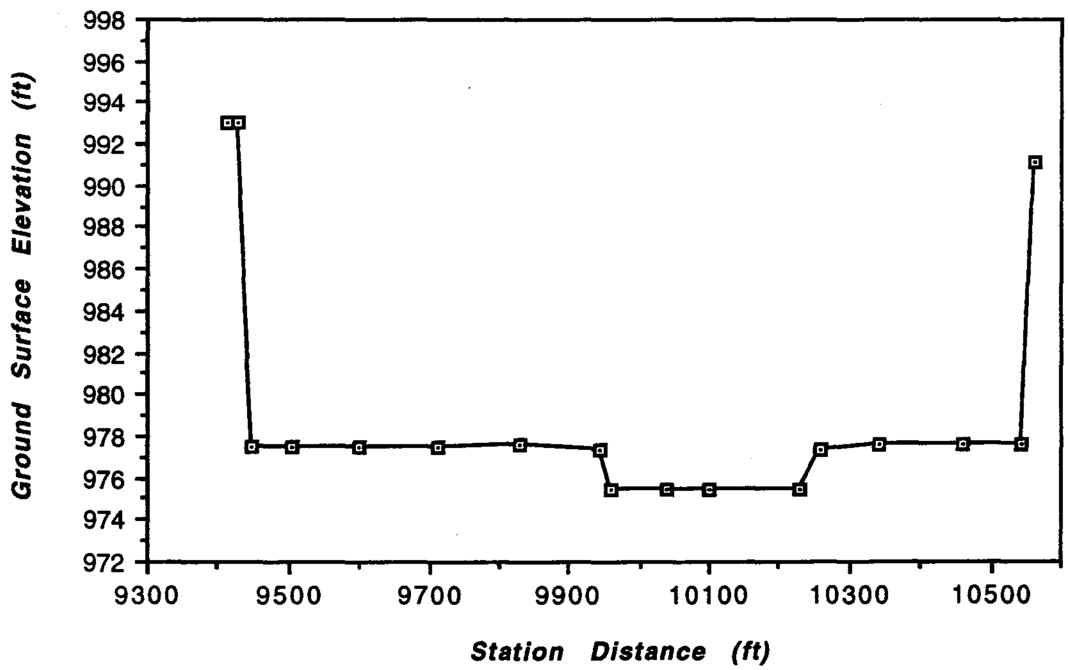

Fig. A-26 - Cross-section plot of Station No. 5.900

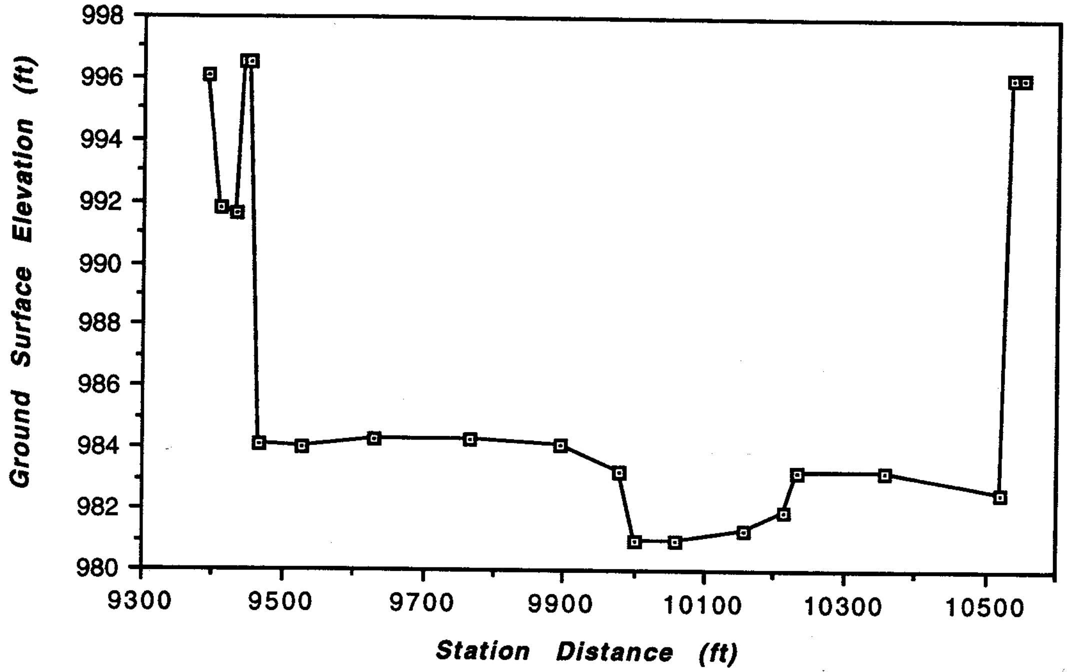

Fig. A-27 - Cross-section plot of Station No. 6.430

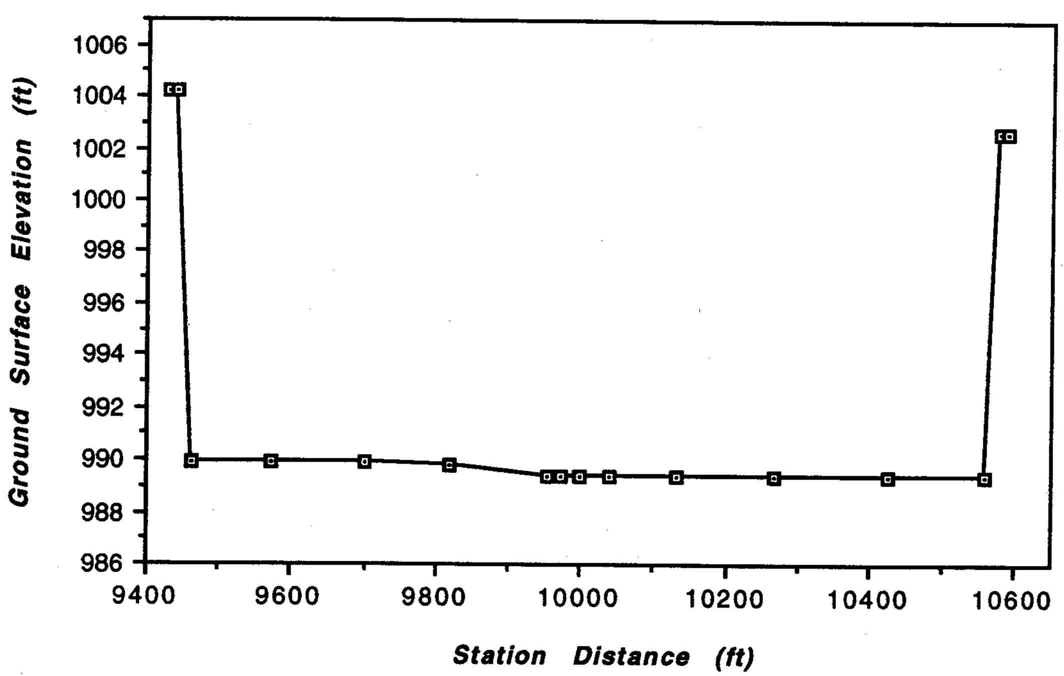

Fig. A-28 - Cross-section plot of Station No. 6.890

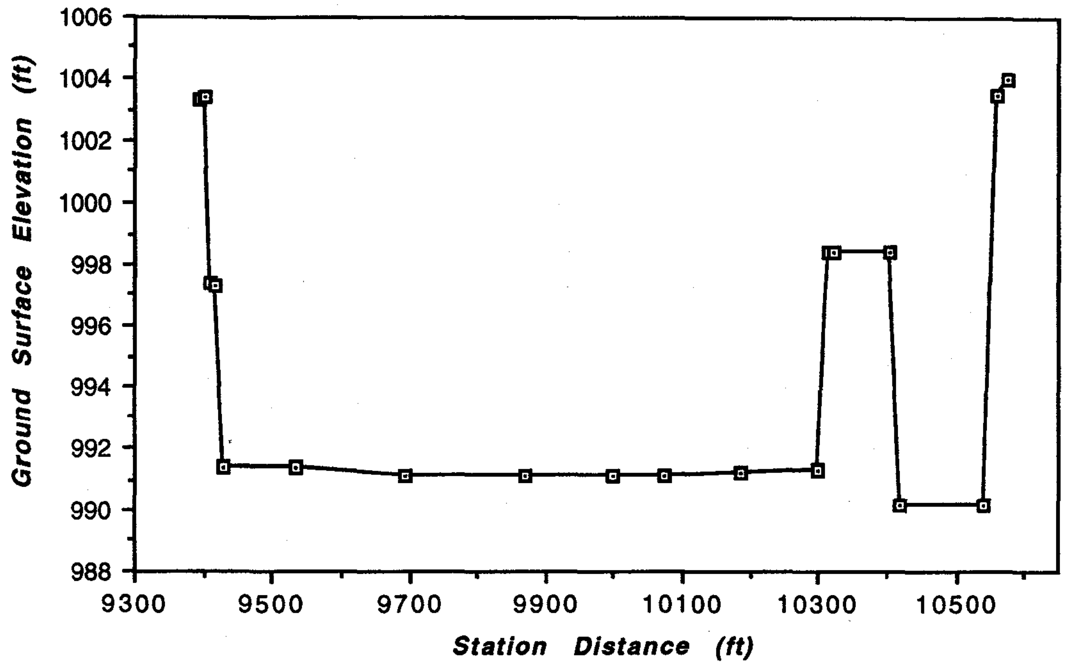

Fig. A-29 - Cross-section plot of Station No. 6.990

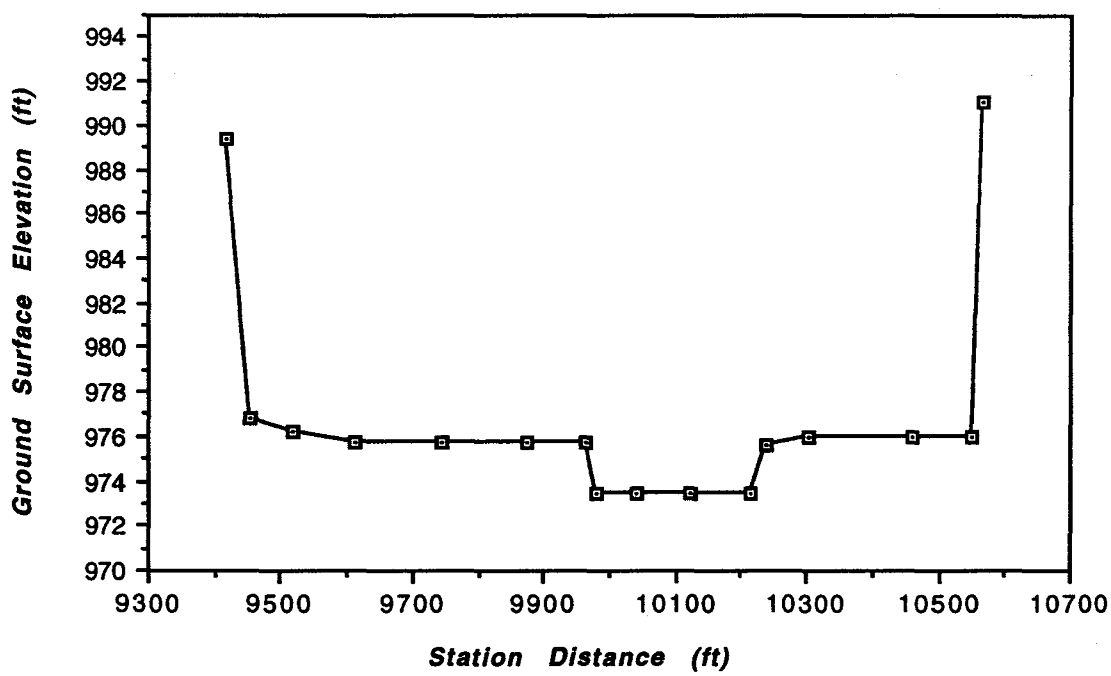

Fig. A-30 - Cross-section plot of Station No. 7.490

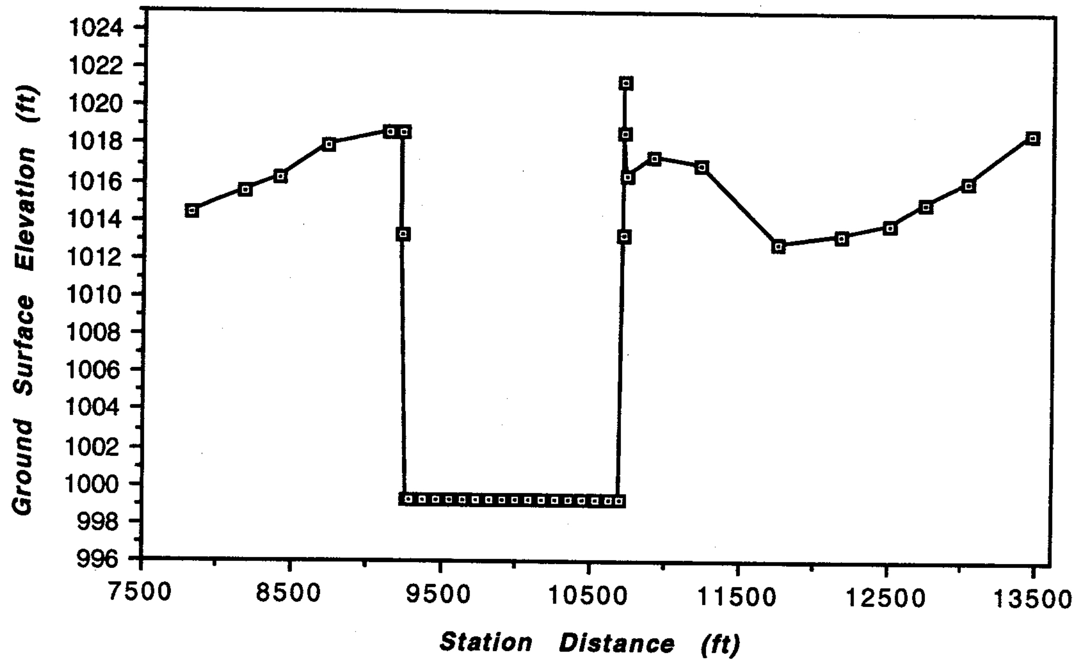

Fig. A-31 - Cross-section plot of Station No. 8.000

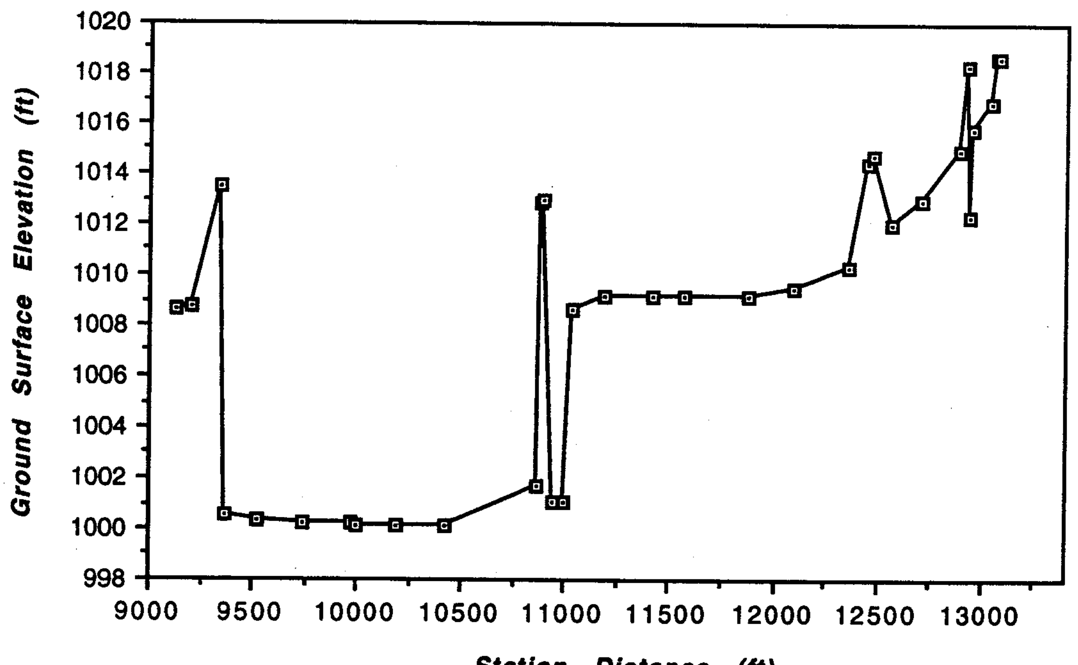

Fig. A-32 - Cross-section plot of Station No. 8.100

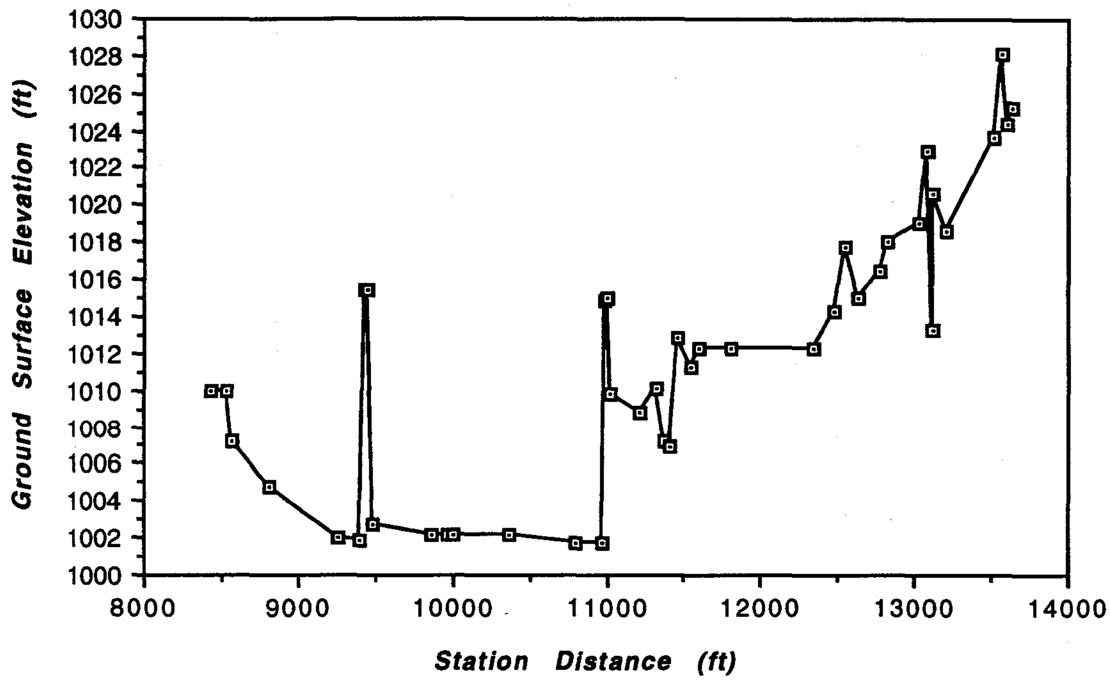

Fig. A-33 - Cross-section plot of Station No. 8.210

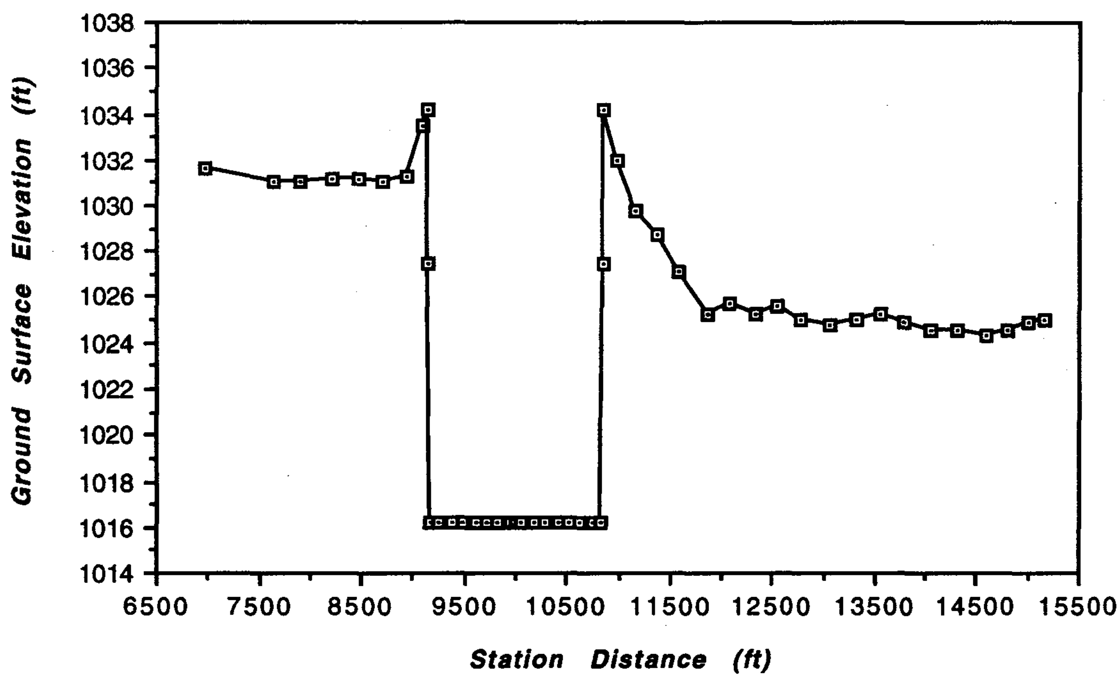

Fig. A-34 - Cross-section plot of Station No. 9.130

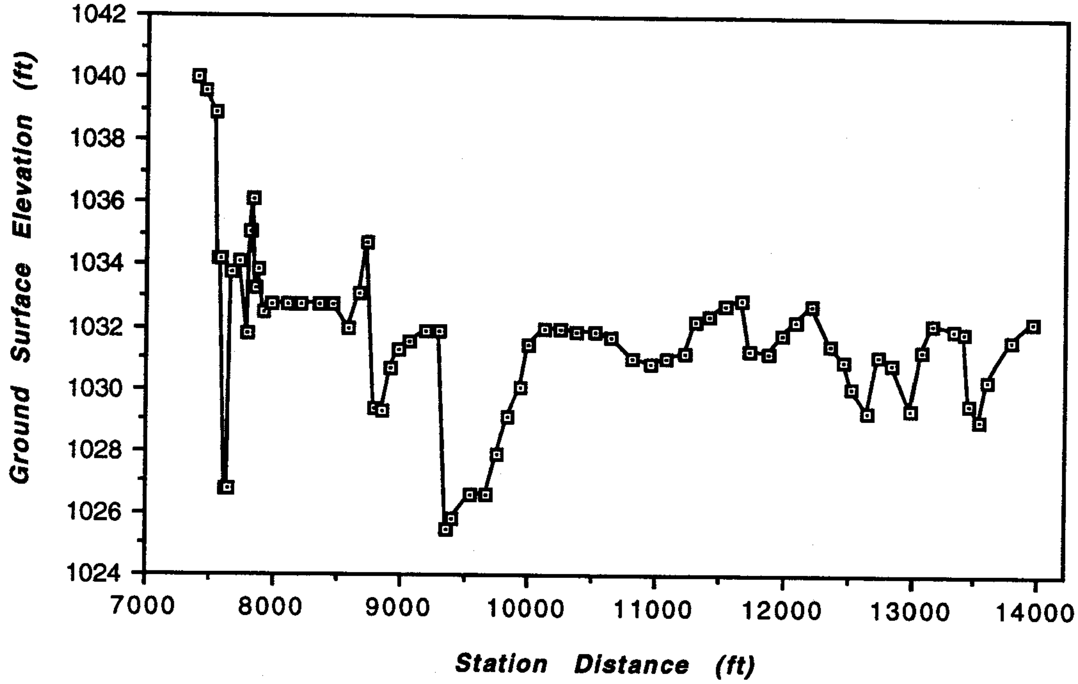

Fig. A-35 - Cross-section plot of Station No. 9.900

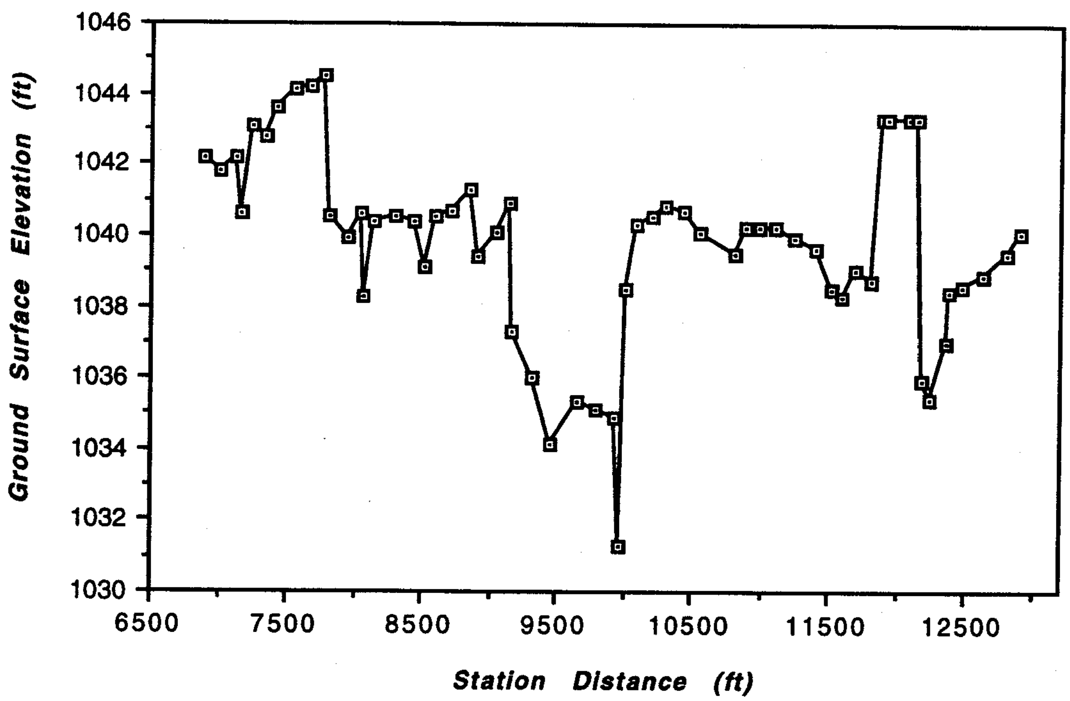

Fig. A-36 - Cross-section plot of Station No. 10.530

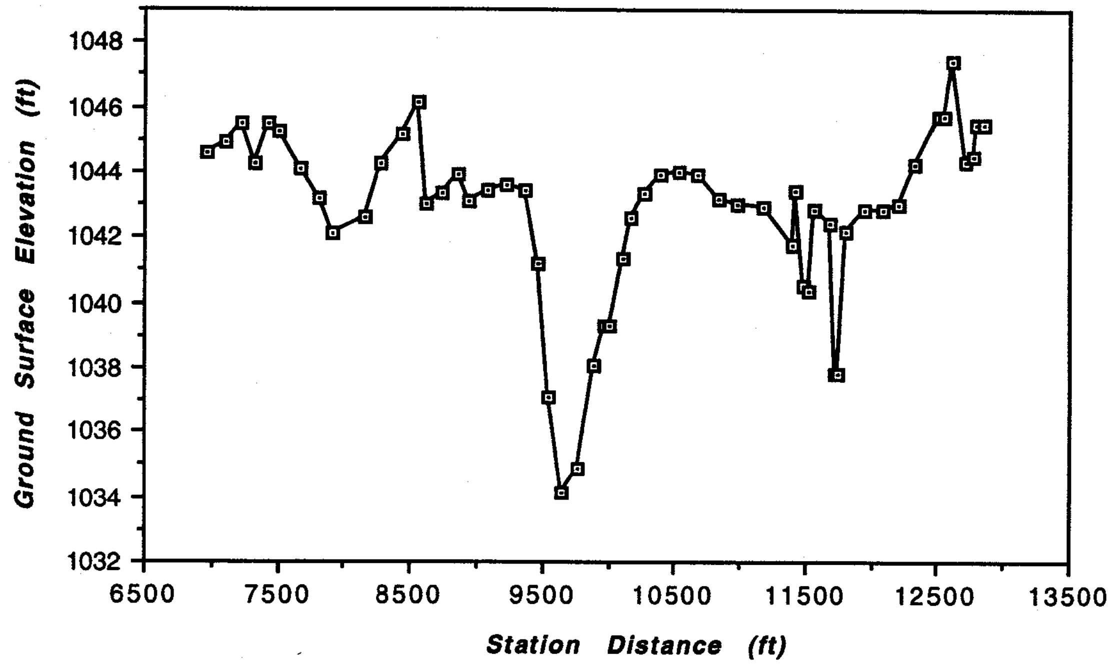

Fig. A-37 - Cross-section plot of Station No. 10.720

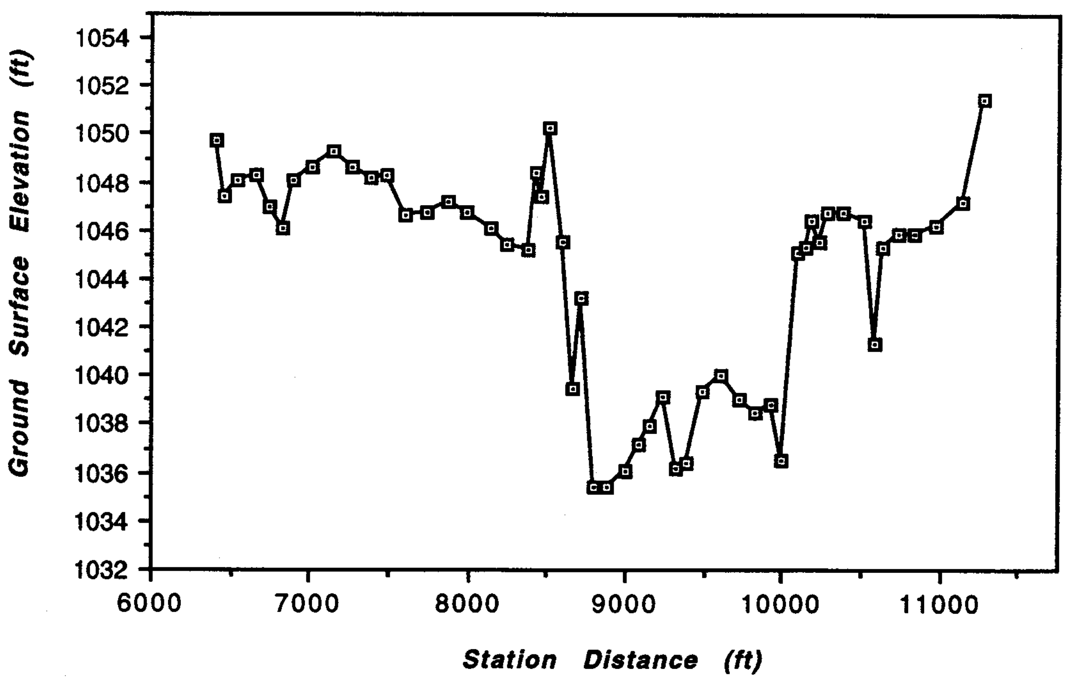

Fig. A-38 - Cross-section plot of Station No. 11.010

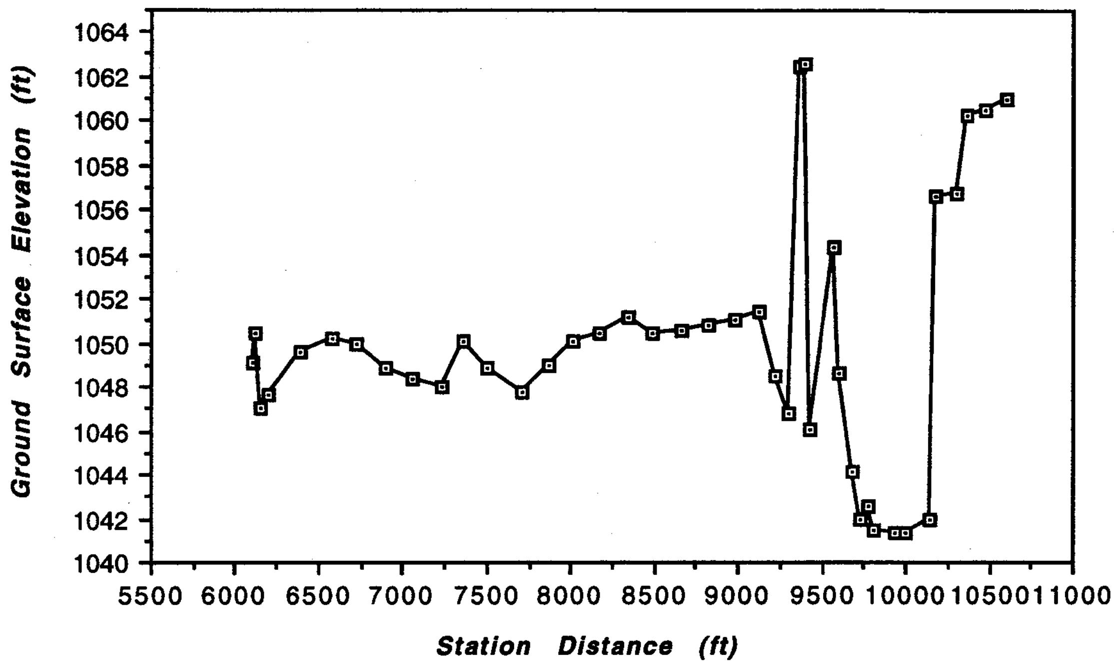

Fig. A-39 - Cross-section plot of Station No. 11.340

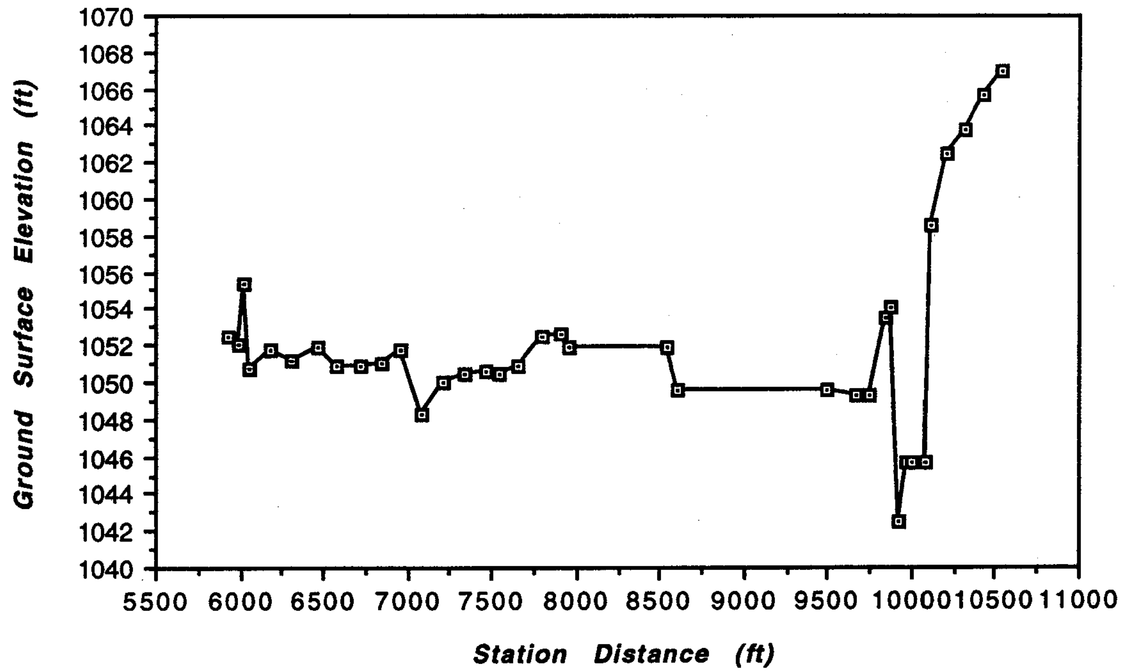

Fig. A-40 - Cross-section plot of Station No. 11.520

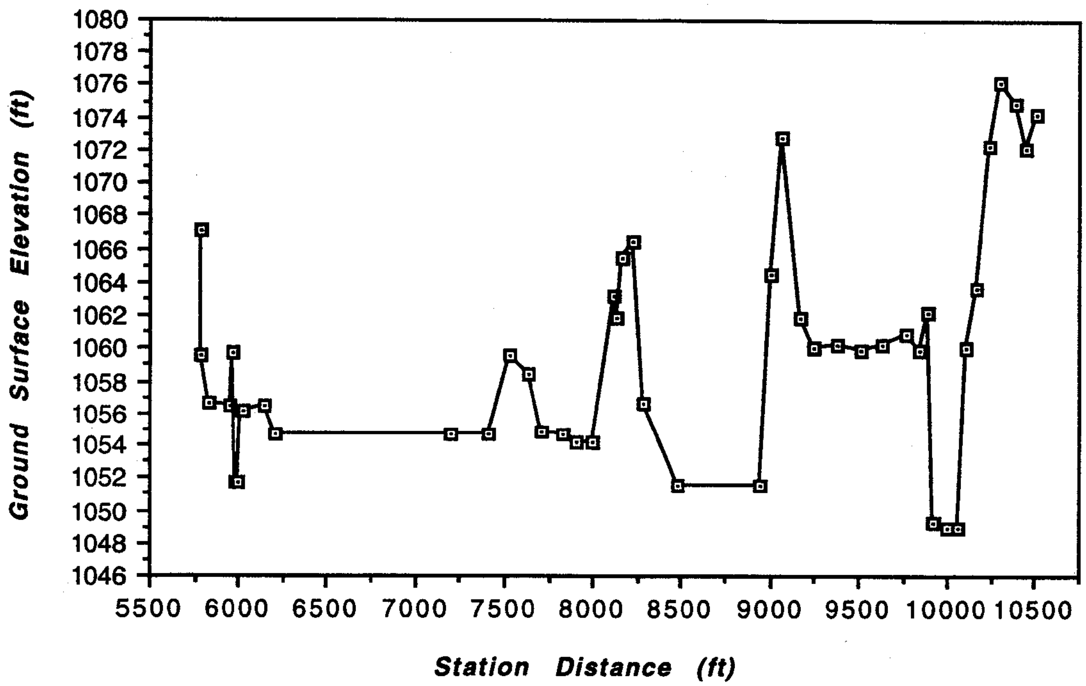

Fig. A-41 - Cross-section plot of Station No. 11.800

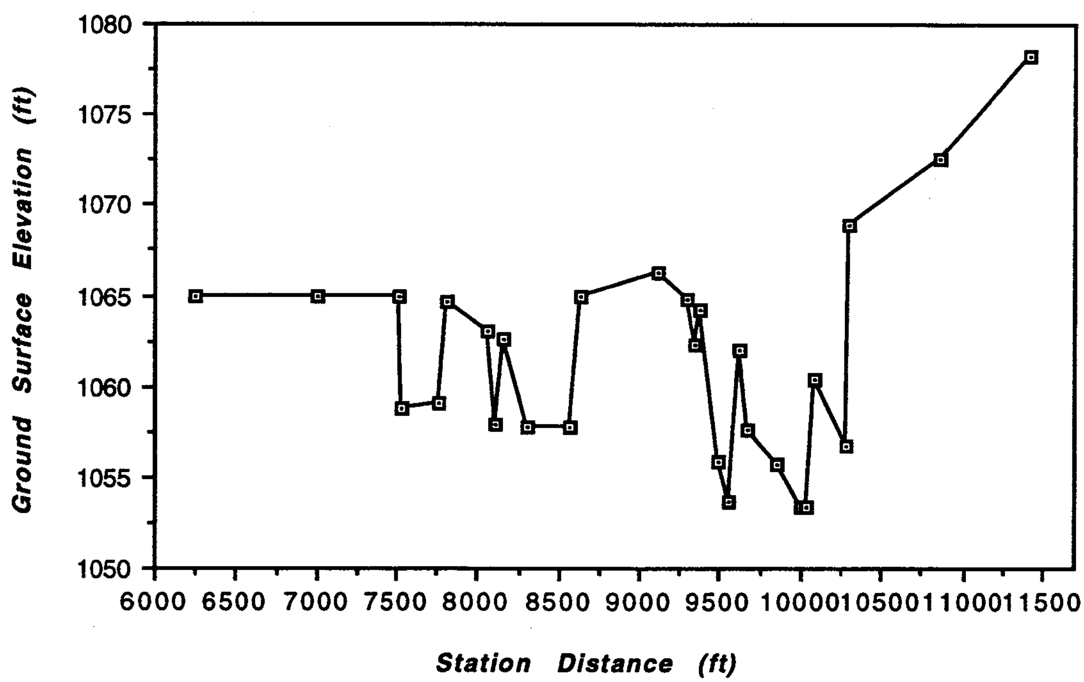

Fig. A-42- Cross-section plot of Station No. 12.380

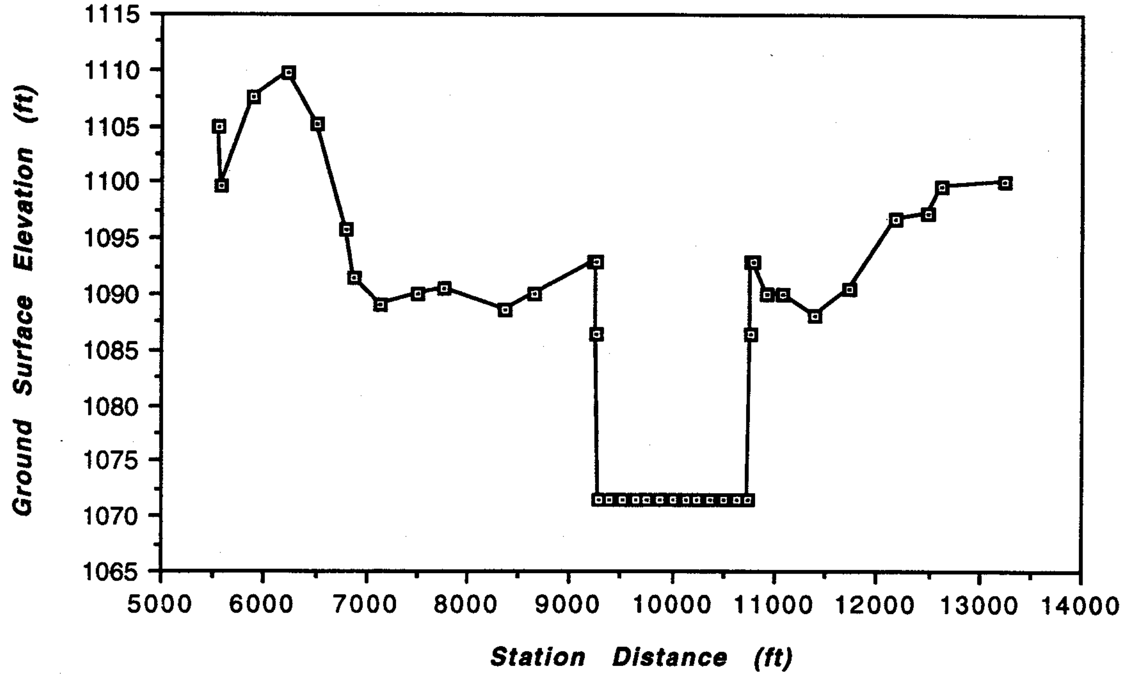

Fig. A-43 - Cross-section plot of Station No. 13.330

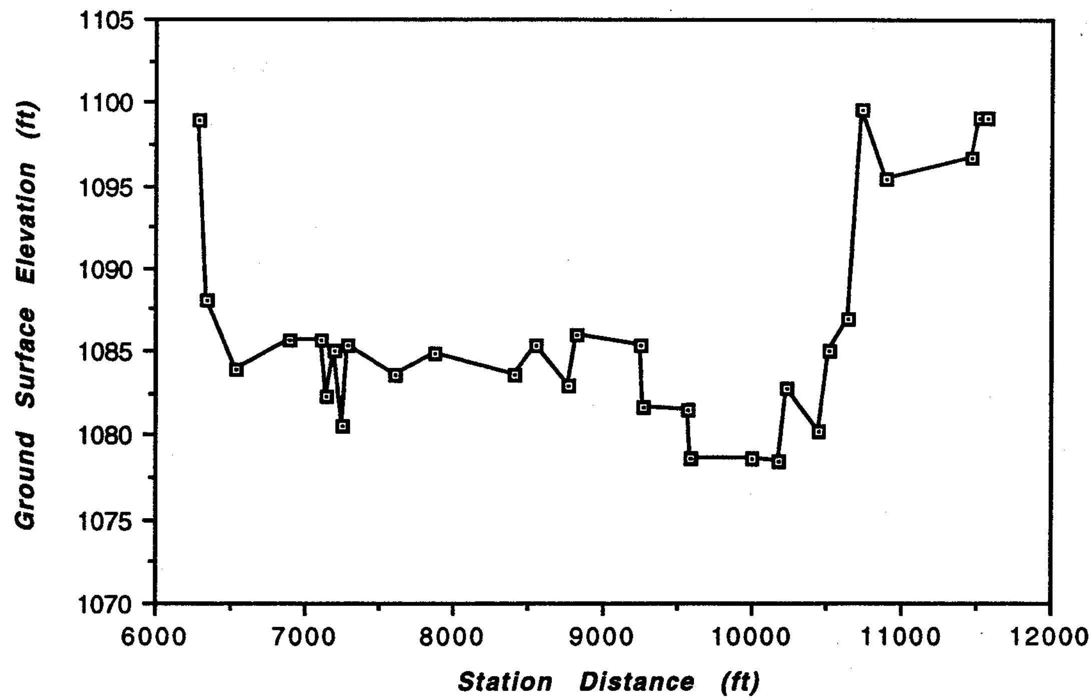

Fig. A-44- Cross-section plot of Station No. 13.810

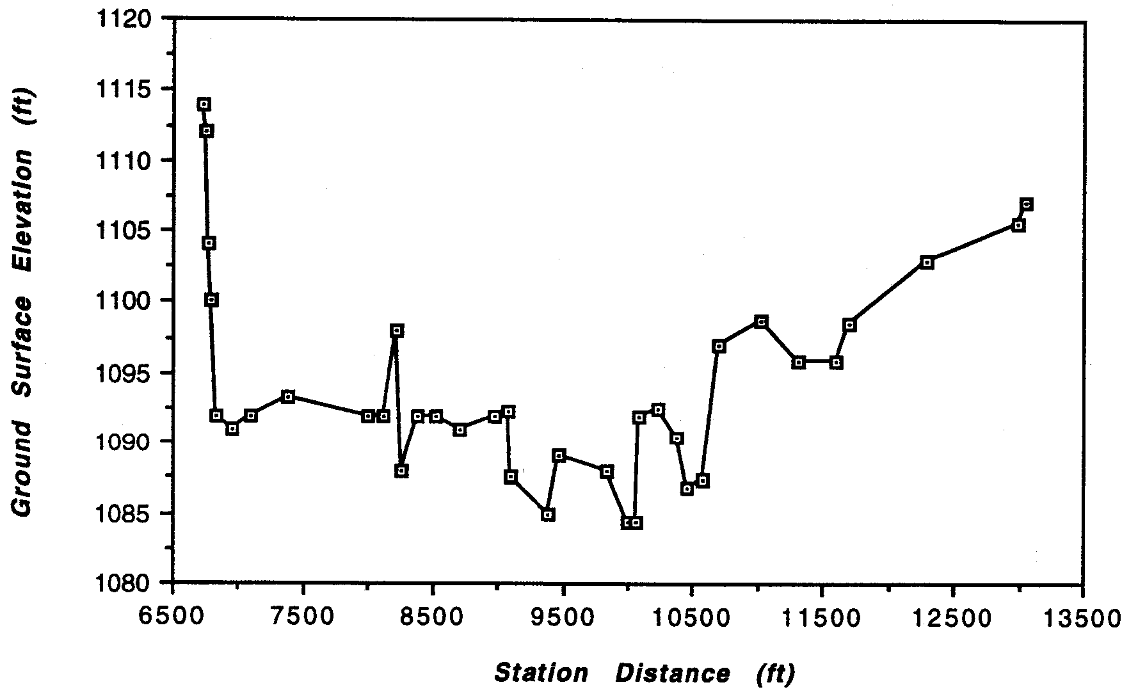

Fig. A-45 - Cross-section plot of Station No. 14.380

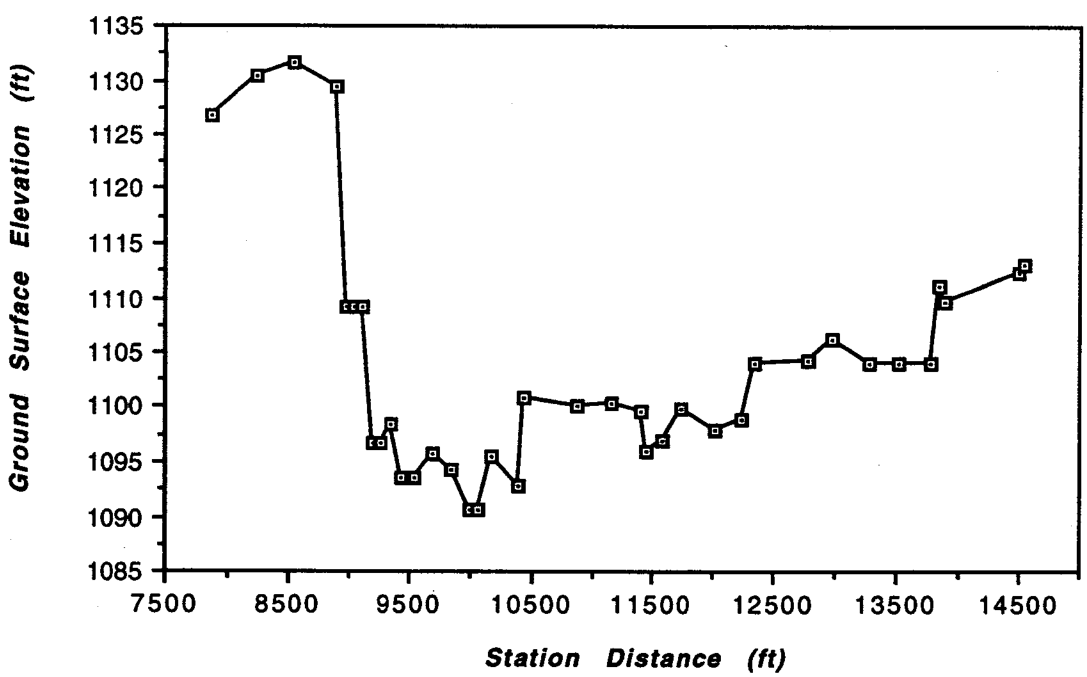

Fig. A-46- Cross-section plot of Station No. 14.850

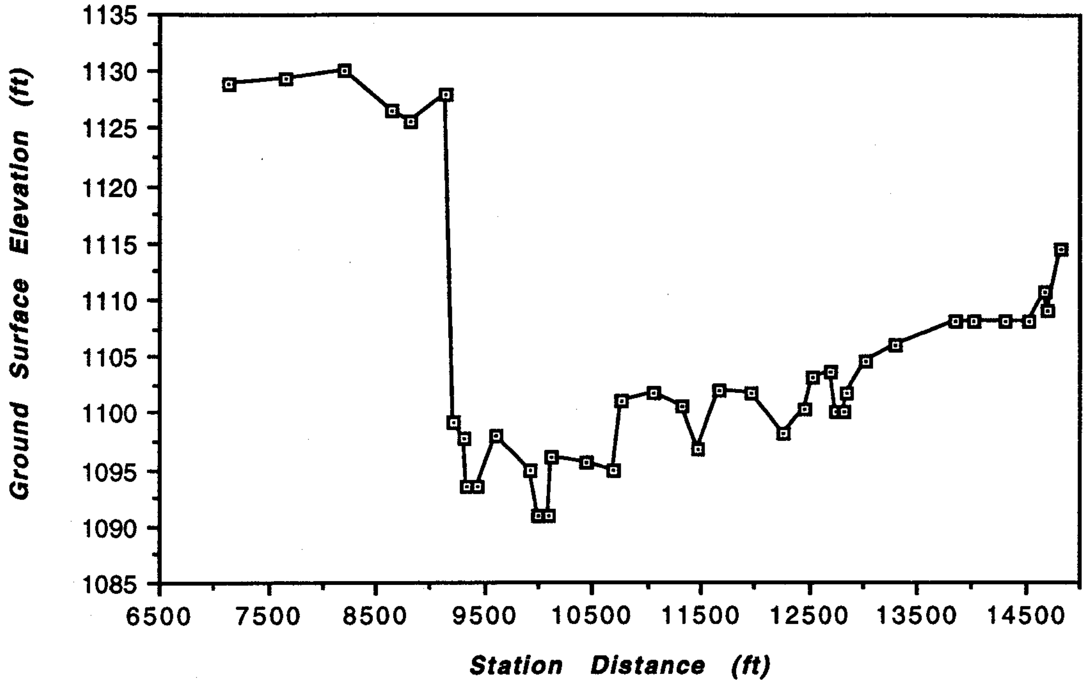

Fig. A-47 - Cross-section plot of Station No. 14.940

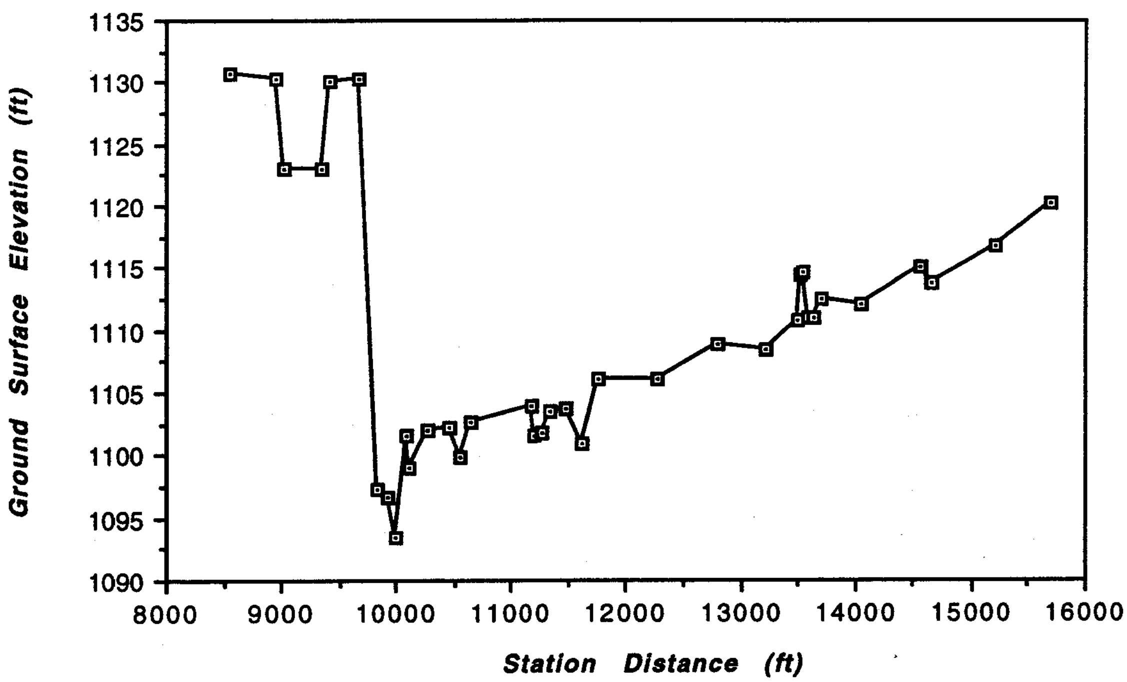

Fig. A-48- Cross-section plot of Station No. 15.320

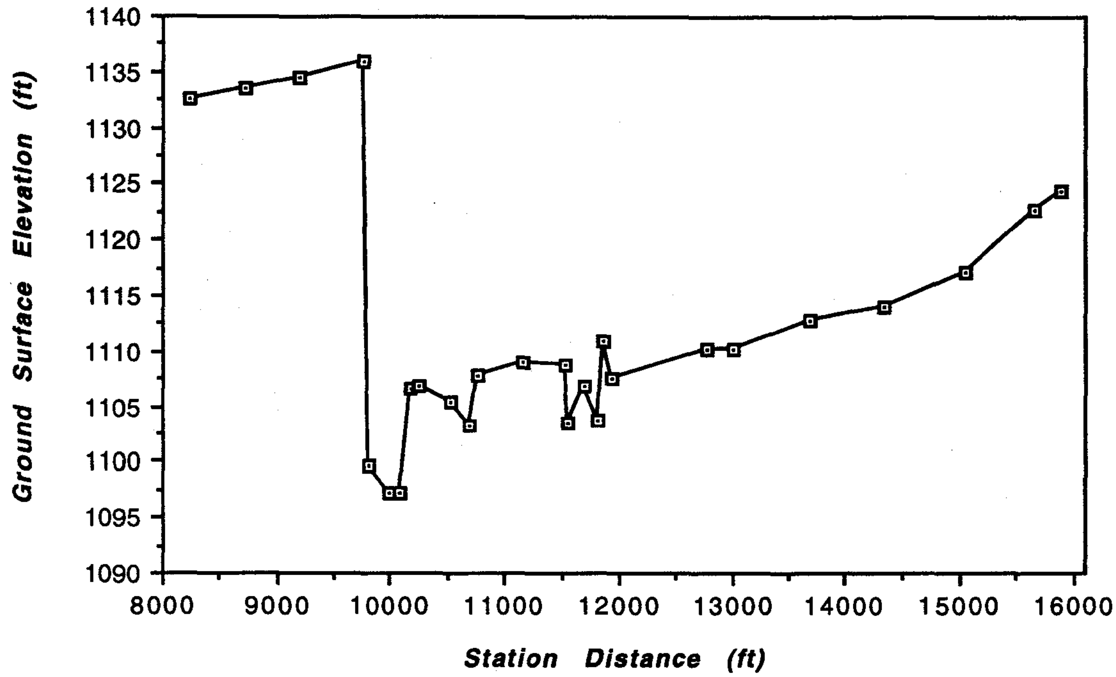

Fig. A-49- Cross-section plot of Station No. 15.510

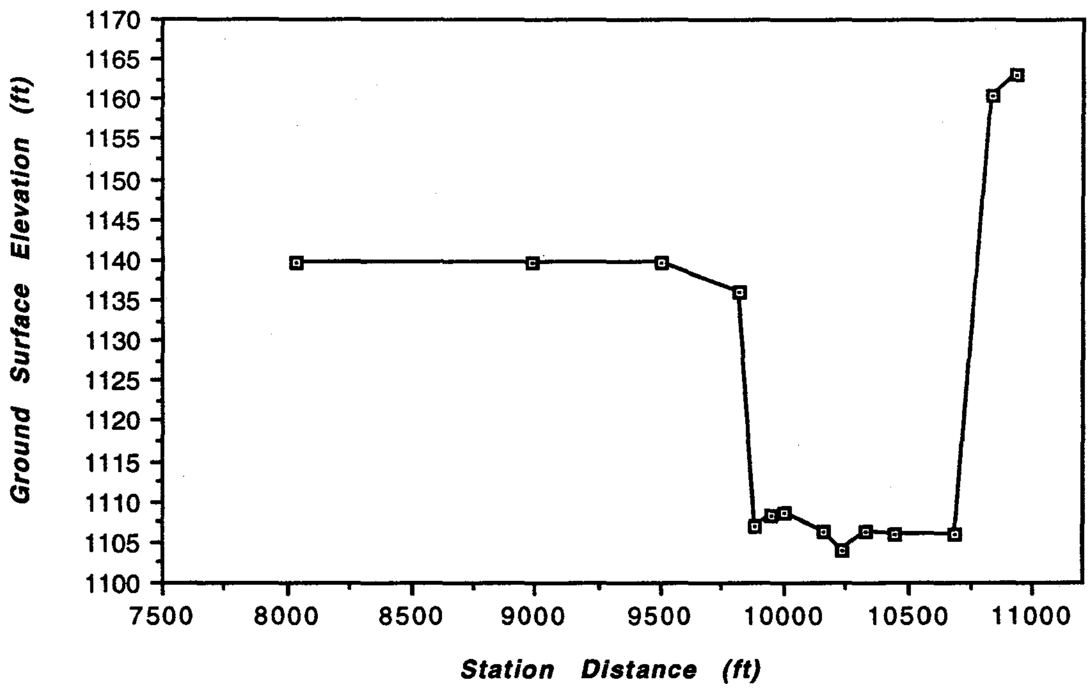

Fig. A-50 - Cross-section plot of Station No. 15.980

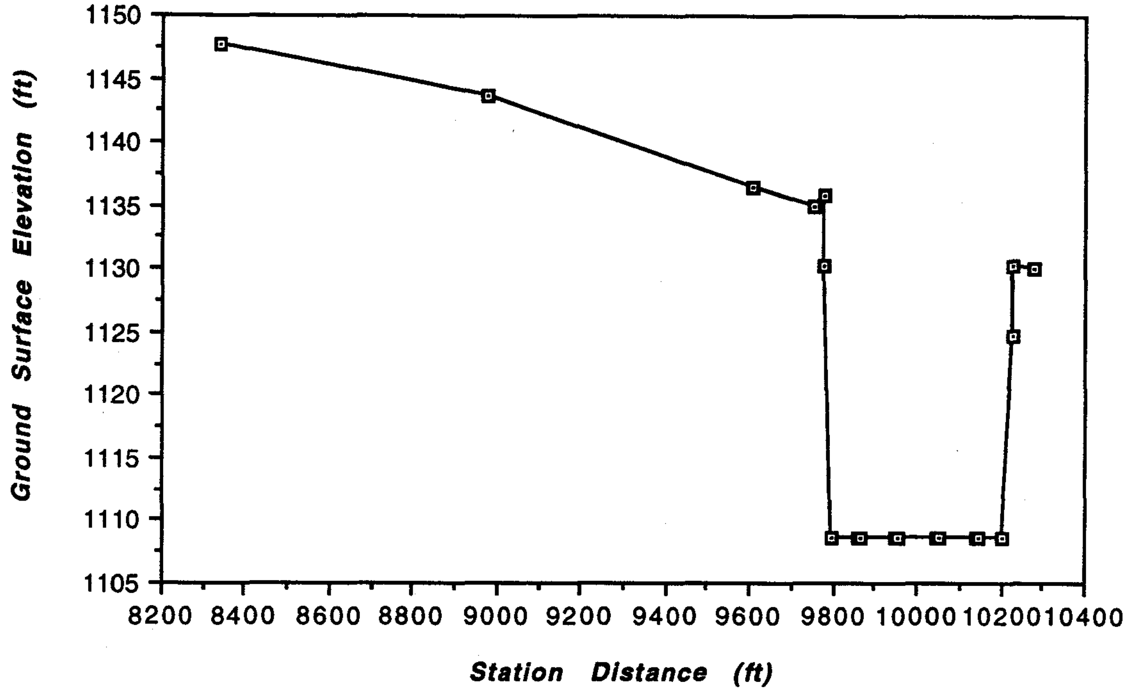

Fig. A-51- Cross-section plot of Station No. 16.420

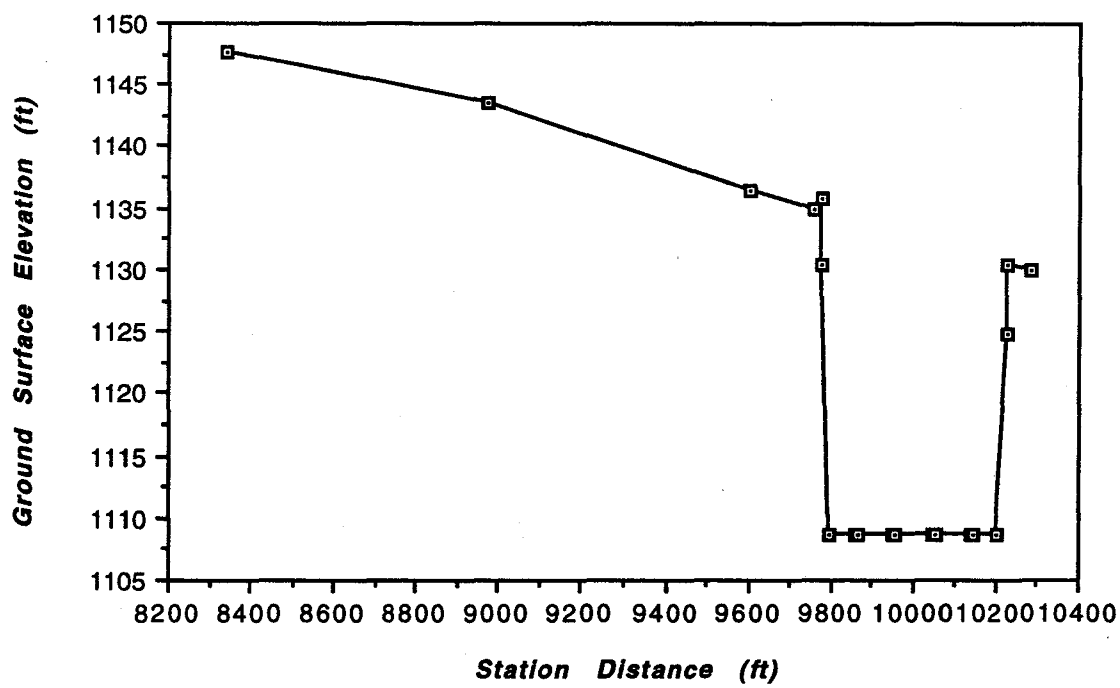

Fig. A-52 - Cross-section plot of Station No. 16.446

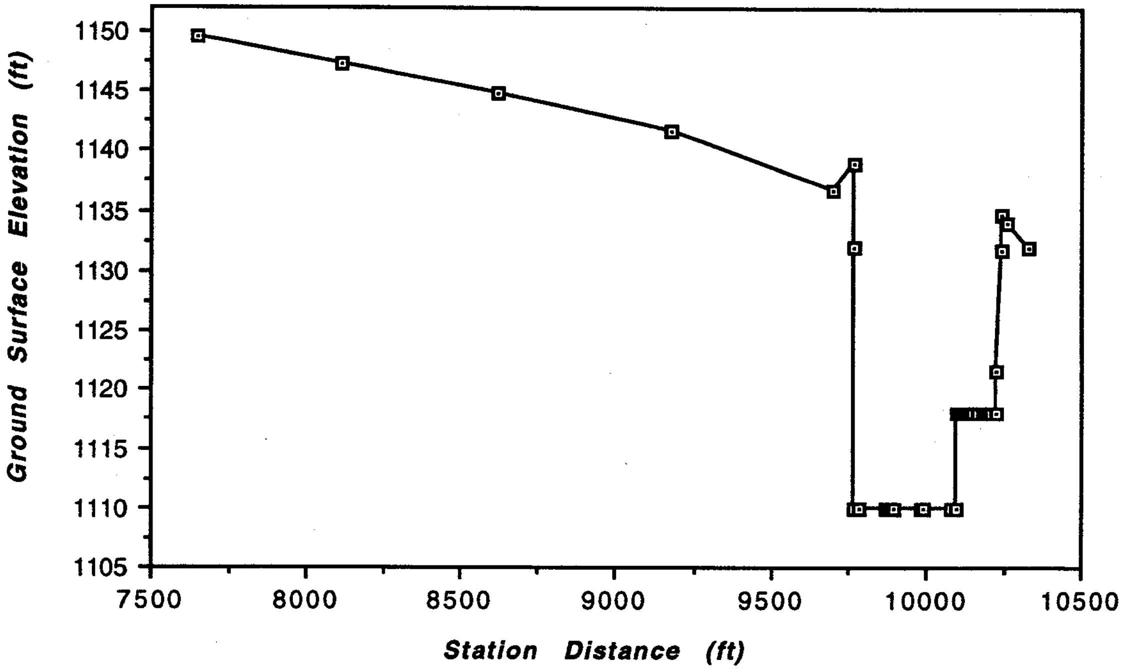

Fig. A-53 - Cross-section plot of Station No. 16.450

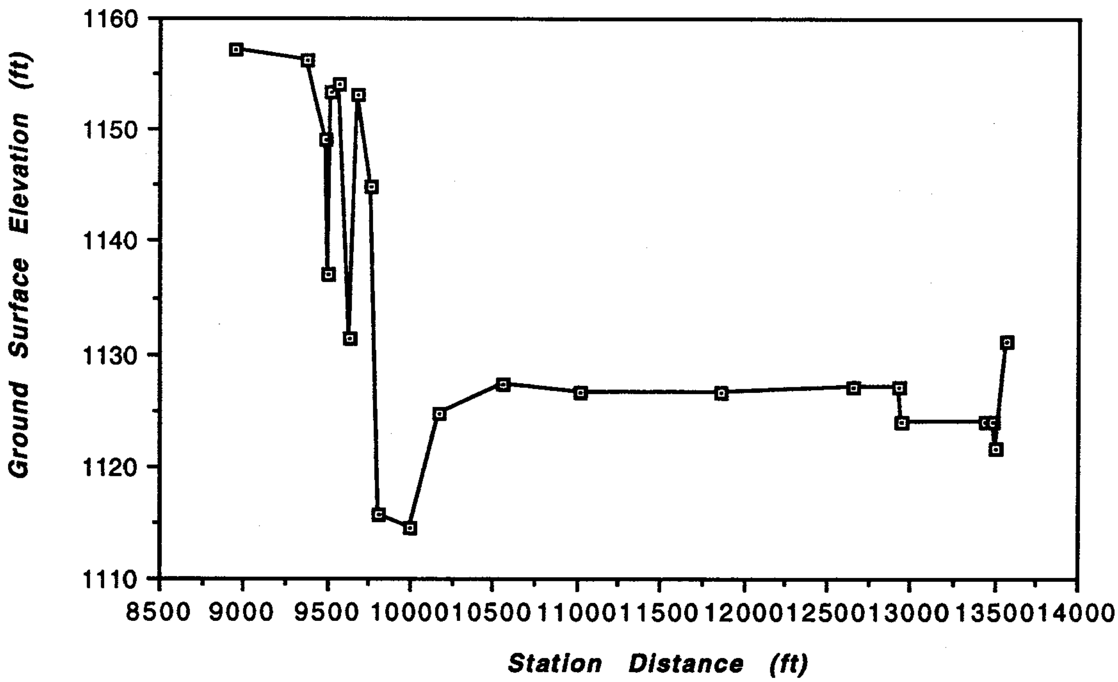

Fig. A-54 - Cross-section plot of Station No. 16.910

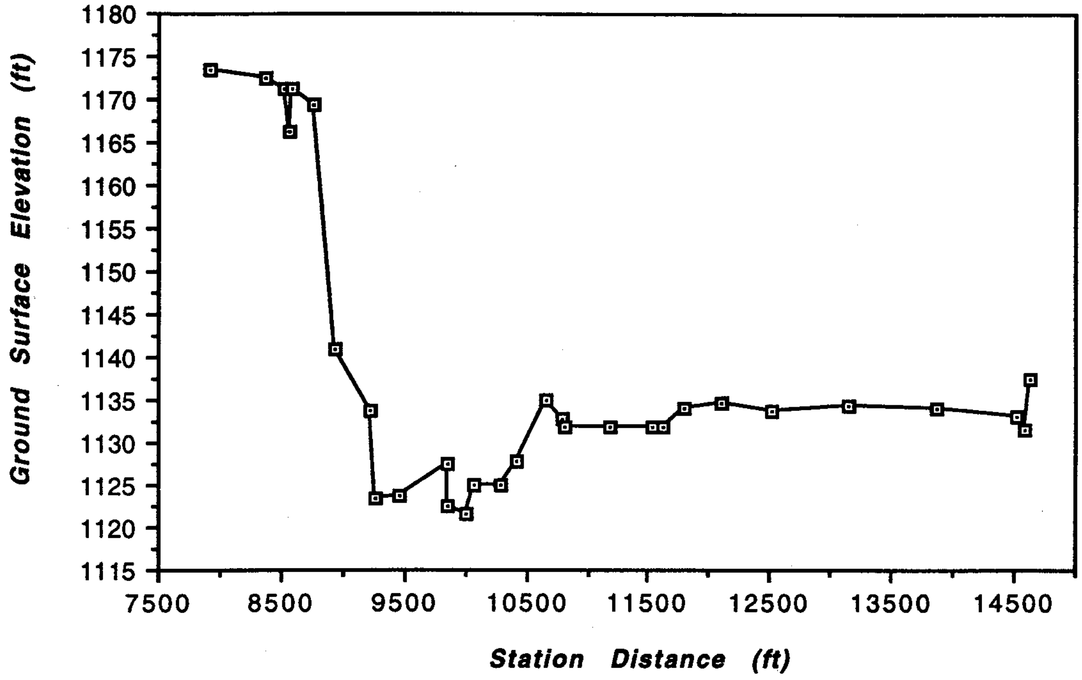

Fig. A-55 - Cross-section plot of Station No. 17.380

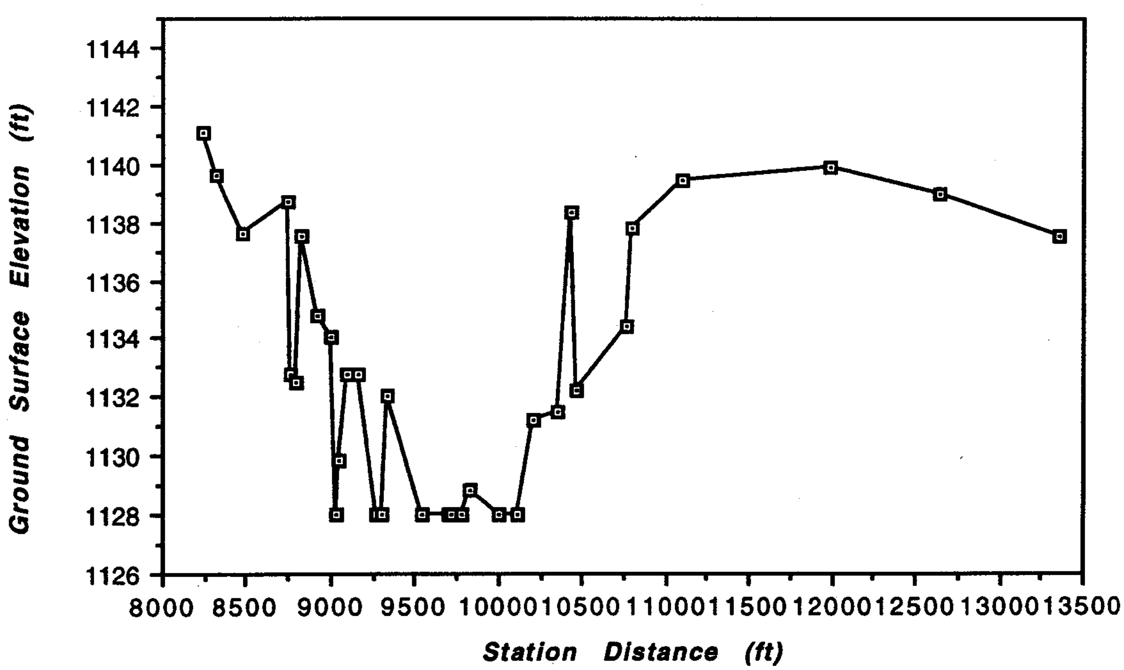

Fig. A-56 - Cross-section plot of Station No. 17.760

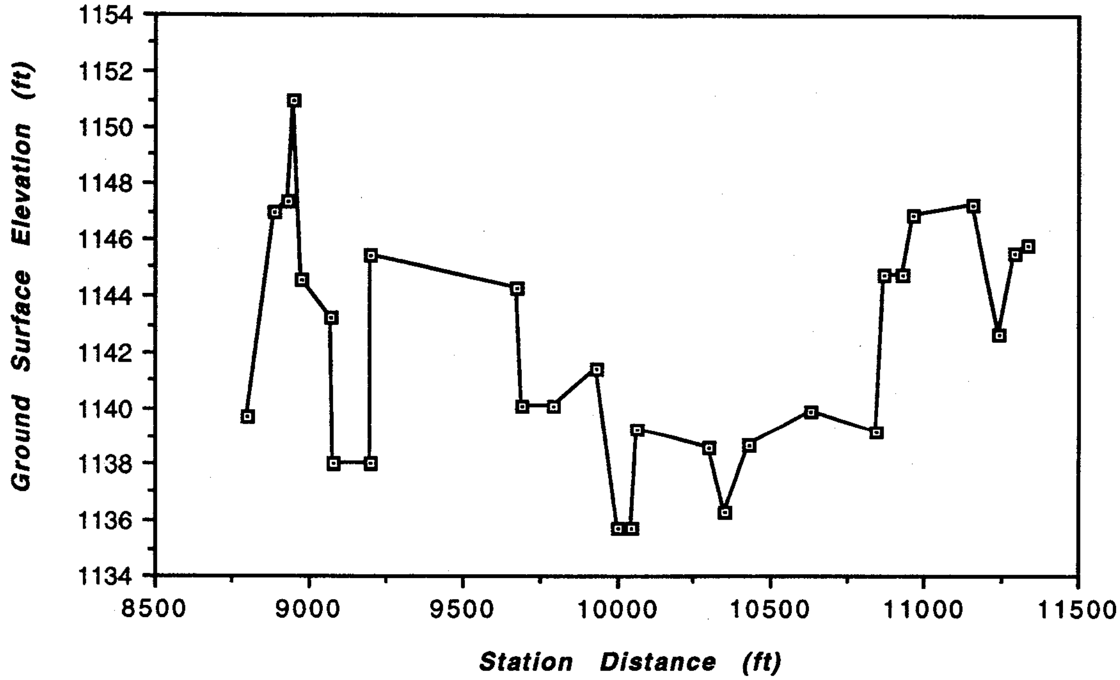

Fig. A-57 - Cross-section plot of Station No. 18.240

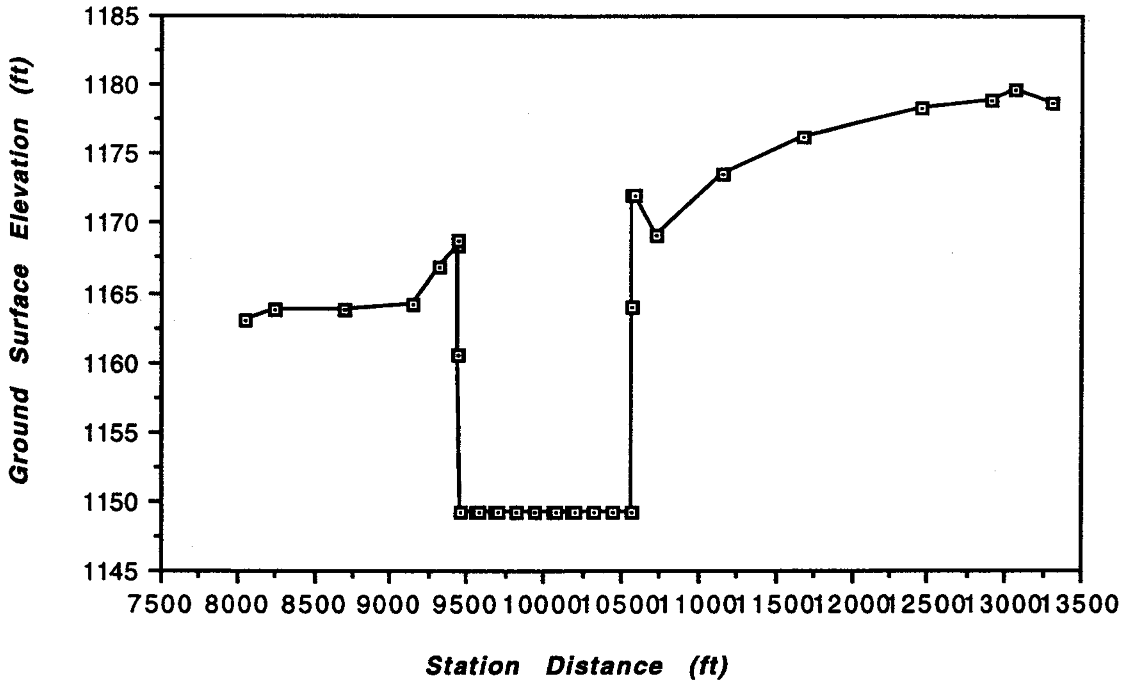

Fig. A-58 - Cross-section plot of Station No. 18.920

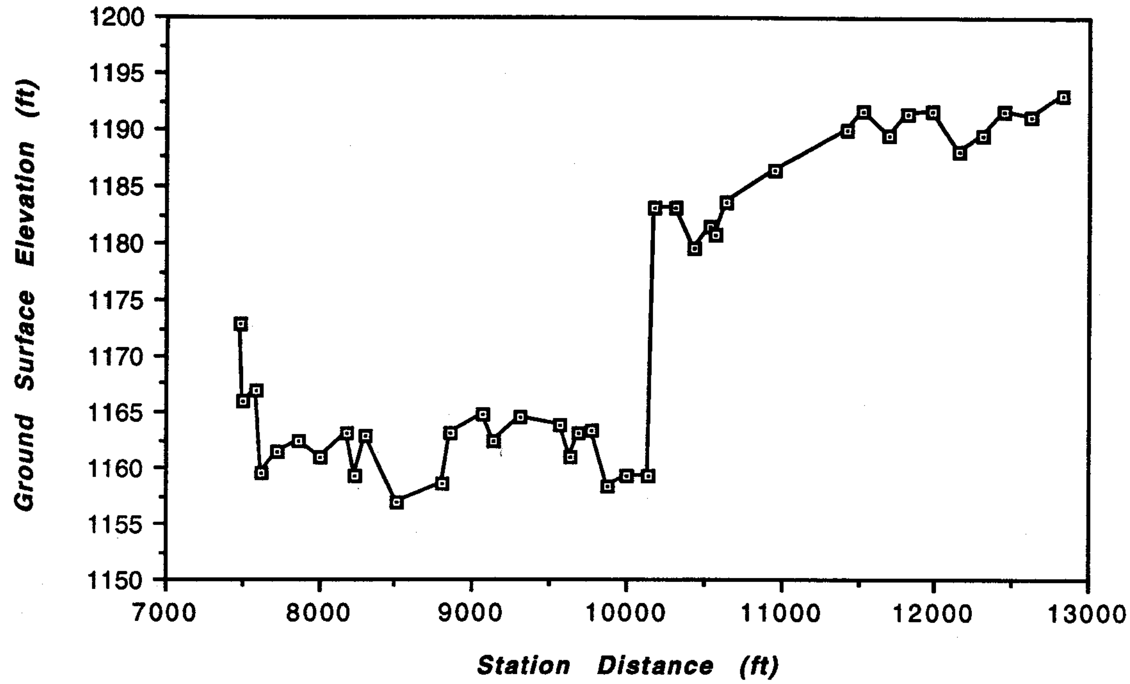

Fig. A-59 - Cross-section plot of Station No. 19.440

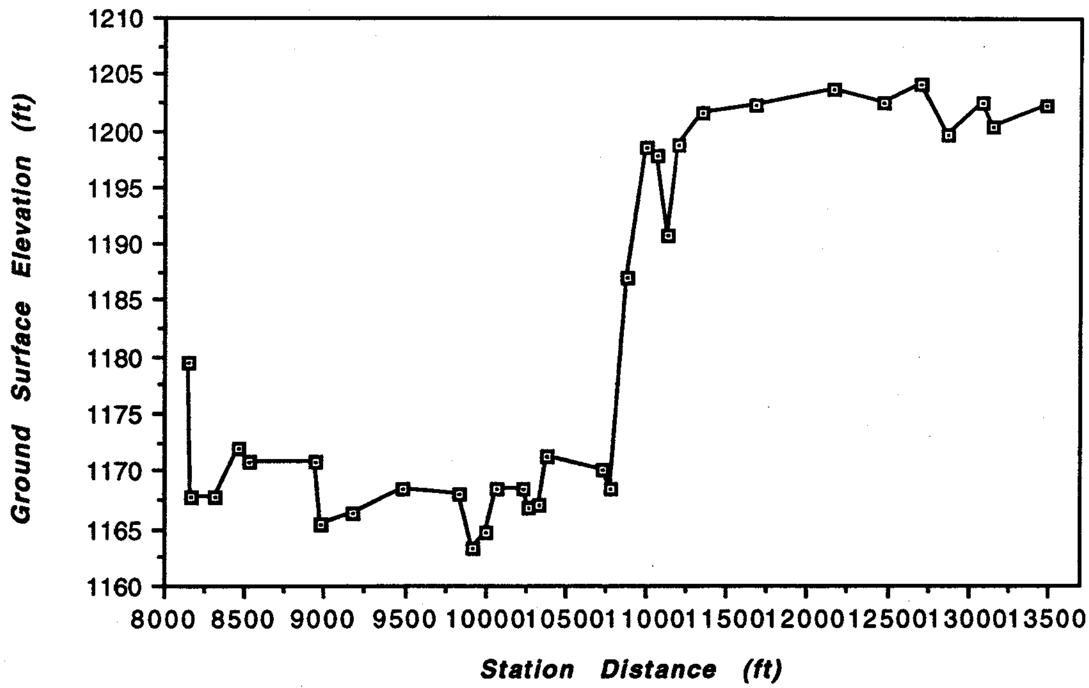

Fig. A-60 - Cross-section plot of Station No. 19.890

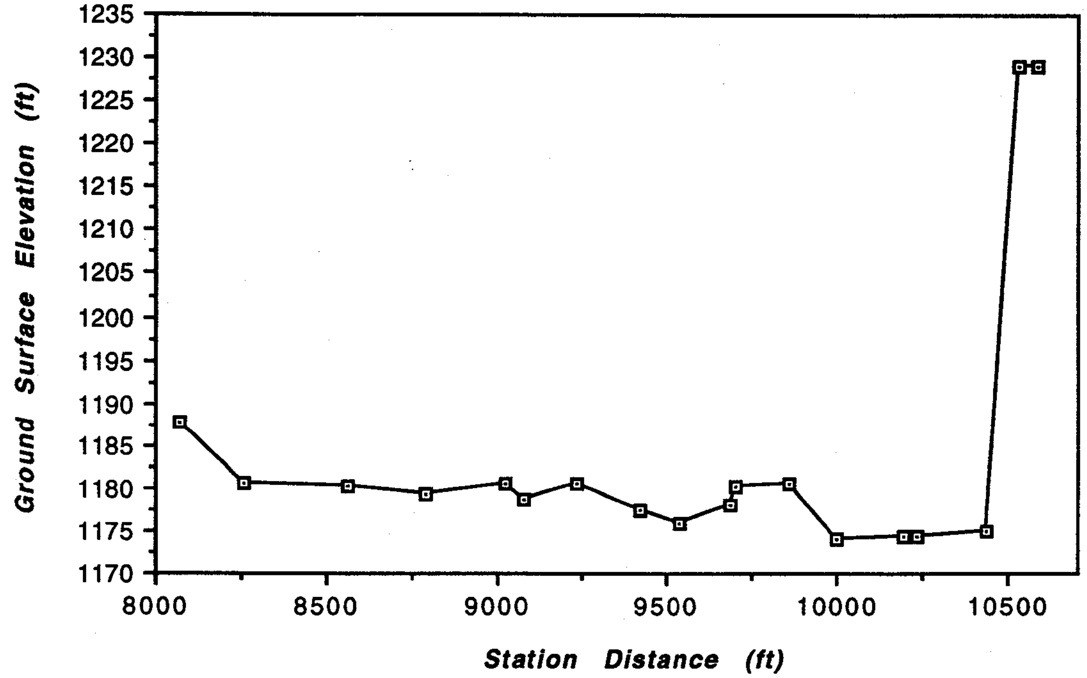

Fig. A-61 - Cross-section plot of Station No. 20.450

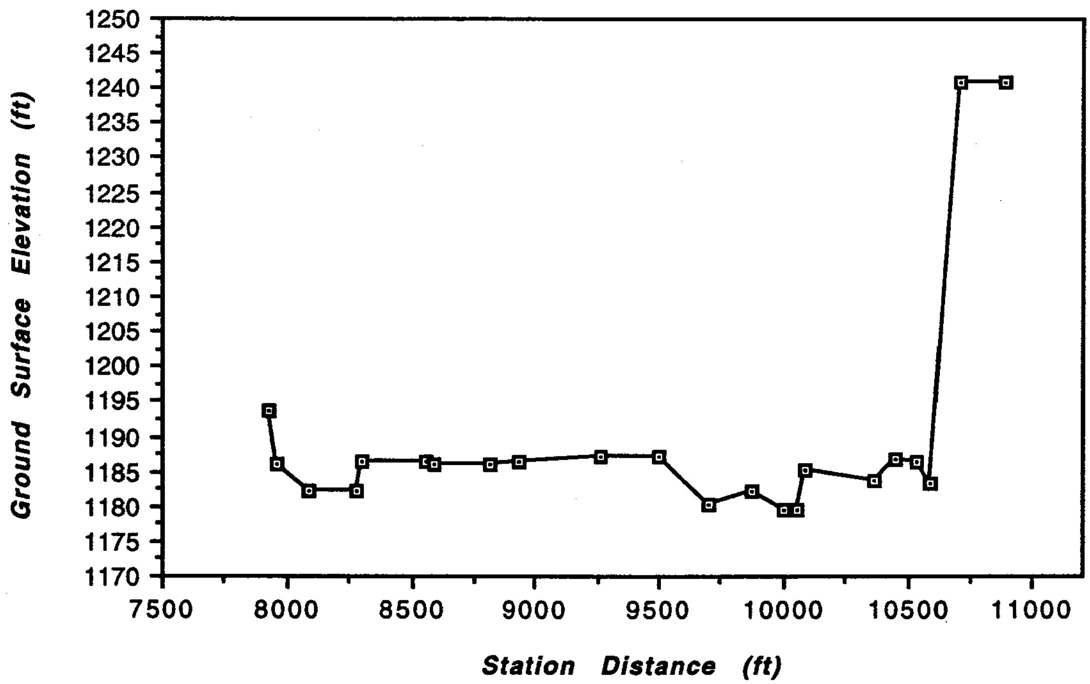

Fig. A-62 - Cross-section plot of Station No. 20.920

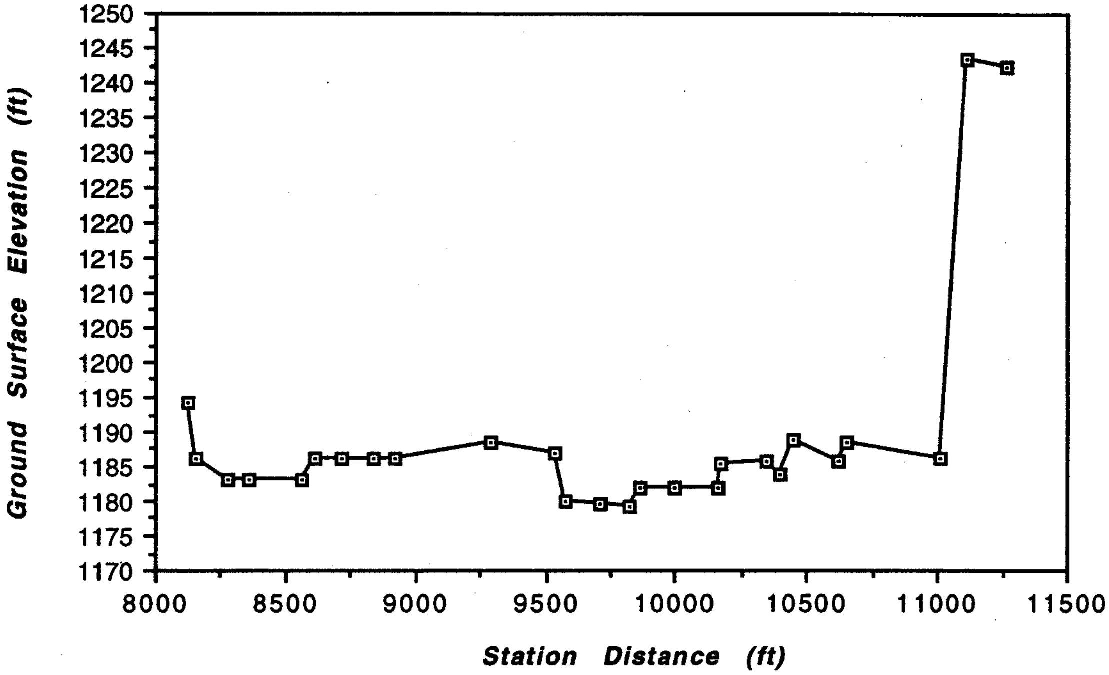

Fig. A-63 - Cross-section plot of Station No. 21.010

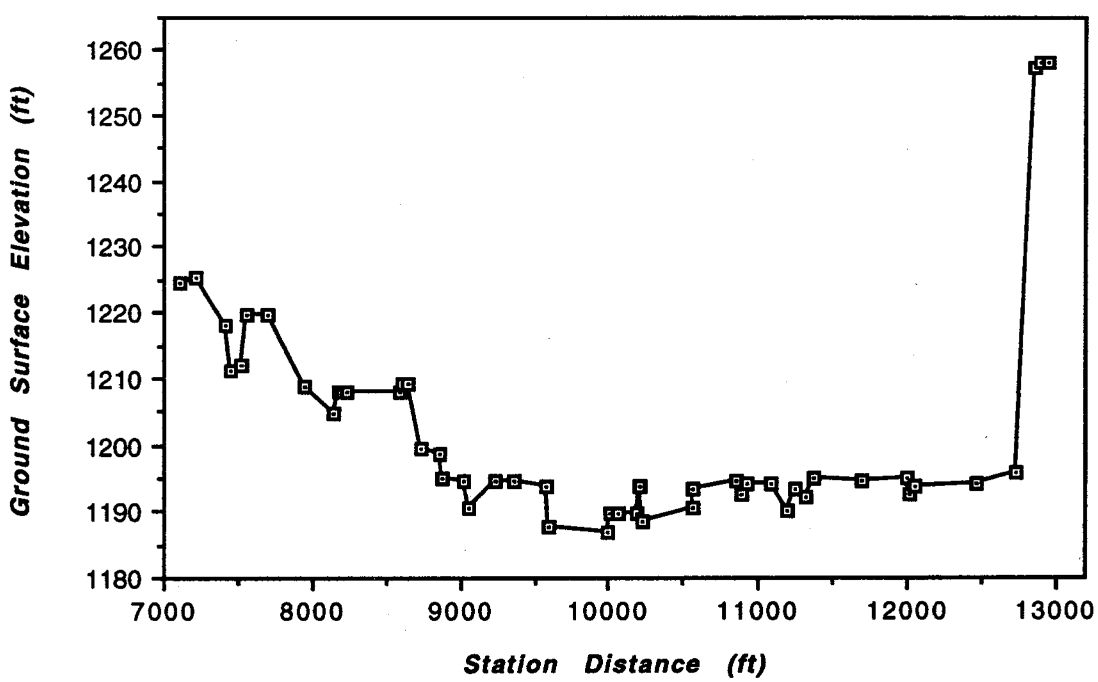

Fig. A-64 - Cross-section plot of Station No. 21.420

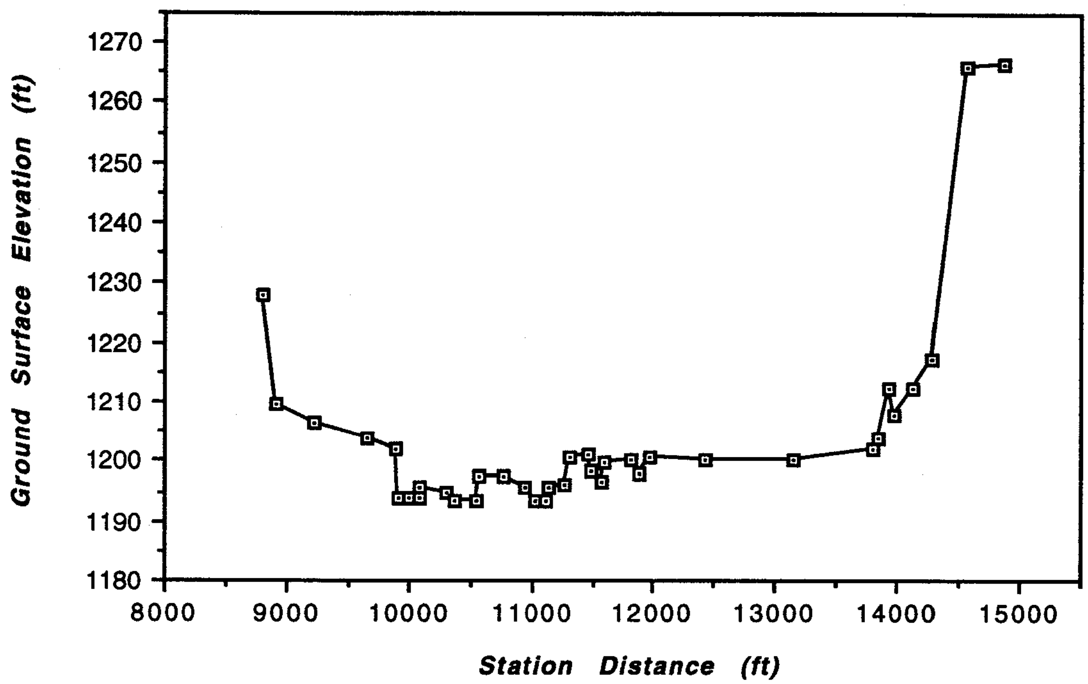

Fig. A-65 - Cross-section plot of Station No. 21.760

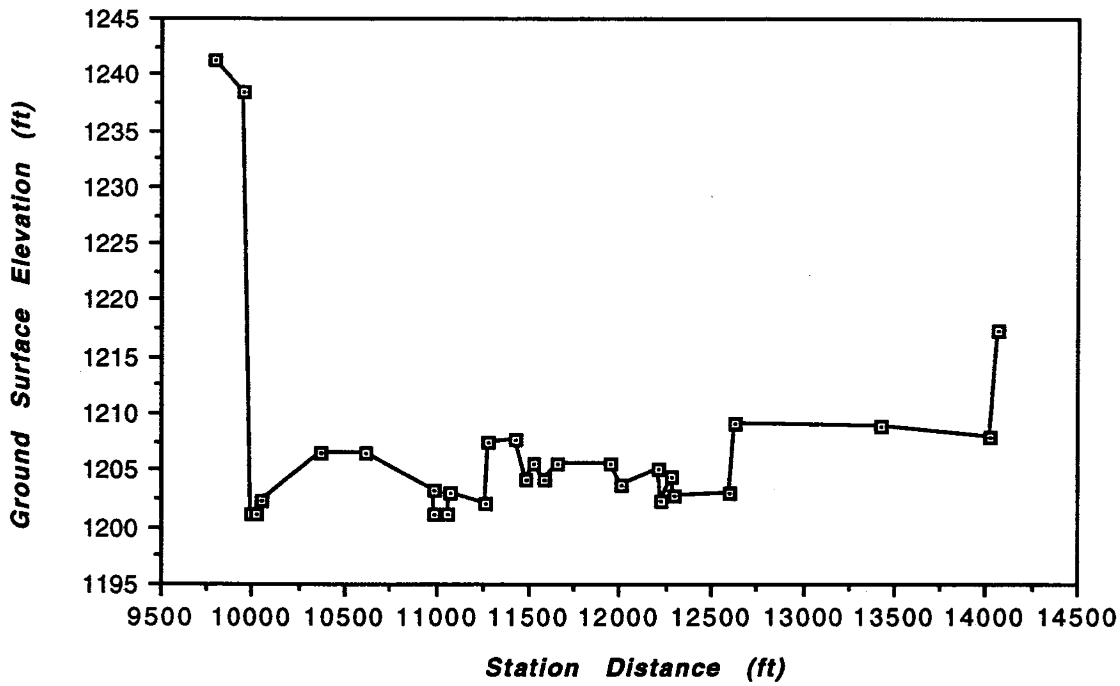

Fig. A-66 - Cross-section plot of Station No. 22.320

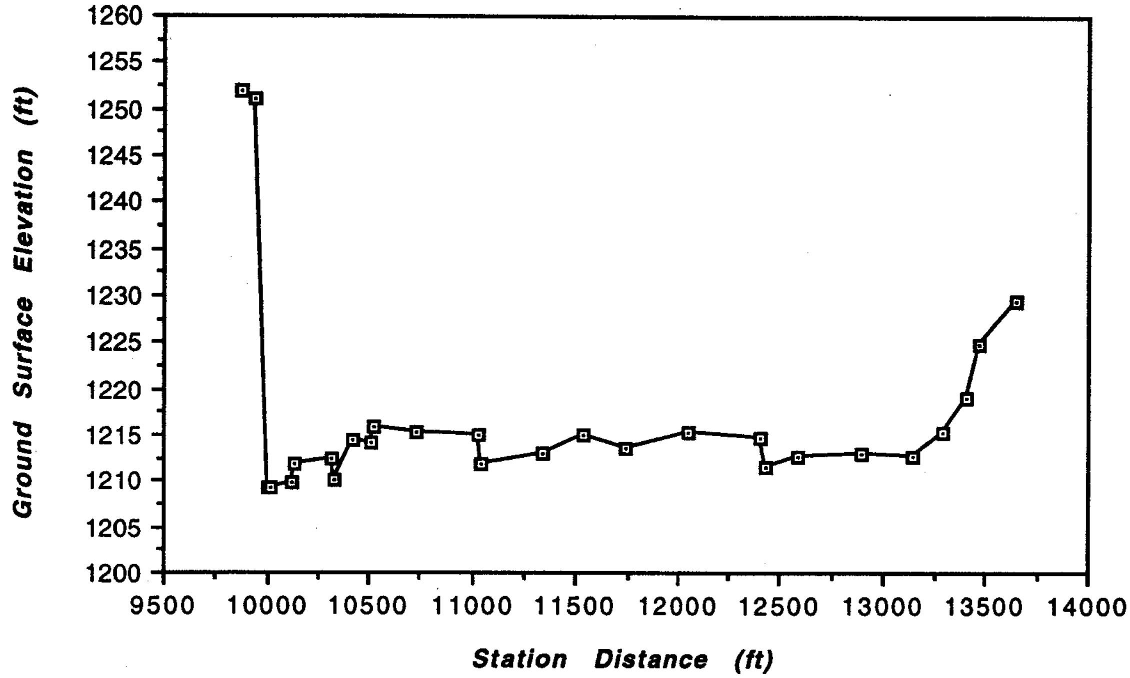

Fig. A-67 - Cross-section plot of Station No. 22.790

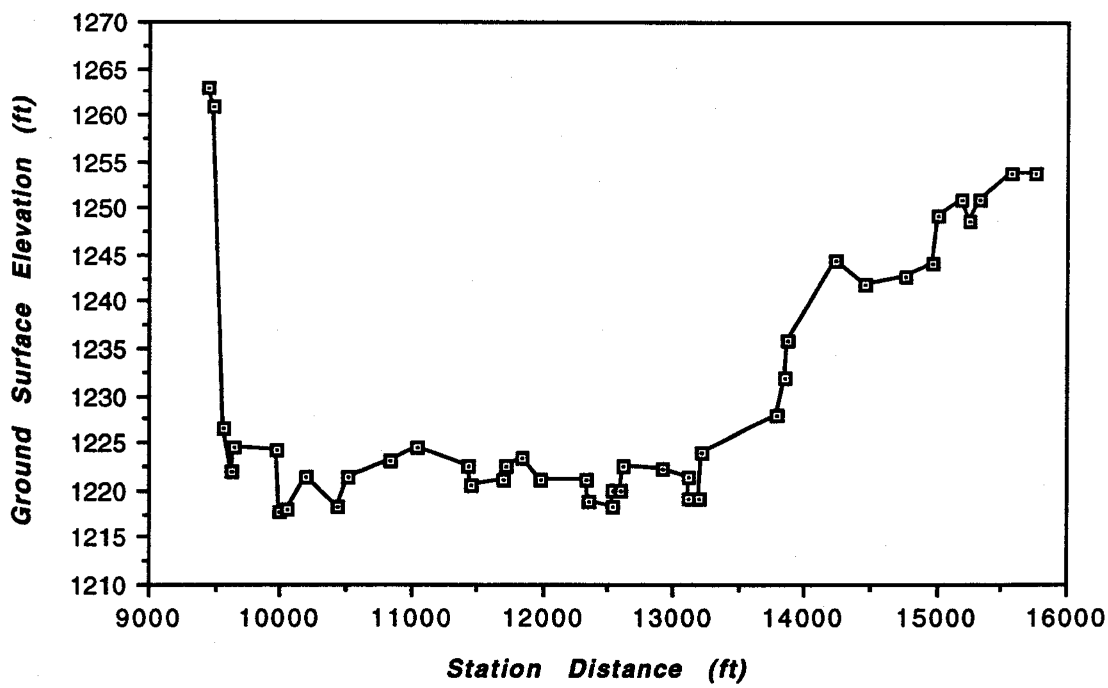

Fig. A-68 - Cross-section plot of Station No. 23.350

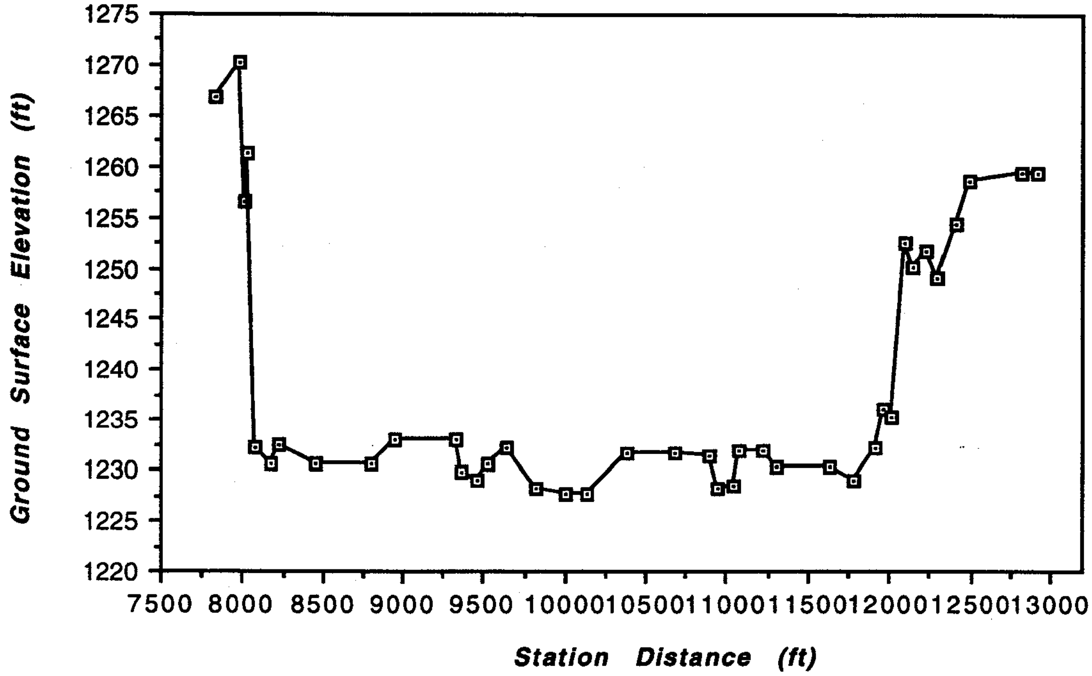

Fig. A-69 - Cross-section plot of Station No. 23.890

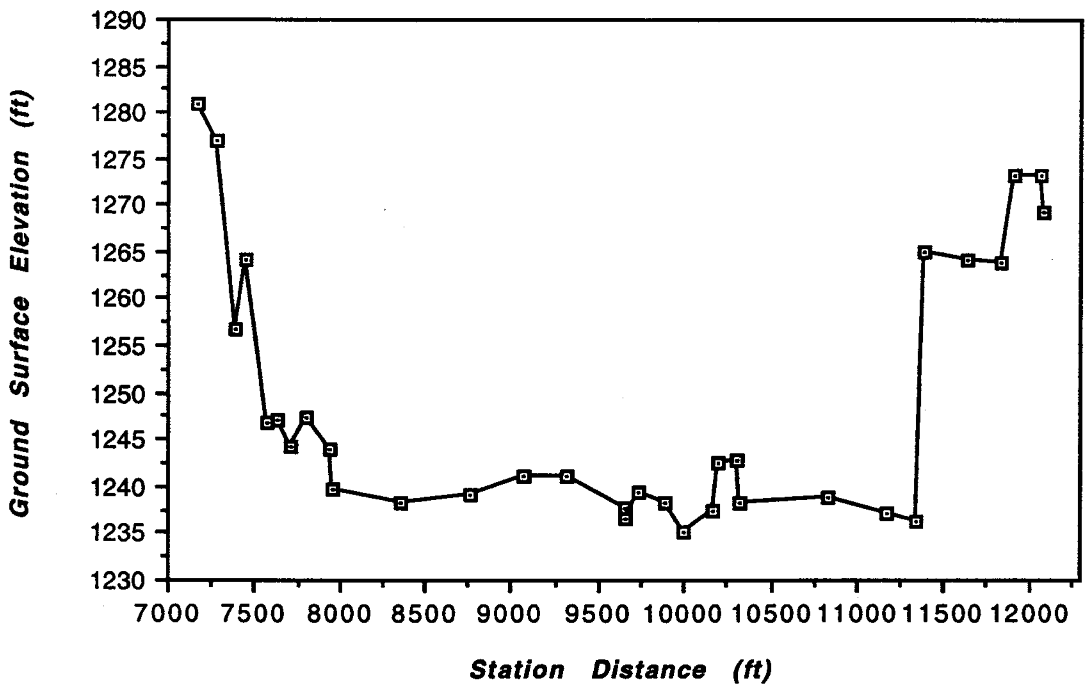

Fig. A-70 - Cross-section plot of Station No. 24.350

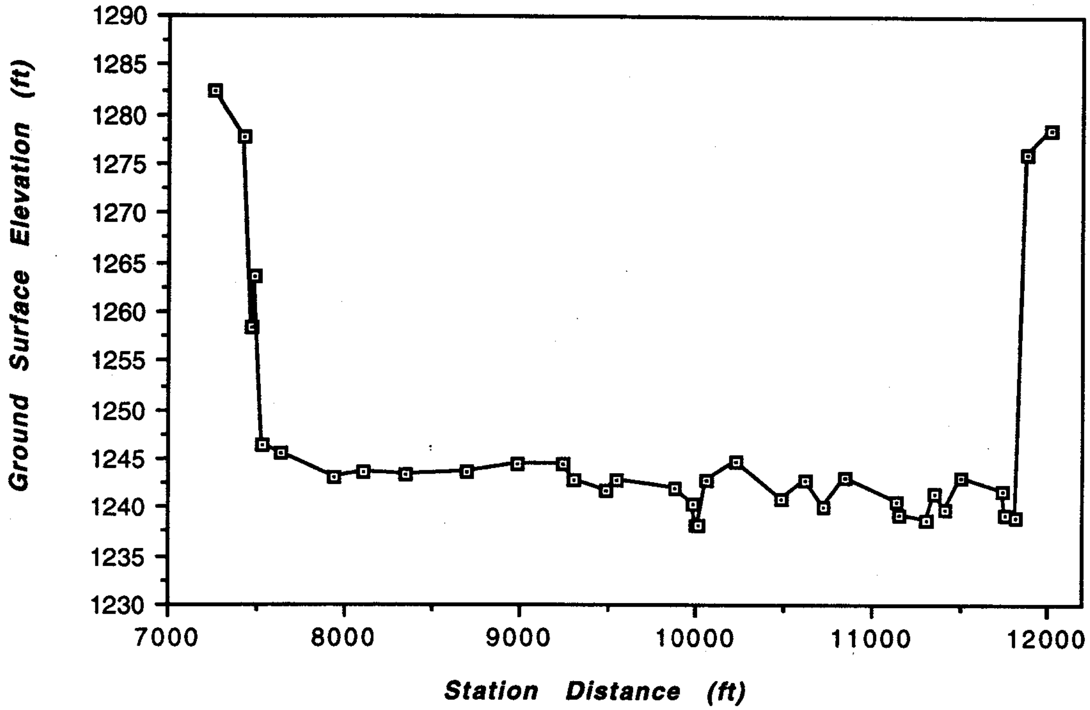

Fig. A-71 - Cross-section plot of Station No. 24.540

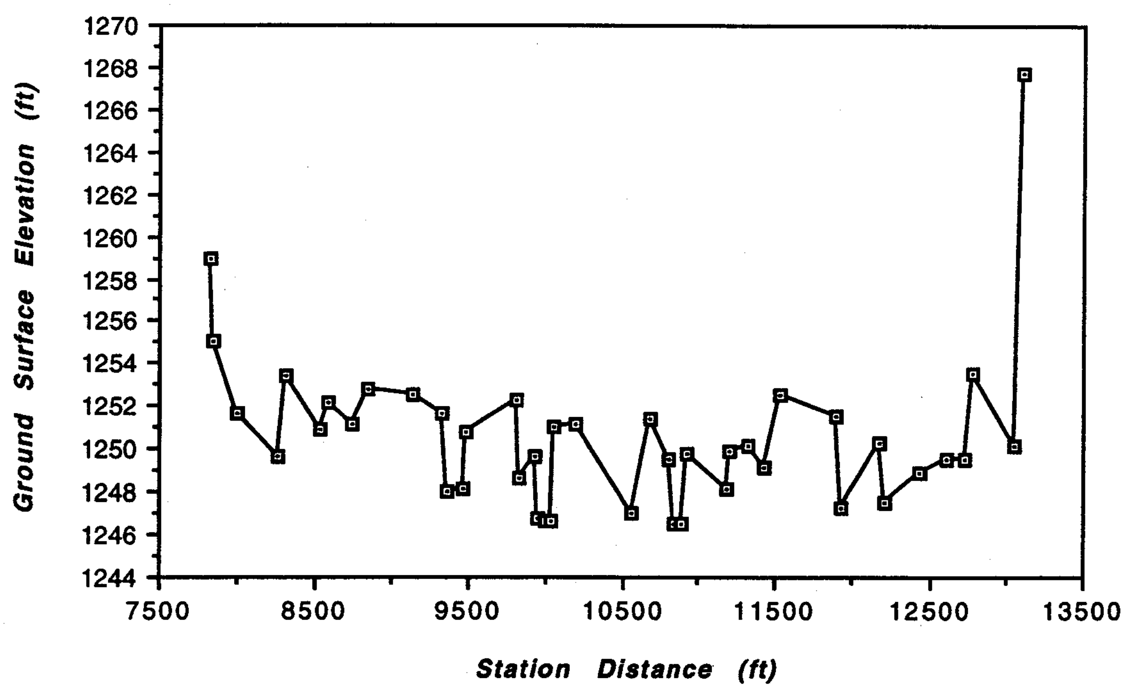

Fig. A-72 - Cross-section plot of Station No. 24.900

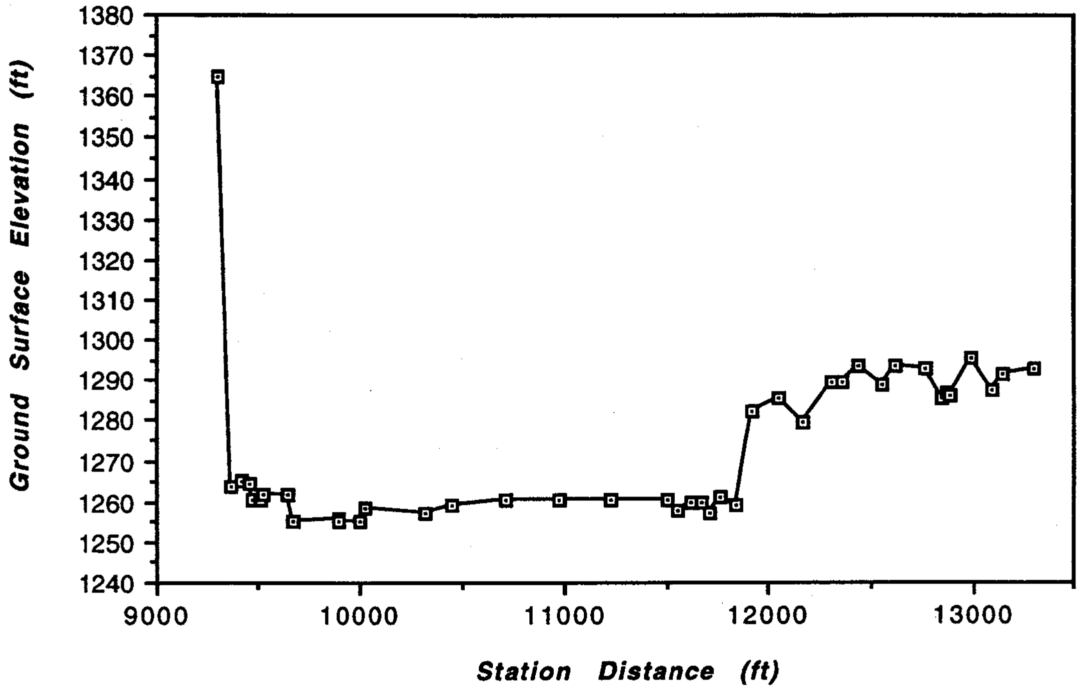

Fig. A-73 - Cross-section plot of Station No. 25.370

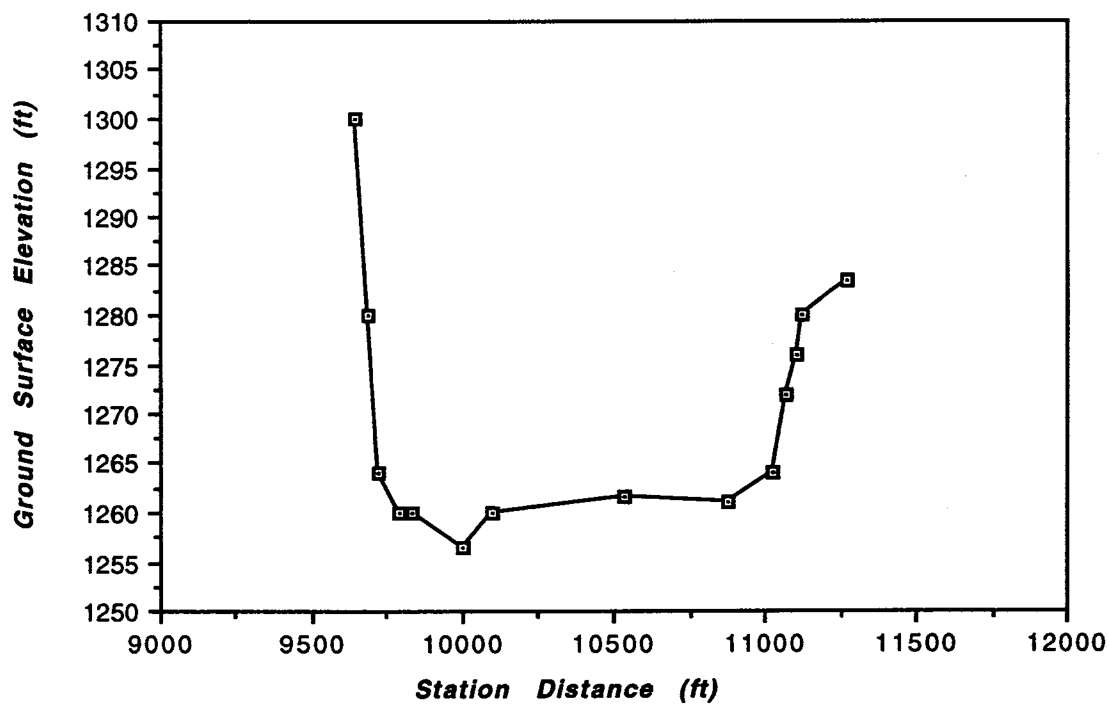

Fig. A-74 - Cross-section plot of Station No. 25.590

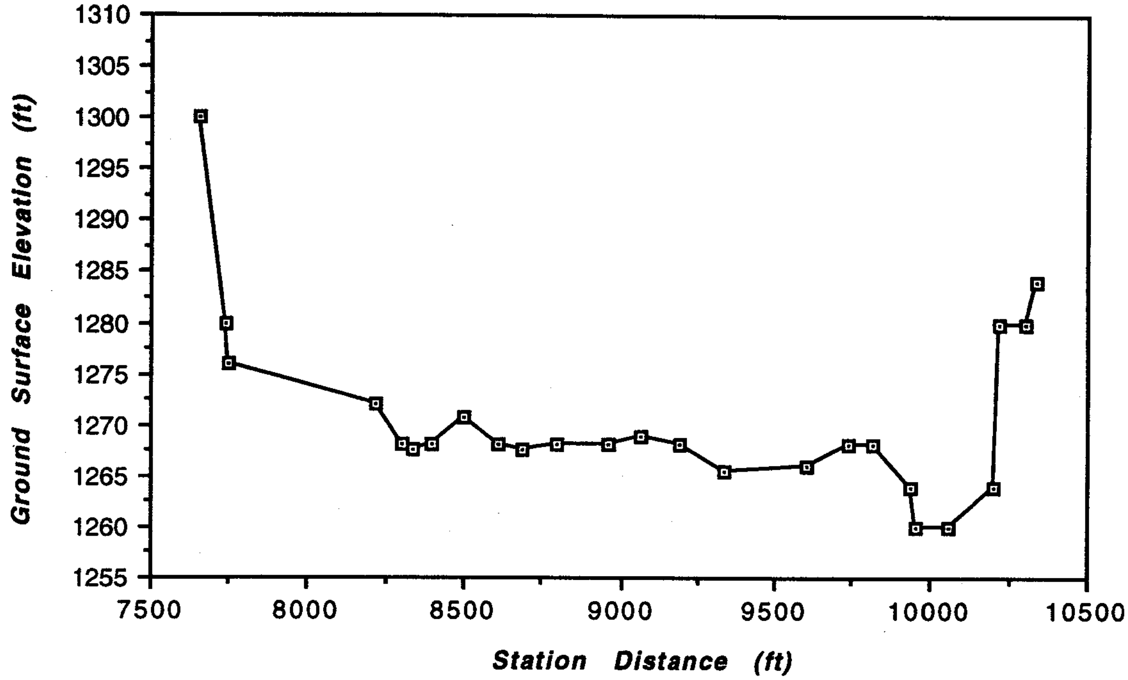

Fig. A-75 - Cross-section plot of Station No. 25.860

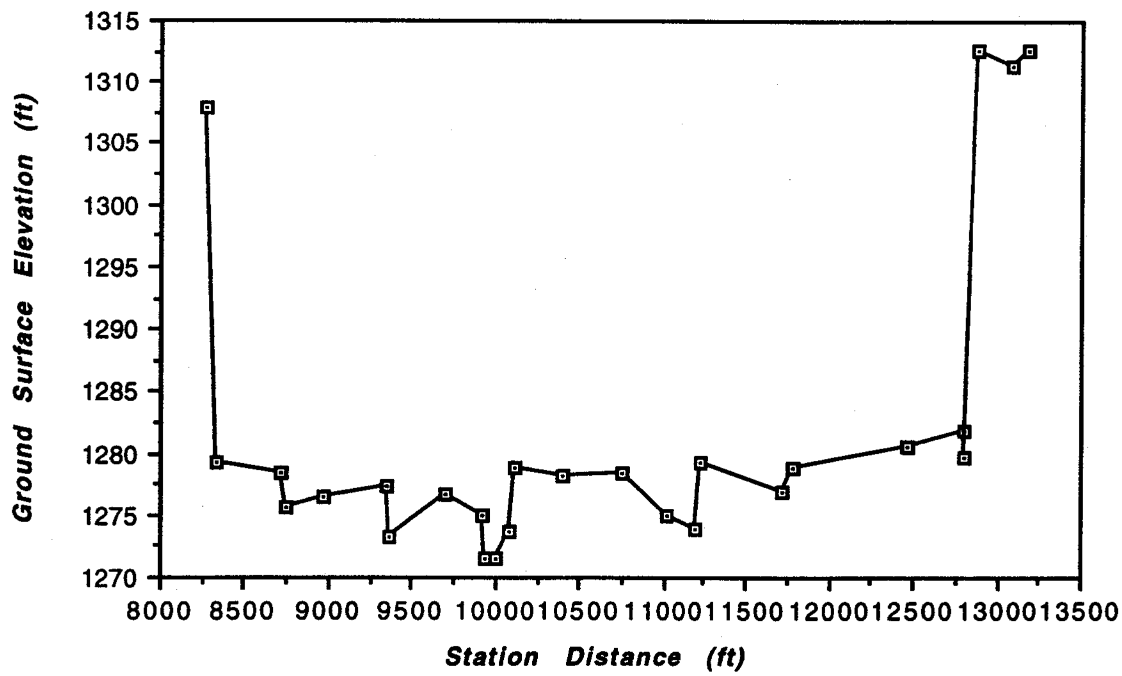

Fig. A-76 - Cross-section plot of Station No. 26.290

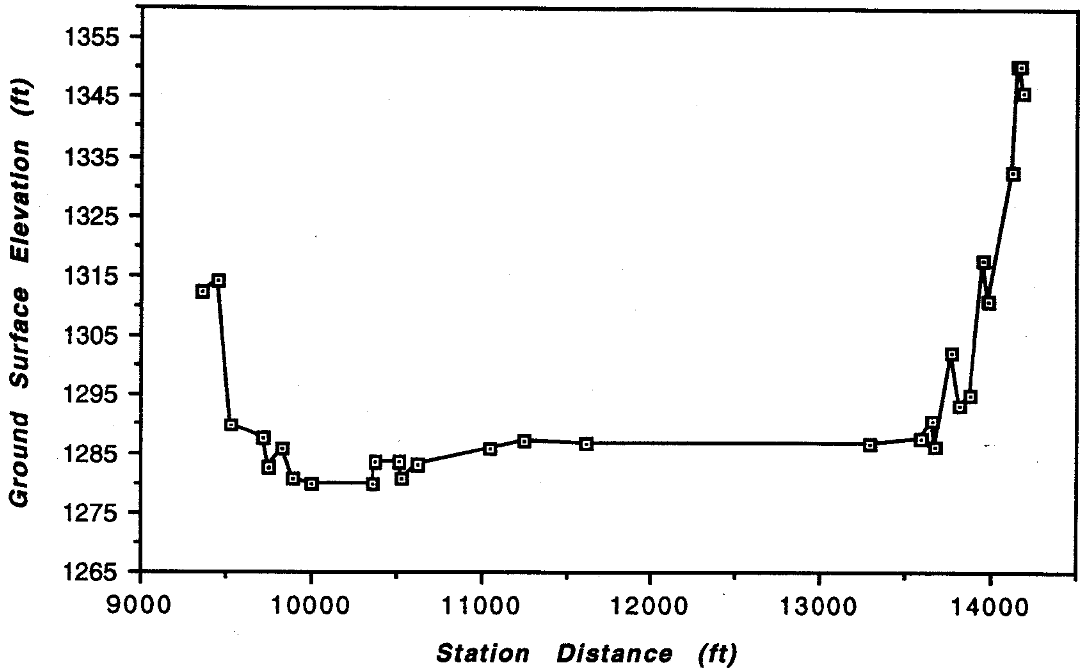

Fig. A-77 - Cross-section plot of Station No. 26.730

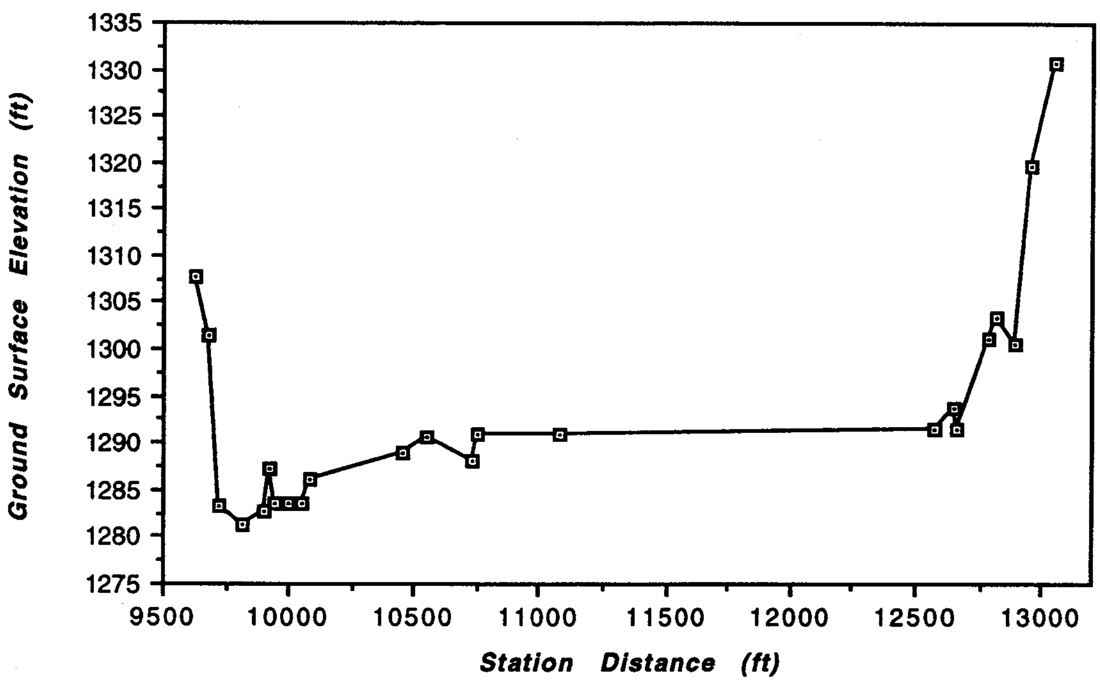

Fig. A-78 - Cross-section plot of Station No. 27.030

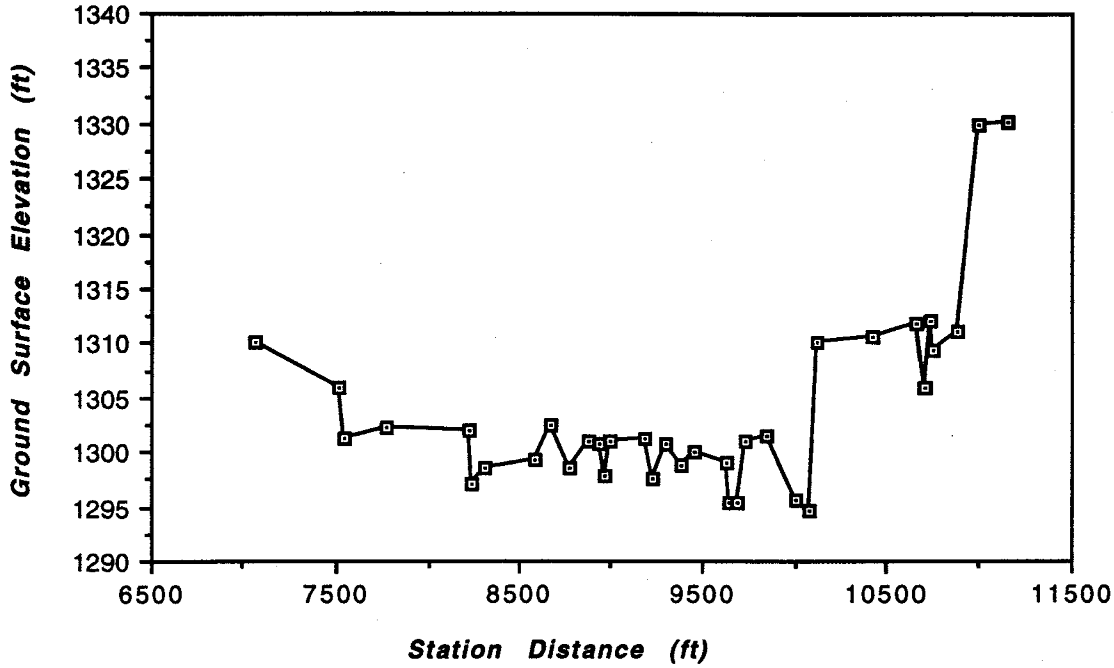

Fig. A-79 - Cross-section plot of Station No. 27.680

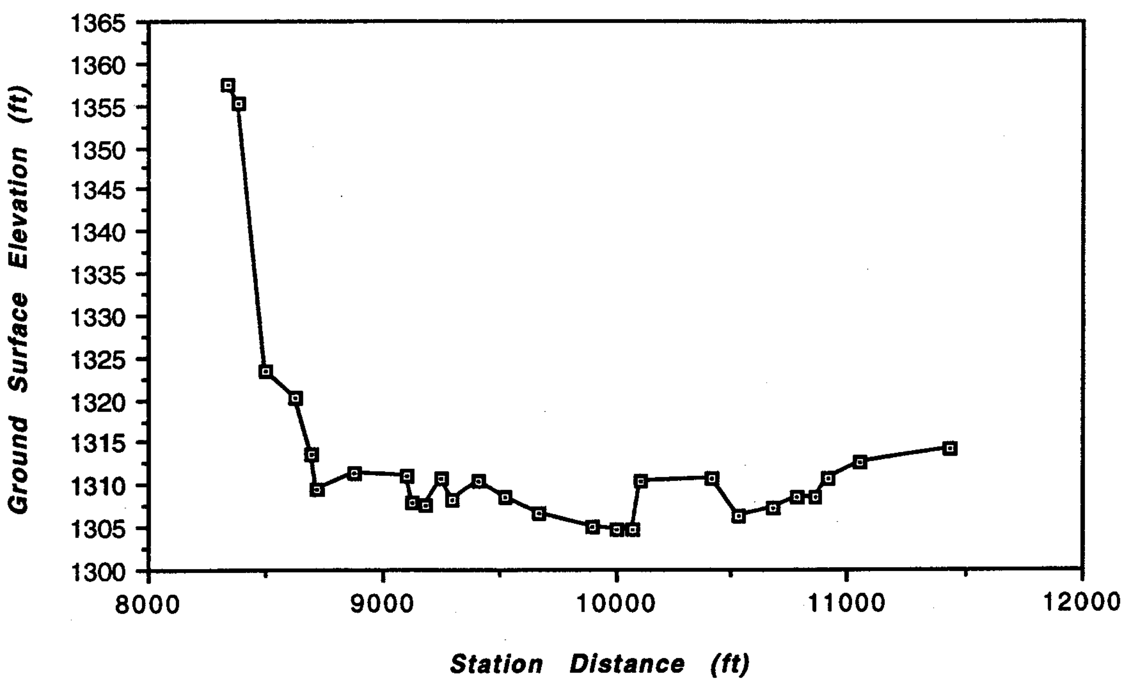

Fig. A-80 - Cross-section plot of Station No. 28.120

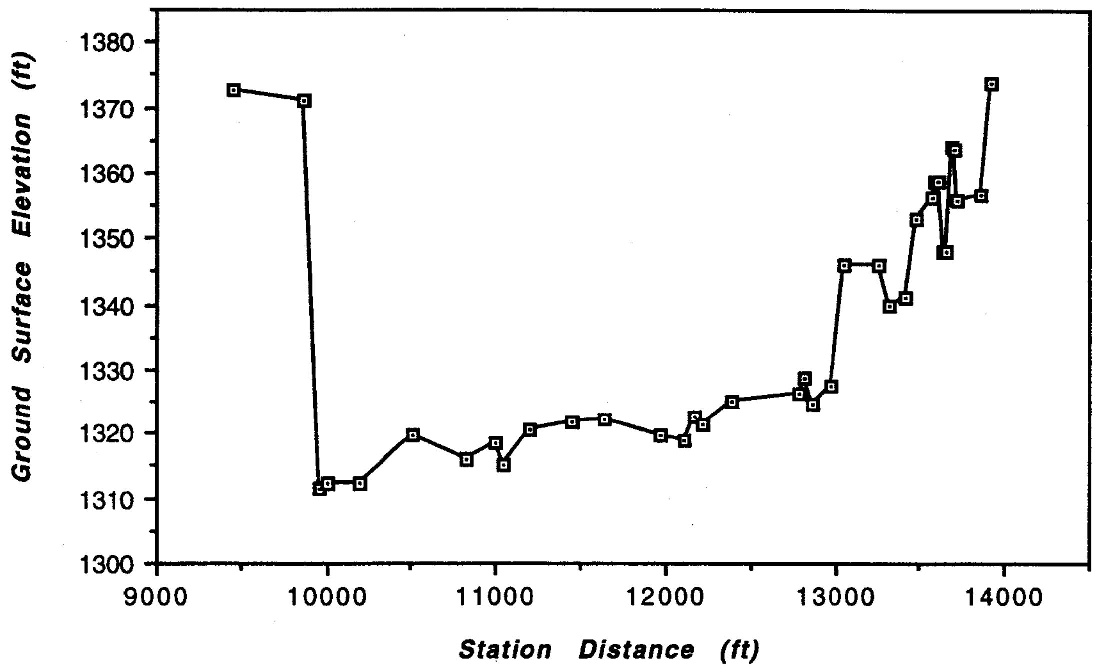

Fig. A-81 - Cross-section plot of Station No. 28.670

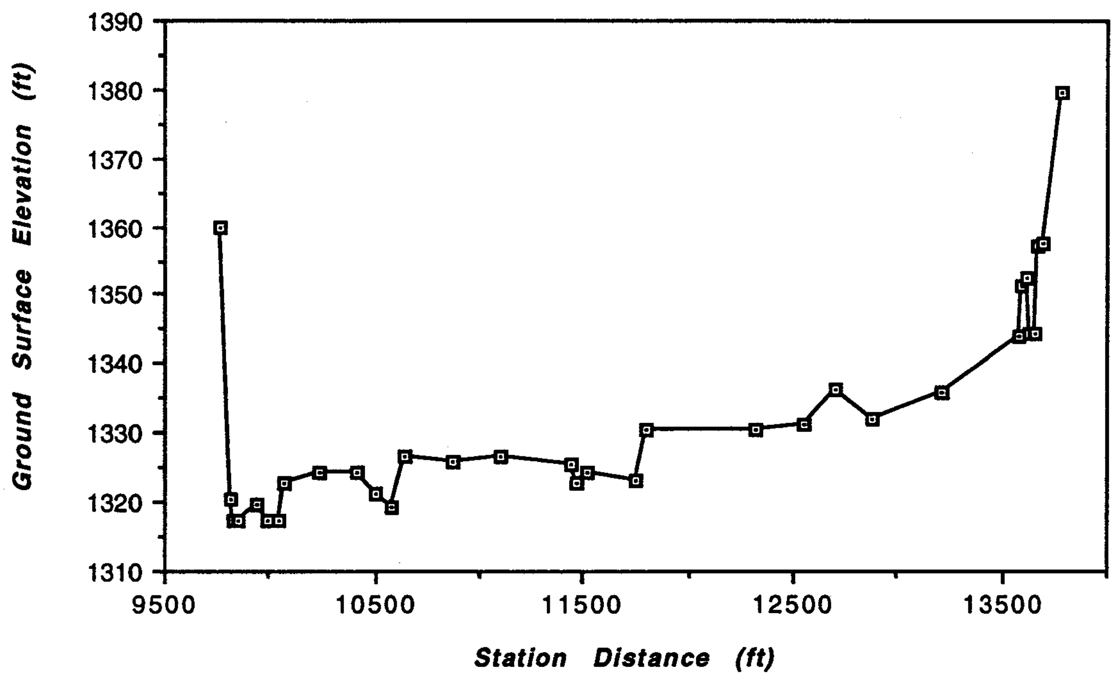

Fig. A-82 - Cross-section plot of Station No. 29.040

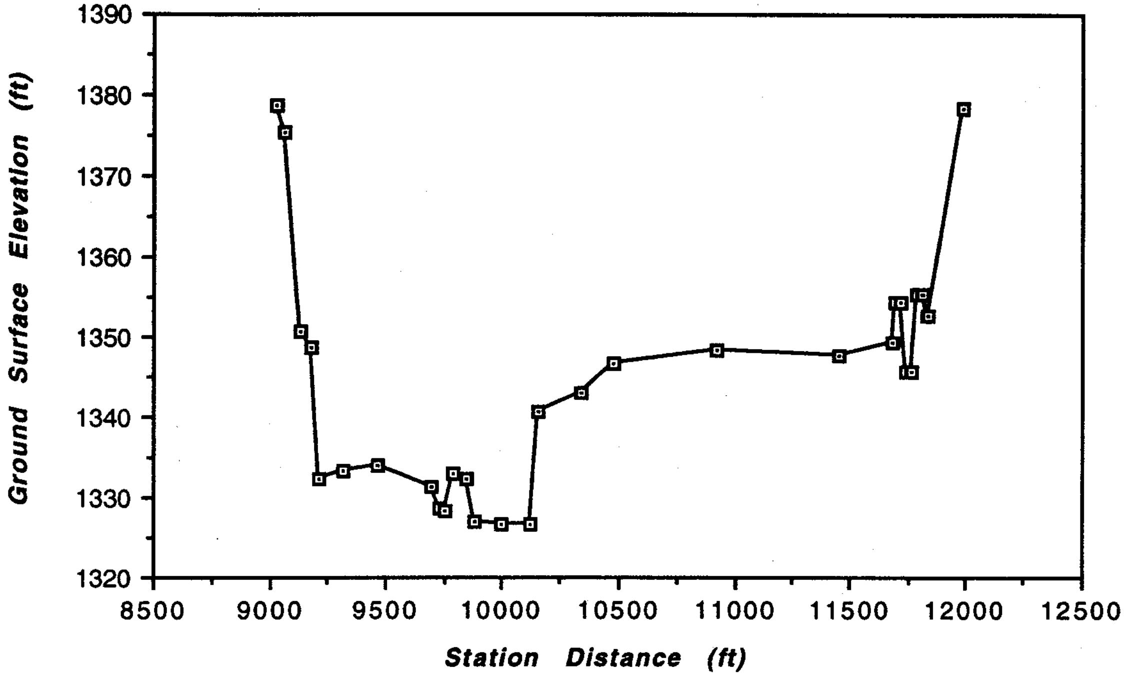

Fig. A-83 - Cross-section plot of Station No. 29.540

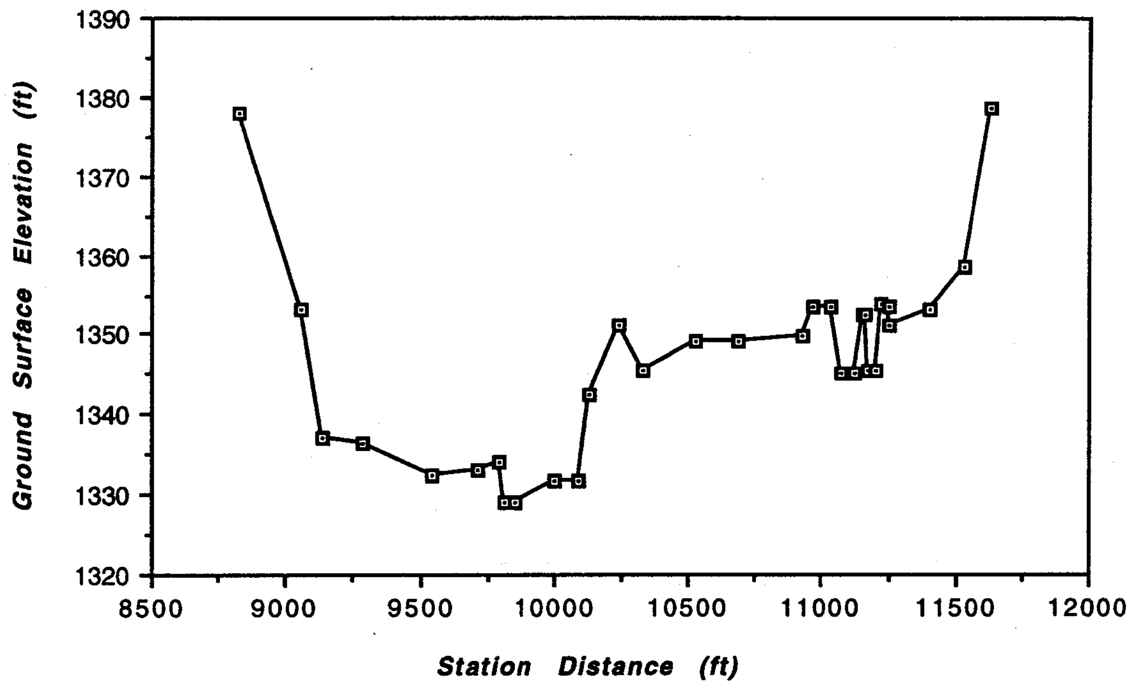

Fig. A-84 - Cross-section plot of Station No. 29.610

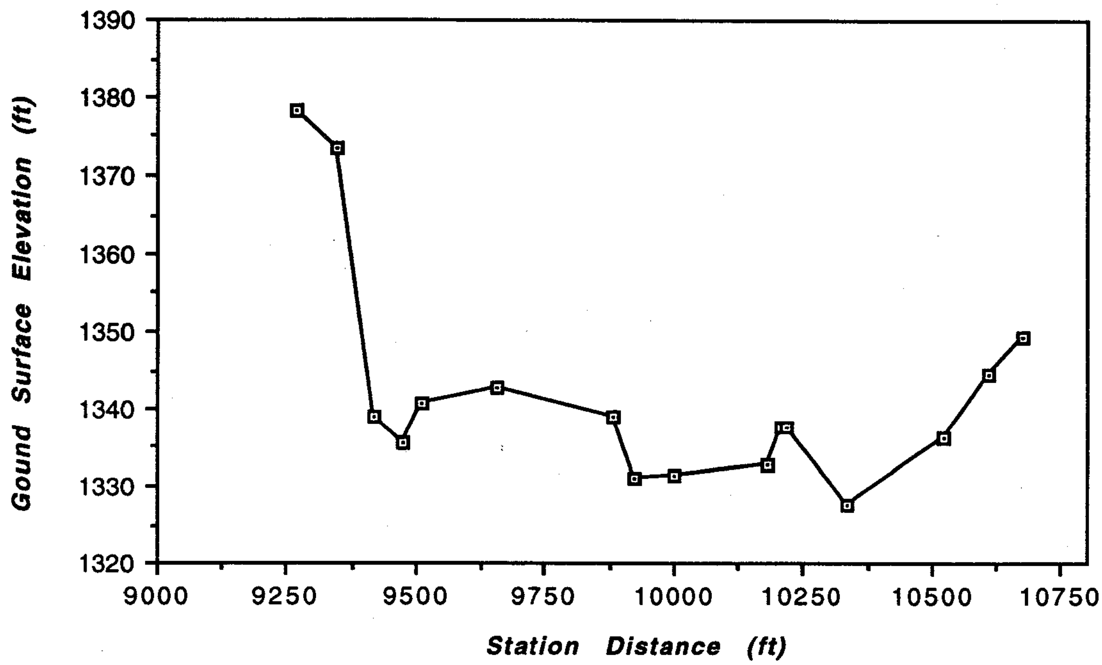

Fig. A-85 - Cross-section plot of Station No. 29.800

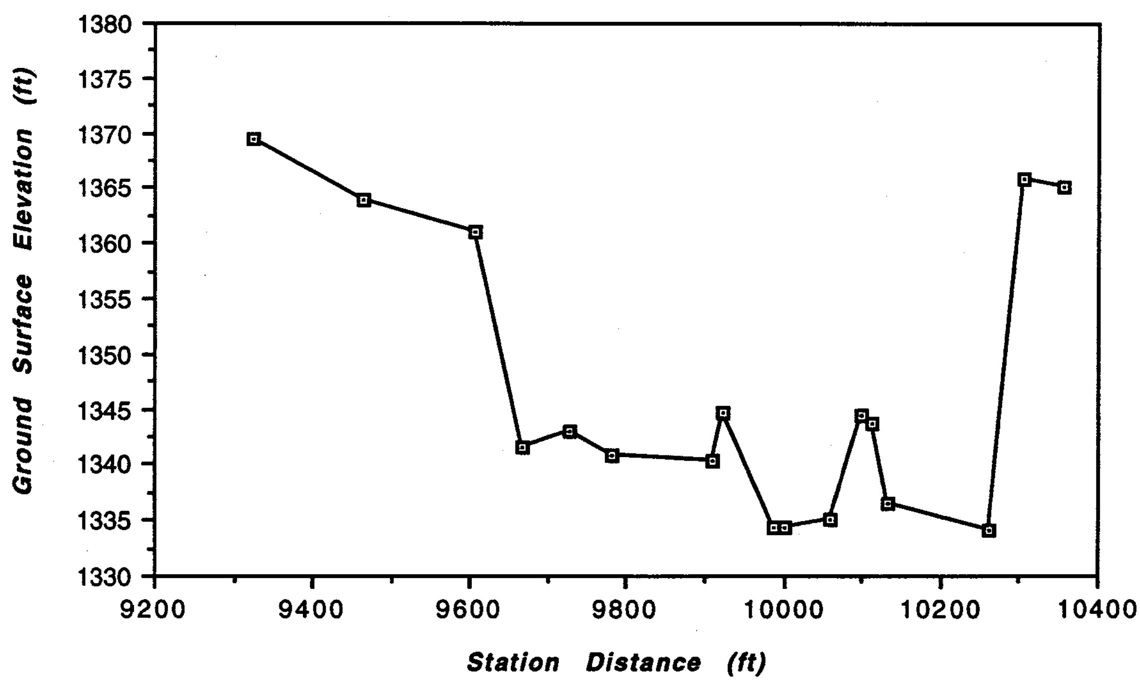

Fig. A-86 - Cross-section plot of Station No. 30.070

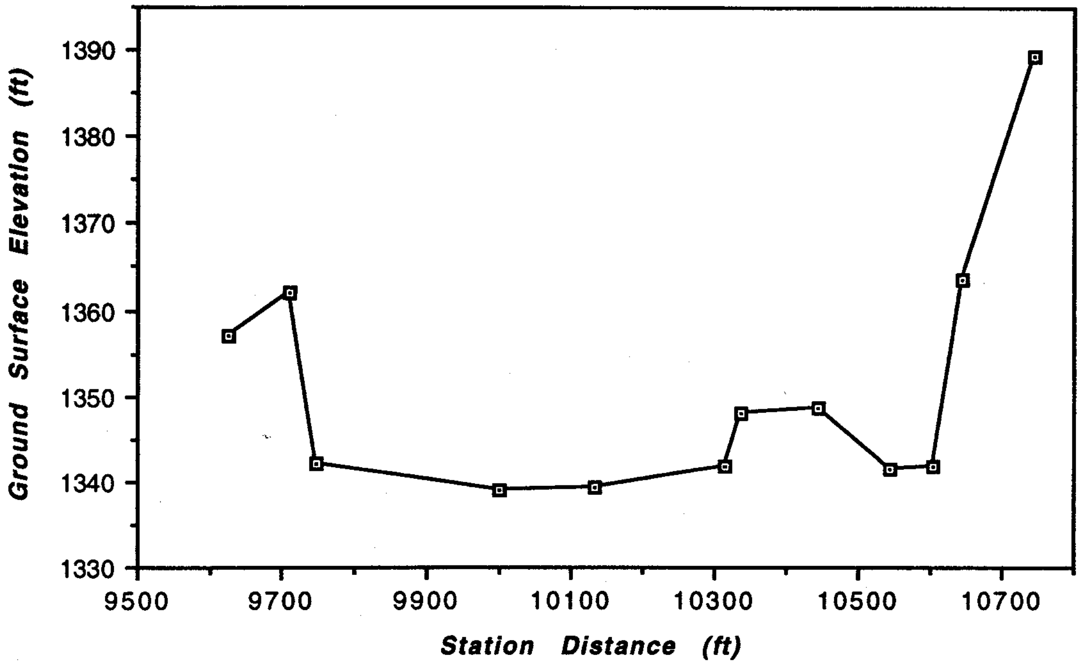

Fig. A-87 - Cross-section plot of Station No. 30.260

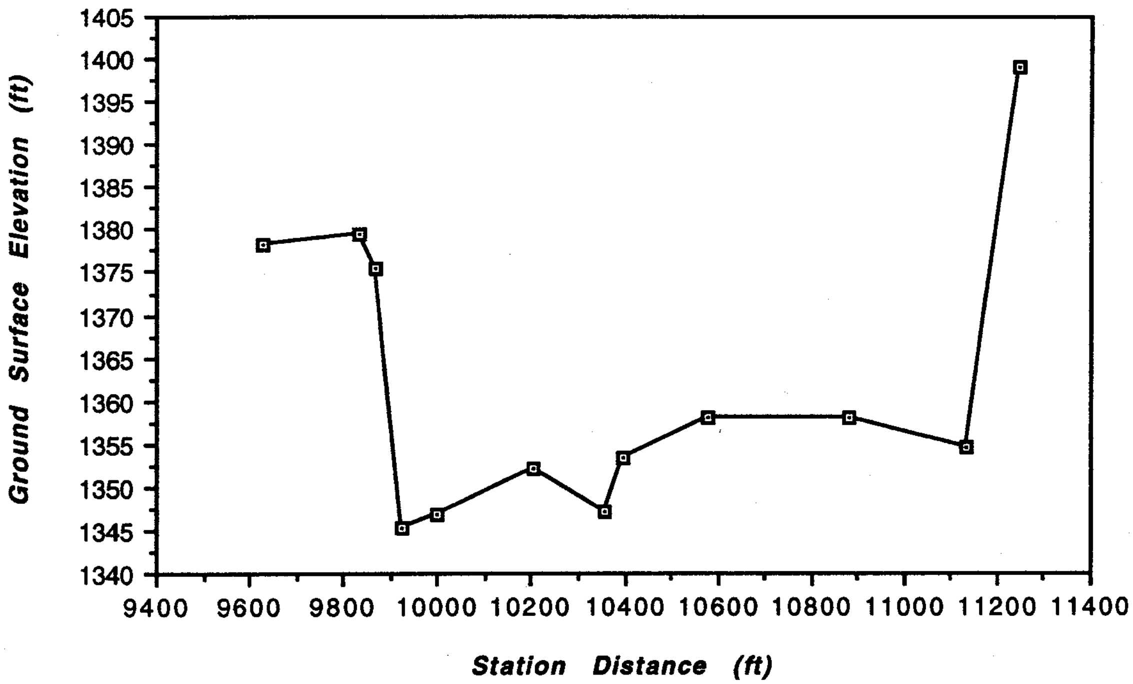

Fig. A-88 - Cross-section plot of Station No. 30.820

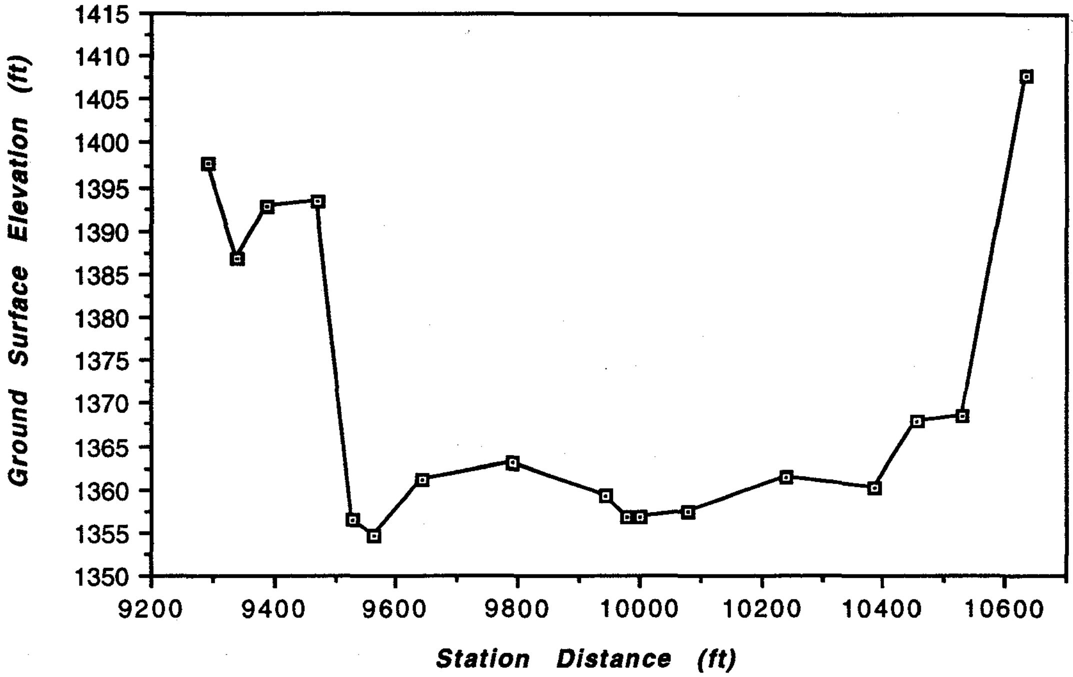

Fig. A-89 - Cross-section plot of Station No. 31.390

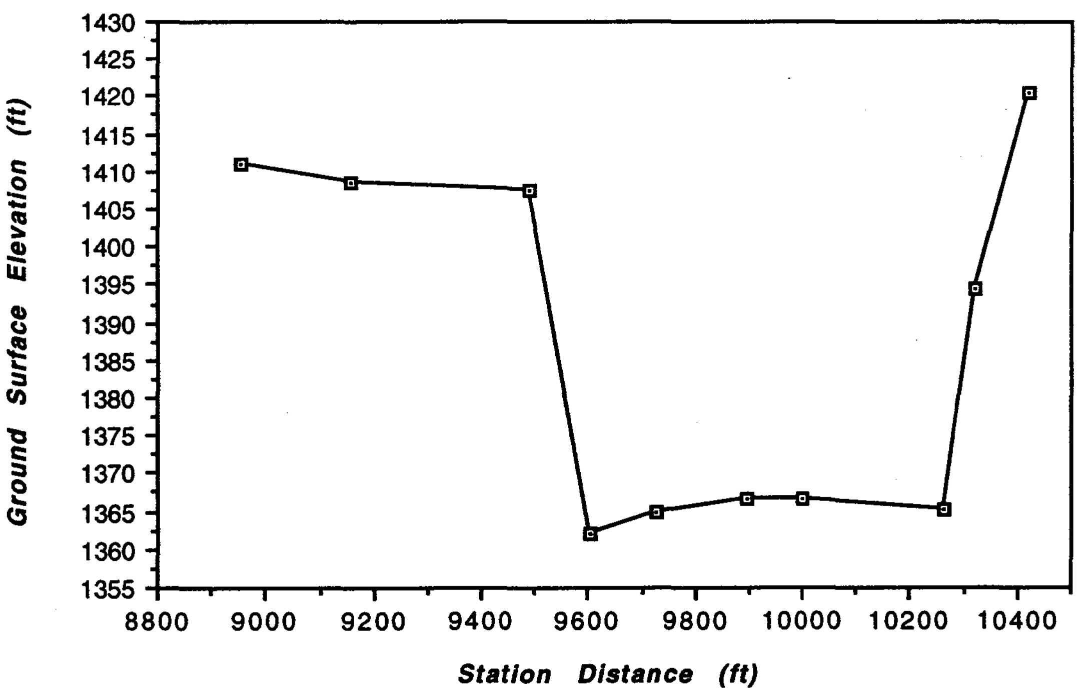

Fig. A-90 - Cross-section plot of Station No. 31.860

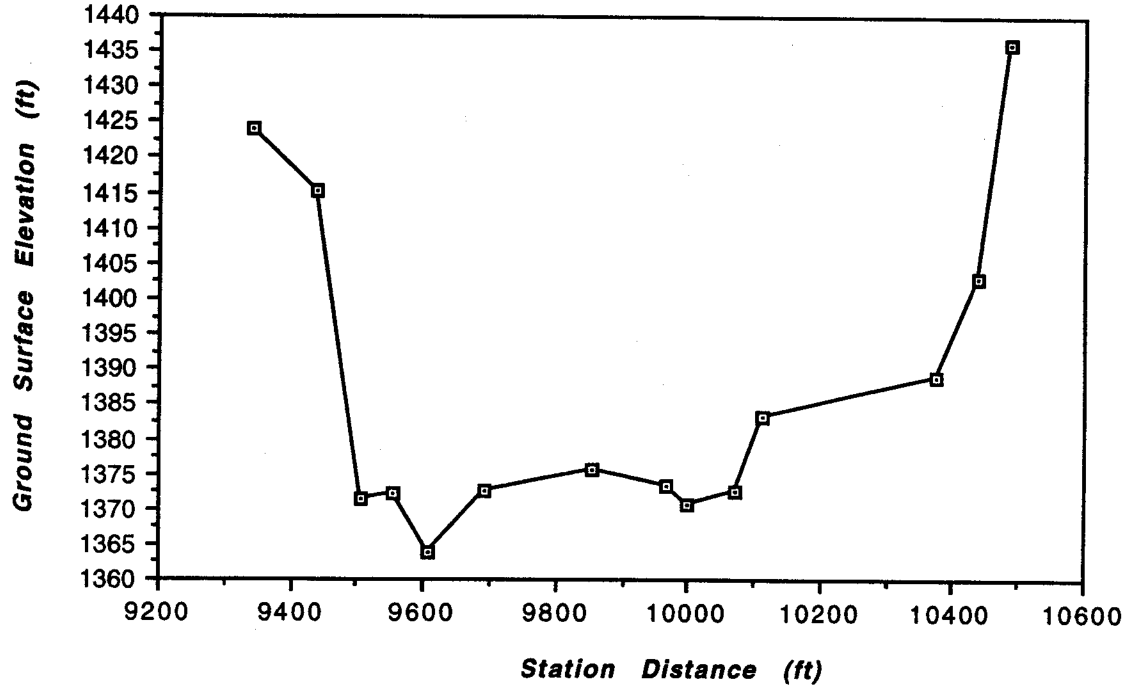

Fig. A-91 - Cross-section plot of Station No. 32.430

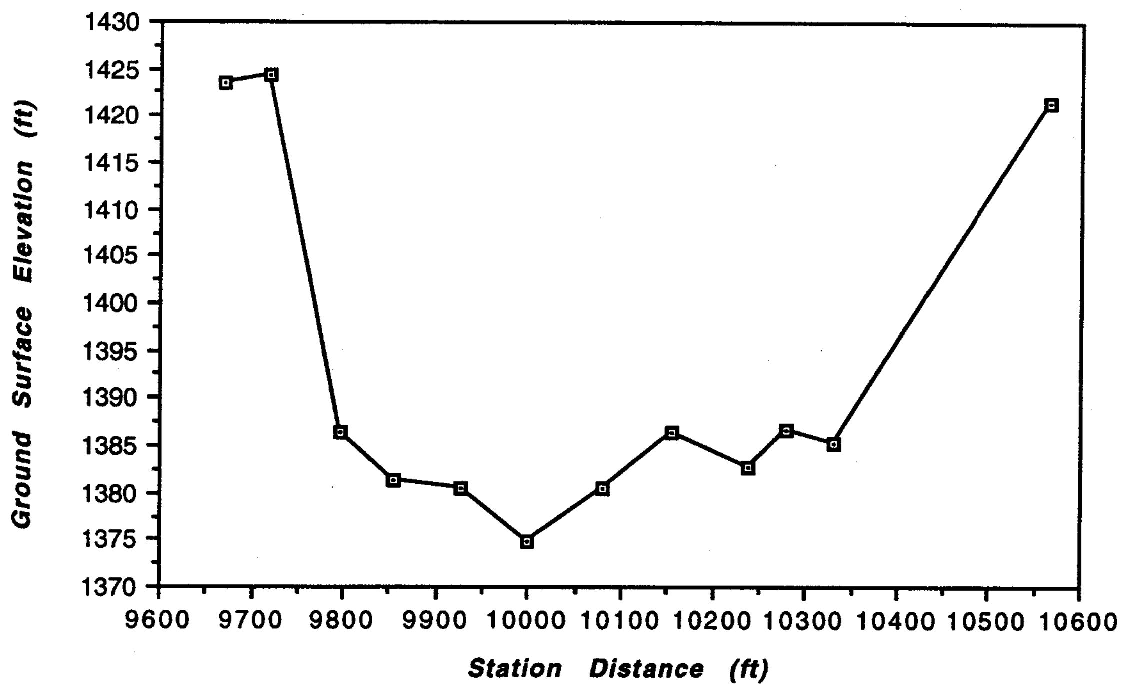

Fig. A-90 - Cross-section plot of Station No. 32.860

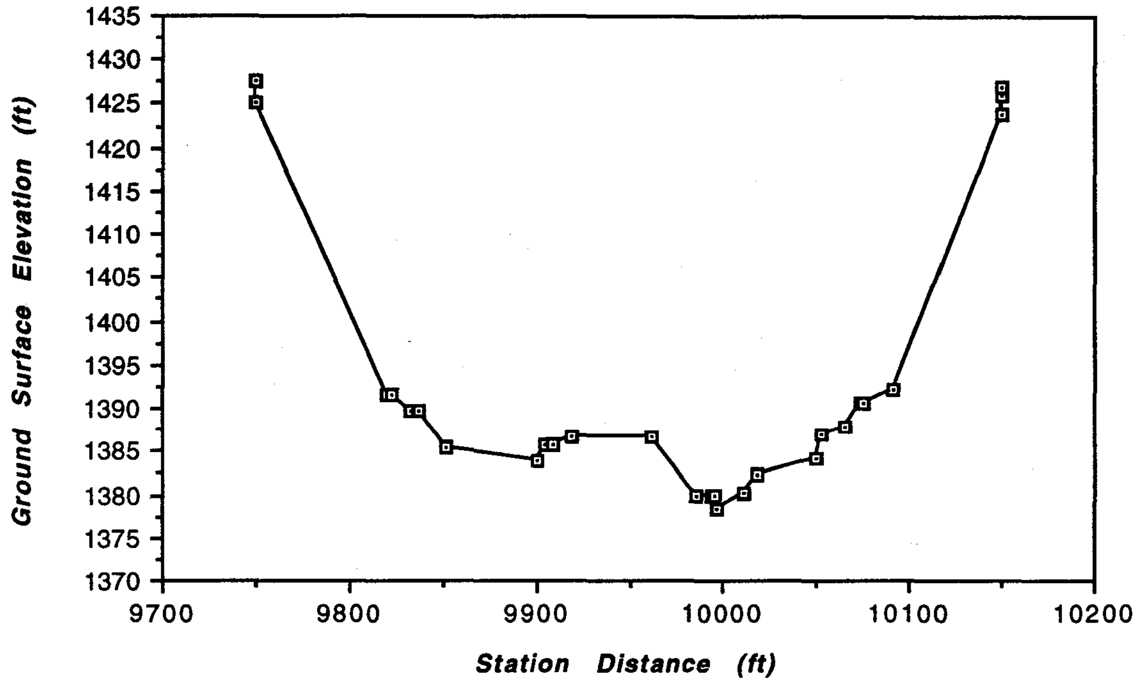

Fig. A-93 - Cross-section plot of Station No. 32.984

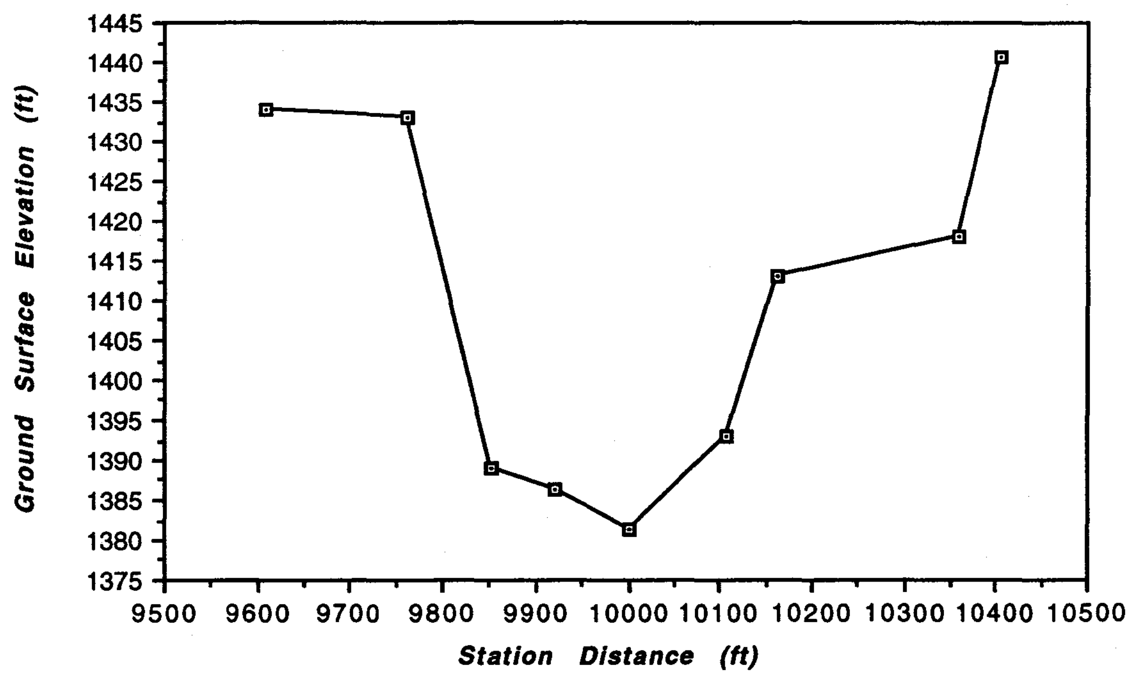

Fig. A-94 - Cross-section plot of Station No. 32.998

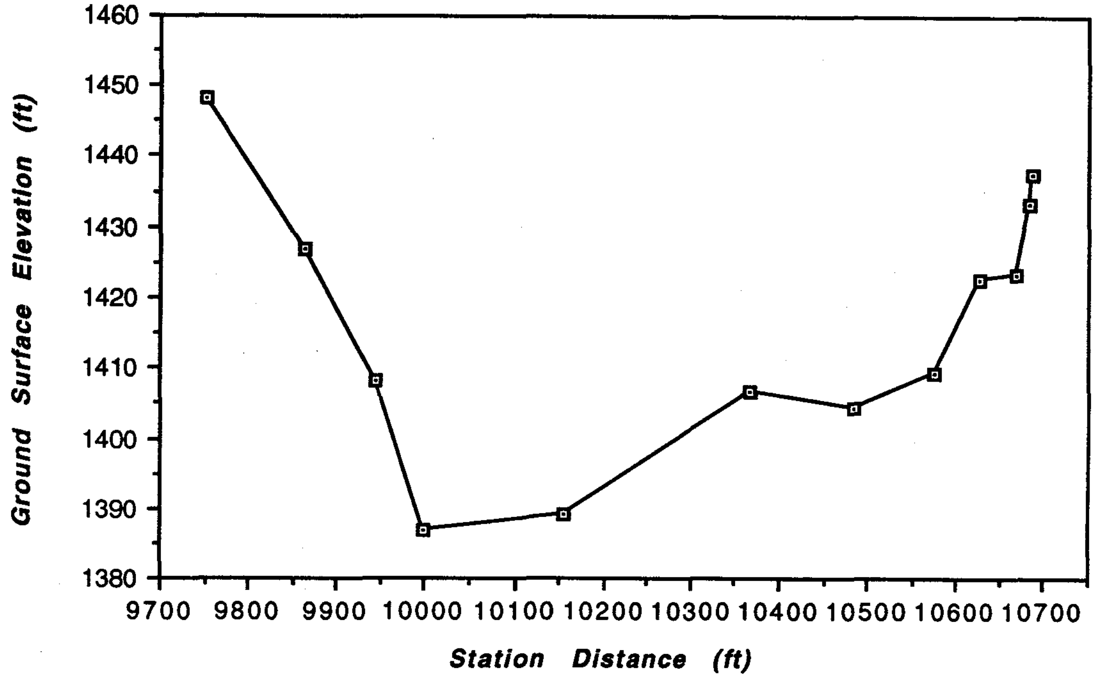

Fig. A-95 - Cross-section plot of Station No. 33.410

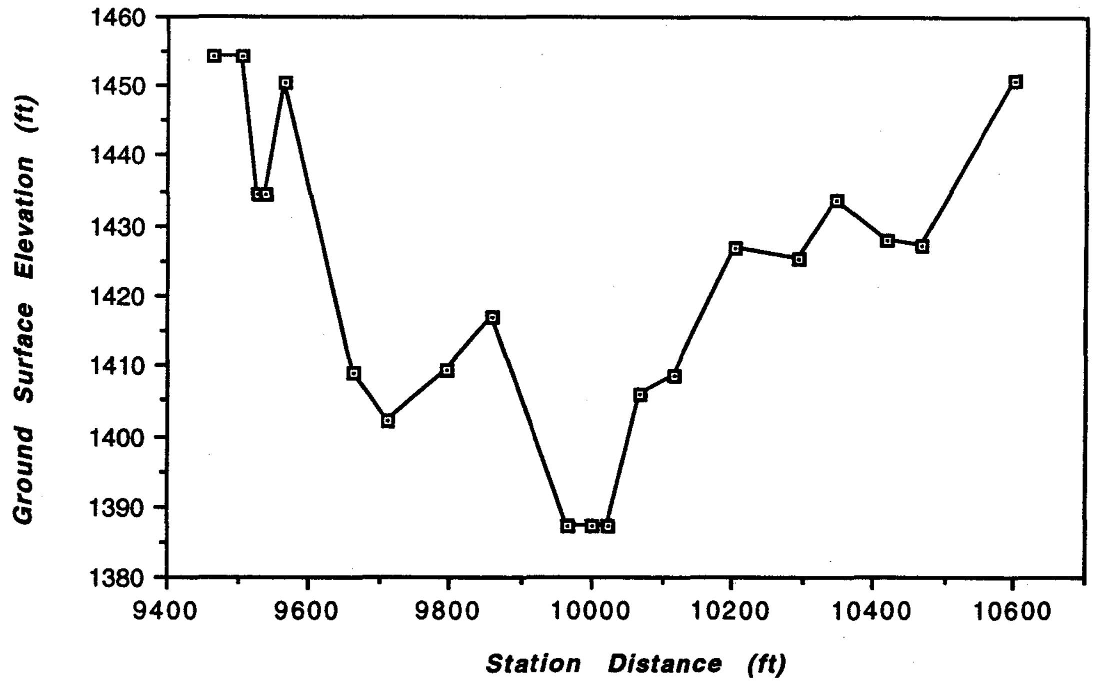

Fig. A-96 - Cross-section plot of Station No. 33.820

APPENDIX B - Sediment Data

B.1 - Sediment Information for the Agua Fria River

Table B-1 - Sediment information for the Agua Fria River

No.	Mile No.	Date Collected	Depth/Other Descriptions	Source/Reference
(1)	0.0947	02-25-83	4"to 6"	SLA (1983)
		03-02-83	12" to 15"	SLA (1983)
	0.0947*		4" to 15"	ASU (1992)
(2)	0.92	02-22-92	0 to 3'	ASU (1992)
(3)	1.33	02-22-92	0 to 3'	ASU (1992)
(4)	1.71	02-22-92	0 to 3'	ASU (1992)
(5)	2.60	02-22-92	0 to 3'	ASU (1992)
(6)	3.27	02-22-92	0 to 3'	ASU (1992)
(7)	3.851	04-11-83	2'	SLA (1983)
	3.851	04-08-83	3' to 10'	SLA (1983)
	3.851	04-09-83	11'	SLA (1983)
	3.851*		2' to 11'	ASU (1992)
(8)	3.946	03-02-83	12" to 15"	SLA (1983)
	3.946*			ASU (1992)
(9)	4.30	03-22-92	0 to 3'	ASU (1992)
(10)	4.754/4.759		9.5' to 11' (2 samples)	SHB (1984)
			14.5' to 16'	SHB (1984)
			24.5' to 26'	SHB (1984)
			39' to 49'	SHB (1984)
	4.757*		9.5' to 49'	ASU (1992)
(11)	5.29	02-22-92	0 to 3'	ASU (1992)
(12)	5.69		44' to 35'	SHB (1982)
(13)	5.75		19.5' to 21'	SHB (1982)
(14)	5.878	04-09-83	2' to 7'	SLA (1983)
(15)	6.43	02-08-92	0 to 3'	ASU (1992)
(16)	6.97/6.99	04-11-83	0 to 10"	SLA (1983)
	6.97/6.99	04-12-83	6'	SLA (1983)
	6.97/6.99	04-11-83	8'	SLA (1983)
	6.98*		0 to 8'	ASU (1992)
(17)	7.49	02-08-92	0 to 3'	ASU (1992)
(18)	7.96/8.01		0 to 18'	SHB (1980)
			14' to 20'	SHB (1980)
			19 1/2' to 21	SHB (1980)
	8.00*		0 to 21'	ASU (1992)
(19)	8.34		2' to 4'	SHB (1991)
			14' to16'	SHB (1991)
			34' to 36'	SHB (1991)
	8.34*		2' to 36'	ASU (1992)
(20)	8.54		3' to 5'	SHB (1991)
			13' to 15'	SHB (1991)
			14' to 16'	SHB (1991)
			24' to 26'	SHB (1991)
			30' to 32'	SHB (1991)
	8.54*		3' to 32'	ASU (1992)
(21)	8.64	02-08-92	0 to 3'	ASU (1992)
(22)	8.73		2' to 4' (2 locations)	SHB (1991)
			12' to 14'	SHB (1991)
			14' to 16'	SHB (1991)
			18' to 20'	SHB (1991)
	8.73*		2' to 20'	ASU (1992)

Table B-1 - Sediment information for the Agua Fria River (continued...)

No.	Mile No.	Date Collected	Depth/Other Descriptions	Source/Reference
(23)	8.83		2' to 4'	SHB (1991)
			23' to 25'	SHB (1991)
	8.83*		2' to 25'	ASU (1992)
(24)	8.93		3' to 5'	SHB (1991)
			34' to 36'	SHB (1991)
	8.93*		3' to 36'	ASU (1992)
(25)	9.02		12' to 14'	SHB (1991)
			28' to 30'	SHB (1991)
	9.02*		12' to 30'	ASU (1992)
(26)	9.13/9.135	07-17-91	1' to 2'	ABC (1991)
	9.13*			ASU (1992)
(27)	9.25		3' to 5'	SHB (1991)
			18' to 20'	SHB (1991)
	9.25*		3' to 20'	ASU (1992)
(28)	9.47	02-28-83	12" to 15"	SLA (1983)
	9.47*		12" to 15"	ASU (1992)
(29)	9.625	04-09-83	3'	SLA (1983)
	9.625*			ASU (1992)
(30)	10.34	04-19-83	0 to 3'	SLA (1983)
	10.34	04-19-83	0 to 5'	SLA (1983)
	10.34*		0 to 5'	ASU (1992)
(31)	10.72	02-08-92	0 to 3'	ASU (1992)
(32)	11.34	02-08-92	0 to 3'	ASU (1992)
(33)	11.80	02-08-92	0 to 3'	ASU (1992)
(34)	12.38	02-08-92	0 to 3'	ASU (1992)
(35)	12.84	02-08-92	0 to 3'	ASU (1992)
(36)	13.31/13.33		14.5' to 16.0'	SHB (1984)
			26' to 27.5'	SHB (1984)
			29' to 39'	SHB (1984)
			30' to 35'	SHB (1984)
	13.32*		14.5' to 39'	ASU (1992)
(37)	13.90	01-18-92	0 to 3'	ASU (1992)
(38)	14.38	01-18-92	0 to 3"	ASU (1992)
(39)	14.94	01-18-92	0 to 3'	ASU (1992)
(40)	15.98	01-18-92	0 to 3'	ASU (1992)
(41)	16.46	02-08-92	0 to 3'	ASU (1992)
(42)	17.09	02-08-92	0 to 3'	ASU (1992)
(43)	17.76	01-18-92	0 to 3'	ASU (1992)
(44)	18.42	01-18-92	0 to 3'	ASU (1992)
(45)	18.90/18.94	11-00-76	5' to 21'	SHB (1980)
	18.92*			ASU (1992)
(46)	19.44	01-18-92	0 to 3'	ASU (1992)
(47)	19.89	01-18-92	0 to 3'	ASU (1992)
(48)	20.45	01-20-92	0 to 3'	ASU (1992)
(49)	20.83	01-20-92	0 to 3'	ASU (1992)
(50)	21.68	06-08-91	0" to 15" (5 Samples)	Ryan (1991)
	21.68*			ASU (1992)
(51)	21.76	06-08-91	0" to 15" (5 Samples)	Ryan (1991)
	21.76*			ASU (1992)

Table B-1 - Sediment information for the Agua Fria River (continued...)

No.	Mile No.	Date Collected	Depth/Other Descriptions	Source/Reference
(52)	22.32	01-20-92	0 to 3'	ASU (1992)
(53)	22.79	01-20-92	0 to 3'	ASU (1992)
(54)	23.35	01-25-92	0 to 3'	ASU (1992)
(55)	23.89	01-25-92	0 to 3'	ASU (1992)
(56)	24.35	01-25-92	0 to 3'	ASU (1992)
(57)	24.90	01-25-92	0 to 3'	ASU (1992)
(58)	25.37	01-25-92	0 to 3'	ASU (1992)
(59)	25.86	01-25-92	0 to 3'	ASU (1992)
(60)	26.29	01-25-92	0 to 1 1/2'	ASU (1992)
(61)	26.55	01-25-92	0 to 3'	ASU (1992)
(62)	26.73	01-25-92	0 to 3'	ASU (1992)
(63)	27.30	01-25-92	0 to 3'	ASU (1992)
(64)	27.58	01-25-92	0 to 3'	ASU (1992)
(65)	27.68	02-01-92	0 to 3'	ASU (1992)
(66)	28.12	05-30-86	0' to 6"	UM (1986)
	28.12	05-30-86	6' to 12'	UM (1986)
	28.12	05-30-86	12' to 15'	UM (1986)
	28.12*		0' to 15'	ASU (1992)
(67)	28.21	02-01-92	0 to 3'	ASU (1992)
(68)	28.67	02-08-92	0 to 3'	ASU (1992)
(69)	29.04	02-22-92	0 to 3'	ASU (1992)
(70)	29.80	02-01-92	0 to 4"	ASU (1992)
(71)	30.26	02-01-92	0 to 3'	ASU (1992)
(72)	30.82	02-01-92	0 to 3'	ASU (1992)
(73)	31.29	02-01-92	0 to 3'	ASU (1992)
(74)	31.86	02-01-92	0 to 3'	ASU (1992)
(75)	32.43	02-01-92	0 to 3'	ASU (1992)
(76)	32.98	02-08-92	0 to 4"	ASU (1992)

B.2 Gradation Curves of Collected Sediment Samples

Table B-2-1 - Gradation data collected at Station 0.0947

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.334	0.00334
1	0.125	2.800	0.02466
2	0.250	15.640	0.12840
3	0.500	29.171	0.13531
4	1.000	54.743	0.25571
5	2.000	73.360	0.18617
6	4.000	77.411	0.04051
7	8.000	81.113	0.03702
8	16.000	84.706	0.03594
9	32.000	88.100	0.03394
10	64.000	88.100	0.00000

Note: * These values are used in the N record.

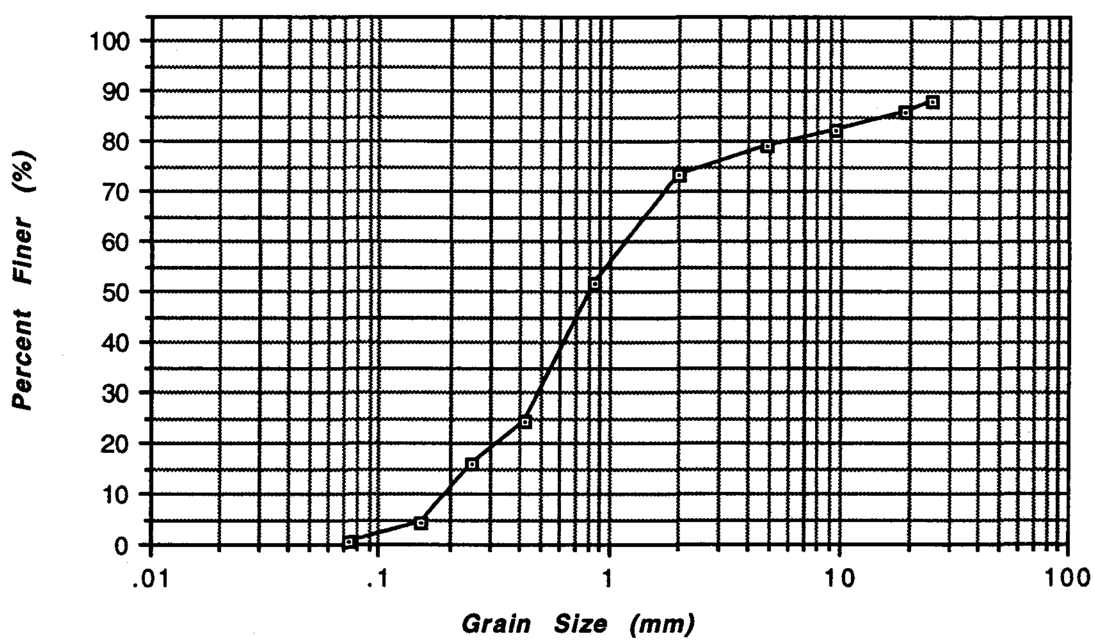

Fig. B-2-1 - Gradation Curve at Mile No. 0.0947

Table B-2-2 - Gradation data collected at Station 0.920

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.168	0.00168
1	0.125	0.787	0.00619
2	0.250	6.020	0.05233
3	0.500	32.531	0.26511
4	1.000	55.248	0.22718
5	2.000	80.830	0.25582
6	4.000	85.019	0.04189
7	8.000	91.464	0.06446
8	16.000	96.291	0.04827
9	32.000	99.291	0.03000
10	64.000	100.000	0.00709

Note: * These values are used in the N record.

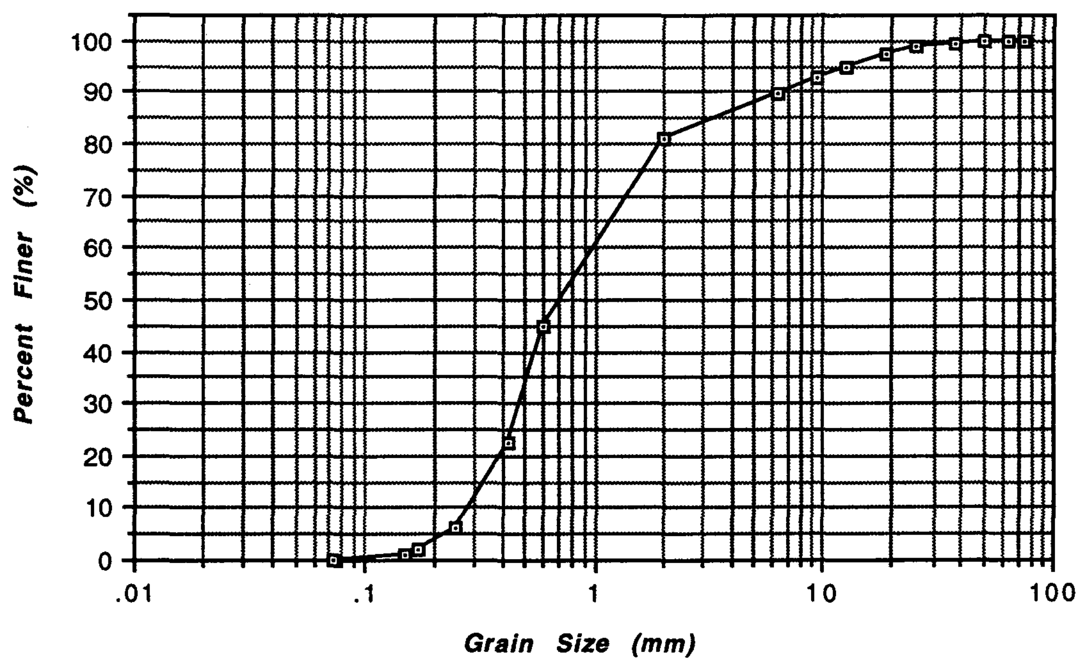

Fig. B-2-2 - Gradation Curve at Mile No. 0.920

Table B-2-3 - Gradation data collected at Station 1.330

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.068	0.00068
1	0.125	0.513	0.00445
2	0.250	5.320	0.04807
3	0.500	26.409	0.21089
4	1.000	46.376	0.19967
5	2.000	71.780	0.25404
6	4.000	79.205	0.07425
7	8.000	87.822	0.08617
8	16.000	95.534	0.07712
9	32.000	99.428	0.03894
10	64.000	100.000	0.00572

Note: * These values are used in the N record.

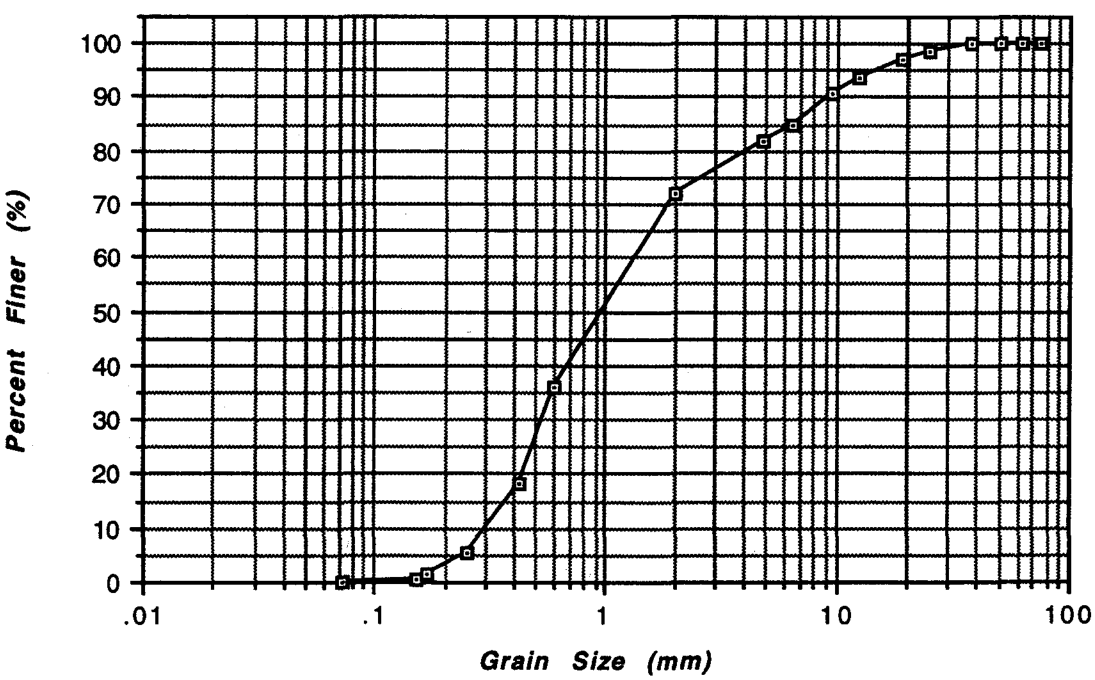

Fig. B-2-3 - Gradation Curve at Mile No. 1.330

Table B-2-4 - Gradation data collected at Station 1.710

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.500	0.00500
1	0.125	1.200	0.00700
2	0.250	5.740	0.04540
3	0.500	20.535	0.14795
4	1.000	32.468	0.11933
5	2.000	47.830	0.15362
6	4.000	54.979	0.07149
7	8.000	67.596	0.12617
8	16.000	75.727	0.08131
9	32.000	84.279	0.08552
10	64.000	100.000	0.15721

Note: * These values are used in the N record.

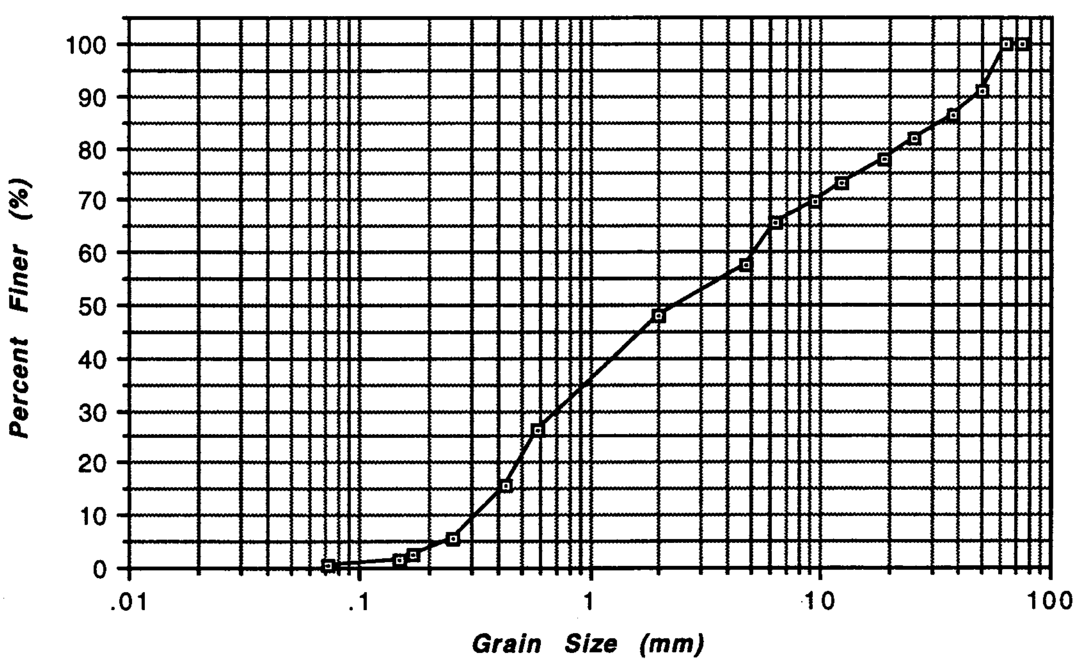

Fig. B-2-4 - Gradation Curve at Mile No. 1.710

Table B-2-5 - Gradation data collected at Station 2.600

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.284	0.00284
1	0.125	1.853	0.01569
2	0.250	13.930	0.12077
3	0.500	52.408	0.38478
4	1.000	73.934	0.21525
5	2.000	90.820	0.16887
6	4.000	93.453	0.02633
7	8.000	95.856	0.02404
8	16.000	97.641	0.01785
9	32.000	99.604	0.01963
10	64.000	100.000	0.00396

Note: * These values are used in the N record.

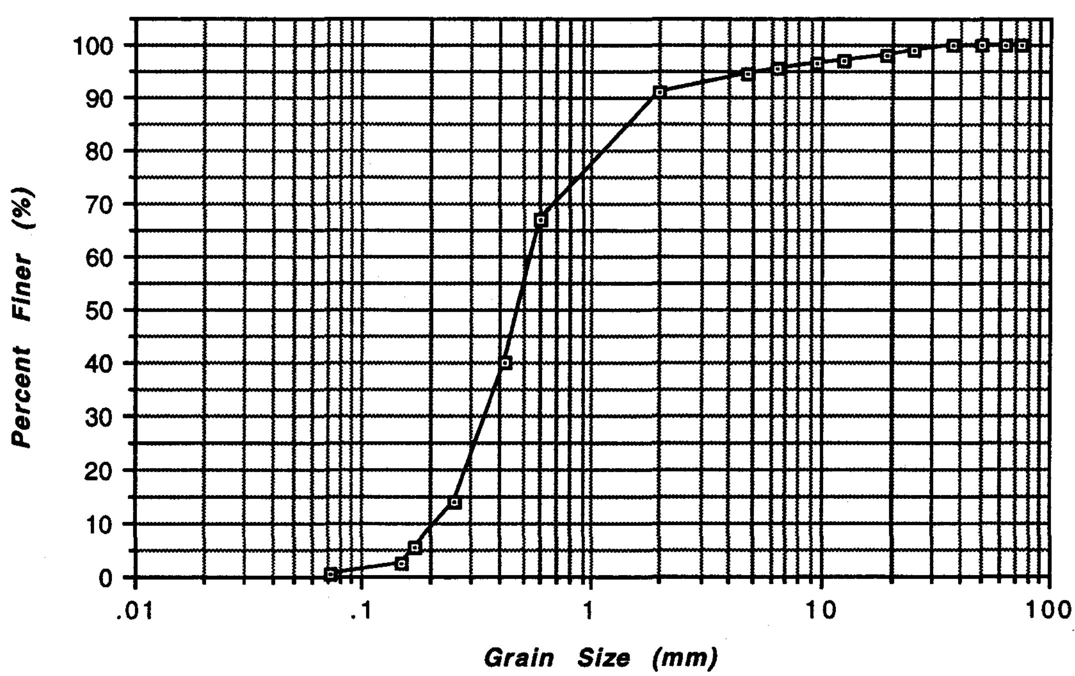

Fig. B-2-5 - Gradation Curve at Mile No. 2.600

Table B-2-6 - Gradation data collected at Station 3.270

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.891	0.00891
1	0.125	2.237	0.01346
2	0.250	10.040	0.07803
3	0.500	41.366	0.31326
4	1.000	57.766	0.16400
5	2.000	72.340	0.14575
6	4.000	76.173	0.03833
7	8.000	90.218	0.14045
8	16.000	92.339	0.02120
9	32.000	95.071	0.02528
10	64.000	97.598	0.02528

Note: * These values are used in the N record.

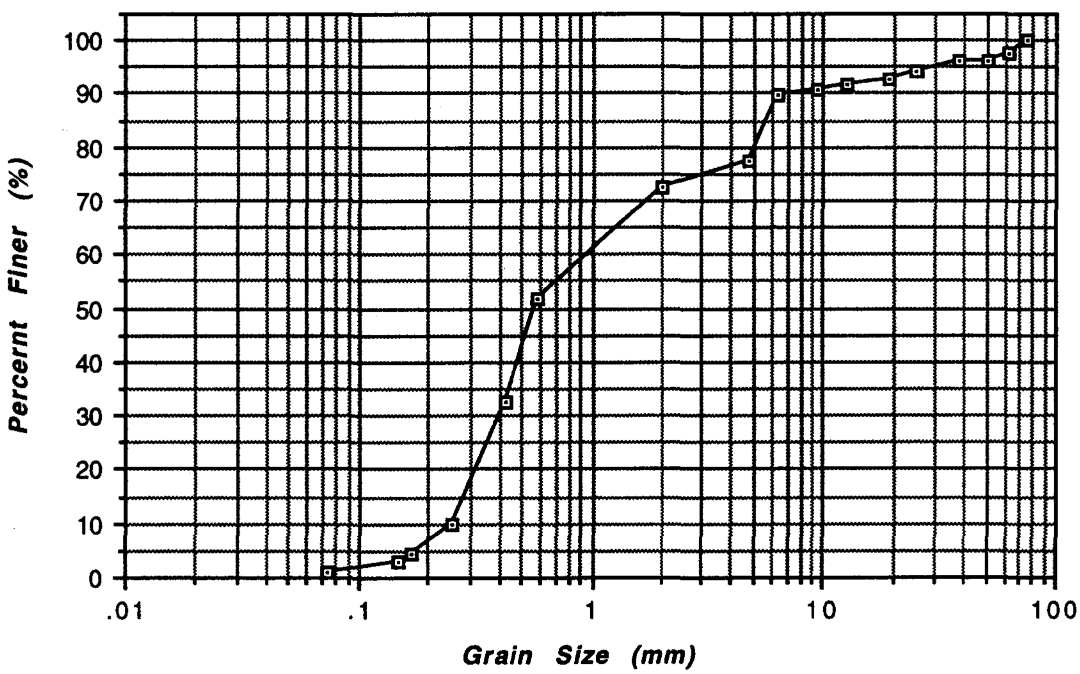

Fig. B-2-6 - Gradation Curve at Mile No. 3.270

Table B-2-7 - Gradation data collected at Station 3.851

No.	*Sediment Size Range (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	3.509	0.03509
1	0.125	6.960	0.03451
2	0.250	28.670	0.21710
3	0.500	50.658	0.21988
4	1.000	71.678	0.21020
5	2.000	84.330	0.12652
6	4.000	87.726	0.03396
7	8.000	90.670	0.02943
8	16.000	92.583	0.01913
9	32.000	96.459	0.03876
10	64.000	97.560	0.01101

Note: * These values are used in the N record.

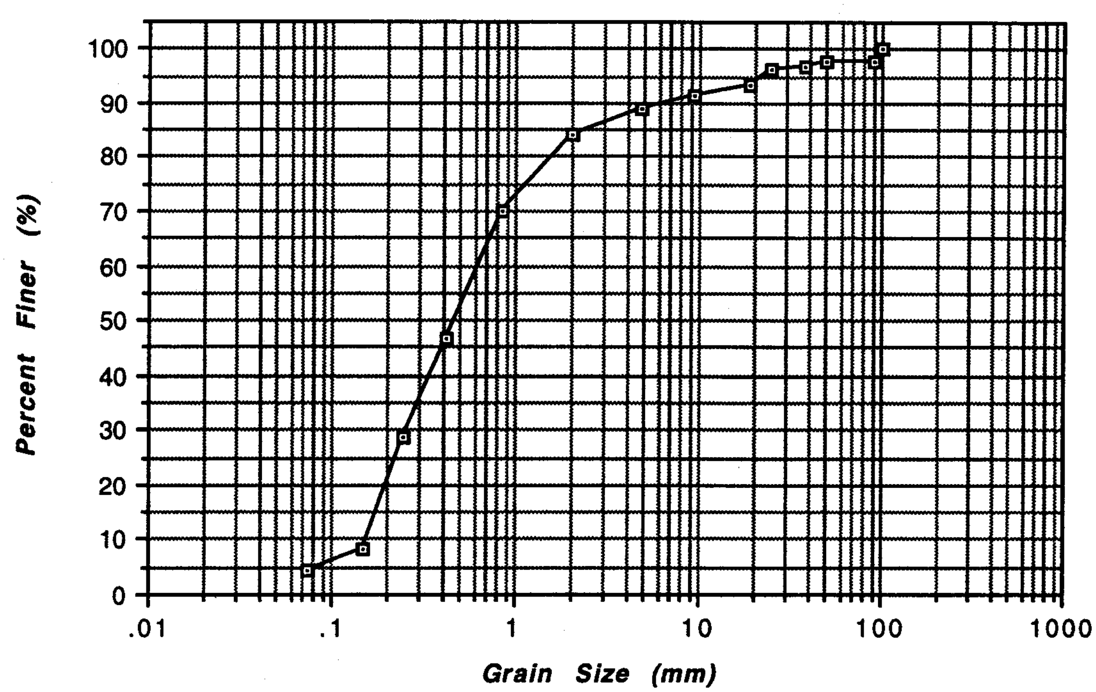

Fig. B-2-7 - Gradation Curve at Mile No. 3.851

Table B-2-8 - Gradation data collected at Station 3.946

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.010	0.00010
1	0.125	0.337	0.00327
2	0.250	6.250	0.05913
3	0.500	15.235	0.08985
4	1.000	38.391	0.23156
5	2.000	61.000	0.22609
6	4.000	70.454	0.09454
7	8.000	79.474	0.09019
8	16.000	90.211	0.10737
9	32.000	94.780	0.04570
10	64.000	95.000	0.00220

Note: * These values are used in the N record.

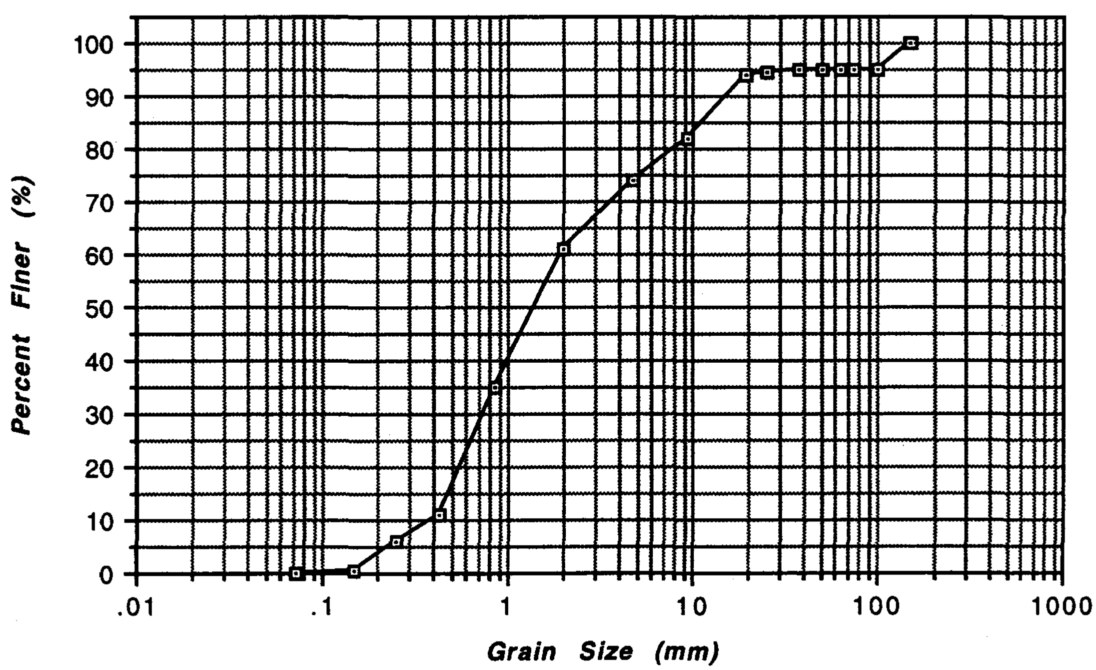

Fig. B-2-8 - Gradation Curve at Mile No. 3.946

Table B-2-9 - Gradation data collected at Station 4.300

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.581	0.01581
1	0.125	3.053	0.01473
2	0.250	9.220	0.06167
3	0.500	25.762	0.16542
4	1.000	36.406	0.10644
5	2.000	48.370	0.11964
6	4.000	53.803	0.05433
7	8.000	77.092	0.23290
8	16.000	84.201	0.07108
9	32.000	91.903	0.07702
10	64.000	100.000	0.08097

Note: * These values are used in the N record.

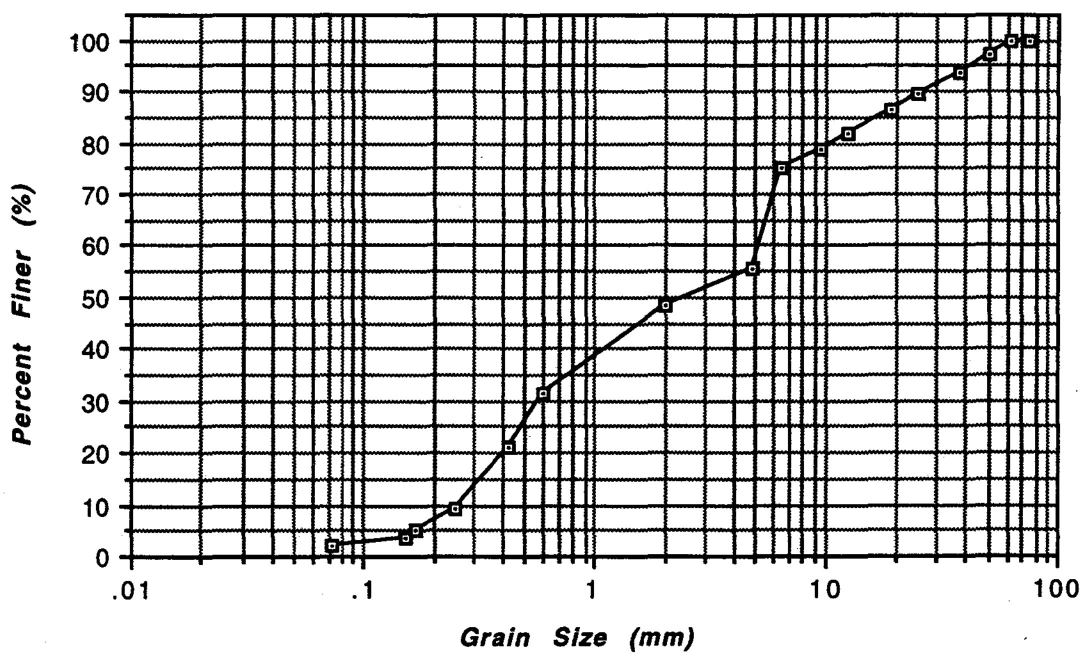

Fig. B-2-9 - Gradation Curve at Mile No. 4.300

Table B-2-10 - Gradation data collected at Station 4.757

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	7.930	0.07930
1	0.125	11.307	0.03377
2	0.250	15.877	0.04570
3	0.500	26.210	0.10333
4	1.000	35.325	0.09115
5	2.000	49.940	0.14615
6	4.000	56.551	0.06611
7	8.000	68.117	0.11566
8	16.000	81.960	0.13843
9	32.000	93.073	0.11113
10	64.000	100.000	0.06927

Note: * These values are used in the N record.

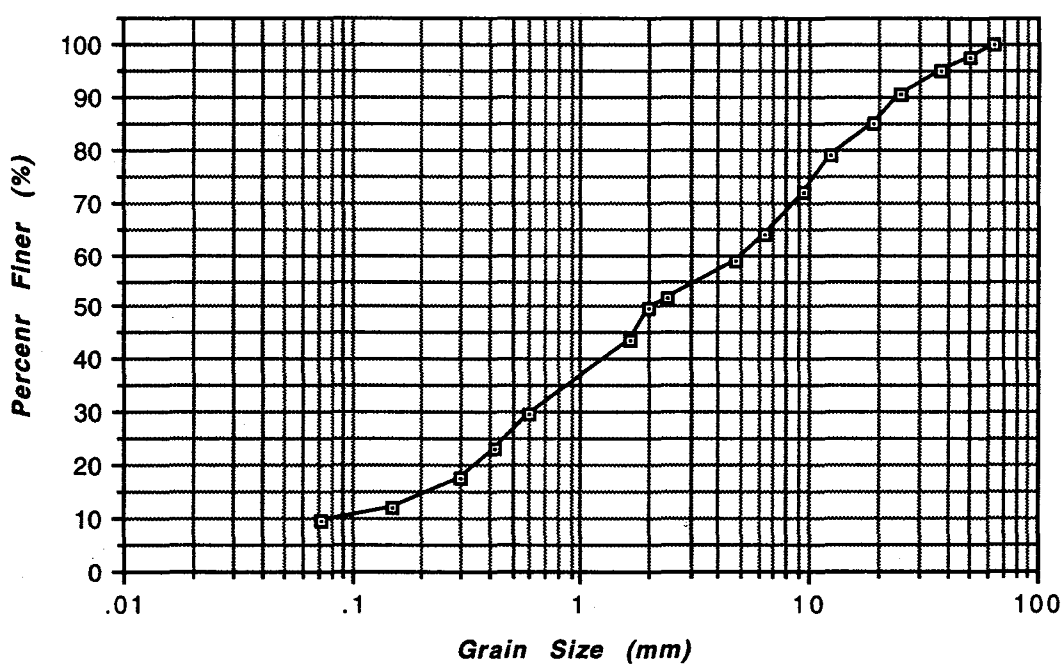

Fig. B-2-10 - Gradation Curve at Mile No. 4.757

Table B-2-11 - Gradation data collected at Station 5.290

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.750	0.00750
1	0.125	1.400	0.00650
2	0.250	9.450	0.08050
3	0.500	42.086	0.32636
4	1.000	62.245	0.20159
5	2.000	82.770	0.20525
6	4.000	86.414	0.03644
7	8.000	90.473	0.04059
8	16.000	94.260	0.03787
9	32.000	97.554	0.03294
10	64.000	100.000	0.02446

Note: * These values are used in the N record.

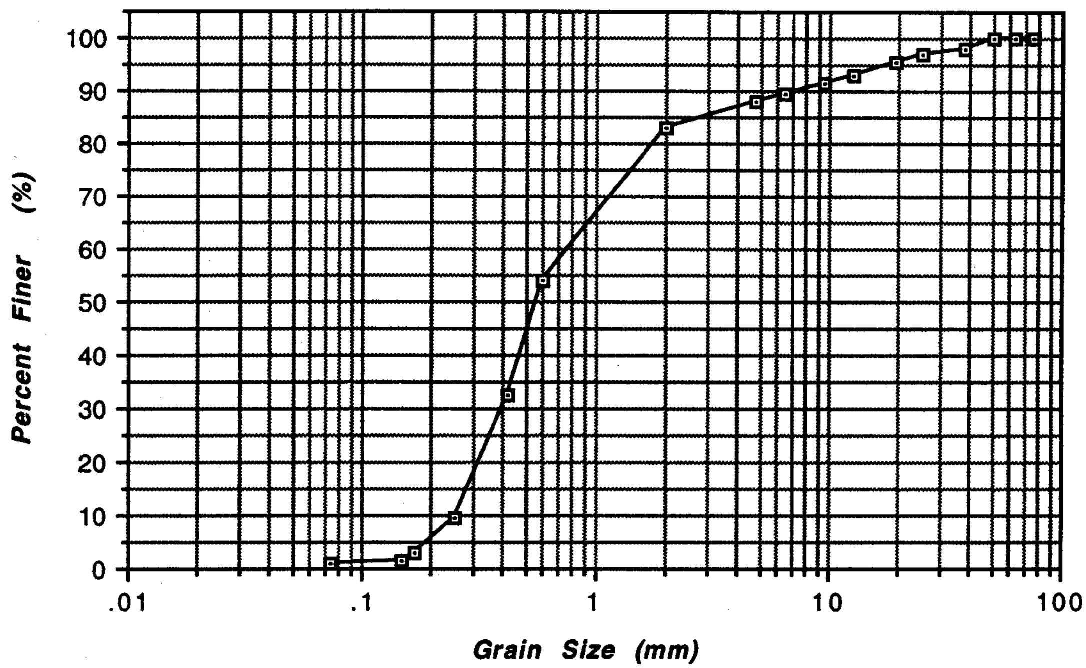

Fig. B-2-11- Gradation Curve at Mile No. 5.290

Table B-2-12- Gradation data collected at Station 5.690

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	29.090	0.29090
1	0.125	38.333	0.09244
2	0.250	48.727	0.10394
3	0.500	65.111	0.16384
4	1.000	72.519	0.07407
5	2.000	85.000	0.12482
6	4.000	88.636	0.03636
7	8.000	92.048	0.03411
8	16.000	97.790	0.05742
9	32.000	100.000	0.02211
10	64.000	100.000	0.0000

Note: * These values are used in the N record.

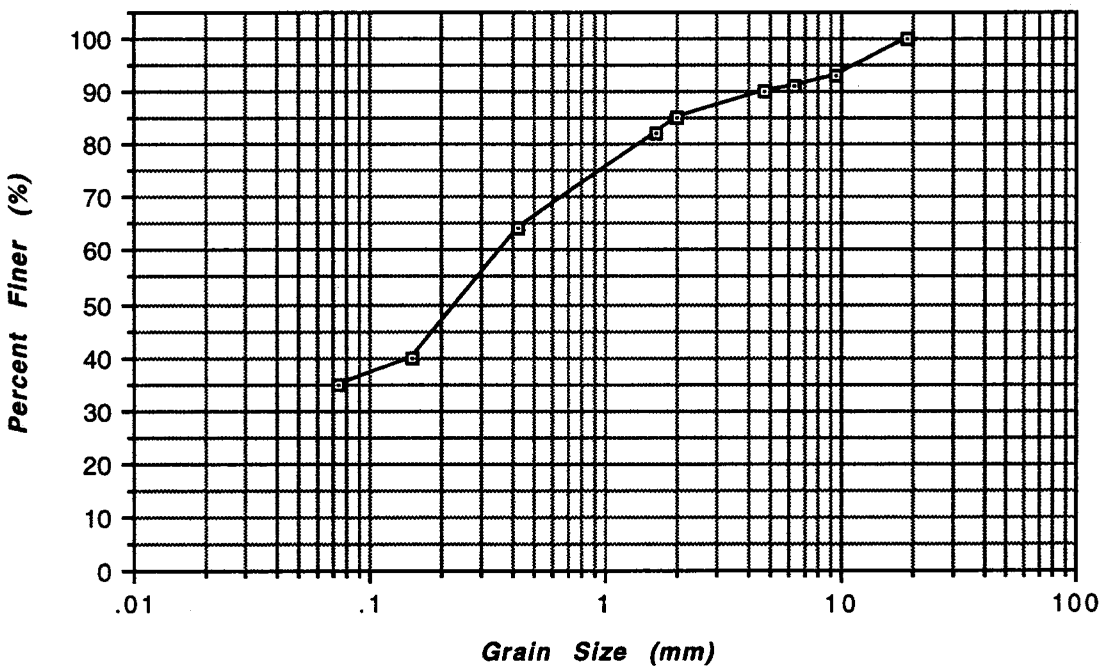

Fig. B-2-12 - Gradation Curve at Mile No. 5.690

Table B-2-13 - Gradation data collected at Station 5.750

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	5.819	0.05819
1	0.125	8.333	0.02514
2	0.250	10.454	0.02121
3	0.500	13.864	0.03410
4	1.000	19.626	0.05761
5	2.000	33.000	0.13374
6	4.000	43.182	0.10182
7	8.000	57.191	0.14009
8	16.000	69.211	0.12020
9	32.000	90.320	0.21110
10	64.000	100.000	0.09680

Note: * These values are used in the N record.

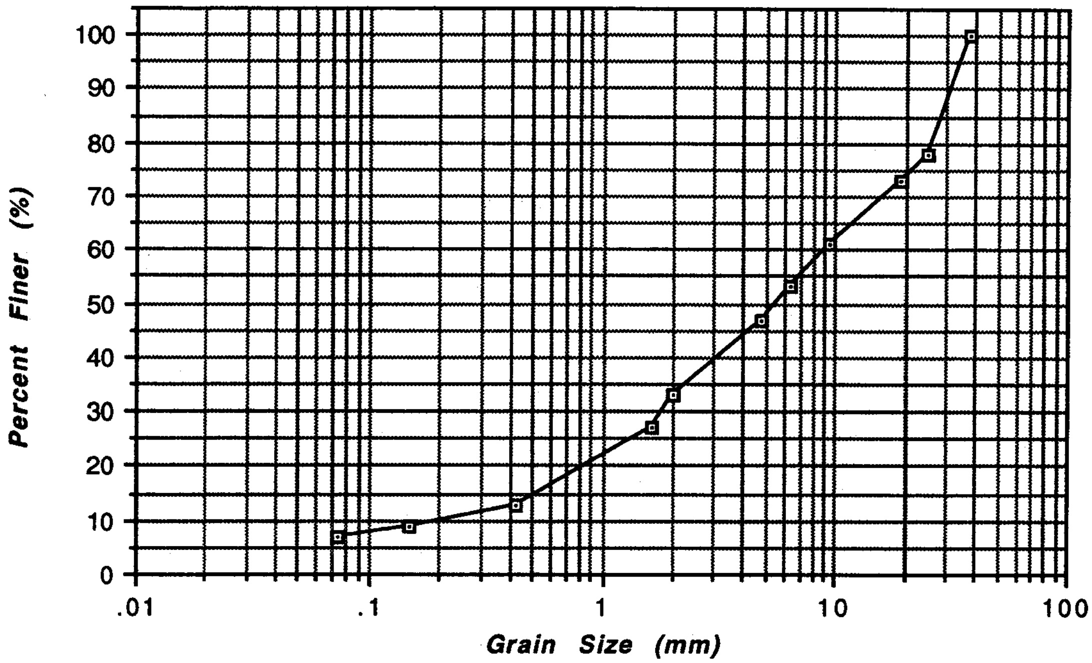

Fig. B-2-13 - Gradation Curve at Mile No. 5.750

Table B-2-14 - Gradation data collected at Station 5.878

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.833	0.00833
1	0.125	1.000	0.00167
2	0.250	8.000	0.07000
3	0.500	19.471	0.11471
4	1.000	48.522	0.29051
5	2.000	72.000	0.23478
6	4.000	79.273	0.07273
7	8.000	88.842	0.09569
8	16.000	96.105	0.07263
9	32.000	100.000	0.03895
10	64.000	100.000	0.00000

Note: * These values are used in the N record.

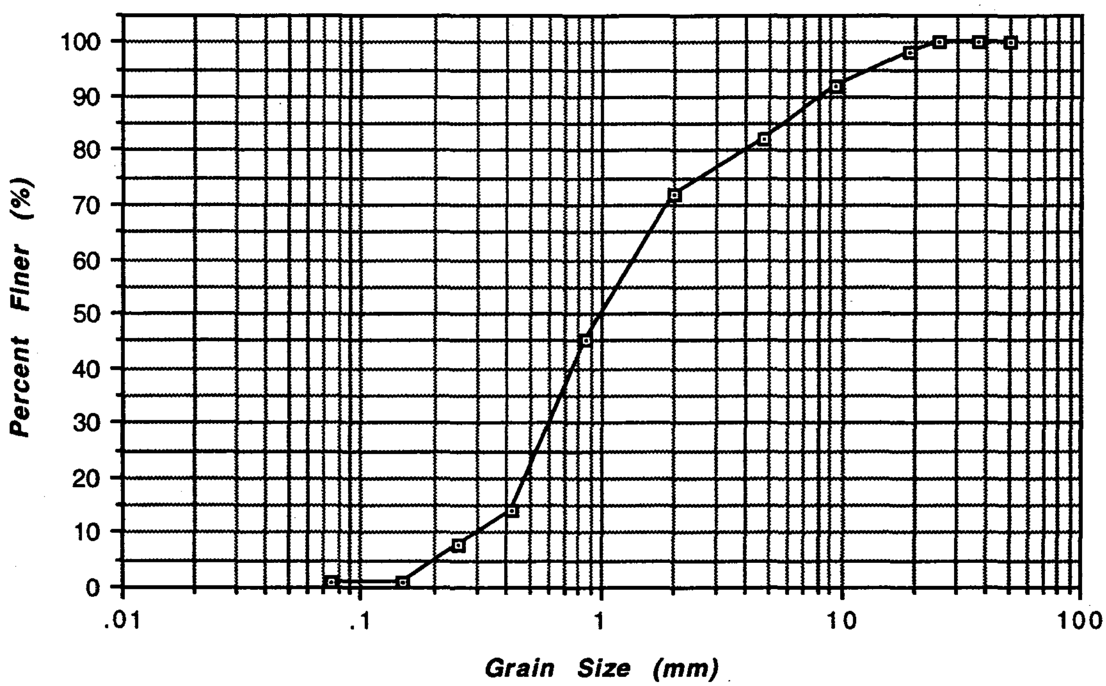

Fig. B-2-14 - Gradation Curve at Mile No. 5.878

Table B-2-15 - Gradation data collected at Station 6.430

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.248	0.01248
1	0.125	3.313	0.02065
2	0.250	12.540	0.09227
3	0.500	37.286	0.24746
4	1.000	52.284	0.14997
5	2.000	70.610	0.18326
6	4.000	78.763	0.08153
7	8.000	84.249	0.05486
8	16.000	90.534	0.06285
9	32.000	96.391	0.05857
10	64.000	100.000	0.03609

Note: * These values are used in the N record.

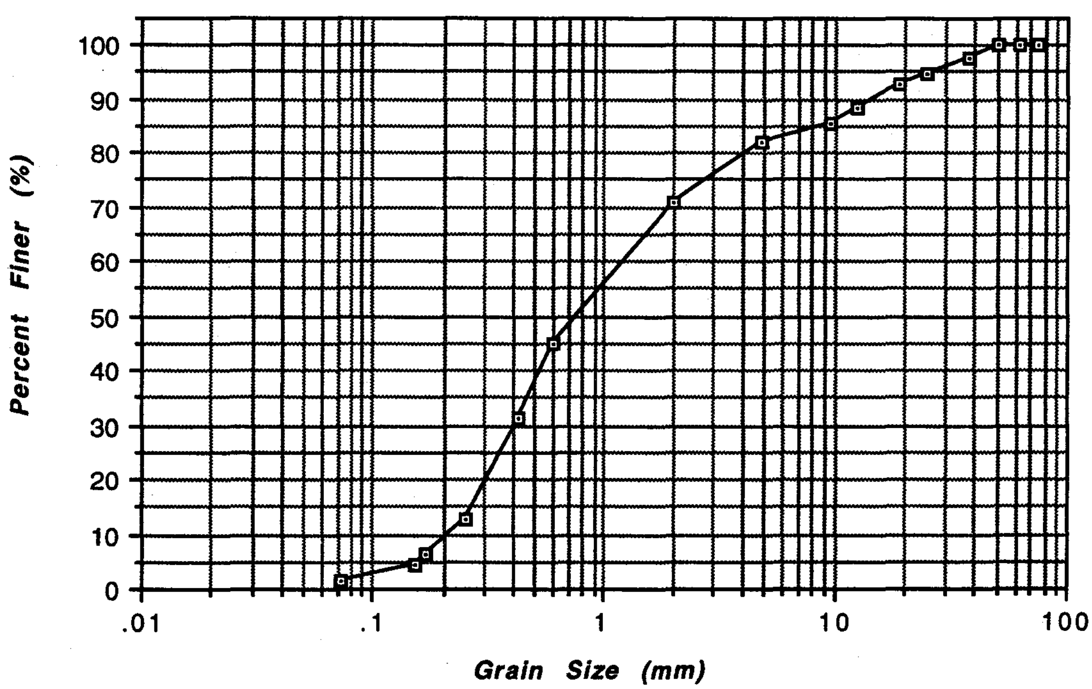

Fig. B-2-15 - Gradation Curve at Mile No. 6.430

Table B-2-16 - Gradation data collected at Station 6.980

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	20.388	0.20388
1	0.125	26.043	0.05655
2	0.250	28.705	0.02661
3	0.500	32.906	0.04201
4	1.000	41.966	0.09060
5	2.000	47.740	0.05774
6	4.000	53.304	0.05564
7	8.000	59.372	0.06069
8	16.000	66.116	0.06744
9	32.000	74.710	0.08595
10	64.000	84.606	0.09895

Note: * These values are used in the N record.

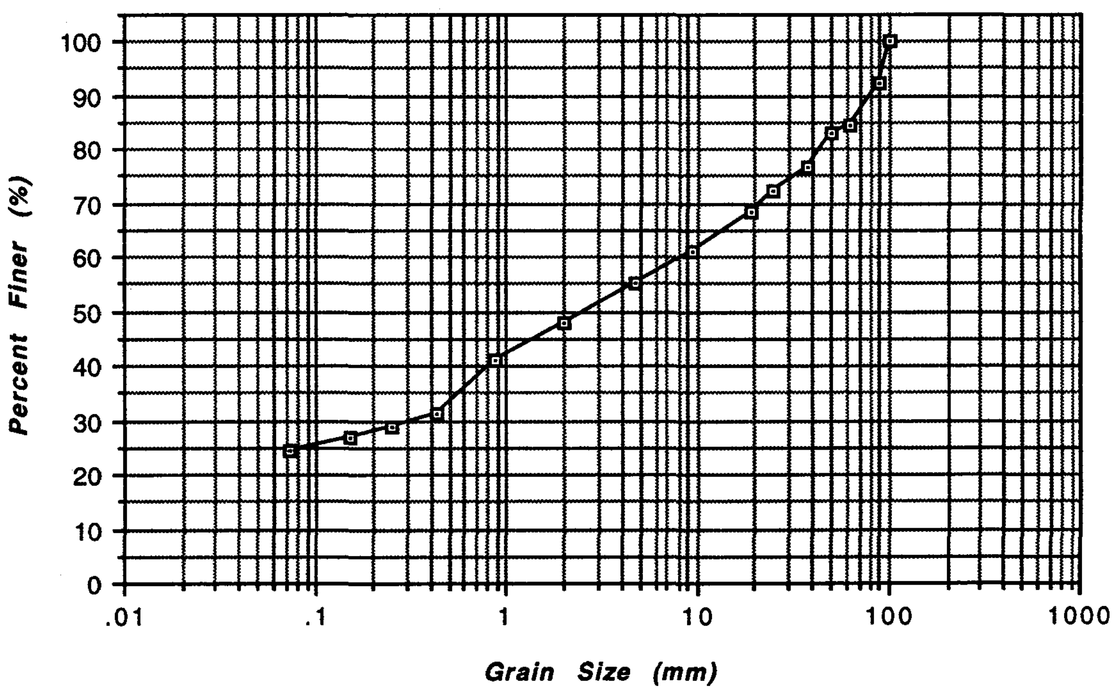

Fig. B-2-16 - Gradation Curve at Mile No. 6.980

Table B-2-17 - Gradation data collected at Station 7.490

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.268	0.00268
1	0.125	0.747	0.00479
2	0.250	3.620	0.02873
3	0.500	14.068	0.10448
4	1.000	27.027	0.12958
5	2.000	47.750	0.20723
6	4.000	55.474	0.07724
7	8.000	65.603	0.10130
8	16.000	77.232	0.11629
9	32.000	87.994	0.10762
10	64.000	96.700	0.08706

Note: * These values are used in the N record.

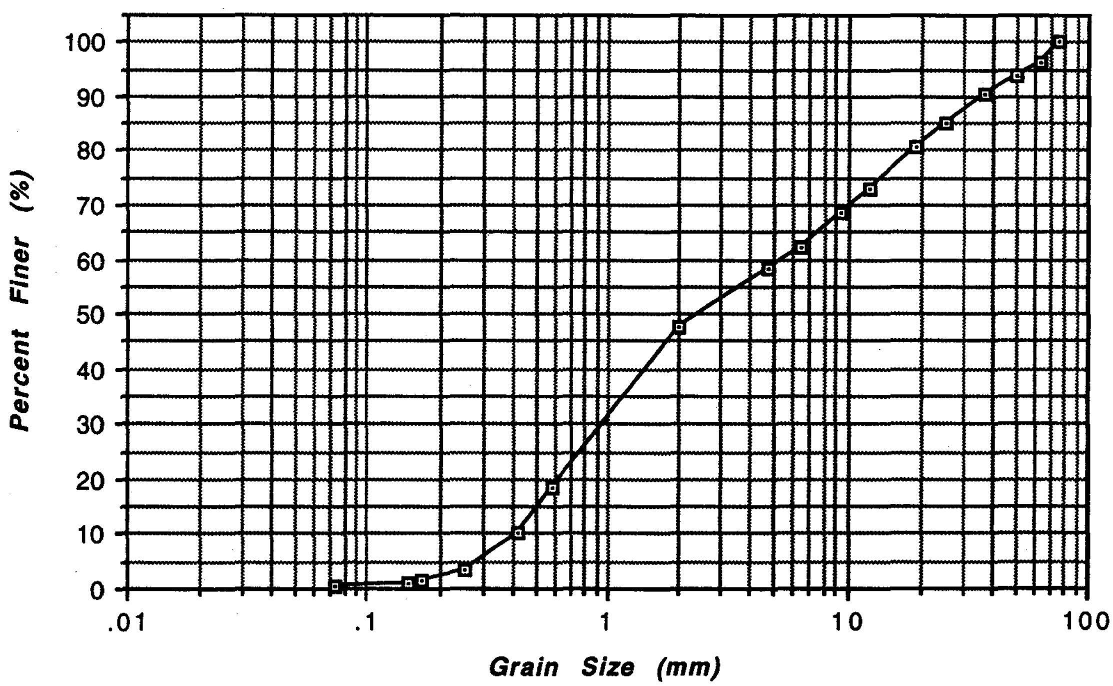

Fig. B-2-17 - Gradation Curve at Mile No. 7.490

Table B-2-18 - Gradation data collected at Station 8.000

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.212	0.02212
1	0.125	2.940	0.00728
2	0.250	5.869	0.02929
3	0.500	16.971	0.11102
4	1.000	47.799	0.30828
5	2.000	59.790	0.11991
6	4.000	66.503	0.06713
7	8.000	71.703	0.05201
8	16.000	75.562	0.03858
9	32.000	85.417	0.09855
10	64.000	93.427	0.08010

Note: * These values are used in the N record.

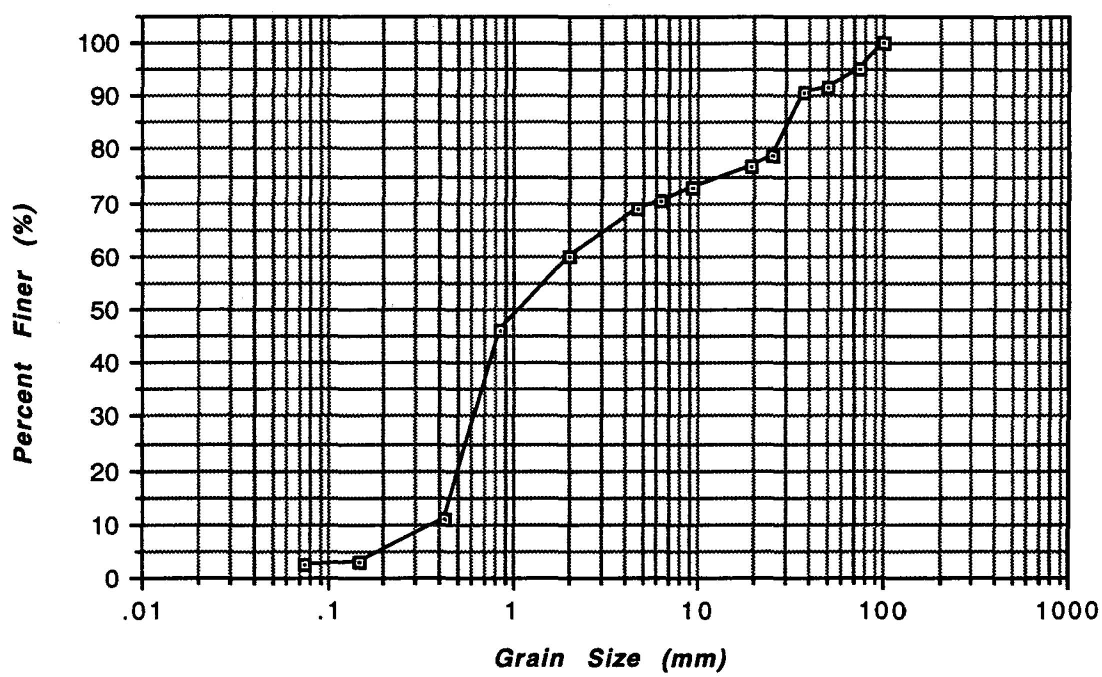

Fig. B-2-18- Gradation Curve at Mile No. 8.000

Table B-2-19 - Gradation data collected at Station 8.340

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	6.210	0.06210
1	0.125	9.157	0.02947
2	0.250	14.000	0.04843
3	0.500	25.816	0.11816
4	1.000	35.076	0.09260
5	2.000	48.670	0.13594
6	4.000	52.641	0.03971
7	8.000	58.765	0.06124
8	16.000	67.540	0.08775
9	32.000	77.320	0.09780
10	64.000	92.667	0.15346

Note: * These values are used in the N record.

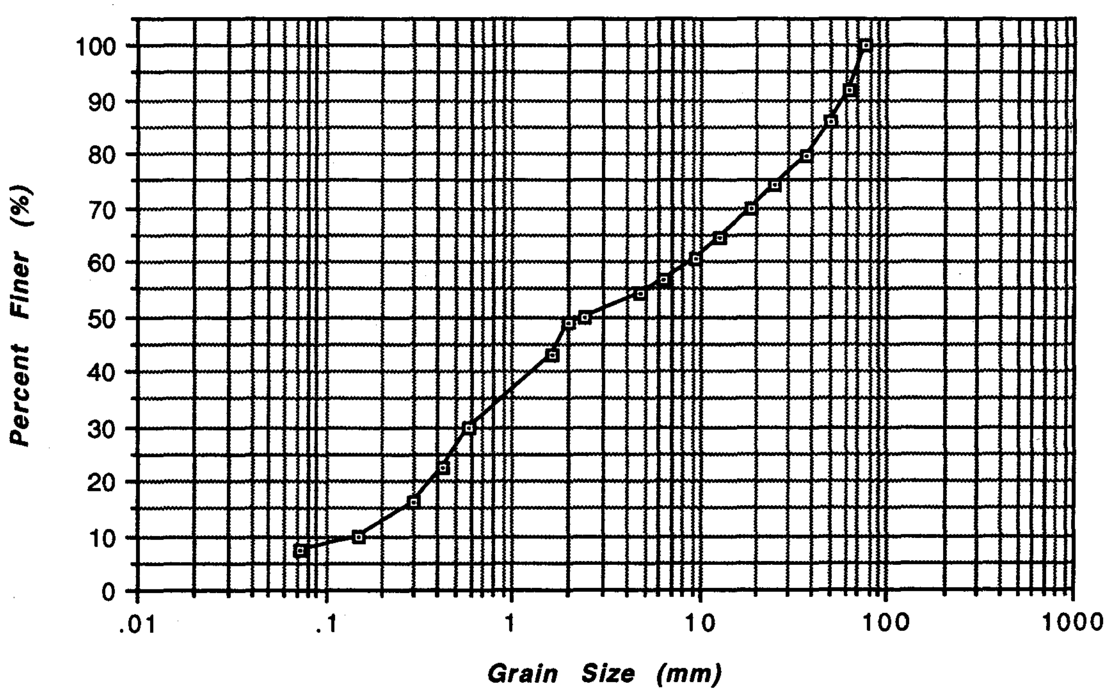

Fig. B-2-19 - Gradation Curve at Mile No. 8.340

Table B-2-20 - Gradation data collected at Station 8.540

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.331	0.01331
1	0.125	2.133	0.00802
2	0.250	5.200	0.03067
3	0.500	15.927	0.10727
4	1.000	26.726	0.10798
5	2.000	43.800	0.17074
6	4.000	49.505	0.05705
7	8.000	55.800	0.06295
8	16.000	64.554	0.08754
9	32.000	78.664	0.14110
10	64.000	97.800	0.19136

Note: * These values are used in the N record.

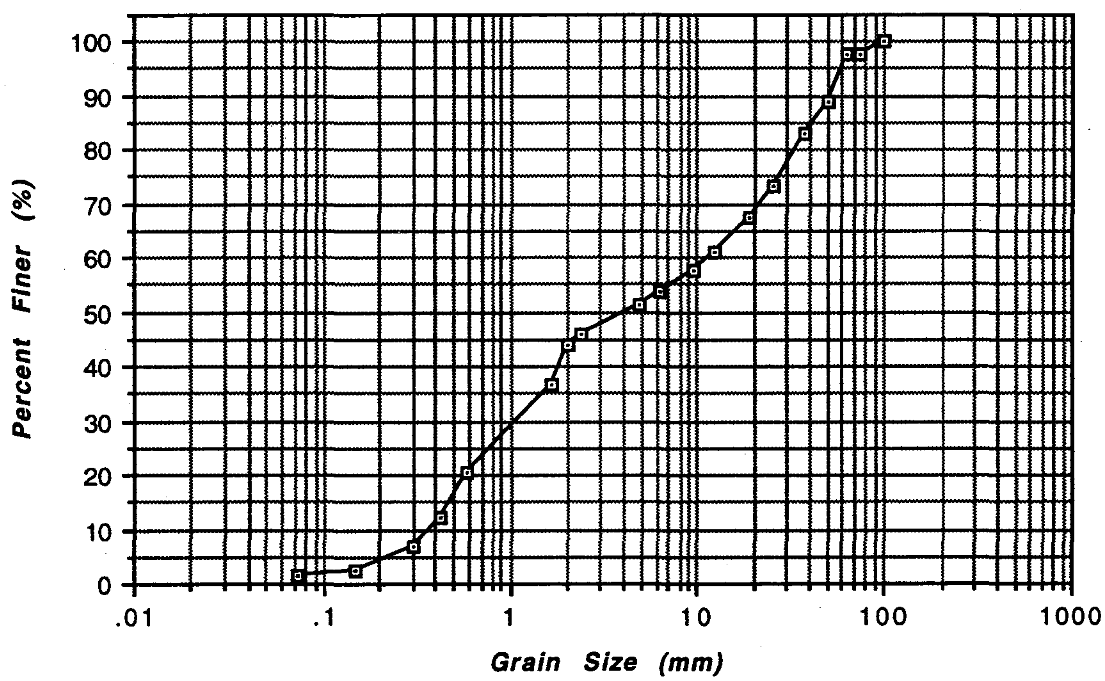

Fig. B-2-20 - Gradation Curve at Mile No. 8.540

Table B-2-21 - Gradation data collected at Station 8.640

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.234	0.00234
1	0.125	0.940	0.00706
2	0.250	6.200	0.05260
3	0.500	32.804	0.26604
4	1.000	59.109	0.26306
5	2.000	82.400	0.23291
6	4.000	84.873	0.02473
7	8.000	87.266	0.02393
8	16.000	89.445	0.02180
9	32.000	91.777	0.02331
10	64.000	96.453	0.04676

Note: * These values are used in the N record.

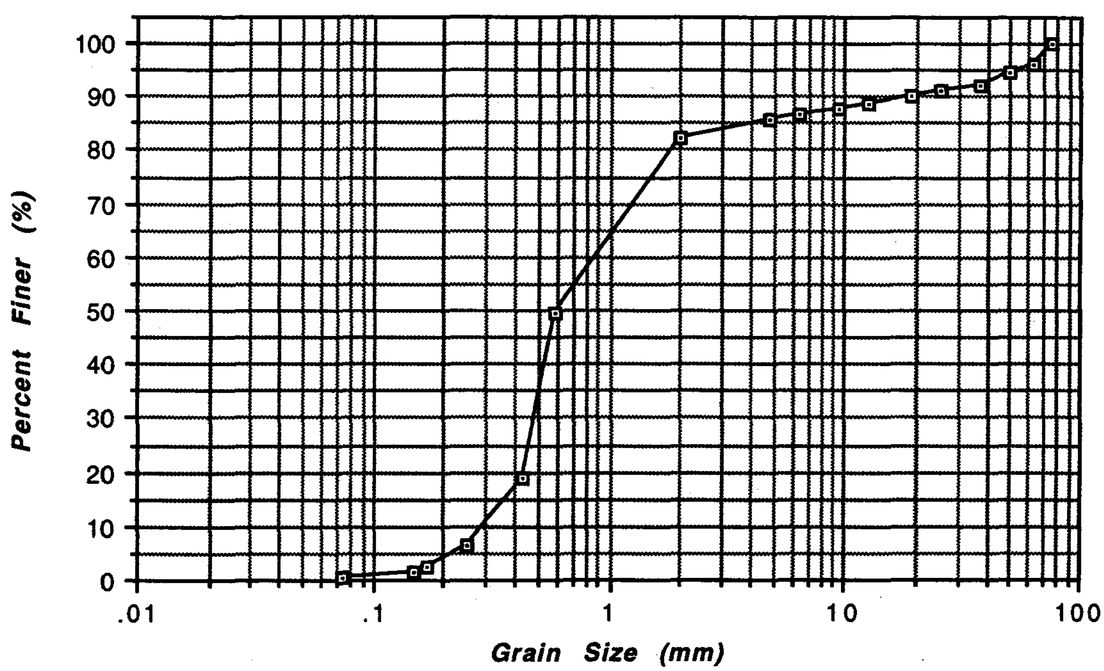

Fig. B-2-21 - Gradation Curve at Mile No. 8.640

Table B-2-22 - Gradation data collected at Station 8.730

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.780	0.01780
1	0.125	4.047	0.02267
2	0.250	12.333	0.08287
3	0.500	30.964	0.18630
4	1.000	45.444	0.14480
5	2.000	66.600	0.21156
6	4.000	71.619	0.05019
7	8.000	75.376	0.03757
8	16.000	77.202	0.01825
9	32.000	86.977	0.09775
10	64.000	94.508	0.07532

Note: * These values are used in the N record.

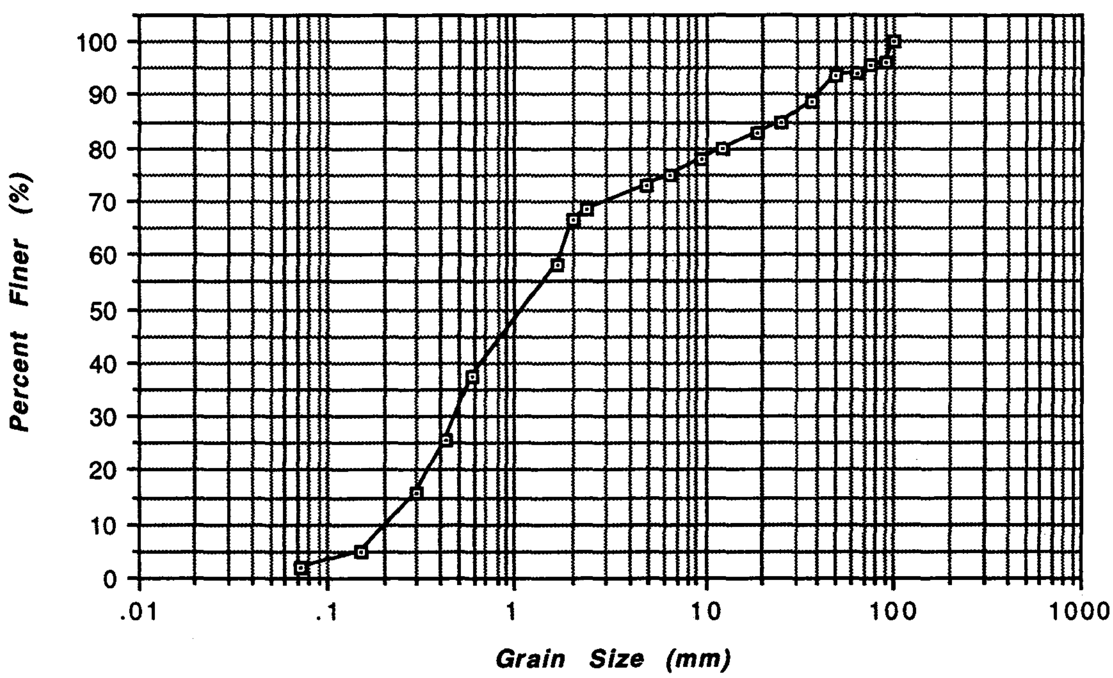

Fig. B-2-22 - Gradation Curve at Mile No. 8.730

Table B-2-23 - Gradation data collected at Station 8.830

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.412	0.02412
1	0.125	3.967	0.01555
2	0.250	10.500	0.06533
3	0.500	30.591	0.20091
4	1.000	47.676	0.17085
5	2.000	70.000	0.22324
6	4.000	74.245	0.04245
7	8.000	77.810	0.03565
8	16.000	81.846	0.04037
9	32.000	87.800	0.05954
10	64.000	96.333	0.08533

Note: * These values are used in the N record.

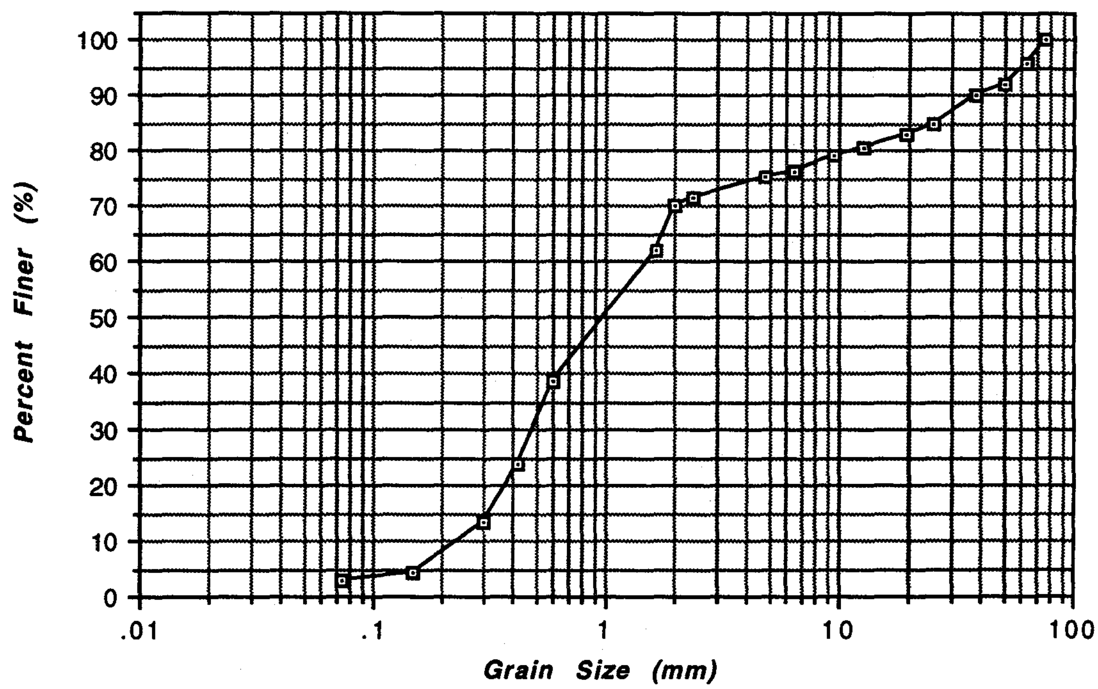

Fig. B-2-23 - Gradation Curve at Mile No. 8.830

Table B-2-24 - Gradation data collected at Station 8.930

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	3.077	0.03077
1	0.125	5.233	0.02157
2	0.250	12.667	0.07433
3	0.500	35.182	0.22515
4	1.000	47.076	0.11894
5	2.000	59.500	0.12424
6	4.000	62.902	0.03402
7	8.000	67.071	0.04170
8	16.000	72.115	0.05044
9	32.000	78.680	0.06565
10	64.000	92.667	0.13987

Note: * These values are used in the N record.

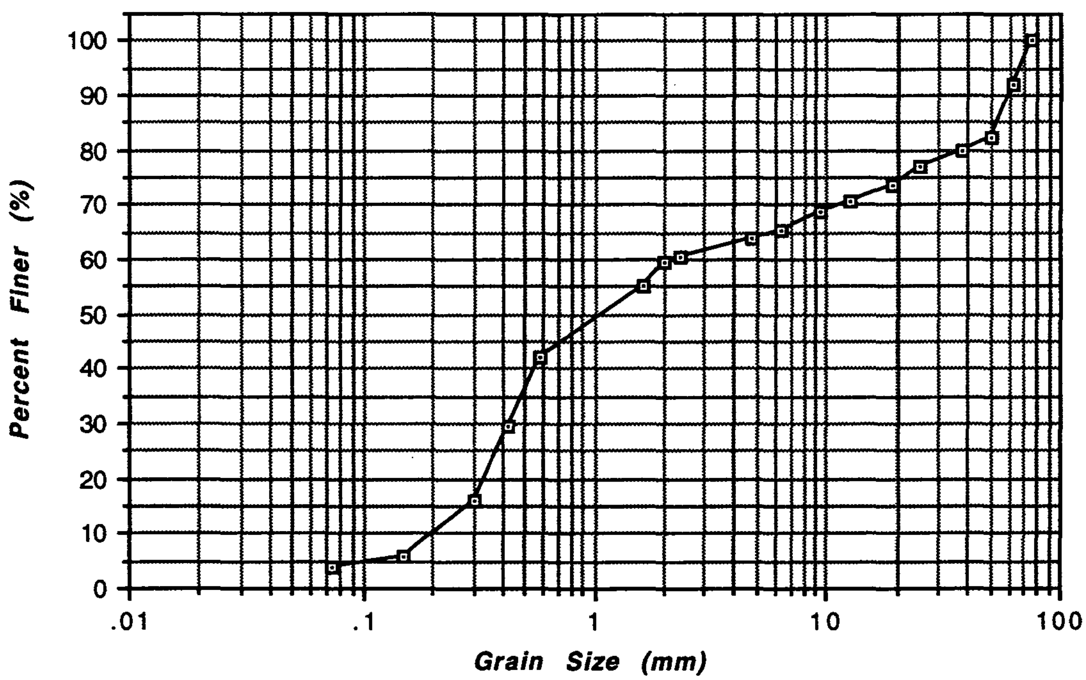

Fig. B-2-24 - Gradation Curve at Mile No. 8.930

Table B-2-25 - Gradation data collected at Station 9.020

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.079	0.02079
1	0.125	3.167	0.01087
2	0.250	5.833	0.02667
3	0.500	14.454	0.08621
4	1.000	22.881	0.08426
5	2.000	36.500	0.13619
6	4.000	41.088	0.04588
7	8.000	46.595	0.05507
8	16.000	54.462	0.07866
9	32.000	64.860	0.10398
10	64.000	80.667	0.15807

Note: * These values are used in the N record.

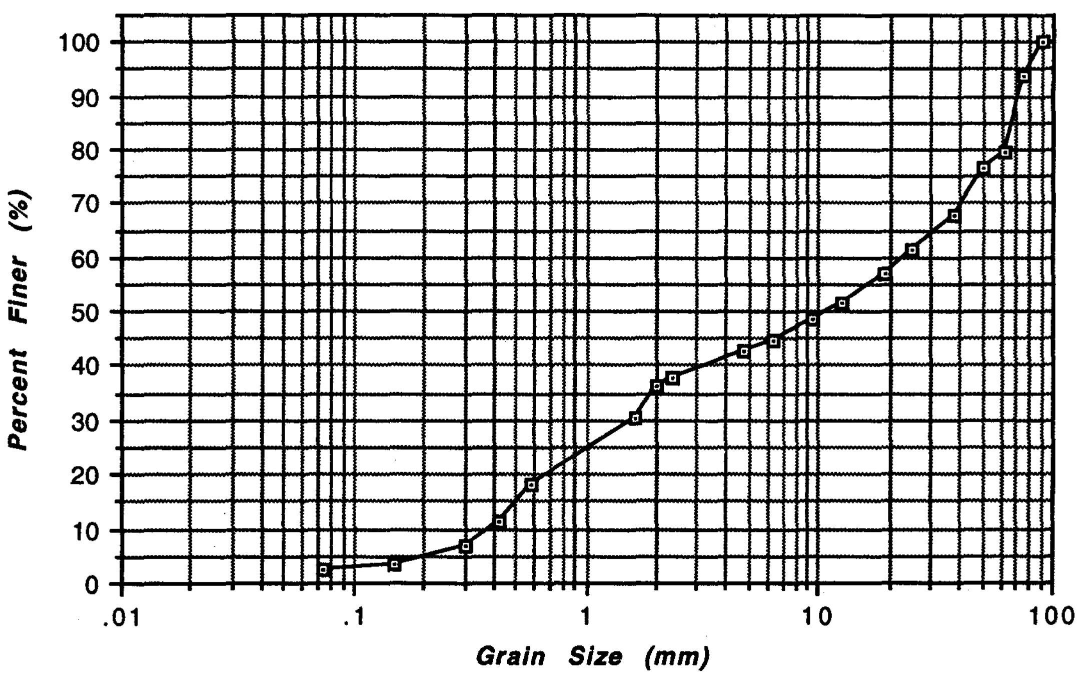

Fig. B-2-25 - Gradation Curve at Mile No. 9.020

Table B-2-26 - Gradation data collected at Station 9.130

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.775	0.00775
1	0.125	1.643	0.00869
2	0.250	6.244	0.04600
3	0.500	19.022	0.12779
4	1.000	46.435	0.27413
5	2.000	62.670	0.16235
6	4.000	68.968	0.06298
7	8.000	75.894	0.06926
8	16.000	83.248	0.07354
9	32.000	92.175	0.08927
10	64.000	98.240	0.06065

Note: * These values are used in the N record.

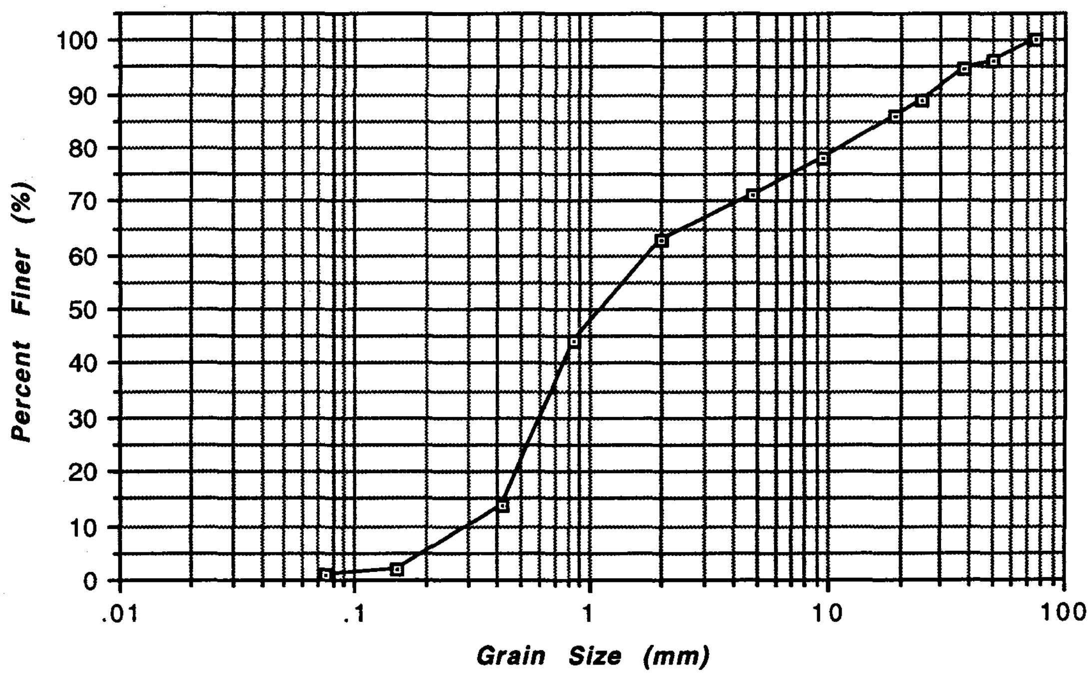

Fig. B-2-26 - Gradation Curve at Mile No. 9.130

Table B-2-27- Gradation data collected at Station 9.250

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.415	0.01414
1	0.125	2.233	0.00819
2	0.250	6.500	0.04267
3	0.500	18.409	0.11909
4	1.000	27.576	0.09167
5	2.000	41.500	0.13924
6	4.000	46.088	0.04588
7	8.000	52.595	0.06507
8	16.000	59.692	0.07097
9	32.000	67.860	0.08168
10	64.000	78.854	0.10994

Note: * These values are used in the N record.

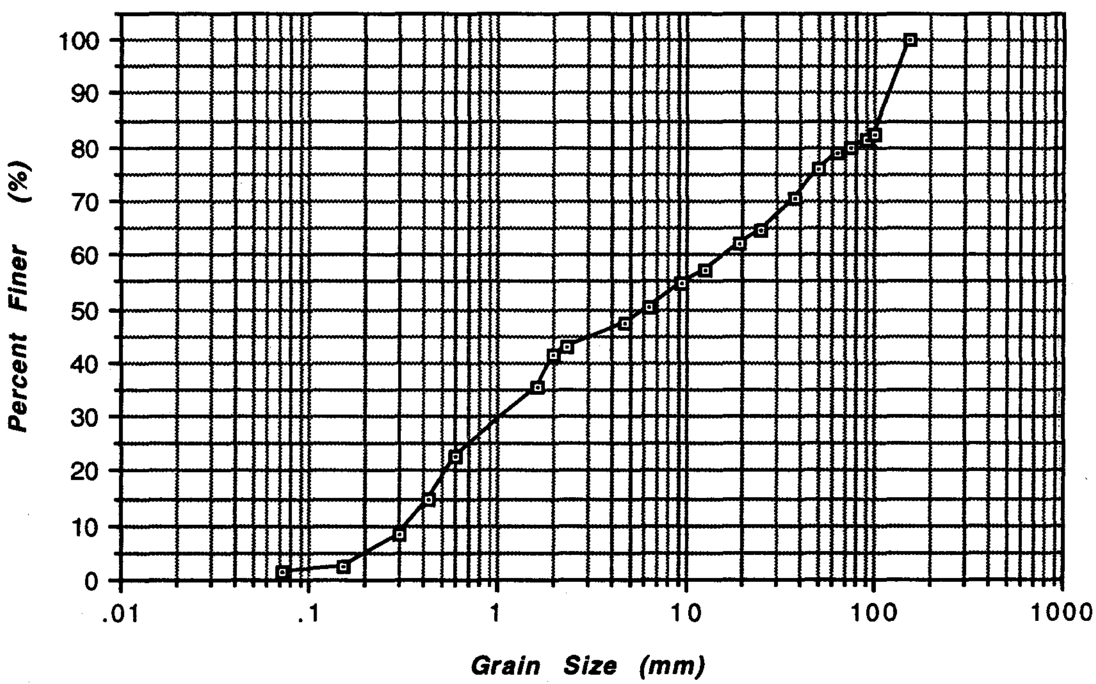

Fig. B-2-27 - Gradation Curve at Mile No. 9.250

Table B-2-28 - Gradation data collected at Station 9.470

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.833	0.00833
1	0.125	2.333	0.01501
2	0.250	8.000	0.05667
3	0.500	19.647	0.11647
4	1.000	49.130	0.29483
5	2.000	70.000	0.20870
6	4.000	77.273	0.07273
7	8.000	83.421	0.06148
8	16.000	91.842	0.08421
9	32.000	98.680	0.06838
10	64.000	100.000	0.01320

Note: * These values are used in the N record.

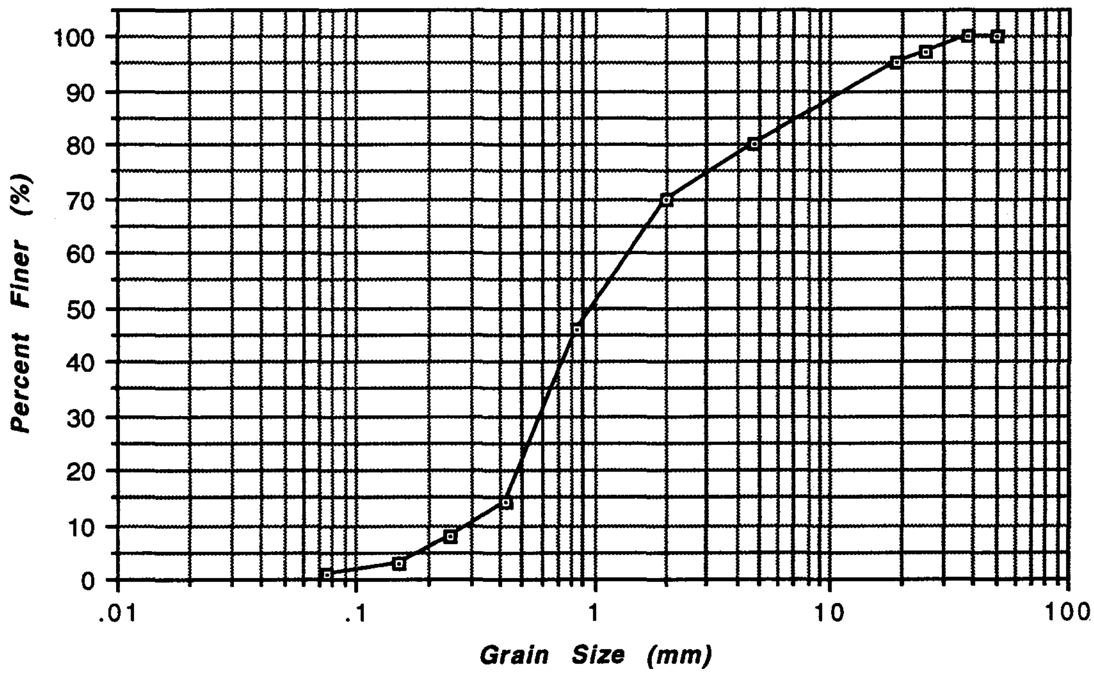

Fig. B-2-28 - Gradation Curve at Mile No. 9.470

Table B-2-29 - Gradation data collected at Station 9.625

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.664	0.01664
1	0.125	2.667	0.01003
2	0.250	7.000	0.04333
3	0.500	13.706	0.06706
4	1.000	34.261	0.20555
5	2.000	56.000	0.21739
6	4.000	61.091	0.05091
7	8.000	67.790	0.06699
8	16.000	74.105	0.06316
9	32.000	80.800	0.06695
10	64.000	87.760	0.06960

Note: * These values are used in the N record.

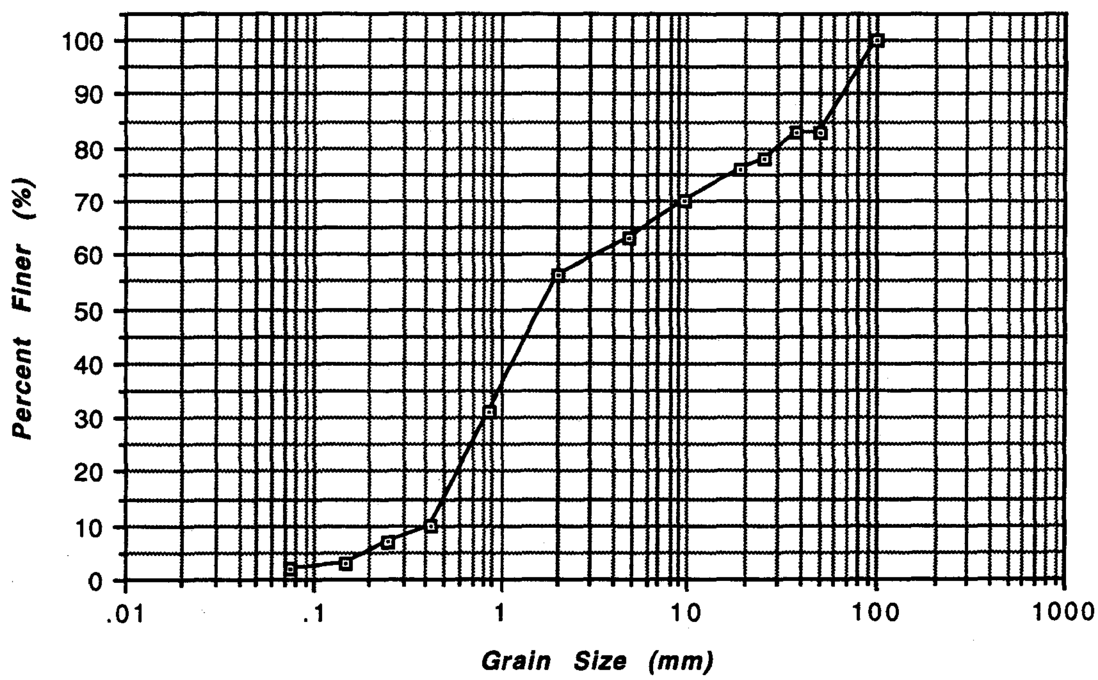

Fig. B-2-29 - Gradation Curve at Mile No. 9.625

Table B-2-30 - Gradation data collected at Station 10.340

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.833	0.00833
1	0.125	1.253	0.00421
2	0.250	3.380	0.02127
3	0.500	6.294	0.02914
4	1.000	14.952	0.08658
5	2.000	24.630	0.09678
6	4.000	31.357	0.06727
7	8.000	41.235	0.09878
8	16.000	53.012	0.11776
9	32.000	67.120	0.14108
10	64.000	85.647	0.18527

Note: * These values are used in the N record.

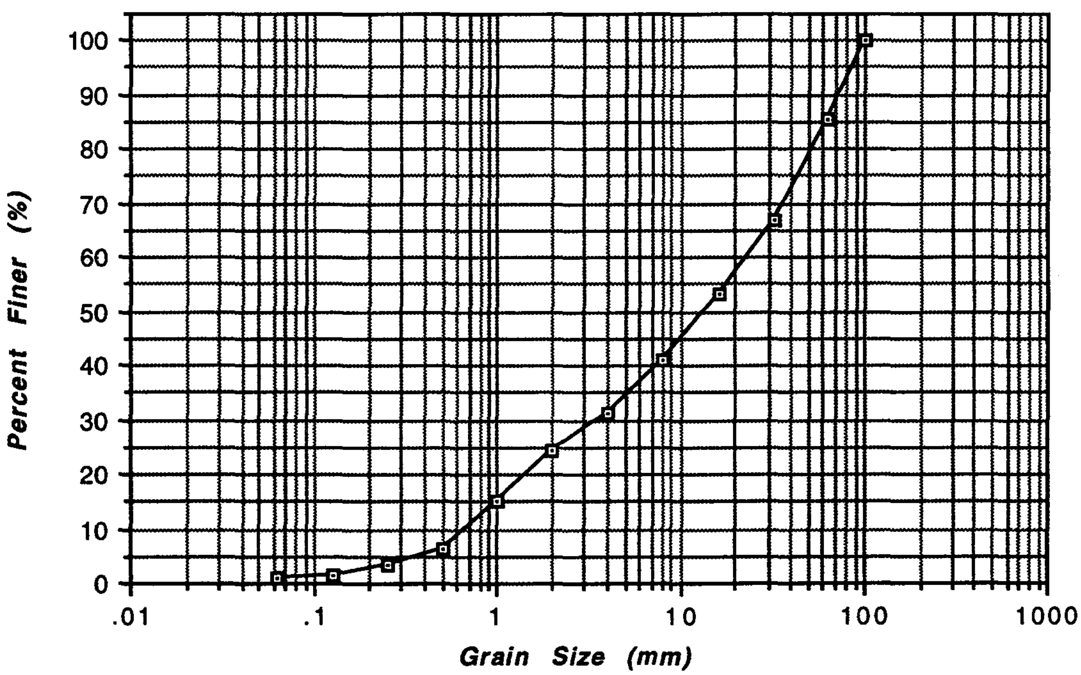

Fig. B-2-30 - Gradation Curve at Mile No. 10.340

Table B-2-31 - Gradation data collected at Station 10.720

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.007	0.01007
1	0.125	2.410	0.01403
2	0.250	8.200	0.05790
3	0.500	14.576	0.06375
4	1.000	23.088	0.08512
5	2.000	38.740	0.15653
6	4.000	51.031	0.12291
7	8.000	63.551	0.12520
8	16.000	75.517	0.11966
9	32.000	87.605	0.12088
10	64.000	97.168	0.09563

Note: * These values are used in the N record.

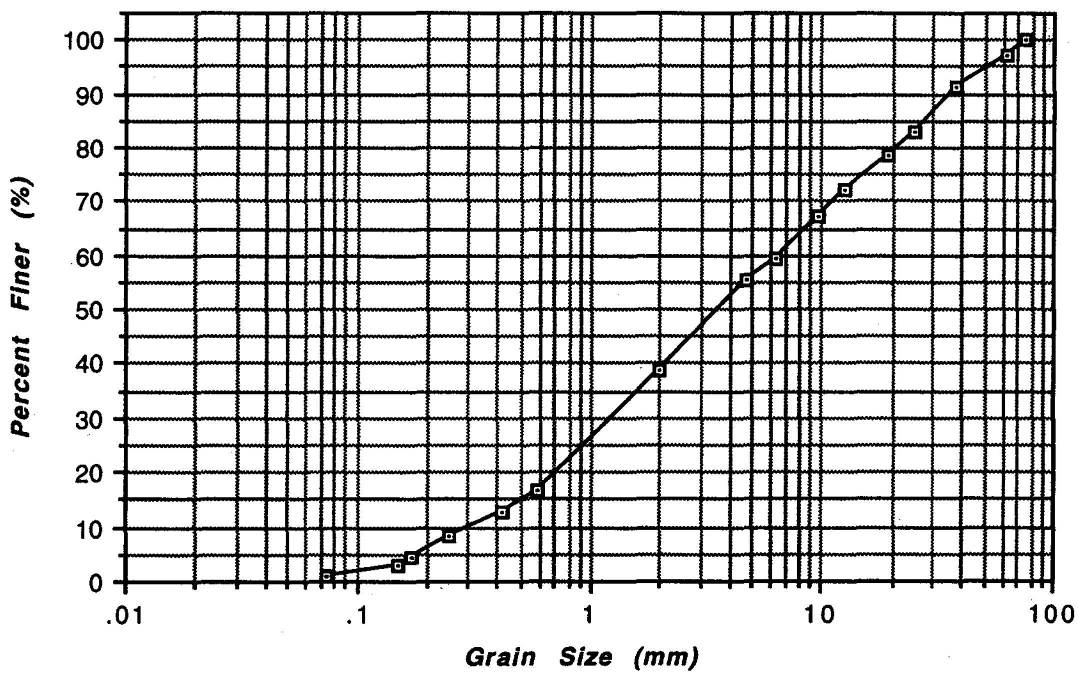

Fig. B-2-31 - Gradation Curve at Mile No. 10.720

Table B-2-32 - Gradation data collected at Station 11.340

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.545	0.02545
1	0.125	5.127	0.02582
2	0.250	12.070	0.06943
3	0.500	25.443	0.13373
4	1.000	37.446	0.12004
5	2.000	53.340	0.15894
6	4.000	58.333	0.04993
7	8.000	67.170	0.08837
8	16.000	78.467	0.11297
9	32.000	91.198	0.12731
10	64.000	100.00	0.08802

Note: * These values are used in the N record.

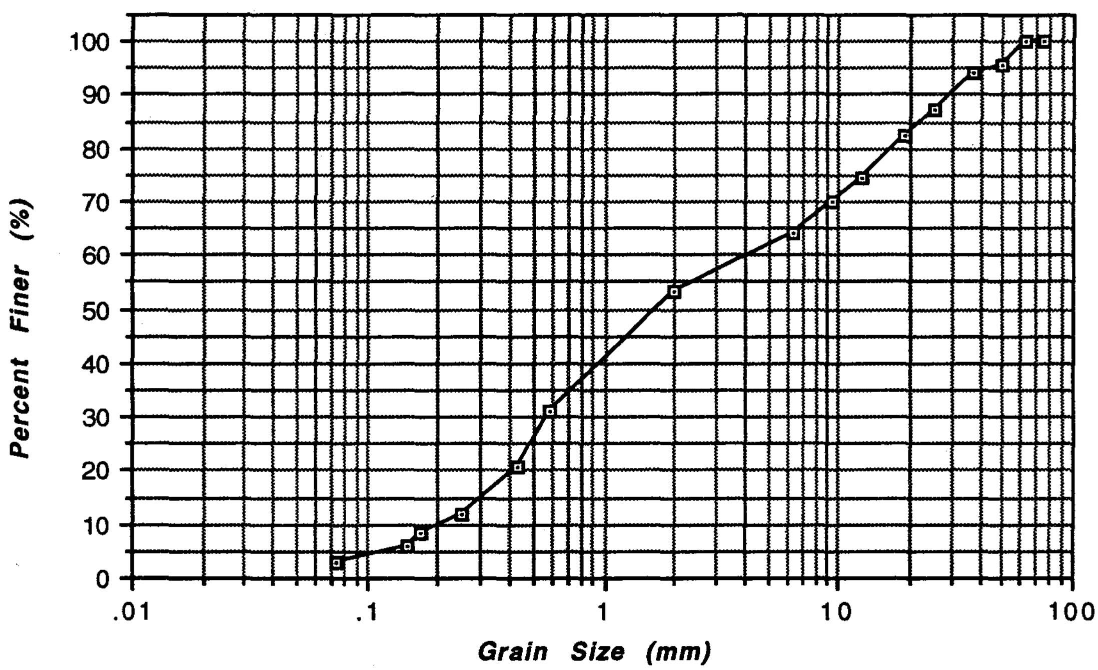

Fig. B-2-32 - Gradation Curve at Mile No. 11.340

Table B-2-33 - Gradation data collected at Station 11.800

No.	Sediment Size (mm)	Percent Finer by Weight (%)	Fraction by Weight*
0	0.062	0.966	0.00966
1	0.125	1.807	0.00841
2	0.250	8.290	0.06483
3	0.500	50.910	0.42620
4	1.000	74.279	0.23369
5	2.000	93.960	0.19681
6	4.000	96.738	0.02778
7	8.000	98.950	0.02211
8	16.000	99.880	0.00931
9	32.000	100.00	0.00120
10	64.000	100.00	0.00000

Note: * These values are used in the N record.

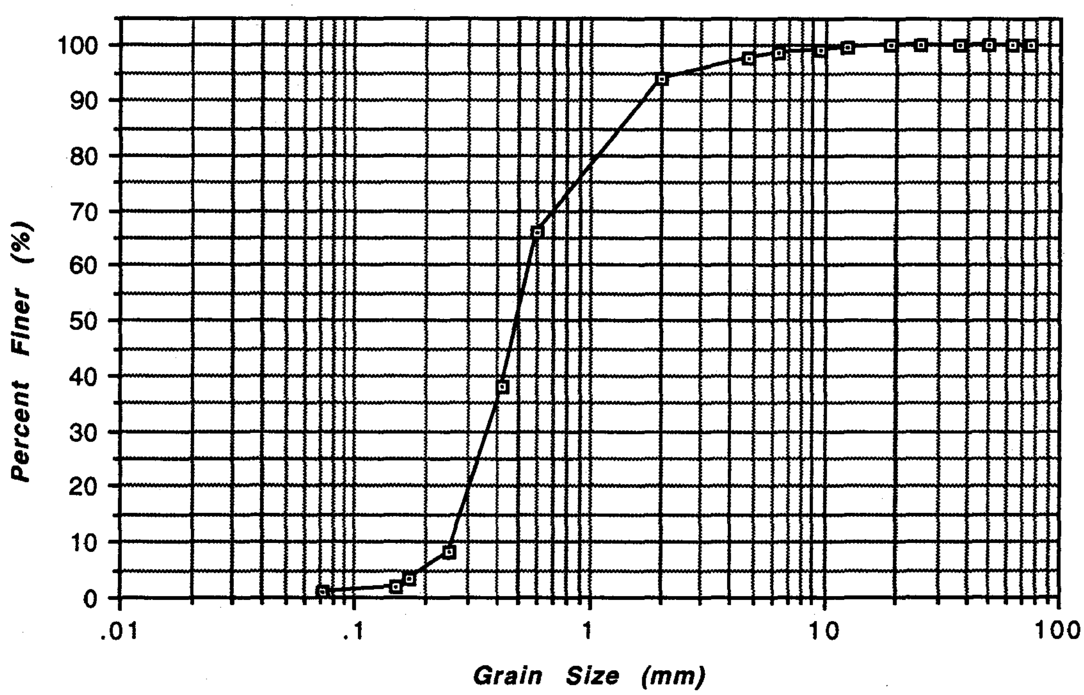

Fig. B-2-33 - Gradation Curve at Mile No. 11.800

Table B-2-34 - Gradation data collected at Station 12.380

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.046	0.02046
1	0.125	12.973	0.10927
2	0.250	26.570	0.13597
3	0.500	48.645	0.22075
4	1.000	58.942	0.10297
5	2.000	70.900	0.11958
6	4.000	75.234	0.04334
7	8.000	80.701	0.05466
8	16.000	85.552	0.04851
9	32.000	89.164	0.03611
10	64.000	99.991	0.10827

Note: * These values are used in the N record.

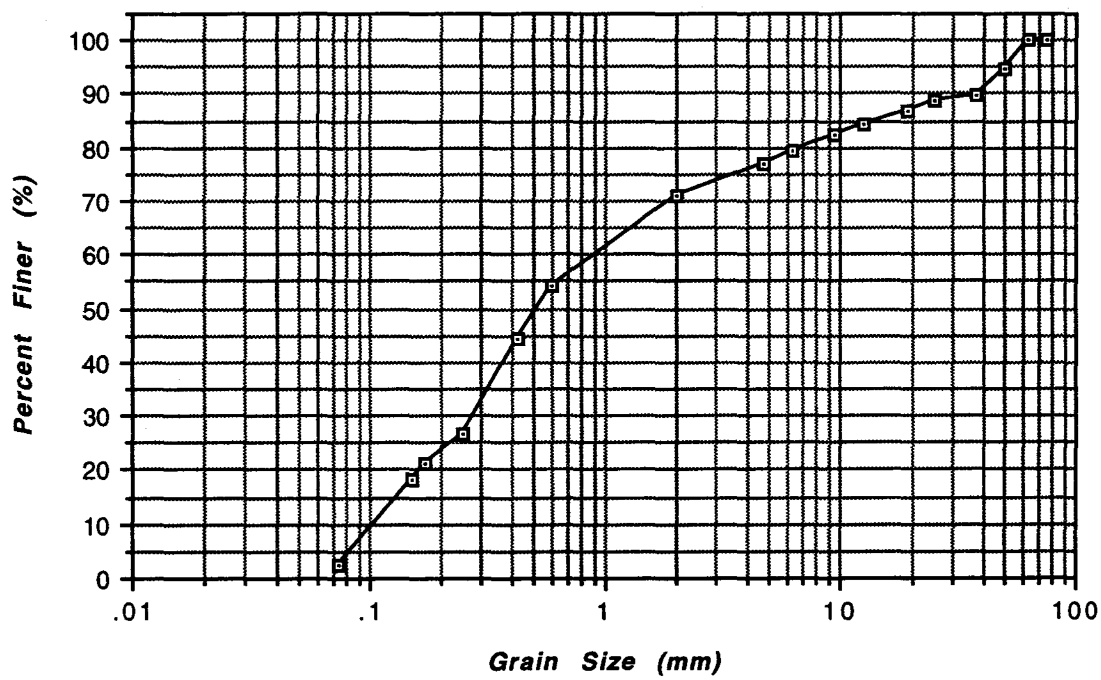

Fig. B-2-34 - Gradation Curve at Mile No. 12.380

Table B-2-35- Gradation data collected at Station 12.840

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.334	0.00334
1	0.125	0.693	0.00359
2	0.250	2.230	0.01537
3	0.500	7.901	0.05671
4	1.000	13.440	0.05540
5	2.000	19.368	0.05928
6	4.000	31.224	0.11856
7	8.000	42.504	0.11280
8	16.000	56.535	0.14032
9	32.000	73.178	0.16642
10	64.000	95.820	0.22642

Note: * These values are used in the N record.

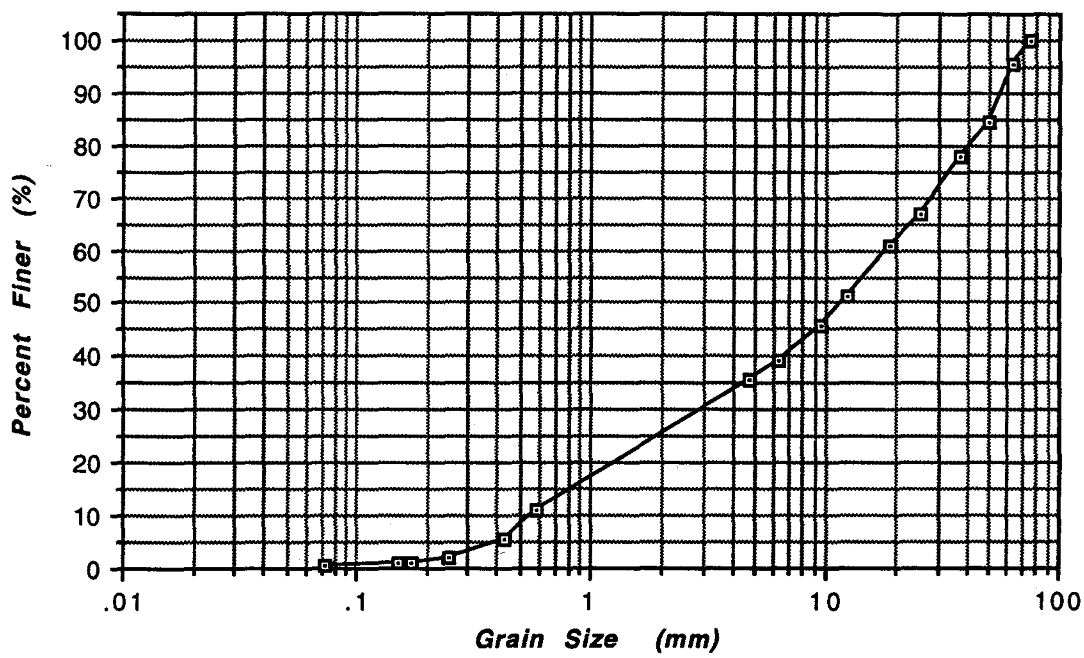

Fig. B-2-35 - Gradation Curve at Mile No. 12.840

Table B-2-36 - Gradation data collected at Station 13.320

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	16.490	0.16490
1	0.125	22.040	0.05550
2	0.250	27.120	0.05080
3	0.500	34.412	0.07292
4	1.000	38.891	0.04479
5	2.000	48.690	0.09799
6	4.000	55.560	0.06870
7	8.000	66.152	0.10593
8	16.000	81.438	0.15285
9	32.000	94.755	0.13318
10	64.000	100.00	0.05245

Note: * These values are used in the N record.

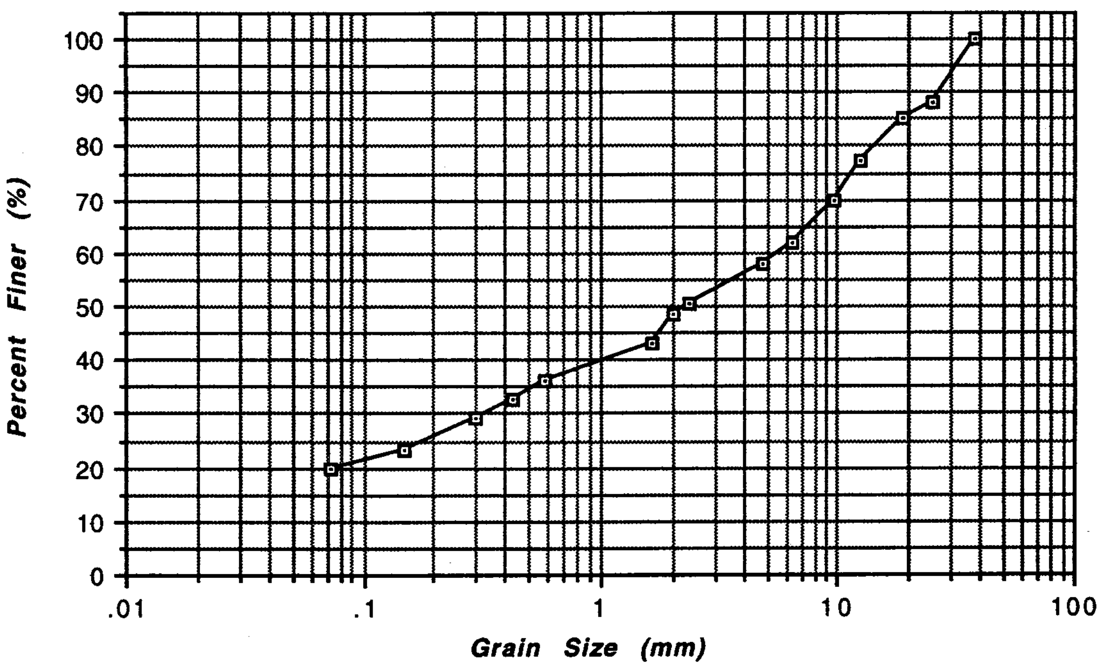

Fig. B-2-36 - Gradation Curve at Mile No. 13.320

Table B-2-37 - Gradation data collected at Station 13.900

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.121	0.02121
1	0.125	2.917	0.00796
2	0.250	8.831	0.05914
3	0.500	24.396	0.15566
4	1.000	49.062	0.24666
5	2.000	69.220	0.20158
6	4.000	75.751	0.06531
7	8.000	82.545	0.06794
8	16.000	89.945	0.07400
9	32.000	95.637	0.05692
10	64.000	100.00	0.04363

Note: * These values are used in the N record.

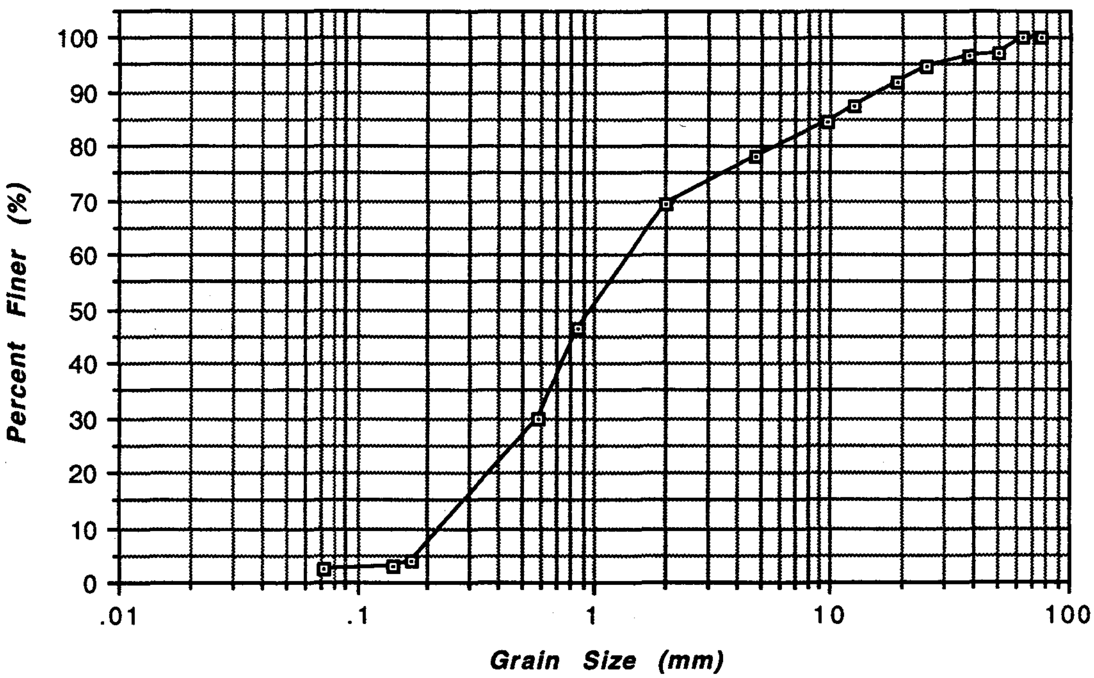

Fig. B-2-37 - Gradation Curve at Mile No. 13.900

Table B-2-38 - Gradation data collected at Station 14.380

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.176	0.00176
1	0.125	0.623	0.00447
2	0.250	6.431	0.05807
3	0.500	21.526	0.15095
4	1.000	42.988	0.21462
5	2.000	62.260	0.19272
6	4.000	70.784	0.08524
7	8.000	80.139	0.09355
8	16.000	87.342	0.07203
9	32.000	95.768	0.08427
10	64.000	100.00	0.04232

Note: * These values are used in the N record.

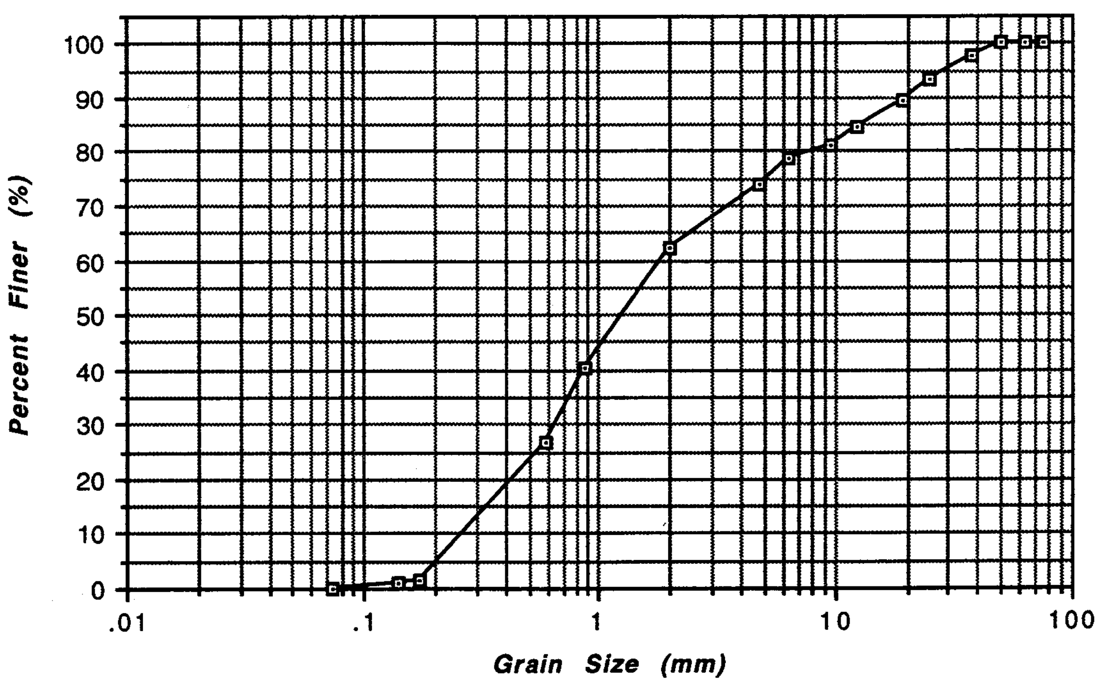

Fig. B-2-38 - Gradation Curve at Mile No. 14.380

Table B-2-39 - Gradation data collected at Station 14.940

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.210	0.00210
1	0.125	0.777	0.00567
2	0.250	3.520	0.02743
3	0.500	13.799	0.10279
4	1.000	27.991	0.14192
5	2.000	53.580	0.25589
6	4.000	63.798	0.10218
7	8.000	73.673	0.09875
8	16.000	84.317	0.10644
9	32.000	94.381	0.10064
10	64.000	100.000	0.05619

Note: * These values are used in the N record.

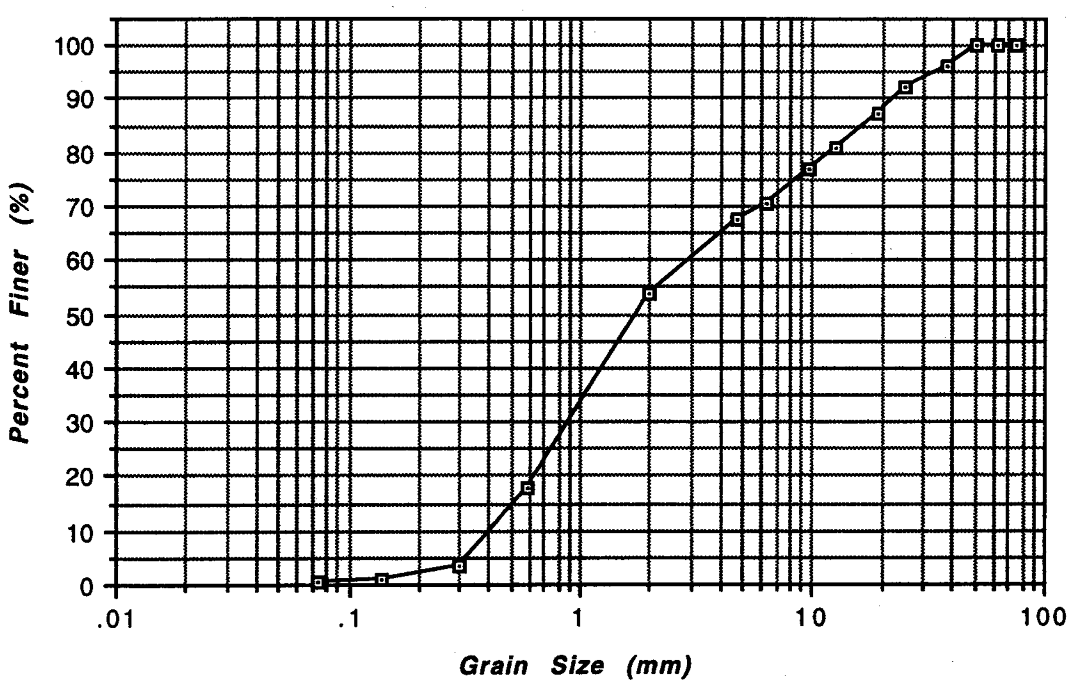

Fig. B-2-39 - Gradation Curve at Mile No. 14.940

Table B-2-40 - Gradation data collected at Station 15.510

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.583	0.00683
1	0.125	1.580	0.00897
2	0.250	7.026	0.05446
3	0.500	19.794	0.12768
4	1.000	32.178	0.12385
5	2.000	45.810	0.13632
6	4.000	54.494	0.08684
7	8.000	67.171	0.12677
8	16.000	77.962	0.10791
9	32.000	89.424	0.11463
10	64.000	100.000	0.10576

Note: * These values are used in the N record.

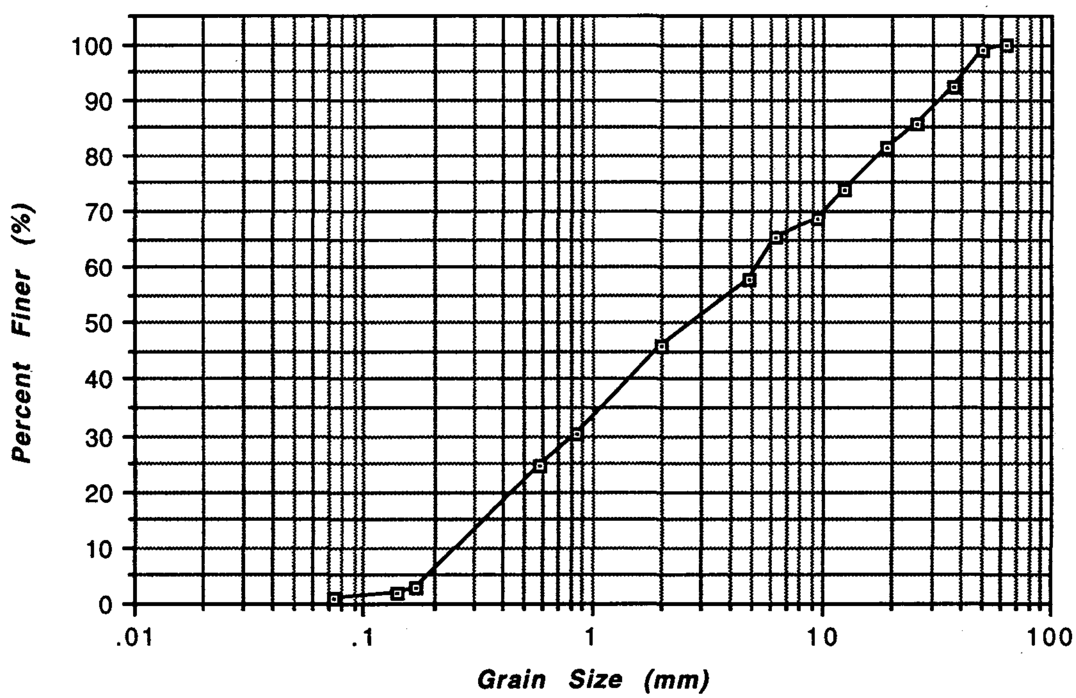

Fig. B-2-40 - Gradation Curve at Mile No. 15.510

Table B-2-41 - Gradation data collected at Station 15.980

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.658	0.00658
1	0.125	1.323	0.00665
2	0.250	2.360	0.01037
3	0.500	20.168	0.17808
4	1.000	26.336	0.06168
5	2.000	34.010	0.07674
6	4.000	39.559	0.05549
7	8.000	48.150	0.08591
8	16.000	58.785	0.10635
9	32.000	76.289	0.17505
10	64.000	97.241	0.20952

Note: * These values are used in the N record.

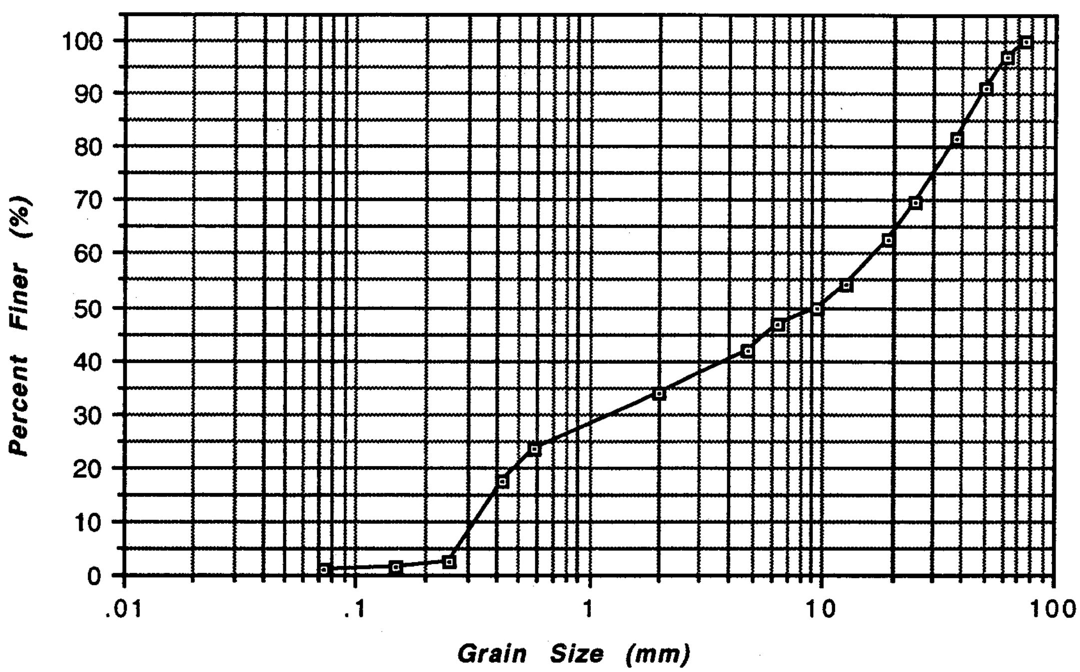

Fig. B-2-41 - Gradation Curve at Mile No. 15.980

Table B-2-42 - Gradation data collected at Station 16.460

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	10.299	0.10299
1	0.125	19.537	0.09238
2	0.250	37.130	0.17593
3	0.500	53.959	0.16829
4	1.000	63.444	0.09484
5	2.000	74.550	0.11106
6	4.000	79.386	0.04836
7	8.000	89.043	0.09657
8	16.000	93.832	0.04790
9	32.000	96.580	0.02748
10	64.000	100.000	0.03420

Note: * These values are used in the N record.

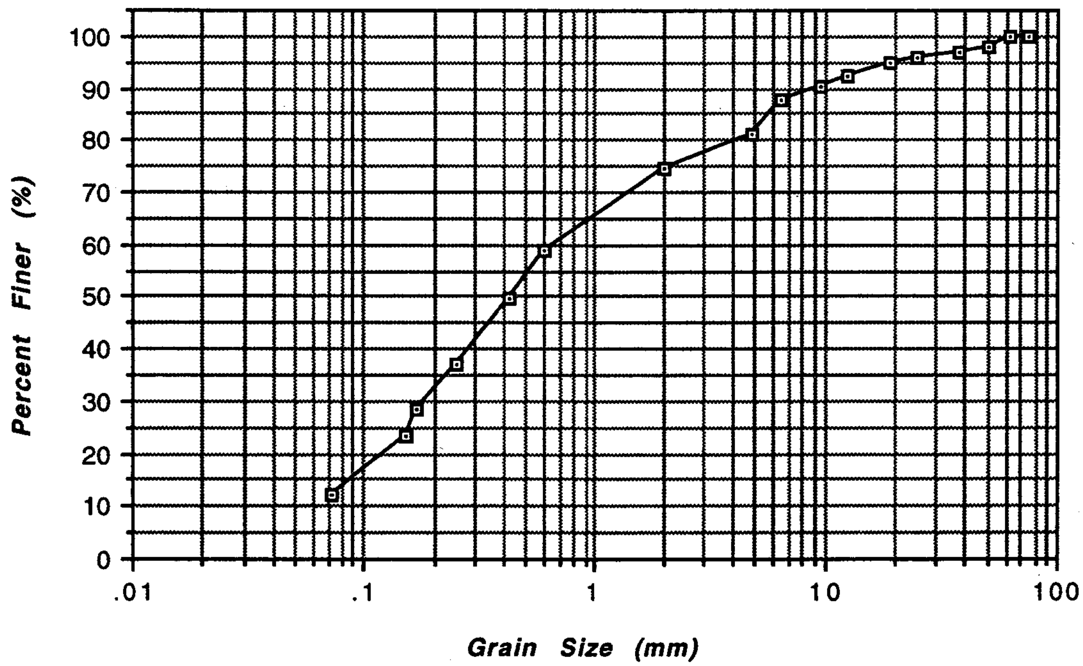

Fig. B-2-42 - Gradation Curve at Mile No. 16.460

Table B-2-43 - Gradation data collected at Station 17.090

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.667	0.00667
1	0.125	1.307	0.00640
2	0.250	3.820	0.02513
3	0.500	9.969	0.06149
4	1.000	17.299	0.07330
5	2.000	29.590	0.12291
6	4.000	36.885	0.07295
7	8.000	83.799	0.46914
8	16.000	92.209	0.08411
9	32.000	97.131	0.04922
10	64.000	97.912	0.00781

Note: * These values are used in the N record.

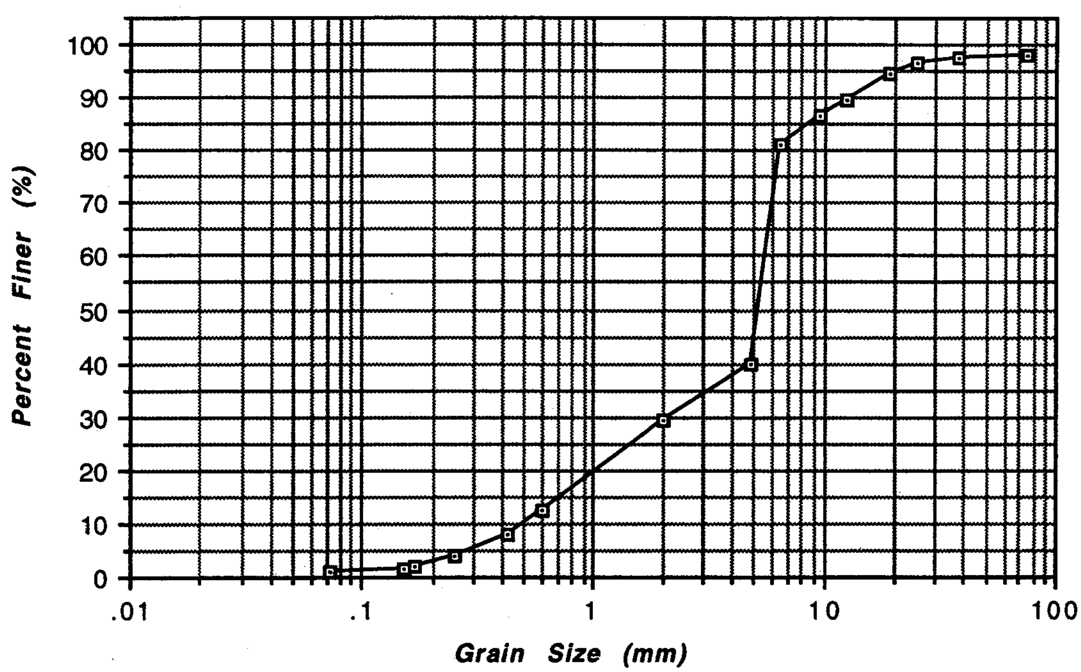

Fig. B-2-43 - Gradation Curve at Mile No. 17.090

Table B-2-44 - Gradation data collected at Station 17.760

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.093	0.00093
1	0.125	0.530	0.00437
2	0.250	3.110	0.02580
3	0.500	14.831	0.11721
4	1.000	27.221	0.12390
5	2.000	47.150	0.19929
6	4.000	55.899	0.08749
7	8.000	67.699	0.11800
8	16.000	74.590	0.06891
9	32.000	87.083	0.12493
10	64.000	100.000	0.12917

Note: * These values are used in the N record.

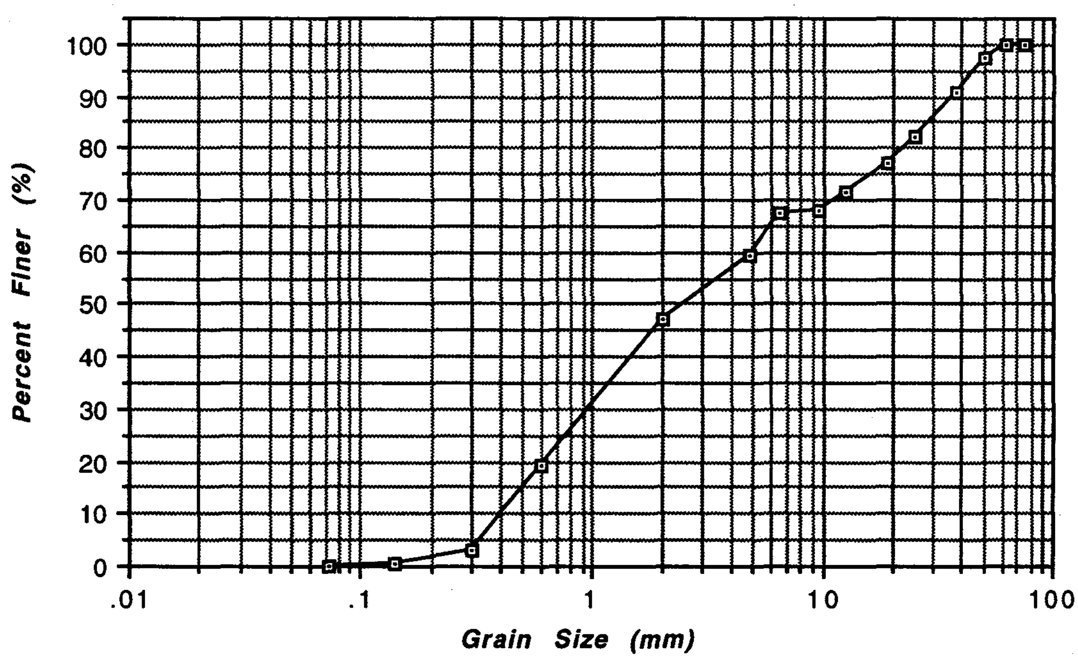

Fig. B-2-44 - Gradation Curve at Mile No. 17.760

Table B-2-45 - Gradation data collected at Station 18.42

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.118	0.00118
1	0.125	0.580	0.00462
2	0.250	15.800	0.15220
3	0.500	38.024	0.22224
4	1.000	49.838	0.11813
5	2.000	62.490	0.12653
6	4.000	67.755	0.05265
7	8.000	75.204	0.07449
8	16.000	85.942	0.10737
9	32.000	95.376	0.09435
10	64.000	100.000	0.04624

Note: * These values are used in the N record.

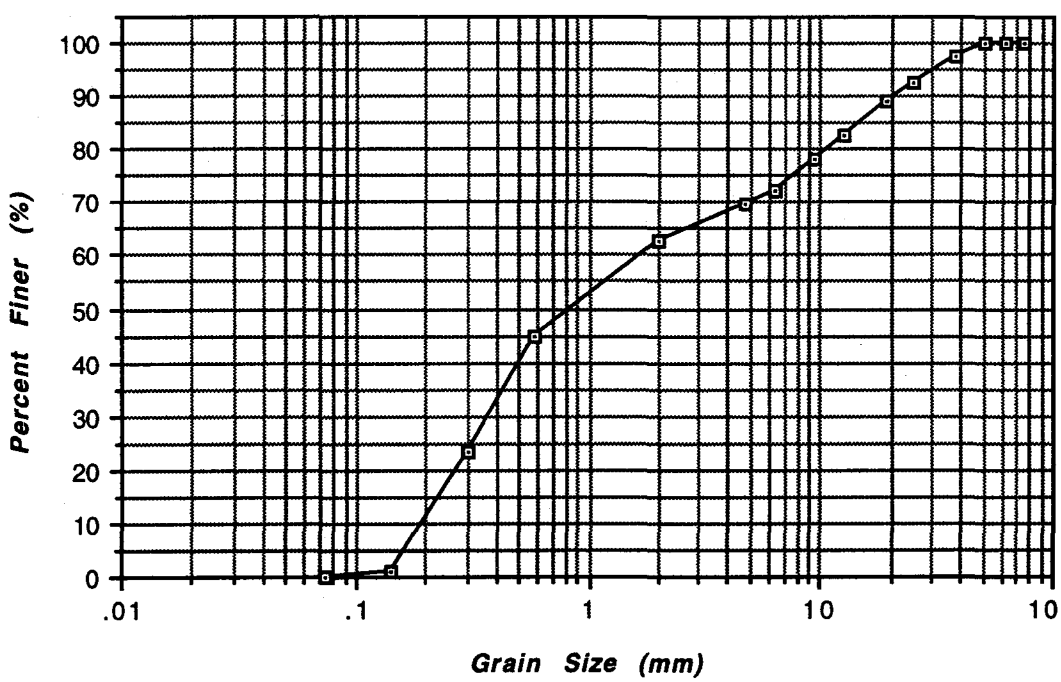

Fig. B-2-45 - Gradation Curve at Mile No. 18.420

Table B-2-46 - Gradation data collected at Station 18.920

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	2.279	0.02279
1	0.125	4.100	0.01821
2	0.250	12.376	0.08276
3	0.500	27.492	0.15116
4	1.000	39.640	0.12148
5	2.000	61.440	0.21800
6	4.000	67.724	0.06284
7	8.000	76.484	0.08761
8	16.000	91.103	0.14618
9	32.000	100.000	0.08897
10	64.000	100.000	0.00000

Note: * These values are used in the N record.

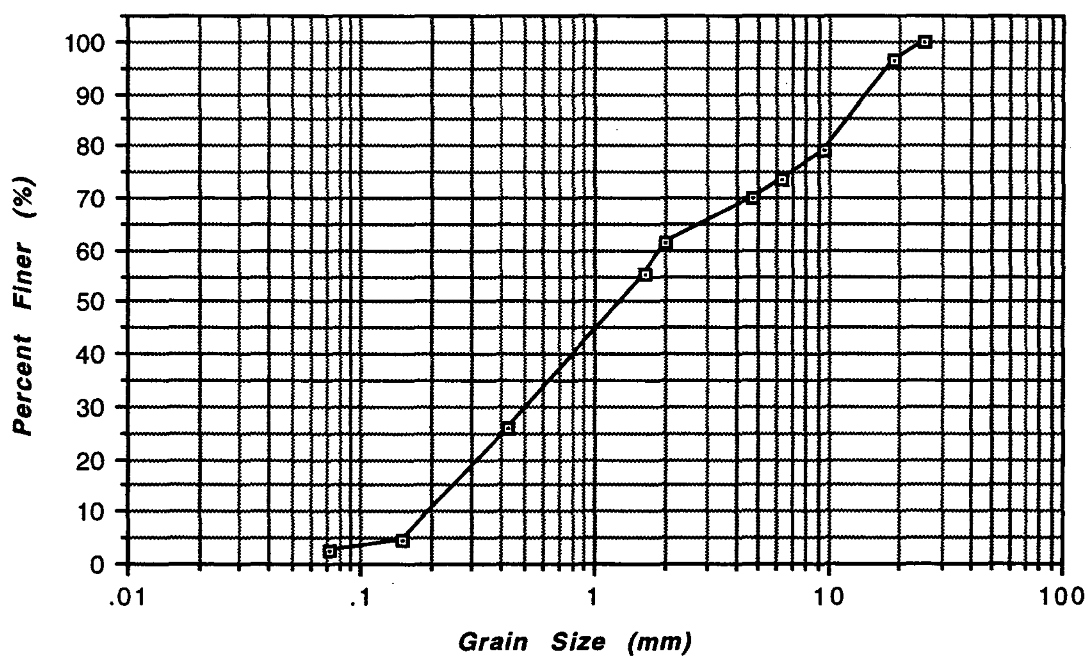

Fig. B-2-46 - Gradation Curve at Mile No. 18.920

Table B-2-47 - Gradation data collected at Station 19.440

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.614	0.01614
1	0.125	2.500	0.00886
2	0.250	3.800	0.01300
3	0.500	43.107	0.39307
4	1.000	50.782	0.07674
5	2.000	57.420	0.06638
6	4.000	61.667	0.04247
7	8.000	67.865	0.06198
8	16.000	76.951	0.09086
9	32.000	87.672	0.10721
10	64.000	95.967	0.08295

Note: * These values are used in the N record.

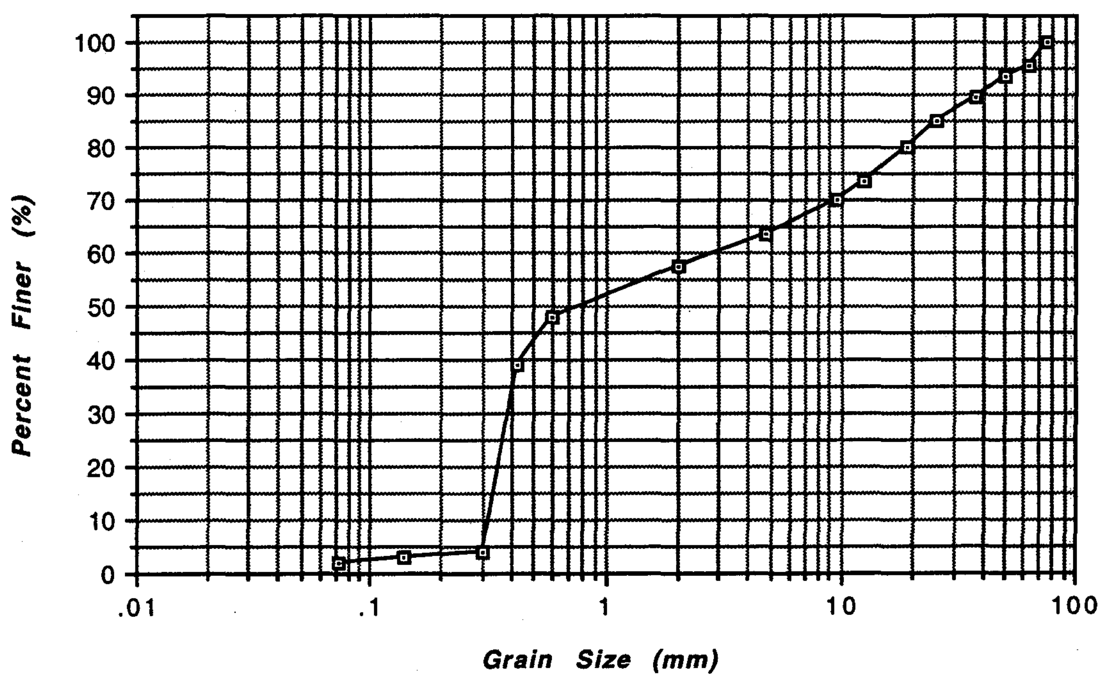

Fig. B-2-47- Gradation Curve at Mile No. 19.440

Table B-2-48 - Gradation data collected at Station 19.890

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.110	0.00110
1	0.125	0.757	0.00647
2	0.250	5.390	0.04633
3	0.500	36.125	0.30735
4	1.000	54.018	0.17892
5	2.000	70.670	0.16652
6	4.000	75.223	0.04553
7	8.000	80.000	0.04777
8	16.000	86.992	0.06992
9	32.000	93.982	0.06989
10	64.000	100.000	0.06018

Note: * These values are used in the N record.

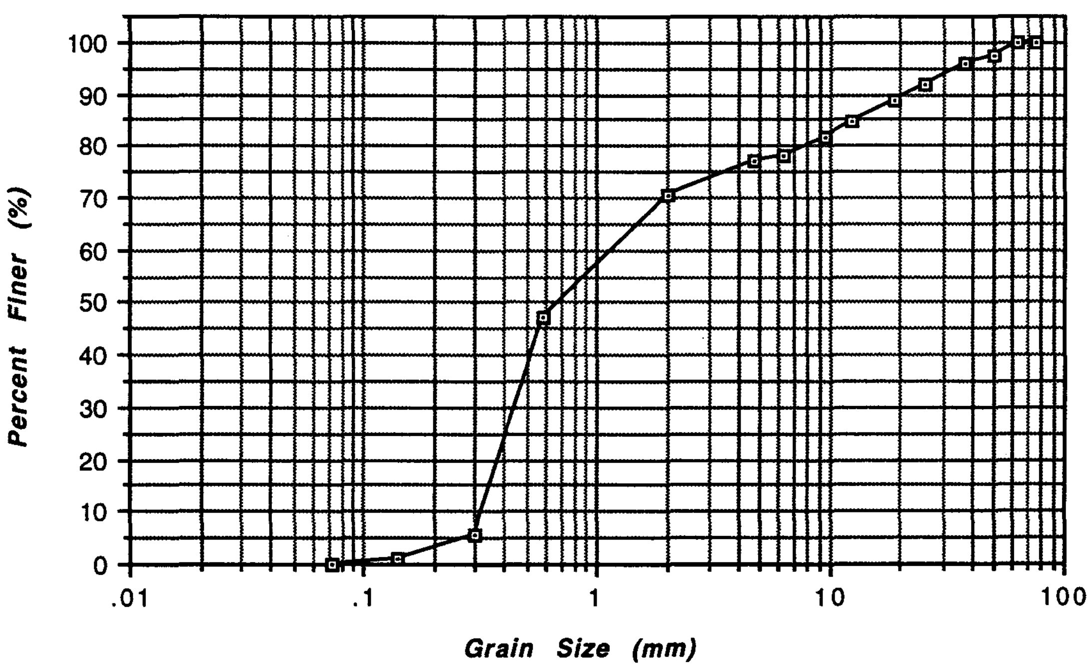

Fig. B-2-48 - Gradation Curve at Mile No. 19.890

Table B-2-49 - Gradation data collected at Station 20.450

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.110	0.00110
1	0.125	1.737	0.01627
2	0.250	10.680	0.08943
3	0.500	40.505	0.29824
4	1.000	71.015	0.30511
5	2.000	80.150	0.09135
6	4.000	82.463	0.02313
7	8.000	85.454	0.02991
8	16.000	90.892	0.05439
9	32.000	97.674	0.06782
10	64.000	100.000	0.02326

Note: * These values are used in the N record.

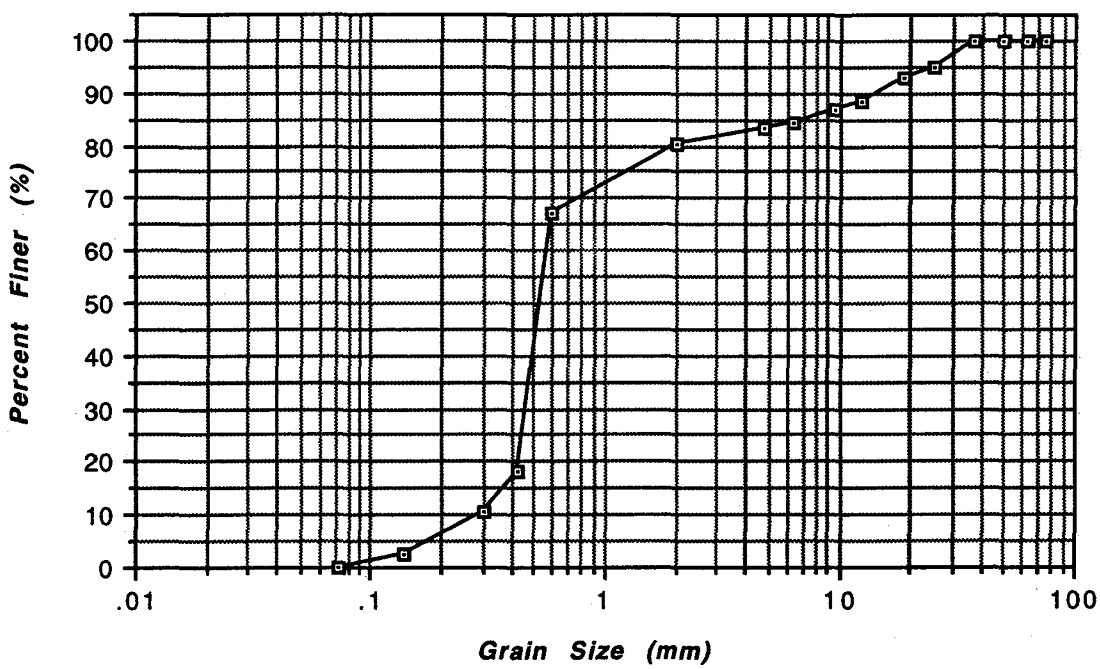

Fig. B-2-49 - Gradation Curve at Mile No. 20.450

Table B-2-50 - Gradation data collected at Station 20.830

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.492	0.00492
1	0.125	1.543	0.01051
2	0.250	5.760	0.04217
3	0.500	28.348	0.22588
4	1.000	52.971	0.24623
5	2.000	75.950	0.22979
6	4.000	79.826	0.03876
7	8.000	83.947	0.04121
8	16.000	89.808	0.05861
9	32.000	95.718	0.05910
10	64.000	100.000	0.04282

Note: * These values are used in the N record.

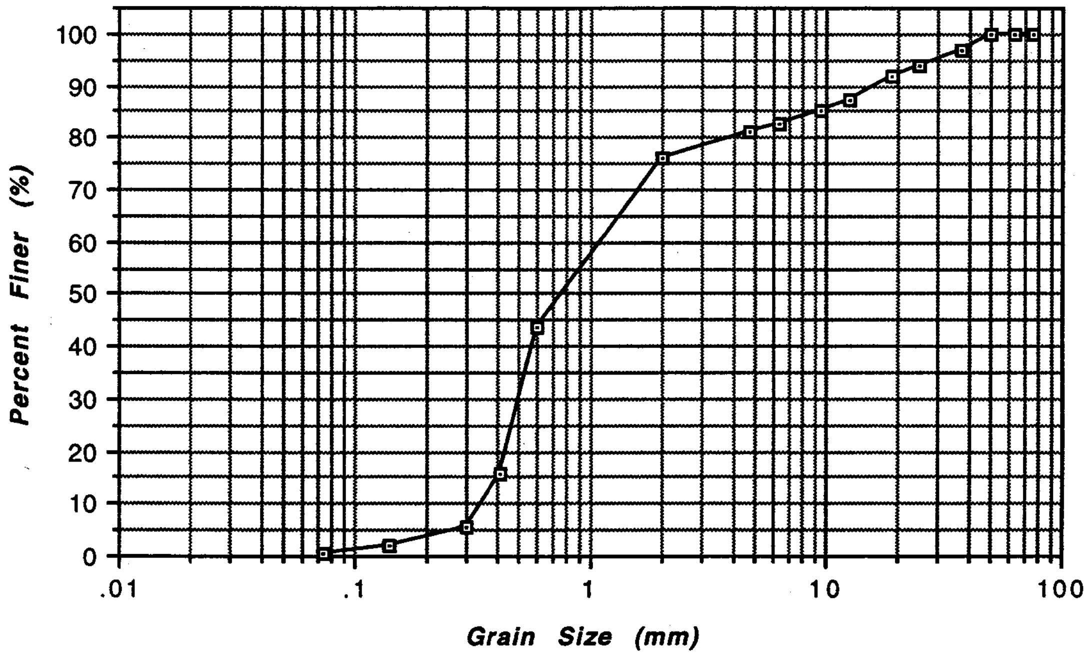

Fig. B-2-50 - Gradation Curve at Mile No. 20.830

Table B-2-51 - Gradation data collected at Station 21.680

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.783	0.00783
1	0.125	2.487	0.01704
2	0.250	10.500	0.08013
3	0.500	30.648	0.20148
4	1.000	66.115	0.35467
5	2.000	78.210	0.12095
6	4.000	85.391	0.07181
7	8.000	90.008	0.04617
8	16.000	94.140	0.04132
9	32.000	97.724	0.03584
10	64.000	100.000	0.02276

Note: * These values are used in the N record.

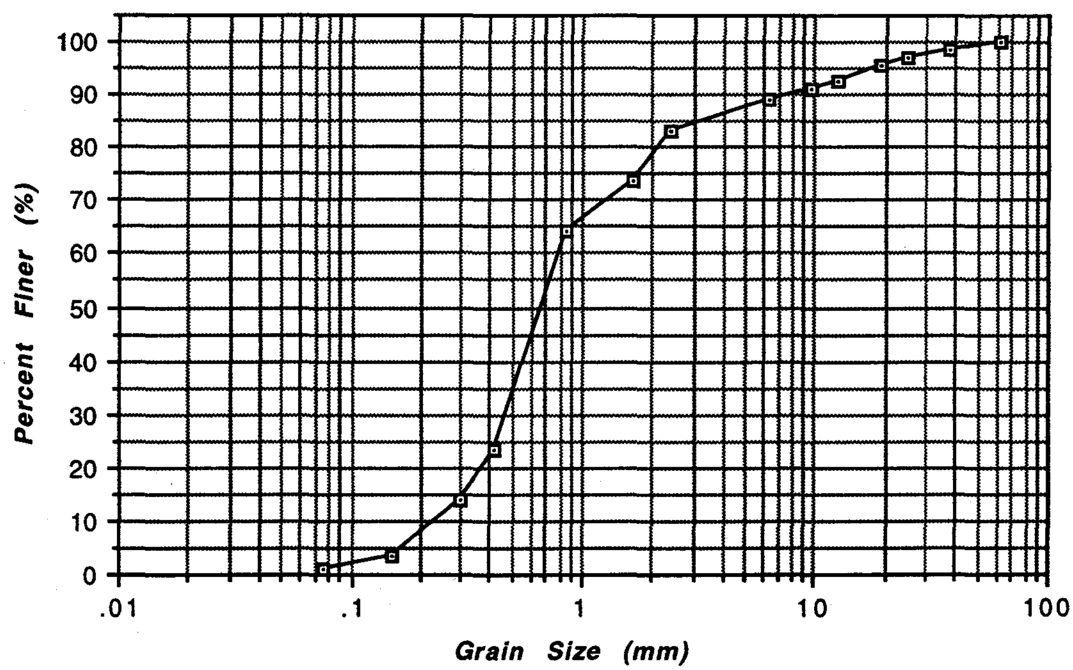

Fig. B-2-51 - Gradation Curve at Mile No. 21.680

Table B-2-52 - Gradation data collected at Station 21.760

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.899	0.00899
1	0.125	2.227	0.01327
2	0.250	10.267	0.08040
3	0.500	30.320	0.20053
4	1.000	63.783	0.33463
5	2.000	77.710	0.13927
6	4.000	86.992	0.09282
7	8.000	92.622	0.05630
8	16.000	95.983	0.03361
9	32.000	98.806	0.02823
10	64.000	100.000	0.01194

Note: * These values are used in the N record.

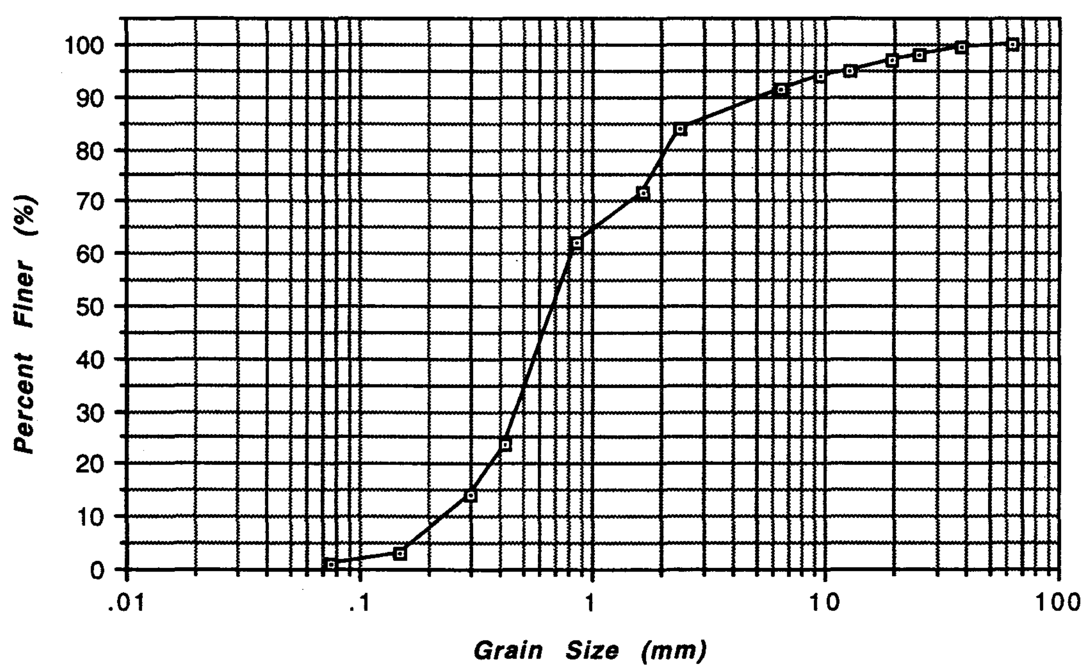

Fig. B-2-52 - Gradation Curve at Mile No. 21.760

Table B-2-53 - Gradation data collected at Station 22.320

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.052	0.00052
1	0.125	0.693	0.00642
2	0.250	6.650	0.05957
3	0.500	31.099	0.24449
4	1.000	48.257	0.17159
5	2.000	68.640	0.20383
6	4.000	76.524	0.07884
7	8.000	84.451	0.07927
8	16.000	91.874	0.07423
9	32.000	97.399	0.05525
10	64.000	100.000	0.02601

Note: * These values are used in the N record.

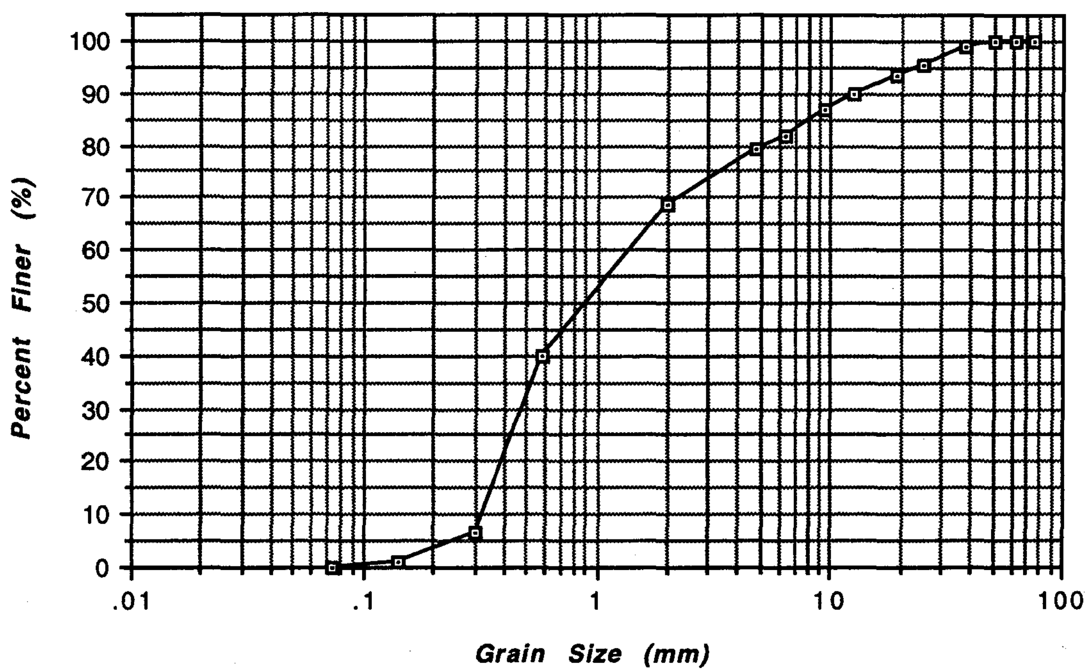

Fig. B-2-53 - Gradation Curve at Mile No. 22.320

Table B-2-54 - Gradation data collected at Station 22.790

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.052	0.00052
1	0.125	0.347	0.00295
2	0.250	8.387	0.08040
3	0.500	30.595	0.22208
4	1.000	57.996	0.27401
5	2.000	75.300	0.17304
6	4.000	80.733	0.05433
7	8.000	86.704	0.05972
8	16.000	91.778	0.05074
9	32.000	96.558	0.04780
10	64.000	100.000	0.03442

Note: * These values are used in the N record.

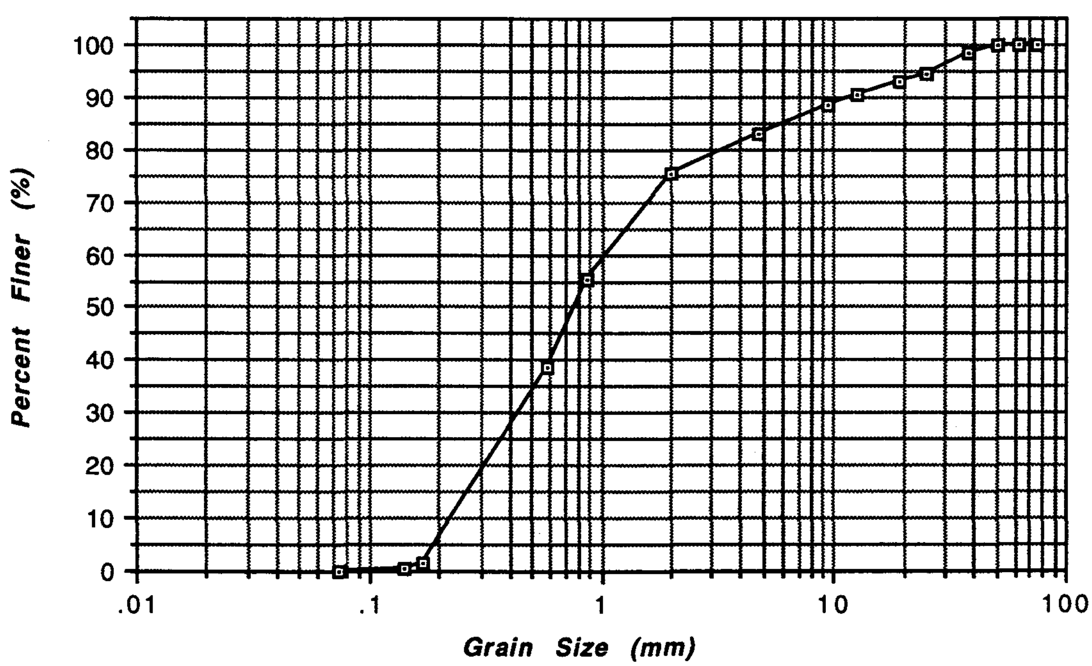

Fig. B-2-54 - Gradation Curve at Mile No. 22.790

Table B-2-55 - Gradation data collected at Station 23.350

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.351	0.00351
1	0.125	1.020	0.00669
2	0.250	6.551	0.05531
3	0.500	19.271	0.12720
4	1.000	37.537	0.18266
5	2.000	52.850	0.15313
6	4.000	59.504	0.06655
7	8.000	68.531	0.09027
8	16.000	78.096	0.09565
9	32.000	87.902	0.09806
10	64.000	97.589	0.09687

Note: * These values are used in the N record.

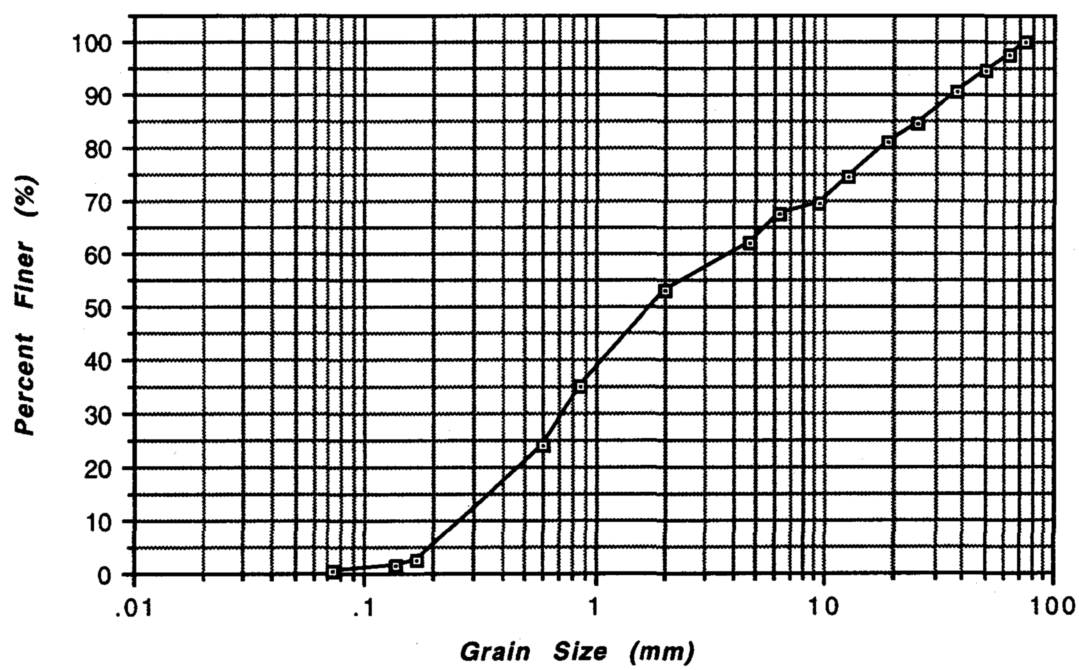

Fig. B-2-55 - Gradation Curve at Mile No. 23.350

Table B-2-56 - Gradation data collected at Station 23.890

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.118	0.00118
1	0.125	0.220	0.00102
2	0.250	1.320	0.01100
3	0.500	19.423	0.18103
4	1.000	36.731	0.17308
5	2.000	63.050	0.26319
6	4.000	71.356	0.08305
7	8.000	80.122	0.08766
8	16.000	87.857	0.07735
9	32.000	92.537	0.04680
10	64.000	97.754	0.05217

Note: * These values are used in the N record.

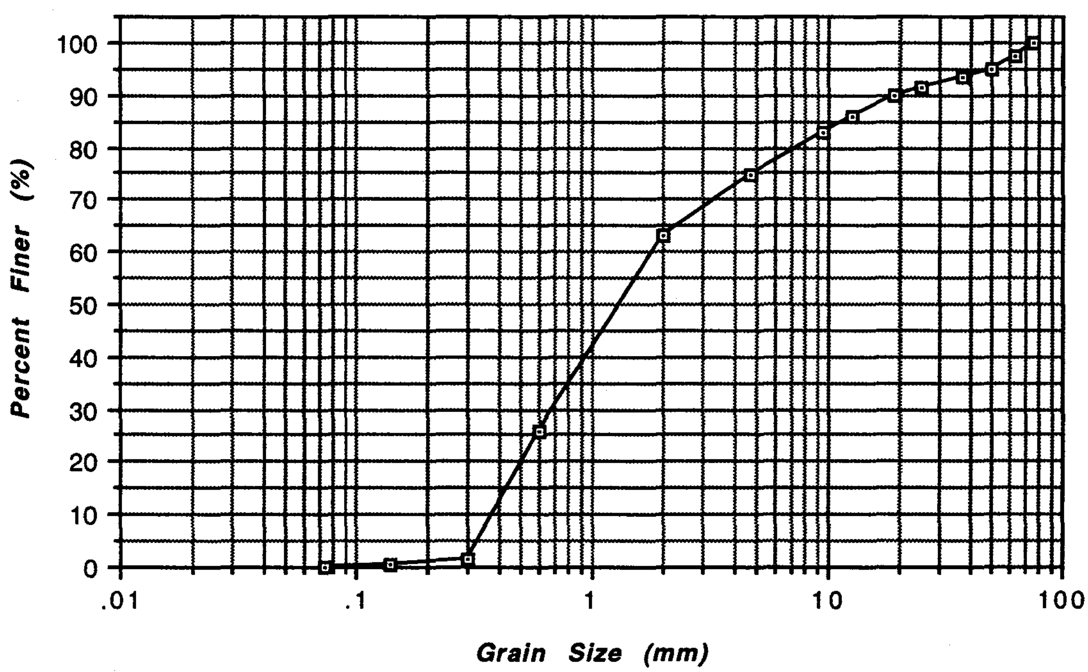

Fig. B-2-56 - Gradation Curve at Mile No. 23.890

Table B-2-57 - Gradation data collected at Station 24.350

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	4.556	0.04556
1	0.125	5.500	0.00944
2	0.250	5.560	0.00060
3	0.500	22.816	0.17255
4	1.000	38.689	0.15874
5	2.000	60.590	0.21901
6	4.000	72.954	0.12364
7	8.000	85.051	0.12097
8	16.000	93.615	0.08564
9	32.000	98.834	0.05219
10	64.000	100.000	0.01166

Note: * These values are used in the N record.

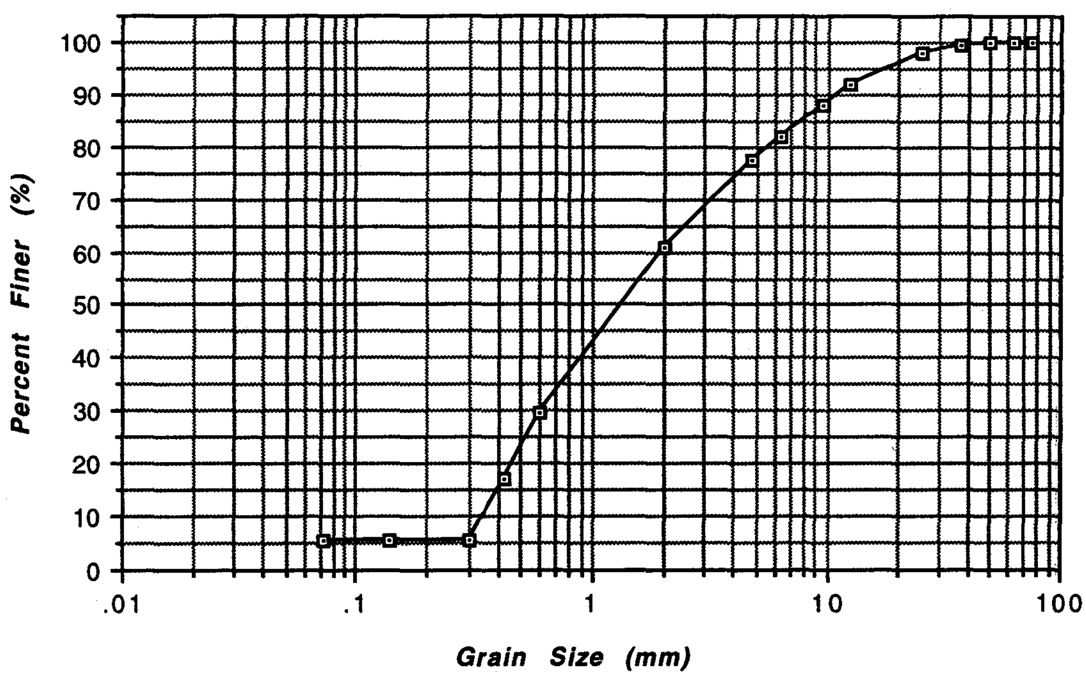

Fig. B-2-57 - Gradation Curve at Mile No. 24.350

Table B-2-58 - Gradation data collected at Station 24.900

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.351	0.00351
1	0.125	1.273	0.00923
2	0.250	5.740	0.04467
3	0.500	27.064	0.21324
4	1.000	41.806	0.14742
5	2.000	59.040	0.17234
6	4.000	64.684	0.05644
7	8.000	71.438	0.06754
8	16.000	81.516	0.10079
9	32.000	93.150	0.11634
10	64.000	100.000	0.06850

Note: * These values are used in the N record.

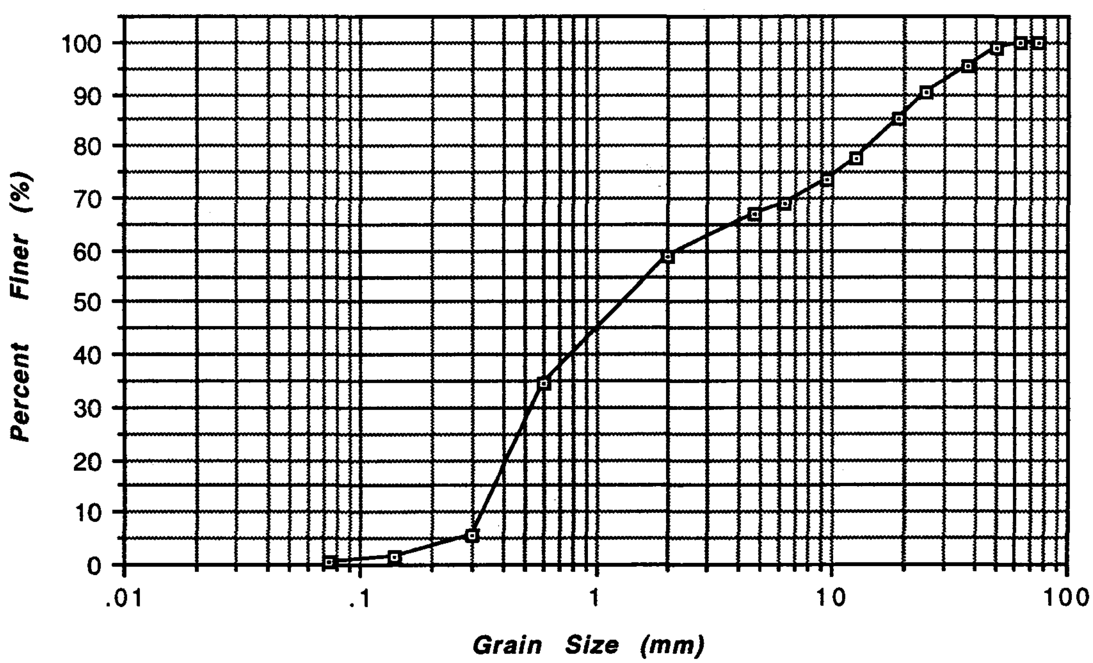

Fig. B-2-58 - Gradation Curve at Mile No. 24.900

Table B-2-59 - Gradation data collected at Station 25.370

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.151	0.00151
1	0.125	0.300	0.00149
2	0.250	1.280	0.00980
3	0.500	9.714	0.08434
4	1.000	21.805	0.12091
5	2.000	43.890	0.22085
6	4.000	54.414	0.20524
7	8.000	69.494	0.15080
8	16.000	81.009	0.11515
9	32.000	91.969	0.10960
10	64.000	100.000	0.08031

Note: * These values are used in the N record.

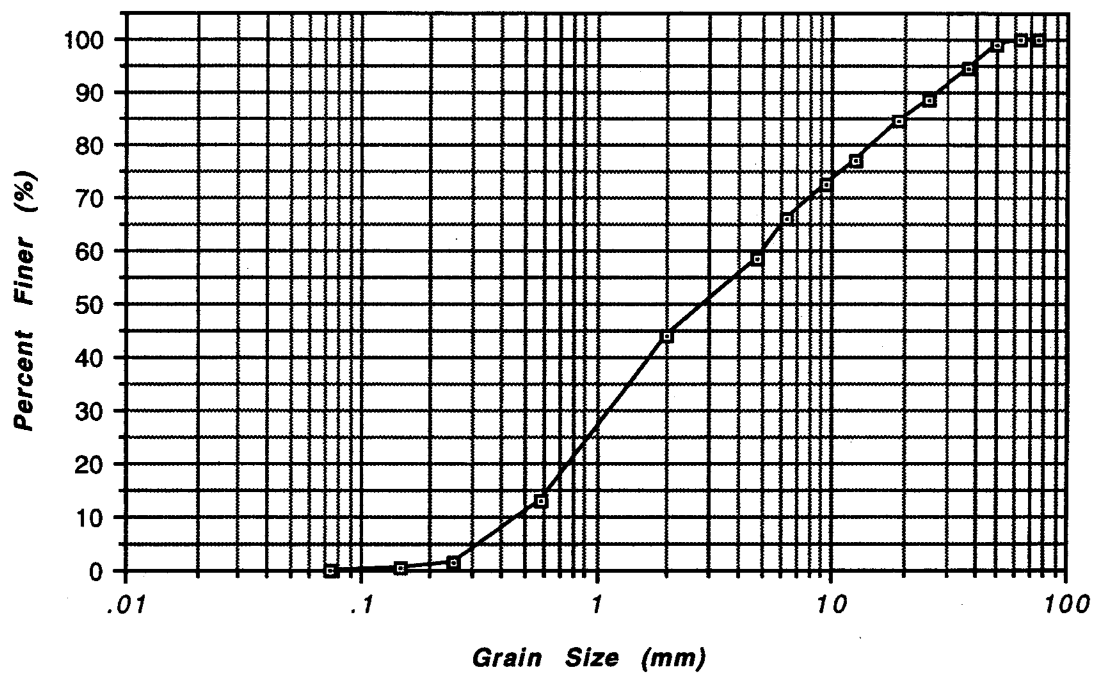

Fig. B-2-59 - Gradation Curve at Mile No. 25.370

Table B-2-60 - Gradation data collected at Station 25.860

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.949	0.00949
1	0.125	1.487	0.00538
2	0.250	4.580	0.03093
3	0.500	13.080	0.08500
4	1.000	34.859	0.21779
5	2.000	65.250	0.30391
6	4.000	76.021	0.10771
7	8.000	85.212	0.09192
8	16.000	89.190	0.03978
9	32.000	94.762	0.05572
10	64.000	98.148	0.03386

Note: * These values are used in the N record.

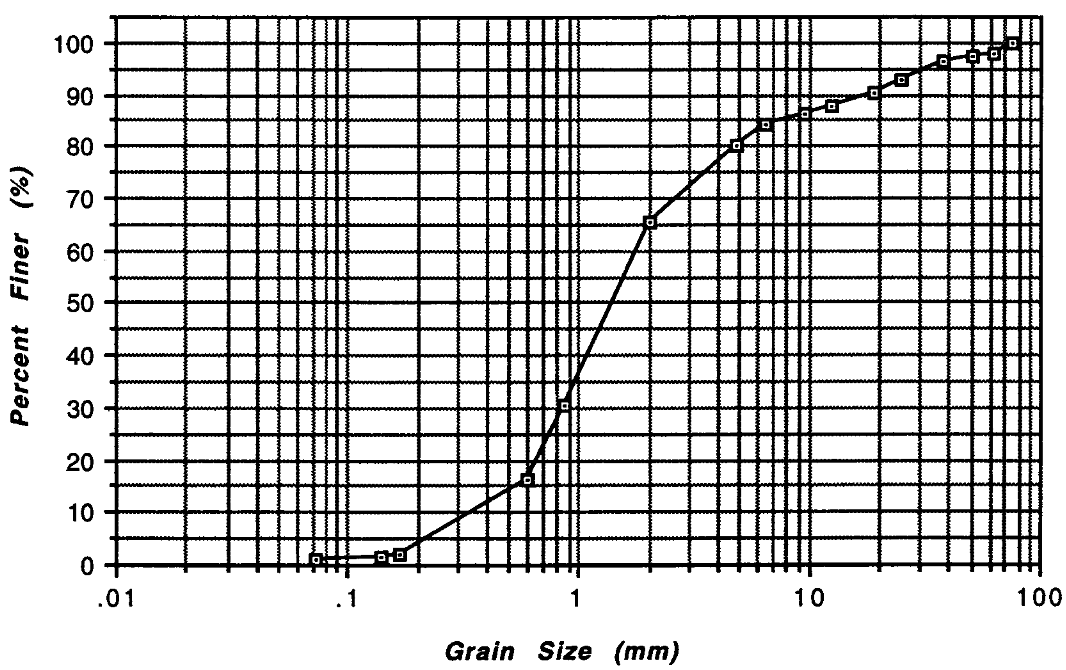

Fig. B-2-60 - Gradation Curve at Mile No. 25.860

Table B-2-61 - Gradation data collected at Station 26.290

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.193	0.00193
1	0.125	0.417	0.00224
2	0.250	4.531	0.04115
3	0.500	15.942	0.11411
4	1.000	36.260	0.20318
5	2.000	56.330	0.20070
6	4.000	63.152	0.06822
7	8.000	71.596	0.08444
8	16.000	79.332	0.07735
9	32.000	87.484	0.08152
10	64.000	97.727	0.10243

Note: * These values are used in the N record.

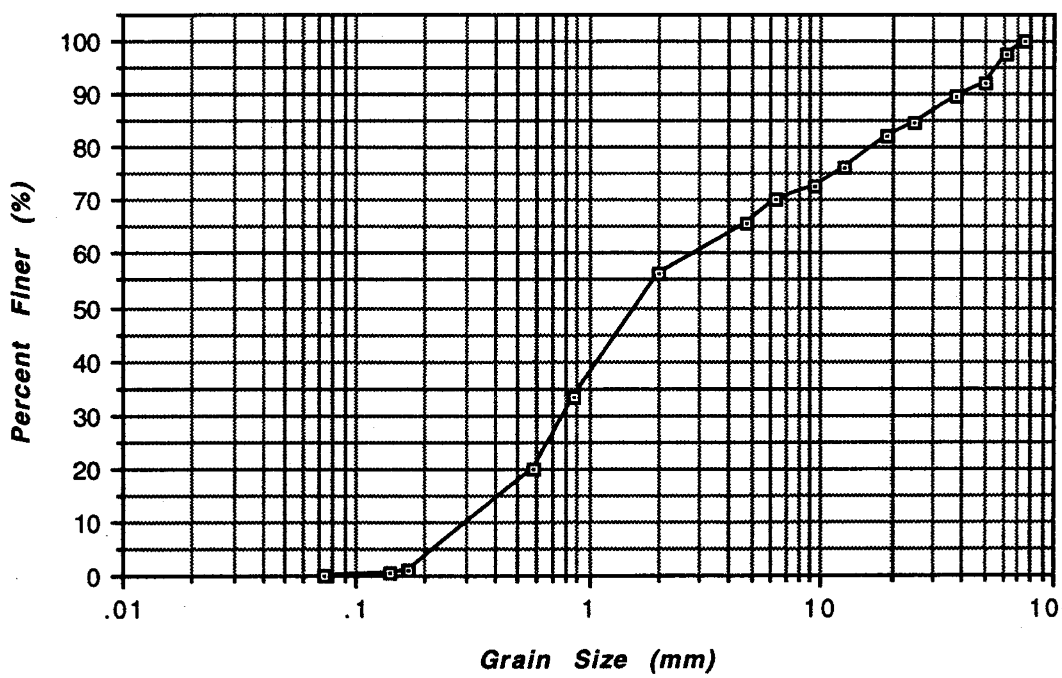

Fig. B-2-61 - Gradation Curve at Mile No. 26.290

Table B-2-62 - Gradation data collected at Station 26.550

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.210	0.00210
1	0.125	0.497	0.00287
2	0.250	1.880	0.01383
3	0.500	8.998	0.07118
4	1.000	18.943	0.09945
5	2.000	36.950	0.18007
6	4.000	48.325	0.11375
7	8.000	65.028	0.16703
8	16.000	78.270	0.13242
9	32.000	91.083	0.12813
10	64.000	100.000	0.08917

Note: * These values are used in the N record.

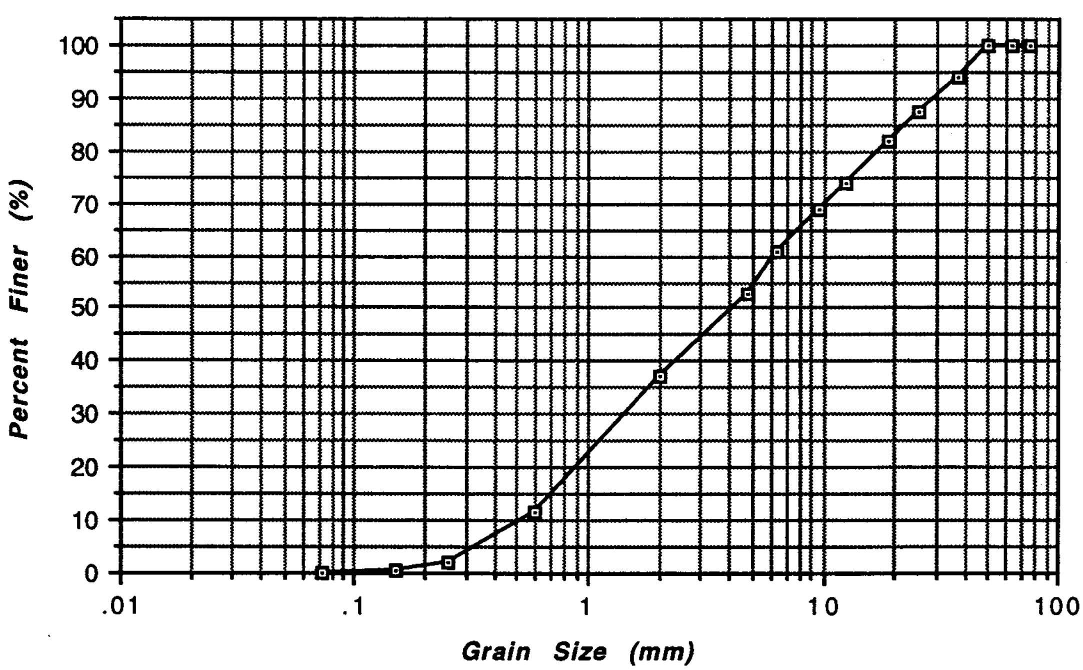

Fig. B-2-62 - Gradation Curve at Mile No. 26.550

Table B-2-63 - Gradation data collected at Station 26.7300

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.077	0.00077
1	0.125	0.130	0.00054
2	0.250	0.323	0.00193
3	0.500	8.589	0.08266
4	1.000	21.793	0.13204
5	2.000	45.020	0.23227
6	4.000	55.151	0.10131
7	8.000	69.835	0.14684
8	16.000	84.259	0.14424
9	32.000	92.917	0.08659
10	64.000	100.000	0.07083

Note: * These values are used in the N record.

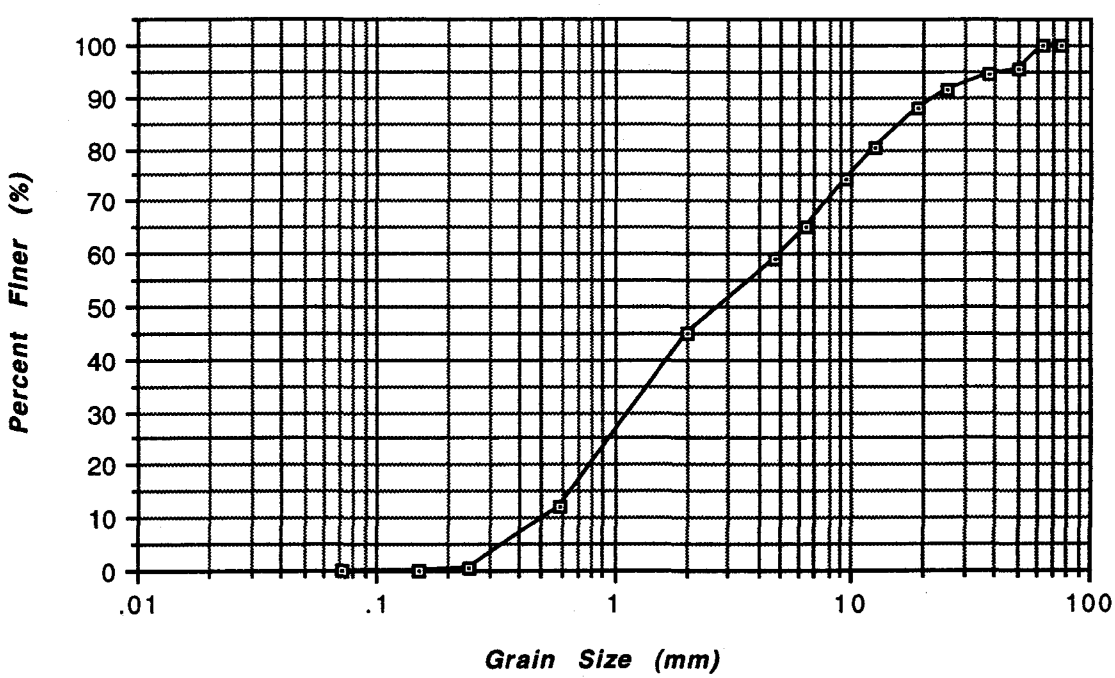

Fig. B-2-63 - Gradation Curve at Mile No. 26.730

Table B-2-64 - Gradation data collected at Station 27.300

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.318	0.00318
1	0.125	0.633	0.00316
2	0.250	1.990	0.01357
3	0.500	8.336	0.06346
4	1.000	20.633	0.12297
5	2.000	43.030	0.22397
6	4.000	53.757	0.10727
7	8.000	67.716	0.13958
8	16.000	76.049	0.08334
9	32.000	86.184	0.10135
10	64.000	96.398	0.10213

Note: * These values are used in the N record.

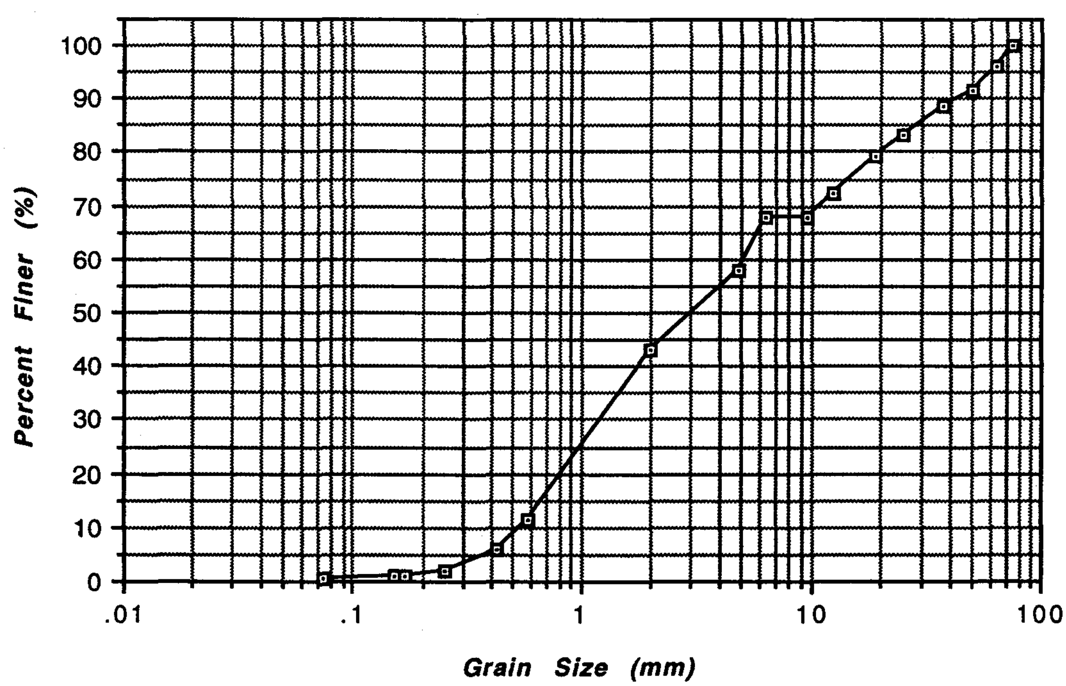

Fig. B-2-64 - Gradation Curve at Mile No. 27.300

Table B-2-65 - Gradation data collected at Station 27.680

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.268	0.00268
1	0.125	0.560	0.00292
2	0.250	2.830	0.02270
3	0.500	16.213	0.13383
4	1.000	27.877	0.11665
5	2.000	43.090	0.15213
6	4.000	50.035	0.06945
7	8.000	63.266	0.13230
8	16.000	76.485	0.13219
9	32.000	89.078	0.12590
10	64.000	99.982	0.10907

Note: * These values are used in the N record.

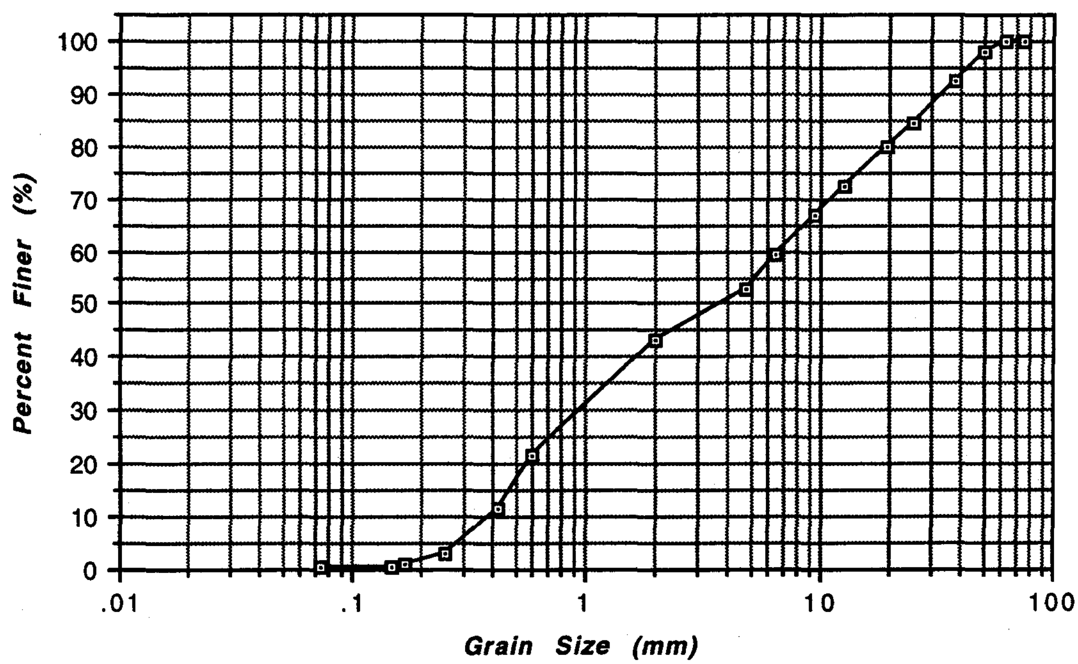

Fig. B-2-65 - Gradation Curve at Mile No. 27.680

Table B-2-66 - Gradation data collected at Station 28.120

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.099	0.01099
1	0.125	1.747	0.00648
2	0.250	3.622	0.01875
3	0.500	9.029	0.05408
4	1.000	15.691	0.06661
5	2.000	33.060	0.17370
6	4.000	43.418	0.10358
7	8.000	53.876	0.10459
8	16.000	65.048	0.11172
9	32.000	76.233	0.11185
10	64.000	90.237	0.14004

Note: * These values are used in the N record.

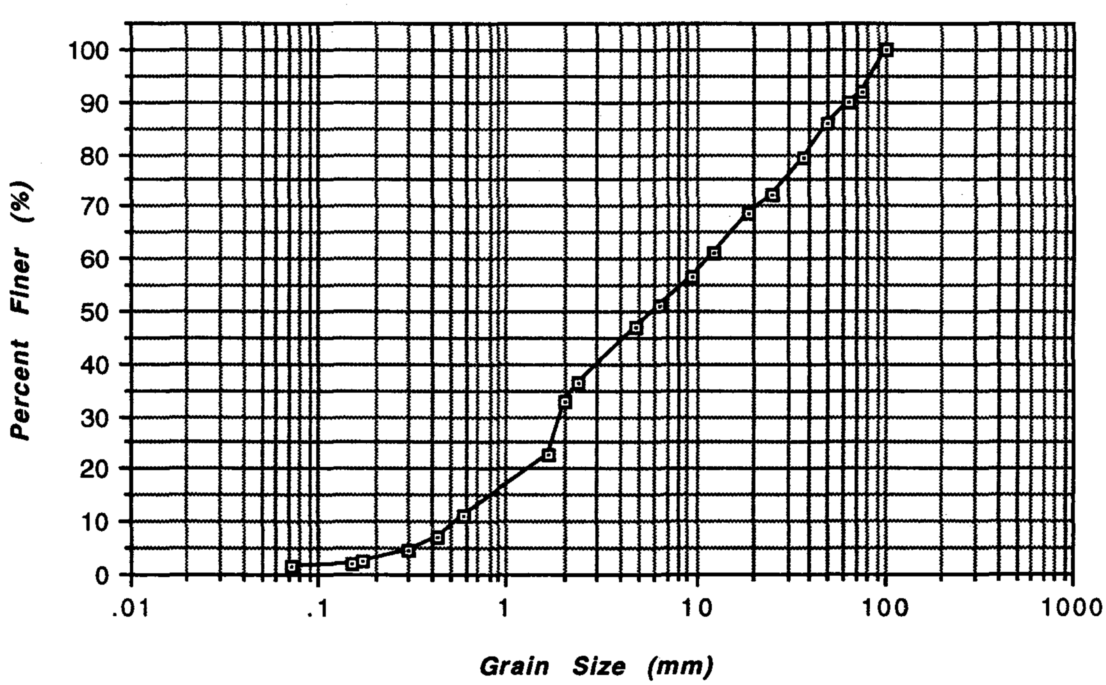

Fig. B-2-66 - Gradation Curve at Mile No. 28.120

Table B-2-67 - Gradation data collected at Station 28.210

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.077	0.00077
1	0.125	0.123	0.00047
2	0.250	0.290	0.00167
3	0.500	1.337	0.01047
4	1.000	3.840	0.02502
5	2.000	8.400	0.04560
6	4.000	11.673	0.03273
7	8.000	21.386	0.09714
8	16.000	46.664	0.25278
9	32.000	73.079	0.26415
10	64.000	99.982	0.26903

Note: * These values are used in the N record.

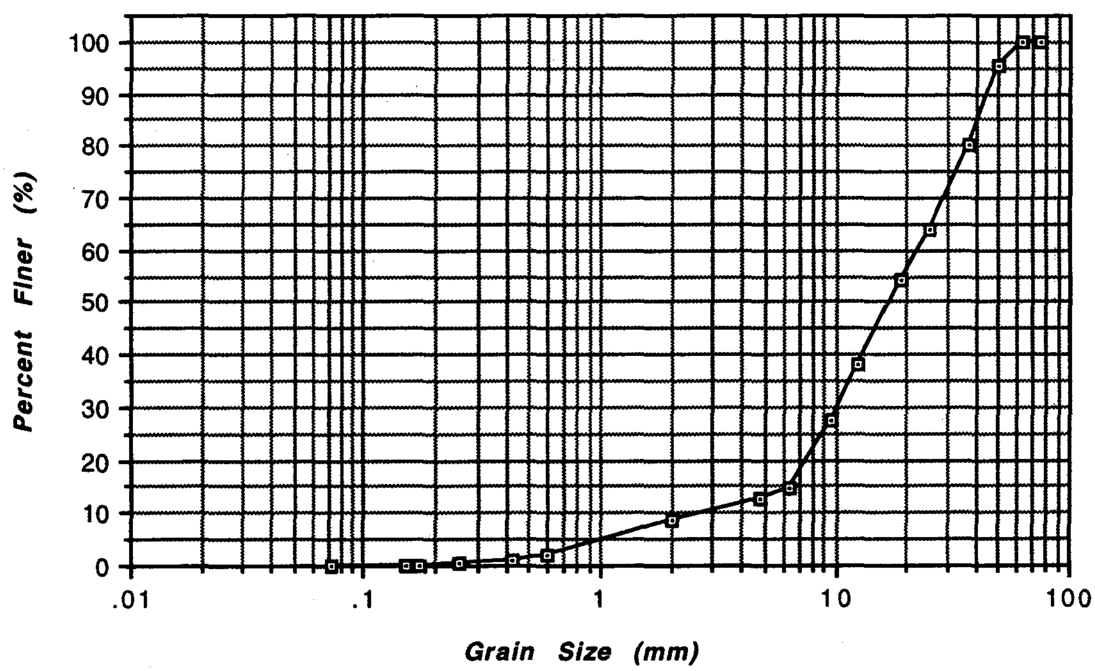

Fig. B-2-67 - Gradation Curve at Mile No. 28.210

Table B-2-68 - Gradation data collected at Station 28.670

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.800	0.00800
1	0.125	2.820	0.02021
2	0.250	10.090	0.07270
3	0.500	26.795	0.16705
4	1.000	46.094	0.19299
5	2.000	75.470	0.29376
6	4.000	82.968	0.07498
7	8.000	89.518	0.06550
8	16.000	94.398	0.04880
9	32.000	98.394	0.03996
10	64.000	100.000	0.01606

Note: * These values are used in the N record.

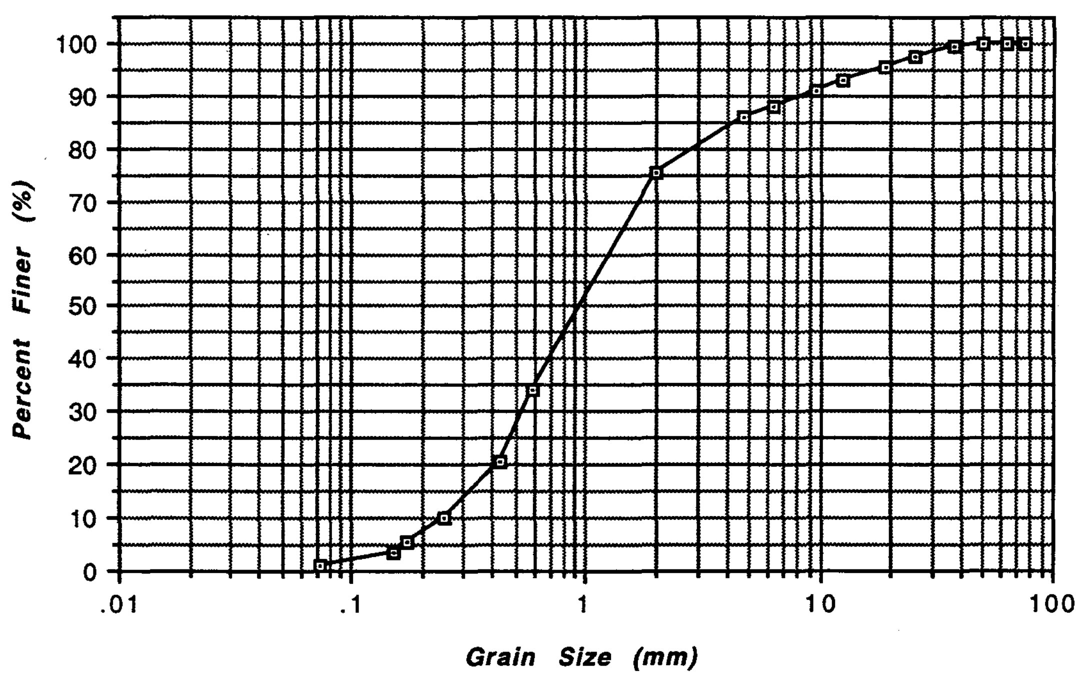

Fig. B-2-68 - Gradation Curve at Mile No. 28.670

Table B-2-69 - Gradation data collected at Station 29.040

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.583	0.00583
1	0.125	1.093	0.00510
2	0.250	2.070	0.00977
3	0.500	4.685	0.02615
4	1.000	11.023	0.06339
5	2.000	23.250	0.12227
6	4.000	34.203	0.10953
7	8.000	45.824	0.11622
8	16.000	62.625	0.16800
9	32.000	81.692	0.19067
10	64.000	100.000	0.18308

Note: * These values are used in the N record.

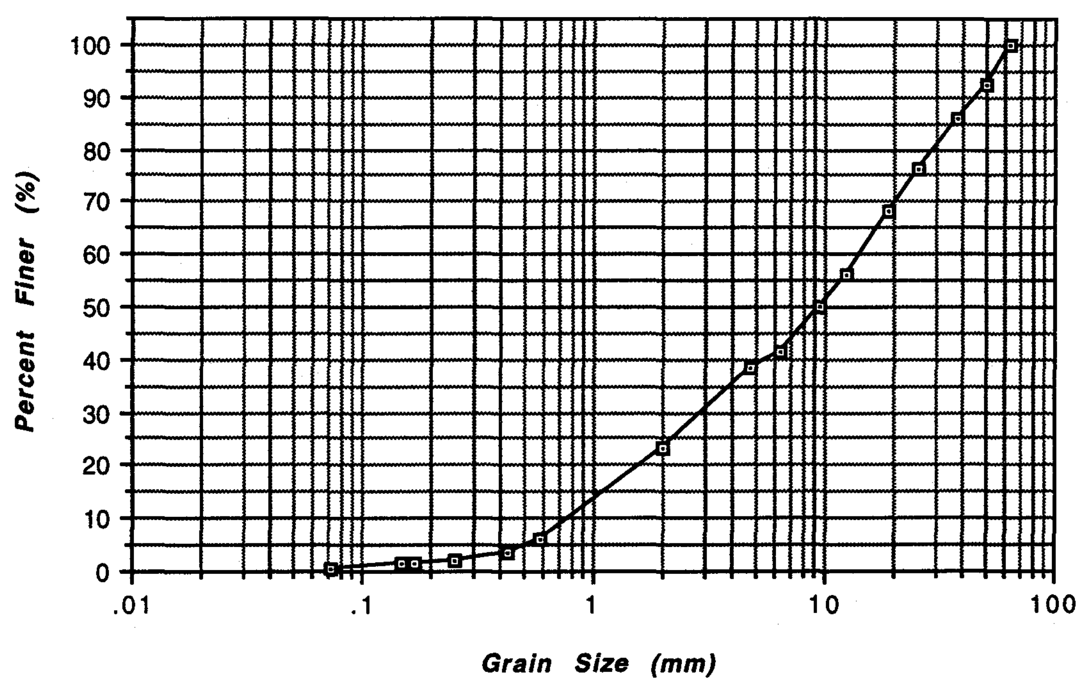

Fig. B-2-69 - Gradation Curve at Mile No. 29.040

Table B-2-70 - Gradation data collected at Station 29.800

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.060	0.00060
1	0.125	0.083	0.00024
2	0.250	0.120	0.00037
3	0.500	0.274	0.00154
4	1.000	0.452	0.00178
5	2.000	0.700	0.00248
6	4.000	1.136	0.00436
7	8.000	2.481	0.01344
8	16.000	7.372	0.04891
9	32.000	29.666	0.22294
10	64.000	91.530	0.61864

Note: * These values are used in the N record.

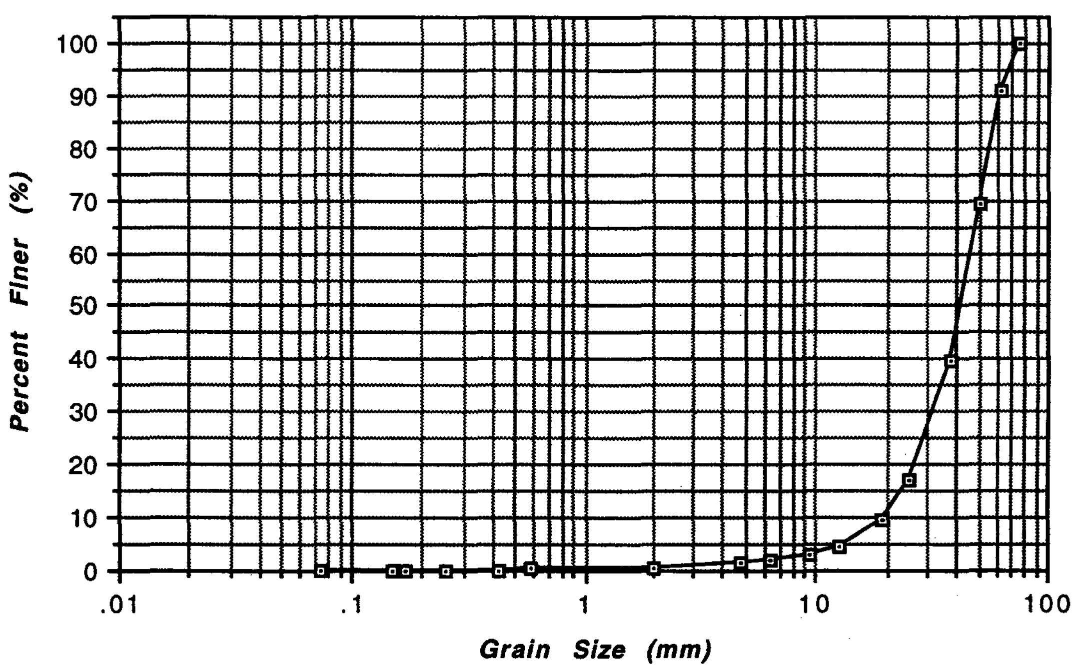

Fig. B-2-70 - Gradation Curve at Mile No. 29.800

Table B-2-71 - Gradation data collected at Station 30.260

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	3.010	0.03010
1	0.125	4.560	0.01550
2	0.250	7.850	0.03290
3	0.500	17.912	0.10062
4	1.000	31.699	0.13788
5	2.000	52.210	0.20511
6	4.000	59.585	0.07375
7	8.000	68.381	0.08796
8	16.000	74.574	0.06193
9	32.000	81.668	0.07095
10	64.000	100.000	0.18332

Note: * These values are used in the N record.

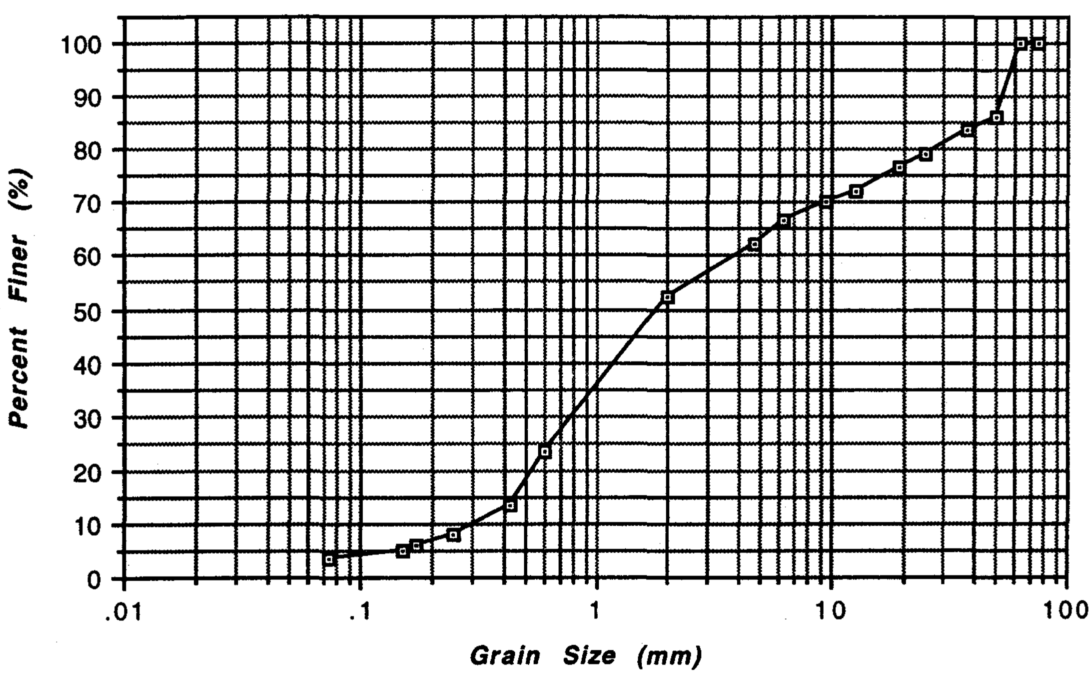

Fig. B-2-71 - Gradation Curve at Mile No. 30.260

Table B-2-72 - Gradation data collected at Station 30.820

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.899	0.00899
1	0.125	1.320	0.00421
2	0.250	2.240	0.00920
3	0.500	5.910	0.03670
4	1.000	13.843	0.07933
5	2.000	28.000	0.14957
6	4.000	37.738	0.08938
7	8.000	46.958	0.09220
8	16.000	58.862	0.11904
9	32.000	72.422	0.13559
10	64.000	100.000	0.027578

Note: * These values are used in the N record.

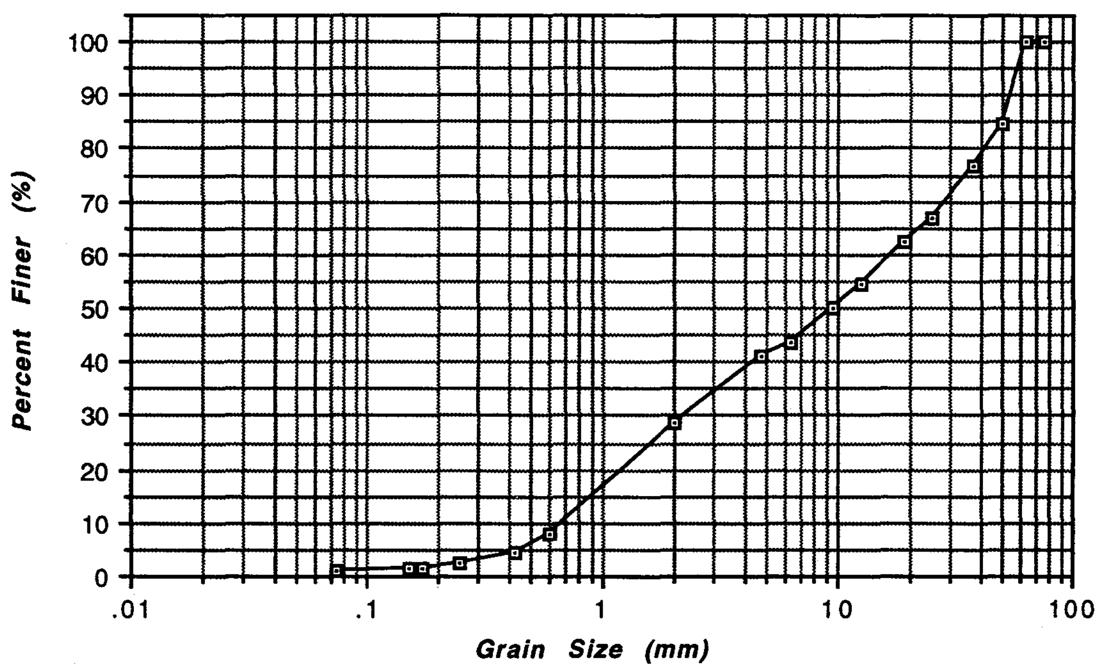

Fig. B-2-72 - Gradation Curve at Mile No. 30.820

Table B-2-73 - Gradation data collected at Station 31.290

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.218	0.00218
1	0.125	0.353	0.00136
2	0.250	0.670	0.00317
3	0.500	5.348	0.04678
4	1.000	21.914	0.16566
5	2.000	54.070	0.32156
6	4.000	67.815	0.13746
7	8.000	82.970	0.15155
8	16.000	91.607	0.08637
9	32.000	96.700	0.05093
10	64.000	100.000	0.03300

Note: * These values are used in the N record.

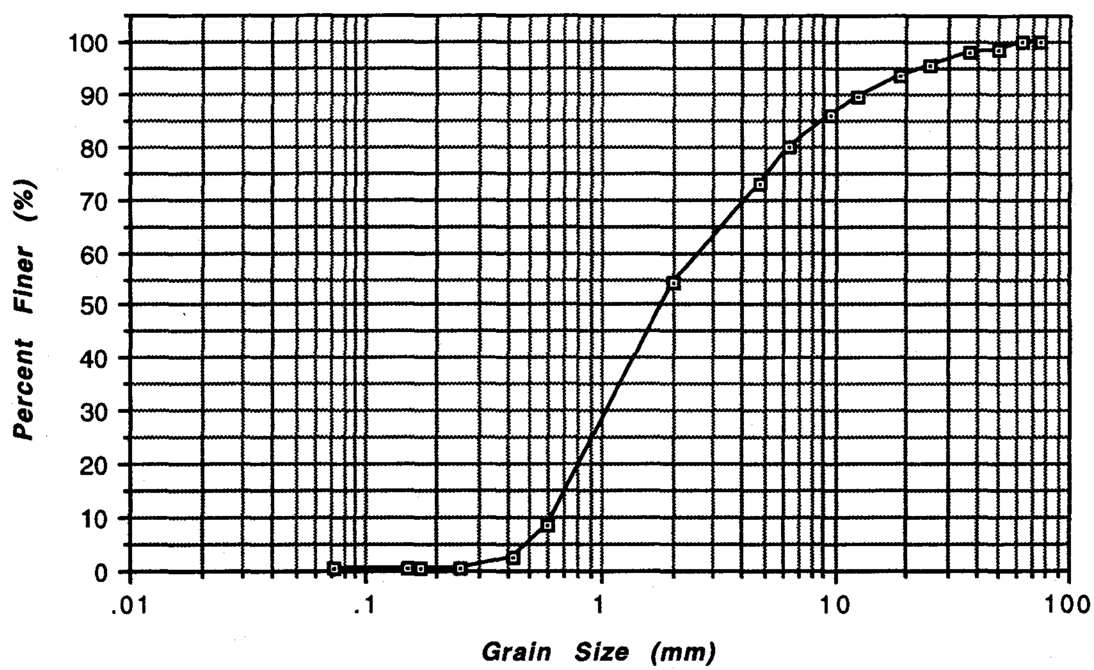

Fig. B-2-73 - Gradation Curve at Mile No. 31.290

Table B-2-74 - Gradation data collected at Station 31.860

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	9.817	0.09817
1	0.125	13.997	0.04180
2	0.250	17.450	0.03453
3	0.500	24.857	0.07407
4	1.000	35.082	0.10225
5	2.000	51.600	0.16518
6	4.000	58.865	0.07265
7	8.000	69.874	0.11009
8	16.000	76.792	0.06917
9	32.000	84.431	0.07639
10	64.000	100.000	0.15569

Note: * These values are used in the N record.

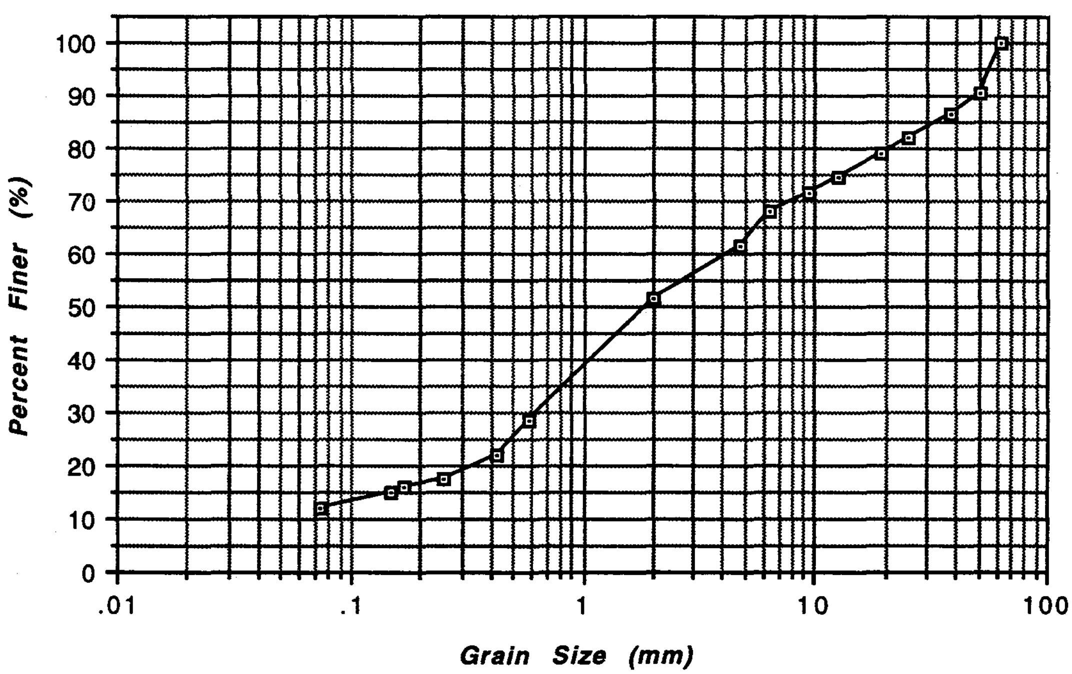

Fig. B-2-74 - Gradation Curve at Mile No. 31.860

Table B-2-75 - Gradation data collected at Station 32.430

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	1.523	0.01523
1	0.125	2.157	0.00634
2	0.250	3.070	0.00913
3	0.500	5.052	0.01982
4	1.000	9.113	0.04061
5	2.000	16.730	0.07617
6	4.000	21.334	0.04604
7	8.000	42.266	0.20933
8	16.000	51.198	0.08932
9	32.000	65.982	0.14784
10	64.000	82.061	0.16079

Note: * These values are used in the N record.

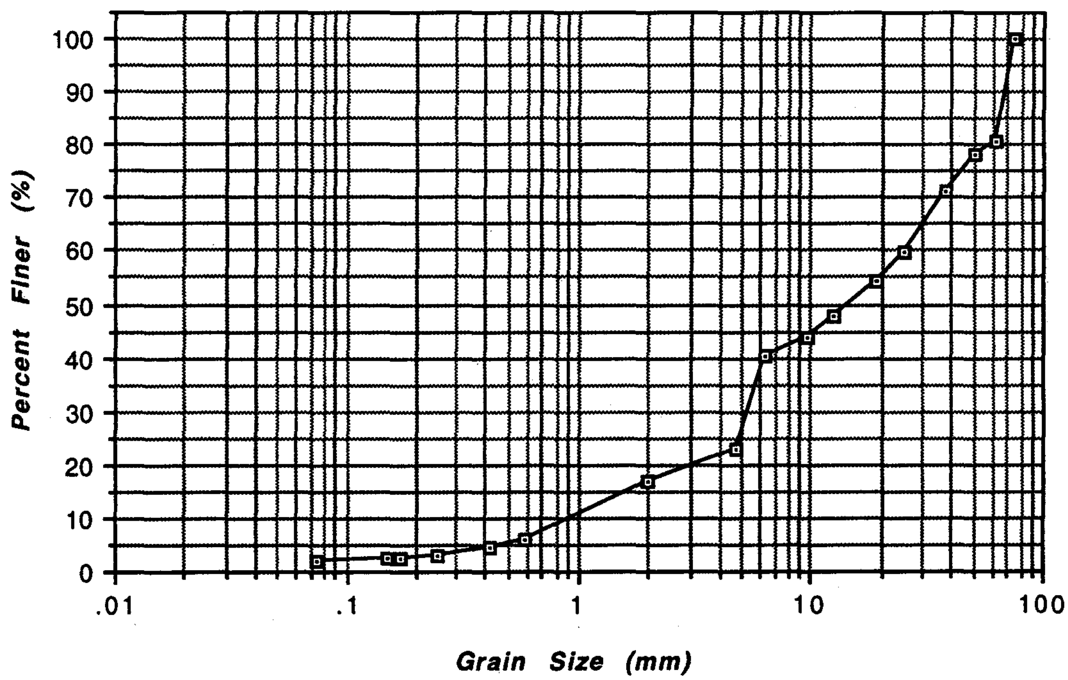

Fig. B-2-75 - Gradation Curve at Mile No. 32.430

Table B-2-76 - Gradation data collected at Station 32.980

No.	*Sediment Size (mm)*	*Percent Finer by Weight (%)*	*Fraction by Weight**
0	0.062	0.326	0.00326
1	0.125	0.590	0.00264
2	0.250	1.510	0.00920
3	0.500	4.495	0.02985
4	1.000	8.831	0.04337
5	2.000	16.030	0.07299
6	4.000	20.517	0.04487
7	8.000	28.544	0.08027
8	16.000	45.147	0.16603
9	32.000	69.229	0.24082
10	64.000	100.000	0.30771

Note: * These values are used in the N record.

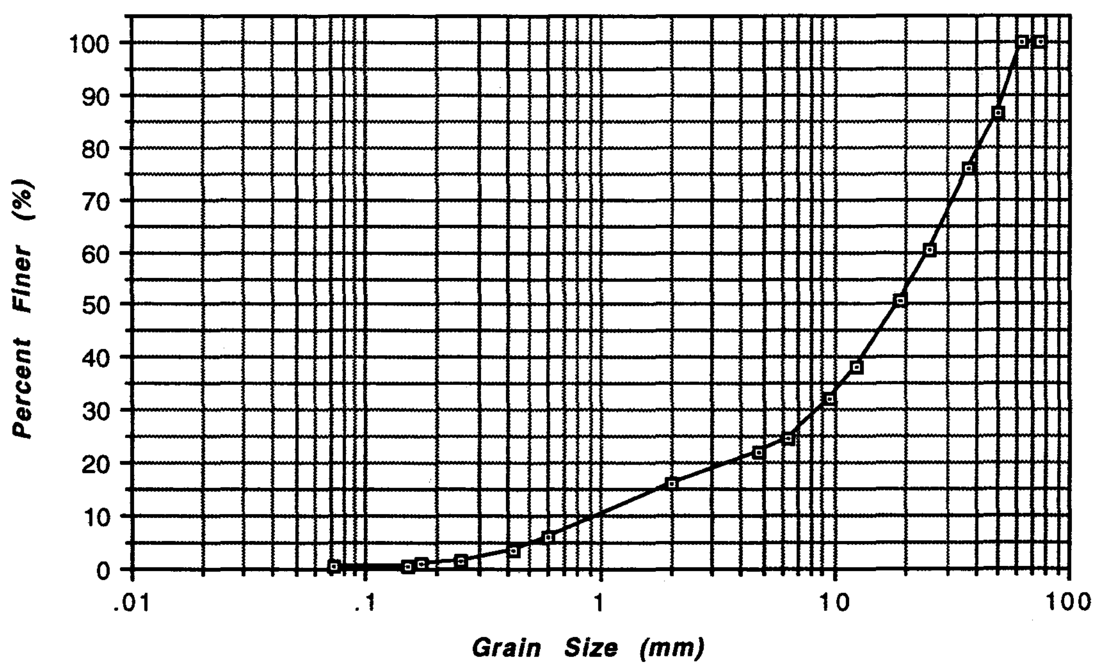

Fig. B-2-76 - Gradation Curve at Mile No. 32.980

B-3 *Inflowing Sediment Loads*

Using the HEC-6 Code, the following information were generated for various sediment transport functions:

Table B-3-1 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 1 [Toffaleti Formula]

Discharge , Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, Gs (tpd)	11301.1	90264.2	145083	156146.0
Very Fine Sand	1532.3	12396.0	20337.2	21664.1
Fine Sand	980.2	7829.2	12881.7	13720.3
Medium Sand	6687.3	53534.2	86004.1	92844.5
Coarse Sand	1696.6	13428.8	21077.6	22848.7
Very Coarse Sand	316.1	2407.8	3748.9	3994.3
Very Fine Gravel	57.1	422.4	674.0	703.6
Fine Gravel	16.8	123.3	201.7	209.4
Medium Gravel	7.7	54.9	90.4	93.8
Coarse Gravel	5.0	28.7	45.8	47.3
Very Coarse Gravel	2.2	38.9	21.2	19.8

Table B-3-2 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 3 [Maddens Modification (1963) of Laursen's Formula]

Discharge, Q (cfs)	4000.0	20000.0	67000.0
Sediment Load, G_S (tpd)	38274.0	278592.0	2200540.0
Very Fine Sand	8837.1	56671.2	404943.3
Fine Sand	3358.2	31233.0	416034.0
Medium Sand	13887.3	138404.5	1010377.9
Coarse Sand	4955.0	35278.1	285938.1
Very Coarse Sand	3501.3	11188.3	52746.9
Very Fine Gravel	1935.9	3774.9	16460.0
Fine Gravel	1178.5	1688.3	8208.0
Medium Gravel	621.2	353.8	5083.2
Coarse Gravel	0.0	0.0	748.2
Very Coarse Gravel	0.0	0.0	0.0

Table B-3-3 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 4 [Yang's Streampower Function]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	13900.2	110223.3	350663.1	604913.3
Very Fine Sand	787.8	6502.5	21510.6	33099.4
Fine Sand	356.7	2875.9	9322.2	16465.0
Medium Sand	4462.1	35162.7	111189.8	194150.7
Coarse Sand	4389.6	34066.4	105560.1	182512.7
Very Coarse Sand	3670.4	28379.6	86480.1	148133.4
Very Fine Gravel	87.8	562.2	1504.2	2211.6
Fine Gravel	84.6	687.7	1988.7	2991.8
Medium Gravel	61.3	985.7	3355.8	5279.0
Coarse Gravel	0.0	1000.7	5465.8	9526.6
Very Coarse Gravel	0.0	0.0	4285.6	10543.0

Table B-3-4 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 5 [Duboys Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	61850.2	325068.1	704987.8	1058847.5
Very Fine Sand	1059.2	5459.6	11691.7	17462.5
Fine Sand	1251.7	6448.8	13816.2	20634.3
Medium Sand	21034.1	108633.0	233061.8	348265.7
Coarse Sand	20427.5	106214.3	228640.8	342183.3
Very Coarse Sand	11998.6	63209.0	136918.4	205500.5
Very Fine Gravel	4063.3	22014.1	48295.6	72914.8
Fine Gravel	1510.2	8793.6	19881.6	30431.3
Medium Gravel	505.5	3949.2	9827.9	15660.9
Coarse Gravel	0.0	346.6	2853.9	5794.4
Very Coarse Gravel	0.0	0.0	0.0	0.0

Table B.3-5 -The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 7 [Ackers and White Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	16700.7	103099.7	318772.6	560082.5
Very Fine Sand	10720.1	51114.0	136075.8	232366.1
Fine Sand	614.1	6705.8	27518.7	54680.3
Medium Sand	2503.1	21199.6	72603.4	129257.7
Coarse Sand	1719.6	13094.9	41144.6	69356.8
Very Coarse Sand	840.9	6480.7	20028.4	33091.4
Very Fine Gravel	201.5	1841.0	6002.1	9993.9
Fine Gravel	94.0	1309.0	4850.2	8381.7
Medium Gravel	7.6	993.4	4811.8	8883.8
Coarse Gravel	0.0	361.4	4220.7	8965.0
Very Coarse Gravel	0.0	0.0	1516.9	5105.8

Table B-3-6 -The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 8 [Colby Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	4032.8	27873.2	66773.6	95300.3
Very Fine Sand	55.1	374.9	985.6	1515.1
Fine Sand	86.5	570.7	1414.8	2145.7
Medium Sand	1607.9	10885.8	26131.2	37353.7
Coarse Sand	2283.3	16041.8	38242.0	54285.8
Very Coarse Sand	0.0	0.0	0.0	0.0
Very Fine Gravel	0.0	0.0	0.0	0.0
Fine Gravel	0.0	0.0	0.0	0.0
Medium Gravel	0.0	0.0	0.0	0.0
Coarse Gravel	0.0	0.0	0.0	0.0
Very Coarse Gravel	0.0	0.0	0.0	0.0

Table B-3-7 -The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 9 [Toffaleti and Schoklitsch Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	15642.6	115699.0	204395.7	245111.6
Very Fine Sand	1571.8	12656.1	21008.2	22607.9
Fine Sand	1034.8	8193.3	13686.1	14899.5
Medium Sand	7932.8	60782.9	102100.9	116496.8
Coarse Sand	3232.8	21702.6	39689.0	50362.3
Very Coarse Sand	1342.8	8074.5	16789.4	23474.5
Very Fine Gravel	413.9	2666.3	6062.6	8874.2
Fine Gravel	110.6	1100.4	2799.02	4264.3
Medium Gravel	7.4	455.5	1597.5	2631.6
Coarse Gravel	4.8	28.7	641.7	1423.9
Very Coarse Gravel	0.0	38.9	21.2	76.6

Table B-3-8 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 10 [Meyer-Peter and Muller Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	10900.6	65493.9	175053.0	271187.9
Very Fine Sand	36.3	191.7	465.1	692.2
Fine Sand	72.0	381.3	927.0	1380.6
Medium Sand	2013.2	10752.0	26239.6	39133.6
Coarse Sand	3227.4	17535.4	43139.3	64518.2
Very Coarse Sand	3054.8	17215.4	43063.9	64776.6
Very Fine Gravel	1576.0	9653.9	25031.6	38110.5
Fine Gravel	768.5	5897.4	16633.5	26014.4
Medium Gravel	152.5	3582.8	12902.4	21595.8
Coarse Gravel	0.0	284.1	6650.6	14236.5
Very Coarse Gravel	0.0	0.0	0.0	729.5

Table B-3-9 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 12 [Toffaleti and Meyer-Peter & Muller Formula]

Discharge, Q (cfs)	4000.0	20000.0	45000.0	67000.0
Sediment Load, G_S (tpd)	21794.4	154974.0	319006.3	426247.1
Very Fine Sand	1557.2	12589.1	20884.8	22454.6
Fine Sand	1033.8	8207.3	13804.4	15097.0
Medium Sand	8496.5	64203.8	112130.1	131876.3
Coarse Sand	4834.4	30759.5	63917.5	87090.2
Very Coarse Sand	3322.8	19373.0	46419.9	68391.1
Very Fine Gravel	1613.5	9950.7	25500.5	38609.1
Fine Gravel	776.4	5958.8	16732.7	26119.2
Medium Gravel	155.0	3601.8	12933.6	21628.6
Coarse Gravel	4.8	291.0	6661.7	14248.0
Very Coarse Gravel	0.0	38.9	21.2	732.8

Table B-3-10 -The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 13 [Madden's Modification (1985) of Laursen's Formula]

Discharge, Q (cfs)	4000.0	20000.0	67000.0
Sediment Load, G_S (tpd)	16351.0	88347.0	274768.0
Very Fine Sand	3726.2	22833.3	84320.8
Fine Sand	1141.8	8852.4	41426.8
Medium Sand	5557.4	40695.3	134117.0
Coarse Sand	3498.5	11547.0	11012.7
Very Coarse Sand	1567.6	2953.4	2481.2
Very Fine Gravel	507.0	957.7	906.7
Fine Gravel	240.2	421.4	412.2
Medium Gravel	112.5	86.6	90.7
Coarse Gravel	0.0	0.0	0.0
Very Coarse Gravel	0.0	0.0	0.0

Table B-3-11 - The water discharge (Q) - sediment discharge (G_s) relationship derived for MTC = 9 at the New River Mouth [Toffaleti and Schoklitsch Formula]

Discharge, Q (cfs)	1000.0	5000.0	10000.0
Sediment Load, G_S (tpd)	1094.2	6855.2	16014.9
Very Fine Sand	309.2	1778.6	4540.5
Fine Sand	473.7	2772.4	6059.4
Medium Sand	157.3	1112.1	2638.8
Coarse Sand	116.2	795.9	1852.0
Very Coarse Sand	35.0	341.0	756.4
Very Fine Gravel	1.4	38.3	94.3
Fine Gravel	0.8	13.5	60.9
Medium Gravel	0.6	1.9	10.7
Coarse Gravel	0.0	1.5	1.9
Very Coarse Gravel	0.0	0.0	0.0

Table B-3-12 - Inflowing Sediment Load at Station 33.82

Discharge, Q (cfs)	4000.0	20000.0	40000.0	60000.0	85000.0
Sediment Load, G_S (tpd)	3082.0	26603.8	56357.5	97056.4	155824.5
Very Fine Sand	678.9	3198.1	7590.6	13896.4	23818.8
Fine Sand	797.6	4516.1	9980.0	17707.9	30111.9
Medium Sand	899.0	6484.7	13541.1	23186.9	37924.5
Coarse Sand	353.7	4170.1	8498.8	14502.4	23048.7
Very Coarse Sand	216.6	2930.2	5848.0	9682.1	14597.5
Very Fine Gravel	66.9	984.5	1922.1	3092.6	4478.8
Fine Gravel	55.5	1088.3	2116.1	3375.3	4808.6
Medium Gravel	11.4	1421.8	2810.0	4529.0	6466.1
Coarse Gravel	1.6	1193.3	2484.4	4151.0	6042.4
Very Coarse Gravel	1.0	616.7	1566.4	2932.9	4527.2

APPENDIX C- Hydrologic Data

C.1 Stage-Discharge Rating Data

Table C.1.1 - Water surface elevation using slope-area method

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	912.54*	914.78	915.60	917.15	918.24
10,000	913.40*	915.74	916.62	918.04	919.08
20,000	914.36*	917.13	918.05	919.24	920.17
30,000	915.16*	918.21	919.17	920.29	921.16
40,000	915.78*	919.06	919.93	920.91	921.75
50,000	916.48*	919.79	920.62	921.56	922.38
60,000	917.25*	920.35	921.20	922.11	922.92
80,000	918.16*	921.35	922.20	923.07	923.84
100,000	918.79*	922.26	923.07	923.91	924.63

Note: Critical depth is assumed at the first cross-section (Station No. 0.16).
* Critical depth is assumed as input.

Table C.1.2 - Water surface elevation using slope-area method
[Energy slope, Se = 0.001]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	914.00	914.62	915.61	917.14	918.24
10,000	915.24	915.83	916.65	918.04	919.08
20,000	916.99	917.55	918.24	919.28	920.18
30,000	918.46	919.02	919.63	920.48	921.25
40,000	919.16	919.73	920.30	921.07	921.82
50,000	919.94	920.52	921.06	921.77	922.49
60,000	920.63	921.20	921.72	922.39	923.07
80,000	921.74	922.30	922.81	923.43	924.06
100,000	922.69	923.21**	923.12**	923.93	924.64

Note: ** Critical depth is assumed by the program.

Table C.1.3 - Water surface elevation by slope-area method [Energy slope, Se = 0.0015]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	913.71	914.56	915.62	917.14	918.24
10,000	914.82	915.65	916.61	918.04	919.08
20,000	916.44	917.25	918.10	919.25	920.17
30,000	917.71	918.53	919.33	920.35	921.18
40,000	918.48	919.31	920.08	920.96	921.77
50,000	919.23	920.08	920.79	921.63	922.41
60,000	919.86	920.73	921.41	922.21	922.97
80,000	920.95	921.80	922.46	923.22	923.93
100,000	921.83	922.58*	922.46*	923.61	924.47

Note: * Critical depth is assumed by the program.

Table C.1.4 - Water surface elevation by slope-area method [Energy slope, Se = 0.002]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	913.53	914.55	915.63	917.13	918.24
10,000	914.56	915.59	916.60	918.04	919.08
20,000	916.06	917.10	918.04	919.24	920.17
30,000	917.24	918.30	919.21	920.30	921.16
40,000	918.00	919.10	919.95	920.92	921.75
50,000	918.74	919.84	920.65	921.57	922.38
60,000	919.37	920.50	921.27	922.15	922.94
80,000	920.38	921.53	922.30	923.13	923.87
100,000	921.26	922.38	923.14	923.94	924.65

Note: * critical depth is assumed by the program.

Table C.1.5 - Water surface elevation by slope-area method
[Energy slope, Se = 0.003]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	913.28	914.58	915.62	917.14	918.24
10,000	914.24	915.56	916.60	918.04	919.08
20,000	915.56	916.98	918.00	919.23	920.16
30,000	916.64	918.11	919.13	920.27	921.15
40,000	917.42	918.95	919.88	920.89	921.74
50,000	918.06	919.64	920.56	921.53	922.36
60,000	918.67	920.26	921.15	922.09	922.91
80,000	919.69	921.33	922.18	923.07	923.84
100,000	920.45	922.14	923.01	923.87	924.61

Table C.1.6 - Water surface elevation by slope-area method
[Energy slope, Se = 0.004]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	913.13	914.61*	915.62	917.14	918.24
10,000	914.00	915.58*	916.61	918.05	919.08
20,000	915.24	916.96	918.00	919.23	920.17
30,000	916.26	918.05	919.11	920.26	921.15
40,000	916.99	918.90*	919.87	920.89	921.74
50,000	917.65	919.60*	920.54	921.52	922.36
60,000	918.18	920.20	921.13	922.08	922.90
80,000	919.16	921.24	922.14	923.04	923.83
100,000	919.94	922.10	922.99	923.86	924.61

Note: * Critical depth is assumed by the program.

Table C.1.7 - Water surface elevation by slope-area method
[Energy slope, Se = 0.005]

Discharge (cfs)	Water Surface Elevation at Stations 0.16	0.25	0.35	0.44	0.54
5,000	913.00	914.63*	915.61	917.14	918.24
10,000	913.84	915.60*	916.60	918.04	919.08
20,000	915.00	916.97*	918.01	919.23	920.17
30,000	915.95	918.05*	919.11	920.26	921.15
40,000	916.69	918.90*	919.87	920.88	921.74
50,000	917.33	919.62*	920.55	921.52	922.36
60,000	917.85	920.21*	921.13	922.80	922.90
80,000	918.77	921.23*	922.13	923.04	923.83
100,000	919.57	922.12*	923.00	923.87	924.61

Note: * Critical depth is assumed by the program.

C.2 Hydrologic Data

Table C.2.1 - Hydrograph for a 50-Year Peak Discharge

N	Time (Days) Duration	Cumulative	New Waddel Release (cfs)	New River Discharge (cfs)	Total (cfs)
1	0.000	0.000	0.00	0.00	0.00
2	1.850	1.850	4625.00	1250.00	5875.00
3	1.390	3.240	9250.00	2500.00	11750.00
4	0.925	4.165	13875.00	3750.00	17625.00
5	0.463	4.628	18500.00	5000.00	23500.00
6	0.925	5.553	13875.00	3750.00	17625.00
7	1.390	6.943	9250.00	2500.00	11750.00
8	1.850	8.793	4625.00	1250.00	5875.00
9	0.000	8.793	0.00	0.00	0.00

Table C.2.2 - Hydrograph for a 100-Year Peak Discharge

N	Time (Days) Duration	Cumulative	New Waddel Release (cfs)	New River Discharge (cfs)	Total (cfs)
1	0.000	0.000	0.00	0.00	0.00
2	1.850	1.850	8000.00	1250.00	9250.00
3	1.390	3.240	16000.00	2500.00	18500.00
4	0.925	4.165	24000.00	3750.00	27750.00
5	0.463	4.628	32000.00	5000.00	37000.00
6	0.925	5.553	24000.00	3750.00	27750.00
7	1.390	6.943	16000.00	2500.00	18500.00
8	1.850	8.793	8000.00	1250.00	9250.00
9	0.000	8.793	0.00	0.00	0.00

Table C.2.3 - Hydrograph for a 200-Year Peak Discharge

N	Time (Days) Duration	Cumulative	New Waddel Release (cfs)	New River Discharge (cfs)	Total (cfs)
1	0.000	0.000	0.00	0.00	0.00
2	1.850	1.850	13500.00	1250.00	14750.00
3	1.390	3.240	27000.00	2500.00	29500.00
4	0.925	4.165	40500.00	3750.00	44250.00
5	0.463	4.628	54000.00	5000.00	59000.00
6	0.925	5.553	40500.00	3750.00	44250.00
7	1.390	6.943	27000.00	2500.00	29500.00
8	1.850	8.793	13500.00	1250.00	14750.00
9	0.000	8.793	0.00	0.00	0.00

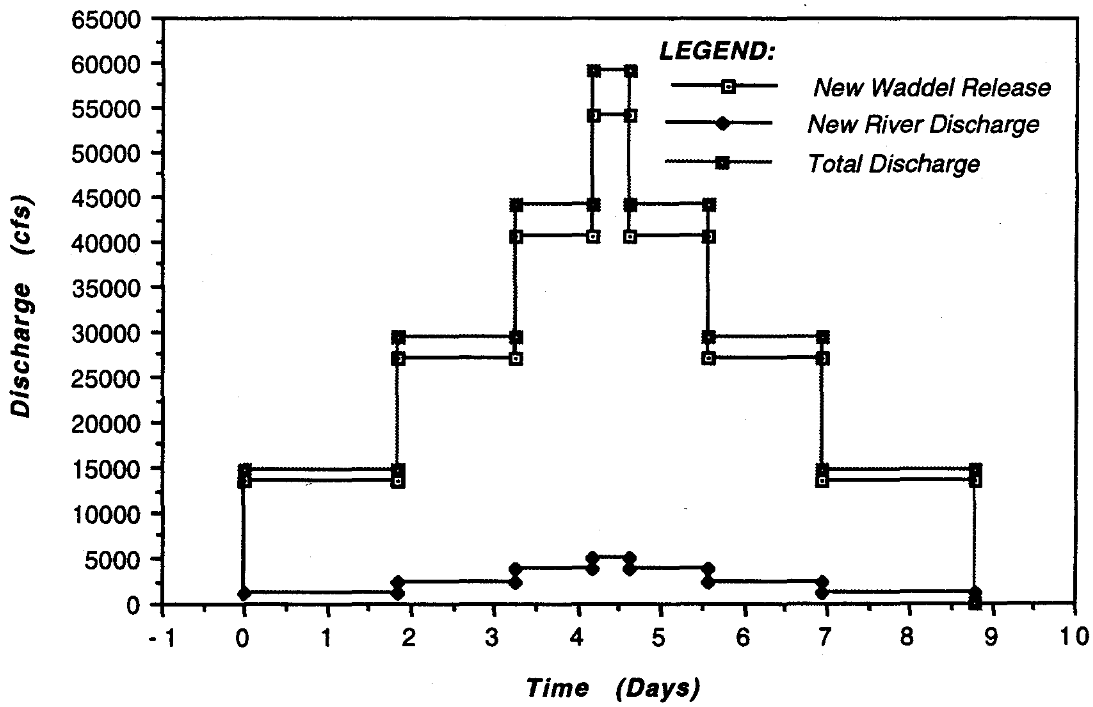

Fig. C.1 - 200-Year Hydrograph

Table C.2.4 - Hydrograph for a 500-Year Peak Discharge

N	Time (Days) Duration	Time (Days) Cumulative	New Waddel Release (cfs)	New River Discharge (cfs)	Total (cfs)
1	0.000	0.000	0.00	0.00	0.00
2	1.850	1.850	21250.00	1250.00	22500.00
3	1.390	3.240	42500.00	2500.00	45000.00
4	0.925	4.165	63750.00	3750.00	67500.00
5	0.463	4.628	85000.00	5000.00	90000.00
6	0.925	5.553	63750.00	3750.00	67500.00
7	1.390	6.943	42500.00	2500.00	45000.00
8	1.850	8.793	21250.00	1250.00	22500.00
9	0.000	8.793	0.00	0.00	0.00

C.3 Peak Discharges at Various Locations Along the Agua Fria River Under New Waddell Dam Condition

Table C.3 - Design Flood Discharge at the Agua Fria River [New Waddell Dam Condition]

Location Along the Agua Fria River	Peak Discharge (cfs) 50-yr	100-yr	200-yr	500-yr
Inflow - Waddell Dam	18,500	32,000	54,000	85,000
Outflow-Waddell Dam [Mile 33.25]	18,500	32,000	54,000	85,000
Bell Road [Mile 18.91]	11,500	20,000	34,000	56,200
U/S New River Confluence [Mile 9.90]	9,500	16,000	27,000	45,000
D/S New River Confluence [Mile 9.81]	10,000	17,000	29,000	47,000
Camelback Road [Mile 9.375]	9,750	16,500	28,000	46,800
Indian School Road [Mile 8.03]	9,500	16,000	27,000	45,800
McDowell Road [Mile 6.34]	9,000	15,500	27,500	44,800
I-10 Freeway [Mile 5.39]	9,000	15,500	27,500	44,800
Avondale	8,750	15,000	25,500	43,800
Gila River Confluence [Mile 0.00]	8,500	14,500	24,500	43,700

The values above were extracted from the attenuation behavior in Table 2.4.

APPENDIX D - Section Geometry for the Gravel Mining Stations (Model II)

D.1 - Hydraulic Information for the Mining Site Stations

Table D-1 - Hydraulic Data for the Mining Site Stations (Model II)

Site Iden	No.	Mile No.	Roughness Coefficient LOB	Main	ROB	Boundary Left	Right	Reach Length	Movable Bed Limit (ft)
	1	13.810	0.04	0.03	0.04	7867	10525	-	9580-10525
A	2	13.855	0.04	0.03	0.04	7867	10525	240	9580-10525
	3	14.380	0.04	0.03	0.04	8125	10691	2725	9458-10691
	4	14.412	0.04	0.03	0.04	8125	10691	240	9458-10691
	5	14.932	0.04	0.03	0.04	9140	11341	-	9207-10430
	6	14.940	0.04	0.03	0.04	9140	11341	45	9207-10430
B	7	15.063	0.04	0.03	0.04	9277	11399	650	9332-10337
	8	15.303	0.04	0.03	0.04	9681	11192	1175	9832-11180
	9	15.320	0.04	0.03	0.04	9681	11192	90	9832-11180
	10	19.944	0.04	0.03	0.04	8141.9	10997	-	9844-10886
	11	19.953	0.04	0.03	0.04	8141.9	10997	45	9844-10886
	12	20.240	0.04	0.03	0.04	7901	10136	1565	9217-10136
	13	20.550	0.04	0.03	0.04	8038	10218	1650	9447-10133
C	14	20.563	0.04	0.03	0.04	8038	10218	70	9447-10133
	15	20.577	0.04	0.03	0.04	8038	10218	70	9447-10133
	16	20.640	0.04	0.03	0.04	7780	10100	373	9342-10037
	17	20.657	0.04	0.03	0.04	7780	10100	90	9342-10037
	18	20.920	0.04	0.03	0.04	8990	10707	1096	9704-10586
	19	20.933	0.04	0.03	0.04	8990	10707	70	9704-10586
	20	21.500	0.04	0.03	0.04	8950	13033	-	9068-11464
	21	21.523	0.04	0.03	0.04	8950	13033	120	9068-11464
	22	21.657	0.04	0.03	0.04	8453	13966	710	10768-11645
D-E	23	21.680	0.04	0.03	0.04	8453	13966	120	10768-11645
	24	21.760	0.04	0.03	0.04	8805	14570	460	8922-9217
	25	21.773	0.04	0.03	0.04	8805	14570	70	8922-9217
	26	21.818	0.04	0.03	0.04	9103	14570	240	8922-9660
	27	21.850	0.04	0.03	0.04	9912	14171	240	9236-11936
	28	22.107	0.04	0.03	0.04	9978	14136	-	10000-11154
F	29	22.130	0.04	0.03	0.04	9978	14136	120	10000-11154
	30	22.320	0.04	0.03	0.04	9946	13430	1005	10000-11529
	31	22.365	0.04	0.03	0.04	9946	13430	240	10000-11529
	32	23.350	0.04	0.03	0.04	9495	13860	-	11442-13850
	33	23.365	0.04	0.03	0.04	9495	13860	80	11442-13850
G	34	23.571	0.04	0.03	0.04	9401	13619	1085	11040-13531
	35	23.694	0.04	0.03	0.04	8893	12851	650	11054-12681
	36	23.851	0.04	0.03	0.04	8023	12101	830	10672-12009
	37	23.874	0.04	0.03	0.04	8023	12101	120	10672-12009
	32	23.350	0.04	0.03	0.04	9495	13860	-	11442-13850
	33	23.365	0.04	0.03	0.04	9495	13860	80	11442-13850
	34	23.571	0.04	0.03	0.04	9401	13619	1085	11225-13531
	35	23.694	0.04	0.03	0.04	8893	12851	650	10920-12681
	36	23.851	0.04	0.03	0.04	8023	12101	830	10672-12009
	37	23.874	0.04	0.03	0.04	8023	12101	120	10672-12009
H	38	24.070	0.04	0.03	0.04	7412	11352	1190	7448-8719
	39	24.085	0.04	0.03	0.04	7412	11352	80	7448-8719
	40	24.170	0.04	0.03	0.04	7030	11239	280	7139-8612
	41	24.193	0.04	0.03	0.04	7030	11239	120	7139-8612
	42	24.350	0.04	0.03	0.04	7383	11392	945	7450-9317
	43	24.365	0.04	0.03	0.04	7383	11392	80	7450-9317
	44	24.468	0.04	0.03	0.04	7430	11477	545	7784-9277
	45	24.491	0.04	0.03	0.04	7430	11477	120	7784-9277

D.2 - Section Geometry at Mining Site A

Table D-A-1 - Section geometry for Station 13.810

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8265.00 (PL)**	-1735.00	1080.50
3	8365.00	100.00	1080.50
4	8485.00	120.00	1080.50
5	9315.00	830.00	1080.50
6	9435.00	120.00	1080.50
7	9535.00 (PL)**	100.00	1080.50

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
** **Property Line**

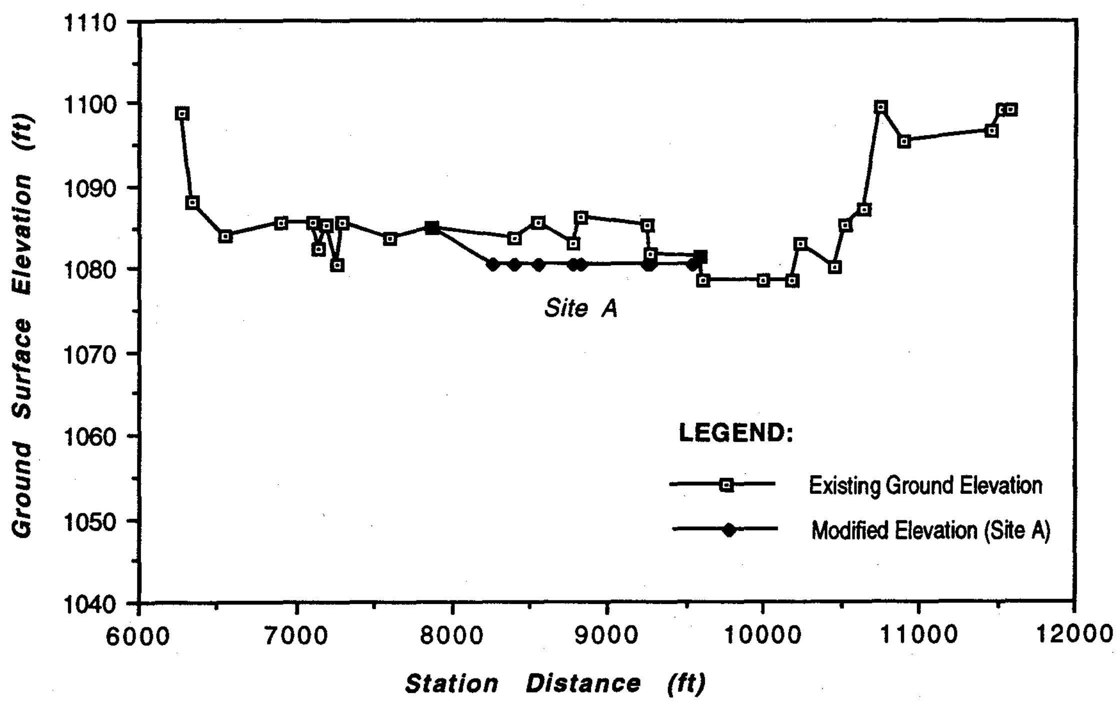

Fig. D-A-1 - Cross-section plot of Station 13.810

Table D-A-2 - Section geometry for Station 13.855

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8265.00 (PL)**	-1735.00	1081.00
3	8365.00	100.00	1081.00
4	8485.00	120.00	1041.00
5	9315.00	830.00	1041.00
6	9435.00	120.00	1081.00
7	9535.00 (PL)**	100.00	1081.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

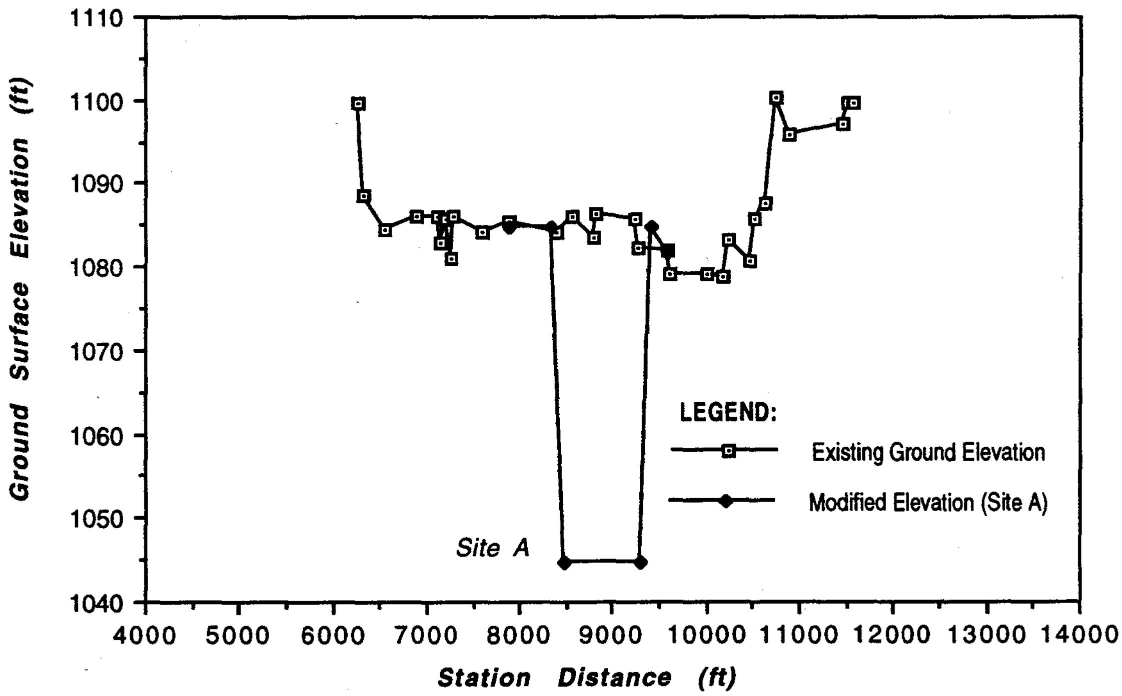

Fig. D-A-2 - Cross-section plot of Station 13.855

Table D-A-3 - Section geometry for Station 14.380

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8140.00 (PL)**	-1860.00	1085.40
3	8240.00	100.00	1085.40
4	8360.00	120.00	1045.40
5	9190.00	830.00	1045.40
6	9310.00	120.00	1085.40
7	9410.00 (PL)**	100.00	1085.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

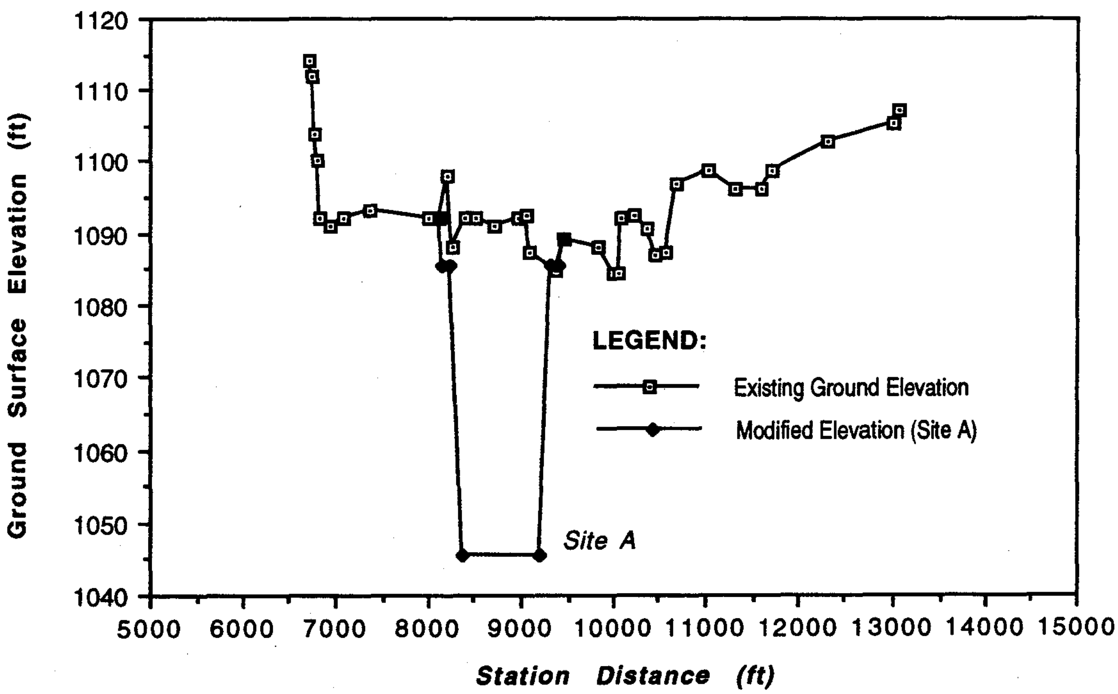

Fig. D-A-3 - Cross-section plot of Station 14.380

Table D-A-4 - Section geometry for Station 14.412

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8140.00 (PL)**	-1860.00	1085.90
3	8240.00	100.00	1085.90
4	8360.00	120.00	1085.90
5	9190.00	830.00	1085.90
6	9310.00	120.00	1085.90
7	9410.00	100.00	1085.90

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

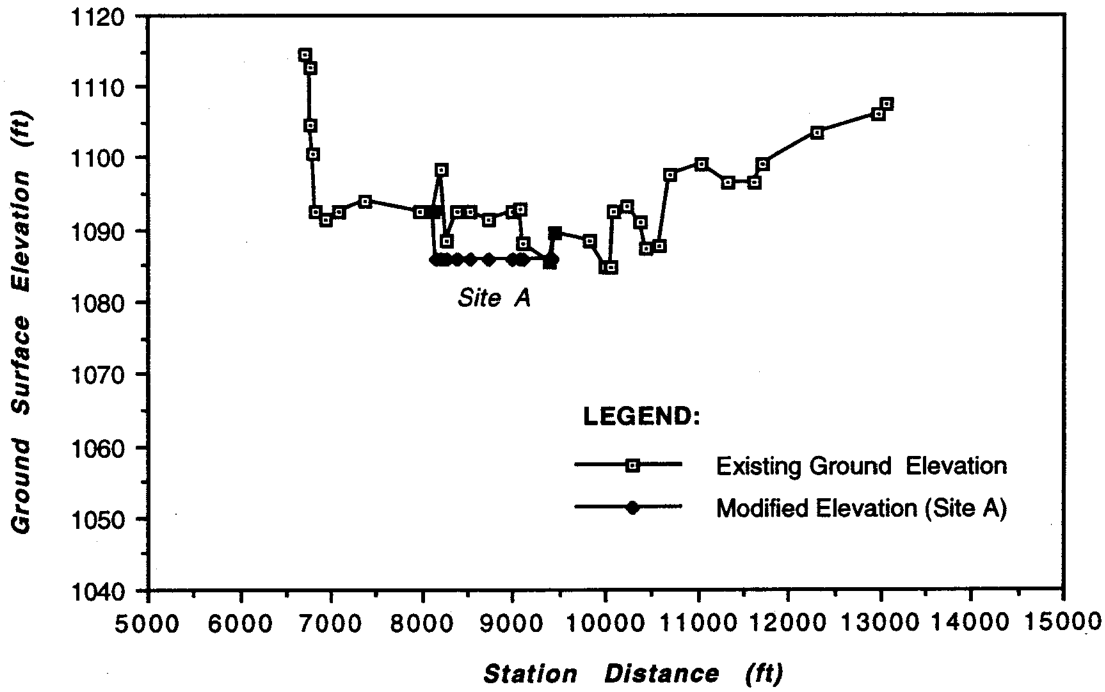

Fig. D-A-4 - Cross-section plot of Station 14.412

D.3- Section Geometry at Mining Site B

Table D-B-1 - Section geometry for Station 14.932

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	10475.00 (PL)**	475.00	1095.00
3	10575.00	100.00	1095.00
4	10665.00	90.00	1095.00
5	11020.00	355.00	1095.00
6	11065.00	45.00	1095.00
7	11115.00 (PL)**	50.00	1095.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

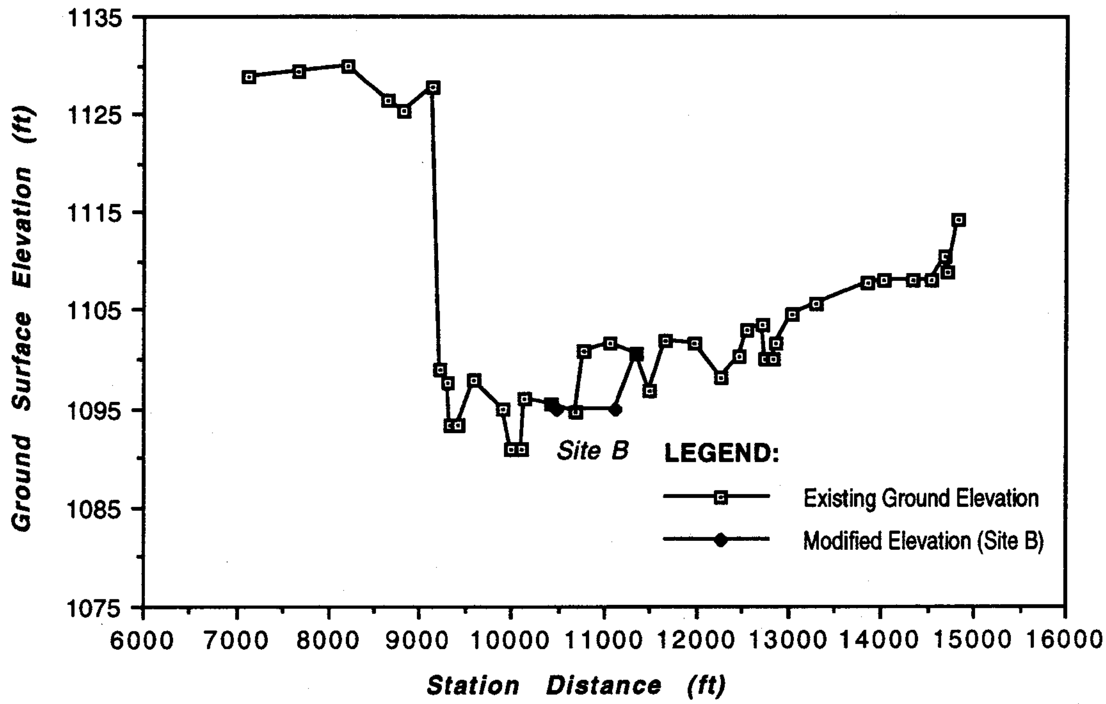

Fig. D-B-1 - Cross-section plot of Station 14.932

Table D-B-2 - Section geometry for Station 14.940

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	10480.00 (PL)**	480.00	1095.10
3	10580.00	100.00	1095.10
4	10670.00	90.00	1080.10
5	11025.00	355.00	1080.10
6	11070.00	45.00	1095.10
7	11120.00 (PL)**	50.00	1095.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

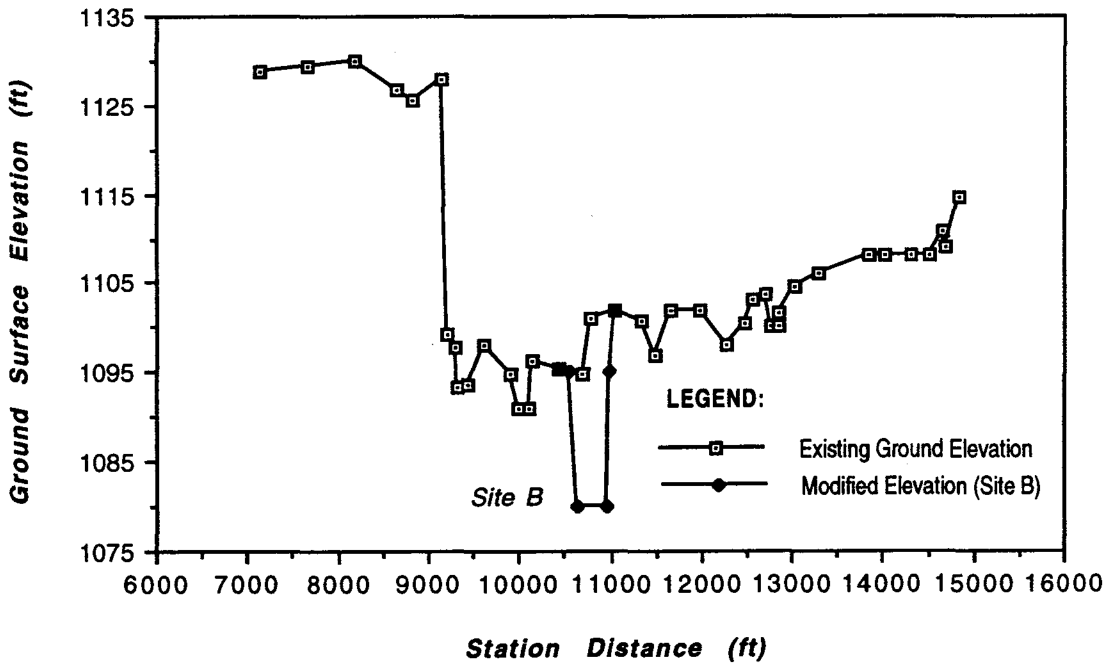

Fig. D-B-2 - Cross-section plot of Station 14.940

Table D-B-3 - Section geometry for Station 15.063

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	10590.00 (PL)**	590.00	1096.40
3	10690.00	00.00	1096.40
4	10735.00	45.00	1081.40
5	11135.00	400.00	1081.40
6	11180.00	45.00	1096.40
7	11230.00	50.00	1096.40

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

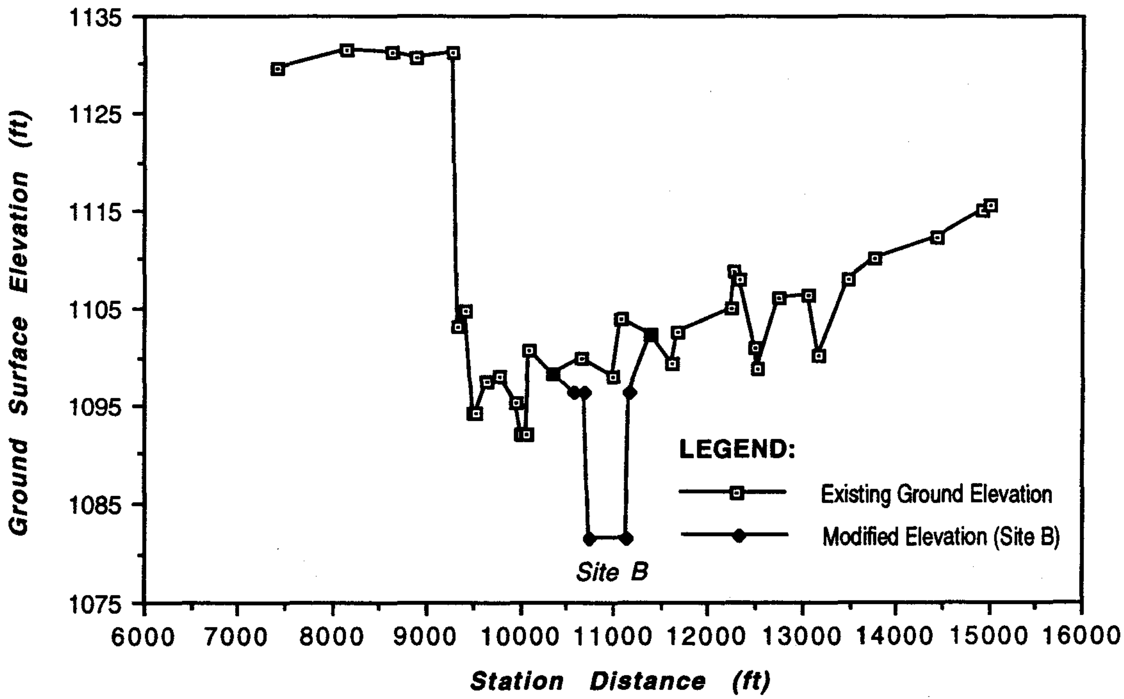

Fig. 5E-3 - Cross-section plot of Station 15.063

Table 5B-4 - Section geometry for Station 15.303

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	10540.00 (PL)**	540.00	1098.80
3	10640.00	100.00	1098.80
4	10685.00	45.00	1083.80
5	11085.00	400.00	1083.80
6	11130.00	45.00	1098.80
7	11180.00	50.00	1098.80

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

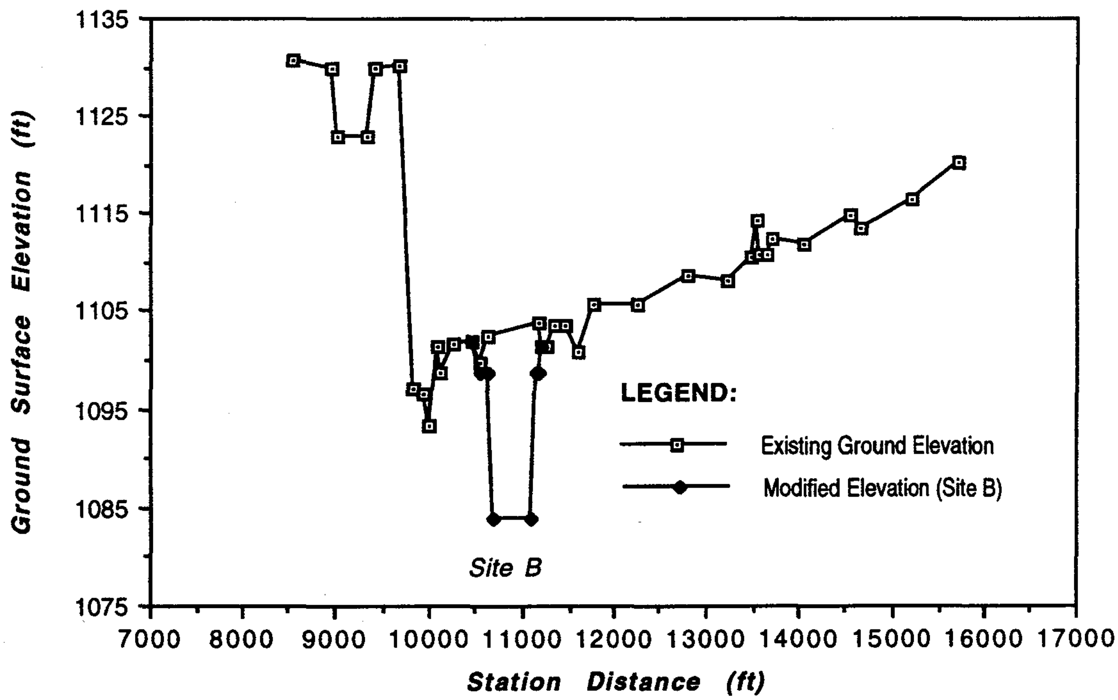

Fig. D-B-4 - Cross-section plot of Station 15.303

Table D-B-5 - Section geometry for Station 15.320

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	10540.00 (PL)**	540.00	1099.00
3	10640.00	100.00	1099.00
4	10685.00	45.00	1099.00
5	11085.00	400.00	1099.00
6	11130.00	45.00	1099.00
7	11180.00	50.00	1099.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

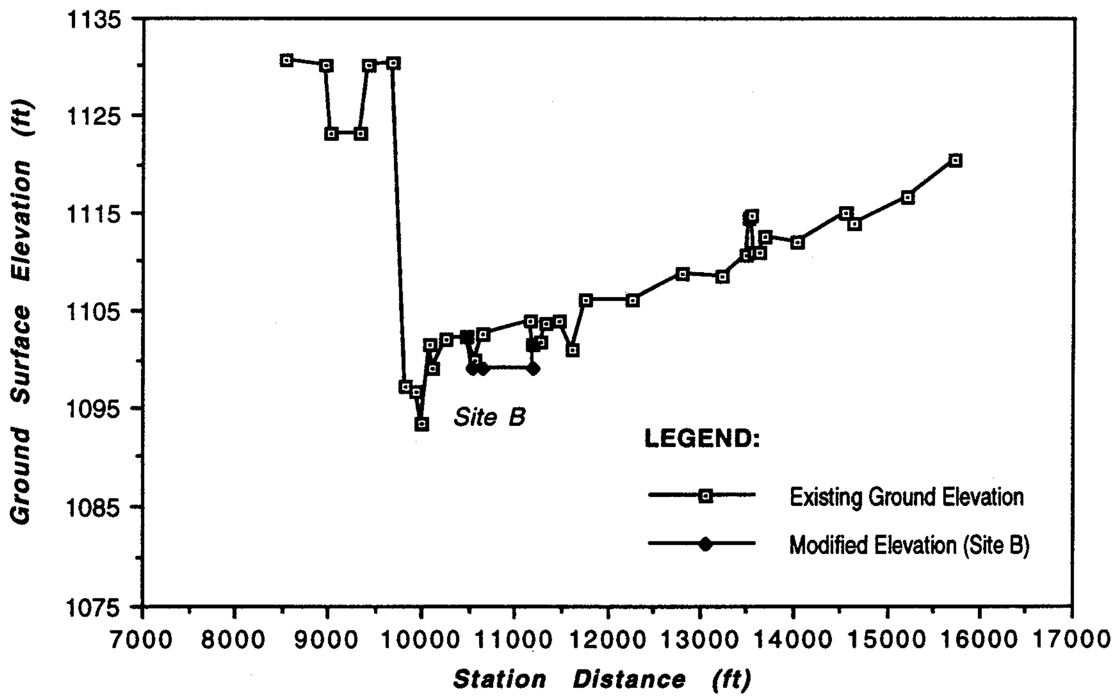

Fig. D-B-5 - Cross-section plot of Station 15.320

D.4 - Section Geometry at Mining Site C

Table D-C-1 - Section geometry for Station 19.944

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8142.00 (PL)**	-1858.00	1172.00
3	8259.00	117.00	1172.00
4	8304.00	45.00	1172.00
5	8839.00	535.00	1172.00
6	8884.00	45.00	1172.00
7	9626.00 (PL)**	742.00	1172.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

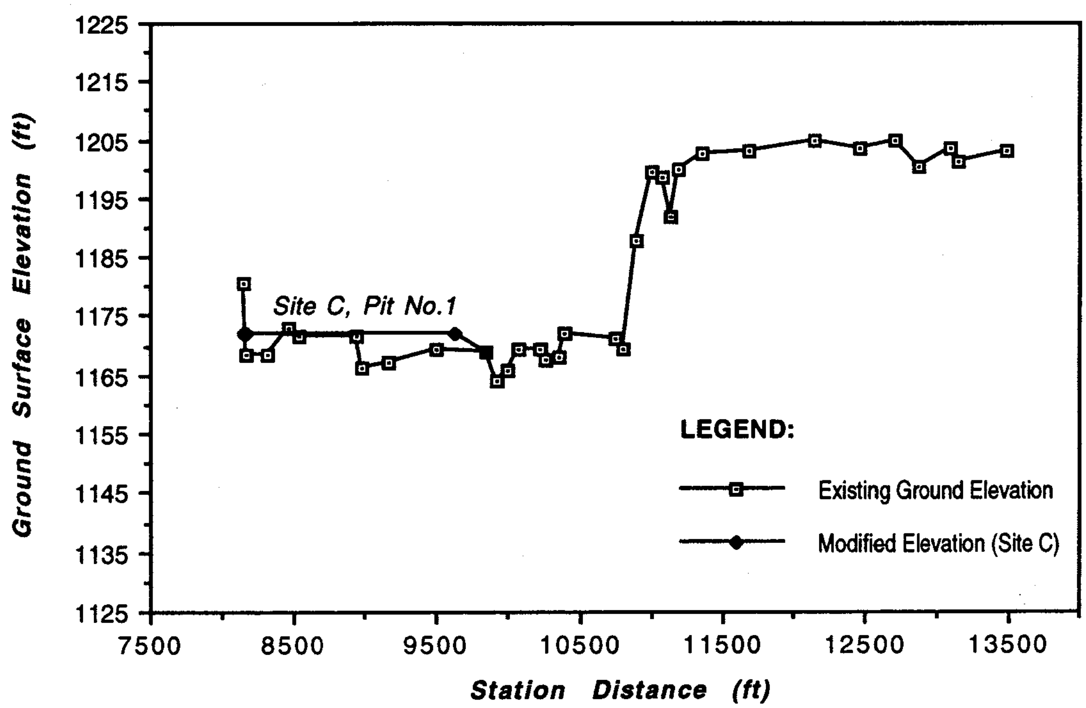

Fig. D-C-1 - Cross-section plot of Station 19.944

Table D-C-2 - Section geometry for Station 19.953

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8142.00 (PL)**	-1858.00	1172.10
3	8259.00	117.00	1172.10
4	8304.00	45.00	1142.10
5	8837.00	535.00	1142.10
6	8884.00	45.00	1172.10
7	9626.00 (PL)**	742.00	1172.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

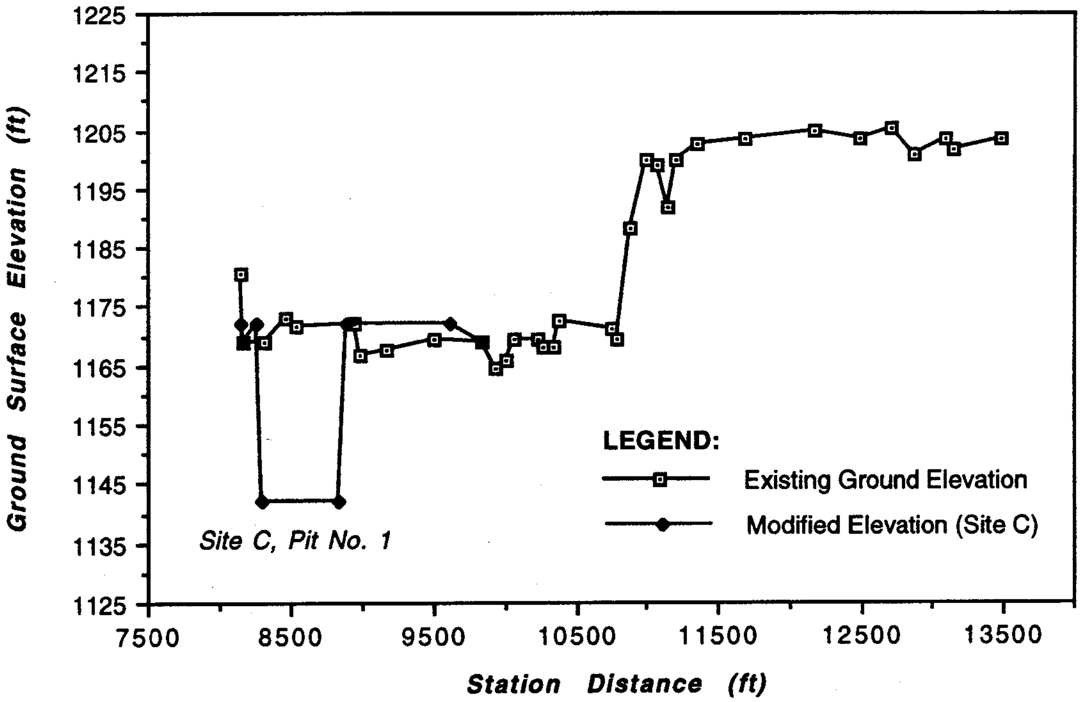

Fig. D-C-2 - Cross-section plot of Station 19.953

Table D-C-3 - Section geometry for Station 20.240

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	7910.00 (PL)**	-2090.00	1177.30
3	8027.00	117.00	1177.30
4	8072.00	45.00	1147.30
5	9091.00	1019.00	1147.30
6	9136.00	45.00	1177.30
7	9216.00 (PL)**	80.00	1177.30

Note: *   Indicated reference point is the river thalweg (Sta 100+00).
****   Property Line**

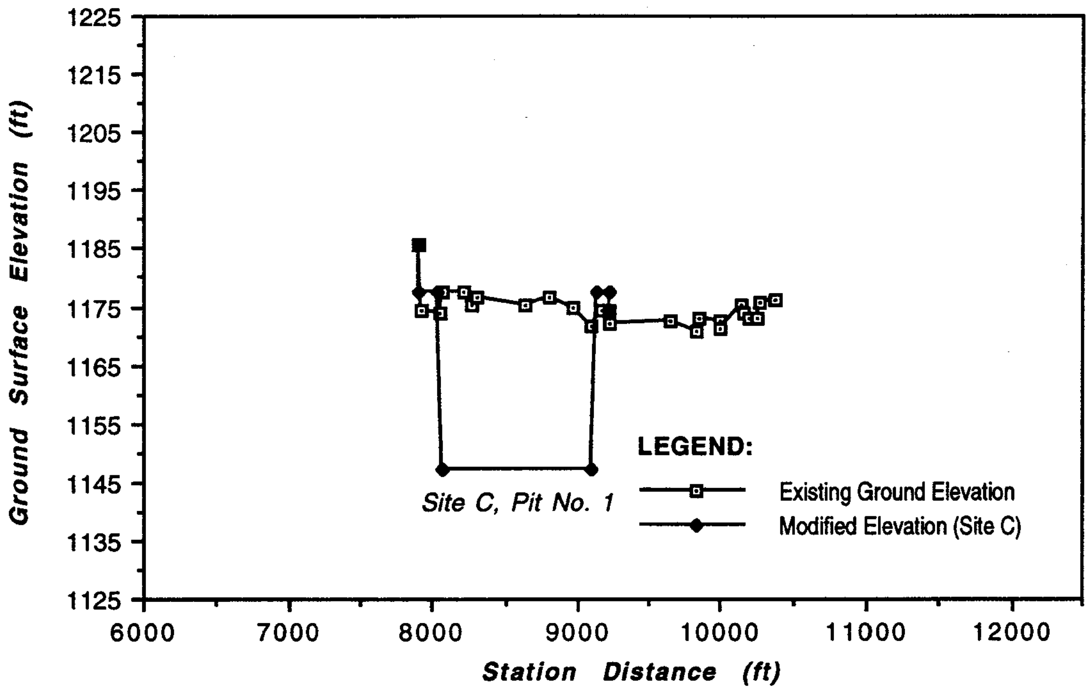

Fig. D-C-3 - Cross-section plot of Station 20.240

Table D-C-4 - Section geometry for Station 20.550

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8045.00 (PL)**	-1955.00	1182.70
3	8162.00	117.00	1182.70
4	8207.00	45.00	1152.70
5	9226.00	1019.00	1152.70
6	9271.00	45.00	1182.70
7	9351.00 (PL)**	80.00	1182.70

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
** **Property Line**

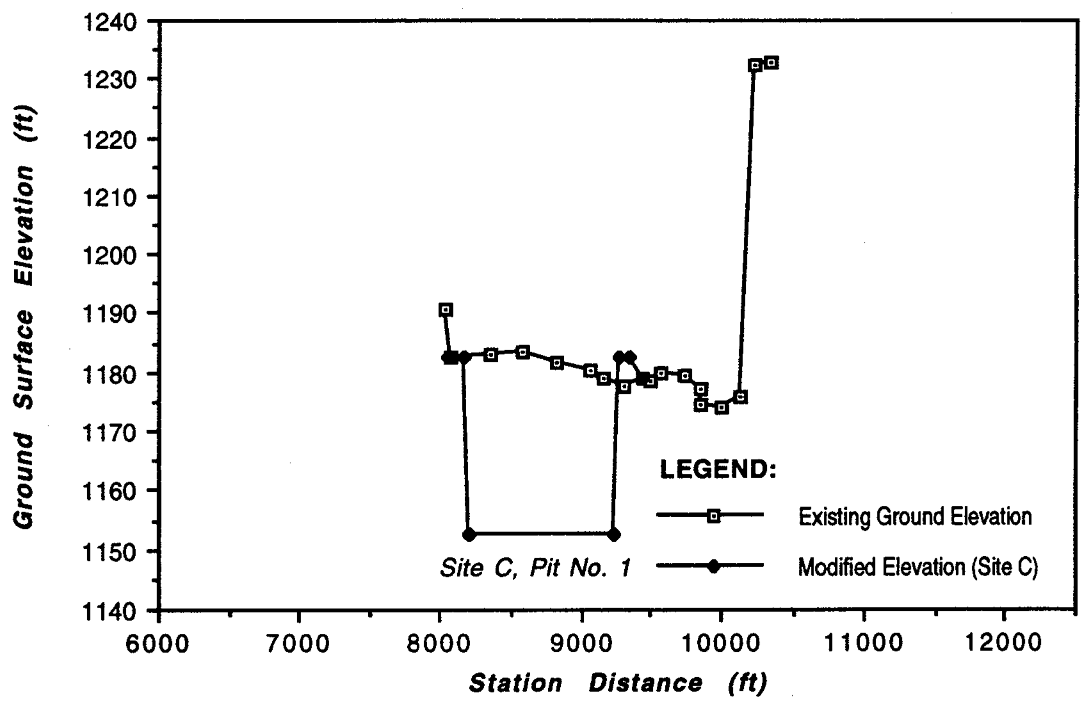

Fig. D-C-4 - Cross-section plot of Station 20.550

Table D-C-5 - Section geometry for Station 20.563

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8045.00 (PL)**	-1955.00	1182.90
3	8162.00	117.00	1182.90
4	8207.00	45.00	1182.90
5	9226.00	1019.00	1182.90
6	9271.00	45.00	1182.90
7	9351.00 (PL)**	80.00	1182.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

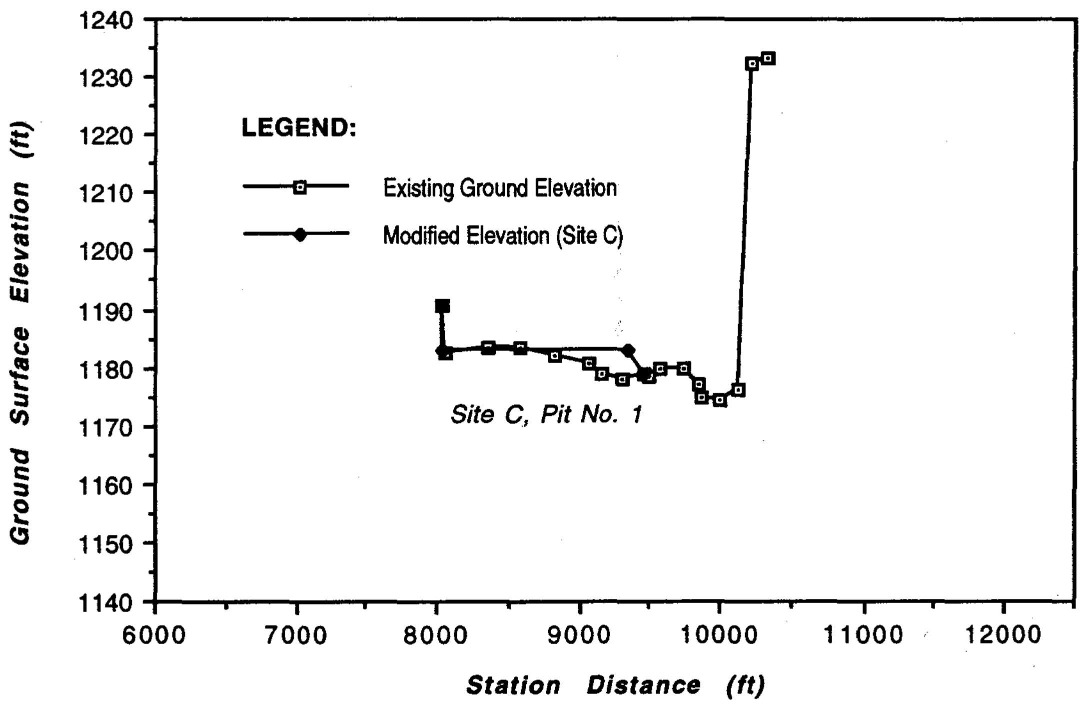

Fig. D-C-5- Cross-section plot of Station 20.563

Table D-C-6 - Section geometry for Station 20.577

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8040.00 (PL)**	-1960.00	1183.10
3	8157.00	117.00	1183.10
4	8202.00	45.00	1153.10
5	9221.00	1019.00	1153.10
6	9266.00	45.00	1183.10
7	9346.00 (PL)**	80.00	1183.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

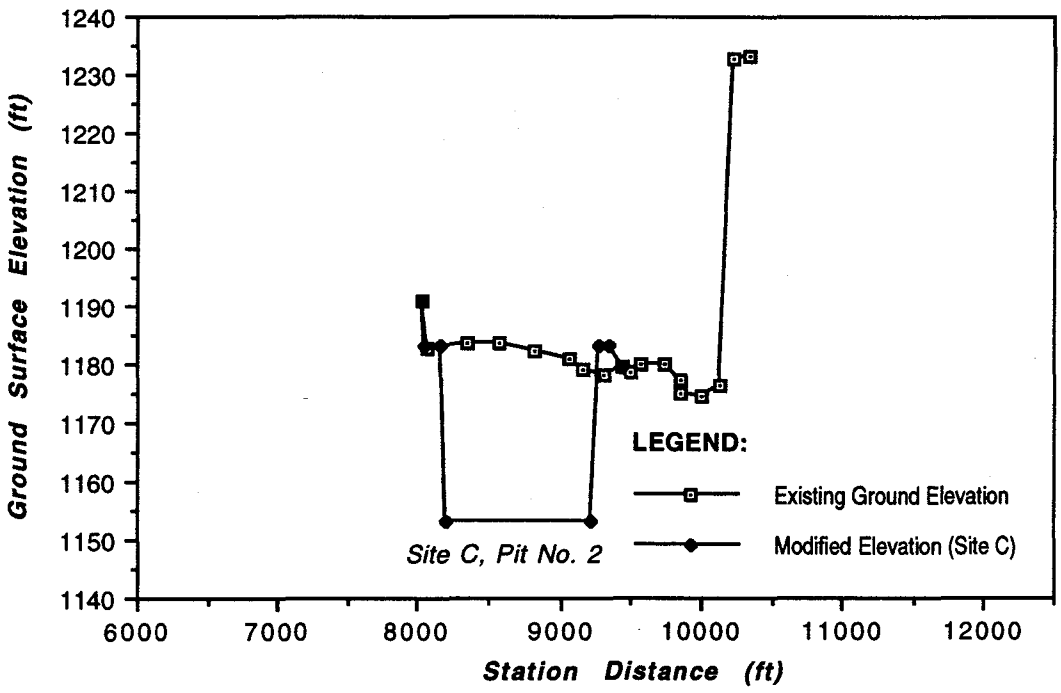

Fig. D-C-6 - Cross-section plot of Station 20.577

Table D-C-7 - Section geometry for Station 20.640

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8000.00 (PL)**	-2000.00	1184.30
3	8117.00	117.00	1184.30
4	8162.00	45.00	1154.30
5	9181.00	1019.00	1154.30
6	9226.00	45.00	1184.30
7	9306.00 (PL)**	80.00	1184.30

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

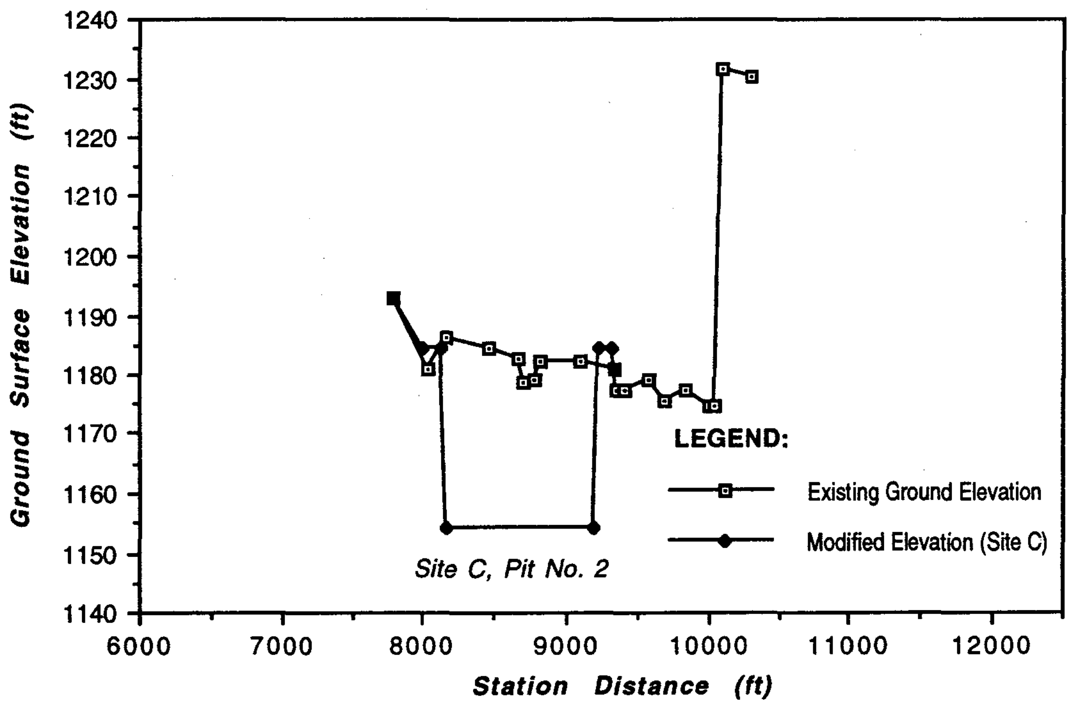

Fig. D-C-7 - Cross-section plot of Station 20.640

Table D-C-8 - Section geometry for Station 20.657

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8640.00 (PL)**	-1360.00	1184.60
3	8741.00	101.00	1184.60
4	8801.00	60.00	1154.60
5	9172.00	371.00	1154.60
6	9217.00	45.00	1184.60
7	9297.00 (PL)**	80.00	1184.60

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

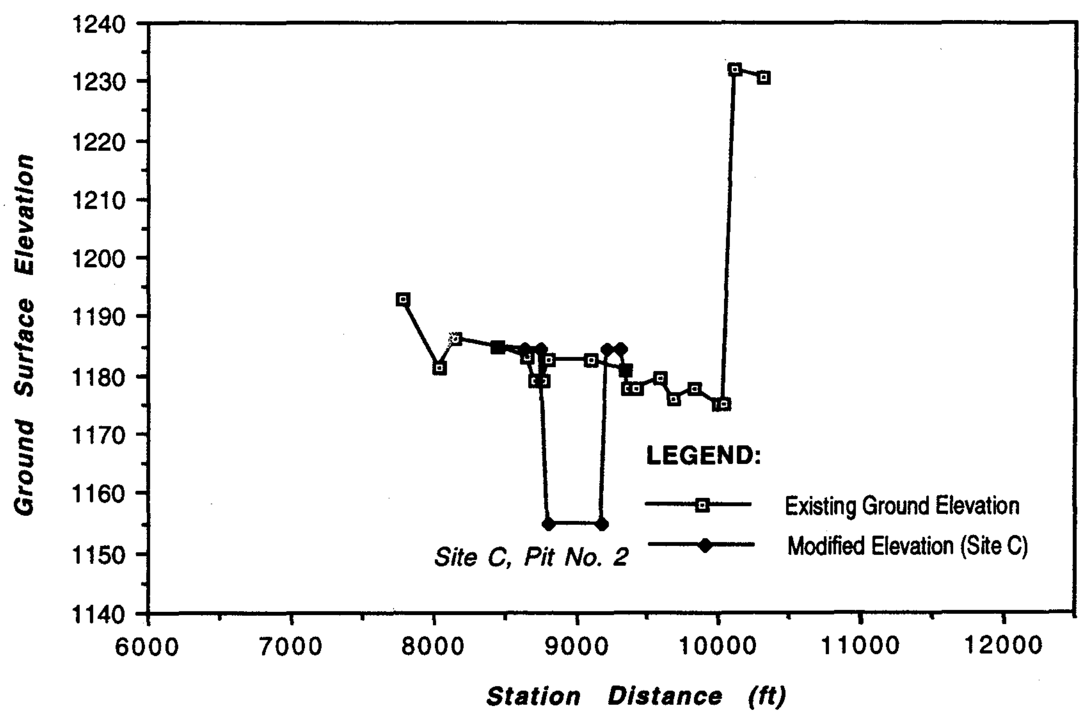

Fig. D-C-8 - Cross-section plot of Station 20.657

Table D-C-9 - Section geometry for Station 20.920

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8990.00 (PL)**	-1010.00	1188.20
3	9091.00	101.00	1188.20
4	9151.00	60.00	1158.20
5	9522.00	371.00	1158.20
6	9567.00	45.00	1188.20
7	9647.00 (PL)**	80.00	1188.20

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

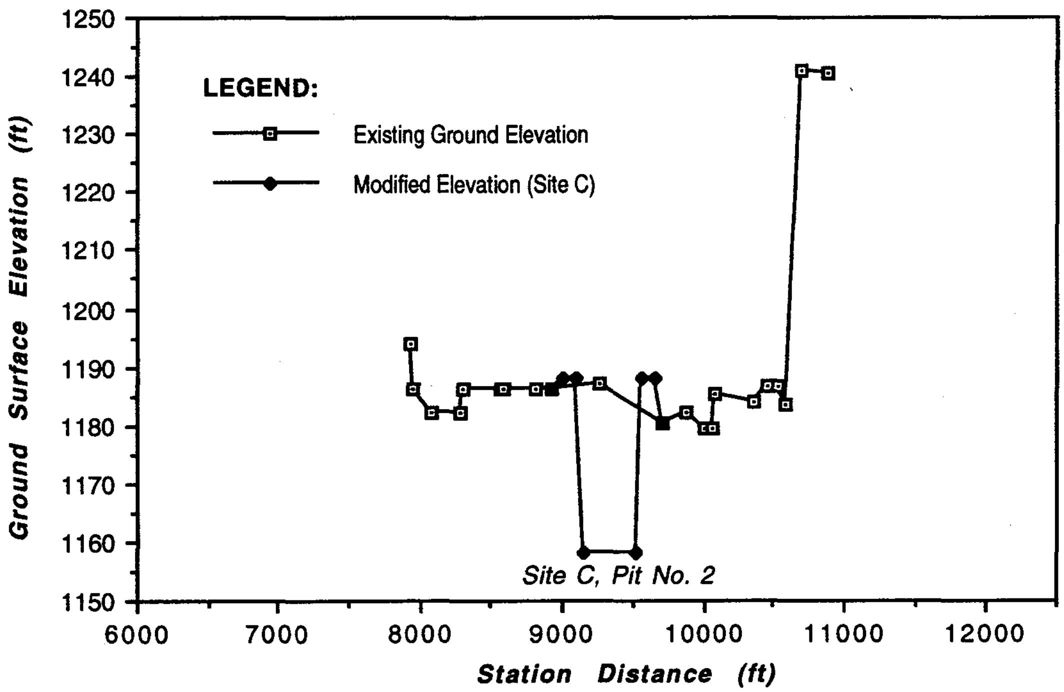

Fig. D-C-9 - Cross-section plot of Station 20.920

Table D-C-10 - Section geometry for Station 20.933

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8990.00 (PL)**	-1010.00	1188.40
3	9091.00	101.00	1188.40
4	9151.00	60.00	1188.40
5	9522.00	371.00	1188.40
6	9567.00	45.00	1188.40
7	9647.00 (PL)**	80.00	1188.40

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

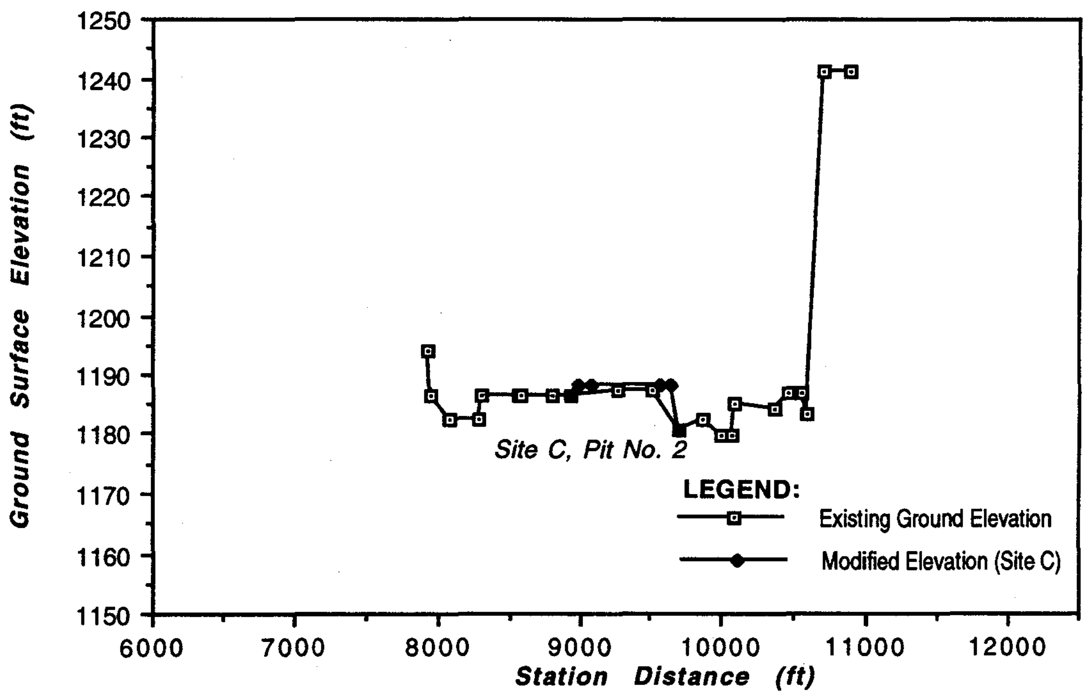

Fig. D-C-10 - Cross-section plot of Station 20.933

D.5 - Section Geometry at Mining Site D

Table D-D -1 - Section geometry for Station 21.657

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8960.00 (PL)**	-1040.00	1204.00
3	9725.00	765.00	1204.00
4	9725.00	0.00	1191.20
5	10485.00	760.00	1191.20
6	10595.00	110.00	1191.20

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

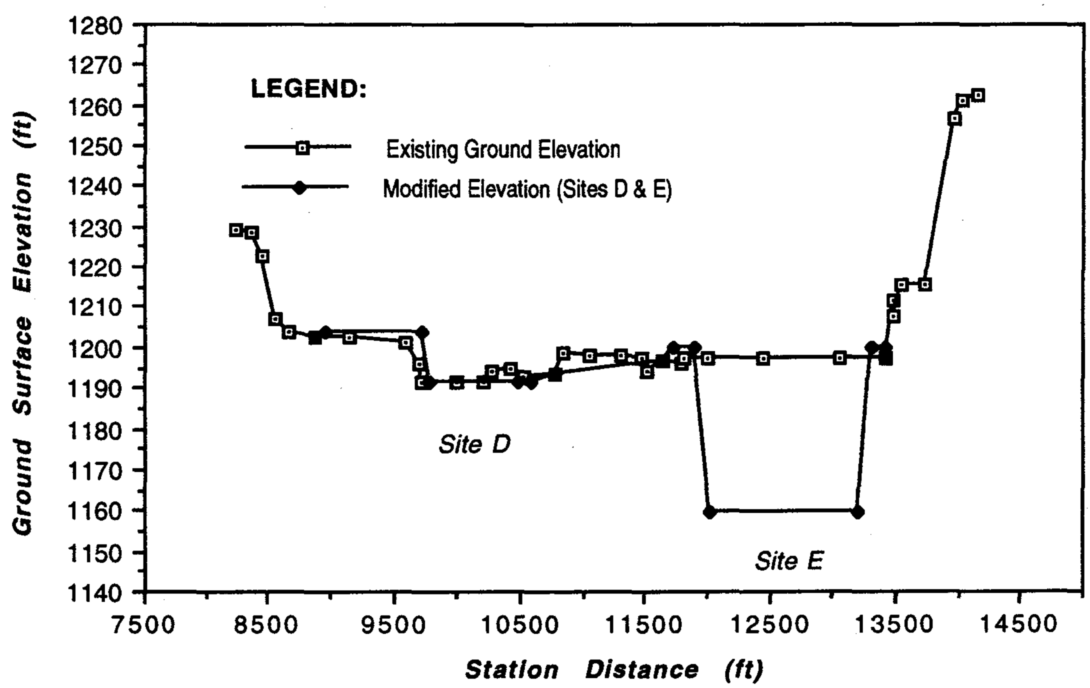

Fig. D-D-1 - Cross-section plot of Station 21.657

Table D-D-2 - Section geometry for Station 21.680

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9040.00 (PL)**	- 960.00	1204.20
3	9735.00	695.00	1204.20
4	9735.00	0.00	1191.40
5	9855.00	120.00	1151.40
6	10455.00	600.00	1151.40
7	10575.00	120.00	1191.40
8	10685.00 (PL)**	110.00	1191.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

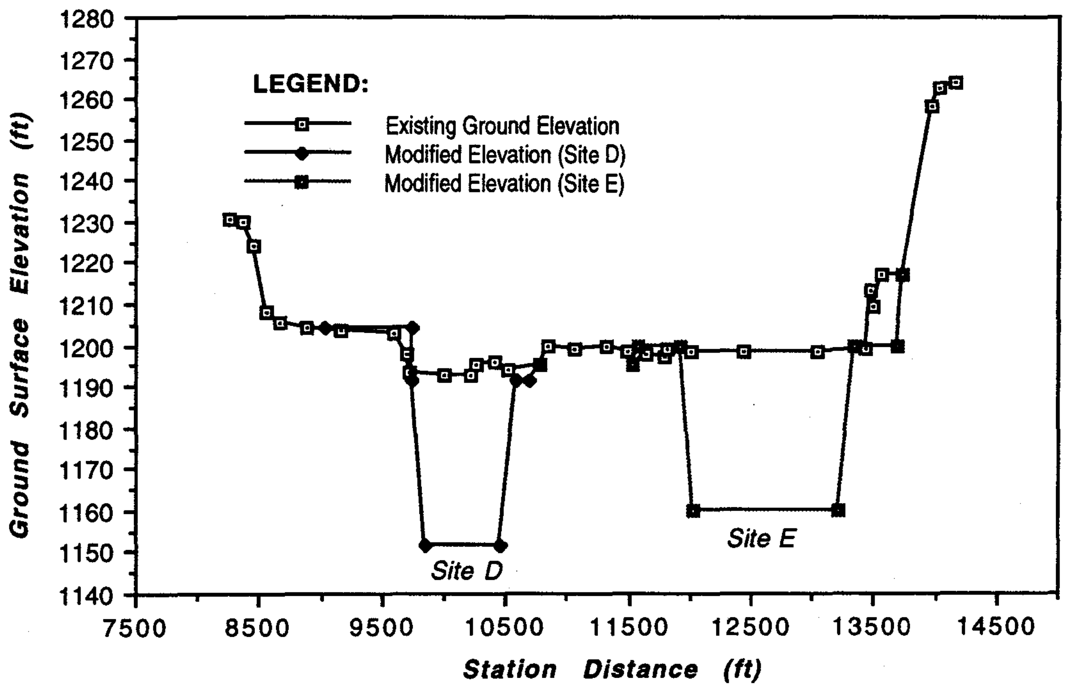

Fig. D-D-2 - Cross-section plot of Station 21.680

Table D-D-3 - Section geometry for Station 21.760

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9495.00 (PL)**	- 505.00	1205.10
3	9905.00	410.00	1205.10
4	9905.00	0.00	1192.30
5	10025.00	120.00	1152.30
6	10975.00	950.00	1152.30
7	11095.00	120.00	1192.30
8	11205.00 (PL)**	110.00	1192.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** **Property Line**

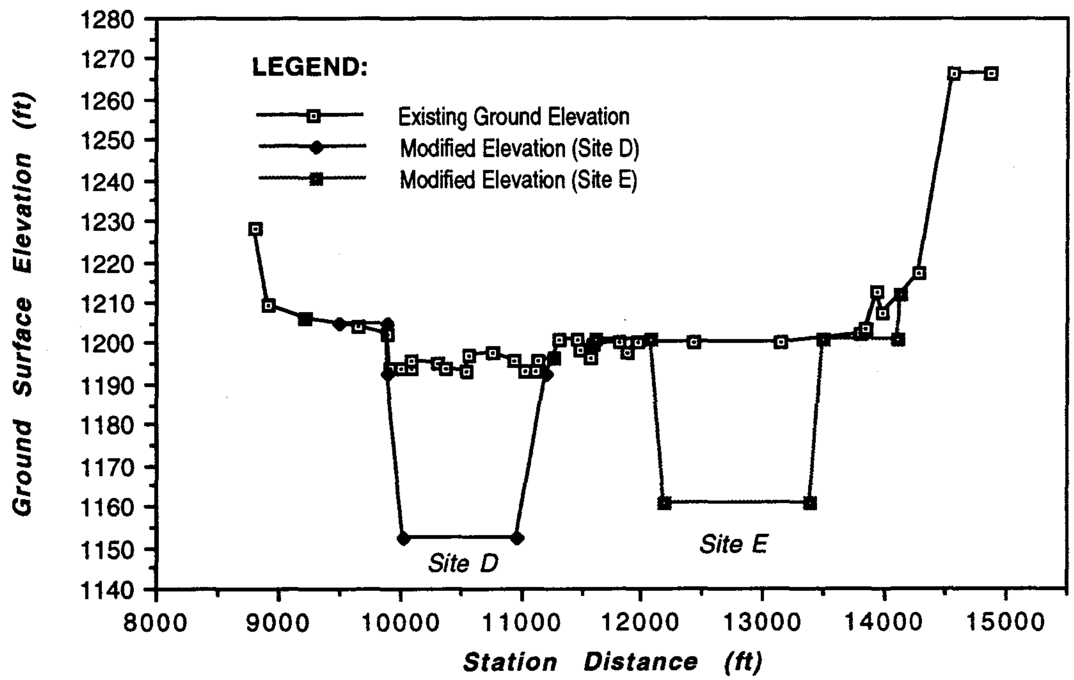

Fig. D-D-3 - Cross-section plot of Station 21.760

Table D-D -4 - Section geometry for Station 21.773

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9570.00 (PL)**	- 430.00	1205.20
3	9925.00	355.00	1205.20
4	9925.00	0.00	1192.40
5	10045.00	120.00	1152.40
6	11040.00	995.00	1152.40
7	11160.00	120.00	1192.40
8	11270.00 (PL)**	110.00	1192.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

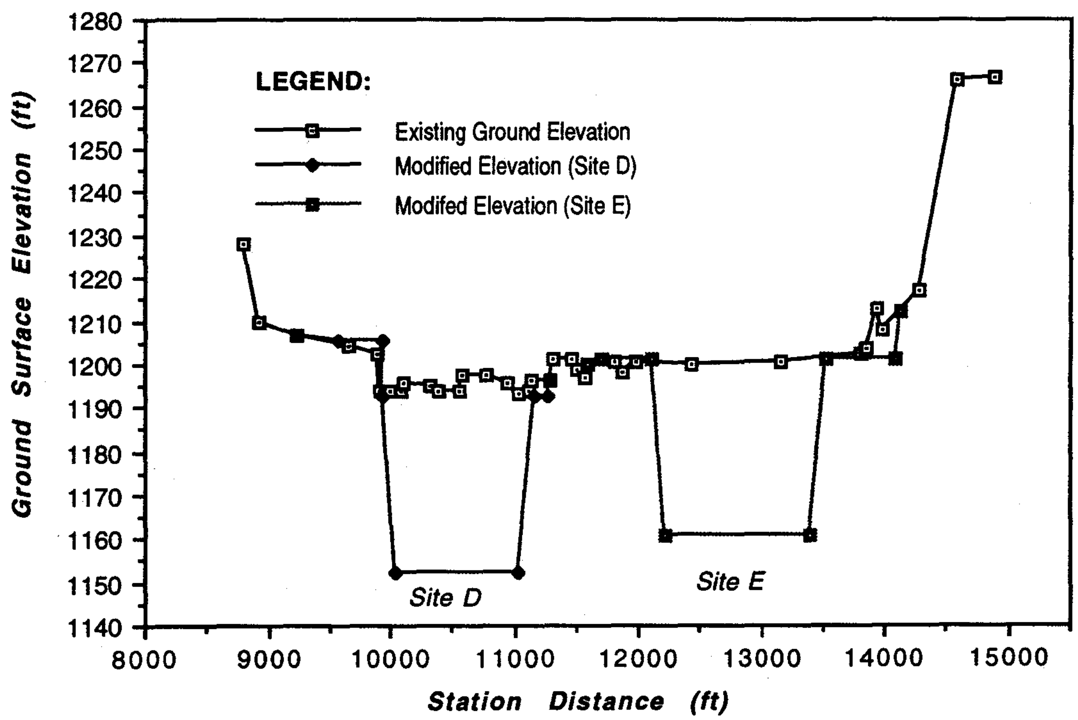

Fig. D-D-4 - Cross-section plot of Station 21.773

Table D-D-5 - Section geometry for Station 21.818

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9750.00 (PL)**	- 250.00	1205.70
3	9955.00	205.00	1205.70
4	9955.00	0.00	1192.90
5	11405.00 (PL)**	1450.00	1192.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

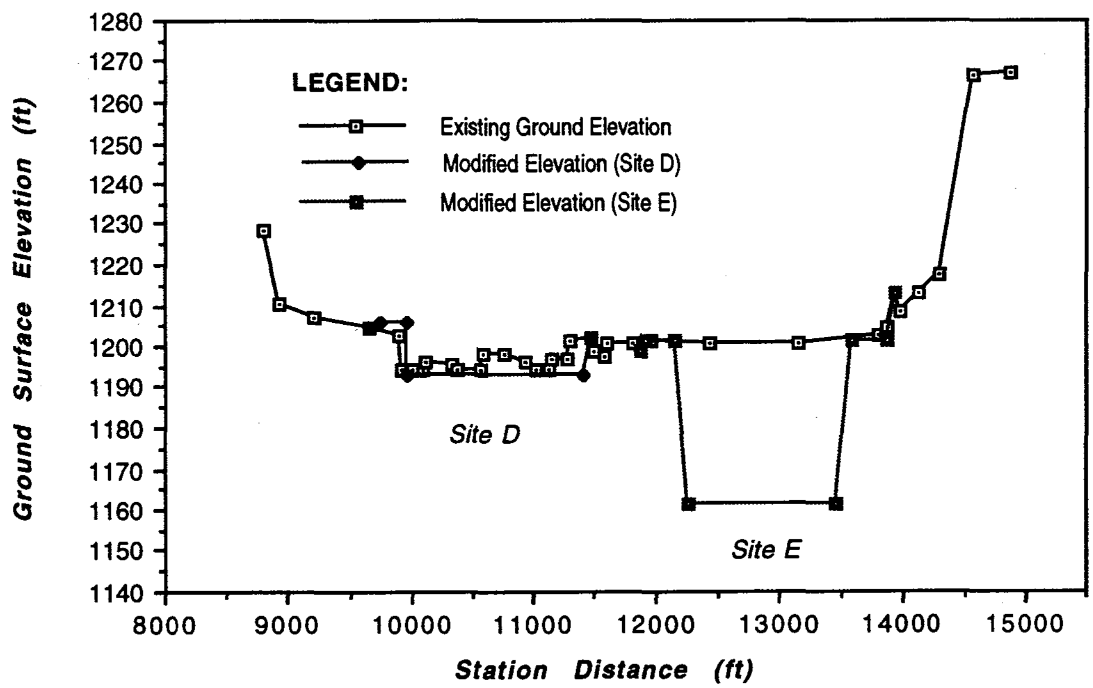

Fig. D-D-5 - Cross-section plot of Station 21.818

D.6 - Section Geometry at Mining Site E

Table D-E -1 - Section geometry for Station 21.500

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11615.00 (PL)**	1615.00	1198.20
3	11760.00	145.00	1198.20
4	11880.00	120.00	1198.20
5	12685.00	805.00	1198.20
6	12805.00 (PL)**	120.00	1198.20

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

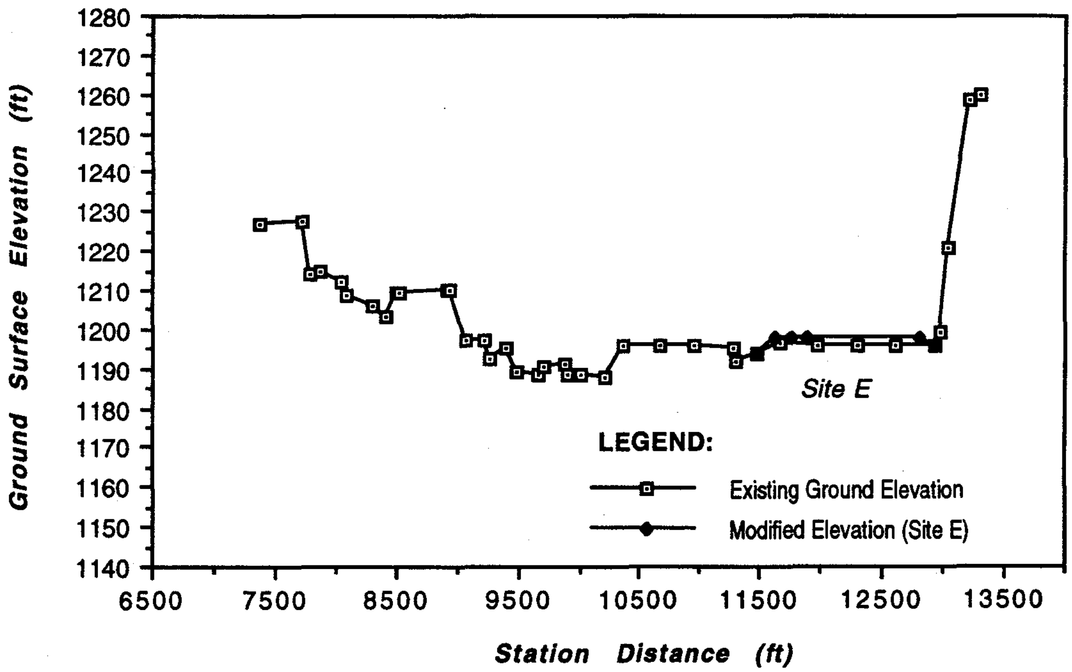

Fig. D-E-1 - Cross-section plot of Station 21.500

Table D-E -2 - Section geometry for Station 21.523

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11420.00 (PL)**	1420.00	1198.40
3	11775.00	355.00	1198.40
4	11895.00	120.00	1158.40
5	12745.00	850.00	1158.40
6	12865.00	120.00	1198.40
7	12975.00 (PL)**	110.00	1198.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

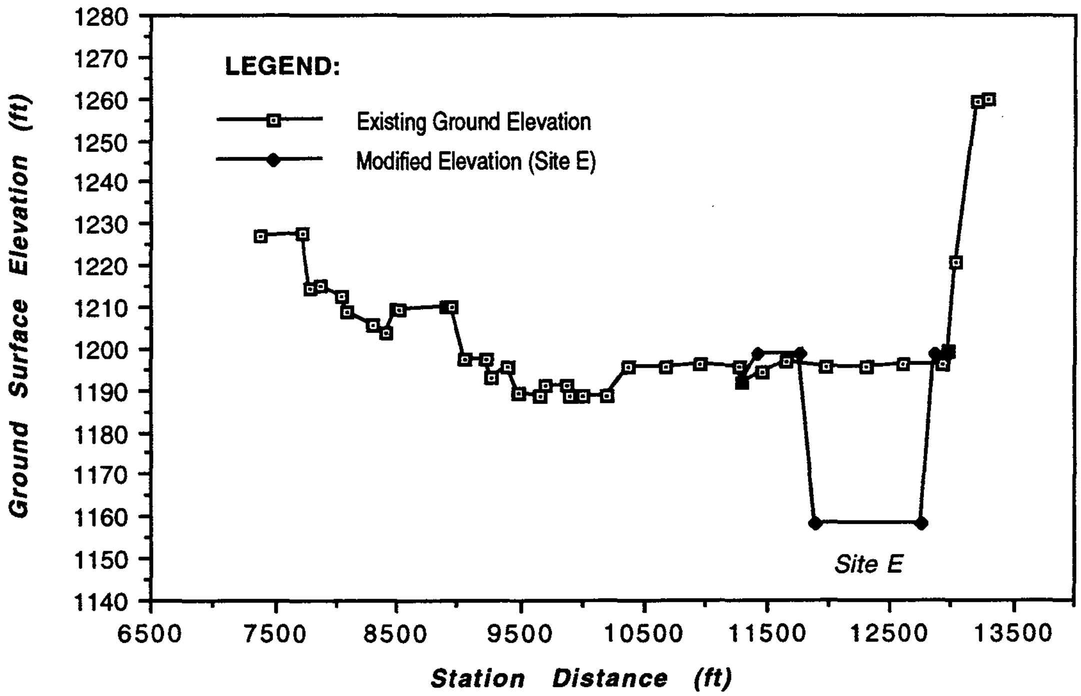

Fig. D-E-2 - Cross-sction plot of Station 21.523

Table D-E -3 - Section geometry for Station 21.657

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11735.00 (PL)**	1735.00	1199.80
3	11895.00	160.00	1199.80
4	12015.00	120.00	1159.80
5	13200.00	1 185.00	1159.80
6	13320.00	120.00	1199.80
7	13410.00 (PL)**	90.00	1199.80

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

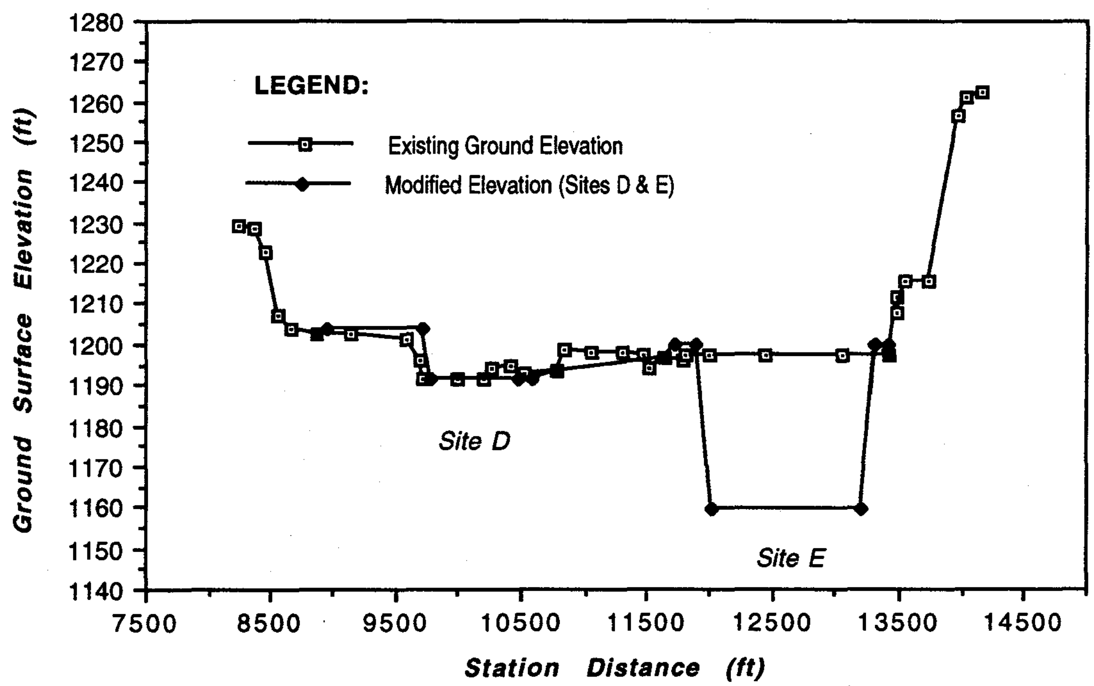

Fig. D-E-3 - Cross-section plot of Station 21.657

Table D-E-4 - Section geometry for Station 21.680

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11575.00 (PL)**	1575.00	1200.00
3	11915.00	340.00	1200.00
4	12035.00	120.00	1160.00
5	13220.00	1185.00	1160.00
6	13340.00	120.00	1200.00
7	13690.00 (PL)**	350.00	1200.00

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

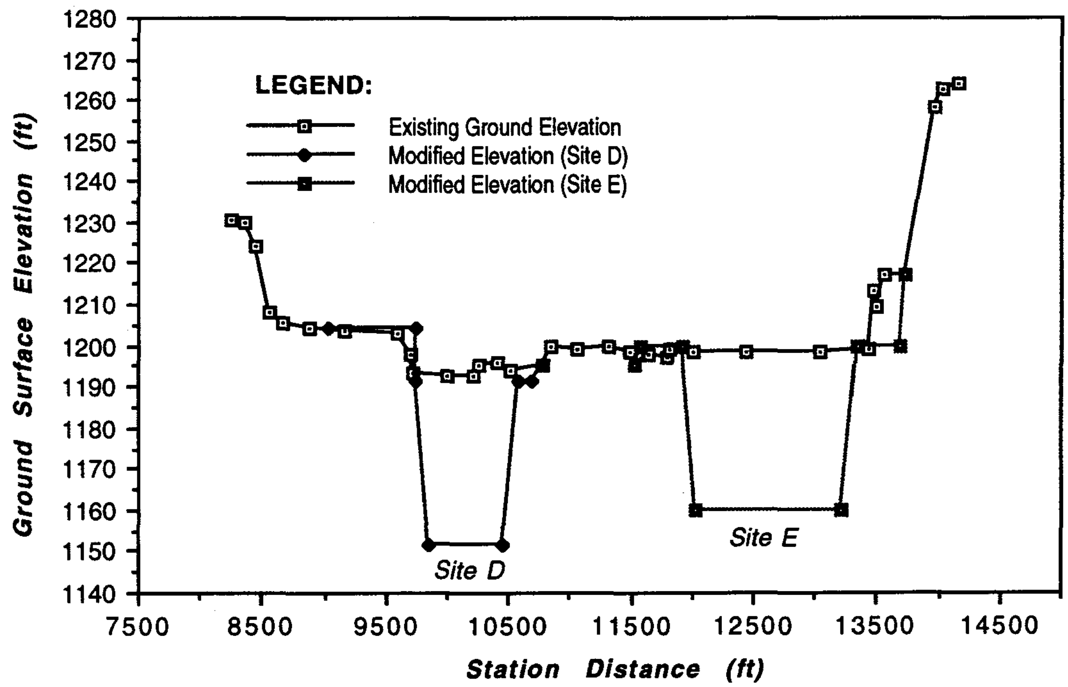

Fig. D-E-4 - Cross-section plot of Station 21.680

Table D-E -5 - Section geometry for Station 21.760

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11625.00 (PL)**	1625.00	1200.90
3	12075.00	450.00	1200.90
4	12195.00	120.00	1160.90
5	13380.00	1185.00	1160.90
6	13500.00	120.00	1200.90
7	14100.00 (PL)**	600.00	1200.90

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

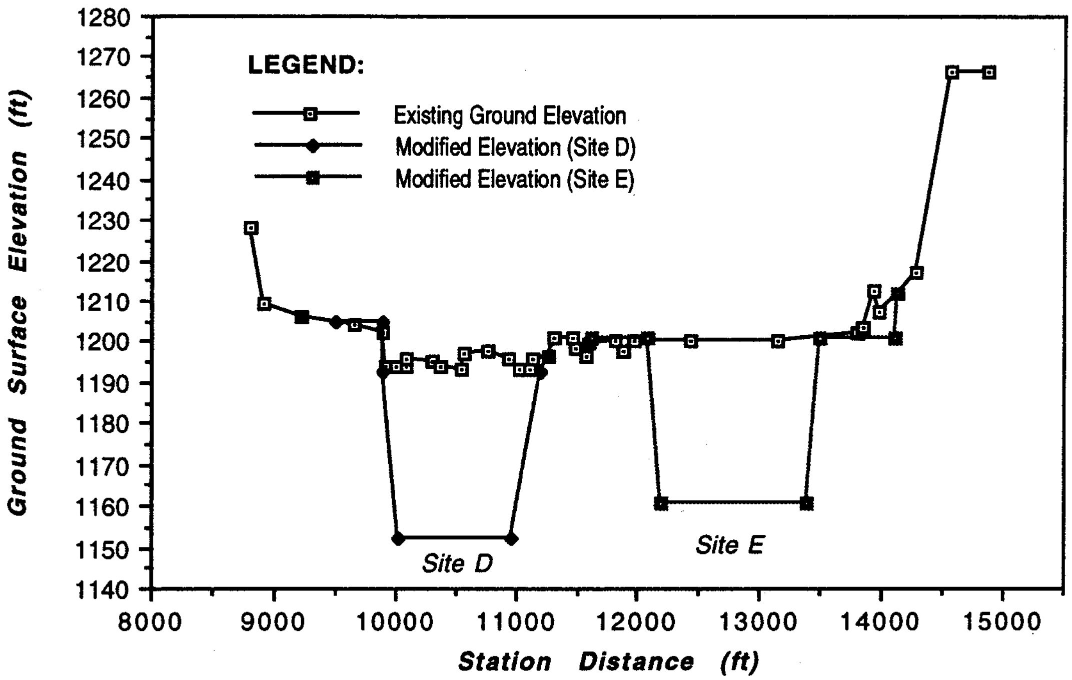

Fig. D-E-5 - Cross-section plot of Station 21.760

Table D-E -6 - Section geometry for Station 21.773

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11695.00 (PL)**	1695.00	1201.00
3	12095.00	400.00	1201.00
4	12215.00	120.00	1161.00
5	13400.00	1185.00	1161.00
6	13520.00	120.00	1201.00
7	14080.00 (PL)**	560.00	1201.00

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

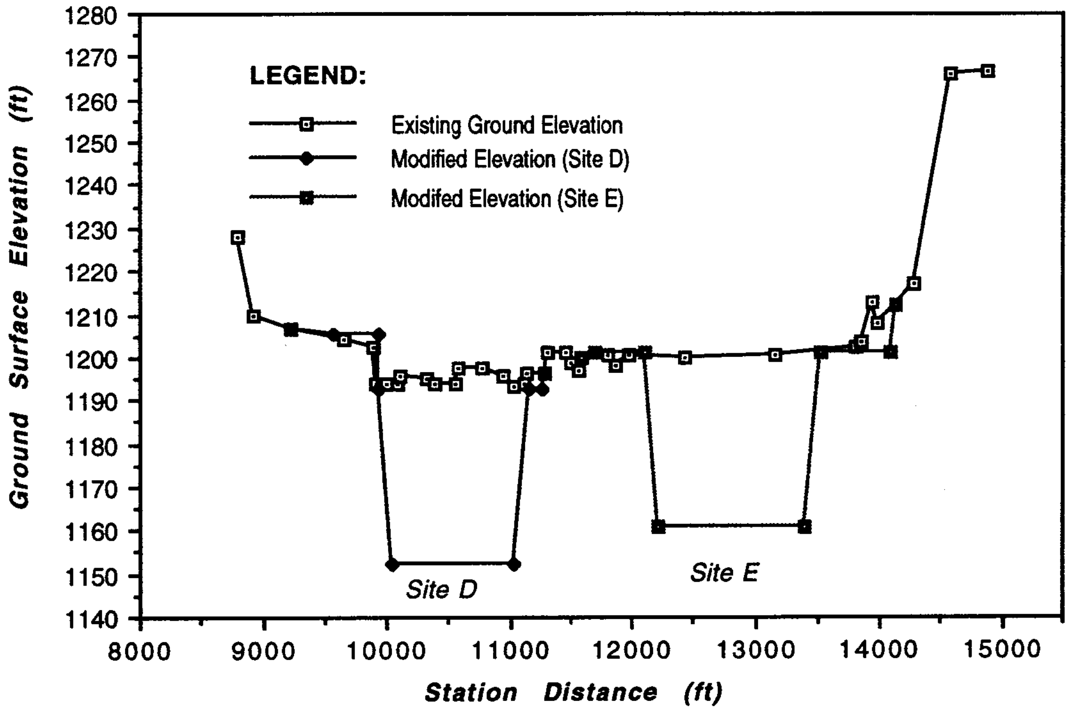

Fig. D-E-6 - Cross-section plot of Station 21.773

Table D-E -7 - Section geometry for Station 21.818

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11930.00 (PL)**	1930.00	1201.50
3	12155.00	225.00	1201.50
4	12275.00	120.00	1161.50
5	13460.00	1185.00	1161.50
6	13580.00	120.00	1201.50
7	13860.00 (PL)**	280.00	1201.50

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

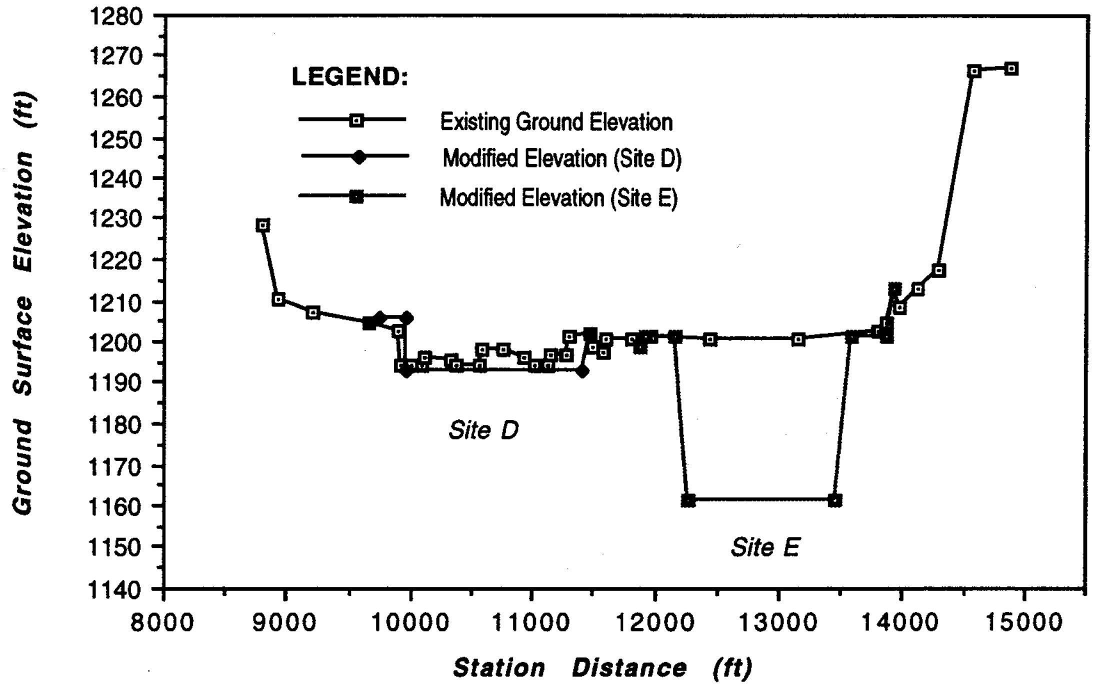

Fig. D-E-7 - Cross-section plot of Station 21.818

Table D-E -8 - Section geometry for Station 21.850

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	12115.00 (PL)**	2115.00	1202.00
3	12225.00	110.00	1202.00
4	13645.00 (PL)**	1420.00	1202.00

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

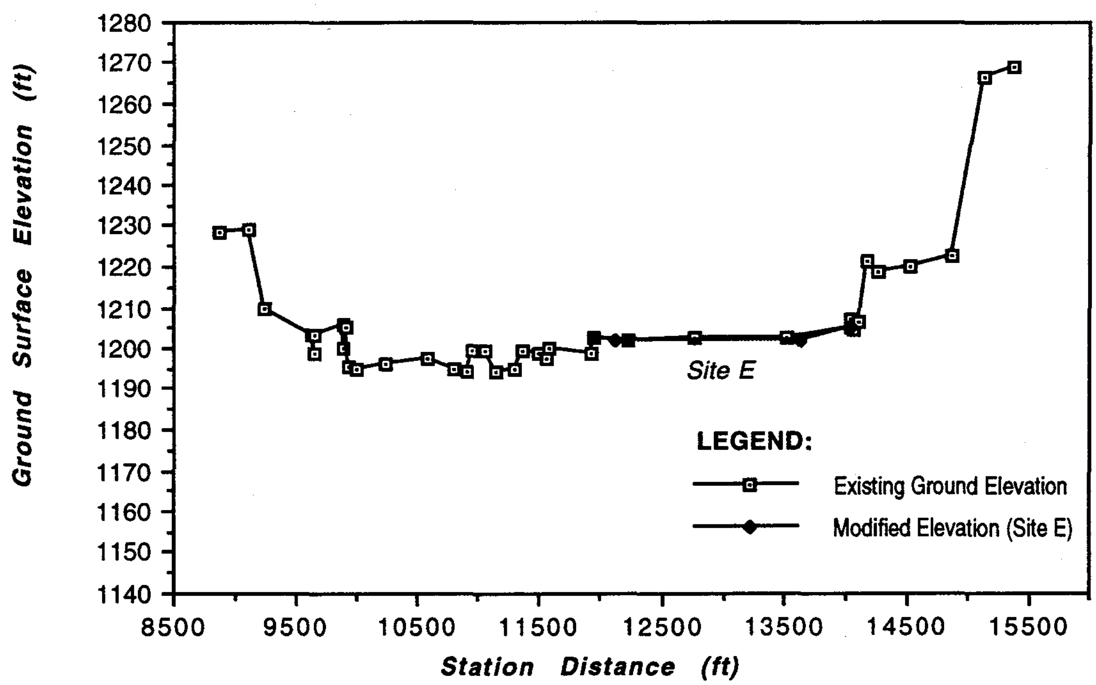

Fig. D-E-8 - Cross-section plot of Station 21.850

D.7 - Section Geometry at Mining Site F

Table D-F-1 - Section geometry for Station 22.107

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11170.00 (PL)**	1170.00	1200.80
3	12605.00	1435.00	1200.80
4	12660.00	55.00	1200.80

**Note: *	Indicated reference point is the river thalweg (Sta 100+00).**
****	Property Line**

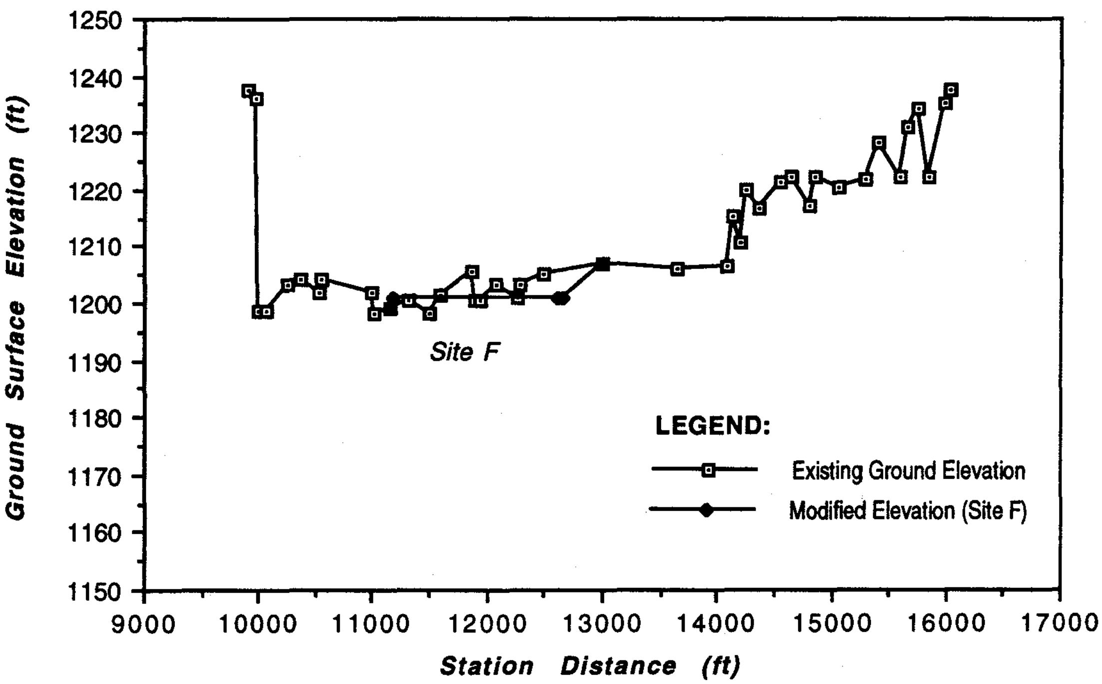

Fig. D-F-1 - Cross-section plot of Station 22.107

Table D-F-2 - Section geometry for Station 22.130

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11280.00 (PL)**	1280.00	1201.00
3	11555.00	275.00	1161.00
4	12545.00	990.00	1161.00
5	12640.00	95.00	1201.00
6	12770.00 (PL)**	130.00	1201.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

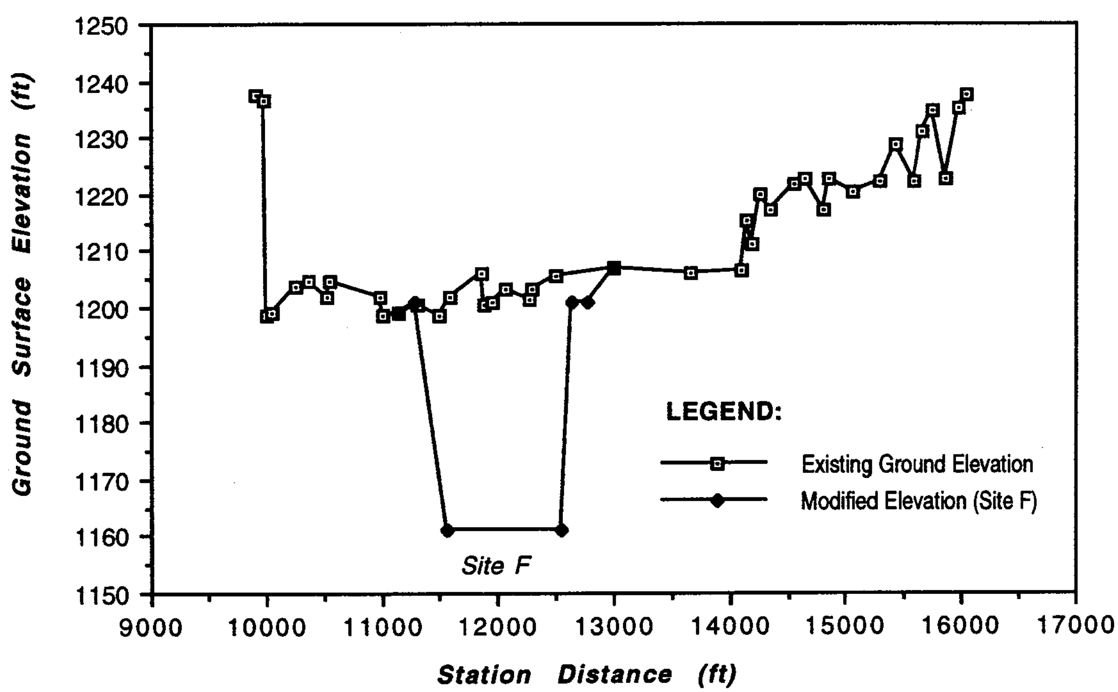

Fig. D-F-2 - Cross-section plot of Station 22.130

Table D-F-3 - Section geometry for Station 22.320

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11625.00 (PL)**	1625.00	1203.00
3	11740.00	115.00	1203.00
4	12015.00	275.00	1163.00
5	12520.00	505.00	1163.00
6	12615.00	95.00	1203.00
7	13185.00 (PL)**	570.00	1203.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

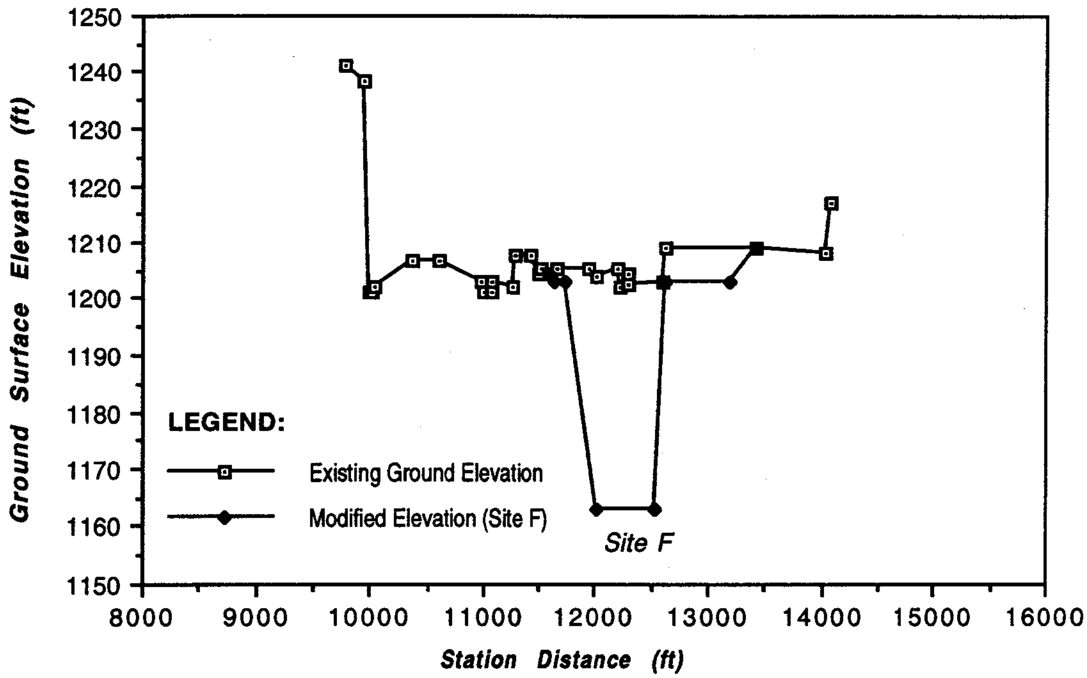

Fig. D-F-3 - Cross-section plot of Station 22.320

Table D-F-4 - Section geometry for Station 22.365

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	11700.00 (PL)**	1700.00	1203.50
3	11815.00	115.00	1203.50
4	12575.00	760.00	1203.50
5	13255.00 (PL)**	680.00	1203.50

**Note: *	Indicated reference point is the river thalweg (Sta 100+00).**
****	Property Line**

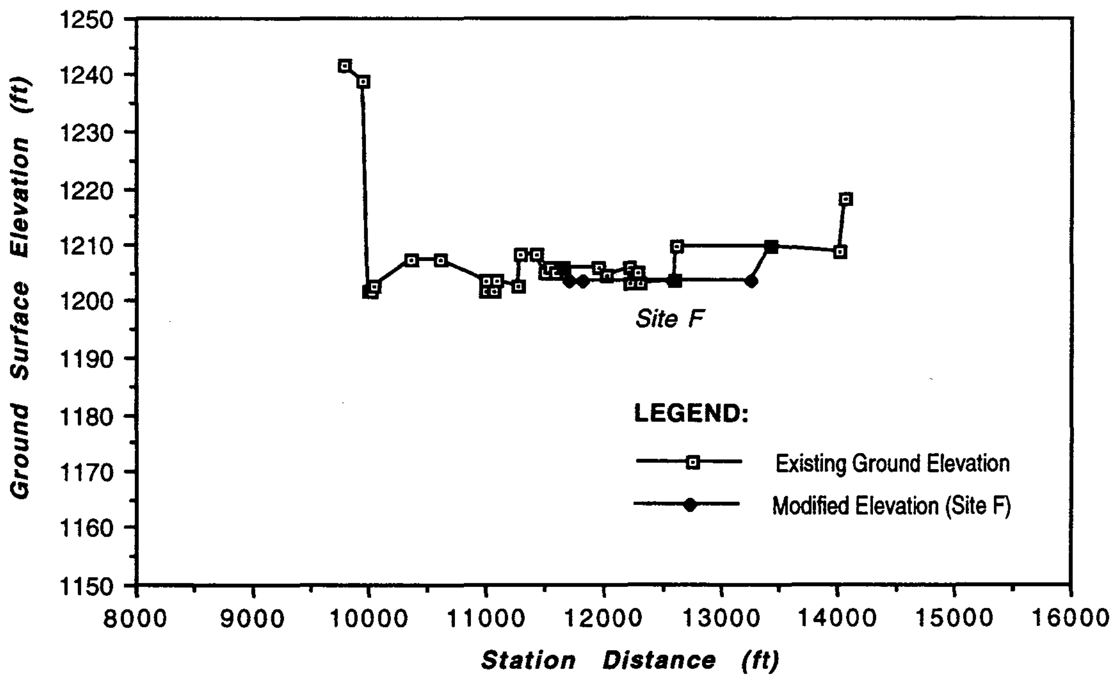

Fig. D-F-4 - Cross-section plot of Station 22.365

D.8 - Section Geometry at Mining Site G

Table D-G-1 - Section geometry for Station 23.350

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9565.00 (PL)**	- 435.00	1220.90
3	9775.00	210.00	1220.90
4	11265.00	1490.00	1220.90
5	11315.00	50.00	1220.90

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

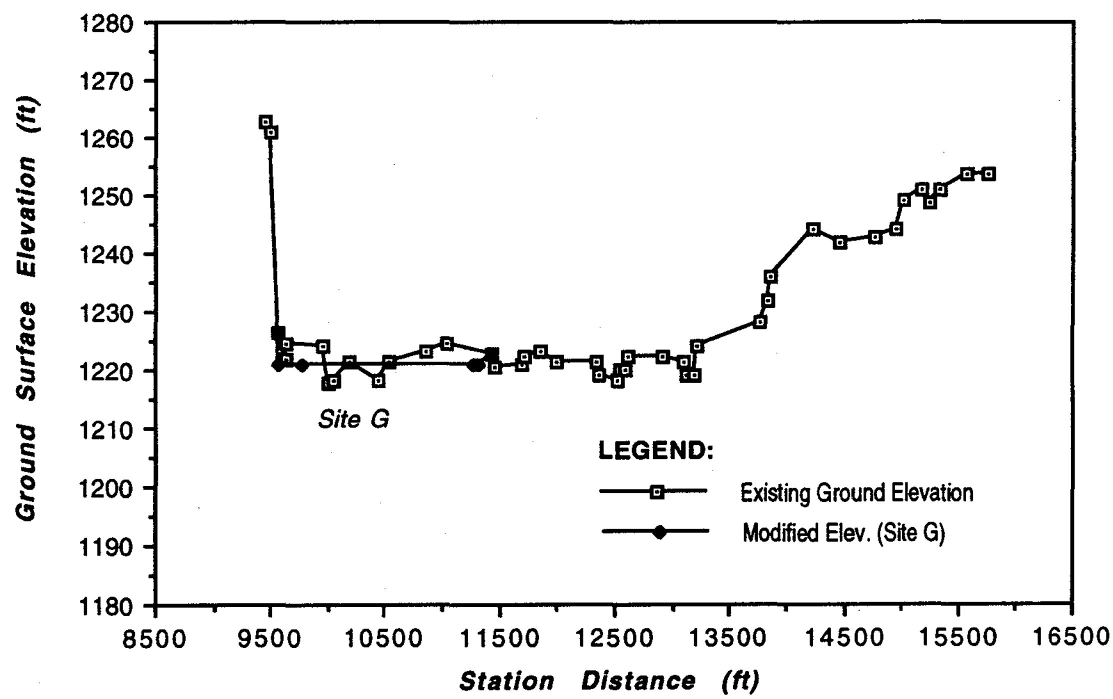

Fig. D-G-1 - Cross-section plot of Station 23.350

Table D-G-2 - Section geometry for Station 23.365

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9590.00 (PL)**	- 410.00	1221.10
3	9790.00	200.00	1221.10
4	9870.00	80.00	1181.10
5	11160.00	1290.00	1181.10
6	11280.00	120.00	1221.10
7	11330.00 (PL)**	50.00	1221.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

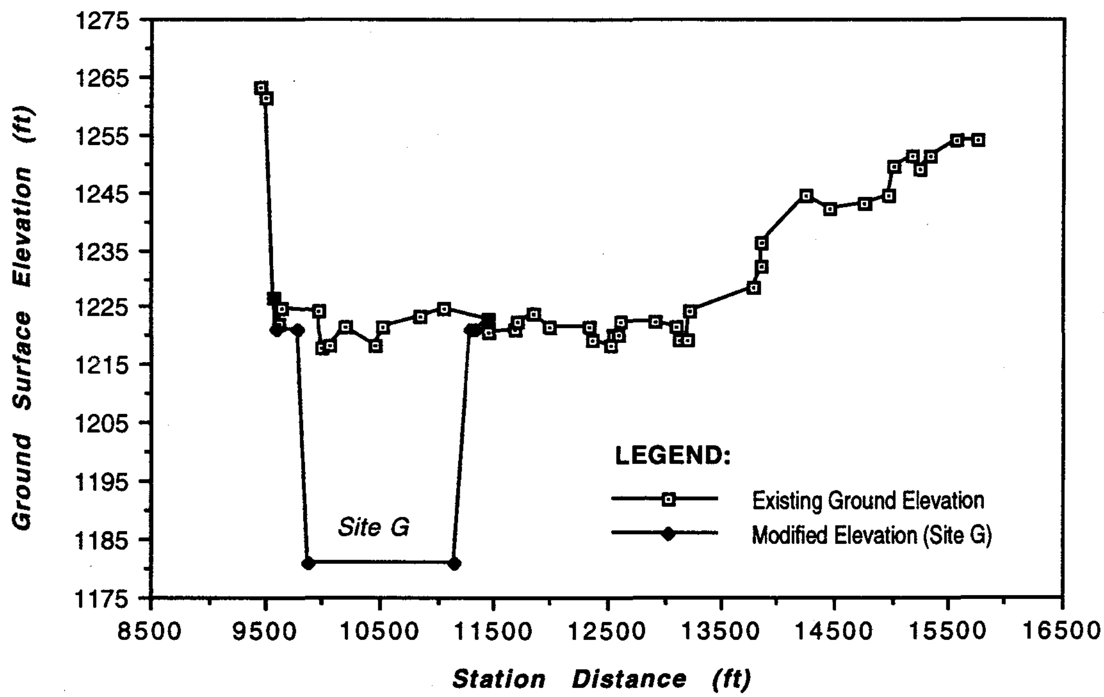

Fig. D-G-2 - Cross-section plot of Station 23.365

Table D-G-3 - Section geometry for Station 23.571

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9670.00 (PL)**	- 330.00	1224.40
3	9720.00	50.00	1224.40
4	9800.00	80.00	1184.40
5	10820.00	1020.00	1184.40
6	10940.00	120.00	1224.40
7	10990.00 (PL)**	50.00	1224.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

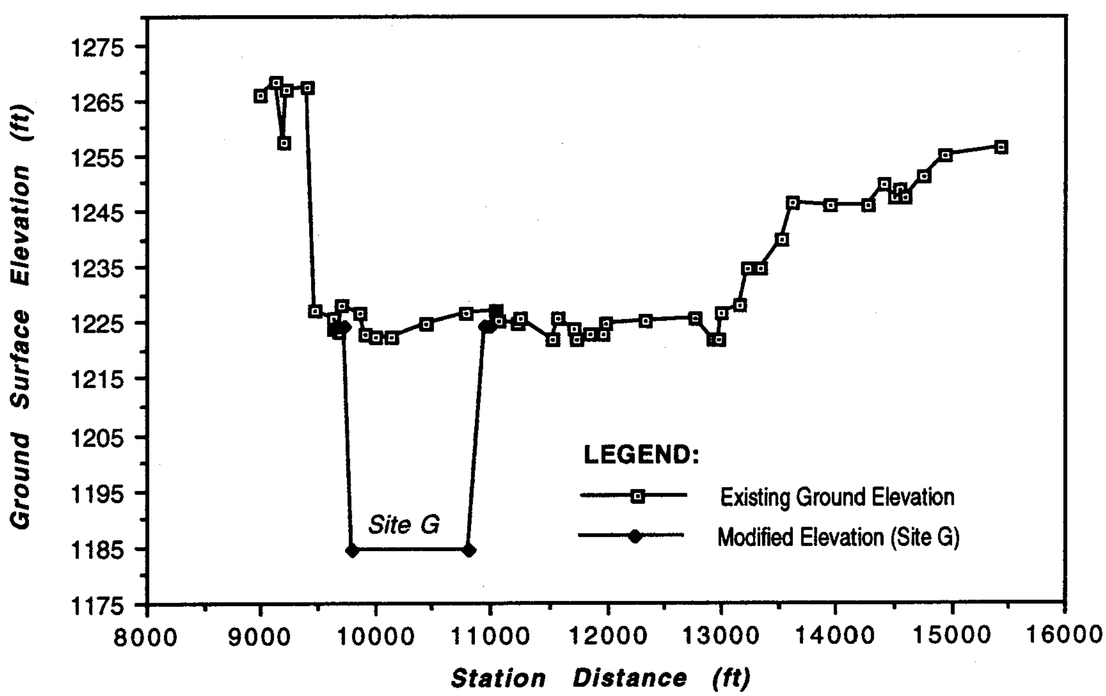

Fig. D-G-3 - Cross-section plot of Station 23.571

Table D-G-4 - Section geometry for Station 23.694

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9650.00 (PL)**	- 350.00	1226.40
3	9700.00	50.00	1226.40
4	9780.00	80.00	1186.40
5	10800.00	1020.00	1186.40
6	10920.00	120.00	1226.40
7	10970.00(PL)**	50.00	1226.40

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

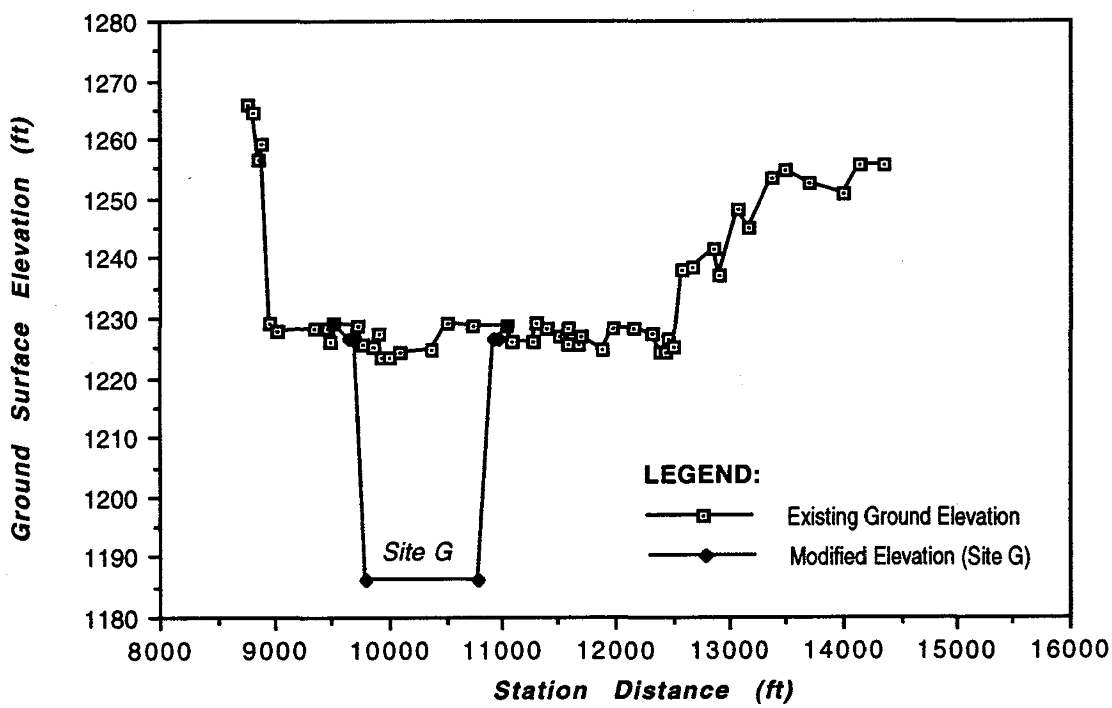

Fig. D-G-4 - Cross-section plot of Station 23.694

Table D-G-5- Section geometry for Station 23.851

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9250.00 (PL)**	- 750.00	1228.90
3	9300.00	50.00	1228.90
4	9380.00	80.00	1188.90
5	10400.00	1020.00	1188.90
6	10520.00	120.00	1228.90
7	10570.00 (PL)**	50.00	1228.90

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

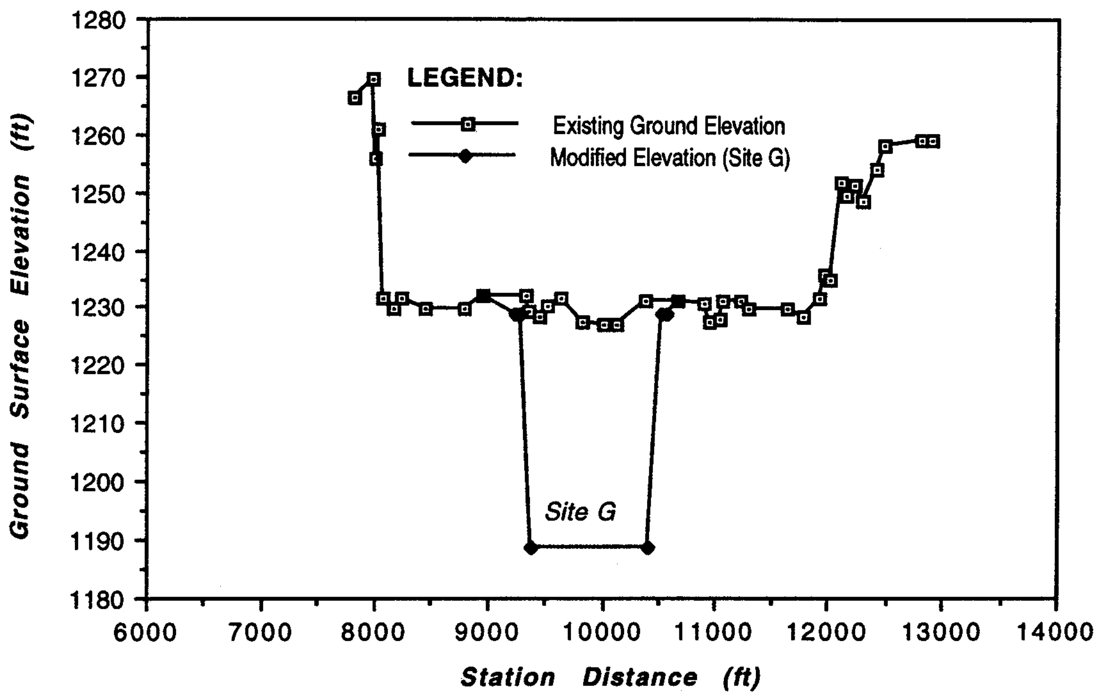

Fig. D-G-5 - Cross-section plot of Station 23.851

Table D-G-6 - Section geometry for Station 23.874

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9210.00 (PL)**	- 790.00	1229.30
3	10530.00 (PL)**	1320.00	1229.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

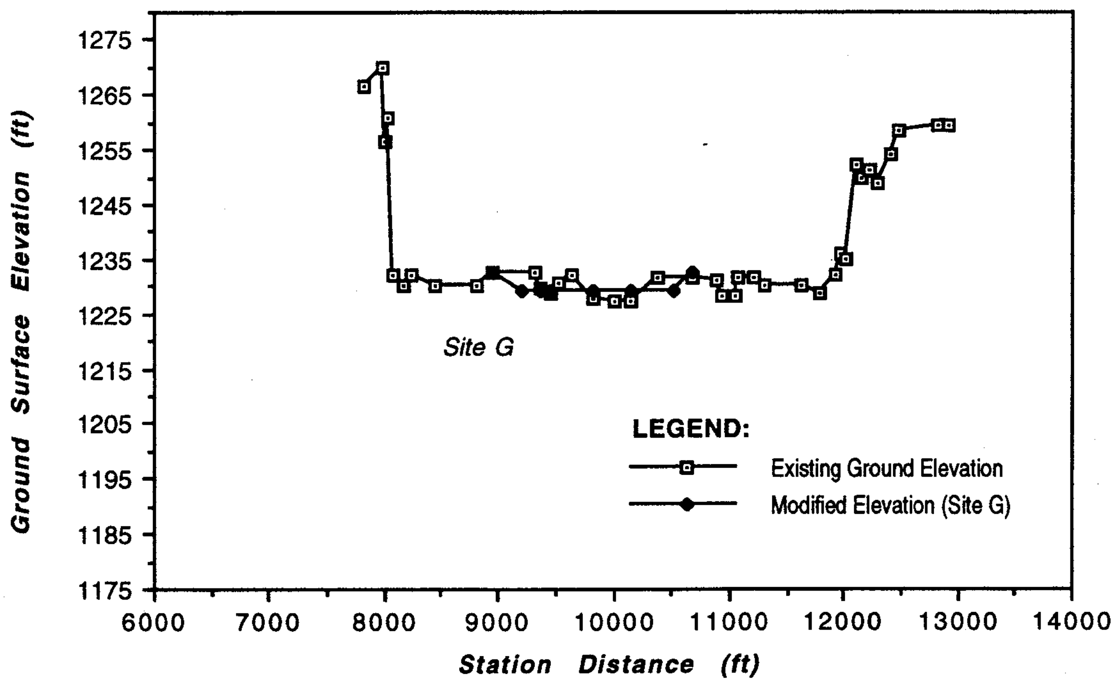

Fig. D-G-6 - Cross-section plot of Station 23.874

D.9 - Section Geometry at Mining Site H

Table D-H-1 - Section geometry for Station 23.350

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9575.00 (PL)**	- 425.00	1220.90
3	10175.00	600.00	1220.90
4	10255.00	80.00	1220.90
5	11145.00	890.00	1220.90
6	11265.00	120.00	1220.90
7	11315.00 (PL)**	50.00	1220.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

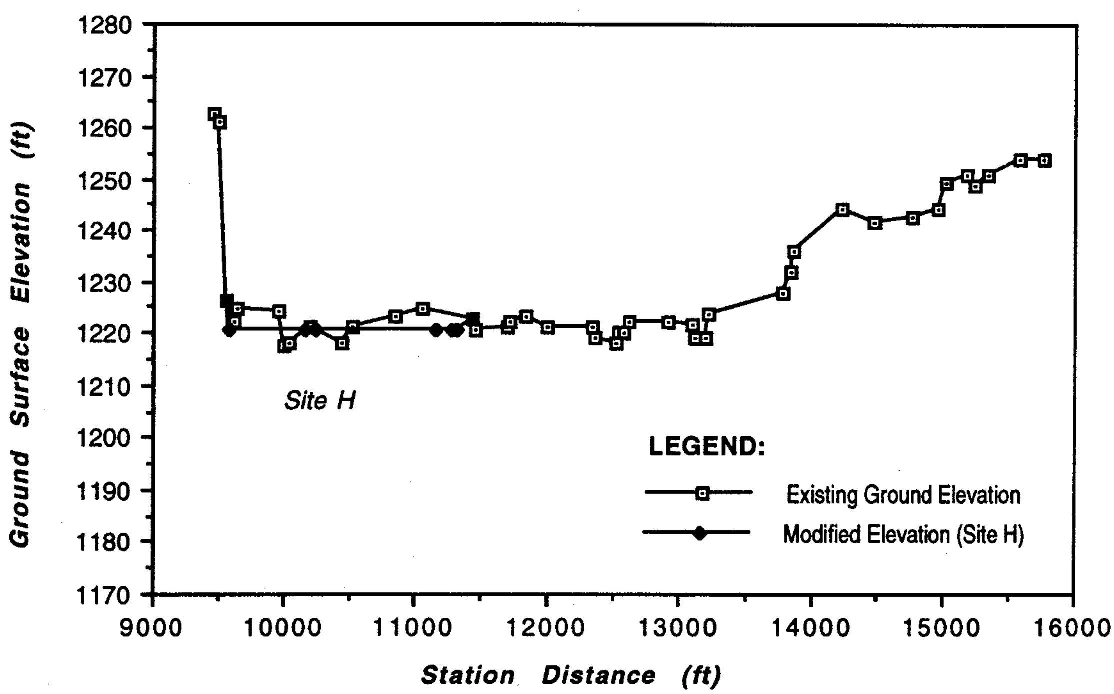

Fig. D-H-1 - Cross-section plot of Station 23.350

Table D-H-2 - Section geometry for Station 23.365

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9590.00 (PL)**	- 410.00	1221.10
3	10160.00	570.00	1221.10
4	10240.00	80.00	1181.10
5	11130.00	890.00	1181.10
6	11250.00	120.00	1221.10
7	11300.00 (PL)**	50.00	1221.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

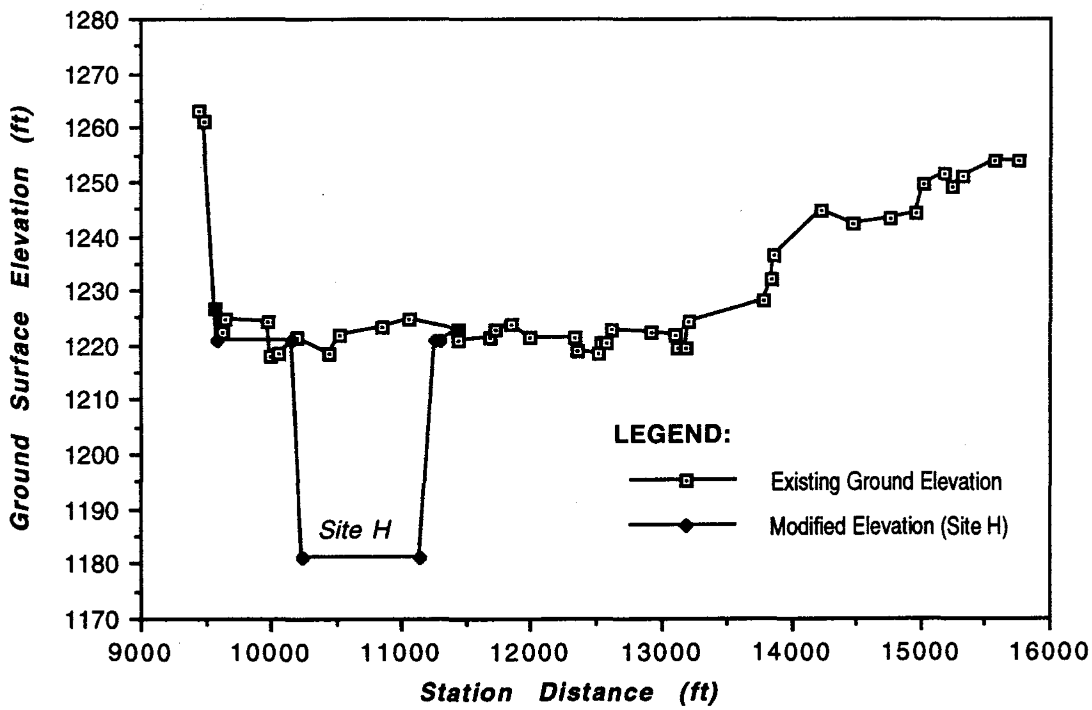

Fig. D-H-2 - Cross-section plot of Station 23.365

Table D-H-3 - Section geometry for Station 23.571

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9670.00 (PL)**	- 330.00	1224.40
3	9925.00	255.00	1224.40
4	10005.00	80.00	1184.40
5	10895.00	890.00	1184.40
6	11015.00	120.00	1224.40
7	11065.00 (PL)**	50.00	1224.40

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

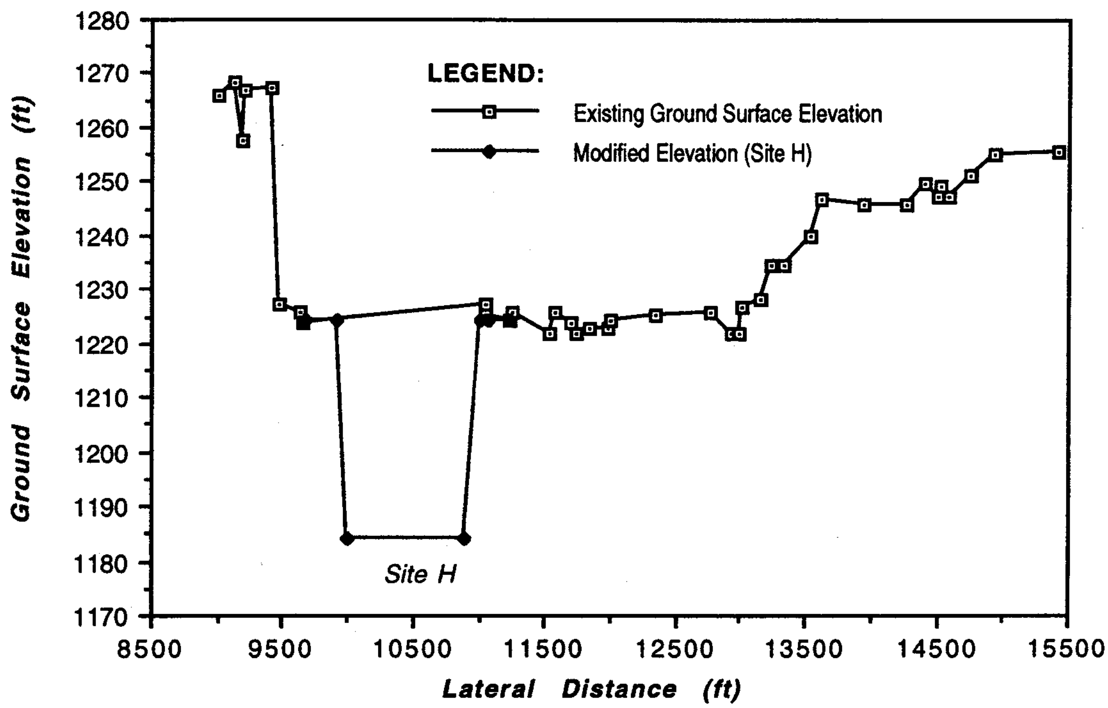

Fig. D-H-3 - Cross-section plot of Station 23.571

Table D-H-4 - Section geometry for Station 23.694

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9575.00 (PL)**	- 425.00	1226.40
3	9630.00	55.00	1226.40
4	9710.00	80.00	1186.40
5	10730.00	1020.00	1186.40
6	10850.00	120.00	1226.40
7	10900.00 (PL)**	50.00	1226.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

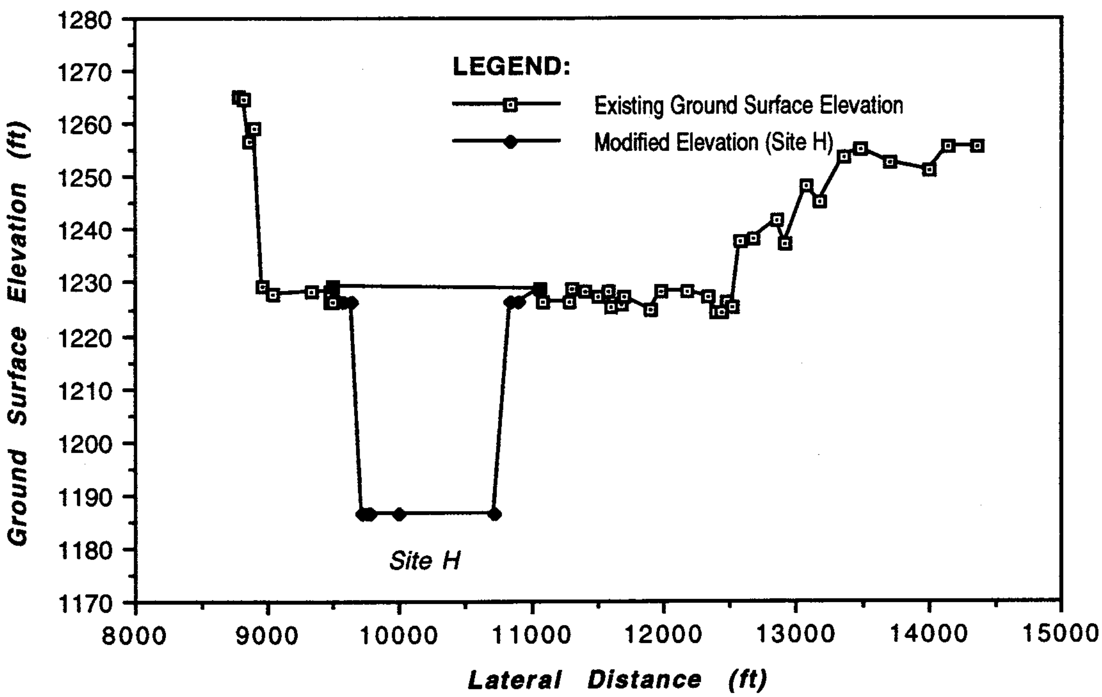

Fig. D.H-4 - Cross-section plot of Station 23.694

Table D-H-5 - Section geometry for Station 23.851

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9255.00 (PL)**	- 745.00	1228.90
3	9310.00	55.00	1228.90
4	9390.00	80.00	1188.90
5	10410.00	1020.00	1188.90
6	10530.00	120.00	1228.90
7	10580.00 (PL)**	50.00	1228.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

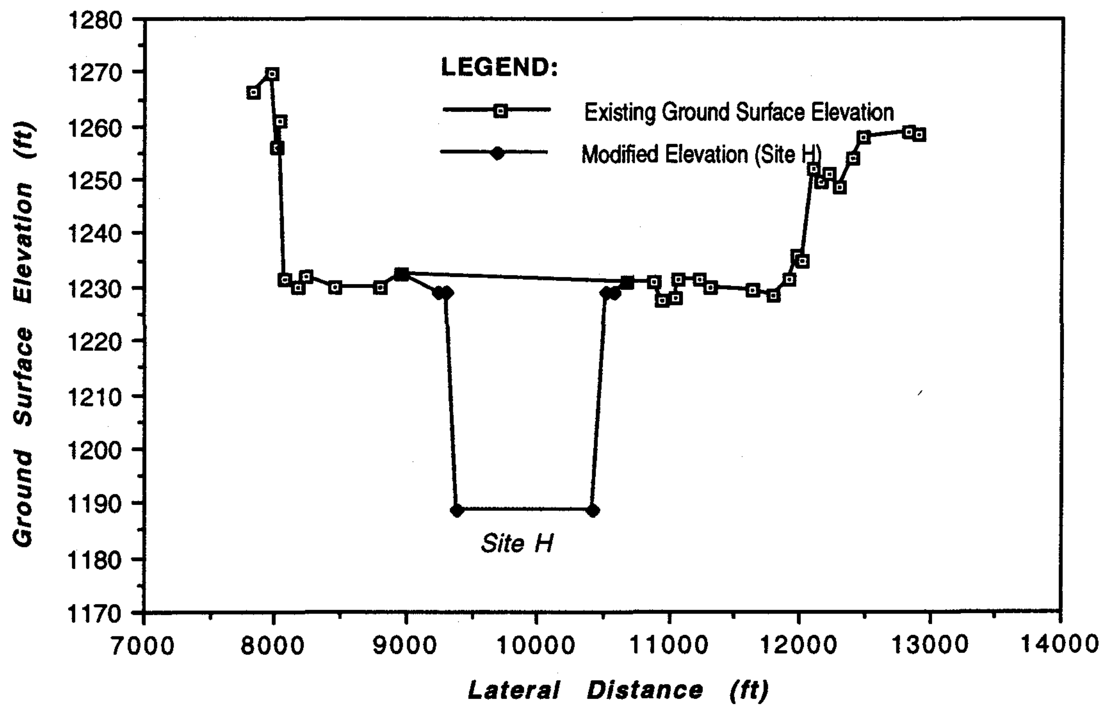

Fig. D-H-5 - Cross-section plot of Station 23.851

Table D-H-6 - Section geometry for Station 23.874

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9210.00 (PL)**	- 790.00	1229.30
3	9265.00	55.00	1229.30
4	9345.00	80.00	1229.30
5	10365.00	1020.00	1229.30
6	10485.00	120.00	1229.30
7	10535.00 (PL)**	50.00	1229.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

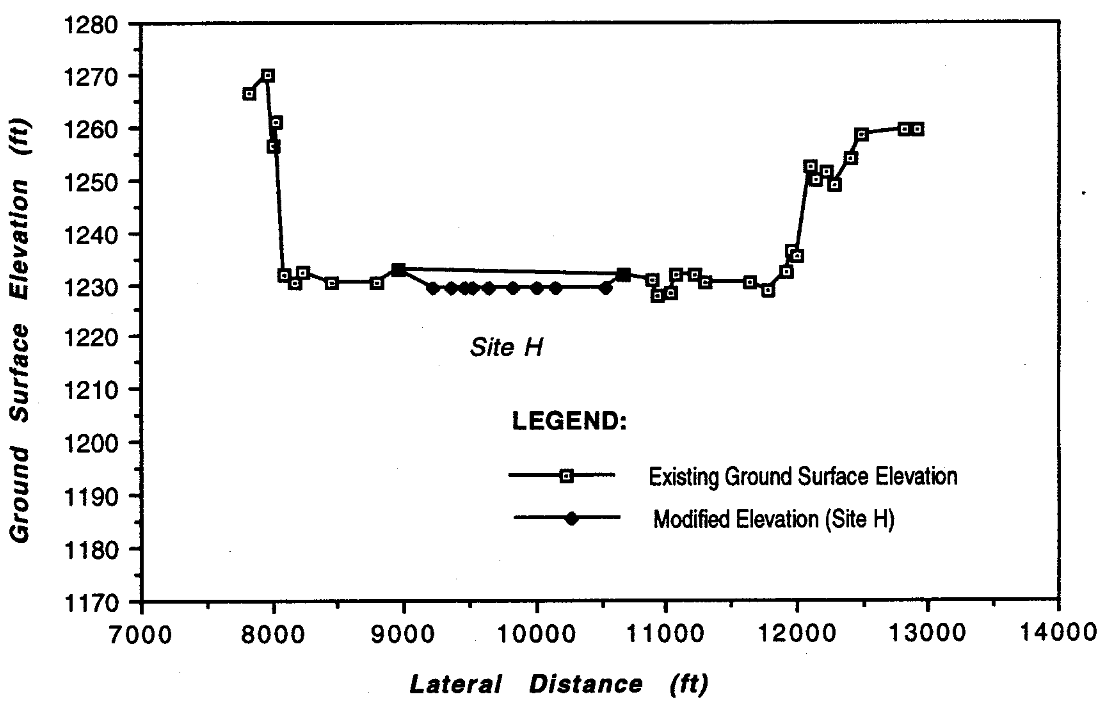

Fig. D-H-6 - Cross-section plot of Station 23.874

Table D-H-7 - Section geometry for Station 24.070

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9065.00 (PL)**	- 935.00	1232.90
3	9195.00	130.00	1232.90
4	9275.00	80.00	1232.90
5	10215.00	940.00	1232.90
6	10335.00	120.00	1232.90
7	10385.00 (PL)**	50.00	1232.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Property Line

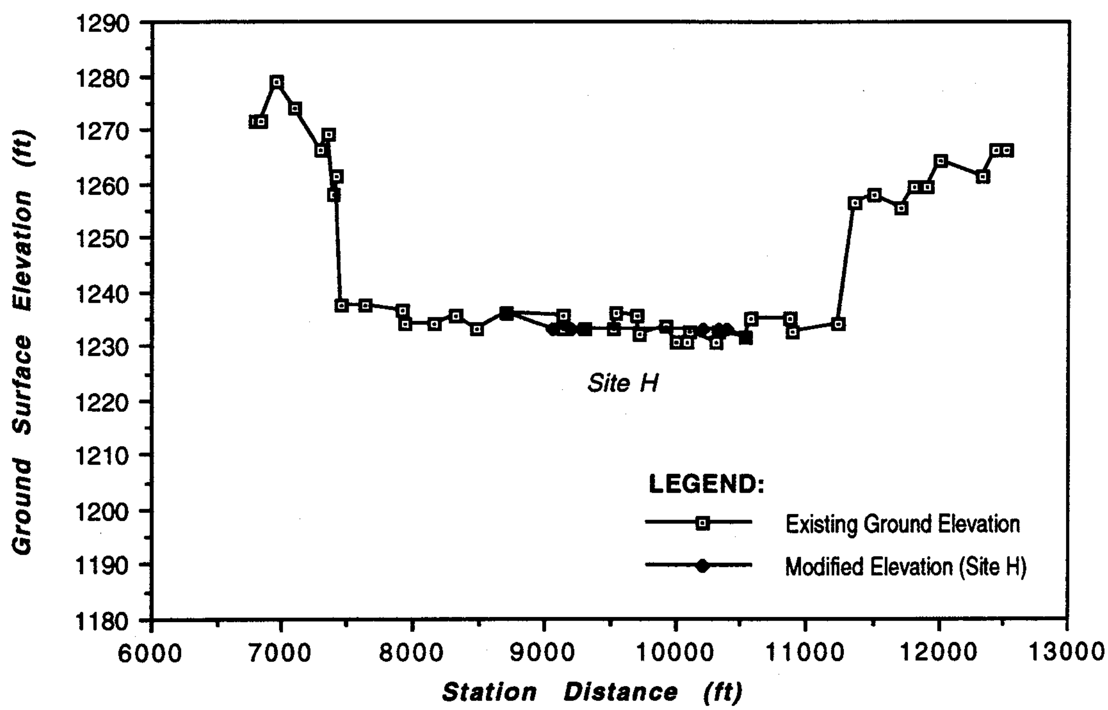

Fig. D-H-7 - Cross-section plot of Station 24.070

Table D-H-8 - Section geometry for Station 24.085

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9035.00 (PL)**	- 965.00	1233.10
3	9165.00	130.00	1233.10
4	9245.00	80.00	1193.10
5	10185.00	940.00	1193.10
6	10305.00	120.00	1233.10
7	10355.00 (PL)**	50.00	1233.10

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
** **Property Line**

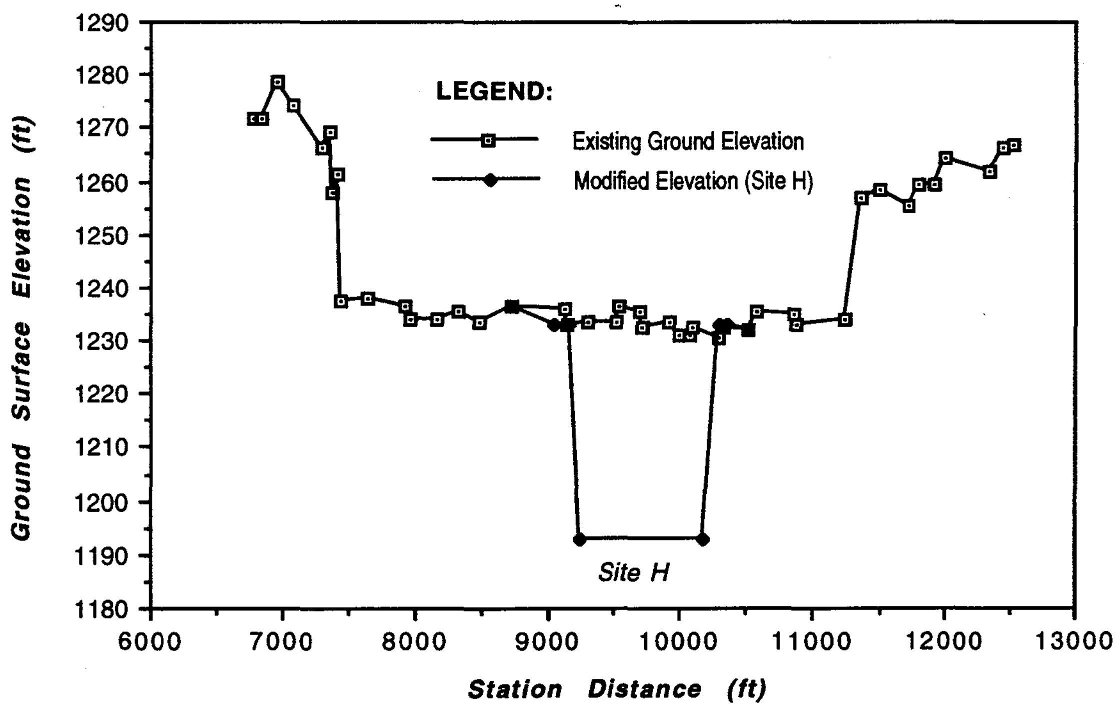

Fig. D-H-8 - Cross-section plot of Station 24.085

Table D-H -9 - Section geometry for Station 24.170

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8970.00 (PL)**	-1030.00	1233.90
3	9100.00	130.00	1233.90
4	9180.00	80.00	1193.90
5	10120.00	940.00	1193.90
6	10240.00	120.00	1233.90
7	10290.00 (PL)**	50.00	1233.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

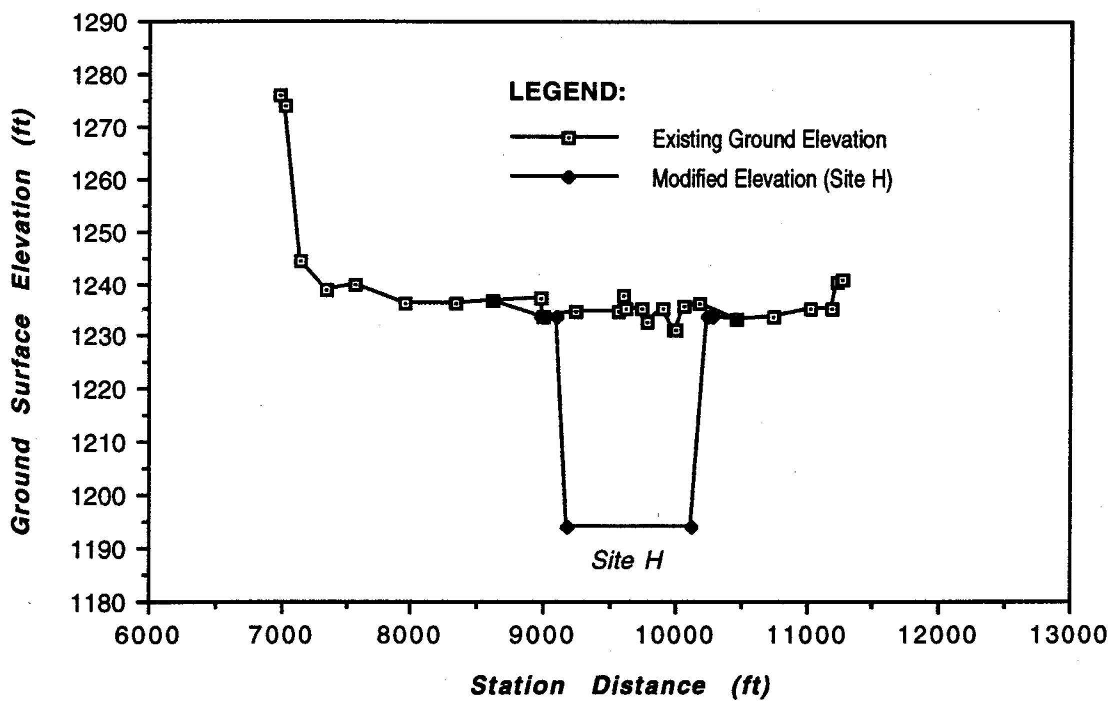

Fig. D-H-9 - Cross-section plot of Station 24.170

Table D-H-10 - Section geometry for Station 24.193

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	8970.00 (PL)**	-1030.00	1234.30
3	9100.00	130.00	1234.30
4	9180.00	80.00	1234.30
5	10120.00	940.00	1234.30
6	10240.00	120.00	1234.30
7	10290.00 (PL)**	50.00	1234.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

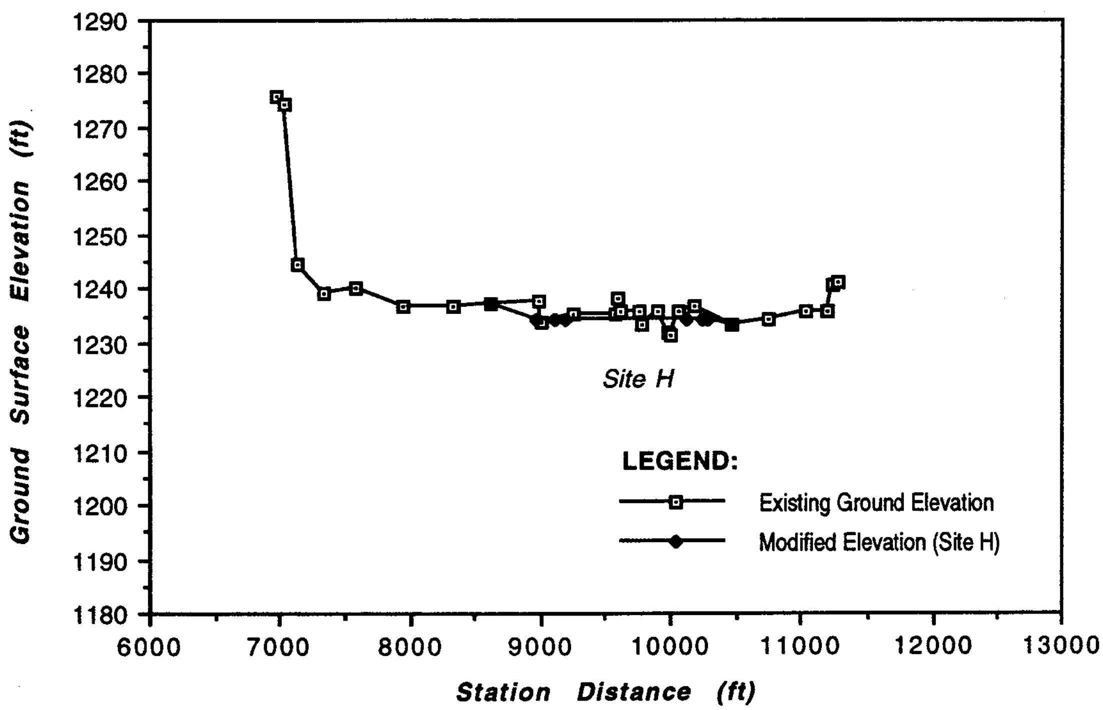

Fig. D-H-10 - Cross-section plot of Station 24.193

Table D-H-11 - Section geometry for Station 24.350

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9475.00 (PL)**	- 525.00	1237.10
3	9605.00	130.00	1237.10
4	9685.00	80.00	1237.10
5	10625.00	940.00	1237.10
6	10745.00	1 20.00	1237.10
7	10795.00 (PL)**	50.00	1237.10

Note: * **Indicated reference point is the river thalweg (Sta 100+00).**
****** **Property Line**

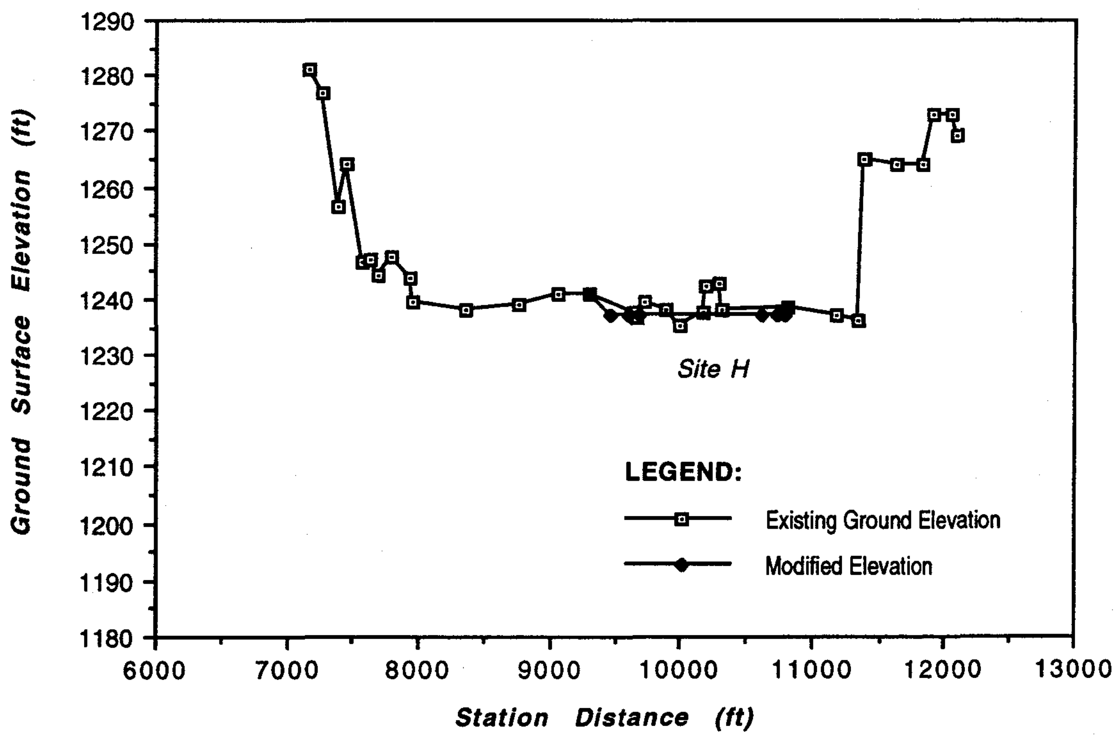

Fig. D-H-11 - Cross-section plot of Station 24.350

Table D-H-12 - Section geometry for Station 24.365

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9470.00 (PL)**	- 530.00	1237.30
3	9600.00	130.00	1237.30
4	9680.00	80.00	1197.30
5	10620.00	940.00	1197.30
6	10740.00	120.00	1237.30
7	10790.00 (PL)**	50.00	1237.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

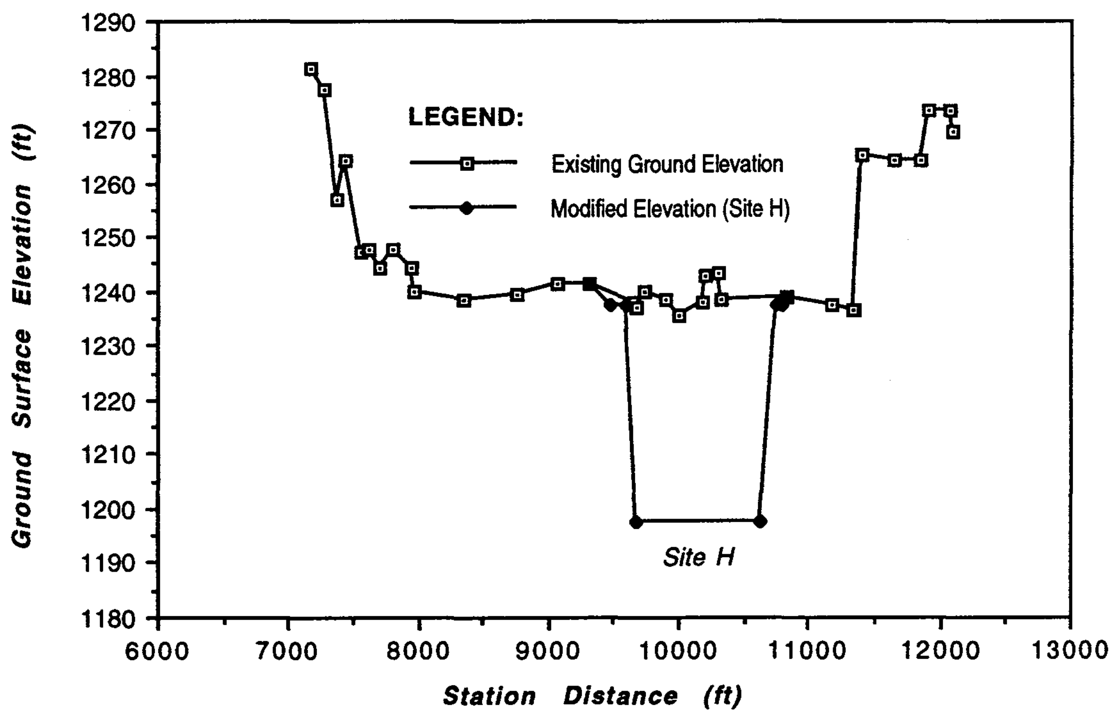

Fig. D-H-12 - Cross-section plot of Station 24.365

Table D-H-13 - Section geometry for Station 24.468

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9350.00 (PL)**	- 650.00	1238.90
3	9480.00	130.00	1238.90
4	9560.00	80.00	1198.90
5	10500.00	940.00	1198.90
6	10620.00	120.00	1238.90
7	10670.00 (PL)**	50.00	1238.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

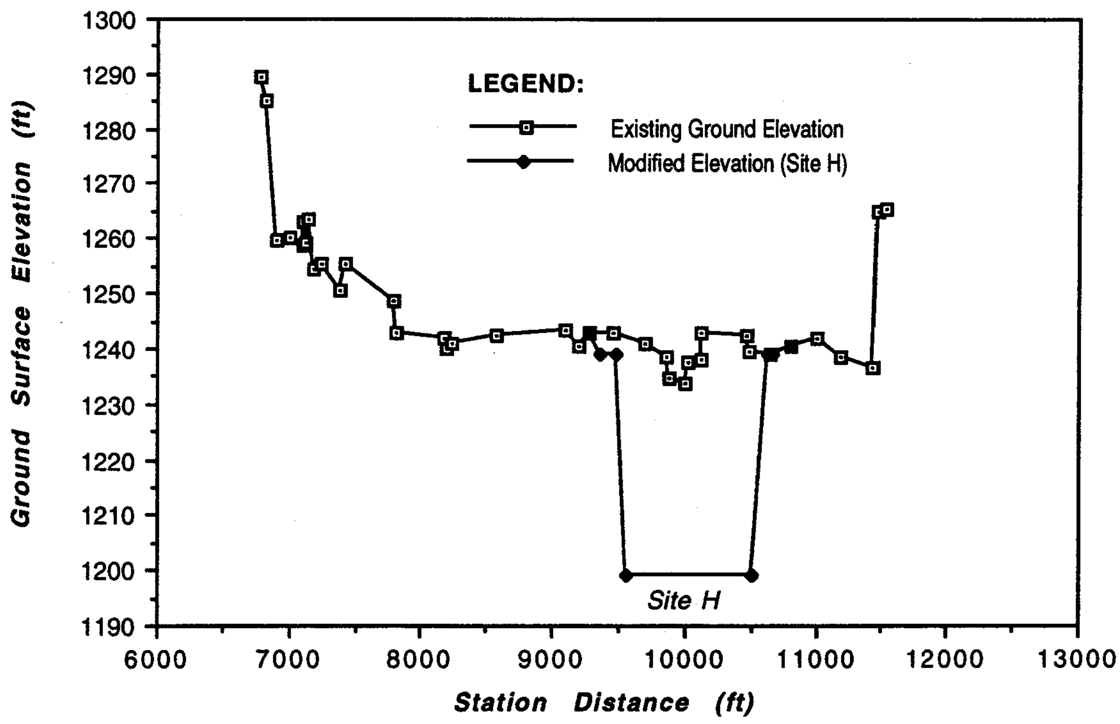

Fig. D-H-13 - Cross-section plot of Station 24.468

Table D-H-14 - Section geometry for Station 24.491

No.	Ground Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)
1	10000.00*	0.00	-
2	9350.00 (PL)**	- 650.00	1239.30
3	9480.00	130.00	1239.30
4	9560.00	80.00	1239.30
5	10500.00	940.00	1239.30
6	10620.00	120.00	1239.30
7	10670.00 (PL)**	50.00	1239.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
**** Property Line**

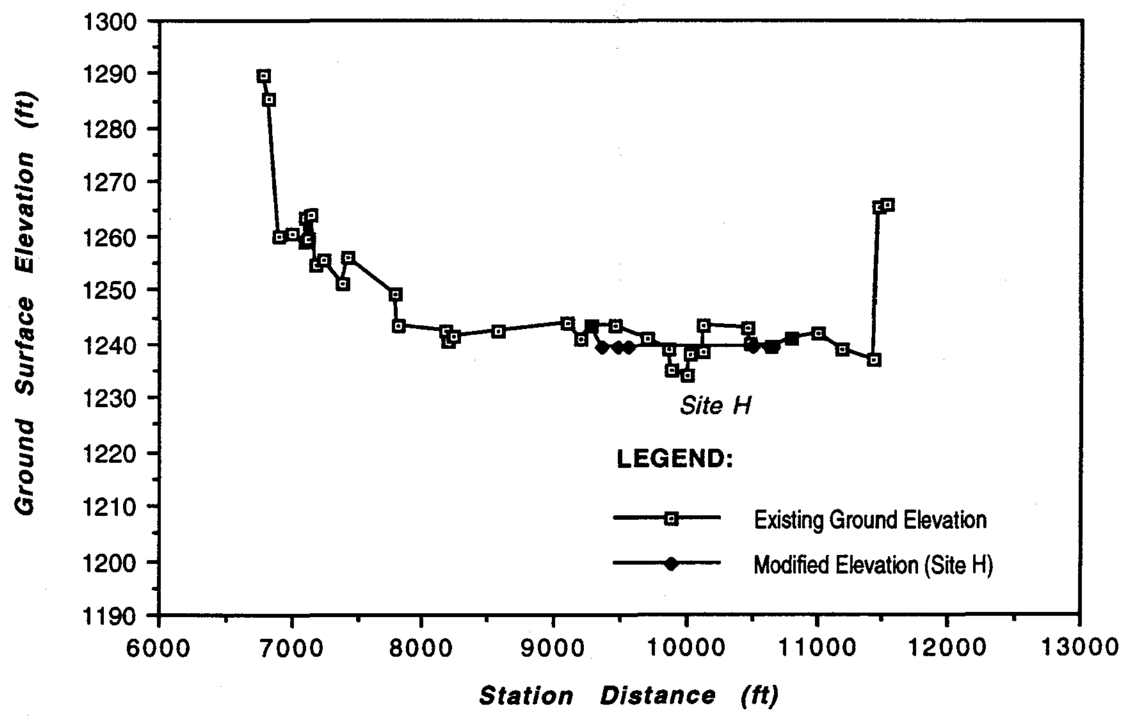

Fig. D-H-14- Cross-section plot of Station 24.491

APPENDIX E - Section Geometry Information for Channel Improvement Site Stations (Model III)

E.1 - Hydraulic Information for the Channel Improvement Stations

Table E-1 - Hydraulic Data for the Channel Improvement Stations (Model III)

Improvement Channel	Mile Number	Roughness Coefficiets			Channel Boundary		Reach Length	Movable Bed Limit (ft)
		LOB	Main	ROB	Left	Right		
No. I	8.100	0.04	0.03	0.04	9474	10526	-	9499.9-10500.1
	8.210	0.04	0.03	0.04	9474	10526	600	9499.9-10500.1
	8.730	0.04	0.03	0.04	9474	10526	2640	9499.9-10500.1
	9.130	0.04	0.03	0.04	9474	10526	2090	9499.9-10500.1
	9.900	0.04	0.03	0.04	8827	9879	3950	8852.9-9853.1
	10.530	0.04	0.03	0.04	9474	10526	3330	9499.9-10500.1
	10.720	0.04	0.03	0.04	9125	10177	1010	9150.9-10151.1
	11.010	0.04	0.03	0.04	8799	9851	1430	8824.9-9825.1
	11.340	0.04	0.03	0.04	9095	10147	1680	9120.9-10121.1
	11.520	0.04	0.03	0.04	9065	10117	980	9090.9-10091.1
	11.800	0.04	0.03	0.04	9181	10233	1415	9206.9-10207.1
	12.380	0.04	0.03	0.04	9250	10302	925	9275.9-10276.1
	12.840	0.04	0.03	0.04	9156	10208	2485	9181.9-10182.1
	13.330	0.04	0.03	0.04	9474	10526	2585	9499.9-10500.1
No. II	16.450	0.04	0.03	0.04	9768.4	10820.4	-	9794.3-10794.5
	16.910	0.04	0.03	0.04	9758.4	10810	2440	9783.9-10784.1
	17.380	0.04	0.03	0.04	9271	10323	2455	9296.9-10297.1
	17.760	0.04	0.03	0.04	9275	10347	1980	9320.9-10321.1
	18.240	0.04	0.03	0.04	9781	10843	2525	9816.9-10817.1
	18.920	0.04	0.03	0.04	9524.9	10576.9	3595	9550.8-10551
	19.440	0.04	0.03	0.04	9088	10140	2800	9113.9-10114.1
	19.890	0.04	0.03	0.04	9474	10526	2375	9499.9-10500.1

Table E.I-1 - Channel geometry at Station 8.10

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1020.10
3	9500.00	26.00	1000.10
4	10500.00	1000.00**	1000.10
5	10526.00	26.00	1020.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

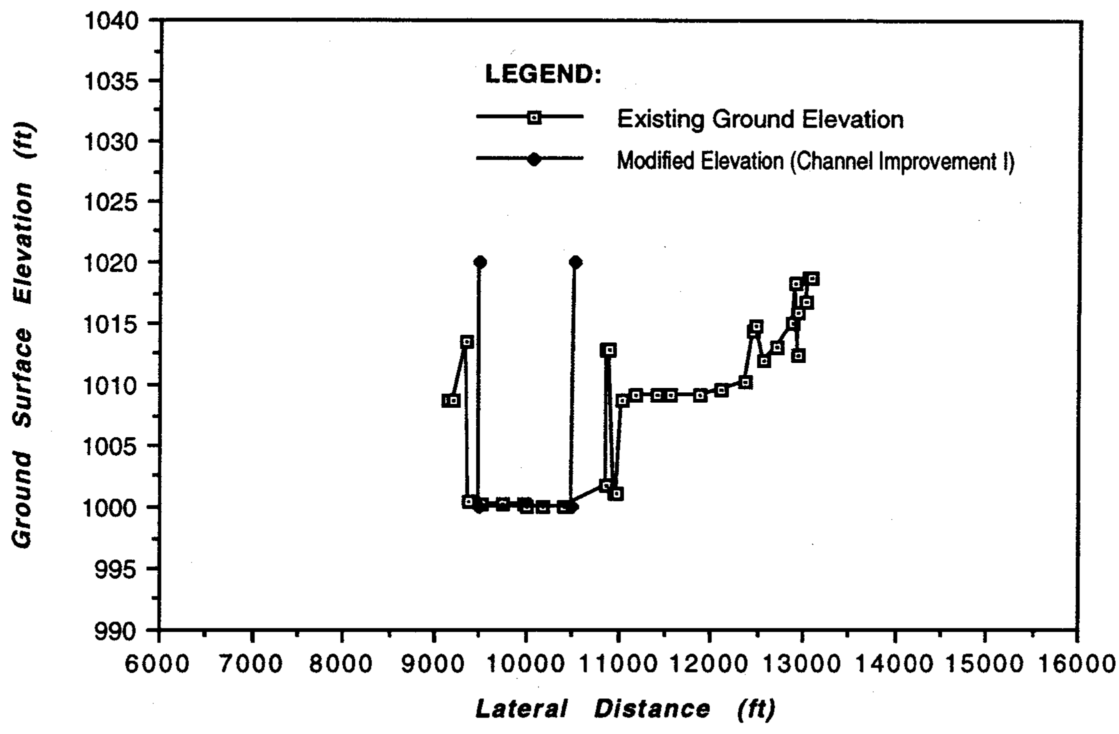

Fig. E.I-1 - Cross-section plot for Station 8.10

Table E.I-2 - Channel geometry at Station 8.21

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1020.80
3	9500.00	26.00	1000.80
4	10500.00	1000.00**	1000.80
5	10526.00	26.00	1020.80

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

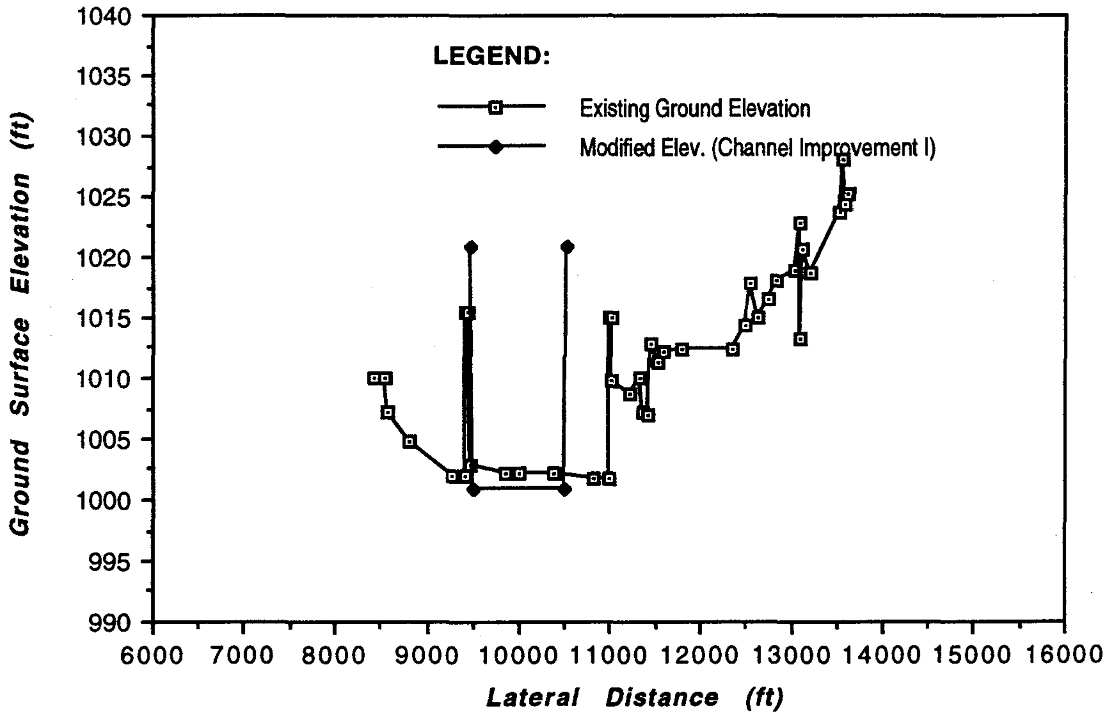

Fig. E.I-2 - Cross-section plot for Station 8.21

Table E.I-3 - Channel geometry at Station 8.73

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1029.30
3	9500.00	26.00	1009.30
4	10500.00	1000.00**	1009.30
5	10526.00	26.00	1029.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

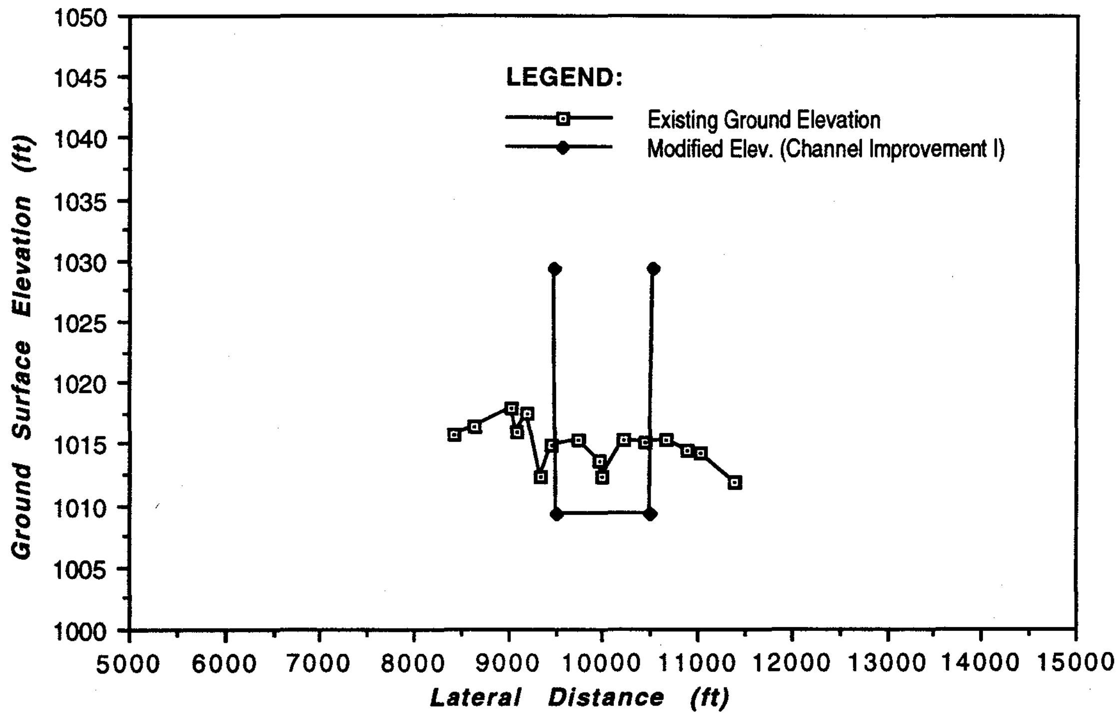

Fig. E.I-3- Cross-section plot for Station 8.73

Table E.I-4 - Channel geometry at Station 9.13

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1035.20
3	9500.00	26.00	1015.20
4	10500.00	1000.00**	1015.20
5	10526.00	26.00	1035.20

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

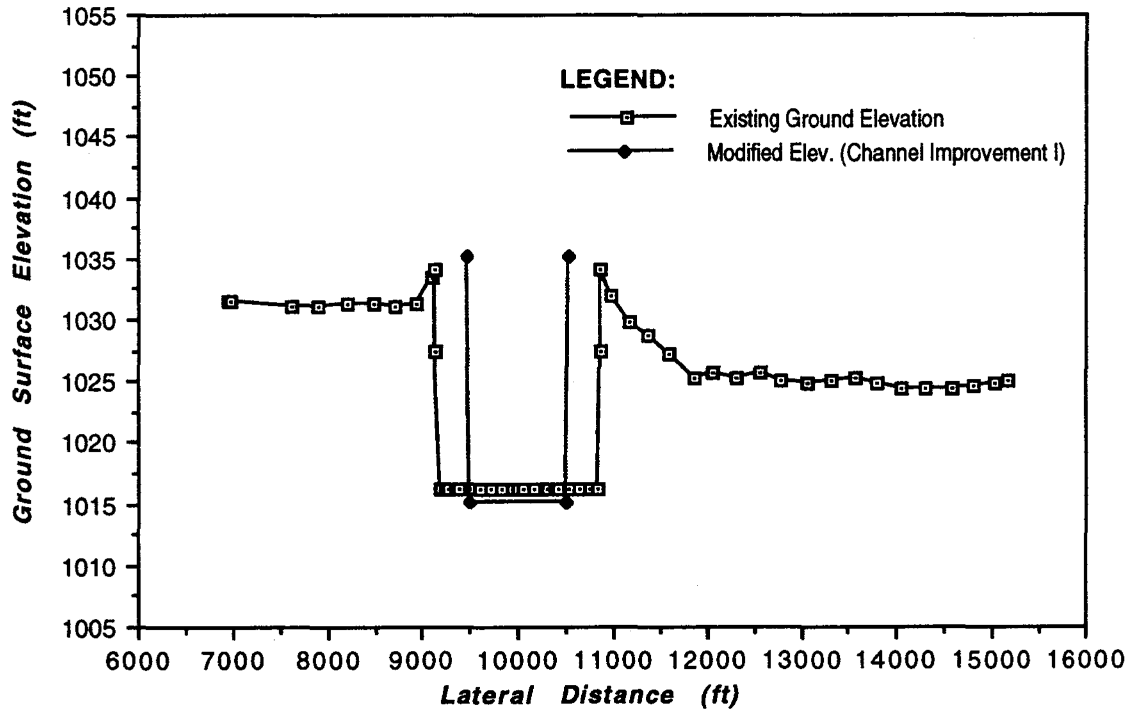

Fig. E.I-4 - Cross-section plot for Station 9.13

Table E.I-5 - Channel geometry at Station 9.90

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	9353.00*	0.00	-
2	8827.00	- 526.00	1046.50
3	8853.00	26.00	1026.50
4	9853.00	1000.00**	1026.50
5	9879.00	26.00	1046.50

Note: * Indicated reference point is the river thalweg (Sta 093+53).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

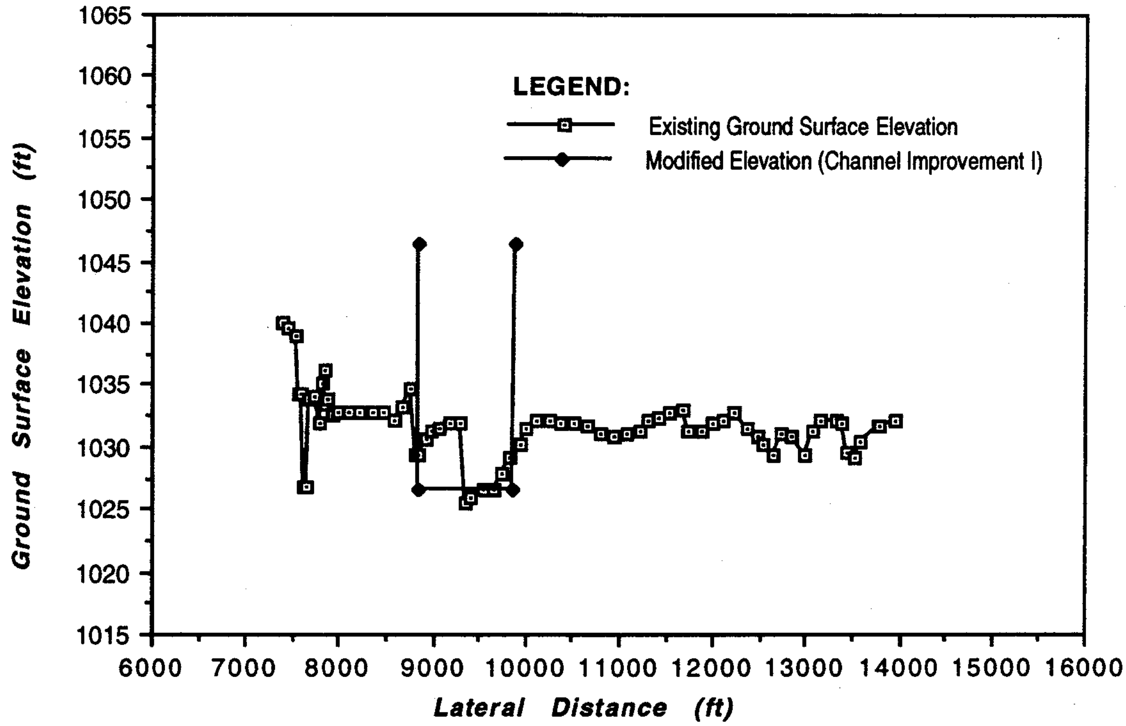

Fig. E.I-5 - Cross-section plot for Station 9.90

Table E.I-6 - Channel geometry at Station 10.53

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1055.90
3	9500.00	26.00	1035.90
4	10500.00	1000.00**	1035.90
5	10526.00	26.00	1055.90

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

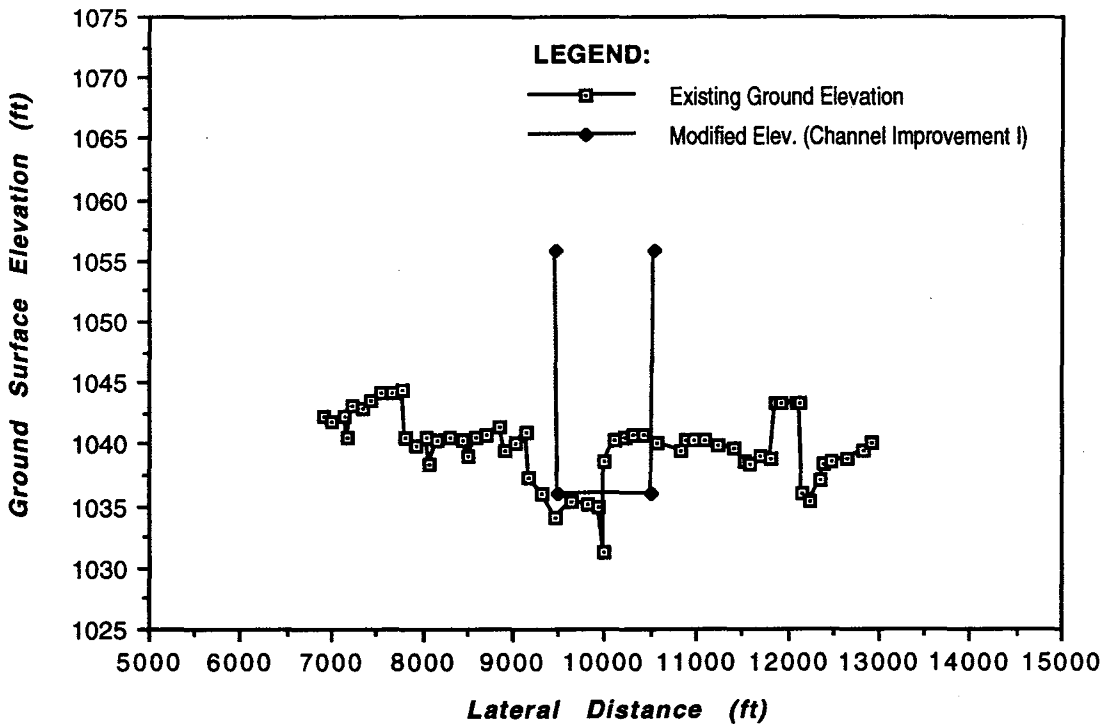

Fig. E.I-6 - Cross-section plot for Station 10.53

Table E.I-7 - Channel geometry at Station 10.72

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	9651.00*	0.00	-
2	9125.00	- 526.00	1058.80
3	9151.00	26.00	1038.80
4	10151.00	1000.00**	1038.80
5	10177.00	26.00	1058.80

Note: * Indicated reference point is the river thalweg (Sta 096+51).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

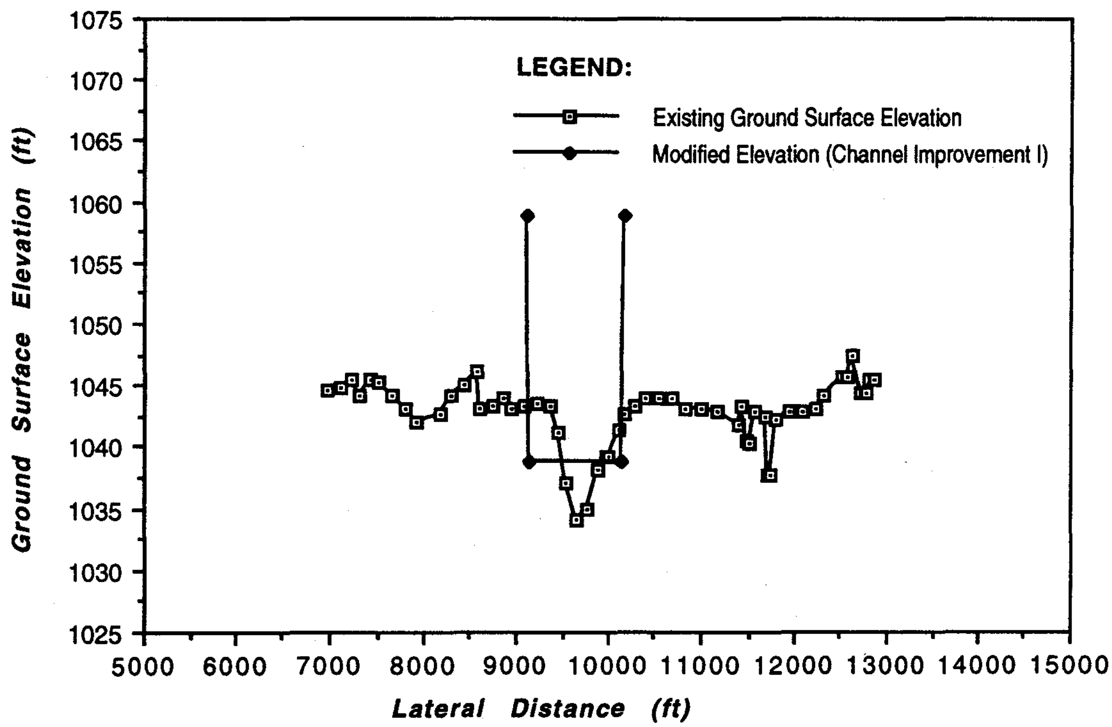

Fig. E.I-7 - Cross-section plot for Station 10.72

Table E.I-8 - Channel geometry at Station 11.01

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	8799.00*	0.00	-
2	8799.00	0.00	1057.80
3	8825.00	26.00	1042.80
4	9825.00	1000.00**	1042.80
5	9851.00	26.00	1057.80

Note: * Indicated reference point is the river thalweg (Sta 087+99).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

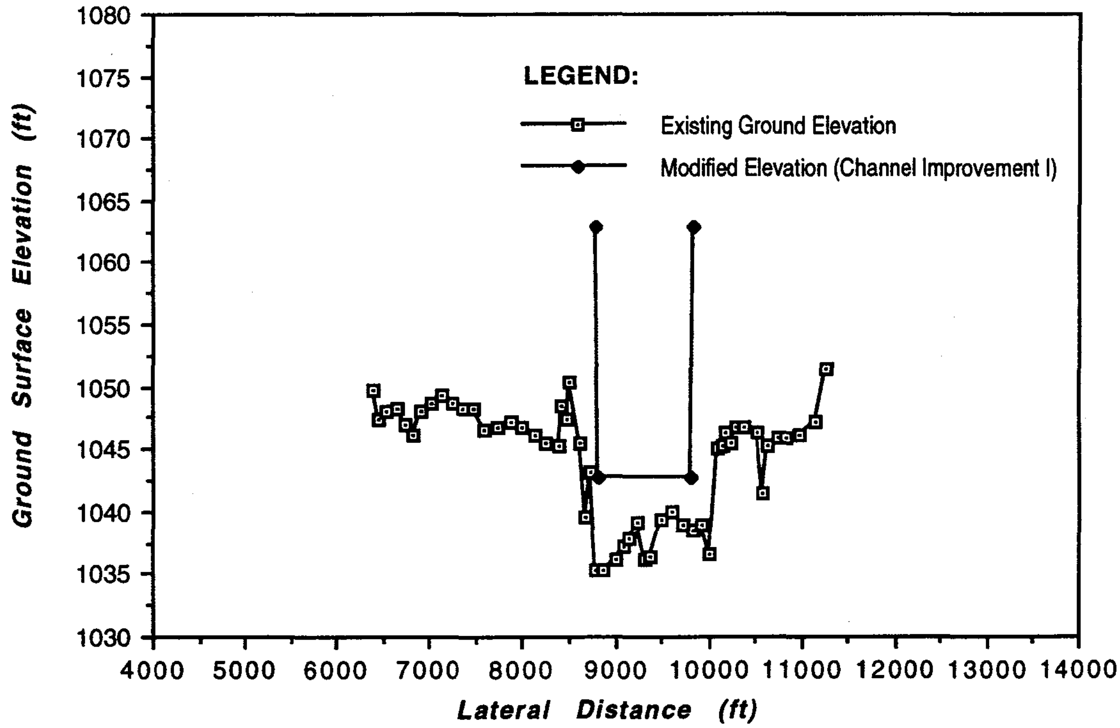

Fig. E.I-8 - Cross-section plot for Station 11.01

Table E.I-9 - Channel geometry at Station 11.34

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9095.00	- 905.00	1067.60
3	9121.00	26.00	1047.60
4	10121.00	1000.00**	1047.60
5	10147.00	26.00	1067.60

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

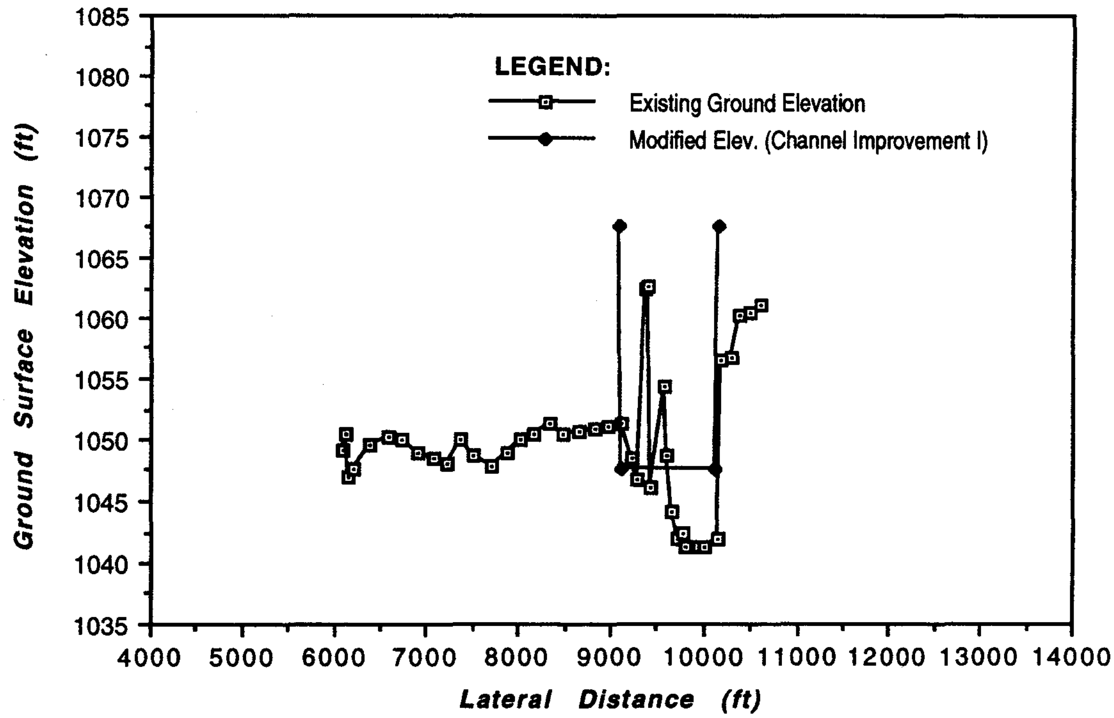

Fig. E.I-9 - Cross-section plot for Station 11.34

Table E.I-10 - Channel geometry at Station 11.52

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9065.00	- 935.00	1070.40
3	9091.00	26.00	1050.40
4	10091.00	1000.00**	1050.40
5	10117.00	26.00	1070.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

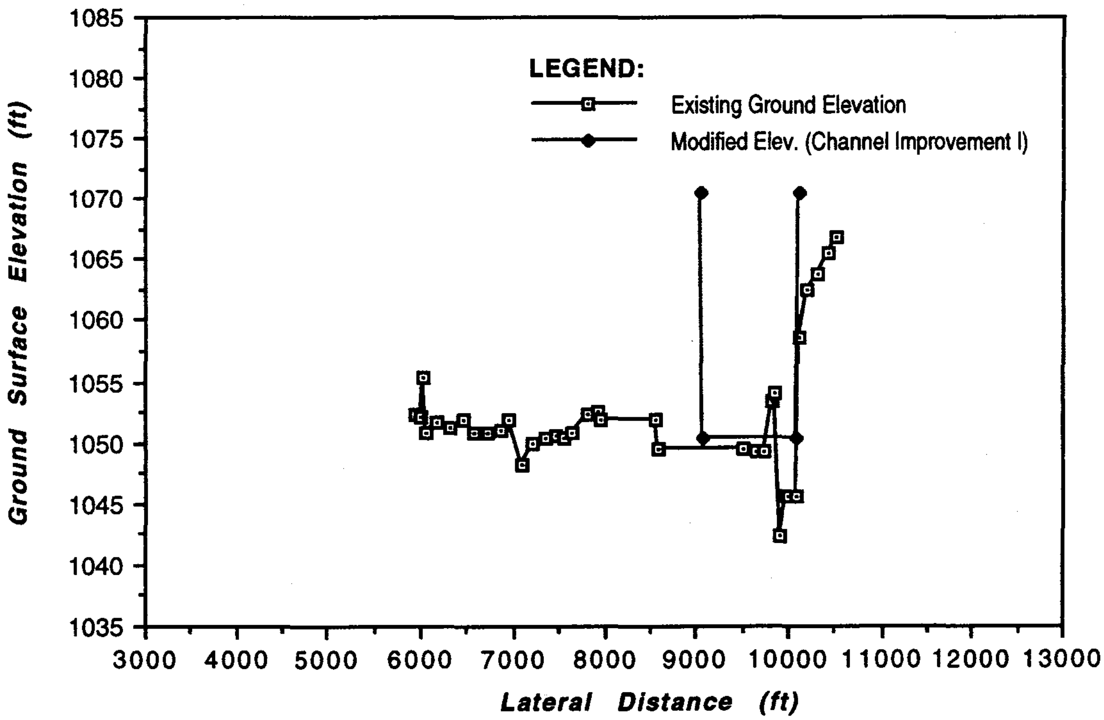

Fig. E.I-10 - Cross-section plot for Station 11.52

Table E.I-11 - Channel geometry at Station 11.80

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9181.00	- 819.00	1074.40
3	9207.00	26.00	1054.40
4	10207.00	1000.00**	1054.40
5	10233.00	26.00	1074.40

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

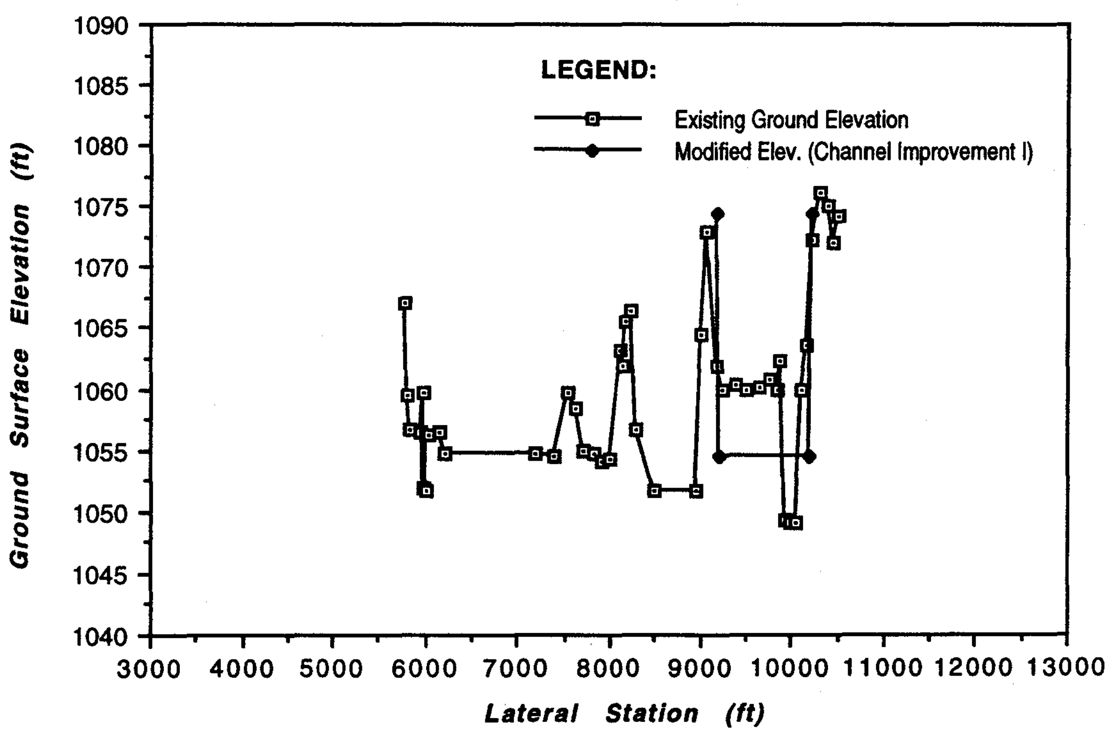

Fig. E.I-11- Cross-section plot for Station 11.80

Table E.I-12 - Channel geometry at Station 12.38

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9250.00	- 750.00	1077.00
3	9276.00	26.00	1057.00
4	10276.00	1000.00**	1057.00
5	10302.00	26.00	1077.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

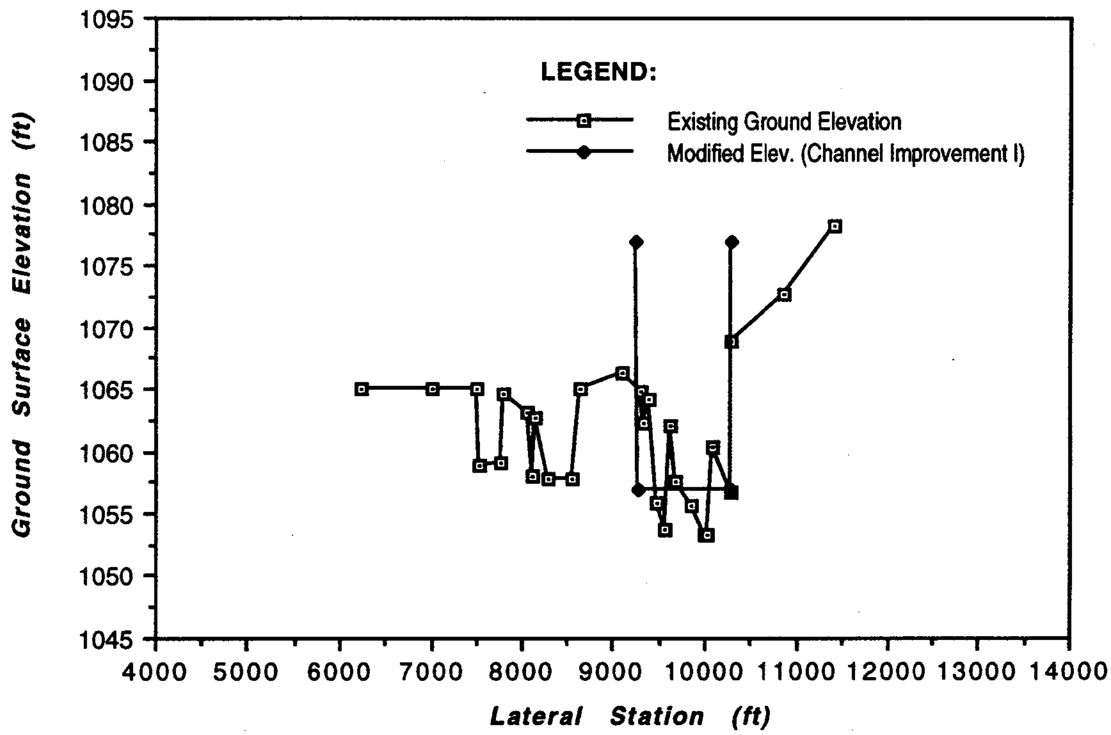

Fig. E.I-12 - Cross-section plot for Station 12.38

Table E.I-13 - Channel geometry at Station 12.84

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9156.00	- 844.00	108410
3	9182.00	26.00	1064.10
4	10182.00	1000.00**	1064.10
5	10208.00	26.00	1084.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

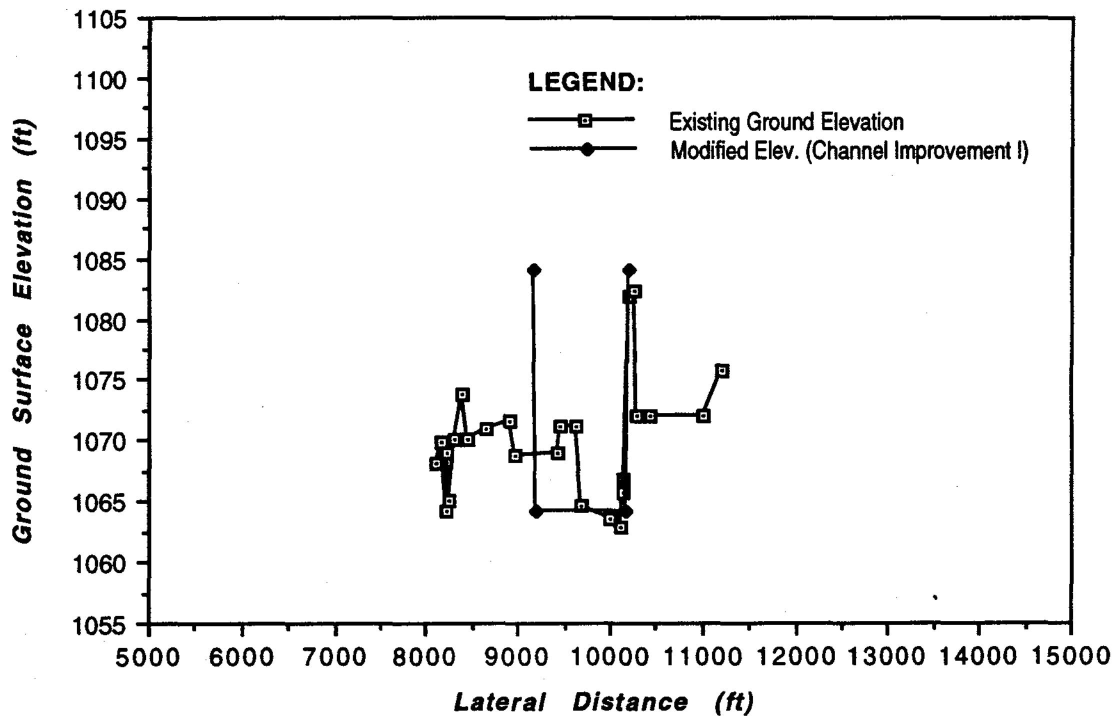

Fig. E.I-13 - Cross-section plot for Station 12.84

Table E.I-14 - Channel geometry at Station 13.33

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	-526.00	1091.50
3	9500.00	26.00	1071.50
4	10500.00	1000.00**	1071.50
5	10526.00	26.00	1091.50

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

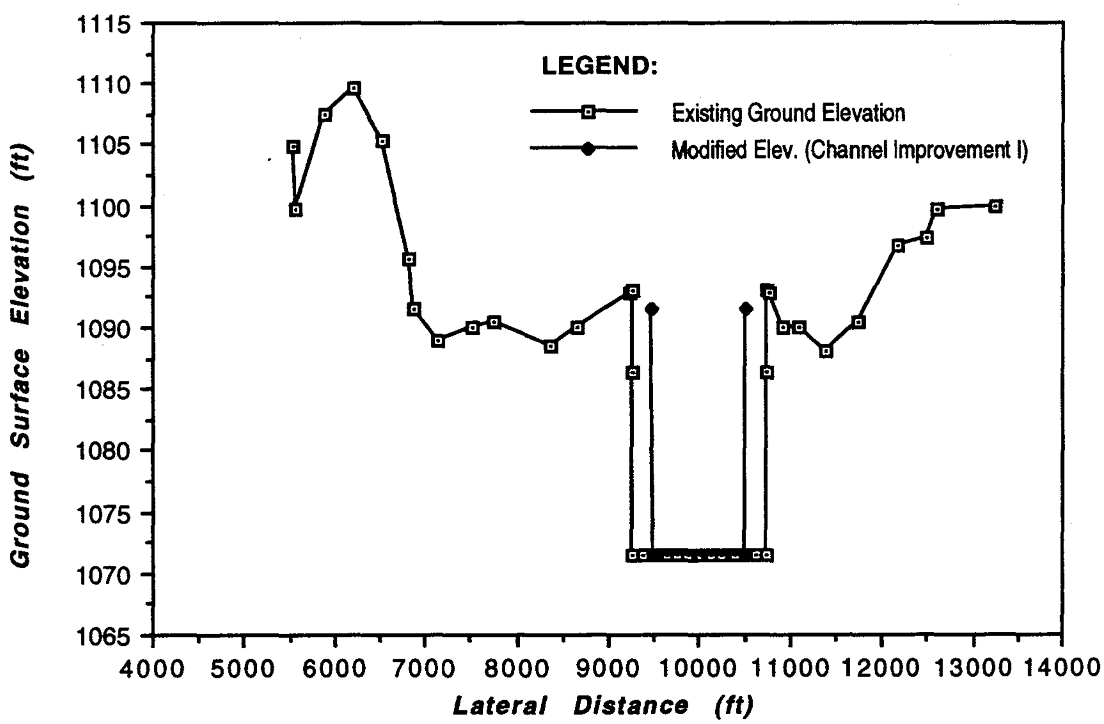

Fig. E.I-14- Cross-section plot for Station 13.33

E.3 - Section Geometry Information for Channel Improvement II

Table E.II-1 - Channel geometry at Station 16.45

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9768.40	- 231.00	1130.00 (1132.00)
3	9794.40	26.00	1110.00
4	10794.40	1000.00**	1110.00
5	10820.40	26.00	1130.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

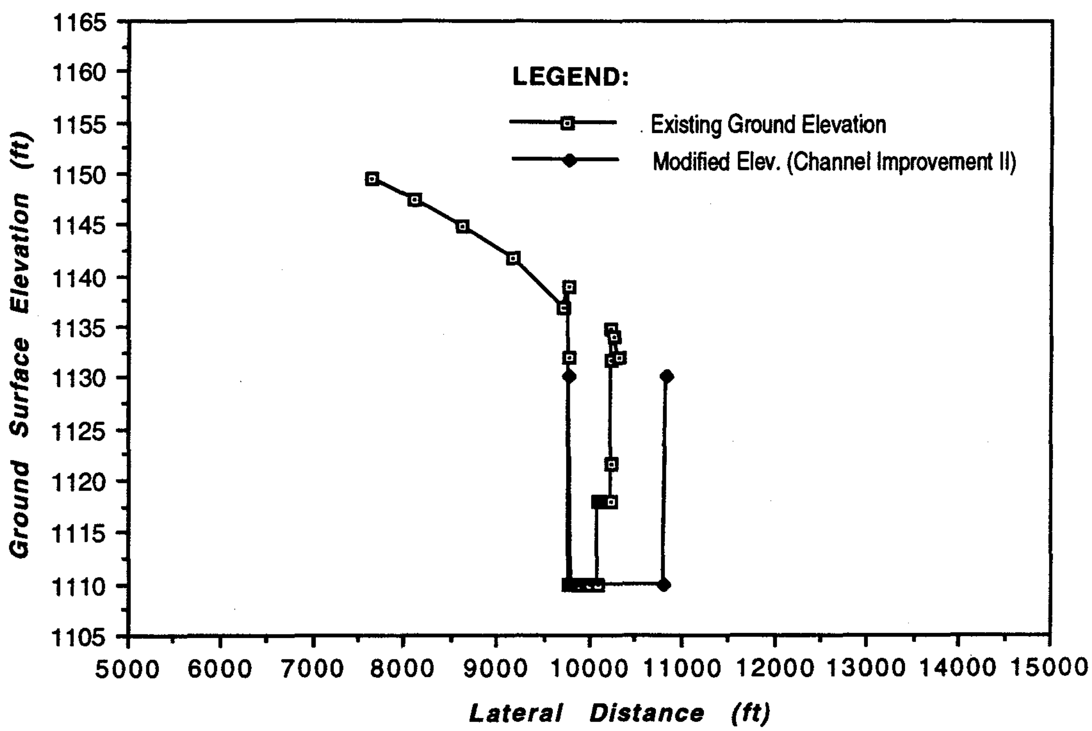

Fig. E.II-1 - Cross-section plot for Station 16.45

Table E.II-2 - Channel geometry at Station 16.91

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9758.00	- 242.00	1137.10
3	9784.00	26.00	1117.10
4	10784.00	1000.00**	1117.10
5	10810.00	26.00	1137.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

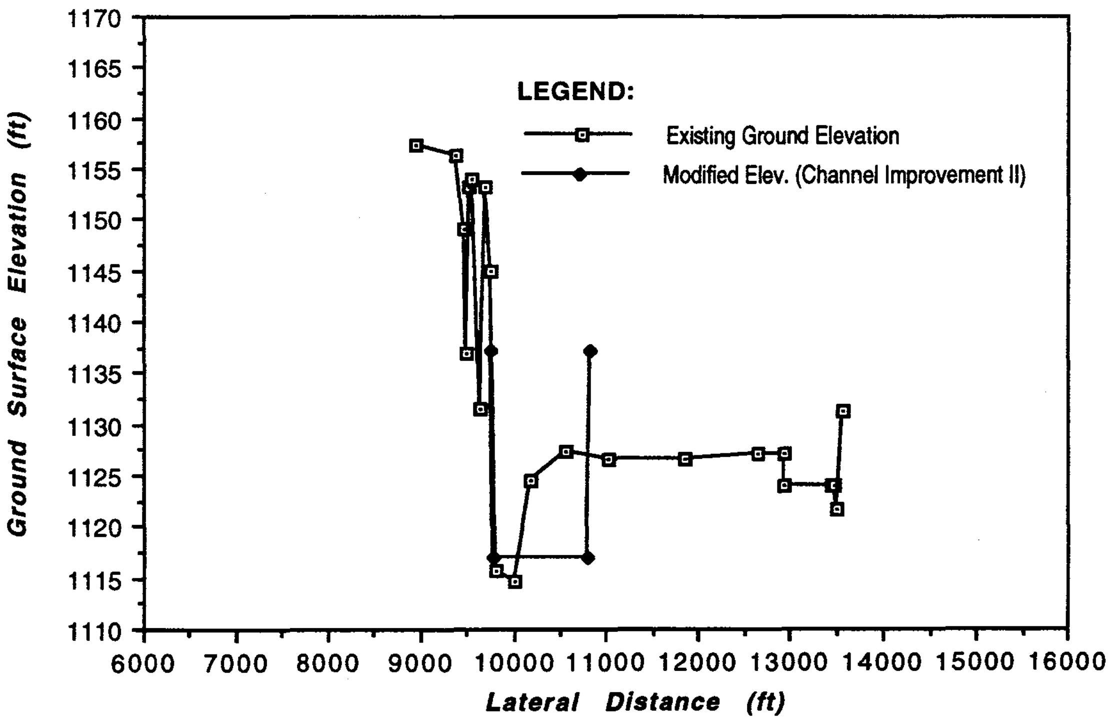

Fig. E.II-2 - Cross-section plot for Station 16.91

Table E.II-3 - Channel geometry at Station 17.38

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9271.00	- 729.00	1144.30
3	9297.00	26.00	1124.30
4	10297.00	1000.00**	1124.30
5	10323.00	26.00	1144.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

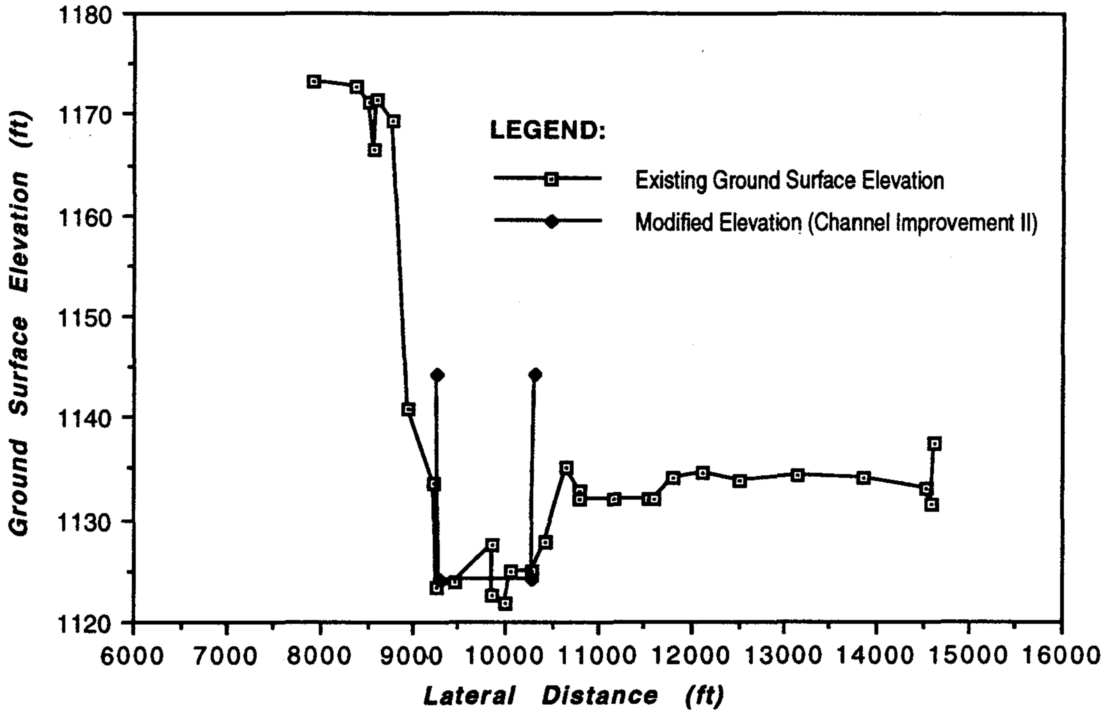

Fig. E.II-3 - Cross-section plot for Station 17.38

Table E.II-4 - Channel geometry at Station 17.76

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9275.00	- 705.00	1150.10
3	9321.00	26.00	1130.10
4	10321.00	1000.00**	1130.10
5	10347.00	26.00	1150.10

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

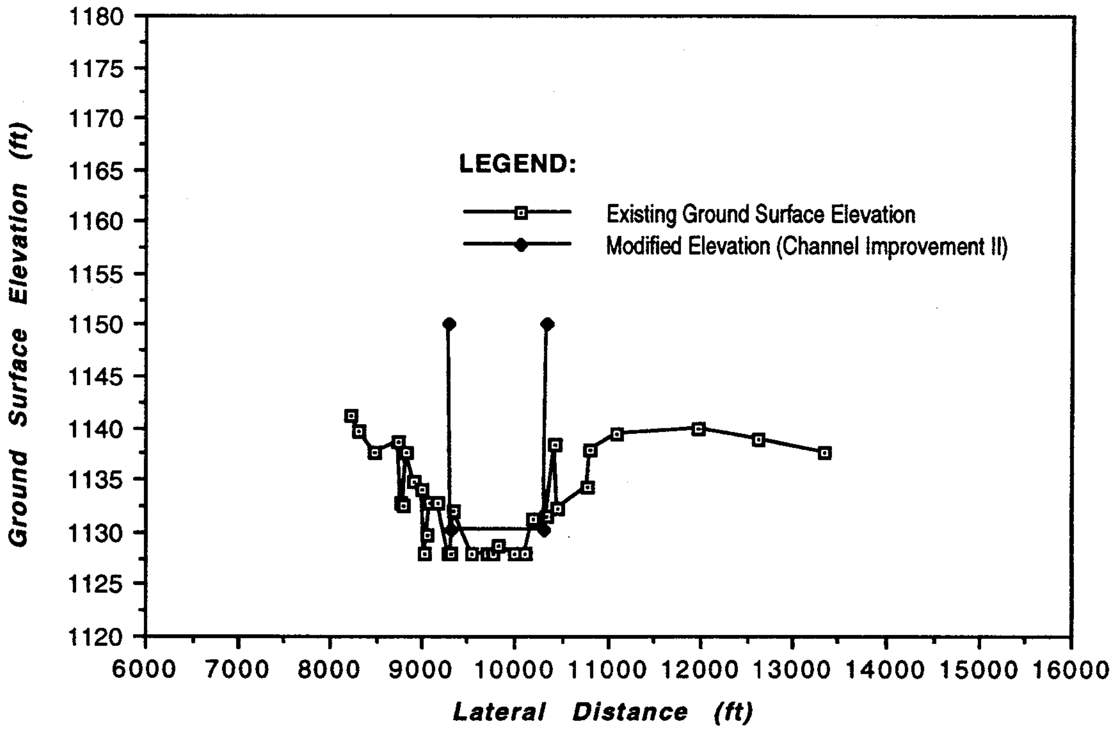

Fig. E.II-4 - Cross-section plot for Station 17.76

Table E.II-5 - Channel geometry at Station 18.24

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9781.00	- 20900	1157.50
3	9817.00	26.00	1137.50
4	10817.00	1000.00**	1137.50
5	10843.00	26.00	1157.50

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

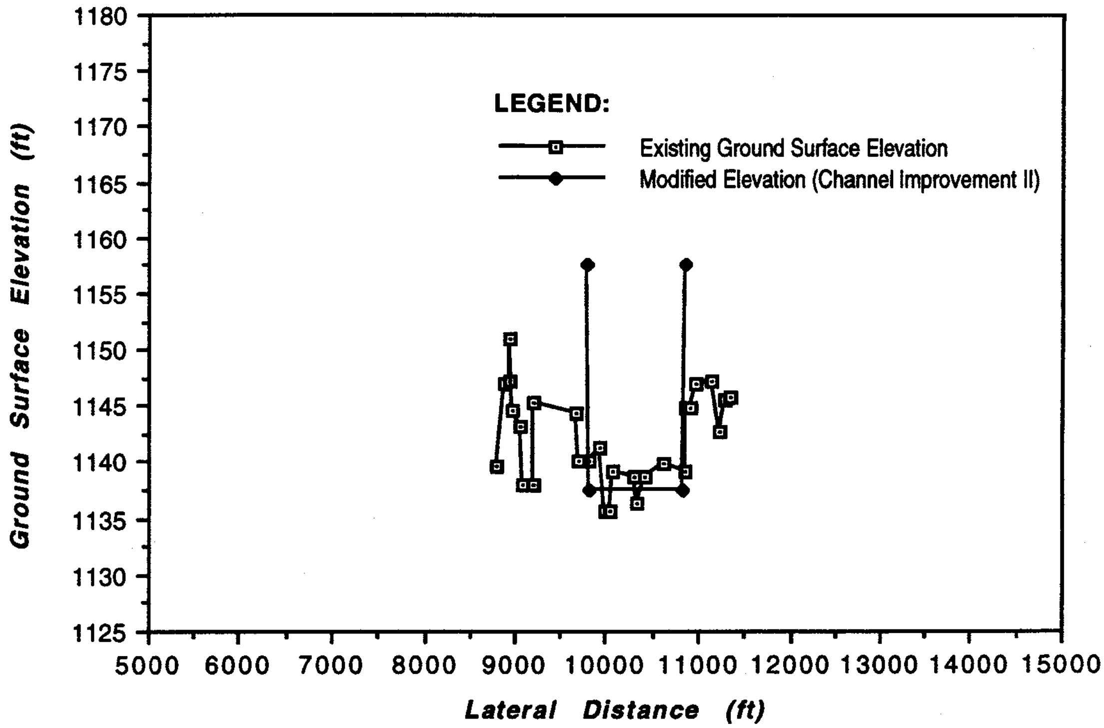

Fig. E.II-5 - Cross-section plot for Station 18.24

Table E.II-6 - Channel geometry at Station 18.92

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9524.90	- 475.10	1168.00
3	9550.90	26.00	1148.00
4	10550.90	1000.00**	1148.00
5	10576.90	26.00	1168.00

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

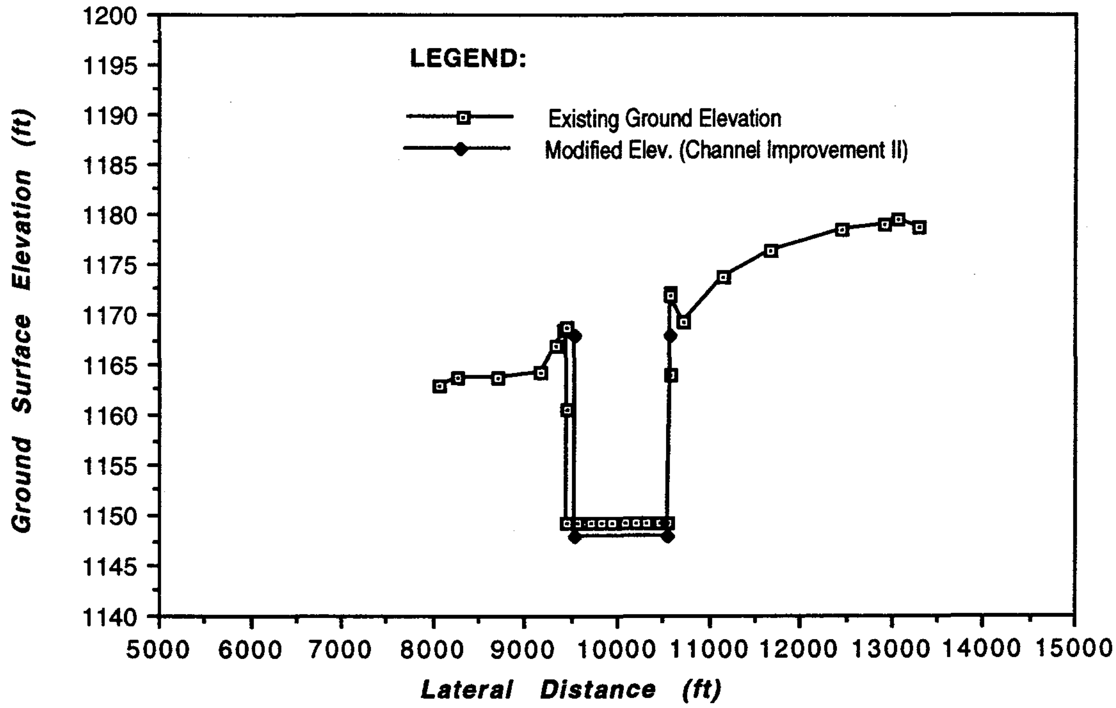

Fig. E.II-6 - Cross-section plot for Station 18.92

Table E.II-7 - Channel geometry at Station 19.44

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9088.00	- 912.00	1176.20
3	9114.00	26.00	1156.20
4	10114.00	1000.00**	1156.20
5	10140..00	26.00	1176.20

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

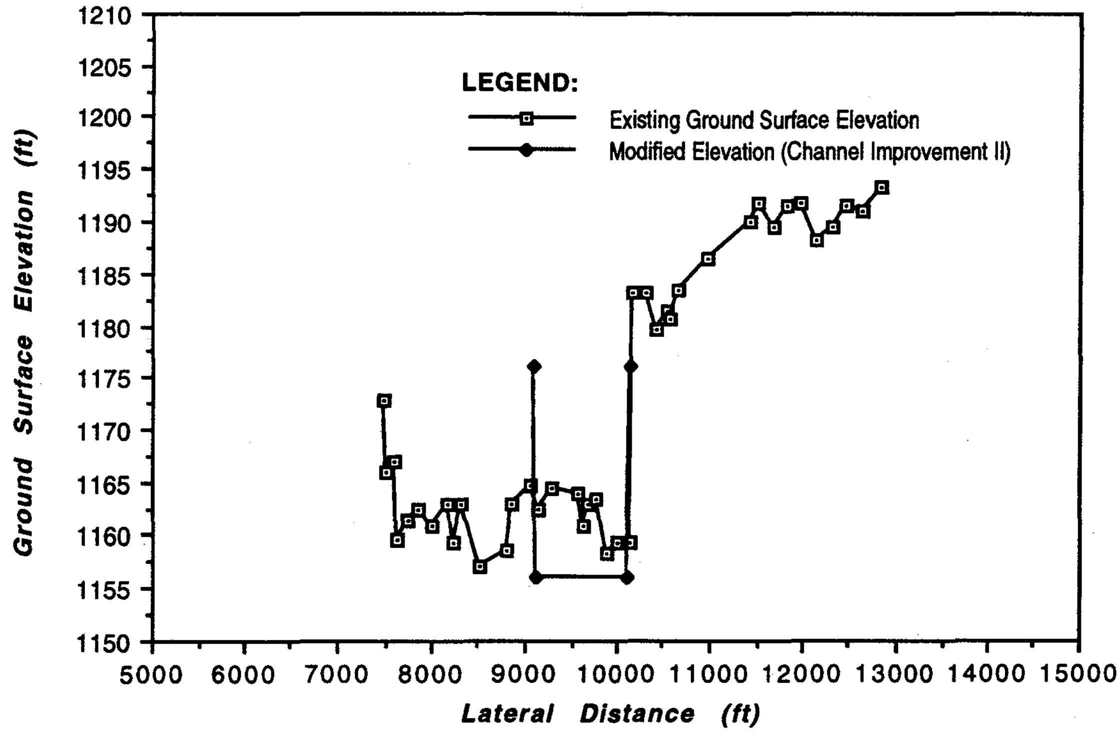

Fig. E.II-7 - Cross-section plot for Station 19.44

Table E.II-8 - Channel geometry at Station 19.89

No.	Lateral Station (ft)	Horizontal Distance Between Stations (ft)	Ground Surface Elevation (ft)***
1	10000.00*	0.00	-
2	9474.00	- 526.00	1183.30
3	9500.00	26.00	1163.30
4	10500.00	1000.00**	1163.30
5	10526.00	26.00	1183.30

Note: * Indicated reference point is the river thalweg (Sta 100+00).
** Proposed 1000-ft wide channel bottom.
*** Levee height is 20.0 ft.

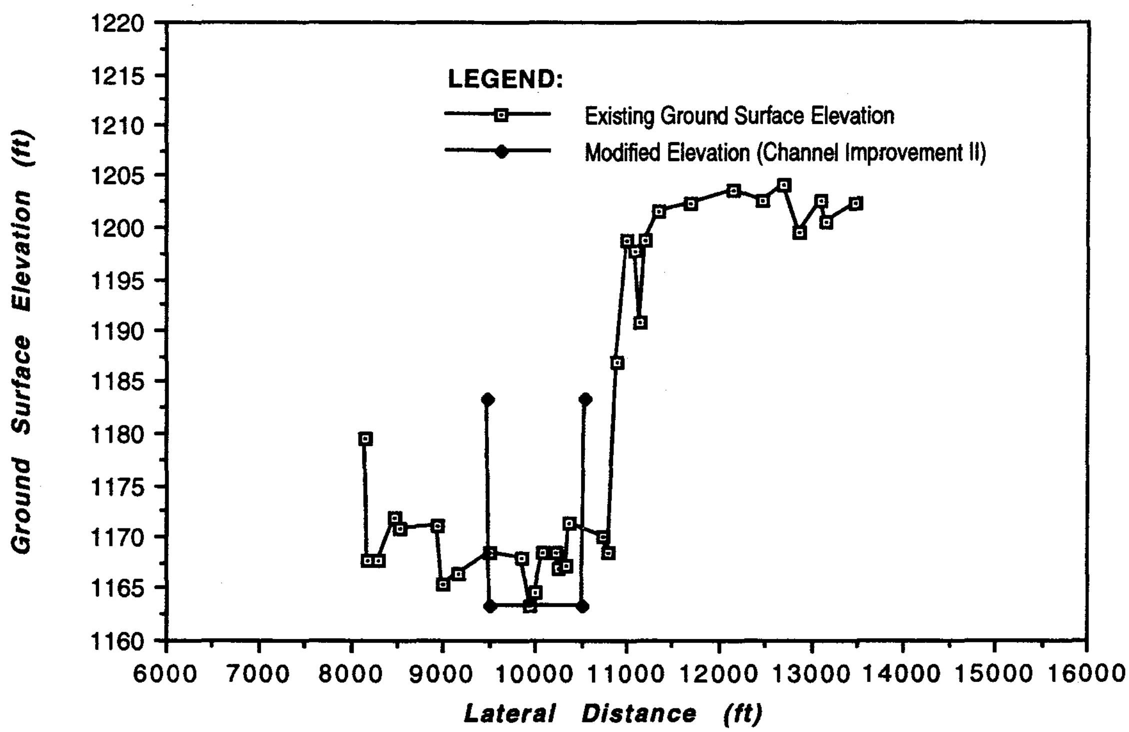

Fig. E.II-8 - Cross-section plot for Station 19.89

APPENDIX F - HEC-6 Input Data Files

F.1 - Input Data File for Model I

```
T1   AGUA FRIA RIVER SEDIMENT TRANSPORT MODELING [HEC-6 DATA]
T2   LAST UPDATED JULY 5, 1993  - MODEL I
T3
NC 0.070   0.040   0.044   .1   .3
X1 0.160   47.0   8000   12725   470   460   465
GR 924.4   4925.0   924.2   5199.0   921.8   5600.0   919.5   5760.0   919.4   5959.0
GR 920.9   6245.0   920.8   6516.0   919.3   6554.0   919.8   6850.0   919.6   7271.0
GR 920.5   7535.0   917.6   8136.0   917.4   8339.0   912.3   8356.0   917.2   8376.0
GR 916.4   8991.0   914.0   9212.0   911.6   9231.0   913.2   9494.0   911.8   9720.0
GR 910.7  10000.0   909.6  10136.0   921.6  10167.0   923.0  10184.0   913.7  10213.0
GR 913.7  10477.0   917.1  10590.0   916.6  10873.0   910.5  10909.0   910.5  11042.0
GR 915.2  11068.0   912.1  11265.0   911.5  11516.0   908.3  11664.0   910.4  11830.0
GR 916.1  11911.0   914.1  12098.0   914.9  12628.0   922.1  12652.0   922.7  12725.0
GR 916.5  12758.0   916.8  13671.0   916.2  14363.0   917.2  14971.0   917.8  15391.0
GR 913.5  15403.0   920.3  15459.0
HD 0.160   10   8000   12725
NC 0.033   0.040   0.039
X1 0.440   40.0   8029   10420   1510   1465   1485
GR 927.5   3107.0   925.0   4575.0   922.8   5984.0   921.8   6974.0   920.3   7816.0
GR 923.1   7847.0   923.3   7915.0   919.1   7942.0   919.1   7995.0   923.7   8029.0
GR 919.5   8152.0   916.2   8640.0   915.1   8999.0   916.8   9023.0   916.7   9798.0
GR 913.9   9815.0   913.5   9842.0   912.8  10000.0   917.6  10016.0   916.2  10201.0
GR 917.0  10263.0   917.7  10313.0   917.7  10385.0   925.2  10420.0   917.7  10455.0
GR 917.8  11076.0   920.3  11103.0   916.9  11133.0   916.4  11365.0   919.1  11391.0
GR 918.7  12229.0   918.8  12650.0   920.6  12691.0   919.8  12785.0   919.6  13644.0
GR 920.4  14355.0   921.0  16110.0   921.8  16630.0   922.9  17240.0   924.0  17640.0
HD 0.440   10   8029   10420
NC 0.034   0.040   0.042
X1 0.730   36.0   8340   12394   1565   1475   1510
GR 926.5   3285.0   926.3   3986.0   925.6   4737.0   925.2   5415.0   925.6   5760.0
GR 925.6   5797.0   925.7   5889.0   925.7   5945.0   924.5   6306.0   924.5   7206.0
GR 924.3   8340.0   921.6   8530.0   921.1   8982.0   919.1   8999.0   918.6   9126.0
GR 921.0   9195.0   920.0   9917.0   917.8   9927.0   917.9  10000.0   916.9  10087.0
GR 928.8  10162.0   919.2  10205.0   917.0  10479.0   919.8  10521.0   918.9  10591.0
GR 928.7  10655.0   919.2  10697.0   919.2  10771.0   922.2  10794.0   921.6  11725.0
GR 922.6  11783.0   924.5  12394.0   924.5  13563.0   924.0  14000.0   924.3  15050.0
GR 926.0   15560
HD 0.730   10   8340   12394
NC 0.040   0.042   0.043
X1 1.330   29.0   8038   10456   3405   3325   3385
GR 934.6   6000.0   933.3   6025.0   932.9   6490.0   931.0   6748.0   931.3   7154.0
GR 931.8   7239.0   933.2   7837.0   934.0   8038.0   931.1   8083.0   929.8   8339.0
GR 931.4   8777.0   929.3   8916.0   931.1   8945.0   929.8   9282.0   929.1   9911.0
GR 927.0  10000.0   925.9  10122.0   925.5  10364.0   932.0  10456.0   925.5  10490.0
GR 931.1  10701.0   931.6  11006.0   930.4  11242.0   934.9  11261.0   931.9  11306.0
GR 933.2  11377.0   934.8  11409.0   936.3  12061.0   941.3  12490.0
HD 1.330   10   8038   10456
NC 0.041   0.040   0.035
X1 1.710   44   9091 10284.4   2000   2585   2480
GR 940.9   5684.9   943.3   5808.0   945.3   6004.6   945.1   6078.9   947.4   6100.1
```

```
GR 947.4   6117.9    939.1   6148.7    948.7   6187.8    948.6   6226.4    934.0   6296.9
GR 936.8   6795.4    942.6   6807.8    942.6   6816.3    935.2   6833.2    933.6   7016.1
GR 935.7   7029.0    935.7   7052.6    932.4   7065.5    932.0   7135.0    934.3   7164.7
GR 934.3   7198.3    931.9   7209.5    934.6   7333.9    933.3   7541.5    933.4   7601.4
GR 936.1   7704.9    936.0   8010.3    935.3   8305.9    935.8   8591.1    935.4   8888.0
GR 935.8   9091.0    933.0   9104.6    933.1   9230.9    931.1   9247.7    929.7   9534.8
GR 928.2   9542.9    928.2   9966.4    928.2  10000.0    930.4  10058.7    930.5  10277.8
GR 935.9  10284.4    941.2  10511.3    951.5  11351.7    952.3  11442.6
HD 1.710       10     9091  10284.4
NC 0.041    0.035    0.035
X1 2.020       31   8839.4  10077.3      890     2065     1965
GR 950.0   5981.1    948.6   6066.6    951.6   6121.6    954.7   6293.7    955.1   6434.3
GR 940.7   6514.7    939.9   6533.9    937.1   6557.3    936.4   6934.6    937.1   7244.1
GR 944.6   7260.1    944.6   7278.4    937.0   7304.1    936.3   7340.1    938.6   7388.3
GR 938.4   7687.8    936.3   7711.0    938.5   7824.6    938.8   7961.0    937.2   8390.4
GR 938.4   8544.9    938.1   8839.4    935.2   8854.5    935.2   9121.5    935.4   9418.2
GR 934.2   9860.0    932.7   9918.6    933.3  10000.0    934.5  10062.4    944.8  10077.3
GR 944.8  10079.1
HD 2.020       10   8839.4  10077.3
NC 0.045    0.031    0.036
X1 2.600       26     9437  10580.6     2700     2945     3320
GR 967.1   7292.0    967.4   7442.4    961.7   7739.8    957.5   7927.3    953.0   8217.8
GR 947.7   8560.5    944.7   8730.1    944.9   9057.3    944.8   9437.0    940.5   9449.9
GR 941.9   9684.7    939.6   9951.4    939.6  10000.0    939.6  10090.3    941.7  10102.7
GR 943.1  10322.7    940.5  10500.3    946.6  10580.6    946.6  10625.8    945.8  10652.9
GR 942.2  10671.4    943.4  10811.0    943.6  10850.0    944.8  11140.9    954.6  11152.0
GR 954.6  11164.0
HD 2.600       10     9437  10580.6
X1 2.800       19     8817    11222     1250      655     1000
GR 956.4   8817.0    952.8   8856.3    944.9   9060.9    943.4   9200.0    943.2   9214.4
GR 943.5   9447.6    942.0  10000.0    943.9  10091.2    943.9  10170.9    942.8  10185.3
GR 943.0  10439.2    945.6  10464.6    945.8  10582.0    943.7  10628.0    945.8  10774.1
GR 945.7  10820.4    942.3  10890.9    945.9  11203.4    956.6  11222.0
HD 2.800       10     8817    11222
X1 3.270       17   9692.6  11130.5     2800     1995     2505
GR 961.5   7808.3    958.3   8137.4    956.3   8362.4    953.4   9316.6    950.7   9692.6
GR 945.5   9724.1    944.5   9770.5    944.8  10000.0    944.8  10158.6    951.4  10188.1
GR 947.8  10278.9    948.5  10405.5    944.5  10606.9    944.5  10822.2    945.7  10915.2
GR 948.5  11116.0    960.5  11130.5
HD 3.270       10   9692.6  11130.5
X1 3.400       23   9760.9  10928.5      760      635      685
GR 961.9   7939.2    957.7   8317.0    955.0   9117.3    952.3   9683.9    952.0   9760.9
GR 945.4   9784.1    945.4  10000.0    945.4  10039.4    950.7  10054.0    951.3  10107.8
GR 953.0  10116.4    953.1  10158.4    951.2  10170.2    951.1  10228.2    945.2  10238.1
GR 945.1  10277.1    950.5  10294.4    948.9  10485.8    946.0  10546.7    949.6  10607.8
GR 950.1  10703.8    952.3  10913.8    963.2  10928.5
HD 3.400       10   9760.9  10928.5
X1 3.430       12   9654.5  10873.4      165      160      165
GR 961.5   7958.9    957.8   8287.1    956.3   8796.5    955.8   9654.5    953.0   9684.2
GR 952.8   9758.5    946.2   9788.6    946.0  10000.0    946.0  10271.7    951.1  10293.1
GR 951.1  10849.9    963.7  10873.4
HD 3.430       10   9654.5  10928.5
X1 3.729      6.0     9420    10603     1575     1585     1580
GR 972.0   9405.0    968.0   9420.0    952.2   9425.0    952.2  10588.0    967.2  10603.0
```

```
GR 967.2 10613.0
HD 3.729 0 0 0
X1 3.734 63.0 9400.9 10599.3 25 25 25
GR 972.4 9400.8 967.5 9400.9 952.3 9416.0 952.3 9422.1 952.3 9474.5
GR 952.3 9474.6 952.3 9481.6 952.3 9481.7 952.3 9554.7 952.3 9554.8
GR 952.3 9561.8 952.3 9561.9 952.3 9634.6 952.3 9634.7 952.3 9641.7
GR 952.3 9641.8 952.3 9714.5 952.3 9714.6 952.3 9721.6 952.3 9721.7
GR 952.3 9794.7 952.3 9794.8 952.3 9801.8 952.3 9801.9 952.3 9874.9
GR 952.3 9875.0 952.3 9882.0 952.3 9882.1 952.3 9955.1 952.3 9955.2
GR 952.3 9962.2 952.3 9962.3 952.3 10034.9 952.3 10035.0 952.3 10042.0
GR 952.3 10042.1 952.3 10115.1 952.3 10115.2 952.3 10122.2 952.3 10122.3
GR 952.3 10194.8 952.3 10194.9 952.3 10201.9 952.3 10202.0 952.3 10275.0
GR 952.3 10275.1 952.3 10282.1 952.3 10282.2 952.3 10355.2 952.3 10355.3
GR 952.3 10362.3 952.3 10362.4 952.3 10434.9 952.3 10435.0 952.3 10442.0
GR 952.3 10442.1 952.3 10515.1 952.3 10515.2 952.3 10522.2 952.3 10522.3
GR 952.3 10585.2 967.6 10599.3 971.1 10599.4
HD 3.734 0 0 0
X1 3.757 7.0 9425 10555 120 120 120
GR 968.3 9400.0 966.5 9425.0 952.3 9454.0 952.4 9708.0 952.1 10000.0
GR 952.1 10538.0 967.7 10555.0
HD 3.757 0 0 0
X1 3.767 92 9428.1 10572.0 50 50 50
GR 970.9 9428.0 966.9 9428.1 952.9 9457.5 952.9 9457.6 952.9 9460.6
GR 952.9 9460.7 952.9 9492.4 952.9 9492.5 952.9 9498.5 952.9 9498.6
GR 952.9 9510.4 952.9 9510.5 952.9 9513.5 952.9 9513.6 952.9 9525.5
GR 952.9 9525.6 952.9 9528.6 952.9 9528.7 952.9 9540.4 952.9 9540.5
GR 952.9 9543.5 952.9 9543.6 952.9 9555.4 952.9 9555.5 952.9 9558.5
GR 952.9 9558.6 952.9 9570.4 952.9 9570.5 952.9 9573.5 952.9 9573.6
GR 952.9 9585.4 952.9 9585.5 952.9 9588.5 952.9 9588.6 952.9 9600.4
GR 952.9 9600.5 952.9 9625.0 952.9 9625.1 952.9 9761.9 966.1 9762.0
GR 966.1 9778.0 952.9 9778.1 952.9 9915.0 966.1 9915.1 966.1 9931.1
GR 952.9 9931.2 952.9 10068.9 966.1 10069.0 966.1 10085.0 952.9 10085.1
GR 952.9 10220.9 966.1 10221.0 966.1 10237.0 952.9 10237.1 952.9 10374.9
GR 952.9 10375.0 952.9 10400.2 952.9 10400.3 952.9 10410.9 952.9 10411.0
GR 952.9 10414.9 952.9 10415.0 952.9 10426.9 952.9 10427.0 952.9 10430.0
GR 952.9 10430.1 952.9 10441.8 952.9 10441.9 952.9 10444.9 952.9 10445.0
GR 952.9 10456.9 952.9 10457.0 952.9 10460.0 952.9 10460.1 952.9 10472.0
GR 952.9 10472.1 952.9 10475.1 952.9 10475.2 952.9 10486.9 952.9 10487.0
GR 952.9 10490.0 952.9 10490.1 952.9 10501.9 952.9 10502.0 952.9 10508.9
GR 952.9 10509.0 952.9 10540.8 952.9 10540.9 952.9 10543.9 952.9 10544.0
GR 967.2 10571.9 970.9 10572.0
HD 3.767 0 0 0
NC .04 .045 .025
X1 4.094 7.0 9440 10578 1770 1760 1765
GR 973.3 9440.0 958.5 9465.0 958.5 9757.0 958.5 10000.0 958.5 10558.0
GR 973.0 10578.0 973.0 10582.0
HD 4.094 10 9440 10578
X1 4.270 15.0 9449 10588 925 925 925
GR 975.0 9440.0 974.9 9449.0 959.5 9466.0 958.0 9791.0 970.4 9807.0
GR 970.6 9818.0 968.3 9822.0 967.9 9877.0 971.5 9883.0 971.5 9891.0
GR 958.0 9910.0 957.1 10000.0 958.9 10317.0 959.7 10563.0 974.4 10588.0
HD 4.270 10 9449 10588
X1 4.700 9.0 9451 10579 2320 2180 2250
GR 978.4 9440.0 978.4 9451.0 961.5 9467.0 960.2 9774.0 959.1 10000.0
```

```
GR 961.1 10353.0    962.8 10562.0    978.8 10579.0    978.9 10595.0
HD 4.700       10     9451    10588
X1 4.754     53.0  9402.5 10572.4      150      310      225
X3    10
GR 973.0   7150.0    972.7   8115.0    973.6   8831.0    984.3   9296.0    988.1   9402.5
GR 988.1   9427.7    980.6   9427.8    960.3   9445.8    960.3   9525.5    960.3   9525.6
GR 960.3   9537.6    960.3   9537.7    960.3   9641.5    960.3   9641.6    960.3   9653.6
GR 960.3   9653.7    960.3   9757.4    960.3   9757.5    960.3   9769.5    960.3   9769.6
GR 960.3   9873.4    960.3   9873.5    960.3   9885.5    960.3   9885.6    960.3   9997.8
GR 960.3   9997.9    960.3 10009.9    960.3 10010.0    960.3 10105.8    960.3 10105.9
GR 960.3 10117.9    960.3 10118.0    960.3 10221.3    960.3 10221.4    960.3 10233.4
GR 960.3 10233.5    960.3 10337.9    960.3 10338.0    960.3 10349.0    960.3 10349.1
GR 960.3 10453.5    960.3 10453.6    960.3 10465.6    960.3 10465.7    960.3 10555.9
GR 981.2 10572.3    988.7 10572.4    988.7 10597.0    987.2 10612.0    978.1 11023.0
GR 978.7 11497.0    980.6 12014.0    982.4 12466.0
HD 4.754       10  9445.8 10555.9
X1 4.790      6.0     9440    10590      357      187      277
GR 980.2   9440.0    964.0   9466.0    961.1 10000.0    964.6 10568.0    980.8 10590.0
GR 980.8 10600.0
HD 4.790       10   9440.0    10590
X1 5.150      9.0     9291    10713     1780     1960     1873
GR 986.0   9275.0    986.0   9291.0    969.9   9310.0    968.1   9678.0    967.4 10000.0
GR 968.7 10469.0    968.9 10691.0    986.0 10713.0    986.0 10720.0
HD 5.150       10     9291    10713
NC  .040     .040     .022
X1 5.290       82  9250.8 10672.4      695      865      775
GR 994.5   9250.7    986.4   9250.8    971.5   9277.5    971.5   9318.7    971.5   9318.8
GR 971.5   9323.4    971.5   9323.5    971.5   9389.9    971.5   9390.0    971.5   9394.5
GR 971.5   9394.6    971.5   9460.9    971.5   9461.0    971.5   9465.6    971.5   9465.7
GR 971.5   9532.1    971.5   9532.2    971.5   9536.8    971.5   9536.9    971.5   9603.3
GR 971.5   9603.4    971.5   9608.0    971.5   9608.1    971.5   9674.5    971.5   9674.6
GR 971.5   9679.2    971.5   9679.3    971.5   9745.7    971.5   9745.8    971.5   9750.4
GR 971.5   9750.5    971.5   9816.9    971.5   9817.0    971.5   9821.6    971.5   9821.7
GR 971.5   9888.1    971.5   9888.2    971.5   9892.8    971.5   9892.9    971.5   9959.3
GR 971.5   9959.4    971.5   9964.0    971.5   9964.1    971.5 10030.0    971.5 10030.1
GR 971.5 10034.7    971.5 10034.8    971.5 10101.2    971.5 10101.3    971.5 10105.9
GR 971.5 10106.0    971.5 10172.3    971.5 10172.4    971.5 10177.0    971.5 10177.1
GR 971.5 10243.7    971.5 10243.8    971.5 10248.4    971.5 10248.5    971.5 10314.9
GR 971.5 10315.0    971.5 10319.6    971.5 10319.7    971.5 10386.0    971.5 10386.1
GR 971.5 10390.7    971.5 10390.8    971.5 10457.2    971.5 10457.3    971.5 10461.9
GR 971.5 10462.0    971.5 10528.4    971.5 10528.5    971.5 10533.0    971.5 10533.1
GR 971.5 10599.5    971.5 10599.6    971.5 10604.2    971.5 10604.3    971.5 10645.5
GR 989.4 10672.3    997.7 10672.4
HD 5.290       10  9250.8 10672.4
NC   .04      .04     .025
X1 5.380     20.0     9266    10656      305      645      465
GR 993.0   9214.0    987.7   9266.0    985.7   9342.0    972.8   9358.0    972.3   9413.0
GR 972.2   9565.0    972.2   9734.0    972.2   9889.0    972.2   9994.0    971.4 10000.0
GR 971.4 10062.0    971.4 10195.0    974.3 10208.0    974.2 10263.0    974.2 10420.0
GR 974.2 10582.0    974.2 10639.0    988.4 10656.0    988.6 10671.0    982.3 10702.0
HD 5.380       10     9266    10656
NC   .04      .04     .022       .3       .5
X1 5.689       42  9371.3 10552.8     1320     1740     1620
GR 996.9   9371.2    990.8   9371.3    973.9   9399.5    973.9   9488.7    973.9   9488.8
```

```
GR 973.9  9496.2   973.9  9496.3   973.9  9606.6   973.9  9606.7   973.9  9614.1
GR 973.9  9614.2   973.9  9725.8   973.9  9725.9   973.9  9733.3   973.9  9733.4
GR 973.9  9843.3   973.9  9843.4   973.9  9850.8   973.9  9850.9   973.9  9961.3
GR 973.9  9961.4   973.9  9968.8   973.9  9968.9   973.9 10078.9   973.9 10079.0
GR 973.9 10086.4   973.9 10086.5   973.9 10196.2   973.9 10196.3   973.9 10203.7
GR 973.9 10203.8   973.9 10314.4   973.9 10314.5   973.9 10321.9   973.9 10322.0
GR 973.9 10432.1   973.9 10432.2   973.9 10439.6   973.9 10439.7   973.9 10524.6
GR 990.8 10552.8   996.9 10552.9
HD 5.689      10  9371.3 10552.8
NC   .04     .04    .025
X1 5.750    22.0    9426   10579     370     370     370
GR 990.7  9287.0   990.7  9295.0   985.9  9330.0   983.9  9362.0   985.6  9388.0
GR 990.1  9416.0   990.3  9426.0   975.3  9477.0   975.3  9595.0   975.5  9715.0
GR 975.5  9864.0   975.5  9981.0   974.0  9994.0   973.7 10030.0   973.7 10095.0
GR 973.7 10244.0   975.6 10259.0   975.6 10349.0   975.7 10474.0   975.7 10565.0
GR 989.2 10579.0   989.6 10596.0
HD 5.750      10    9426   10579
X1 5.900    17.0  9429.0 10561.0     945     950     950
GR 993.0  9414.0   993.0  9429.0   977.5  9447.0   977.5  9506.0   977.5  9598.0
GR 977.5  9714.0   977.6  9829.0   977.4  9946.0   975.4  9958.0   975.5 10040.0
GR 975.5 10099.0   975.5 10230.0   977.4 10257.0   977.6 10344.0   977.6 10459.0
GR 977.6 10544.0   991.1 10561.0
HD 5.900      10    9429   10561
X1 6.430    20.0  9452.0 10537.0    2960    2755    2855
GR 996.1  9390.0   991.8  9409.0   991.6  9433.0   996.5  9443.0   996.5  9452.0
GR 984.1  9467.0   984.0  9528.0   984.3  9631.0   984.3  9768.0   984.1  9894.0
GR 983.2  9980.0   981.0 10000.0   981.0 10057.0   981.3 10156.0   981.9 10213.0
GR 983.2 10232.0   983.2 10359.0   982.5 10519.0   996.1 10537.0   996.1 10550.0
HD 6.430      10    9452   10537
X1 6.890    16.0  9439.0 10577.0    2510    2185    2345
GR1004.2  9428.0  1004.2  9439.0   989.9  9461.0   989.9  9574.0   989.9  9700.0
GR 989.8  9818.0   989.4  9954.0   989.4  9973.0   989.4 10000.0   989.4 10039.0
GR 989.4 10132.0   989.4 10266.0   989.4 10427.0   989.4 10558.0  1002.7 10577.0
GR1002.7 10588.0
HD 6.890      10    9439   10577
X1 6.990    19.0  9400.0 10559.0     525     575     550
GR1003.3  9393.0  1003.4  9400.0   997.4  9411.0   997.3  9418.0   991.4  9429.0
GR 991.4  9534.0   991.1  9695.0   991.1  9871.0   991.1 10000.0   991.1 10072.0
GR 991.2 10186.0   991.3 10300.0   998.4 10313.0   998.4 10323.0   998.4 10404.0
GR 990.2 10418.0   990.2 10540.0  1003.5 10559.0  1004.0 10574.0
HD 6.990      10    9400   10559
X1 7.490    13.0  9509.0 10525.0    2645    2610    2595
GR1009.5  9493.0  1009.5  9509.0   995.2  9526.0   995.4  9612.0   995.6  9736.0
GR 995.5  9871.0   995.3 10000.0   995.3 10064.0   995.4 10173.0   995.7 10289.0
GR 995.7 10474.0  1010.9 10525.0  1010.9 10541.0
HD 7.490      10    9509   10525
NC 0.022   0.022   0.022      .3      .5
X1 8.000      85  9235.5 10725.0    2865    2540    2685
X3    10
GR1014.4  7828.0  1015.5  8173.0  1016.3  8411.0  1017.9  8735.0  1018.7  9144.0
GR1018.6  9235.4  1013.3  9235.5   999.2  9263.1   999.2  9271.2   999.2  9271.3
GR 999.2  9285.3   999.2  9285.4   999.2  9362.9   999.2  9363.0   999.2  9377.0
GR 999.2  9377.1   999.2  9452.9   999.2  9453.0   999.2  9467.0   999.2  9467.1
GR 999.2  9542.9   999.2  9543.0   999.2  9557.0   999.2  9557.1   999.2  9632.9
```

```
GR 999.2  9633.0   999.2  9647.0   999.2  9647.1   999.2  9722.9   999.2  9723.0
GR 999.2  9737.0   999.2  9737.1   999.2  9812.9   999.2  9813.0   999.2  9827.0
GR 999.2  9827.1   999.2  9902.9   999.2  9903.0   999.2  9917.0   999.2  9917.1
GR 999.2  9992.9   999.2  9993.0   999.2 10007.0   999.2 10007.1   999.2 10082.9
GR 999.2 10083.0   999.2 10097.0   999.2 10097.1   999.2 10172.9   999.2 10173.0
GR 999.2 10187.0   999.2 10187.1   999.2 10262.9   999.2 10263.0   999.2 10277.0
GR 999.2 10277.1   999.2 10352.8   999.2 10352.9   999.2 10366.9   999.2 10367.0
GR 999.2 10442.9   999.2 10443.0   999.2 10457.0   999.2 10457.1   999.2 10532.9
GR 999.2 10533.0   999.2 10547.0   999.2 10547.1   999.2 10622.9   999.2 10623.0
GR 999.2 10637.0   999.2 10637.1   999.2 10697.5  1013.3 10725.0  1021.3 10725.1
GR1018.6 10725.2  1016.4 10735.0  1017.3 10914.0  1016.9 11234.0  1012.8 11759.0
GR1013.2 12195.0  1013.8 12510.0  1014.9 12742.0  1016.1 13028.0  1018.6 13458.0
HD 8.000      10  9235.5 10725.0
NC  .04    .04   .025     .1     .3
X1 8.100    33.0  9350.0 10883.0     195    1255     535
X3    10
GR1008.6  9134.0  1008.7  9204.0  1013.5  9350.0  1000.5  9366.0  1000.3  9525.0
GR1000.2  9746.0  1000.2  9975.0  1000.1 10000.0  1000.1 10188.0  1000.1 10419.0
GR1001.7 10867.0  1012.8 10883.0  1012.9 10896.0  1001.1 10947.0  1001.1 10996.0
GR1008.6 11040.0  1009.2 11183.0  1009.2 11417.0  1009.2 11573.0  1009.2 11879.0
GR1009.5 12097.0  1010.3 12365.0  1014.4 12451.0  1014.7 12485.0  1012.0 12572.0
GR1013.0 12715.0  1014.9 12885.0  1018.3 12923.0  1012.3 12938.0  1015.8 12949.0
GR1016.8 13044.0  1018.6 13064.0  1018.6 13079.0
HD 8.100      10  9350.0 10883.0
X1 8.210    41.0  9461.0 10989.0     470     800     600
X3    10
GR1009.9  8425.0  1009.9  8544.0  1007.2  8568.0  1004.7  8815.0  1002.0  9267.0
GR1001.9  9408.0  1015.5  9429.0  1015.5  9461.0  1002.8  9487.0  1002.2  9868.0
GR1002.2  9975.0  1002.2 10000.0  1002.2 10370.0  1001.8 10802.0  1001.8 10977.0
GR1014.9 10989.0  1015.0 11009.0  1009.8 11027.0  1008.8 11218.0  1010.1 11326.0
GR1007.2 11370.0  1006.9 11411.0  1012.8 11456.0  1011.2 11540.0  1012.2 11605.0
GR1012.3 11807.0  1012.3 12337.0  1014.3 12482.0  1017.8 12554.0  1015.0 12632.0
GR1016.5 12768.0  1018.1 12832.0  1019.0 13032.0  1022.9 13092.0  1013.2 13111.0
GR1020.6 13125.0  1018.6 13203.0  1023.6 13524.0  1028.1 13565.0  1024.4 13605.0
GR1025.3 13637.0
HD 8.210      10  9641.0 10989.0
NC  .022   .022   .022     .3     .5
X1 9.130      95  9137.5  10860.    5480    3840    4730
GR1031.6  6963.0  1031.6  6964.0  1031.1  7630.0  1031.0  7901.0  1031.2  8217.0
GR1031.2  8482.0  1031.0  8698.0  1031.3  8928.0  1033.5  9101.0  1033.5  9101.1
GR1034.2  9137.4  1027.5  9137.5  1016.2  9172.6  1016.2  9249.0  1016.2  9249.1
GR1016.2  9255.1  1016.2  9255.2  1016.2  9364.1  1016.2  9364.2  1016.2  9370.2
GR1016.2  9370.3  1016.2  9479.1  1016.2  9479.2  1016.2  9485.2  1016.2  9485.3
GR1016.2  9594.1  1016.2  9594.2  1016.2  9600.2  1016.2  9600.3  1016.2  9709.1
GR1016.2  9709.2  1016.2  9715.2  1016.2  9715.3  1016.2  9824.1  1016.2  9824.2
GR1016.2  9830.2  1016.2  9830.3  1016.2  9939.1  1016.2  9939.2  1016.2  9945.2
GR1016.2  9945.3  1016.2  10000.  1016.2 10053.9  1016.2 10054.0  1016.2 10055.4
GR1016.2 10060.0  1016.2 10060.1  1016.2 10169.4  1016.2 10169.5  1016.2 10175.5
GR1016.2 10175.6  1016.2 10284.0  1016.2 10284.1  1016.2 10289.9  1016.2 10290.0
GR1016.2 10399.4  1016.2 10399.5  1016.2 10405.5  1016.2 10405.6  1016.2 10513.9
GR1016.2 10514.0  1016.2 10515.4  1016.2 10519.0  1016.2 10520.0  1016.2 10520.1
GR1016.2 10628.9  1016.2 10629.0  1016.2 10635.0  1016.2 10635.1  1016.2 10744.4
GR1016.2 10744.5  1016.2 10750.5  1016.2 10750.6  1016.2 10827.1  1027.5 10860.0
GR1034.2 10860.1  1032.0 10986.0  1029.8 11176.0  1028.7 11374.0  1027.1 11579.0
```

GR1025.2 11859.0 1025.7 12067.0 1025.2 12326.0 1025.6 12556.0 1025.0 12785.0
GR1024.8 13071.0 1025.0 13319.0 1025.2 13557.0 1024.9 13797.0 1024.5 14035.0
GR1024.5 14296.0 1024.3 14582.0 1024.6 14807.0 1024.9 15012.0 1025.0 15173.0
HD 9.130 10 9137.5 10860.0
QT
NC 0 0 0.025 0.1 0.3
X1 9.900 72 9296 10257 4105 3720 3950
GR1040.0 7390.0 1039.6 7453.0 1038.9 7535.0 1034.2 7570.0 1034.2 7587.0
GR1026.8 7620.0 1026.8 7643.0 1033.8 7677.0 1034.1 7725.0 1031.8 7787.0
GR1035.1 7816.0 1036.1 7835.0 1033.3 7853.0 1033.9 7874.0 1032.5 7918.0
GR1032.7 7981.0 1032.7 8110.0 1032.7 8217.0 1032.7 8347.0 1032.7 8471.0
GR1032.0 8578.0 1033.1 8663.0 1034.7 8742.0 1029.4 8801.0 1029.3 8850.0
GR1030.7 8915.0 1031.3 8974.0 1031.5 9056.0 1031.9 9190.0 1031.9 9296.0
GR1025.5 9353.0 1025.8 9410.0 1026.6 9543.0 1026.6 9678.0 1027.9 9756.0
GR1029.1 9845.0 1030.1 9941.0 1031.4 10000.0 1032.0 10125.0 1032.0 10257.0
GR1031.9 10377.0 1031.9 10518.0 1031.7 10660.0 1031.0 10812.0 1030.8 10956.0
GR1031.0 11086.0 1031.2 11234.0 1032.2 11320.0 1032.4 11422.0 1032.7 11547.0
GR1032.9 11677.0 1031.3 11738.0 1031.2 11879.0 1031.8 11986.0 1032.2 12101.0
GR1032.7 12227.0 1031.4 12357.0 1030.9 12468.0 1030.1 12530.0 1029.3 12653.0
GR1031.1 12731.0 1030.8 12846.0 1029.4 12987.0 1031.3 13072.0 1032.1 13163.0
GR1032.0 13318.0 1031.9 13400.0 1029.5 13447.0 1029.0 13528.0 1030.3 13594.0
GR1031.6 13782.0 1032.2 13950.0
HD 9.900 10 9296 10257
NC .04 .04 .03
X1 10.53 59 9141 10087 3320 2680 3330
GR1042.2 6900.0 1041.8 7011.0 1042.2 7133.0 1040.6 7170.0 1043.1 7244.0
GR1042.8 7347.0 1043.6 7427.0 1044.1 7552.0 1044.2 7681.0 1044.5 7780.0
GR1040.5 7806.0 1039.9 7941.0 1040.6 8043.0 1038.3 8073.0 1040.4 8148.0
GR1040.5 8308.0 1040.4 8447.0 1039.1 8510.0 1040.5 8598.0 1040.7 8716.0
GR1041.3 8842.0 1039.4 8903.0 1040.1 9042.0 1040.9 9141.0 1037.3 9172.0
GR1036.0 9318.0 1034.1 9465.0 1035.3 9650.0 1035.1 9799.0 1034.9 9935.0
GR1031.3 9976.0 1038.5 10000.0 1040.3 10087.0 1040.5 10211.0 1040.8 10306.0
GR1040.7 10431.0 1040.1 10559.0 1039.5 10812.0 1040.2 10890.0 1040.2 10984.0
GR1040.2 11096.0 1039.9 11242.0 1039.6 11405.0 1038.5 11508.0 1038.3 11589.0
GR1039.0 11686.0 1038.7 11812.0 1043.3 11883.0 1043.3 11928.0 1043.3 12093.0
GR1043.3 12139.0 1035.9 12173.0 1035.4 12240.0 1037.0 12361.0 1038.4 12386.0
GR1038.6 12476.0 1038.9 12641.0 1039.5 12816.0 1040.1 12900.0
HD 10.53 10 9141 10087
X1 10.72 56 9360 10386 1040 880 1010
GR1044.6 6959.0 1044.9 7103.0 1045.5 7231.0 1044.2 7323.0 1045.5 7425.0
GR1045.2 7514.0 1044.1 7664.0 1043.2 7804.0 1042.1 7920.0 1042.6 8159.0
GR1044.2 8280.0 1045.1 8434.0 1046.1 8560.0 1043.0 8611.0 1043.3 8733.0
GR1043.9 8851.0 1043.1 8941.0 1043.4 9086.0 1043.6 9224.0 1043.4 9360.0
GR1041.2 9466.0 1037.1 9554.0 1034.1 9651.0 1034.9 9772.0 1038.1 9883.0
GR1039.3 9962.0 1039.3 10000.0 1041.4 10104.0 1042.6 10179.0 1043.3 10280.0
GR1043.9 10386.0 1044.0 10537.0 1043.9 10672.0 1043.2 10833.0 1043.0 10986.0
GR1042.9 11179.0 1041.8 11394.0 1043.4 11430.0 1040.5 11473.0 1040.4 11514.0
GR1042.8 11560.0 1042.4 11684.0 1037.8 11718.0 1037.8 11745.0 1042.2 11798.0
GR1042.8 11943.0 1042.8 12086.0 1043.0 12218.0 1044.2 12321.0 1045.7 12508.0
GR1045.7 12561.0 1047.4 12619.0 1044.3 12722.0 1044.5 12768.0 1045.5 12788.0
GR1045.5 12855.0
HD 10.72 10 9360 10386
NC .045 .045 .059 .1 .3
X1 11.01 53 8515 10287 1610 1320 1430

```
GR1049.7  6400.0  1047.4  6457.0  1048.1  6533.0  1048.3  6651.0  1047.0  6742.0
GR1046.1  6822.0  1048.1  6893.0  1048.6  7019.0  1049.3  7141.0  1048.6  7259.0
GR1048.2  7375.0  1048.3  7481.0  1046.6  7595.0  1046.8  7741.0  1047.2  7866.0
GR1046.8  7991.0  1046.1  8135.0  1045.4  8248.0  1045.2  8375.0  1048.4  8429.0
GR1047.4  8461.0  1050.3  8515.0  1045.5  8604.0  1039.5  8661.0  1043.2  8720.0
GR1035.4  8799.0  1035.4  8886.0  1036.1  9006.0  1037.2  9088.0  1037.9  9148.0
GR1039.2  9236.0  1036.2  9326.0  1036.4  9397.0  1039.4  9494.0  1040.0  9608.0
GR1039.0  9730.0  1038.5  9834.0  1038.8  9937.0  1036.5 10000.0  1045.1 10102.0
GR1045.3 10148.0  1046.4 10178.0  1045.5 10236.0  1046.8 10287.0  1046.8 10389.0
GR1046.4 10522.0  1041.4 10589.0  1045.3 10634.0  1045.9 10739.0  1045.9 10835.0
GR1046.2 10977.0  1047.2 11138.0  1051.5 11275.0
HD 11.01     10    8515   10287
NC 0.045  0.055  0.035   0.4   0.6
X1 11.34     41   9573   10178    885    1855    1680
X3    10
GR1049.1  6097.0  1050.4  6114.0  1047.0  6152.0  1047.7  6201.0  1049.6  6389.0
GR1050.2  6573.0  1049.9  6724.0  1048.9  6894.0  1048.4  7061.0  1048.0  7226.0
GR1050.1  7357.0  1048.8  7509.0  1047.8  7702.0  1049.0  7871.0  1050.1  8017.0
GR1050.4  8177.0  1051.2  8348.0  1050.4  8493.0  1050.6  8658.0  1050.8  8828.0
GR1051.0  8974.0  1051.4  9123.0  1048.5  9224.0  1046.8  9298.0  1062.4  9365.0
GR1062.6  9390.0  1046.1  9428.0  1054.3  9573.0  1048.6  9601.0  1044.1  9675.0
GR1042.0  9722.0  1042.5  9771.0  1041.4  9803.0  1041.3  9942.0  1041.3 10000.0
GR1041.9 10147.0  1056.6 10178.0  1056.8 10295.0  1060.3 10368.0  1060.5 10482.0
GR1061.0 10597.0
HD 11.34     10    9573   10178
NC                 0.1   0.3
X1 11.52     36   9873   10117    980    980    980
GR1052.4  5930.0  1052.0  5988.0  1055.4  6027.0  1050.7  6060.0  1051.7  6182.0
GR1051.2  6305.0  1051.9  6462.0  1050.8  6571.0  1050.9  6715.0  1051.0  6849.0
GR1051.8  6962.0  1048.2  7089.0  1050.0  7210.0  1050.4  7345.0  1050.6  7465.0
GR1050.4  7550.0  1050.8  7652.0  1052.4  7800.0  1052.6  7916.0  1051.9  7950.0
GR1051.9  8550.0  1049.5  8600.0  1049.5  9501.0  1049.3  9665.0  1049.3  9745.0
GR1053.5  9840.0  1054.1  9873.0  1042.4  9922.0  1045.6  9964.0  1045.6 10000.0
GR1045.6 10082.0  1058.5 10117.0  1062.5 10209.0  1063.8 10315.0  1065.6 10431.0
GR1066.9 10534.0
HD 11.52     10    9873   10117
X1 11.80     46    8224   10302    1415    1415    1415
GR1067.1  5780.0  1059.5  5793.0  1056.6  5830.0  1056.5  5946.0  1059.8  5964.0
GR1051.8  5983.0  1051.7  5996.0  1056.2  6015.0  1056.2  6032.0  1056.5  6147.0
GR1054.7  6200.0  1054.7  7200.0  1054.6  7406.0  1059.6  7529.0  1058.4  7629.0
GR1054.9  7711.0  1054.7  7825.0  1054.1  7909.0  1054.2  8003.0  1063.1  8113.0
GR1061.9  8139.0  1065.5  8163.0  1066.5  8224.0  1056.7  8280.0  1051.6  8480.0
GR1051.6  8950.0  1064.5  8998.0  1072.8  9070.0  1061.9  9175.0  1060.0  9249.0
GR1060.3  9379.0  1059.9  9514.0  1060.2  9635.0  1060.8  9771.0  1059.9  9852.0
GR1062.2  9893.0  1049.3  9925.0  1049.0 10000.0  1049.0 10062.0  1060.0 10110.0
GR1063.6 10163.0  1072.3 10233.0  1076.2 10302.0  1075.0 10388.0  1072.1 10447.0
GR1074.2 10502.0
HD 11.80     10    8224   10302
X1 12.38   28.0  9379.0   10302    2885    2885    2885
GR1064.9  6240.0  1064.9  7002.0  1064.9  7519.0  1058.8  7538.0  1059.1  7761.0
GR1064.6  7806.0  1063.0  8056.0  1057.9  8112.0  1062.6  8159.0  1057.8  8303.0
GR1057.8  8562.0  1065.0  8628.0  1066.3  9110.0  1064.8  9294.0  1062.3  9338.0
GR1064.2  9379.0  1055.9  9491.0  1053.7  9566.0  1062.0  9621.0  1057.6  9676.0
GR1055.7  9850.0  1053.3 10000.0  1053.4 10035.0  1060.4 10086.0  1056.7 10286.0
```

```
GR1068.9  10302.0   1072.6  10857.0   1078.2  11420.0
HD 12.38       10     9379    10302
X1 13.33       72   9251.1  10758.5     5075     5065     5070
GR1104.9   5540.0   1099.6   5578.0   1107.5   5891.0   1109.7   6222.0   1105.2   6522.0
GR1095.7   6809.0   1091.5   6880.0   1089.0   7130.0   1090.0   7510.0   1090.5   7760.0
GR1088.5   8360.0   1090.0   8660.0   1092.8   9228.2   1093.0   9251.0   1086.4   9251.1
GR1071.5   9268.5   1071.5   9370.4   1071.5   9370.5   1071.5   9379.5   1071.5   9379.6
GR1071.5   9498.4   1071.5   9498.5   1071.5   9507.5   1071.5   9507.6   1071.5   9623.4
GR1071.5   9623.5   1071.5   9632.5   1071.5   9632.6   1071.5   9748.4   1071.5   9748.5
GR1071.5   9757.5   1071.5   9757.6   1071.5   9873.4   1071.5   9873.5   1071.5   9882.5
GR1071.5   9882.6   1071.5   9995.4   1071.5   9995.5   1071.5  10004.5   1071.5  10004.6
GR1071.5  10117.4   1071.5  10117.5   1071.5  10126.5   1071.5  10126.6   1071.5  10245.9
GR1071.5  10246.0   1071.5  10255.0   1071.5  10255.1   1071.5  10376.4   1071.5  10376.5
GR1071.5  10385.5   1071.5  10385.6   1071.5  10504.4   1071.5  10504.5   1071.5  10513.5
GR1071.5  10513.6   1071.5  10630.0   1071.5  10630.1   1071.5  10639.1   1071.5  10639.2
GR1071.5  10741.1   1086.4  10758.5   1093.0  10758.6   1092.8  10784.0   1090.0  10910.0
GR1090.1  11080.0   1088.0  11380.0   1090.4  11740.0   1096.7  12172.0   1097.3  12475.0
GR1099.6  12607.0   1100.0  13232.0
HD 13.33       10   9251.1  10758.5
X1 13.81     30.0     9250    10525     2575     2575     2575
GR1099.0   6280.0   1088.1   6333.0   1083.9   6543.0   1085.6   6895.0   1085.6   7105.0
GR1082.3   7145.0   1085.1   7198.0   1080.5   7254.0   1085.4   7285.0   1083.6   7601.0
GR1084.8   7867.0   1083.6   8402.0   1085.4   8555.0   1083.0   8776.0   1086.0   8816.0
GR1085.3   9250.0   1081.7   9271.0   1081.5   9580.0   1078.6   9597.0   1078.6  10000.0
GR1078.4  10183.0   1082.8  10226.0   1080.2  10454.0   1085.1  10525.0   1087.0  10634.0
GR1099.6  10738.0   1095.4  10896.0   1096.7  11458.0   1099.1  11517.0   1099.1  11575.0
HD 13.81       10     9250    10525
NC            .04       .1       .3
X1 14.38     36.0     8210    10691     2410     3365     2965
GR1114.0   6715.0   1112.0   6750.0   1104.0   6765.0   1100.0   6790.0   1092.0   6830.0
GR1091.0   6950.0   1092.0   7095.0   1093.3   7380.0   1092.0   7990.0   1092.0   8125.0
GR1098.0   8210.0   1088.0   8260.0   1092.0   8390.0   1092.0   8525.0   1091.0   8715.0
GR1092.0   8985.0   1092.3   9071.0   1087.5   9095.0   1084.9   9381.0   1089.1   9458.0
GR1088.0   9838.0   1084.4  10000.0   1084.4  10065.0   1092.0  10085.0   1092.6  10234.0
GR1090.5  10369.0   1086.9  10445.0   1087.3  10571.0   1097.0  10691.0   1098.7  11028.0
GR1096.0  11319.0   1096.0  11605.0   1098.6  11704.0   1102.9  12300.0   1105.5  12986.0
GR1107.2  13055.0
HD 14.38       10     8210    10691
X1 14.85     37.0     9106    10454     2290     2390     2430
GR1126.8   7870.0   1130.3   8231.0   1131.5   8555.0   1129.3   8905.0   1109.1   8978.0
GR1109.1   9053.0   1109.1   9106.0   1096.7   9197.0   1096.6   9259.0   1098.5   9354.0
GR1093.6   9431.0   1093.5   9545.0   1095.7   9695.0   1094.3   9862.0   1090.5  10000.0
GR1090.5  10077.0   1095.6  10178.0   1092.8  10404.0   1100.9  10454.0   1100.0  10870.0
GR1100.4  11172.0   1099.7  11409.0   1095.9  11456.0   1096.9  11575.0   1099.9  11720.0
GR1098.0  12018.0   1098.8  12225.0   1104.1  12350.0   1104.3  12771.0   1106.2  12981.0
GR1104.0  13275.0   1104.0  13521.0   1104.0  13777.0   1111.1  13842.0   1109.6  13895.0
GR1112.3  14491.0   1113.0  14537.0
HD 14.85       10     9106    10454
X1 14.94     39.0     9140    10772      470      470      470
GR1128.8   7130.0   1129.4   7664.0   1130.1   8199.0   1126.6   8655.0   1125.5   8818.0
GR1127.9   9140.0   1099.1   9207.0   1097.8   9308.0   1093.4   9327.0   1093.5   9428.0
GR1098.0   9604.0   1094.9   9921.0   1091.0  10000.0   1091.0  10107.0   1096.2  10127.0
GR1095.5  10430.0   1094.8  10691.0   1101.0  10772.0   1101.8  11056.0   1100.6  11341.0
GR1096.9  11486.0   1101.9  11664.0   1101.8  11970.0   1098.2  12274.0   1100.4  12471.0
```

```
GR1103.2 12548.0   1103.7 12714.0   1100.0 12761.0   1100.0 12839.0   1101.7 12862.0
GR1104.6 13038.0   1105.9 13298.0   1108.0 13844.0   1108.2 14020.0   1108.2 14322.0
GR1108.2 14521.0   1110.7 14669.0   1109.1 14693.0   1114.5 14821.0
HD 14.94      10    9140   10772
X1 15.32      36    9681   11762    2065    1815    1950
GR1130.8  8550.0   1130.2  8960.0   1123.1  9017.0   1123.1  9350.0   1130.0  9421.0
GR1130.3  9681.0   1097.2  9832.0   1096.7  9930.0   1093.5 10000.0   1101.5 10078.0
GR1099.0 10111.0   1101.9 10262.0   1102.2 10464.0   1099.9 10548.0   1102.6 10640.0
GR1104.0 11166.0   1101.6 11192.0   1101.7 11269.0   1103.6 11329.0   1103.8 11469.0
GR1101.0 11607.0   1106.0 11762.0   1106.0 12259.0   1108.8 12799.0   1108.4 13228.0
GR1110.7 13486.0   1114.4 13529.0   1114.6 13551.0   1111.0 13578.0   1111.0 13644.0
GR1112.5 13701.0   1112.0 14045.0   1115.0 14555.0   1113.8 14647.0   1116.7 15208.0
GR1120.3 15704.0
HD 15.32      10    9681   11762
NC  .04      .04     .03      .1      .3
X1 15.51    26.0    9756   11854     955    1015     985
X3    10
GR1132.5  8225.0   1133.5  8731.0   1134.5  9204.0   1135.8  9756.0   1099.6  9807.0
GR1097.3 10000.0   1097.3 10089.0   1106.7 10175.0   1106.9 10257.0   1105.4 10533.0
GR1103.3 10702.0   1107.7 10757.0   1109.1 11151.0   1108.7 11527.0   1103.5 11559.0
GR1106.9 11700.0   1103.8 11808.0   1110.9 11854.0   1107.5 11935.0   1110.1 12774.0
GR1110.3 13006.0   1112.8 13696.0   1114.1 14347.0   1117.2 15047.0   1122.8 15652.0
GR1124.4 15898.0
HD 15.51      10    9756   11854
X1 15.98    14.0    9825   10836    2425    2365    2395
X3    10
GR1139.6  8040.0   1139.5  8983.0   1139.6  9505.0   1135.9  9825.0   1106.8  9884.0
GR1108.1  9954.0   1108.6 10000.0   1106.3 10158.0   1103.9 10238.0   1106.2 10332.0
GR1106.0 10456.0   1106.0 10684.0   1160.3 10836.0   1163.1 10929.0
HD 15.98      10    9825   10836
NC                      .3      .5
X1 16.42      28  9776.8 10225.4    2185    2225    2215
X3    10
GR1147.6  8340.0   1143.6  8975.0   1136.5  9604.0   1134.9  9754.0   1135.8  9776.7
GR1130.3  9776.8   1108.7  9798.4   1108.7  9859.0   1108.7  9859.1   1108.7  9865.0
GR1108.7  9865.1   1108.7  9950.9   1108.7  9951.0   1108.7  9957.0   1108.7  9957.1
GR1108.7 10046.0   1108.7 10046.1   1108.7 10051.9   1108.7 10052.0   1108.7 10052.1
GR1108.7 10138.1   1108.7 10138.2   1108.7 10144.2   1108.7 10144.3   1108.7 10203.8
GR1124.8 10225.3   1130.3 10225.4   1130.0 10282.0
HD 16.42      10  9776.8 10225.4
X116.446      64  9768.4 10241.0      95      95      95
X3    10
GR1149.6  7650.0   1147.3  8109.0   1144.8  8614.0   1141.7  9172.0   1136.7  9700.0
GR1139.0  9766.0   1132.0  9768.4   1110.0  9768.5   1110.0  9787.4   1110.0  9871.4
GR1110.0  9882.3   1110.0  9882.4   1110.0  9888.4   1110.0  9888.5   1110.0  9894.3
GR1110.0  9894.4   1110.0  9984.4   1110.0  9984.5   1110.0  9996.5   1110.0  9996.6
GR1110.0 10080.4   1110.0 10080.5   1110.0 10092.5   1118.0 10092.6   1118.0 10100.9
GR1118.0 10101.0   1118.0 10103.7   1118.0 10104.1   1118.0 10116.9   1118.0 10117.0
GR1118.0 10119.4   1118.0 10119.5   1118.0 10132.3   1118.0 10132.4   1118.0 10134.9
GR1118.0 10135.0   1118.0 10147.4   1118.0 10147.5   1118.0 10149.9   1118.0 10150.0
GR1118.0 10162.8   1118.0 10162.9   1118.0 10165.3   1118.0 10165.4   1118.0 10177.9
GR1118.0 10178.0   1118.0 10180.7   1118.0 10180.8   1118.0 10193.9   1118.0 10194.0
GR1118.0 10196.4   1118.0 10196.5   1118.0 10209.3   1118.0 10209.4   1118.0 10211.9
GR1118.0 10212.0   1118.0 10225.2   1118.0 10225.3   1121.6 10227.9   1121.6 10228.0
```

```
GR1131.7 10241.0  1134.7 10241.1  1133.9 10259.0  1132.0 10330.0
HD16.446      10  9768.4 10241.0
X1 16.45      64  9768.4 10241.0      20      20      20
X3    10
GR1149.6  7650.0  1147.3  8109.0  1144.8  8614.0  1141.7  9172.0  1136.7  9700.0
GR1139.0  9766.0  1132.0  9768.4  1110.0  9768.5  1110.0  9787.4  1110.0  9871.4
GR1110.0  9882.3  1110.0  9882.4  1110.0  9888.4  1110.0  9888.5  1110.0  9894.3
GR1110.0  9894.4  1110.0  9984.4  1110.0  9984.5  1110.0  9996.5  1110.0  9996.6
GR1110.0 10080.4  1110.0 10080.5  1110.0 10092.5  1118.0 10092.6  1118.0 10100.9
GR1118.0 10101.0  1118.0 10103.7  1118.0 10104.1  1118.0 10116.9  1118.0 10117.0
GR1118.0 10119.4  1118.0 10119.5  1118.0 10132.3  1118.0 10132.4  1118.0 10134.9
GR1118.0 10135.0  1118.0 10147.4  1118.0 10147.5  1118.0 10149.9  1118.0 10150.0
GR1118.0 10162.8  1118.0 10162.9  1118.0 10165.3  1118.0 10165.4  1118.0 10177.9
GR1118.0 10178.0  1118.0 10180.7  1118.0 10180.8  1118.0 10193.9  1118.0 10194.0
GR1118.0 10196.4  1118.0 10196.5  1118.0 10209.3  1118.0 10209.4  1118.0 10211.9
GR1118.0 10212.0  1118.0 10225.2  1118.0 10225.3  1121.6 10227.9  1121.6 10228.0
GR1131.7 10241.0  1134.7 10241.1  1133.9 10259.0  1132.0 10330.0
HD 16.45      10  9768.4 10241.0
NC          .040     0.1     0.3
X1 16.91    22.0    9758   10178    2515    2200    2440
GR1157.2  8940.0  1156.2  9371.0  1149.0  9481.0  1137.0  9504.0  1153.3  9525.0
GR1154.0  9567.0  1131.4  9634.0  1153.1  9684.0  1144.8  9758.0  1115.6  9804.0
GR1114.6 10000.0  1124.6 10178.0  1127.2 10550.0  1126.5 11022.0  1126.6 11856.0
GR1127.0 12659.0  1127.0 12926.0  1124.0 12946.0  1124.0 13447.0  1124.0 13483.0
GR1121.7 13509.0  1131.2 13564.0
HD 16.91      10    9758   10178
NC  .045     .04
X1 17.38    30.0    9233   10670    2930    2140    2455
GR1173.3  7910.0  1172.6  8368.0  1171.1  8528.0  1166.4  8562.0  1171.3  8593.0
GR1169.3  8760.0  1140.8  8931.0  1133.6  9233.0  1123.5  9271.0  1123.8  9463.0
GR1127.5  9845.0  1122.5  9863.0  1121.7 10000.0  1124.9 10068.0  1124.9 10289.0
GR1127.7 10427.0  1135.1 10670.0  1132.9 10799.0  1132.0 10805.0  1132.0 11178.0
GR1132.0 11531.0  1132.0 11610.0  1134.1 11796.0  1134.6 12108.0  1133.8 12513.0
GR1134.4 13146.0  1134.1 13870.0  1133.0 14530.0  1131.6 14592.0  1137.5 14638.0
HD 17.38      10    9233   10670
X1 17.76    33.0    8819   10431    2140    1900    1980
GR1141.1  8240.0  1139.6  8320.0  1137.6  8483.0  1138.7  8742.0  1132.8  8767.0
GR1132.5  8796.0  1137.5  8819.0  1134.8  8919.0  1134.0  8995.0  1128.0  9034.0
GR1129.8  9054.0  1132.8  9095.0  1132.8  9158.0  1128.0  9273.0  1128.0  9307.0
GR1132.0  9337.0  1128.0  9539.0  1128.0  9703.0  1128.0  9724.0  1128.0  9779.0
GR1128.8  9833.0  1128.0 10000.0  1128.0 10109.0  1131.2 10214.0  1131.5 10347.0
GR1138.3 10431.0  1132.2 10463.0  1134.4 10767.0  1137.8 10792.0  1139.4 11097.0
GR1139.9 11982.0  1139.0 12635.0  1137.5 13350.0
HD 17.76      10    8819   10431
X1 18.24    28.0    8972   10927    2335    2690    2525
GR1139.7  8800.0  1147.0  8886.0  1147.3  8934.0  1151.0  8949.0  1144.6  8972.0
GR1143.2  9072.0  1138.0  9076.0  1138.0  9198.0  1145.4  9204.0  1144.3  9676.0
GR1140.1  9693.0  1140.1  9799.0  1141.4  9937.0  1135.7 10000.0  1135.7 10046.0
GR1139.2 10063.0  1138.6 10302.0  1136.3 10346.0  1138.7 10430.0  1139.9 10626.0
GR1139.1 10843.0  1144.8 10869.0  1144.8 10927.0  1146.9 10964.0  1147.2 11153.0
GR1142.7 11242.0  1145.5 11290.0  1145.8 11340.0
HD 18.24      10    8972   10927
X1 18.92      52  9447.5 10577.0    3620    3800    3595
X3    10
```

```
GR1163.0  8060.0   1163.7  8254.0   1163.8  8693.0   1164.2  9148.0   1166.9  9325.0
GR1168.4  9434.5   1168.8  9447.5   1160.5  9447.6   1149.2  9457.6   1149.2  9565.7
GR1149.2  9565.8   1149.2  9573.3   1149.2  9573.4   1149.2  9691.8   1149.2  9691.9
GR1149.2  9699.4   1149.2  9699.5   1149.2  9817.8   1149.2  9817.9   1149.2  9825.4
GR1149.2  9825.5   1149.2  9943.9   1149.2  9944.0   1149.2  9951.5   1149.2  9951.6
GR1149.2 10070.2   1149.2 10070.3   1149.2 10077.8   1149.2 10077.9   1149.2 10196.0
GR1149.2 10196.1   1149.2 10203.6   1149.2 10203.7   1149.2 10322.0   1149.2 10322.1
GR1149.2 10329.6   1149.2 10329.7   1149.2 10447.4   1149.2 10447.5   1149.2 10455.0
GR1149.2 10455.1   1149.2 10563.5   1163.9 10576.9   1172.0 10577.0   1171.9 10590.0
GR1169.2 10727.0   1173.6 11160.0   1176.2 11672.0   1178.3 12466.0   1178.9 12918.0
GR1179.6 13066.0   1178.6 13305.0
HD 18.92      10  9447.5 10577.0
NC  0.04   0.04   0.03     .1     .3
X1 19.44    40.0    7491   10174    2805    2795    2800
GR1172.9  7491.0   1165.9  7506.0   1166.9  7595.0   1159.6  7627.0   1161.4  7731.0
GR1162.5  7859.0   1160.9  8000.0   1163.0  8172.0   1159.3  8229.0   1162.8  8307.0
GR1157.0  8510.0   1158.5  8795.0   1163.0  8849.0   1164.8  9063.0   1162.5  9141.0
GR1164.5  9298.0   1163.9  9574.0   1160.9  9628.0   1163.0  9684.0   1163.3  9781.0
GR1158.4  9881.0   1159.4 10000.0   1159.4 10140.0   1183.1 10174.0   1183.2 10319.0
GR1179.6 10437.0   1181.5 10531.0   1180.7 10572.0   1183.5 10645.0   1186.5 10961.0
GR1190.0 11422.0   1191.7 11525.0   1189.6 11691.0   1191.4 11816.0   1191.7 11982.0
GR1188.2 12154.0   1189.6 12309.0   1191.6 12445.0   1191.1 12623.0   1193.2 12818.0
HD 19.44      10    7491   10174
X1 19.89    33.0    8142   10997    2375    2375    2375
GR1179.6  8142.0   1167.7  8170.0   1167.7  8313.0   1171.9  8461.0   1170.7  8537.0
GR1170.9  8940.0   1165.4  8978.0   1166.4  9173.0   1168.5  9498.0   1167.9  9844.0
GR1163.3  9930.0   1164.7 10000.0   1168.5 10067.0   1168.5 10231.0   1166.9 10267.0
GR1167.1 10344.0   1171.3 10381.0   1170.1 10742.0   1168.4 10791.0   1187.0 10886.0
GR1198.6 10997.0   1197.7 11072.0   1190.8 11136.0   1198.8 11190.0   1201.5 11346.0
GR1202.2 11679.0   1203.7 12153.0   1202.6 12468.0   1204.1 12707.0   1199.6 12868.0
GR1202.5 13091.0   1200.4 13148.0   1202.2 13477.0
HD 19.89      10    8142   10997
X1 20.45    18.0  8070.0 10526.0    2955    2955    2955
GR1187.7  8070.0   1180.6  8256.0   1180.3  8565.0   1179.3  8786.0   1180.5  9022.0
GR1178.6  9074.0   1180.7  9230.0   1177.6  9418.0   1175.9  9534.0   1178.0  9686.0
GR1180.3  9704.0   1180.5  9855.0   1174.1 10000.0   1174.4 10191.0   1174.5 10235.0
GR1175.0 10432.0   1229.0 10526.0   1229.2 10586.0
HD 20.45      10    8142   10997
X1 20.92    22.0  7924.0 10707.0    1705    2630    2490
GR1193.7  7924.0   1186.0  7956.0   1182.0  8088.0   1182.0  8276.0   1186.4  8301.0
GR1186.4  8561.0   1186.0  8587.0   1186.0  8811.0   1186.3  8931.0   1187.2  9261.0
GR1187.1  9502.0   1180.3  9704.0   1182.0  9870.0   1179.5 10000.0   1179.5 10060.0
GR1185.1 10092.0   1183.8 10370.0   1186.8 10452.0   1186.5 10542.0   1183.3 10586.0
GR1240.9 10707.0   1240.7 10888.0
HD 20.92      10    7924   10707
X1 21.01    26.0  8125.0 10446.0     180     450     430
GR1194.1  8125.0   1186.0  8152.0   1183.0  8281.0   1183.0  8354.0   1183.0  8562.0
GR1186.1  8610.0   1186.0  8713.0   1186.0  8842.0   1186.0  8920.0   1188.6  9289.0
GR1187.1  9531.0   1180.1  9576.0   1179.8  9709.0   1179.3  9822.0   1181.8  9861.0
GR1182.1 10000.0   1182.1 10156.0   1185.3 10172.0   1185.8 10339.0   1183.7 10394.0
GR1189.0 10446.0   1185.7 10615.0   1188.3 10647.0   1186.1 11010.0   1243.3 11107.0
GR1242.4 11265.0
HD 21.01      10    8125   10446
X1 21.42    49.0  9359.0 10853.0    2190    2140    2165
```

```
GR1224.5   7114.0   1225.2   7218.0   1218.2   7416.0   1211.3   7456.0   1211.8   7527.0
GR1219.5   7559.0   1219.7   7707.0   1208.7   7951.0   1204.6   8154.0   1208.1   8189.0
GR1208.1   8209.0   1208.0   8232.0   1208.0   8599.0   1209.1   8617.0   1209.1   8642.0
GR1199.3   8734.0   1198.5   8868.0   1195.0   8887.0   1194.6   9028.0   1190.5   9053.0
GR1194.6   9239.0   1194.7   9359.0   1193.8   9582.0   1187.7   9597.0   1187.0  10000.0
GR1189.8  10017.0   1189.9  10056.0   1189.9  10192.0   1193.6  10204.0   1188.3  10227.0
GR1190.7  10561.0   1193.3  10574.0   1194.5  10853.0   1192.5  10888.0   1194.0  10931.0
GR1194.0  11080.0   1190.1  11202.0   1193.2  11246.0   1192.0  11311.0   1194.8  11366.0
GR1194.6  11690.0   1194.8  12000.0   1192.4  12026.0   1193.9  12051.0   1194.0  12458.0
GR1195.6  12730.0   1257.3  12864.0   1258.2  12903.0   1258.3  12958.0
HD 21.42      10   9359.0   10853
X1 21.76    37.0   9887.0 11304.0    1650    1830    1815
GR1228.1   8805.0   1209.5   8922.0   1206.3   9217.0   1203.9   9660.0   1202.0   9887.0
GR1193.9   9915.0   1193.8  10000.0   1193.8  10088.0   1195.6  10103.0   1194.9  10320.0
GR1193.5  10376.0   1193.4  10555.0   1197.3  10579.0   1197.6  10764.0   1195.6  10937.0
GR1193.3  11023.0   1193.4  11119.0   1195.9  11148.0   1196.1  11280.0   1200.8  11304.0
GR1201.2  11468.0   1198.4  11495.0   1196.6  11568.0   1199.8  11592.0   1200.2  11813.0
GR1197.9  11871.0   1200.4  11970.0   1200.0  12435.0   1200.3  13151.0   1202.1  13796.0
GR1203.7  13853.0   1212.4  13935.0   1207.7  13964.0   1212.1  14121.0   1217.0  14284.0
GR1266.1  14570.0   1266.3  14870.0
HD 21.76      10     9887   11304
X1 22.32    29.0   9946.0 12625.0    2655    2480    2940
GR1241.3   9793.0   1238.4   9946.0   1201.1  10000.0   1201.2  10023.0   1202.2  10044.0
GR1206.6  10368.0   1206.6  10615.0   1203.2  10989.0   1201.0  10999.0   1201.1  11063.0
GR1203.0  11080.0   1202.0  11264.0   1207.5  11286.0   1207.6  11421.0   1204.2  11488.0
GR1205.5  11529.0   1204.2  11586.0   1205.5  11657.0   1205.5  11944.0   1203.8  12003.0
GR1205.2  12205.0   1202.3  12225.0   1204.5  12288.0   1202.7  12304.0   1203.0  12596.0
GR1209.0  12625.0   1208.9  13430.0   1208.0  14025.0   1217.2  14068.0
HD 22.32      10     9946   12625
NC 0.040   0.031    0.030
X1 22.79    27.0   9941.0 13467.0    2510    2335    2510
GR1251.9   9874.0   1251.2   9941.0   1209.1  10000.0   1209.1  10014.0   1209.9  10117.0
GR1211.7  10136.0   1212.4  10314.0   1210.0  10336.0   1214.5  10427.0   1214.0  10515.0
GR1215.9  10524.0   1215.4  10737.0   1215.1  11031.0   1211.7  11045.0   1212.9  11344.0
GR1214.9  11538.0   1213.6  11747.0   1215.3  12059.0   1214.6  12405.0   1211.6  12427.0
GR1212.7  12591.0   1213.1  12892.0   1212.6  13139.0   1215.3  13290.0   1219.1  13408.0
GR1224.9  13467.0   1229.4  13648.0
HD 22.79      10     9941   13467
NC 0.040   0.034    0.030
X1 23.35    43.0   9967.0 13219.0    2970    2570    2930
GR1262.8   9454.0   1260.9   9495.0   1226.5   9564.0   1222.0   9623.0   1224.6   9642.0
GR1224.2   9967.0   1217.6  10000.0   1218.1  10049.0   1221.3  10198.0   1218.3  10445.0
GR1221.4  10531.0   1223.2  10851.0   1224.6  11047.0   1222.6  11442.0   1220.5  11450.0
GR1221.1  11694.0   1222.4  11718.0   1223.4  11842.0   1221.2  11990.0   1221.2  12330.0
GR1218.9  12354.0   1218.3  12523.0   1220.0  12540.0   1220.0  12590.0   1222.4  12612.0
GR1222.2  12920.0   1221.5  13110.0   1219.0  13123.0   1219.2  13202.0   1223.9  13219.0
GR1228.0  13780.0   1232.0  13850.0   1236.0  13860.0   1244.3  14238.0   1241.8  14464.0
GR1242.7  14758.0   1244.0  14959.0   1249.1  15014.0   1251.0  15184.0   1248.8  15245.0
GR1250.9  15333.0   1253.7  15578.0   1253.8  15753.0
HD 23.35      10     9967   13219
NC 0.039   0.035    0.030
X1 23.89    39.0     9324   11071    2875    2620    2860
GR1266.8   7830.0   1270.3   7975.0   1256.6   8004.0   1261.3   8023.0   1232.2   8081.0
GR1230.5   8170.0   1232.4   8230.0   1230.6   8450.0   1230.6   8803.0   1232.9   8953.0
```

```
GR1232.9  9324.0   1229.8  9359.0   1229.0  9453.0   1230.7  9526.0   1232.2  9649.0
GR1228.1  9829.0   1227.6 10000.0   1227.7 10139.0   1231.6 10382.0   1231.7 10672.0
GR1231.3 10890.0   1228.3 10935.0   1228.4 11039.0   1231.9 11071.0   1231.9 11221.0
GR1230.3 11304.0   1230.2 11634.0   1229.0 11788.0   1232.1 11920.0   1236.2 11972.0
GR1235.4 12009.0   1252.5 12101.0   1250.1 12152.0   1251.7 12229.0   1249.1 12295.0
GR1254.4 12406.0   1258.7 12485.0   1259.5 12817.0   1259.5 12913.0
HD 23.89     10    9324   11071
NC 0.040   0.034   0.030
X1 24.35    32.0  7939.0 10201.0    1990    2730    2445
GR1280.9  7170.0   1276.9  7277.0   1256.6  7383.0   1264.0  7450.0   1246.8  7565.0
GR1247.2  7627.0   1244.2  7704.0   1247.3  7800.0   1243.9  7939.0   1239.6  7961.0
GR1238.3  8358.0   1239.2  8768.0   1241.1  9067.0   1241.0  9317.0   1237.8  9652.0
GR1236.5  9664.0   1239.4  9728.0   1238.3  9893.0   1235.2 10000.0   1237.5 10174.0
GR1242.5 10201.0   1242.8 10300.0   1238.2 10325.0   1238.7 10825.0   1237.1 11179.0
GR1236.3 11345.0   1264.9 11392.0   1264.2 11635.0   1263.8 11839.0   1273.2 11913.0
GR1273.1 12061.0   1269.2 12083.0
HD 24.35     10   7939.0 10201.0
NC 0.038   0.031   0.030
X1 24.54    36.0  9240.0 10227.0     880    1140     980
GR1282.4  7259.0   1277.8  7423.0   1258.4  7466.0   1263.6  7490.0   1246.5  7527.0
GR1245.6  7636.0   1243.2  7946.0   1243.5  8106.0   1243.4  8353.0   1243.6  8697.0
GR1244.5  8990.0   1244.5  9240.0   1242.9  9311.0   1241.6  9485.0   1242.9  9550.0
GR1242.1  9879.0   1240.3  9989.0   1238.3 10000.0   1238.3 10014.0   1242.7 10058.0
GR1244.6 10227.0   1240.8 10491.0   1242.8 10616.0   1240.2 10736.0   1243.1 10847.0
GR1240.6 11132.0   1239.2 11150.0   1238.8 11312.0   1241.5 11351.0   1239.8 11413.0
GR1243.1 11501.0   1241.6 11750.0   1239.2 11764.0   1239.1 11816.0   1276.1 11876.0
GR1278.6 12013.0
HD 24.54     10    9240   10227
NC 0.030   0.030   0.030
X1 24.90    43.0  9334.0 11529.0    2055    1850    1905
GR1258.9  7820.0   1255.0  7838.0   1251.6  8006.0   1249.7  8269.0   1253.4  8308.0
GR1250.9  8530.0   1252.2  8594.0   1251.2  8738.0   1252.8  8845.0   1252.5  9147.0
GR1251.6  9334.0   1248.0  9359.0   1248.2  9467.0   1250.8  9482.0   1252.3  9813.0
GR1248.6  9839.0   1249.7  9933.0   1246.8  9959.0   1246.6 10000.0   1246.6 10037.0
GR1251.0 10053.0   1251.1 10206.0   1247.0 10559.0   1251.4 10684.0   1249.5 10806.0
GR1246.5 10832.0   1246.5 10895.0   1249.8 10918.0   1248.1 11176.0   1249.9 11194.0
GR1250.2 11328.0   1249.2 11417.0   1252.5 11529.0   1251.5 11894.0   1247.3 11933.0
GR1250.3 12174.0   1247.5 12200.0   1248.9 12432.0   1249.5 12596.0   1249.5 12718.0
GR1253.6 12781.0   1250.2 13053.0   1267.8 13098.0
HD 24.90     10    9334   11529
NC 0.040   0.040   0.030
X1 25.37    41.0  9459.0 11916.0    2420    2365    2485
GR1364.9  9300.0   1263.8  9366.0   1265.3  9414.0   1264.5  9459.0   1260.5  9477.0
GR1260.3  9509.0   1261.7  9524.0   1261.8  9638.0   1255.1  9673.0   1256.0  9890.0
GR1255.1  9896.0   1255.0 10000.0   1258.4 10016.0   1256.9 10326.0   1259.4 10451.0
GR1260.2 10717.0   1260.5 10976.0   1260.3 11222.0   1260.8 11504.0   1258.1 11553.0
GR1259.9 11613.0   1259.9 11663.0   1257.2 11706.0   1260.9 11754.0   1259.0 11833.0
GR1282.4 11916.0   1285.6 12047.0   1279.8 12169.0   1289.6 12311.0   1289.6 12356.0
GR1293.3 12435.0   1288.6 12562.0   1293.2 12628.0   1293.1 12768.0   1285.7 12846.0
GR1286.6 12867.0   1286.0 12884.0   1295.4 12994.0   1287.3 13095.0   1291.8 13151.0
GR1293.1 13301.0
HD 25.37     10    9459   11916
X1 25.59     14    9685   11070    1065    1230    1125
GR1300.0  9640.0   1280.0  9685.0   1264.0  9725.0   1260.0  9790.0   1260.0  9840.0
```

GR1256.5 10000.0 1260.0 10100.0 1261.5 10530.0 1261.0 10875.0 1264.0 11025.0
GR1272.0 11070.0 1276.0 11100.0 1280.0 11120.0 1283.4 11270.0
HD 25.59 10 9685 11070
NC .040 .040 .030
X1 25.86 25 8220 10215 1425 1495 1455
GR1300.0 7650.0 1280.0 7740.0 1276.0 7750.0 1272.0 8220.0 1268.0 8300.0
GR1267.5 8340.0 1268.0 8395.0 1270.8 8500.0 1268.0 8615.0 1267.6 8690.0
GR1268.0 8795.0 1268.0 8960.0 1269.0 9060.0 1268.0 9190.0 1265.6 9335.0
GR1266.0 9600.0 1268.0 9740.0 1268.0 9820.0 1264.0 9940.0 1260.0 9950.0
GR1260.0 10055.0 1264.0 10200.0 1280.0 10215.0 1280.0 10300.0 1284.0 10340.0
HD 25.86 10 8220 10215
NC .041 .041 .033
X1 26.29 26.0 8722 11227 2090 2295 2240
GR1307.9 8275.0 1279.3 8338.0 1278.4 8722.0 1275.7 8754.0 1276.5 8962.0
GR1277.4 9349.0 1273.2 9372.0 1276.7 9696.0 1274.9 9925.0 1271.6 9943.0
GR1271.6 10000.0 1273.7 10084.0 1278.8 10120.0 1278.2 10393.0 1278.4 10757.0
GR1275.0 11021.0 1273.9 11201.0 1279.2 11227.0 1276.8 11724.0 1278.8 11784.0
GR1280.5 12462.0 1281.9 12794.0 1279.6 12804.0 1312.6 12882.0 1311.4 13079.0
GR1312.6 13190.0
HD 26.29 10 8722 11227
X1 26.73 30.0 9720 11263 2320 2310 2330
GR1312.2 9355.0 1313.9 9457.0 1289.8 9540.0 1287.5 9720.0 1282.4 9755.0
GR1285.6 9834.0 1280.7 9898.0 1279.8 10000.0 1279.9 10364.0 1283.4 10385.0
GR1283.4 10521.0 1280.9 10543.0 1283.2 10628.0 1285.7 11057.0 1287.2 11263.0
GR1286.8 11621.0 1286.8 13292.0 1287.3 13590.0 1290.5 13648.0 1286.3 13673.0
GR1302.5 13759.0 1293.3 13811.0 1295.0 13870.0 1317.7 13944.0 1310.7 13981.0
GR1332.7 14126.0 1350.7 14161.0 1350.7 14176.0 1346.0 14188.0 1346.0 14190.0
HD 26.73 10 9720 11263
NC .048 .043 .035
X1 27.03 23.0 9679 10553 1660 1020 1590
GR1307.8 9627.0 1301.5 9679.0 1283.2 9723.0 1281.2 9814.0 1282.6 9900.0
GR1287.2 9922.0 1283.5 9949.0 1283.4 10000.0 1283.4 10054.0 1286.2 10079.0
GR1288.9 10450.0 1290.7 10553.0 1288.0 10732.0 1291.0 10749.0 1291.0 11081.0
GR1291.4 12573.0 1293.7 12649.0 1291.4 12657.0 1301.2 12783.0 1303.3 12821.0
GR1300.5 12889.0 1319.6 12961.0 1330.8 13050.0
HD 27.03 10 9679 10553
NC .040 .040 .035
X1 27.68 35.0 8224 10125 4120 3200 3430
GR1310.1 7060.0 1305.9 7509.0 1301.3 7550.0 1302.2 7781.0 1301.9 8224.0
GR1297.0 8243.0 1298.6 8317.0 1299.3 8587.0 1302.4 8679.0 1298.7 8774.0
GR1301.1 8870.0 1300.8 8938.0 1297.9 8961.0 1301.1 8999.0 1301.3 9184.0
GR1297.6 9230.0 1300.8 9293.0 1298.8 9379.0 1300.1 9459.0 1299.0 9624.0
GR1295.3 9640.0 1295.4 9695.0 1301.1 9738.0 1301.6 9853.0 1295.7 10000.0
GR1294.7 10078.0 1310.2 10125.0 1310.7 10428.0 1311.8 10663.0 1305.9 10703.0
GR1312.1 10728.0 1309.4 10746.0 1311.0 10884.0 1330.0 10991.0 1330.2 11145.0
HD 27.68 10 8224 10125
X1 28.12 27.0 9108 10107 2360 2375 2355
GR1357.3 8340.0 1355.3 8384.0 1323.5 8506.0 1320.1 8630.0 1313.6 8697.0
GR1309.5 8719.0 1311.3 8878.0 1311.1 9108.0 1307.8 9129.0 1307.5 9182.0
GR1310.6 9258.0 1308.2 9300.0 1310.5 9411.0 1308.6 9524.0 1306.6 9675.0
GR1304.9 9906.0 1304.6 10000.0 1304.6 10076.0 1310.3 10107.0 1310.7 10411.0
GR1306.3 10527.0 1307.3 10680.0 1308.6 10781.0 1308.5 10866.0 1310.8 10916.0
GR1312.7 11051.0 1314.2 11435.0
HD 28.12 10 9108 10107

X1 28.67 36.0 9950 11203 2785 2925 2885
GR1372.7 9450.0 1371.0 9866.0 1311.5 9964.0 1312.2 10000.0 1312.2 10192.0
GR1319.8 10514.0 1316.1 10819.0 1318.6 10989.0 1315.2 11044.0 1320.5 11203.0
GR1321.6 11445.0 1322.3 11634.0 1319.8 11968.0 1318.7 12107.0 1322.5 12170.0
GR1321.3 12228.0 1325.2 12397.0 1326.4 12792.0 1328.9 12823.0 1324.8 12860.0
GR1327.4 12972.0 1345.8 13057.0 1345.8 13259.0 1339.7 13321.0 1341.1 13419.0
GR1352.8 13484.0 1356.1 13572.0 1358.7 13589.0 1358.8 13606.0 1348.0 13629.0
GR1348.2 13655.0 1363.9 13681.0 1363.8 13698.0 1355.7 13713.0 1356.7 13851.0
GR1373.9 13912.0
HD 28.67 10 9950 11203
NC .042 .042 .035
X1 29.04 33.0 9808 10638 2100 1270 1975
GR1360.0 9770 1320.3 9815.0 1317.3 9828.0 1317.2 9859.0 1319.6 9940.0
GR1317.2 10000.0 1317.2 10048.0 1322.9 10073.0 1324.3 10239.0 1324.4 10414.0
GR1321.2 10499.0 1319.4 10584.0 1326.7 10638.0 1326.0 10868.0 1326.7 11104.0
GR1325.3 11444.0 1322.9 11472.0 1324.3 11521.0 1323.1 11750.0 1330.4 11802.0
GR1330.3 12323.0 1331.2 12554.0 1336.4 12706.0 1332.2 12882.0 1335.8 13217.0
GR1343.9 13578.0 1351.5 13599.0 1352.4 13621.0 1344.3 13633.0 1344.4 13654.0
GR1357.1 13668.0 1357.5 13697.0 1379.5 13780.0
HD 29.04 10 9808 10638
X1 29.54 29.0 9198 10150 2750 2235 2640
GR1378.7 9025.0 1375.5 9068.0 1350.7 9135.0 1348.6 9179.0 1332.4 9217.0
GR1333.5 9321.0 1333.9 9460.0 1331.2 9697.0 1328.7 9726.0 1328.4 9758.0
GR1332.9 9782.0 1332.2 9846.0 1327.0 9882.0 1326.7 10000.0 1326.7 10116.0
GR1340.7 10150.0 1343.0 10343.0 1346.5 10482.0 1348.3 10927.0 1347.8 11457.0
GR1349.2 11687.0 1354.2 11697.0 1354.2 11723.0 1345.8 11737.0 1345.8 11763.0
GR1355.3 11783.0 1355.4 11812.0 1352.6 11829.0 1378.3 11981.0
HD 29.54 10 9198 10150
X129.611 31.0 9052 10244 315 315 375
X3 10
GR1377.8 8825.0 1353.2 9052.0 1337.2 9136.0 1336.3 9285.0 1332.4 9541.0
GR1332.9 9713.0 1334.0 9791.0 1328.9 9812.0 1328.9 9849.0 1331.6 10000.0
GR1331.6 10094.0 1342.3 10133.0 1351.2 10244.0 1345.5 10331.0 1349.1 10528.0
GR1349.1 10688.0 1349.9 10923.0 1353.4 10966.0 1353.4 11037.0 1345.1 11072.0
GR1345.1 11124.0 1352.5 11156.0 1352.5 11163.0 1345.4 11178.0 1345.5 11204.0
GR1353.7 11221.0 1353.4 11251.0 1351.1 11259.0 1353.1 11405.0 1358.4 11533.0
GR1378.5 11635.0
HD29.611 10 9052 10244
X1 29.80 16.0 9347 10610 1295 1340 1400
GR1378.4 9270.0 1373.4 9347.0 1338.8 9419.0 1335.4 9475.0 1340.8 9512.0
GR1342.7 9656.0 1338.9 9882.0 1331.2 9924.0 1331.4 10000.0 1332.7 10180.0
GR1337.6 10205.0 1337.6 10215.0 1327.7 10335.0 1336.3 10521.0 1344.4 10610.0
GR1349.2 10676.0
HD 29.80 10 9347 10610
X1 30.07 17.0 9604 10306 1425 1440 1420
GR1369.4 9325.0 1363.9 9463.0 1360.9 9604.0 1341.5 9665.0 1343.1 9728.0
GR1340.8 9781.0 1340.4 9910.0 1344.6 9925.0 1334.4 9986.0 1334.4 10000.0
GR1335.0 10060.0 1344.5 10098.0 1343.6 10114.0 1336.6 10132.0 1334.0 10261.0
GR1365.9 10306.0 1365.0 10356.0
HD 30.07 10 9604 10306
X1 30.26 12.0 9711 10643 870 1090 1005
GR1357.2 9625.0 1361.9 9711.0 1342.1 9749.0 1338.9 10000.0 1339.3 10135.0
GR1341.7 10314.0 1347.9 10338.0 1348.7 10444.0 1341.6 10545.0 1341.7 10604.0
GR1363.6 10643.0 1389.4 10743.0

```
HD 30.26     10      9711    10643
NC 0.043     0.043   0.045
X1 30.82     12.0    9865    11244    2955     2840     2960
GR1378.3   9630.0   1379.5    9833.0   1375.4    9865.0   1345.2    9924.0   1346.7  10000.0
GR1352.0  10201.0   1347.0   10358.0   1353.5   10398.0   1358.1   10582.0   1357.9  10879.0
GR1354.5  11132.0   1399.1   11244.0
HD 30.82     10      9865    11244
NC 0.043     0.043   0.037
X1 31.39     17.0    9470    10633    2900     3165     2970
GR1397.8   9290.0   1386.7    9342.0   1392.7    9386.0   1393.4    9470.0   1356.5   9526.0
GR1354.7   9561.0   1361.2    9643.0   1363.1    9792.0   1359.4    9942.0   1356.8   9978.0
GR1356.9  10000.0   1357.4   10080.0   1361.5   10242.0   1360.1   10387.0   1368.0  10456.0
GR1368.6  10528.0   1407.9   10633.0
HD 31.39     10      9470    10633
X1 31.86     10.0    9490    10321    2550     2485     2505
GR1411.1   8955.0   1408.4    9155.0   1407.3    9490.0   1362.0    9604.0   1364.9   9727.0
GR1366.7   9894.0   1366.7   10000.0   1365.3   10261.0   1394.3   10321.0   1420.6  10419.0
HD 31.86     10      9490    10321
NC 0.043     0.052   0.040
X1 32.43     14.0    9438    10437    2885     2970     2980
GR1424.1   9340.0   1415.1    9438.0   1371.3    9508.0   1372.3    9554.0   1363.8   9607.0
GR1372.6   9692.0   1375.5    9852.0   1373.4    9965.0   1370.7   10000.0   1372.7  10073.0
GR1383.1  10112.0   1388.9   10373.0   1403.2   10437.0   1436.0   10487.0
HD 32.43     10      9438    10437
NC  .049     .049    .042
X1 32.86     12.0    9719    10564    2405     2135     2295
GR1423.4   9670.0   1424.3    9719.0   1386.4    9797.0   1381.2    9855.0   1380.4   9928.0
GR1374.9  10000.0   1380.6   10079.0   1386.5   10155.0   1382.6   10239.0   1386.6  10279.0
GR1385.4  10331.0   1421.4   10564.0
HD 32.86     10      9719    10564
NC  .047     .055    .032
X132.984     33      9750    10150    648      648      648
GR1427.7   9750.0   1425.2    9750.1   1391.6    9820.0   1391.6    9823.0   1391.6   9823.1
GR1389.7   9833.0   1389.7    9833.1   1389.7    9837.0   1385.5    9851.0   1384.0   9900.0
GR1385.8   9904.0   1385.8    9909.0   1385.8    9909.1   1386.6    9919.0   1386.6   9919.1
GR1386.6   9962.0   1380.0    9985.0   1380.0    9985.1   1380.0    9995.0   1380.0   9995.1
GR1378.4   9997.0   1380.2   10011.0   1382.2   10018.0   1384.2   10050.0   1386.8  10053.0
GR1387.9  10065.0   1387.9   10065.1   1390.7   10075.0   1390.7   10075.1   1392.3  10091.0
GR1423.8  10150.0   1426.0   10150.0   1427.0   10150.1
HD32.984     10      9750    10150
X132.998     9.0     9762    10164    72       72       72
GR1434.1   9610.0   1433.1    9762.0   1389.0    9851.0   1386.3    9920.0   1381.4  10000.0
GR1393.1  10108.0   1413.1   10164.0   1417.9   10358.0   1440.7   10405.0
HD32.998     10      9762    10164
NC  .060     .050    .050
X1 33.41     12.0    9750    10687    1880     2270     2170
GR1448.1   9750.0   1426.7    9864.0   1408.3    9944.0   1386.9   10000.0   1389.1  10157.0
GR1406.8  10366.0   1404.5   10483.0   1409.5   10576.0   1422.7   10626.0   1423.4  10668.0
GR1433.5  10685.0   1437.7   10687.0
HD 33.41     10      9750    10687
X1 33.82     20.0    9565    10600    2165     2220     2175
GR1454.2   9465.0   1454.2    9506.0   1434.5    9527.0   1434.5    9538.0   1450.5   9565.0
GR1408.8   9662.0   1402.1    9714.0   1409.2    9795.0   1417.1    9861.0   1387.4   9966.0
GR1387.4  10000.0   1387.4   10023.0   1405.9   10068.0   1408.6   10117.0   1426.7  10204.0
```

```
GR1425.4  10292.0    1433.9  10347.0    1428.1  10416.0    1427.2  10466.0    1450.9  10600.0
HD 33.82        10     9565    10600
EJ
T4   AGUA FRIA RIVER SEDIMENT TRANSPORT STUDY - SEPTEMBER-AUGUST 1992 PROJECT
T5                    RIVER COVERAGE [MILE 0.16 TO MILE 33.82]
T6                    PREPARED BY: CARLOS CORTEZ CARRIAGA
T7                          UPDATED ON:  MAY 15, 1992
T8   ************************************************************************
I1          10       0       0   0.999  32.174
I4           9       1      10   2.65       0       0       0       0       0
I5          .5      .5     .25     .5     .25       0     1.0
LQ      Q    0.01    4000.   20000.   40000.   60000.   85000.
LT     QS    0.01    3082.   26604.   56358.   97056.  155824.
LF     VFS 0.22029 0.22029 0.12021 0.13469 0.14318 0.15286
LF      FS 0.25878 0.25878 0.16975 0.17708 0.18245 0.19324
LF      MS 0.29170 0.29170 0.24375 0.24027 0.23890 0.24338
LF      CS 0.11476 0.11476 0.15675 0.15080 0.14942 0.14791
LF     VCS 0.07028 0.07028 0.11014 0.10377 0.09976 0.09368
LF     VFG 0.02171 0.02171 0.03701 0.03411 0.03186 0.02874
LF      FG 0.01800 0.01800 0.04091 0.03755 0.03478 0.03086
LF      MG 0.00371 0.00371 0.05344 0.04986 0.04666 0.04150
LF      CG 0.00053 0.00053 0.04486 0.04408 0.04277 0.03878
LF     VCG 0.00031 0.00031 0.02318 0.02779 0.03022 0.02905
N   0.160           0.20997 0.20997 0.88000         0.02466 0.12840 0.13531 0.25571
N           0.18617 0.04051 0.03702 0.03594 0.03394 0.00000
N   0.440           0.20997 0.04092 0.95000         0.00619 0.05233 0.26511 0.22718
N           0.25582 0.04189 0.06446 0.04827 0.03000 0.00709
N   0.730           0.20997 0.04092 0.95000         0.00619 0.05233 0.26511 0.22718
N           0.25582 0.04189 0.06446 0.04827 0.03000 0.00709
N   1.330           0.20997 0.04955 0.95000         0.00445 0.04807 0.21089 0.19967
N           0.25404 0.07425 0.08617 0.07712 0.03894 0.00572
N   1.710           0.20997 0.18396 0.95000         0.00700 0.04540 0.14795 0.11933
N           0.15362 0.07149 0.12617 0.08131 0.08552 0.15721
N   2.020           0.20997 0.18396 0.95000         0.00700 0.04540 0.14795 0.11933
N           0.15362 0.07149 0.12617 0.08131 0.08552 0.15721
N   2.600           0.20997 0.01908 0.95000         0.01569 0.12077 0.38478 0.21525
N           0.16886 0.02633 0.02404 0.01785 0.01963 0.00396
N   2.800           0.20997 0.01908 0.95000         0.01569 0.12077 0.38478 0.21525
N           0.16886 0.02633 0.02404 0.01785 0.01963 0.00396
N   3.270           0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N           0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N   3.400           0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N           0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N   3.430           0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N           0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N   3.729           0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N           0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N   3.734           0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N           0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N   3.757           0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N           0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N   3.767           0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N           0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N   4.094           0.20997 0.12303 0.95000         0.00327 0.05913 0.08985 0.23156
```

N		0.22609	0.09454	0.09019	0.10737	0.04570	0.00220	
N	4.270	0.20997	0.13909	0.95000	0.01473	0.06167	0.16542	0.10644
N		0.11964	0.05433	0.23290	0.07108	0.07702	0.08097	
N	4.700	0.20997	0.12303	0.95000	0.03377	0.04570	0.10333	0.09115
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927	
N	4.754	0.20997	0.12303	0.95000	0.03377	0.04570	0.10333	0.09115
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927	
N	4.790	0.20997	0.12303	0.95000	0.03377	0.04570	0.10333	0.09115
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927	
N	5.150	0.20997	0.05963	0.95000	0.00650	0.08050	0.32636	0.20159
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446	
N	5.290	0.20997	0.05963	0.95000	0.00650	0.08050	0.32636	0.20159
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446	
N	5.380	0.20997	0.05963	0.95000	0.00650	0.08050	0.32636	0.20159
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446	
N	5.689	0.10499	0.04007	0.95000	0.09244	0.10394	0.16384	0.07407
N		0.12482	0.03636	0.03411	0.05742	0.02210	0.00000	
N	5.750	0.20997	0.11371	0.95000	0.02514	0.02121	0.03410	0.05761
N		0.13374	0.10182	0.14009	0.12020	0.21110	0.09680	
N	5.900	0.10499	0.04675	0.95000	0.00167	0.07000	0.11471	0.29051
N		0.23478	0.07273	0.09569	0.07263	0.03895	0.00000	
N	6.430	0.20997	0.08439	0.95000	0.02065	0.09227	0.24746	0.14997
N		0.18326	0.08153	0.05486	0.06285	0.05857	0.03609	
N	6.890	0.20997	0.20997	0.84606	0.05655	0.02661	0.04201	0.09060
N		0.05774	0.05564	0.06069	0.06744	0.08595	0.09895	
N	6.990	0.20997	0.20997	0.84606	0.05655	0.02661	0.04201	0.09060
N		0.05774	0.05564	0.06069	0.06744	0.08595	0.09895	
N	7.490	0.20997	0.18355	0.95000	0.00479	0.02873	0.10448	0.12958
N		0.20723	0.07724	0.10130	0.11629	0.10762	0.08706	
N	8.000	0.20997	0.20029	0.93000	0.00728	0.02929	0.11102	0.30828
N		0.11991	0.06713	0.05201	0.03858	0.09855	0.08010	
N	8.100	0.20997	0.20029	0.93000	0.00728	0.02929	0.11102	0.30828
N		0.11991	0.06713	0.05201	0.03858	0.09855	0.08010	
N	8.210	0.20669	0.20029	0.92000	0.02947	0.04843	0.11816	0.09260
N		0.13594	0.03971	0.06124	0.08775	0.09780	0.15346	
N	9.130	0.20997	0.13321	0.95000	0.00869	0.04600	0.12779	0.27413
N		0.16235	0.06298	0.06926	0.07354	0.08927	0.06065	
N	9.900	0.20997	0.20997	0.87760	0.01003	0.04333	0.06706	0.20555
N		0.21739	0.05091	0.06699	0.06316	0.06695	0.06960	
N	10.530	0.20997	0.20997	0.85647	0.00421	0.02127	0.02914	0.08658
N		0.09678	0.06727	0.09878	0.11776	0.14108	0.18527	
N	10.720	0.20997	0.17890	0.95000	0.01403	0.05790	0.06375	0.08512
N		0.15652	0.12291	0.12520	0.11966	0.12088	0.09563	
N	11.010	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N		0.15894	0.04993	0.08837	0.11297	0.12731	0.08802	
N	11.340	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N		0.15894	0.04993	0.08837	0.11297	0.12731	0.08802	
N	11.520	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N		0.15894	0.04993	0.08837	0.11297	0.12731	0.08802	
N	11.800	0.10998	0.00902	0.95000	0.00841	0.06483	0.42620	0.23369
N		0.19681	0.02778	0.02211	0.00930	0.00120	0.00000	
N	12.380	0.20997	0.16713	0.95000	0.10927	0.13597	0.22075	0.10297
N		0.11958	0.04334	0.05466	0.04851	0.03611	0.10827	
N	13.330	0.20997	0.10583	0.95000	0.05550	0.05080	0.07292	0.04479

N		0.09799	0.06870	0.10593	0.15285	0.13318	0.05245	
N	13.810	0.20997	0.10583	0.95000	0.05550	0.05080	0.07292	0.04479
N		0.09799	0.06870	0.10593	0.15285	0.13318	0.05245	
N	14.380	0.20997	0.09819	0.95000	0.00447	0.05807	0.15095	0.21462
N		0.19272	0.08524	0.09355	0.07203	0.08427	0.04232	
N	14.850	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N		0.25589	0.10218	0.09875	0.10644	0.10064	0.05619	
N	14.940	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N		0.25589	0.10218	0.09875	0.10644	0.10064	0.05619	
N	15.320	0.20997	0.13913	0.95000	0.00897	0.05446	0.12768	0.12385
N		0.13632	0.08684	0.12677	0.10791	0.11463	0.10576	
N	15.510	0.20997	0.13913	0.95000	0.00897	0.05446	0.12768	0.12385
N		0.13632	0.08684	0.12677	0.10791	0.11463	0.10576	
N	15.980	0.20997	0.19271	0.95000	0.00665	0.01037	0.17808	0.06168
N		0.07674	0.05549	0.08591	0.10635	0.17505	0.20952	
N	16.420	0.20997	0.06234	0.95000	0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420	
N	16.446	0.20997	0.06234	0.95000	0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420	
N	16.450	0.20997	0.06234	0.95000	0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420	
N	16.910	0.20997	0.06703	0.95000	0.00640	0.02513	0.06149	0.07330
N		0.12291	0.07295	0.46914	0.08411	0.04922	0.00781	
N	17.380	0.20997	0.06703	0.95000	0.00640	0.02513	0.06149	0.07330
N		0.12291	0.07295	0.46914	0.08411	0.04922	0.00781	
N	17.760	0.20997	0.14885	0.95000	0.00437	0.02580	0.11721	0.12390
N		0.19929	0.08749	0.11800	0.06891	0.12493	0.12917	
N	18.240	0.20997	0.10170	0.95000	0.00462	0.15220	0.22224	0.11813
N		0.12652	0.05265	0.07449	0.10737	0.09435	0.04624	
N	18.920	0.10499	0.05946	0.95000	0.01821	0.08276	0.15116	0.12148
N		0.21800	0.06284	0.08761	0.14618	0.08897	0.00000	
N	19.440	0.20997	0.19383	0.95000	0.00886	0.01300	0.39307	0.07674
N		0.06638	0.04247	0.06198	0.09086	0.10721	0.08295	
N	19.890	0.20997	0.11515	0.95000	0.00647	0.04633	0.30735	0.17892
N		0.16653	0.04553	0.04777	0.06992	0.06989	0.06018	
N	20.450	0.20997	0.08406	0.95000	0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326	
N	20.920	0.20997	0.09533	0.95000	0.01051	0.04217	0.22588	0.24623
N		0.22979	0.03876	0.04121	0.05860	0.05910	0.04282	
N	21.010	0.20997	0.09533	0.95000	0.01051	0.04217	0.22588	0.24623
N		0.22979	0.03876	0.04121	0.05860	0.05910	0.04282	
N	21.420	0.20997	0.05955	0.95000	0.01704	0.08013	0.20148	0.35467
N		0.12095	0.07181	0.04617	0.04132	0.03584	0.02276	
N	21.760	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02823	0.01194	
N	22.320	0.20997	0.07723	0.95000	0.00642	0.05957	0.24449	0.17159
N		0.20383	0.07884	0.07927	0.07423	0.05525	0.02601	
N	22.790	0.20997	0.08817	0.95000	0.00295	0.08040	0.22208	0.27401
N		0.17304	0.05433	0.05972	0.05074	0.04780	0.03442	
N	23.350	0.20997	0.17333	0.95000	0.00669	0.05531	0.12720	0.18266
N		0.15313	0.06654	0.09027	0.09565	0.09806	0.09687	
N	23.890	0.20997	0.16437	0.95000	0.00102	0.01100	0.18103	0.17308
N		0.26319	0.08305	0.08766	0.07735	0.04680	0.05217	
N	24.350	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874

```
N         0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.540          0.20997 0.06172 0.95000          0.00944 0.00060 0.17255 0.15874
N         0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.900          0.20997 0.11878 0.95000          0.00923 0.04467 0.21324 0.14742
N         0.17234 0.05644 0.06754 0.10076 0.11634 0.06850
N 25.370          0.20997 0.12678 0.95000          0.00149 0.00980 0.08434 0.12091
N         0.22085 0.10524 0.15080 0.11515 0.10960 0.08031
N 25.590          0.20997 0.12678 0.95000          0.00149 0.00980 0.08434 0.12091
N         0.22085 0.10524 0.15080 0.11515 0.10960 0.08031
N 25.860          0.20997 0.10795 0.95000          0.00538 0.03093 0.08500 0.21779
N         0.30391 0.10771 0.09192 0.03978 0.05572 0.03386
N 26.290          0.20997 0.18668 0.95000          0.00224 0.04115 0.11411 0.20318
N         0.20070 0.06822 0.08444 0.07735 0.08152 0.10243
N 26.730          0.20997 0.15103 0.95000          0.00054 0.00193 0.08266 0.13204
N         0.23227 0.10131 0.14684 0.14424 0.08659 0.07083
N 27.030          0.20997 0.19690 0.95000          0.00316 0.01357 0.06346 0.12297
N         0.22397 0.10727 0.13958 0.08334 0.10135 0.10213
N 27.680          0.20997 0.14198 0.95000          0.00292 0.02270 0.13383 0.11664
N         0.15213 0.06945 0.13230 0.13219 0.12590 0.10907
N 28.120          0.20997 0.20569 0.90000          0.00648 0.01875 0.05408 0.06661
N         0.17370 0.10358 0.10459 0.11172 0.11185 0.14004
N 28.670          0.20997 0.05813 0.95000          0.02020 0.07270 0.16705 0.19299
N         0.29376 0.07498 0.06550 0.04880 0.03996 0.01606
N 29.040          0.20997 0.17791 0.95000          0.00510 0.00977 0.02614 0.06339
N         0.12227 0.10953 0.11622 0.16800 0.19067 0.18308
N 29.540          0.20997 0.20519 0.90000          0.00024 0.00037 0.00154 0.00178
N         0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.611          0.20997 0.20519 0.90000          0.00024 0.00037 0.00154 0.00178
N         0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.800          0.20997 0.20519 0.90000          0.00024 0.00037 0.00154 0.00178
N         0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 30.070          0.20997 0.19118 0.95000          0.01550 0.03290 0.10062 0.13788
N         0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.260          0.20997 0.19118 0.95000          0.01550 0.03290 0.10062 0.13788
N         0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.820          0.20997 0.19285 0.95000          0.00421 0.00920 0.03670 0.07932
N         0.14957 0.08938 0.09220 0.11904 0.13559 0.27578
N 31.390          0.20997 0.07865 0.95000          0.00136 0.00317 0.04678 0.16566
N         0.32156 0.13746 0.15154 0.08637 0.05093 0.03300
N 31.860          0.20997 0.18391 0.95000          0.04180 0.03453 0.07407 0.10225
N         0.16518 0.07265 0.11009 0.06917 0.07639 0.15569
N 32.430          0.20997 0.16079 0.82061          0.00634 0.00913 0.01982 0.04061
N         0.07617 0.04604 0.20933 0.08932 0.14784 0.16079
N 32.860          0.20997 0.19086 0.95000          0.00264 0.00920 0.02984 0.04337
N         0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.984          0.20997 0.19086 0.95000          0.00264 0.00920 0.02984 0.04337
N         0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.998          0.20997 0.19086 0.95000          0.00264 0.00920 0.02984 0.04337
N         0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.410          0.20997 0.19086 0.95000          0.00264 0.00920 0.02984 0.04337
N         0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.820          0.20997 0.19086 0.95000          0.00264 0.00920 0.02984 0.04337
N         0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
$LOCAL
```

```
LQL    Q   000.1   1000.   5000.  10000.
LTL   QS   000.1   1094.   6855.  16015.
LFL  VFS 0.28256 0.28256 0.25945 0.28352
LFL   FS 0.43291 0.43291 0.40442 0.37836
LFL   MS 0.14372 0.14372 0.16223 0.16477
LFL   CS 0.10623 0.10623 0.11610 0.11564
LFL  VCS 0.03200 0.03200 0.04974 0.04723
LFL  VFG 0.00126 0.00126 0.00559 0.00589
LFL   FG 0.00076 0.00076 0.00197 0.00380
LFL   MG 0.00056 0.00056 0.00028 0.00067
LFL   CG 0.00000 0.00000 0.00022 0.00012
LFL  VCG 0.00000 0.00000 0.00000 0.00000
$HYD
$RATING
RC          19    5000    4000 913.885   0.000   1.086   2.048   2.896   3.638
RC       4.286   4.848   5.334   5.755   6.119   6.436   6.716   6.969   7.204
RC       7.432   7.661   7.902   8.164   8.456
$B       2
$KL
*    TIME DURATION 1 - HYDROGRAPH 1
Q  5875.   1250.
T   60.   60.
X         0.1    1.8
*    TIME DURATION 2 - HYDROGRAPH 1
Q  5875.   1250.
W  0.05
*    TIME DURATION 3 - HYDROGRAPH 1
Q 11750.   2500.
X         0.1    1.3
*    TIME DURATION 4 - HYDROGRAPH 1
Q 11750.   2500.
W  0.09
*    TIME DURATION 5 - HYDROGRAPH 1
Q 17625.   3750.
X         0.1    0.9
*    TIME DURATION 6 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*    TIME DURATION 7 - HYDROGRAPH 1
Q 23500.   5000.
X         0.1    0.4
*    TIME DURATION 8 - HYDROGRAPH 1
Q 23500.   5000.
W 0.0625
*    TIME DURATION 9 - HYDROGRAPH 1
Q 17625.   3750.
X         0.1    0.9
*    TIME DURATION 10 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*    TIME DURATION 11 - HYDROGRAPH 1
Q 11750.   2500.
X         0.1    1.3
*    TIME DURATION 12 - HYDROGRAPH 1
```

```
Q 11750.     2500.
W    0.09
*       TIME DURATION 13 - HYDROGRAPH 1
Q   5875.    1250.
X           0.1     1.8
*    B  TIME DURATION 14 - HYDROGRAPH 1
Q   5875.    1250.
W    0.05
$$END
```

F.2- Input Data File for Model II

```
T1    AGUA FRIA RIVER SEDIMENT TRANSPORT MODELING [HEC-6 DATA]
T2    LAST UPDATED JULY 5, 1993  - MODEL IIB
T3
NC 0.070   0.040   0.044     .1      .3
X1 0.160    47.0    8000   12725    470     460     465
GR 924.4  4925.0   924.2  5199.0   921.8  5600.0   919.5  5760.0   919.4  5959.0
GR 920.9  6245.0   920.8  6516.0   919.3  6554.0   919.8  6850.0   919.6  7271.0
GR 920.5  7535.0   917.6  8136.0   917.4  8339.0   912.3  8356.0   917.2  8376.0
GR 916.4  8991.0   914.0  9212.0   911.6  9231.0   913.2  9494.0   911.8  9720.0
GR 910.7 10000.0   909.6 10136.0   921.6 10167.0   923.0 10184.0   913.7 10213.0
GR 913.7 10477.0   917.1 10590.0   916.6 10873.0   910.5 10909.0   910.5 11042.0
GR 915.2 11068.0   912.1 11265.0   911.5 11516.0   908.3 11664.0   910.4 11830.0
GR 916.1 11911.0   914.1 12098.0   914.9 12628.0   922.1 12652.0   922.7 12725.0
GR 916.5 12758.0   916.8 13671.0   916.2 14363.0   917.2 14971.0   917.8 15391.0
GR 913.5 15403.0   920.3 15459.0
HD 0.160      10    8000   12725
NC 0.033   0.040   0.039
X1 0.440    40.0    8029   10420   1510    1465    1485
GR 927.5  3107.0   925.0  4575.0   922.8  5984.0   921.8  6974.0   920.3  7816.0
GR 923.1  7847.0   923.3  7915.0   919.1  7942.0   919.1  7995.0   923.7  8029.0
GR 919.5  8152.0   916.2  8640.0   915.1  8999.0   916.8  9023.0   916.7  9798.0
GR 913.9  9815.0   913.5  9842.0   912.8 10000.0   917.6 10016.0   916.2 10201.0
GR 917.0 10263.0   917.7 10313.0   917.7 10385.0   925.2 10420.0   917.7 10455.0
GR 917.8 11076.0   920.3 11103.0   916.9 11133.0   916.4 11365.0   919.1 11391.0
GR 918.7 12229.0   918.8 12650.0   920.6 12691.0   919.8 12785.0   919.6 13644.0
GR 920.4 14355.0   921.0 16110.0   921.8 16630.0   922.9 17240.0   924.0 17640.0
HD 0.440      10    8029   10420
NC 0.034   0.040   0.042
X1 0.730    36.0    8340   12394   1565    1475    1510
GR 926.5  3285.0   926.3  3986.0   925.6  4737.0   925.2  5415.0   925.6  5760.0
GR 925.6  5797.0   925.7  5889.0   925.7  5945.0   924.5  6306.0   924.5  7206.0
GR 924.3  8340.0   921.6  8530.0   921.1  8982.0   919.1  8999.0   918.6  9126.0
GR 921.0  9195.0   920.0  9917.0   917.8  9927.0   917.9 10000.0   916.9 10087.0
GR 928.8 10162.0   919.2 10205.0   917.0 10479.0   919.8 10521.0   918.9 10591.0
GR 928.7 10655.0   919.2 10697.0   919.2 10771.0   922.2 10794.0   921.6 11725.0
GR 922.6 11783.0   924.5 12394.0   924.5 13563.0   924.0 14000.0   924.3 15050.0
GR 926.0   15560
HD 0.730      10    8340   12394
NC 0.040   0.042   0.043
X1 1.330    29.0    8038   10456   3405    3325    3385
GR 934.6  6000.0   933.3  6025.0   932.9  6490.0   931.0  6748.0   931.3  7154.0
GR 931.8  7239.0   933.2  7837.0   934.0  8038.0   931.1  8083.0   929.8  8339.0
GR 931.4  8777.0   929.3  8916.0   931.1  8945.0   929.8  9282.0   929.1  9911.0
GR 927.0 10000.0   925.9 10122.0   925.5 10364.0   932.0 10456.0   925.5 10490.0
GR 931.1 10701.0   931.6 11006.0   930.4 11242.0   934.9 11261.0   931.9 11306.0
GR 933.2 11377.0   934.8 11409.0   936.3 12061.0   941.3 12490.0
HD 1.330      10    8038   10456
NC 0.041   0.040   0.035
X1 1.710      44    9091 10284.4   2000    2585    2480
GR 940.9  5684.9   943.3  5808.0   945.3  6004.6   945.1  6078.9   947.4  6100.1
GR 947.4  6117.9   939.1  6148.7   948.7  6187.8   948.6  6226.4   934.0  6296.9
```

```
GR 936.8  6795.4   942.6  6807.8   942.6  6816.3   935.2  6833.2   933.6  7016.1
GR 935.7  7029.0   935.7  7052.6   932.4  7065.5   932.0  7135.0   934.3  7164.7
GR 934.3  7198.3   931.9  7209.5   934.6  7333.9   933.3  7541.5   933.4  7601.4
GR 936.1  7704.9   936.0  8010.3   935.3  8305.9   935.8  8591.1   935.4  8888.0
GR 935.8  9091.0   933.0  9104.6   933.1  9230.9   931.1  9247.7   929.7  9534.8
GR 928.2  9542.9   928.2  9966.4   928.2 10000.0   930.4 10058.7   930.5 10277.8
GR 935.9 10284.4   941.2 10511.3   951.5 11351.7   952.3 11442.6
HD 1.710      10    9091 10284.4
NC 0.041   0.035   0.035
X1 2.020      31  8839.4 10077.3     890    2065    1965
GR 950.0  5981.1   948.6  6066.6   951.6  6121.6   954.7  6293.7   955.1  6434.3
GR 940.7  6514.7   939.9  6533.9   937.1  6557.3   936.4  6934.6   937.1  7244.1
GR 944.6  7260.1   944.6  7278.4   937.0  7304.1   936.3  7340.1   938.6  7388.3
GR 938.4  7687.8   936.3  7711.0   938.5  7824.6   938.8  7961.0   937.2  8390.4
GR 938.4  8544.9   938.1  8839.4   935.2  8854.5   935.2  9121.5   935.4  9418.2
GR 934.2  9860.0   932.7  9918.6   933.3 10000.0   934.5 10062.4   944.8 10077.3
GR 944.8 10079.1
HD 2.020      10  8839.4 10077.3
NC 0.045   0.031   0.036
X1 2.600      26    9437 10580.6    2700    2945    3320
GR 967.1  7292.0   967.4  7442.4   961.7  7739.8   957.5  7927.3   953.0  8217.8
GR 947.7  8560.5   944.7  8730.1   944.9  9057.3   944.8  9437.0   940.5  9449.9
GR 941.9  9684.7   939.6  9951.4   939.6 10000.0   939.6 10090.3   941.7 10102.7
GR 943.1 10322.7   940.5 10500.3   946.6 10580.6   946.6 10625.8   945.8 10652.9
GR 942.2 10671.4   943.4 10811.0   943.6 10850.0   944.8 11140.9   954.6 11152.0
GR 954.6 11164.0
HD 2.600      10    9437 10580.6
X1 2.800      19    8817   11222    1250     655    1000
GR 956.4  8817.0   952.8  8856.3   944.9  9060.9   943.4  9200.0   943.2  9214.4
GR 943.5  9447.6   942.0 10000.0   943.9 10091.2   943.9 10170.9   942.8 10185.3
GR 943.0 10439.2   945.6 10464.6   945.8 10582.0   943.7 10628.0   945.8 10774.1
GR 945.7 10820.4   942.3 10890.9   945.9 11203.4   956.6 11222.0
HD 2.800      10    8817   11222
X1 3.270      17  9692.6 11130.5    2800    1995    2505
GR 961.5  7808.3   958.3  8137.4   956.3  8362.4   953.4  9316.6   950.7  9692.6
GR 945.5  9724.1   944.5  9770.5   944.8 10000.0   944.8 10158.6   951.4 10188.1
GR 947.8 10278.9   948.5 10405.5   944.5 10606.9   944.5 10822.2   945.7 10915.2
GR 948.5 11116.0   960.5 11130.5
HD 3.270      10  9692.6 11130.5
X1 3.400      23  9760.9 10928.5     760     635     685
GR 961.9  7939.2   957.7  8317.0   955.0  9117.3   952.3  9683.9   952.0  9760.9
GR 945.4  9784.1   945.4 10000.0   945.4 10039.4   950.7 10054.0   951.3 10107.8
GR 953.0 10116.4   953.1 10158.4   951.2 10170.2   951.1 10228.2   945.2 10238.1
GR 945.1 10277.1   950.5 10294.4   948.9 10485.8   946.0 10546.7   949.6 10607.8
GR 950.1 10703.8   952.3 10913.8   963.2 10928.5
HD 3.400      10  9760.9 10928.5
X1 3.430      12  9654.5 10873.4     165     160     165
GR 961.5  7958.9   957.8  8287.1   956.3  8796.5   955.8  9654.5   953.0  9684.2
GR 952.8  9758.5   946.2  9788.6   946.0 10000.0   946.0 10271.7   951.1 10293.1
GR 951.1 10849.9   963.7 10873.4
HD 3.430      10  9654.5 10928.5
X1 3.729     6.0    9420   10603    1575    1585    1580
GR 972.0  9405.0   968.0  9420.0   952.2  9425.0   952.2 10588.0   967.2 10603.0
GR 967.2 10613.0
```

```
HD 3.729      0      0      0
X1 3.734    63.0  9400.9 10599.3     25     25     25
GR 972.4  9400.8   967.5  9400.9   952.3  9416.0   952.3  9422.1   952.3  9474.5
GR 952.3  9474.6   952.3  9481.6   952.3  9481.7   952.3  9554.7   952.3  9554.8
GR 952.3  9561.8   952.3  9561.9   952.3  9634.6   952.3  9634.7   952.3  9641.7
GR 952.3  9641.8   952.3  9714.5   952.3  9714.6   952.3  9721.6   952.3  9721.7
GR 952.3  9794.7   952.3  9794.8   952.3  9801.8   952.3  9801.9   952.3  9874.9
GR 952.3  9875.0   952.3  9882.0   952.3  9882.1   952.3  9955.1   952.3  9955.2
GR 952.3  9962.2   952.3  9962.3   952.3 10034.9   952.3 10035.0   952.3 10042.0
GR 952.3 10042.1   952.3 10115.1   952.3 10115.2   952.3 10122.2   952.3 10122.3
GR 952.3 10194.8   952.3 10194.9   952.3 10201.9   952.3 10202.0   952.3 10275.0
GR 952.3 10275.1   952.3 10282.1   952.3 10282.2   952.3 10355.2   952.3 10355.3
GR 952.3 10362.3   952.3 10362.4   952.3 10434.9   952.3 10435.0   952.3 10442.0
GR 952.3 10442.1   952.3 10515.1   952.3 10515.2   952.3 10522.2   952.3 10522.3
GR 952.3 10585.2   967.6 10599.3   971.1 10599.4
HD 3.734      0      0      0
X1 3.757     7.0    9425   10555    120    120    120
GR 968.3  9400.0   966.5  9425.0   952.3  9454.0   952.4  9708.0   952.1 10000.0
GR 952.1 10538.0   967.7 10555.0
HD 3.757      0      0      0
X1 3.767      92  9428.1 10572.0     50     50     50
GR 970.9  9428.0   966.9  9428.1   952.9  9457.5   952.9  9457.6   952.9  9460.6
GR 952.9  9460.7   952.9  9492.4   952.9  9492.5   952.9  9498.5   952.9  9498.6
GR 952.9  9510.4   952.9  9510.5   952.9  9513.5   952.9  9513.6   952.9  9525.5
GR 952.9  9525.6   952.9  9528.6   952.9  9528.7   952.9  9540.4   952.9  9540.5
GR 952.9  9543.5   952.9  9543.6   952.9  9555.4   952.9  9555.5   952.9  9558.5
GR 952.9  9558.6   952.9  9570.4   952.9  9570.5   952.9  9573.5   952.9  9573.6
GR 952.9  9585.4   952.9  9585.5   952.9  9588.5   952.9  9588.6   952.9  9600.4
GR 952.9  9600.5   952.9  9625.0   952.9  9625.1   952.9  9761.9   966.1  9762.0
GR 966.1  9778.0   952.9  9778.1   952.9  9915.0   966.1  9915.1   966.1  9931.1
GR 952.9  9931.2   952.9 10068.9   966.1 10069.0   966.1 10085.0   952.9 10085.1
GR 952.9 10220.9   966.1 10221.0   966.1 10237.0   952.9 10237.1   952.9 10374.9
GR 952.9 10375.0   952.9 10400.2   952.9 10400.3   952.9 10410.9   952.9 10411.0
GR 952.9 10414.9   952.9 10415.0   952.9 10426.9   952.9 10427.0   952.9 10430.0
GR 952.9 10430.1   952.9 10441.8   952.9 10441.9   952.9 10444.9   952.9 10445.0
GR 952.9 10456.9   952.9 10457.0   952.9 10460.0   952.9 10460.1   952.9 10472.0
GR 952.9 10472.1   952.9 10475.1   952.9 10475.2   952.9 10486.9   952.9 10487.0
GR 952.9 10490.0   952.9 10490.1   952.9 10501.9   952.9 10502.0   952.9 10508.9
GR 952.9 10509.0   952.9 10540.8   952.9 10540.9   952.9 10543.9   952.9 10544.0
GR 967.2 10571.9   970.9 10572.0
HD 3.767      0      0      0
NC   .04    .045    .025
X1 4.094     7.0    9440   10578   1770   1760   1765
GR 973.3  9440.0   958.5  9465.0   958.5  9757.0   958.5 10000.0   958.5 10558.0
GR 973.0 10578.0   973.0 10582.0
HD 4.094      10    9440   10578
X1 4.270    15.0    9449   10588    925    925    925
GR 975.0  9440.0   974.9  9449.0   959.5  9466.0   958.0  9791.0   970.4  9807.0
GR 970.6  9818.0   968.3  9822.0   967.9  9877.0   971.5  9883.0   971.5  9891.0
GR 958.0  9910.0   957.1 10000.0   958.9 10317.0   959.7 10563.0   974.4 10588.0
HD 4.270      10    9449   10588
X1 4.700     9.0    9451   10579   2320   2180   2250
GR 978.4  9440.0   978.4  9451.0   961.5  9467.0   960.2  9774.0   959.1 10000.0
GR 961.1 10353.0   962.8 10562.0   978.8 10579.0   978.9 10595.0
```

HD 4.700 10 9451 10588
X1 4.754 53.0 9402.5 10572.4 150 310 225
X3 10
GR 973.0 7150.0 972.7 8115.0 973.6 8831.0 984.3 9296.0 988.1 9402.5
GR 988.1 9427.7 980.6 9427.8 960.3 9445.8 960.3 9525.5 960.3 9525.6
GR 960.3 9537.6 960.3 9537.7 960.3 9641.5 960.3 9641.6 960.3 9653.6
GR 960.3 9653.7 960.3 9757.4 960.3 9757.5 960.3 9769.5 960.3 9769.6
GR 960.3 9873.4 960.3 9873.5 960.3 9885.5 960.3 9885.6 960.3 9997.8
GR 960.3 9997.9 960.3 10009.9 960.3 10010.0 960.3 10105.8 960.3 10105.9
GR 960.3 10117.9 960.3 10118.0 960.3 10221.3 960.3 10221.4 960.3 10233.4
GR 960.3 10233.5 960.3 10337.9 960.3 10338.0 960.3 10349.0 960.3 10349.1
GR 960.3 10453.5 960.3 10453.6 960.3 10465.6 960.3 10465.7 960.3 10555.9
GR 981.2 10572.3 988.7 10572.4 988.7 10597.0 987.2 10612.0 978.1 11023.0
GR 978.7 11497.0 980.6 12014.0 982.4 12466.0
HD 4.754 10 9445.8 10555.9
X1 4.790 6.0 9440 10590 357 187 277
GR 980.2 9440.0 964.0 9466.0 961.1 10000.0 964.6 10568.0 980.8 10590.0
GR 980.8 10600.0
HD 4.790 10 9440.0 10590
X1 5.150 9.0 9291 10713 1780 1960 1873
GR 986.0 9275.0 986.0 9291.0 969.9 9310.0 968.1 9678.0 967.4 10000.0
GR 968.7 10469.0 968.9 10691.0 986.0 10713.0 986.0 10720.0
HD 5.150 10 9291 10713
NC .040 .040 .022
X1 5.290 82 9250.8 10672.4 695 865 775
GR 994.5 9250.7 986.4 9250.8 971.5 9277.5 971.5 9318.7 971.5 9318.8
GR 971.5 9323.4 971.5 9323.5 971.5 9389.9 971.5 9390.0 971.5 9394.5
GR 971.5 9394.6 971.5 9460.9 971.5 9461.0 971.5 9465.6 971.5 9465.7
GR 971.5 9532.1 971.5 9532.2 971.5 9536.8 971.5 9536.9 971.5 9603.3
GR 971.5 9603.4 971.5 9608.0 971.5 9608.1 971.5 9674.5 971.5 9674.6
GR 971.5 9679.2 971.5 9679.3 971.5 9745.7 971.5 9745.8 971.5 9750.4
GR 971.5 9750.5 971.5 9816.9 971.5 9817.0 971.5 9821.6 971.5 9821.7
GR 971.5 9888.1 971.5 9888.2 971.5 9892.8 971.5 9892.9 971.5 9959.3
GR 971.5 9959.4 971.5 9964.0 971.5 9964.1 971.5 10030.0 971.5 10030.1
GR 971.5 10034.7 971.5 10034.8 971.5 10101.2 971.5 10101.3 971.5 10105.9
GR 971.5 10106.0 971.5 10172.3 971.5 10172.4 971.5 10177.0 971.5 10177.1
GR 971.5 10243.7 971.5 10243.8 971.5 10248.4 971.5 10248.5 971.5 10314.9
GR 971.5 10315.0 971.5 10319.6 971.5 10319.7 971.5 10386.0 971.5 10386.1
GR 971.5 10390.7 971.5 10390.8 971.5 10457.2 971.5 10457.3 971.5 10461.9
GR 971.5 10462.0 971.5 10528.4 971.5 10528.5 971.5 10533.0 971.5 10533.1
GR 971.5 10599.5 971.5 10599.6 971.5 10604.2 971.5 10604.3 971.5 10645.5
GR 989.4 10672.3 997.7 10672.4
HD 5.290 10 9250.8 10672.4
NC .04 .04 .025
X1 5.380 20.0 9266 10656 305 645 465
GR 993.0 9214.0 987.7 9266.0 985.7 9342.0 972.8 9358.0 972.3 9413.0
GR 972.2 9565.0 972.2 9734.0 972.2 9889.0 972.2 9994.0 971.4 10000.0
GR 971.4 10062.0 971.4 10195.0 974.3 10208.0 974.2 10263.0 974.2 10420.0
GR 974.2 10582.0 974.2 10639.0 988.4 10656.0 988.6 10671.0 982.3 10702.0
HD 5.380 10 9266 10656
NC .04 .04 .022 .3 .5
X1 5.689 42 9371.3 10552.8 1320 1740 1620
GR 996.9 9371.2 990.8 9371.3 973.9 9399.5 973.9 9488.7 973.9 9488.8
GR 973.9 9496.2 973.9 9496.3 973.9 9606.6 973.9 9606.7 973.9 9614.1

```
GR 973.9  9614.2   973.9  9725.8   973.9  9725.9   973.9  9733.3   973.9  9733.4
GR 973.9  9843.3   973.9  9843.4   973.9  9850.8   973.9  9850.9   973.9  9961.3
GR 973.9  9961.4   973.9  9968.8   973.9  9968.9   973.9 10078.9   973.9 10079.0
GR 973.9 10086.4   973.9 10086.5   973.9 10196.2   973.9 10196.3   973.9 10203.7
GR 973.9 10203.8   973.9 10314.4   973.9 10314.5   973.9 10321.9   973.9 10322.0
GR 973.9 10432.1   973.9 10432.2   973.9 10439.6   973.9 10439.7   973.9 10524.6
GR 990.8 10552.8   996.9 10552.9
HD 5.689      10  9371.3 10552.8
NC   .04     .04   .025
X1 5.750    22.0    9426   10579     370     370     370
GR 990.7  9287.0   990.7  9295.0   985.9  9330.0   983.9  9362.0   985.6  9388.0
GR 990.1  9416.0   990.3  9426.0   975.3  9477.0   975.3  9595.0   975.5  9715.0
GR 975.5  9864.0   975.5  9981.0   974.0  9994.0   973.7 10030.0   973.7 10095.0
GR 973.7 10244.0   975.6 10259.0   975.6 10349.0   975.7 10474.0   975.7 10565.0
GR 989.2 10579.0   989.6 10596.0
HD 5.750      10    9426   10579
X1 5.900    17.0  9429.0 10561.0     945     950     950
GR 993.0  9414.0   993.0  9429.0   977.5  9447.0   977.5  9506.0   977.5  9598.0
GR 977.5  9714.0   977.6  9829.0   977.4  9946.0   975.4  9958.0   975.5 10040.0
GR 975.5 10099.0   975.5 10230.0   977.4 10257.0   977.6 10344.0   977.6 10459.0
GR 977.6 10544.0   991.1 10561.0
HD 5.900      10    9429   10561
X1 6.430    20.0  9452.0 10537.0    2960    2755    2855
GR 996.1  9390.0   991.8  9409.0   991.6  9433.0   996.5  9443.0   996.5  9452.0
GR 984.1  9467.0   984.0  9528.0   984.3  9631.0   984.3  9768.0   984.1  9894.0
GR 983.2  9980.0   981.0 10000.0   981.0 10057.0   981.3 10156.0   981.9 10213.0
GR 983.2 10232.0   983.2 10359.0   982.5 10519.0   996.1 10537.0   996.1 10550.0
HD 6.430      10    9452   10537
X1 6.890    16.0  9439.0 10577.0    2510    2185    2345
GR1004.2  9428.0  1004.2  9439.0   989.9  9461.0   989.9  9574.0   989.9  9700.0
GR 989.8  9818.0   989.4  9954.0   989.4  9973.0   989.4 10000.0   989.4 10039.0
GR 989.4 10132.0   989.4 10266.0   989.4 10427.0   989.4 10558.0  1002.7 10577.0
GR1002.7 10588.0
HD 6.890      10    9439   10577
X1 6.990    19.0  9400.0 10559.0     525     575     550
GR1003.3  9393.0  1003.4  9400.0   997.4  9411.0   997.3  9418.0   991.4  9429.0
GR 991.4  9534.0   991.1  9695.0   991.1  9871.0   991.1 10000.0   991.1 10072.0
GR 991.2 10186.0   991.3 10300.0   998.4 10313.0   998.4 10323.0   998.4 10404.0
GR 990.2 10418.0   990.2 10540.0  1003.5 10559.0  1004.0 10574.0
HD 6.990      10    9400   10559
X1 7.490    13.0  9509.0 10525.0    2645    2610    2595
GR1009.5  9493.0  1009.5  9509.0   995.2  9526.0   995.4  9612.0   995.6  9736.0
GR 995.5  9871.0   995.3 10000.0   995.3 10064.0   995.4 10173.0   995.7 10289.0
GR 995.7 10474.0  1010.9 10525.0  1010.9 10541.0
HD 7.490      10    9509   10525
NC 0.022   0.022   0.022      .3      .5
X1 8.000      85  9235.5 10725.0    2865    2540    2685
X3    10
GR1014.4  7828.0  1015.5  8173.0  1016.3  8411.0  1017.9  8735.0  1018.7  9144.0
GR1018.6  9235.4  1013.3  9235.5   999.2  9263.1   999.2  9271.2   999.2  9271.3
GR 999.2  9285.3   999.2  9285.4   999.2  9362.9   999.2  9363.0   999.2  9377.0
GR 999.2  9377.1   999.2  9452.9   999.2  9453.0   999.2  9467.0   999.2  9467.1
GR 999.2  9542.9   999.2  9543.0   999.2  9557.0   999.2  9557.1   999.2  9632.9
GR 999.2  9633.0   999.2  9647.0   999.2  9647.1   999.2  9722.9   999.2  9723.0
```

```
GR 999.2  9737.0    999.2  9737.1    999.2  9812.9    999.2  9813.0    999.2  9827.0
GR 999.2  9827.1    999.2  9902.9    999.2  9903.0    999.2  9917.0    999.2  9917.1
GR 999.2  9992.9    999.2  9993.0    999.2 10007.0    999.2 10007.1    999.2 10082.9
GR 999.2 10083.0    999.2 10097.0    999.2 10097.1    999.2 10172.9    999.2 10173.0
GR 999.2 10187.0    999.2 10187.1    999.2 10262.9    999.2 10263.0    999.2 10277.0
GR 999.2 10277.1    999.2 10352.8    999.2 10352.9    999.2 10366.9    999.2 10367.0
GR 999.2 10442.9    999.2 10443.0    999.2 10457.0    999.2 10457.1    999.2 10532.9
GR 999.2 10533.0    999.2 10547.0    999.2 10547.1    999.2 10622.9    999.2 10623.0
GR 999.2 10637.0    999.2 10637.1    999.2 10697.5   1013.3 10725.0   1021.3 10725.1
GR1018.6 10725.2   1016.4 10735.0   1017.3 10914.0   1016.9 11234.0   1012.8 11759.0
GR1013.2 12195.0   1013.8 12510.0   1014.9 12742.0   1016.1 13028.0   1018.6 13458.0
HD 8.000      10  9235.5 10725.0
NC   .04    .04   .025     .1      .3
X1 8.100    33.0  9350.0 10883.0     195     1255      535
X3    10
GR1008.6  9134.0   1008.7  9204.0   1013.5  9350.0   1000.5  9366.0   1000.3  9525.0
GR1000.2  9746.0   1000.2  9975.0   1000.1 10000.0   1000.1 10188.0   1000.1 10419.0
GR1001.7 10867.0   1012.8 10883.0   1012.9 10896.0   1001.1 10947.0   1001.1 10996.0
GR1008.6 11040.0   1009.2 11183.0   1009.2 11417.0   1009.2 11573.0   1009.2 11879.0
GR1009.5 12097.0   1010.3 12365.0   1014.4 12451.0   1014.7 12485.0   1012.0 12572.0
GR1013.0 12715.0   1014.9 12885.0   1018.3 12923.0   1012.3 12938.0   1015.8 12949.0
GR1016.8 13044.0   1018.6 13064.0   1018.6 13079.0
HD 8.100      10  9350.0 10883.0
X1 8.210    41.0  9461.0 10989.0     470      800      600
X3    10
GR1009.9  8425.0   1009.9  8544.0   1007.2  8568.0   1004.7  8815.0   1002.0  9267.0
GR1001.9  9408.0   1015.5  9429.0   1015.5  9461.0   1002.8  9487.0   1002.2  9868.0
GR1002.2  9975.0   1002.2 10000.0   1002.2 10370.0   1001.8 10802.0   1001.8 10977.0
GR1014.9 10989.0   1015.0 11009.0   1009.8 11027.0   1008.8 11218.0   1010.1 11326.0
GR1007.2 11370.0   1006.9 11411.0   1012.8 11456.0   1011.2 11540.0   1012.2 11605.0
GR1012.3 11807.0   1012.3 12337.0   1014.3 12482.0   1017.8 12554.0   1015.0 12632.0
GR1016.5 12768.0   1018.1 12832.0   1019.0 13032.0   1022.9 13092.0   1013.2 13111.0
GR1020.6 13125.0   1018.6 13203.0   1023.6 13524.0   1028.1 13565.0   1024.4 13605.0
GR1025.3 13637.0
HD 8.210      10  9641.0 10989.0
NC  .022   .022   .022     .3      .5
X1 9.130      95  9137.5  10860.    5480     3840     4730
GR1031.6  6963.0   1031.6  6964.0   1031.1  7630.0   1031.0  7901.0   1031.2  8217.0
GR1031.2  8482.0   1031.0  8698.0   1031.3  8928.0   1033.5  9101.0   1033.5  9101.1
GR1034.2  9137.4   1027.5  9137.5   1016.2  9172.6   1016.2  9249.0   1016.2  9249.1
GR1016.2  9255.1   1016.2  9255.2   1016.2  9364.1   1016.2  9364.2   1016.2  9370.2
GR1016.2  9370.3   1016.2  9479.1   1016.2  9479.2   1016.2  9485.2   1016.2  9485.3
GR1016.2  9594.1   1016.2  9594.2   1016.2  9600.2   1016.2  9600.3   1016.2  9709.1
GR1016.2  9709.2   1016.2  9715.2   1016.2  9715.3   1016.2  9824.1   1016.2  9824.2
GR1016.2  9830.2   1016.2  9830.3   1016.2  9939.1   1016.2  9939.2   1016.2  9945.2
GR1016.2  9945.3   1016.2  10000.   1016.2 10053.9   1016.2 10054.0   1016.2 10055.4
GR1016.2 10060.0   1016.2 10060.1   1016.2 10169.4   1016.2 10169.5   1016.2 10175.5
GR1016.2 10175.6   1016.2 10284.0   1016.2 10284.1   1016.2 10289.9   1016.2 10290.0
GR1016.2 10399.4   1016.2 10399.5   1016.2 10405.5   1016.2 10405.6   1016.2 10513.9
GR1016.2 10514.0   1016.2 10515.4   1016.2 10519.0   1016.2 10520.0   1016.2 10520.1
GR1016.2 10628.9   1016.2 10629.0   1016.2 10635.0   1016.2 10635.1   1016.2 10744.4
GR1016.2 10744.5   1016.2 10750.5   1016.2 10750.6   1016.2 10827.1   1027.5 10860.0
GR1034.2 10860.1   1032.0 10986.0   1029.8 11176.0   1028.7 11374.0   1027.1 11579.0
GR1025.2 11859.0   1025.7 12067.0   1025.2 12326.0   1025.6 12556.0   1025.0 12785.0
```

```
GR1024.8 13071.0   1025.0 13319.0   1025.2 13557.0   1024.9 13797.0   1024.5 14035.0
GR1024.5 14296.0   1024.3 14582.0   1024.6 14807.0   1024.9 15012.0   1025.0 15173.0
HD 9.130        10  9137.5 10860.0
QT
NC     0       0 0.025    0.1     0.3
X1 9.900        72     9296    10257     4105      3720      3950
GR1040.0  7390.0   1039.6  7453.0   1038.9  7535.0   1034.2  7570.0   1034.2  7587.0
GR1026.8  7620.0   1026.8  7643.0   1033.8  7677.0   1034.1  7725.0   1031.8  7787.0
GR1035.1  7816.0   1036.1  7835.0   1033.3  7853.0   1033.9  7874.0   1032.5  7918.0
GR1032.7  7981.0   1032.7  8110.0   1032.7  8217.0   1032.7  8347.0   1032.7  8471.0
GR1032.0  8578.0   1033.1  8663.0   1034.7  8742.0   1029.4  8801.0   1029.3  8850.0
GR1030.7  8915.0   1031.3  8974.0   1031.5  9056.0   1031.9  9190.0   1031.9  9296.0
GR1025.5  9353.0   1025.8  9410.0   1026.6  9543.0   1026.6  9678.0   1027.9  9756.0
GR1029.1  9845.0   1030.1  9941.0   1031.4 10000.0   1032.0 10125.0   1032.0 10257.0
GR1031.9 10377.0   1031.9 10518.0   1031.7 10660.0   1031.0 10812.0   1030.8 10956.0
GR1031.0 11086.0   1031.2 11234.0   1032.2 11320.0   1032.4 11422.0   1032.7 11547.0
GR1032.9 11677.0   1031.3 11738.0   1031.2 11879.0   1031.8 11986.0   1032.2 12101.0
GR1032.7 12227.0   1031.4 12357.0   1030.9 12468.0   1030.1 12530.0   1029.3 12653.0
GR1031.1 12731.0   1030.8 12846.0   1029.4 12987.0   1031.3 13072.0   1032.1 13163.0
GR1032.0 13318.0   1031.9 13400.0   1029.5 13447.0   1029.0 13528.0   1030.3 13594.0
GR1031.6 13782.0   1032.2 13950.0
HD 9.900        10     9296    10257
NC   .04       .04      .03
X1 10.53        59     9141    10087     3320      2680      3330
GR1042.2  6900.0   1041.8  7011.0   1042.2  7133.0   1040.6  7170.0   1043.1  7244.0
GR1042.8  7347.0   1043.6  7427.0   1044.1  7552.0   1044.2  7681.0   1044.5  7780.0
GR1040.5  7806.0   1039.9  7941.0   1040.6  8043.0   1038.3  8073.0   1040.4  8148.0
GR1040.5  8308.0   1040.4  8447.0   1039.1  8510.0   1040.5  8598.0   1040.7  8716.0
GR1041.3  8842.0   1039.4  8903.0   1040.1  9042.0   1040.9  9141.0   1037.3  9172.0
GR1036.0  9318.0   1034.1  9465.0   1035.3  9650.0   1035.1  9799.0   1034.9  9935.0
GR1031.3  9976.0   1038.5 10000.0   1040.3 10087.0   1040.5 10211.0   1040.8 10306.0
GR1040.7 10431.0   1040.1 10559.0   1039.5 10812.0   1040.2 10890.0   1040.2 10984.0
GR1040.2 11096.0   1039.9 11242.0   1039.6 11405.0   1038.5 11508.0   1038.3 11589.0
GR1039.0 11686.0   1038.7 11812.0   1043.3 11883.0   1043.3 11928.0   1043.3 12093.0
GR1043.3 12139.0   1035.9 12173.0   1035.4 12240.0   1037.0 12361.0   1038.4 12386.0
GR1038.6 12476.0   1038.9 12641.0   1039.5 12816.0   1040.1 12900.0
HD 10.53        10     9141    10087
X1 10.72        56     9360    10386     1040       880      1010
GR1044.6  6959.0   1044.9  7103.0   1045.5  7231.0   1044.2  7323.0   1045.5  7425.0
GR1045.2  7514.0   1044.1  7664.0   1043.2  7804.0   1042.1  7920.0   1042.6  8159.0
GR1044.2  8280.0   1045.1  8434.0   1046.1  8560.0   1043.0  8611.0   1043.3  8733.0
GR1043.9  8851.0   1043.1  8941.0   1043.4  9086.0   1043.6  9224.0   1043.4  9360.0
GR1041.2  9466.0   1037.1  9554.0   1034.1  9651.0   1034.9  9772.0   1038.1  9883.0
GR1039.3  9962.0   1039.3 10000.0   1041.4 10104.0   1042.6 10179.0   1043.3 10280.0
GR1043.9 10386.0   1044.0 10537.0   1043.9 10672.0   1043.2 10833.0   1043.0 10986.0
GR1042.9 11179.0   1041.8 11394.0   1043.4 11430.0   1040.5 11473.0   1040.4 11514.0
GR1042.8 11560.0   1042.4 11684.0   1037.8 11718.0   1037.8 11745.0   1042.2 11798.0
GR1042.8 11943.0   1042.8 12086.0   1043.0 12218.0   1044.2 12321.0   1045.7 12508.0
GR1045.7 12561.0   1047.4 12619.0   1044.3 12722.0   1044.5 12768.0   1045.5 12788.0
GR1045.5 12855.0
HD 10.72        10     9360    10386
NC  .045      .045     .059       .1       .3
X1 11.01        53     8515    10287     1610      1320      1430
GR1049.7  6400.0   1047.4  6457.0   1048.1  6533.0   1048.3  6651.0   1047.0  6742.0
```

```
GR1046.1  6822.0  1048.1  6893.0  1048.6  7019.0  1049.3  7141.0  1048.6  7259.0
GR1048.2  7375.0  1048.3  7481.0  1046.6  7595.0  1046.8  7741.0  1047.2  7866.0
GR1046.8  7991.0  1046.1  8135.0  1045.4  8248.0  1045.2  8375.0  1048.4  8429.0
GR1047.4  8461.0  1050.3  8515.0  1045.5  8604.0  1039.5  8661.0  1043.2  8720.0
GR1035.4  8799.0  1035.4  8886.0  1036.1  9006.0  1037.2  9088.0  1037.9  9148.0
GR1039.2  9236.0  1036.2  9326.0  1036.4  9397.0  1039.4  9494.0  1040.0  9608.0
GR1039.0  9730.0  1038.5  9834.0  1038.8  9937.0  1036.5 10000.0  1045.1 10102.0
GR1045.3 10148.0  1046.4 10178.0  1045.5 10236.0  1046.8 10287.0  1046.8 10389.0
GR1046.4 10522.0  1041.4 10589.0  1045.3 10634.0  1045.9 10739.0  1045.9 10835.0
GR1046.2 10977.0  1047.2 11138.0  1051.5 11275.0
HD 11.01    10    8515   10287
NC 0.045  0.055  0.035    0.4    0.6
X1 11.34    41    9573   10178    885    1855    1680
X3    10
GR1049.1  6097.0  1050.4  6114.0  1047.0  6152.0  1047.7  6201.0  1049.6  6389.0
GR1050.2  6573.0  1049.9  6724.0  1048.9  6894.0  1048.4  7061.0  1048.0  7226.0
GR1050.1  7357.0  1048.8  7509.0  1047.8  7702.0  1049.0  7871.0  1050.1  8017.0
GR1050.4  8177.0  1051.2  8348.0  1050.4  8493.0  1050.6  8658.0  1050.8  8828.0
GR1051.0  8974.0  1051.4  9123.0  1048.5  9224.0  1046.8  9298.0  1062.4  9365.0
GR1062.6  9390.0  1046.1  9428.0  1054.3  9573.0  1048.6  9601.0  1044.1  9675.0
GR1042.0  9722.0  1042.5  9771.0  1041.4  9803.0  1041.3  9942.0  1041.3 10000.0
GR1041.9 10147.0  1056.6 10178.0  1056.8 10295.0  1060.3 10368.0  1060.5 10482.0
GR1061.0 10597.0
HD 11.34    10    9573   10178
NC                  0.1    0.3
X1 11.52    36    9873   10117    980    980    980
GR1052.4  5930.0  1052.0  5988.0  1055.4  6027.0  1050.7  6060.0  1051.7  6182.0
GR1051.2  6305.0  1051.9  6462.0  1050.8  6571.0  1050.9  6715.0  1051.0  6849.0
GR1051.8  6962.0  1048.2  7089.0  1050.0  7210.0  1050.4  7345.0  1050.6  7465.0
GR1050.4  7550.0  1050.8  7652.0  1052.4  7800.0  1052.6  7916.0  1051.9  7950.0
GR1051.9  8550.0  1049.5  8600.0  1049.5  9501.0  1049.3  9665.0  1049.3  9745.0
GR1053.5  9840.0  1054.1  9873.0  1042.4  9922.0  1045.6  9964.0  1045.6 10000.0
GR1045.6 10082.0  1058.5 10117.0  1062.5 10209.0  1063.8 10315.0  1065.6 10431.0
GR1066.9 10534.0
HD 11.52    10    9873   10117
X1 11.80    46    8224   10302    1415    1415    1415
GR1067.1  5780.0  1059.5  5793.0  1056.6  5830.0  1056.5  5946.0  1059.8  5964.0
GR1051.8  5983.0  1051.7  5996.0  1056.2  6015.0  1056.2  6032.0  1056.5  6147.0
GR1054.7  6200.0  1054.7  7200.0  1054.6  7406.0  1059.6  7529.0  1058.4  7629.0
GR1054.9  7711.0  1054.7  7825.0  1054.1  7909.0  1054.2  8003.0  1063.1  8113.0
GR1061.9  8139.0  1065.5  8163.0  1066.5  8224.0  1056.7  8280.0  1051.6  8480.0
GR1051.6  8950.0  1064.5  8998.0  1072.8  9070.0  1061.9  9175.0  1060.0  9249.0
GR1060.3  9379.0  1059.9  9514.0  1060.2  9635.0  1060.8  9771.0  1059.9  9852.0
GR1062.2  9893.0  1049.3  9925.0  1049.0 10000.0  1049.0 10062.0  1060.0 10110.0
GR1063.6 10163.0  1072.3 10233.0  1076.2 10302.0  1075.0 10388.0  1072.1 10447.0
GR1074.2 10502.0
HD 11.80    10    8224   10302
X1 12.38   28.0  9379.0   10302    2885    2885    2885
GR1064.9  6240.0  1064.9  7002.0  1064.9  7519.0  1058.8  7538.0  1059.1  7761.0
GR1064.6  7806.0  1063.0  8056.0  1057.9  8112.0  1062.6  8159.0  1057.8  8303.0
GR1057.8  8562.0  1065.0  8628.0  1066.3  9110.0  1064.8  9294.0  1062.3  9338.0
GR1064.2  9379.0  1055.9  9491.0  1053.7  9566.0  1062.0  9621.0  1057.6  9676.0
GR1055.7  9850.0  1053.3 10000.0  1053.4 10035.0  1060.4 10086.0  1056.7 10286.0
GR1068.9 10302.0  1072.6 10857.0  1078.2 11420.0
```

```
HD 12.38      10    9379   10302
X1 13.33      72  9251.1 10758.5   5075    5065    5070
GR1104.9  5540.0  1099.6  5578.0  1107.5  5891.0  1109.7  6222.0  1105.2  6522.0
GR1095.7  6809.0  1091.5  6880.0  1089.0  7130.0  1090.0  7510.0  1090.5  7760.0
GR1088.5  8360.0  1090.0  8660.0  1092.8  9228.2  1093.0  9251.0  1086.4  9251.1
GR1071.5  9268.5  1071.5  9370.4  1071.5  9370.5  1071.5  9379.5  1071.5  9379.6
GR1071.5  9498.4  1071.5  9498.5  1071.5  9507.5  1071.5  9507.6  1071.5  9623.4
GR1071.5  9623.5  1071.5  9632.5  1071.5  9632.6  1071.5  9748.4  1071.5  9748.5
GR1071.5  9757.5  1071.5  9757.6  1071.5  9873.4  1071.5  9873.5  1071.5  9882.5
GR1071.5  9882.6  1071.5  9995.4  1071.5  9995.5  1071.5 10004.5  1071.5 10004.6
GR1071.5 10117.4  1071.5 10117.5  1071.5 10126.5  1071.5 10126.6  1071.5 10245.9
GR1071.5 10246.0  1071.5 10255.0  1071.5 10255.1  1071.5 10376.4  1071.5 10376.5
GR1071.5 10385.5  1071.5 10385.6  1071.5 10504.4  1071.5 10504.5  1071.5 10513.5
GR1071.5 10513.6  1071.5 10630.0  1071.5 10630.1  1071.5 10639.1  1071.5 10639.2
GR1071.5 10741.1  1086.4 10758.5  1093.0 10758.6  1092.8 10784.0  1090.0 10910.0
GR1090.1 11080.0  1088.0 11380.0  1090.4 11740.0  1096.7 12172.0  1097.3 12475.0
GR1099.6 12607.0  1100.0 13232.0
HD 13.33      10  9251.1 10758.5
NC  0.04    0.04    0.03
X1 13.81    30.0    7867   10525    2560    2560    2560
X3    10
GR1099.0  6280.0  1088.1  6333.0  1083.9  6543.0  1085.6  6895.0  1085.6  7105.0
GR1082.3  7145.0  1085.1  7198.0  1080.5  7254.0  1085.4  7285.0  1083.6  7601.0
GR1084.8  7867.0  1080.5  8265.0  1080.5  8365.0  1080.5  8485.0  1080.5  9315.0
GR1080.5  9435.0  1080.5  9535.0  1081.5  9580.0  1078.6  9597.0  1078.6 10000.0
GR1078.4 10183.0  1082.8 10226.0  1080.2 10454.0  1085.1 10525.0  1087.0 10634.0
GR1099.6 10738.0  1095.4 10896.0  1096.7 11458.0  1099.1 11517.0  1099.1 11575.0
HD 13.81    10.0    8265   10454
X113.855    30.0    7867   10525     240     240     240
X3    10
GR1099.5  6280.0  1088.6  6333.0  1084.4  6543.0  1086.1  6895.0  1086.1  7105.0
GR1082.8  7145.0  1085.6  7198.0  1081.0  7254.0  1085.9  7285.0  1084.1  7601.0
GR1085.3  7867.0  1081.0  8265.0  1081.0  8365.0  1041.0  8485.0  1041.0  9315.0
GR1081.0  9435.0  1081.0  9535.0  1082.0  9580.0  1079.1  9597.0  1079.1 10000.0
GR1078.9 10183.0  1083.3 10226.0  1080.7 10454.0  1085.6 10525.0  1087.5 10634.0
GR1100.1 10738.0  1095.9 10896.0  1097.2 11458.0  1099.6 11517.0  1099.6 11575.0
HD13.855    10.0    8265   10454
X1 14.38    36.0    8125   10691    2170    3125    2725
X3    10
GR1114.0  6715.0  1112.0  6750.0  1104.0  6765.0  1100.0  6790.0  1092.0  6830.0
GR1091.0  6950.0  1092.0  7095.0  1093.3  7380.0  1092.0  7990.0  1092.0  8125.0
GR1085.4  8140.0  1085.4  8240.0  1045.4  8360.0  1045.4  9190.0  1085.4  9310.0
GR1085.4  9320.0  1085.4  9350.0  1085.4  9400.0  1085.4  9410.0  1089.1  9458.0
GR1088.0  9838.0  1084.4 10000.0  1084.4 10065.0  1092.0 10085.0  1092.6 10234.0
GR1090.5 10369.0  1086.9 10445.0  1087.3 10571.0  1097.0 10691.0  1098.7 11028.0
GR1096.0 11319.0  1096.0 11605.0  1098.6 11704.0  1102.9 12300.0  1105.5 12986.0
GR1107.2 13055.0
HD 14.38    10.0    8140   10571
X114.412    36.0    8125   10691     240     240     240
X3    10
GR1114.5  6715.0  1112.5  6750.0  1104.5  6765.0  1100.5  6790.0  1092.5  6830.0
GR1091.5  6950.0  1092.5  7095.0  1093.8  7380.0  1092.5  7990.0  1092.5  8125.0
GR1085.9  8140.0  1085.9  8240.0  1085.9  8360.0  1085.9  9190.0  1085.9  9310.0
GR1085.9  9350.0  1085.9  9375.0  1085.9  9400.0  1085.9  9410.0  1089.6  9458.0
```

GR1088.5 9838.0 1084.9 10000.0 1084.9 10065.0 1092.5 10085.0 1093.1 10234.0
GR1091.0 10369.0 1087.4 10445.0 1087.8 10571.0 1097.5 10691.0 1099.2 11028.0
GR1096.5 11319.0 1096.5 11605.0 1099.1 11704.0 1103.4 12300.0 1106.0 12986.0
GR1107.7 13055.0
HD14.412 10.0 8140 10571
X1 14.85 37.0 9106 10454 2050 2150 2190
GR1126.8 7870.0 1130.3 8231.0 1131.5 8555.0 1129.3 8905.0 1109.1 8978.0
GR1109.1 9053.0 1109.1 9106.0 1096.7 9197.0 1096.6 9259.0 1098.5 9354.0
GR1093.6 9431.0 1093.5 9545.0 1095.7 9695.0 1094.3 9862.0 1090.5 10000.0
GR1090.5 10077.0 1095.6 10178.0 1092.8 10404.0 1100.9 10454.0 1100.0 10870.0
GR1100.4 11172.0 1099.7 11409.0 1095.9 11456.0 1096.9 11575.0 1099.9 11720.0
GR1098.0 12018.0 1098.8 12225.0 1104.1 12350.0 1104.3 12771.0 1106.2 12981.0
GR1104.0 13275.0 1104.0 13521.0 1104.0 13777.0 1111.1 13842.0 1109.6 13895.0
GR1112.3 14491.0 1113.0 14537.0
HD 14.85 10.0 9106 10454
X114.932 44.0 9140 11341 425 425 425
X3 10
GR1128.7 7130.0 1129.3 7664.0 1130.0 8199.0 1126.5 8655.0 1125.4 8818.0
GR1127.8 9140.0 1099.0 9207.0 1097.7 9308.0 1093.3 9327.0 1093.4 9428.0
GR1097.9 9604.0 1094.8 9921.0 1090.1 10000.0 1090.9 10107.0 1096.1 10127.0
GR1095.5 10430.0 1095.0 10475.0 1095.0 10575.0 1095.0 10665.0 1095.0 11020.0
GR1095.0 11030.0 1095.0 11060.0 1095.0 11065.0 1095.0 11115.0 1100.5 11341.0
GR1096.8 11486.0 1101.8 11664.0 1101.7 11970.0 1098.1 12274.0 1100.3 12471.0
GR1103.1 12548.0 1103.6 12714.0 1099.9 12761.0 1099.9 12839.0 1101.6 12862.0
GR1104.5 13038.0 1105.8 13298.0 1107.9 13844.0 1108.1 14020.0 1108.1 14322.0
GR1108.1 14521.0 1110.6 14669.0 1109.0 14693.0 1114.4 14821.0
HD14.932 10.0 9207 10475
X1 14.94 44.0 9140 11341 45 45 45
X3 10
GR1128.8 7130.0 1129.4 7664.0 1130.1 8199.0 1126.6 8655.0 1125.5 8818.0
GR1127.9 9140.0 1099.1 9207.0 1097.8 9308.0 1093.4 9327.0 1093.5 9428.0
GR1098.0 9604.0 1094.9 9921.0 1091.0 10000.0 1091.0 10107.0 1096.2 10127.0
GR1095.5 10430.0 1095.1 10480.0 1095.1 10580.0 1080.1 10670.0 1080.1 11025.0
GR1095.1 11070.0 1095.1 11100.0 1095.1 11110.0 1095.1 11120.0 1100.6 11341.0
GR1096.9 11486.0 1101.9 11664.0 1101.8 11970.0 1098.2 12274.0 1100.4 12471.0
GR1103.2 12548.0 1103.7 12714.0 1100.0 12761.0 1100.0 12839.0 1101.7 12862.0
GR1104.6 13038.0 1105.9 13298.0 1108.0 13844.0 1108.2 14020.0 1108.2 14322.0
GR1108.2 14521.0 1110.7 14669.0 1109.1 14693.0 1114.5 14821.0
HD 14.94 10.0 9207 10475
X115.063 40.0 9277 11399 650 650 650
X3 10
GR1129.5 7425.0 1131.5 8149.0 1131.2 8614.0 1130.8 8893.0 1130.3 9277.0
GR1103.1 9332.0 1104.7 9426.0 1094.3 9498.0 1094.3 9541.0 1097.4 9644.0
GR1097.9 9772.0 1095.3 9968.0 1092.1 10000.0 1092.1 10060.0 1100.6 10106.0
GR1098.2 10337.0 1096.4 10590.0 1096.4 10690.0 1081.4 10735.0 1081.4 11135.0
GR1096.4 11180.0 1096.4 11190.0 1096.4 11200.0 1096.4 11230.0 1102.2 11399.0
GR1099.4 11631.0 1102.5 11691.0 1105.0 12248.0 1108.8 12275.0 1107.9 12321.0
GR1100.9 12497.0 1098.7 12533.0 1106.0 12753.0 1106.4 13055.0 1100.1 13184.0
GR1107.9 13490.0 1110.0 13772.0 1112.3 14455.0 1115.0 14926.0 1115.6 15017.0
HD15.063 10.0 9332 10590
X115.303 41 9681 11192 1175 1175 1175
X3 10
GR1130.6 8550.0 1130.0 8960.0 1122.9 9017.0 1122.9 9350.0 1129.8 9421.0
GR1130.1 9681.0 1097.0 9832.0 1096.5 9930.0 1093.3 10000.0 1101.3 10078.0

```
GR1098.8 10111.0   1101.7 10262.0   1102.0 10464.0   1098.8 10540.0   1098.8 10640.0
GR1083.8 10685.0   1083.8 11085.0   1098.8 11130.0   1098.8 11150.0   1098.8 11170.0
GR1098.8 11180.0   1101.4 11192.0   1101.5 11269.0   1103.4 11329.0   1103.6 11469.0
GR1100.8 11607.0   1105.8 11762.0   1105.8 12259.0   1108.6 12799.0   1108.2 13228.0
GR1110.5 13486.0   1114.2 13529.0   1114.4 13551.0   1110.8 13578.0   1110.8 13644.0
GR1112.3 13701.0   1111.8 14045.0   1114.8 14555.0   1113.6 14647.0   1116.5 15208.0
GR1120.1  15704.0
HD15.303     10.0    9832    10540
X1 15.32      41    9681   11192      90      90      90
X3    10
GR1130.8   8550.0   1130.2   8960.0   1123.1   9017.0   1123.1   9350.0   1130.0   9421.0
GR1130.3   9681.0   1097.2   9832.0   1096.7   9930.0   1093.5 10000.0   1101.5 10078.0
GR1099.0 10111.0   1101.9 10262.0   1102.2 10464.0   1099.0 10540.0   1099.0 10640.0
GR1099.0 10685.0   1099.0 11085.0   1099.0 11130.0   1099.0 11150.0   1099.0 11160.0
GR1099.0 11180.0   1101.6 11192.0   1101.7 11269.0   1103.6 11329.0   1103.8 11469.0
GR1101.0 11607.0   1106.0 11762.0   1106.0 12259.0   1108.8 12799.0   1108.4 13228.0
GR1110.7 13486.0   1114.4 13529.0   1114.6 13551.0   1111.0 13578.0   1111.0 13644.0
GR1112.5 13701.0   1112.0 14045.0   1115.0 14555.0   1113.8 14647.0   1116.7 15208.0
GR1120.3  15704.0
HD 15.32     10.0    9832    10540
NC   .04     .04    .03     .1      .3
X1 15.51     26.0    9756    11854      955     1015      985
X3    10
GR1132.5   8225.0   1133.5   8731.0   1134.5   9204.0   1135.8   9756.0   1099.6   9807.0
GR1097.3 10000.0   1097.3 10089.0   1106.7 10175.0   1106.9 10257.0   1105.4 10533.0
GR1103.3 10702.0   1107.7 10757.0   1109.1 11151.0   1108.7 11527.0   1103.5 11559.0
GR1106.9 11700.0   1103.8 11808.0   1110.9 11854.0   1107.5 11935.0   1110.1 12774.0
GR1110.3 13006.0   1112.8 13696.0   1114.1 14347.0   1117.2 15047.0   1122.8 15652.0
GR1124.4  15898.0
HD 15.51      10    9756    11854
X1 15.98     14.0    9825    10836     2425     2365     2395
X3    10
GR1139.6   8040.0   1139.5   8983.0   1139.6   9505.0   1135.9   9825.0   1106.8   9884.0
GR1108.1   9954.0   1108.6 10000.0   1106.3 10158.0   1103.9 10238.0   1106.2 10332.0
GR1106.0 10456.0   1106.0 10684.0   1160.3 10836.0   1163.1 10929.0
HD 15.98      10    9825    10836
NC                          .3      .5
X1 16.42       28  9776.8 10225.4     2185     2225     2215
X3    10
GR1147.6   8340.0   1143.6   8975.0   1136.5   9604.0   1134.9   9754.0   1135.8   9776.7
GR1130.3   9776.8   1108.7   9798.4   1108.7   9859.0   1108.7   9859.1   1108.7   9865.0
GR1108.7   9865.1   1108.7   9950.9   1108.7   9951.0   1108.7   9957.0   1108.7   9957.1
GR1108.7 10046.0   1108.7 10046.1   1108.7 10051.9   1108.7 10052.0   1108.7 10052.1
GR1108.7 10138.1   1108.7 10138.2   1108.7 10144.2   1108.7 10144.3   1108.7 10203.8
GR1124.8 10225.3   1130.3 10225.4   1130.0 10282.0
HD 16.42       10  9776.8 10225.4
X116.446       64  9768.4 10241.0       95       95       95
X3    10
GR1149.6   7650.0   1147.3   8109.0   1144.8   8614.0   1141.7   9172.0   1136.7   9700.0
GR1139.0   9766.0   1132.0   9768.4   1110.0   9768.5   1110.0   9787.4   1110.0   9871.4
GR1110.0   9882.3   1110.0   9882.4   1110.0   9888.4   1110.0   9888.5   1110.0   9894.3
GR1110.0   9894.4   1110.0   9984.4   1110.0   9984.5   1110.0   9996.5   1110.0   9996.6
GR1110.0 10080.4   1110.0 10080.5   1110.0 10092.5   1118.0 10092.6   1118.0 10100.9
GR1118.0 10101.0   1118.0 10103.7   1118.0 10104.1   1118.0 10116.9   1118.0 10117.0
```

```
GR1118.0 10119.4   1118.0 10119.5   1118.0 10132.3   1118.0 10132.4   1118.0 10134.9
GR1118.0 10135.0   1118.0 10147.4   1118.0 10147.5   1118.0 10149.9   1118.0 10150.0
GR1118.0 10162.8   1118.0 10162.9   1118.0 10165.3   1118.0 10165.4   1118.0 10177.9
GR1118.0 10178.0   1118.0 10180.7   1118.0 10180.8   1118.0 10193.9   1118.0 10194.0
GR1118.0 10196.4   1118.0 10196.5   1118.0 10209.3   1118.0 10209.4   1118.0 10211.9
GR1118.0 10212.0   1118.0 10225.2   1118.0 10225.3   1121.6 10227.9   1121.6 10228.0
GR1131.7 10241.0   1134.7 10241.1   1133.9 10259.0   1132.0 10330.0
HD16.446      10  9768.4 10241.0
X1 16.45      64 9768.4 10241.0      20       20       20
X3    10
GR1149.6  7650.0  1147.3  8109.0  1144.8  8614.0  1141.7  9172.0  1136.7  9700.0
GR1139.0  9766.0  1132.0  9768.4  1110.0  9768.5  1110.0  9787.4  1110.0  9871.4
GR1110.0  9882.3  1110.0  9882.4  1110.0  9888.4  1110.0  9888.5  1110.0  9894.3
GR1110.0  9894.4  1110.0  9984.4  1110.0  9984.5  1110.0  9996.5  1110.0  9996.6
GR1110.0 10080.4   1110.0 10080.5   1110.0 10092.5   1118.0 10092.6   1118.0 10100.9
GR1118.0 10101.0   1118.0 10103.7   1118.0 10104.1   1118.0 10116.9   1118.0 10117.0
GR1118.0 10119.4   1118.0 10119.5   1118.0 10132.3   1118.0 10132.4   1118.0 10134.9
GR1118.0 10135.0   1118.0 10147.4   1118.0 10147.5   1118.0 10149.9   1118.0 10150.0
GR1118.0 10162.8   1118.0 10162.9   1118.0 10165.3   1118.0 10165.4   1118.0 10177.9
GR1118.0 10178.0   1118.0 10180.7   1118.0 10180.8   1118.0 10193.9   1118.0 10194.0
GR1118.0 10196.4   1118.0 10196.5   1118.0 10209.3   1118.0 10209.4   1118.0 10211.9
GR1118.0 10212.0   1118.0 10225.2   1118.0 10225.3   1121.6 10227.9   1121.6 10228.0
GR1131.7 10241.0   1134.7 10241.1   1133.9 10259.0   1132.0 10330.0
HD 16.45      10  9768.4 10241.0
NC        .040         0.1    0.3
X1 16.91    22.0    9758   10178    2515    2200    2440
GR1157.2  8940.0  1156.2  9371.0  1149.0  9481.0  1137.0  9504.0  1153.3  9525.0
GR1154.0  9567.0  1131.4  9634.0  1153.1  9684.0  1144.8  9758.0  1115.6  9804.0
GR1114.6 10000.0   1124.6 10178.0   1127.2 10550.0   1126.5 11022.0   1126.6 11856.0
GR1127.0 12659.0   1127.0 12926.0   1124.0 12946.0   1124.0 13447.0   1124.0 13483.0
GR1121.7  13509.0   1131.2  13564.0
HD 16.91      10    9758   10178
NC  .045     .04
X1 17.38    30.0    9233   10670    2930    2140    2455
GR1173.3  7910.0  1172.6  8368.0  1171.1  8528.0  1166.4  8562.0  1171.3  8593.0
GR1169.3  8760.0  1140.8  8931.0  1133.6  9233.0  1123.5  9271.0  1123.8  9463.0
GR1127.5  9845.0  1122.5  9863.0  1121.7 10000.0  1124.9 10068.0  1124.9 10289.0
GR1127.7 10427.0   1135.1 10670.0   1132.9 10799.0   1132.0 10805.0   1132.0 11178.0
GR1132.0 11531.0   1132.0 11610.0   1134.1 11796.0   1134.6 12108.0   1133.8 12513.0
GR1134.4 13146.0   1134.1 13870.0   1133.0 14530.0   1131.6 14592.0   1137.5 14638.0
HD 17.38      10    9233   10670
X1 17.76    33.0    8819   10431    2140    1900    1980
GR1141.1  8240.0  1139.6  8320.0  1137.6  8483.0  1138.7  8742.0  1132.8  8767.0
GR1132.5  8796.0  1137.5  8819.0  1134.8  8919.0  1134.0  8995.0  1128.0  9034.0
GR1129.8  9054.0  1132.8  9095.0  1132.8  9158.0  1128.0  9273.0  1128.0  9307.0
GR1132.0  9337.0  1128.0  9539.0  1128.0  9703.0  1128.0  9724.0  1128.0  9779.0
GR1128.8  9833.0  1128.0 10000.0  1128.0 10109.0  1131.2 10214.0  1131.5 10347.0
GR1138.3 10431.0   1132.2 10463.0   1134.4 10767.0   1137.8 10792.0   1139.4 11097.0
GR1139.9 11982.0   1139.0 12635.0   1137.5 13350.0
HD 17.76      10    8819   10431
X1 18.24    28.0    8972   10927    2335    2690    2525
GR1139.7  8800.0  1147.0  8886.0  1147.3  8934.0  1151.0  8949.0  1144.6  8972.0
GR1143.2  9072.0  1138.0  9076.0  1138.0  9198.0  1145.4  9204.0  1144.3  9676.0
GR1140.1  9693.0  1140.1  9799.0  1141.4  9937.0  1135.7 10000.0  1135.7 10046.0
```

```
GR1139.2 10063.0  1138.6 10302.0  1136.3 10346.0  1138.7 10430.0  1139.9 10626.0
GR1139.1 10843.0  1144.8 10869.0  1144.8 10927.0  1146.9 10964.0  1147.2 11153.0
GR1142.7 11242.0  1145.5 11290.0  1145.8 11340.0
HD 18.24      10    8972   10927
X1 18.92      52  9447.5 10577.0    3620    3800    3595
X3    10
GR1163.0  8060.0  1163.7  8254.0  1163.8  8693.0  1164.2  9148.0  1166.9  9325.0
GR1168.4  9434.5  1168.8  9447.5  1160.5  9447.6  1149.2  9457.6  1149.2  9565.7
GR1149.2  9565.8  1149.2  9573.3  1149.2  9573.4  1149.2  9691.8  1149.2  9691.9
GR1149.2  9699.4  1149.2  9699.5  1149.2  9817.8  1149.2  9817.9  1149.2  9825.4
GR1149.2  9825.5  1149.2  9943.9  1149.2  9944.0  1149.2  9951.5  1149.2  9951.6
GR1149.2 10070.2  1149.2 10070.3  1149.2 10077.8  1149.2 10077.9  1149.2 10196.0
GR1149.2 10196.1  1149.2 10203.6  1149.2 10203.7  1149.2 10322.0  1149.2 10322.1
GR1149.2 10329.6  1149.2 10329.7  1149.2 10447.4  1149.2 10447.5  1149.2 10455.0
GR1149.2 10455.1  1149.2 10563.5  1163.9 10576.9  1172.0 10577.0  1171.9 10590.0
GR1169.2 10727.0  1173.6 11160.0  1176.2 11672.0  1178.3 12466.0  1178.9 12918.0
GR1179.6 13066.0  1178.6 13305.0
HD 18.92      10  9447.5 10577.0
NC  0.04    0.04    0.03      .1      .3
X1 19.44    40.0    7491   10174    2805    2795    2800
GR1172.9  7491.0  1165.9  7506.0  1166.9  7595.0  1159.6  7627.0  1161.4  7731.0
GR1162.5  7859.0  1160.9  8000.0  1163.0  8172.0  1159.3  8229.0  1162.8  8307.0
GR1157.0  8510.0  1158.5  8795.0  1163.0  8849.0  1164.8  9063.0  1162.5  9141.0
GR1164.5  9298.0  1163.9  9574.0  1160.9  9628.0  1163.0  9684.0  1163.3  9781.0
GR1158.4  9881.0  1159.4 10000.0  1159.4 10140.0  1183.1 10174.0  1183.2 10319.0
GR1179.6 10437.0  1181.5 10531.0  1180.7 10572.0  1183.5 10645.0  1186.5 10961.0
GR1190.0 11422.0  1191.7 11525.0  1189.6 11691.0  1191.4 11816.0  1191.7 11982.0
GR1188.2 12154.0  1189.6 12309.0  1191.6 12445.0  1191.1 12623.0  1193.2 12818.0
HD 19.44      10    7491   10174
X1 19.89    33.0    8142   10997    2375    2375    2375
GR1179.6  8142.0  1167.7  8170.0  1167.7  8313.0  1171.9  8461.0  1170.7  8537.0
GR1170.9  8940.0  1165.4  8978.0  1166.4  9173.0  1168.5  9498.0  1167.9  9844.0
GR1163.3  9930.0  1164.7 10000.0  1168.5 10067.0  1168.5 10231.0  1166.9 10267.0
GR1167.1 10344.0  1171.3 10381.0  1170.1 10742.0  1168.4 10791.0  1187.0 10886.0
GR1198.6 10997.0  1197.7 11072.0  1190.8 11136.0  1198.8 11190.0  1201.5 11346.0
GR1202.2 11679.0  1203.7 12153.0  1202.6 12468.0  1204.1 12707.0  1199.6 12868.0
GR1202.5 13091.0  1200.4 13148.0  1202.2 13477.0
HD 19.89      10    8142   10997
NC  0.04    0.04    0.03
X119.944    33.0  8141.9   10997     285     285     285
X3    10
GR1180.5  8142.0  1172.0  8142.0  1172.0  8259.0  1172.0  8304.0  1172.0  8839.0
GR1172.0  8884.0  1172.0  9400.0  1172.0  9500.0  1172.0  9626.0  1168.8  9844.0
GR1164.2  9930.0  1165.6 10000.0  1169.4 10067.0  1169.4 10231.0  1167.8 10267.0
GR1168.0 10344.0  1172.2 10381.0  1171.0 10742.0  1169.3 10791.0  1187.9 10886.0
GR1199.5 10997.0  1198.6 11072.0  1191.7 11136.0  1199.7 11190.0  1202.4 11346.0
GR1203.1 11679.0  1204.6 12153.0  1203.5 12468.0  1205.0 12707.0  1200.5 12868.0
GR1203.4 13091.0  1201.3 13148.0  1203.1 13477.0
HD19.944    10.0    8142   10886
X119.953    33.0  8141.9   10997      45      45      45
X3    10
GR1180.7  8142.0  1172.1  8142.0  1172.1  8259.0  1142.1  8304.0  1142.1  8837.0
GR1172.1  8884.0  1172.1  9610.0  1172.1  9620.0  1172.1  9626.0  1169.0  9844.0
GR1164.4  9930.0  1165.8 10000.0  1169.6 10067.0  1169.6 10231.0  1168.0 10267.0
```

```
GR1168.2 10344.0   1172.4 10381.0   1171.2 10742.0   1169.5 10791.0   1188.1 10886.0
GR1199.7 10997.0   1198.8 11072.0   1191.9 11136.0   1199.9 11190.0   1202.5 11346.0
GR1203.3 11679.0   1204.8 12153.0   1203.7 12468.0   1205.2 12707.0   1200.7 12868.0
GR1203.6 13091.0   1201.5 13148.0   1203.3 13477.0
HD19.953    10.0    8142    10886
X120.240    20.0    7901    10136   1565.0   1565.0   1565.0
X3    10
GR1185.7   7901.0   1177.3   7910.0   1177.3   8027.0   1147.3   8072.0   1147.3   9091.0
GR1177.3   9136.0   1177.3   9216.0   1174.5   9217.0   1171.9   9228.0   1172.7   9635.0
GR1170.9   9822.0   1173.2   9850.0   1172.5   9993.0   1171.0 10000.0   1175.4 10136.0
GR1174.1 10165.0   1172.8 10197.0   1172.9 10248.0   1175.8 10273.0   1176.0 10370.0
HD20.240    10.0    7910    10000
X1 20.55    18.0    8038    10218   1650.0   1650.0   1650.0
X3    10
GR1190.5   8038.0   1182.7   8045.0   1182.7   8162.0   1152.7   8207.0   1152.7   9200.0
GR1152.7   9226.0   1182.7   9271.0   1182.7   9351.0   1178.9   9447.0   1178.4   9499.0
GR1179.7   9571.0   1179.5   9733.0   1177.0   9845.0   1174.7   9860.0   1174.3 10000.0
GR1175.8 10133.0   1232.3 10218.0   1232.8 10334.0
HD 20.55    10.0    8045    10133
X120.563    18.0    8038    10218    70.0    70.0    70.0
X3    10
GR1190.7   8038.0   1182.9   8045.0   1182.9   8162.0   1182.9   8207.0   1182.9   9200.0
GR1182.9   9226.0   1182.9   9271.0   1182.9   9351.0   1179.1   9447.0   1178.6   9499.0
GR1179.9   9571.0   1179.7   9733.0   1177.2   9845.0   1174.9   9860.0   1174.5 10000.0
GR1176.0 10133.0   1232.5 10218.0   1233.0 10334.0
HD20.563    10.0    8045    10133
X120.577    18.0    8038    10218    70.0    70.0    70.0
X3    10
GR1191.0   8038.0   1183.1   8040.0   1183.1   8157.0   1153.1   8202.0   1153.1   9221.0
GR1153.1   9221.0   1183.1   9266.0   1183.1   9346.0   1179.4   9447.0   1178.9   9499.0
GR1180.4   9571.0   1180.0   9733.0   1177.5   9845.0   1175.2   9860.0   1174.8 10000.0
GR1176.3 10133.0   1232.8 10218.0   1233.3 10334.0
HD20.577    10.0    8045    10133
X1 20.64    19.0    7780    10100   373.0   373.0   373.0
X3    10
GR1192.7   7780.0   1184.3   8000.0   1184.3   8117.0   1154.3   8162.0   1154.3   8500.0
GR1154.3   9100.0   1154.3   9181.0   1184.3   9226.0   1184.3   9306.0   1180.7   9342.0
GR1177.5   9353.0   1177.5   9415.0   1179.3   9582.0   1175.5   9686.0   1177.4   9835.0
GR1174.8 10000.0   1174.8 10037.0   1231.5 10100.0   1230.1 10302.0
HD 20.64    10.0    8000    10037
X120.657    24.0    7780    10100    90.0    90.0    90.0
X3    10
GR1193.0   7780.0   1181.1   8036.0   1186.4   8154.0   1184.7   8460.0   1184.6   8640.0
GR1184.6   8741.0   1154.6   8801.0   1154.6   8900.0   1154.6   8950.0   1154.6   9000.0
GR1154.6   9170.0   1154.6   9172.0   1184.6   9217.0   1184.6   9297.0   1181.0   9342.0
GR1177.8   9353.0   1177.8   9415.0   1179.6   9582.0   1175.8   9686.0   1177.7   9835.0
GR1175.1 10000.0   1175.1 10037.0   1231.8 10100.0   1230.4 10302.0
HD20.657    10.0    8000    10037
X1 20.92    27.0    8990    10707    1096    1096    1096
X3    10
GR1193.7   7924.0   1186.0   7956.0   1182.0   8088.0   1182.0   8276.0   1186.4   8301.0
GR1186.4   8561.0   1186.0   8587.0   1186.0   8811.0   1186.3   8931.0   1188.2   8990.0
GR1188.2   9091.0   1158.2   9151.0   1158.2   9300.0   1158.2   9522.0   1188.2   9567.0
GR1188.2   9647.0   1180.3   9704.0   1182.0   9870.0   1179.5 10000.0   1179.5 10060.0
```

```
GR1185.1 10092.0  1183.8 10370.0  1186.8 10452.0  1186.5 10542.0  1183.3 10586.0
GR1240.9 10707.0  1240.7 10888.0
HD 20.92   10.0   9091   10586
X120.933   27.0   8990   10707    70    70    70
X3    10
GR1193.9  7924.0  1186.2  7956.0  1182.2  8088.0  1182.2  8276.0  1186.6  8301.0
GR1186.6  8561.0  1186.2  8587.0  1186.2  8811.0  1186.5  8931.0  1188.4  8990.0
GR1188.4  9091.0  1188.4  9151.0  1188.4  9522.0  1188.4  9560.0  1188.4  9567.0
GR1188.4  9647.0  1180.4  9704.0  1182.2  9870.0  1179.7 10000.0  1179.7 10060.0
GR1185.3 10092.0  1184.0 10370.0  1187.0 10452.0  1186.7 10542.0  1183.5 10586.0
GR1241.1 10707.0  1240.9 10888.0
HD20.933   10.0   9091   10586
X1 21.01   26.0 8125.0 10446.0   110   380   360
GR1194.1  8125.0  1186.0  8152.0  1183.0  8281.0  1183.0  8354.0  1183.0  8562.0
GR1186.1  8610.0  1186.0  8713.0  1186.0  8842.0  1186.0  8920.0  1188.6  9289.0
GR1187.1  9531.0  1180.1  9576.0  1179.8  9709.0  1179.3  9822.0  1181.8  9861.0
GR1182.1 10000.0  1182.1 10156.0  1185.3 10172.0  1185.8 10339.0  1183.7 10394.0
GR1189.0 10446.0  1185.7 10615.0  1188.3 10647.0  1186.1 11010.0  1243.3 11107.0
GR1242.4 11265.0
HD 21.01    10   8125   10446
X1 21.42   49.0 9359.0 10853.0  2190  2140  2165
GR1224.5  7114.0  1225.2  7218.0  1218.2  7416.0  1211.3  7456.0  1211.8  7527.0
GR1219.5  7559.0  1219.7  7707.0  1208.7  7951.0  1204.6  8154.0  1208.1  8189.0
GR1208.1  8209.0  1208.0  8232.0  1208.0  8599.0  1209.1  8617.0  1209.1  8642.0
GR1199.3  8734.0  1198.5  8868.0  1195.0  8887.0  1194.6  9028.0  1190.5  9053.0
GR1194.6  9239.0  1194.7  9359.0  1193.8  9582.0  1187.7  9597.0  1187.0 10000.0
GR1189.8 10017.0  1189.9 10056.0  1189.9 10192.0  1193.6 10204.0  1188.3 10227.0
GR1190.7 10561.0  1193.3 10574.0  1194.5 10853.0  1192.5 10888.0  1194.0 10931.0
GR1194.0 11080.0  1190.1 11202.0  1193.2 11246.0  1192.0 11311.0  1194.8 11366.0
GR1194.6 11690.0  1194.8 12000.0  1192.4 12026.0  1193.9 12051.0  1194.0 12458.0
GR1195.6 12730.0  1257.3 12864.0  1258.2 12903.0  1258.3 12958.0
HD 21.42    10 9359.0  10853
X121.500   40.0   8950   13033  450.0  470.0  460.0
X3    10
GR1226.8  7378.0  1227.3  7718.0  1213.9  7781.0  1215.0  7876.0  1212.3  8052.0
GR1208.6  8092.0  1205.7  8305.0  1203.6  8422.0  1209.3  8501.0  1209.3  8509.0
GR1209.3  8530.0  1209.7  8917.0  1209.7  8931.0  1209.7  8950.0  1197.1  9068.0
GR1197.0  9221.0  1192.6  9271.0  1195.2  9407.0  1189.2  9496.0  1188.4  9661.0
GR1190.7  9704.0  1190.9  9871.0  1188.2  9900.0  1188.2 10000.0  1188.1 10205.0
GR1195.6 10365.0  1195.6 10665.0  1195.7 10953.0  1195.0 11267.0  1191.5 11296.0
GR1193.8 11464.0  1198.2 11615.0  1198.2 11760.0  1198.2 12685.0  1198.2 12805.0
GR1196.2 12929.0  1199.0 12976.0  1220.6 13033.0  1258.7 13215.0  1259.5 13298.0
HD21.500   10.0   9068   12976
X121.523   40.0   8950   13033  120.0  120.0  120.0
X3    10
GR1227.0  7378.0  1227.5  7718.0  1214.1  7781.0  1215.2  7876.0  1212.5  8052.0
GR1208.8  8092.0  1205.9  8305.0  1203.8  8422.0  1209.5  8501.0  1209.5  8509.0
GR1209.5  8530.0  1209.9  8917.0  1209.9  8931.0  1209.9  8950.0  1197.3  9068.0
GR1197.2  9221.0  1192.8  9271.0  1195.4  9407.0  1189.4  9496.0  1188.6  9661.0
GR1190.9  9704.0  1191.1  9871.0  1188.4  9900.0  1188.4 10000.0  1188.3 10205.0
GR1195.8 10365.0  1195.8 10665.0  1195.9 10953.0  1195.2 11267.0  1191.7 11296.0
GR1198.4 11420.0  1198.4 11775.0  1158.4 11895.0  1158.4 12745.0  1198.4 12865.0
GR1198.4 12975.0  1199.2 12976.0  1220.8 13033.0  1258.9 13215.0  1259.7 13298.0
HD21.523   10.0   9068   12976
```

```
X121.657    40.0    8453   13966   710.0   710.0   710.0
X3    10
GR1228.9   8245.0   1228.5   8369.0   1222.9   8453.0   1206.8   8546.0   1204.1   8656.0
GR1202.5   8881.0   1204.0   8960.0   1204.0   8970.0   1204.0   8980.0   1204.0   8985.0
GR1204.0   9725.0   1191.2   9725.0   1191.2 10000.0   1191.2 10485.0   1191.2 10595.0
GR1193.6 10768.0   1198.6 10831.0   1198.0 11046.0   1198.1 11312.0   1197.2 11482.0
GR1193.8 11520.0   1196.5 11645.0   1199.8 11735.0   1199.8 11895.0   1159.8 12015.0
GR1159.8 13200.0   1199.8 13320.0   1199.8 13330.0   1199.8 13340.0   1199.8 13350.0
GR1199.8 13360.0   1199.8 13410.0   1197.6 13424.0   1211.6 13471.0   1207.7 13489.0
GR1215.6 13552.0   1215.7 13730.0   1256.7 13966.0   1261.2 14034.0   1262.6 14154.0
HD21.657      10    8546   13730
X121.680    35.0    8453   13966   120.0   120.0   120.0
X3    10
GR1230.3   8245.0   1229.9   8369.0   1224.3   8453.0   1208.2   8546.0   1205.5   8656.0
GR1203.9   8881.0   1204.2   9040.0   1204.2   9698.0   1204.2   9735.0   1191.4   9735.0
GR1151.4   9855.0   1151.4 10000.0   1151.4 10455.0   1191.4 10575.0   1191.4 10685.0
GR1195.0 10768.0   1200.0 10831.0   1199.4 11046.0   1199.5 11312.0   1198.6 11482.0
GR1195.2 11520.0   1200.0 11575.0   1200.0 11915.0   1160.0 12035.0   1160.0 12500.0
GR1160.5 13000.0   1160.0 13100.0   1160.0 13200.0   1160.0 13220.0   1200.0 13340.0
GR1200.0 13690.0   1217.1 13730.0   1258.1 13966.0   1262.6 14034.0   1264.0 14154.0
HD21.680      10    8546   13730
X1 21.76    32.0    8805   14570   460.0   460.0   460.0
X3    10
GR1228.1   8805.0   1209.5   8922.0   1206.3   9217.0   1205.1   9495.0   1205.1   9905.0
GR1192.3   9905.0   1152.3 10025.0   1152.3 10975.0   1192.3 11095.0   1192.3 11097.0
GR1192.3 11100.0   1192.3 11150.0   1192.3 11205.0   1196.1 11280.0   1200.8 11304.0
GR1201.2 11468.0   1198.4 11495.0   1196.6 11568.0   1199.8 11592.0   1200.9 11625.0
GR1200.9 12075.0   1160.9 12195.0   1160.9 13380.0   1200.9 13500.0   1200.9 13600.0
GR1200.9 13700.0   1200.9 14000.0   1200.9 14100.0   1212.1 14121.0   1217.0 14284.0
GR1266.1 14570.0   1266.3 14870.0
HD 21.76    10.0    8922   14284
X121.773    32.0    8805   14570    70.0    70.0    70.0
X3    10
GR1228.2   8805.0   1209.6   8922.0   1206.4   9217.0   1205.2   9570.0   1205.2   9887.0
GR1205.2   9925.0   1192.4   9925.0   1152.4 10045.0   1152.4 10100.0   1152.4 11030.0
GR1152.4 11040.0   1192.4 11160.0   1192.4 11270.0   1196.2 11280.0   1200.9 11304.0
GR1201.3 11468.0   1198.5 11495.0   1196.7 11568.0   1199.9 11592.0   1201.0 11695.0
GR1201.0 12095.0   1161.0 12215.0   1161.0 12500.0   1161.0 12600.0   1161.0 13000.0
GR1161.0 13400.0   1201.0 13520.0   1201.0 14080.0   1212.2 14121.0   1217.1 14284.0
GR1266.2 14570.0   1266.4 14870.0
HD21.773    10.0    8922   14284
X121.818    32.0    8805   14570   240.0   240.0   240.0
X3    10
GR1228.7   8805.0   1210.1   8922.0   1206.9   9217.0   1204.5   9660.0   1205.7   9750.0
GR1205.7   9887.0   1205.7   9955.0   1192.9   9955.0   1192.9 10000.0   1192.9 11405.0
GR1201.8 11468.0   1199.0 11495.0   1197.2 11568.0   1200.4 11592.0   1200.8 11813.0
GR1198.5 11871.0   1201.5 11930.0   1201.5 12155.0   1161.5 12275.0   1161.5 13460.0
GR1201.5 13580.0   1201.5 13600.0   1201.5 13650.0   1201.5 13700.0   1201.5 13800.0
GR1201.5 13860.0   1213.0 13935.0   1208.3 13964.0   1212.7 14121.0   1217.6 14284.0
GR1266.7 14570.0   1266.9 14870.0
HD21.818      10    8922   14284
X121.850    38.0    9103   14171   240.0   240.0   240.0
X3    10
GR1228.5   8864.0   1228.8   9103.0   1209.4   9236.0   1203.1   9631.0   1198.5   9642.0
```

```
GR1203.2   9657.0   1205.8   9889.0   1200.1   9897.0   1205.2   9912.0   1195.2   9929.0
GR1195.0  10000.0   1196.0  10233.0   1197.3  10589.0   1194.6  10792.0   1194.2  10911.0
GR1199.4  10957.0   1199.4  11055.0   1194.5  11148.0   1195.0  11307.0   1199.6  11368.0
GR1198.5  11501.0   1197.1  11565.0   1200.1  11584.0   1198.9  11922.0   1202.3  11936.0
GR1202.0  12115.0   1202.0  12225.0   1202.0  13645.0   1205.4  14048.0   1207.3  14059.0
GR1204.2  14073.0   1206.6  14116.0   1221.1  14171.0   1218.8  14273.0   1219.8  14518.0
GR1222.8  14881.0   1266.6  15134.0   1269.1  15377.0
HD21.850     10.0   9236    14116
X122.107     36.0   9978    14136    1230.0   1130.0   1380.0
X3   10
GR1237.5   9912.0   1236.3   9978.0   1198.6  10000.0   1198.7  10062.0   1203.4  10250.0
GR1204.2  10362.0   1201.7  10521.0   1204.3  10547.0   1201.7  10988.0   1198.2  11001.0
GR1199.0  11154.0   1200.8  11170.0   1200.8  12605.0   1200.8  12610.0   1200.8  12630.0
GR1200.8  12660.0   1206.8  13003.0   1206.0  13654.0   1206.4  14096.0   1215.2  14136.0
GR1210.7  14196.0   1219.7  14246.0   1216.7  14354.0   1221.4  14552.0   1222.4  14646.0
GR1217.1  14805.0   1222.4  14848.0   1220.2  15061.0   1221.8  15279.0   1228.4  15415.0
GR1222.0  15582.0   1231.0  15653.0   1234.4  15743.0   1222.4  15855.0   1235.0  15980.0
GR1237.5  16037.0
HD22.107      10    10000   14096
X122.130     36.0   9978    14136    120.0    120.0    120.0
X3   10
GR1237.7   9912.0   1236.5   9978.0   1198.8  10000.0   1198.9  10062.0   1203.6  10250.0
GR1204.4  10362.0   1201.9  10521.0   1204.5  10547.0   1201.9  10988.0   1198.4  11001.0
GR1199.2  11154.0   1201.0  11280.0   1161.0  11555.0   1161.0  12545.0   1201.0  12640.0
GR1201.0  12770.0   1207.0  13003.0   1206.2  13654.0   1206.6  14096.0   1215.4  14136.0
GR1210.9  14196.0   1219.9  14246.0   1216.9  14354.0   1221.6  14552.0   1222.6  14646.0
GR1217.3  14805.0   1222.6  14848.0   1220.4  15061.0   1222.0  15279.0   1228.6  15415.0
GR1222.2  15582.0   1231.2  15653.0   1234.6  15743.0   1222.6  15855.0   1235.2  15980.0
GR1237.7  16037.0
HD22.130      10    10000   14096
X1 22.32     29.0   9946    13430    1005     1005     1005
X3   10
GR1241.3   9793.0   1238.4   9946.0   1201.1  10000.0   1201.2  10023.0   1202.2  10044.0
GR1206.6  10368.0   1206.6  10615.0   1203.2  10989.0   1201.0  10999.0   1201.1  11063.0
GR1203.0  11080.0   1202.0  11264.0   1207.5  11286.0   1207.6  11421.0   1204.2  11488.0
GR1205.5  11529.0   1203.0  11625.0   1203.0  11740.0   1163.0  12015.0   1163.0  12520.0
GR1203.0  12615.0   1203.0  12700.0   1203.0  12800.0   1203.0  12900.0   1203.0  13000.0
GR1203.0  13185.0   1208.9  13430.0   1208.0  14025.0   1217.2  14068.0
HD 22.32      10    10000   13185
X122.365     29.0   9946    13430    240      240      240
X3   10
GR1241.8   9793.0   1238.9   9946.0   1201.6  10000.0   1201.7  10023.0   1202.7  10044.0
GR1207.1  10368.0   1207.1  10615.0   1203.7  10989.0   1201.5  10999.0   1201.6  11063.0
GR1203.5  11080.0   1202.5  11264.0   1208.0  11286.0   1208.1  11421.0   1204.7  11488.0
GR1206.0  11529.0   1204.7  11586.0   1206.0  11657.0   1203.5  11700.0   1203.5  11815.0
GR1203.5  11900.0   1203.5  12000.0   1203.5  12500.0   1203.5  12575.0   1203.5  13000.0
GR1203.5  13255.0   1209.4  13430.0   1208.5  14025.0   1217.7  14068.0
HD22.365      10    10000   13255
NC 0.040   0.031    0.030
X1 22.79     27.0  9941.0 13467.0    2510     2335     2510
GR1251.9   9874.0   1251.2   9941.0   1209.1  10000.0   1209.1  10014.0   1209.9  10117.0
GR1211.7  10136.0   1212.4  10314.0   1210.0  10336.0   1214.5  10427.0   1214.0  10515.0
GR1215.9  10524.0   1215.4  10737.0   1215.1  11031.0   1211.7  11045.0   1212.9  11344.0
GR1214.9  11538.0   1213.6  11747.0   1215.3  12059.0   1214.6  12405.0   1211.6  12427.0
```

```
GR1212.7  12591.0   1213.1  12892.0   1212.6  13139.0   1215.3  13290.0   1219.1  13408.0
GR1224.9  13467.0   1229.4  13648.0
HD 22.79     10     9941    13467
NC 0.040   0.034    0.030
X1 23.35    43.0    9495    13860   2970.0   2570.0   2930.0
X3    10
GR1262.8   9454.0   1260.9   9495.0   1226.5   9564.0   1220.9   9575.0   1220.9   9775.0
GR1220.9   9800.0   1220.9   9900.0   1220.9   9950.0   1220.9   9960.0   1220.9   9980.0
GR1220.9  10000.0   1220.9  11265.0   1220.9  11315.0   1222.6  11442.0   1220.5  11450.0
GR1221.1  11694.0   1222.4  11718.0   1223.4  11842.0   1221.2  11990.0   1221.2  12330.0
GR1218.9  12354.0   1218.3  12523.0   1220.0  12540.0   1220.0  12590.0   1222.4  12612.0
GR1222.2  12920.0   1221.5  13110.0   1219.0  13123.0   1219.2  13202.0   1223.9  13219.0
GR1228.0  13780.0   1232.0  13850.0   1236.0  13860.0   1244.3  14238.0   1241.8  14464.0
GR1242.7  14758.0   1244.0  14959.0   1249.1  15014.0   1251.0  15184.0   1248.8  15245.0
GR1250.9  15333.0   1253.7  15578.0   1253.8  15753.0
HD 23.35     10     9564    13780
X123.365    43.0    9495    13860     80.0     80.0     80.0
X3    10
GR1263.0   9454.0   1261.1   9495.0   1226.7   9564.0   1221.1   9590.0   1221.1   9790.0
GR1181.1   9870.0   1181.1   9967.0   1181.1  10000.0   1181.1  10400.0   1181.1  10500.0
GR1181.1  11160.0   1221.1  11280.0   1221.1  11300.0   1222.8  11442.0   1220.7  11450.0
GR1221.3  11694.0   1222.6  11718.0   1223.6  11842.0   1221.4  11990.0   1221.4  12330.0
GR1219.1  12354.0   1218.5  12523.0   1220.2  12540.0   1220.2  12590.0   1222.6  12612.0
GR1222.4  12920.0   1221.7  13110.0   1219.2  13123.0   1219.4  13202.0   1224.1  13219.0
GR1228.2  13780.0   1232.2  13850.0   1236.2  13860.0   1244.5  14238.0   1242.0  14464.0
GR1242.9  14758.0   1244.2  14959.0   1249.3  15014.0   1251.2  15184.0   1249.0  15245.0
GR1251.1  15333.0   1253.9  15578.0   1254.0  15753.0
HD23.365     10     9564    13780
X123.571    46.0    9401    13619   1085.0   1085.0   1085.0
X3    10
GR1266.0   9000.0   1268.4   9137.0   1257.4   9193.0   1266.9   9217.0   1267.2   9401.0
GR1227.0   9469.0   1225.8   9632.0   1223.7   9646.0   1224.4   9670.0   1224.4   9720.0
GR1224.4   9925.0   1184.4  10005.0   1184.4  10895.0   1224.4  11015.0   1224.4  11016.0
GR1224.4  11050.0   1224.4  11060.0   1224.4  11065.0   1224.5  11225.0   1225.5  11243.0
GR1222.0  11532.0   1225.5  11576.0   1223.9  11706.0   1221.8  11727.0   1223.0  11843.0
GR1222.7  11975.0   1224.5  11997.0   1225.2  12337.0   1225.6  12764.0   1222.0  12925.0
GR1222.0  12984.0   1226.8  13011.0   1228.2  13154.0   1234.7  13235.0   1234.7  13341.0
GR1239.9  13531.0   1246.7  13619.0   1245.8  13940.0   1246.0  14269.0   1249.9  14417.0
GR1247.4  14505.0   1249.0  14539.0   1247.2  14595.0   1251.2  14744.0   1255.0  14937.0
GR1255.5  15413.7
HD23.571     10     9469    13531
X123.694    51.0    8893    12851    650.0    650.0    650.0
X3    10
GR1265.2   8775.0   1264.5   8815.0   1256.5   8864.0   1259.1   8893.0   1229.1   8951.0
GR1227.9   9031.0   1228.1   9348.0   1228.0   9472.0   1226.0   9481.0   1226.0   9491.0
GR1229.2   9503.0   1226.4   9575.0   1226.4   9630.0   1186.4   9710.0   1186.4  10000.0
GR1186.4  10730.0   1226.4  10850.0   1226.4  10860.0   1226.4  10870.0   1226.4  10880.0
GR1226.4  10900.0   1228.5  11054.0   1226.0  11090.0   1226.1  11287.0   1228.9  11309.0
GR1228.3  11399.0   1227.0  11508.0   1228.1  11578.0   1225.4  11591.0   1225.6  11676.0
GR1227.0  11709.0   1224.6  11893.0   1228.3  11971.0   1228.3  12173.0   1227.3  12336.0
GR1224.3  12399.0   1224.1  12448.0   1226.2  12472.0   1225.3  12522.0   1237.9  12572.0
GR1238.2  12681.0   1241.5  12851.0   1237.2  12913.0   1248.3  13081.0   1245.1  13173.0
GR1253.6  13363.0   1254.9  13478.0   1252.6  13698.0   1250.9  14006.0   1255.5  14138.0
GR1255.7  14355.0
```

```
HD23.694     10    8951   12681
X123.851     39.0    8023   12101   830.0   830.0   830.0
X3    10
GR1266.2   7830.0   1269.7   7975.0   1256.0   8004.0   1260.7   8023.0   1231.6   8081.0
GR1229.9   8170.0   1231.8   8230.0   1230.0   8450.0   1230.0   8803.0   1232.3   8953.0
GR1228.9   9255.0   1228.9   9310.0   1228.9   9350.0   1228.9   9360.0   1228.9   9370.0
GR1188.9   9390.0   1188.9  10410.0   1228.9  10530.0   1228.9  10580.0   1231.1  10672.0
GR1230.7  10890.0   1227.7  10935.0   1227.8  11039.0   1231.3  11071.0   1231.3  11221.0
GR1229.7  11304.0   1229.6  11634.0   1228.4  11788.0   1231.5  11920.0   1235.6  11972.0
GR1234.8  12009.0   1251.9  12101.0   1249.5  12152.0   1251.1  12229.0   1248.5  12295.0
GR1253.8  12406.0   1258.1  12485.0   1258.9  12817.0   1258.6  12913.0
HD23.851     10    8081   12009
X123.874     39.0    8023   12101   120.0   120.0   120.0
X3    10
GR1266.5   7830.0   1270.0   7975.0   1256.3   8004.0   1261.0   8023.0   1231.9   8081.0
GR1230.2   8170.0   1232.1   8230.0   1230.3   8450.0   1230.3   8803.0   1232.6   8953.0
GR1229.3   9210.0   1229.3   9359.0   1229.3   9453.0   1229.3   9526.0   1229.3   9649.0
GR1229.3   9829.0   1229.3  10000.0   1229.3  10139.0   1229.3  10535.0   1231.7  10672.0
GR1231.0  10890.0   1228.0  10935.0   1228.1  11039.0   1231.6  11071.0   1231.6  11221.0
GR1230.3  11304.0   1230.2  11634.0   1229.0  11788.0   1232.1  11920.0   1236.2  11972.0
GR1235.1  12009.0   1252.2  12101.0   1249.8  12152.0   1251.4  12229.0   1248.8  12295.0
GR1254.1  12406.0   1258.4  12485.0   1259.2  12817.0   1259.2  12913.0
HD23.874     10    8081   12009
NC 0.039   0.035   0.030
X124.070     38.0    7412   11352   1190.0   1190.0   1190.0
X3    10
GR1271.5   6780.0   1271.5   6834.0   1278.6   6951.0   1274.1   7084.0   1266.1   7294.0
GR1269.1   7360.0   1257.8   7389.0   1261.1   7412.0   1237.4   7448.0   1237.6   7632.0
GR1236.4   7917.0   1234.0   7951.0   1234.0   8168.0   1235.5   8321.0   1233.1   8484.0
GR1236.2   8719.0   1232.9   9065.0   1232.9   9195.0   1232.9   9275.0   1232.9   9500.0
GR1232.9  10000.0   1232.9  10215.0   1232.9  10335.0   1232.9  10385.0   1231.6  10523.0
GR1235.1  10578.0   1235.0  10867.0   1232.6  10889.0   1234.0  11244.0   1256.4  11352.0
GR1258.1  11503.0   1255.3  11711.0   1259.1  11799.0   1259.1  11910.0   1264.0  12010.0
GR1261.5  12338.0   1266.2  12431.0   1266.3  12513.0
HD24.070     10    7448   11244
X124.085     38.0   7412   11352    80.0    80.0    80.0
X3    10
GR1271.7   6780.0   1271.7   6834.0   1278.8   6951.0   1274.3   7084.0   1266.3   7294.0
GR1269.3   7360.0   1258.0   7389.0   1261.3   7412.0   1237.6   7448.0   1237.8   7632.0
GR1236.6   7917.0   1234.2   7951.0   1234.2   8168.0   1235.7   8321.0   1233.3   8484.0
GR1236.4   8719.0   1233.1   9035.0   1233.1   9165.0   1233.1   9170.0   1233.1   9200.0
GR1193.1   9245.0   1193.1  10185.0   1233.1  10305.0   1233.1  10355.0   1231.8  10523.0
GR1235.3  10578.0   1235.2  10867.0   1232.8  10889.0   1234.2  11244.0   1256.6  11352.0
GR1258.3  11503.0   1255.5  11711.0   1259.3  11799.0   1259.3  11910.0   1264.2  12010.0
GR1261.7  12338.0   1266.4  12431.0   1266.5  12513.0
HD24.085     10    7448   11244
X1 24.17     22.0   7030   11239   280.0   280.0   280.0
X3    10
GR1275.7   6980.0   1273.8   7030.0   1244.2   7139.0   1238.7   7349.0   1239.8   7578.0
GR1236.5   7944.0   1236.3   8335.0   1236.8   8612.0   1233.9   8970.0   1233.9   9100.0
GR1193.9   9180.0   1193.9  10000.0   1193.9  10120.0   1233.9  10240.0   1233.9  10250.0
GR1233.9  10290.0   1233.1  10461.0   1233.8  10753.0   1235.2  11028.0   1235.3  11193.0
GR1240.4  11239.0   1240.6  11279.0
HD 24.17     10    7139   11193
```

X124.193 22.0 7030 11239 120.0 120.0 120.0
X3 10
GR1276.1 6980.0 1274.2 7030.0 1244.6 7139.0 1239.1 7349.0 1240.2 7578.0
GR1236.9 7944.0 1236.7 8335.0 1237.2 8612.0 1234.3 8970.0 1234.3 9100.0
GR1234.3 9180.0 1234.3 10000.0 1234.3 10120.0 1234.3 10240.0 1234.3 10250.0
GR1234.3 10290.0 1233.5 10461.0 1234.2 10753.0 1235.6 11028.0 1235.7 11193.0
GR1240.8 11239.0 1241.0 11279.0
HD24.193 10 7139 11193
NC 0.040 0.034 0.030
X1 24.35 32.0 7383 11392 945 945 945
X3 10
GR1280.9 7170.0 1276.9 7277.0 1256.6 7383.0 1264.0 7450.0 1246.8 7565.0
GR1247.2 7627.0 1244.2 7704.0 1247.3 7800.0 1243.9 7939.0 1239.6 7961.0
GR1238.3 8358.0 1239.2 8768.0 1241.1 9067.0 1241.0 9317.0 1237.1 9475.0
GR1237.1 9605.0 1237.1 9685.0 1237.1 9893.0 1237.1 10000.0 1237.1 10174.0
GR1237.1 10201.0 1237.1 10300.0 1237.1 10795.0 1238.7 10825.0 1237.1 11179.0
GR1236.3 11345.0 1264.9 11392.0 1264.2 11635.0 1263.8 11839.0 1273.2 11913.0
GR1273.1 12061.0 1269.2 12083.0
HD 24.35 10 7450 11345
X124.365 32.0 7383 11392 80 80 80
X3 10
GR1281.1 7170.0 1277.1 7277.0 1256.8 7383.0 1264.2 7450.0 1247.0 7565.0
GR1247.4 7627.0 1244.4 7704.0 1247.5 7800.0 1244.1 7939.0 1239.8 7961.0
GR1238.5 8358.0 1239.4 8768.0 1241.3 9067.0 1241.2 9317.0 1237.3 9470.0
GR1237.3 9600.0 1197.3 9680.0 1197.3 9893.0 1197.3 10000.0 1197.3 10174.0
GR1197.3 10620.0 1237.3 10740.0 1237.3 10790.0 1238.9 10825.0 1237.3 11179.0
GR1236.5 11345.0 1265.1 11392.0 1264.4 11635.0 1264.0 11839.0 1273.4 11913.0
GR1273.3 12061.0 1269.4 12083.0
HD24.365 10 7450 11345
X124.468 33.0 7430 11477 545.0 545.0 545.0
X3 10
GR1289.3 6781.0 1285.1 6824.0 1259.6 6899.0 1260.2 7000.0 1258.5 7099.0
GR1263.1 7113.0 1259.2 7127.0 1263.5 7145.0 1254.3 7192.0 1255.3 7240.0
GR1250.7 7387.0 1255.5 7430.0 1248.7 7784.0 1242.7 7806.0 1241.8 8182.0
GR1239.8 8201.0 1240.8 8227.0 1242.2 8577.0 1243.3 9103.0 1240.5 9202.0
GR1242.7 9277.0 1238.9 9350.0 1238.9 9480.0 1198.9 9560.0 1198.9 10500.0
GR1238.9 10620.0 1238.9 10670.0 1240.6 10799.0 1241.7 11004.0 1238.6 11184.0
GR1236.8 11422.0 1265.0 11477.0 1265.3 11540.0
HD24.468 10 7784 11422
X124.491 33.0 7430 11477 120.0 120.0 120.0
X3 10
GR1289.6 6781.0 1285.4 6824.0 1259.9 6899.0 1260.5 7000.0 1258.8 7099.0
GR1263.4 7113.0 1259.5 7127.0 1263.8 7145.0 1254.6 7192.0 1255.6 7240.0
GR1251.0 7387.0 1255.8 7430.0 1249.0 7784.0 1243.0 7806.0 1242.1 8182.0
GR1240.1 8201.0 1241.1 8227.0 1242.5 8577.0 1243.6 9103.0 1240.8 9202.0
GR1243.0 9277.0 1239.3 9350.0 1239.3 9480.0 1239.3 9560.0 1239.3 10500.0
GR1239.3 10620.0 1239.3 10670.0 1240.9 10799.0 1242.0 11004.0 1238.9 11184.0
GR1237.1 11422.0 1265.3 11477.0 1265.6 11540.0
HD24.491 10 7784 11422
X1 24.54 36.0 9240.0 10227.0 135 395 235
GR1282.4 7259.0 1277.8 7423.0 1258.4 7466.0 1263.6 7490.0 1246.5 7527.0
GR1245.6 7636.0 1243.2 7946.0 1243.5 8106.0 1243.4 8353.0 1243.6 8697.0
GR1244.5 8990.0 1244.5 9240.0 1242.9 9311.0 1241.6 9485.0 1242.9 9550.0
GR1242.1 9879.0 1240.3 9989.0 1238.3 10000.0 1238.3 10014.0 1242.7 10058.0

```
GR1244.6  10227.0   1240.8  10491.0   1242.8  10616.0   1240.2  10736.0   1243.1  10847.0
GR1240.6  11132.0   1239.2  11150.0   1238.8  11312.0   1241.5  11351.0   1239.8  11413.0
GR1243.1  11501.0   1241.6  11750.0   1239.2  11764.0   1239.1  11816.0   1276.1  11876.0
GR1278.6  12013.0
HD 24.54      10    9240    10227
NC 0.030    0.030    0.030
X1 24.90    43.0  9334.0 11529.0    2055     1850     1905
GR1258.9   7820.0   1255.0   7838.0   1251.6   8006.0   1249.7   8269.0   1253.4   8308.0
GR1250.9   8530.0   1252.2   8594.0   1251.2   8738.0   1252.8   8845.0   1252.5   9147.0
GR1251.6   9334.0   1248.0   9359.0   1248.2   9467.0   1250.8   9482.0   1252.3   9813.0
GR1248.6   9839.0   1249.7   9933.0   1246.8   9959.0   1246.6  10000.0   1246.6  10037.0
GR1251.0  10053.0   1251.1  10206.0   1247.0  10559.0   1251.4  10684.0   1249.5  10806.0
GR1246.5  10832.0   1246.5  10895.0   1249.8  10918.0   1248.1  11176.0   1249.9  11194.0
GR1250.2  11328.0   1249.2  11417.0   1252.5  11529.0   1251.5  11894.0   1247.3  11933.0
GR1250.3  12174.0   1247.5  12200.0   1248.9  12432.0   1249.5  12596.0   1249.5  12718.0
GR1253.6  12781.0   1250.2  13053.0   1267.8  13098.0
HD 24.90      10    9334    11529
NC 0.040    0.040    0.030
X1 25.37    41.0  9459.0 11916.0    2420     2365     2485
GR1364.9   9300.0   1263.8   9366.0   1265.3   9414.0   1264.5   9459.0   1260.5   9477.0
GR1260.3   9509.0   1261.7   9524.0   1261.8   9638.0   1255.1   9673.0   1256.0   9890.0
GR1255.1   9896.0   1255.0  10000.0   1258.4  10016.0   1256.9  10326.0   1259.4  10451.0
GR1260.2  10717.0   1260.5  10976.0   1260.3  11222.0   1260.8  11504.0   1258.1  11553.0
GR1259.9  11613.0   1259.9  11663.0   1257.2  11706.0   1260.9  11754.0   1259.0  11833.0
GR1282.4  11916.0   1285.6  12047.0   1279.8  12169.0   1289.6  12311.0   1289.6  12356.0
GR1293.3  12435.0   1288.6  12562.0   1293.2  12628.0   1293.1  12768.0   1285.7  12846.0
GR1286.6  12867.0   1286.0  12884.0   1295.4  12994.0   1287.3  13095.0   1291.8  13151.0
GR1293.1  13301.0
HD 25.37      10    9459    11916
X1 25.59      14    9685    11070    1065     1230     1125
GR1300.0   9640.0   1280.0   9685.0   1264.0   9725.0   1260.0   9790.0   1260.0   9840.0
GR1256.5  10000.0   1260.0  10100.0   1261.5  10530.0   1261.0  10875.0   1264.0  11025.0
GR1272.0  11070.0   1276.0  11100.0   1280.0  11120.0   1283.4  11270.0
HD 25.59      10    9685    11070
NC  .040     .040    .030
X1 25.86      25    8220    10215    1425     1495     1455
GR1300.0   7650.0   1280.0   7740.0   1276.0   7750.0   1272.0   8220.0   1268.0   8300.0
GR1267.5   8340.0   1268.0   8395.0   1270.8   8500.0   1268.0   8615.0   1267.6   8690.0
GR1268.0   8795.0   1268.0   8960.0   1269.0   9060.0   1268.0   9190.0   1265.6   9335.0
GR1266.0   9600.0   1268.0   9740.0   1268.0   9820.0   1264.0   9940.0   1260.0   9950.0
GR1260.0  10055.0   1264.0  10200.0   1280.0  10215.0   1280.0  10300.0   1284.0  10340.0
HD 25.86      10    8220    10215
NC  .041     .041    .033
X1 26.29    26.0    8722    11227    2090     2295     2240
GR1307.9   8275.0   1279.3   8338.0   1278.4   8722.0   1275.7   8754.0   1276.5   8962.0
GR1277.4   9349.0   1273.2   9372.0   1276.7   9696.0   1274.9   9925.0   1271.6   9943.0
GR1271.6  10000.0   1273.7  10084.0   1278.8  10120.0   1278.2  10393.0   1278.4  10757.0
GR1275.0  11021.0   1273.9  11201.0   1279.2  11227.0   1276.8  11724.0   1278.8  11784.0
GR1280.5  12462.0   1281.9  12794.0   1279.6  12804.0   1312.6  12882.0   1311.4  13079.0
GR1312.6  13190.0
HD 26.29      10    8722    11227
X1 26.73    30.0    9720    11263    2320     2310     2330
GR1312.2   9355.0   1313.9   9457.0   1289.8   9540.0   1287.5   9720.0   1282.4   9755.0
GR1285.6   9834.0   1280.7   9898.0   1279.8  10000.0   1279.9  10364.0   1283.4  10385.0
```

```
GR1283.4 10521.0  1280.9 10543.0  1283.2 10628.0  1285.7 11057.0  1287.2 11263.0
GR1286.8 11621.0  1286.8 13292.0  1287.3 13590.0  1290.5 13648.0  1286.3 13673.0
GR1302.5 13759.0  1293.3 13811.0  1295.0 13870.0  1317.7 13944.0  1310.7 13981.0
GR1332.7 14126.0  1350.7 14161.0  1350.7 14176.0  1346.0 14188.0  1346.0 14190.0
HD 26.73     10    9720   11263
NC  .048    .043    .035
X1 27.03    23.0    9679   10553    1660    1020    1590
GR1307.8  9627.0  1301.5  9679.0  1283.2  9723.0  1281.2  9814.0  1282.6  9900.0
GR1287.2  9922.0  1283.5  9949.0  1283.4 10000.0  1283.4 10054.0  1286.2 10079.0
GR1288.9 10450.0  1290.7 10553.0  1288.0 10732.0  1291.0 10749.0  1291.0 11081.0
GR1291.4 12573.0  1293.7 12649.0  1291.4 12657.0  1301.2 12783.0  1303.3 12821.0
GR1300.5 12889.0  1319.6 12961.0  1330.8 13050.0
HD 27.03     10    9679   10553
NC  .040    .040    .035
X1 27.68    35.0    8224   10125    4120    3200    3430
GR1310.1  7060.0  1305.9  7509.0  1301.3  7550.0  1302.2  7781.0  1301.9  8224.0
GR1297.0  8243.0  1298.6  8317.0  1299.3  8587.0  1302.4  8679.0  1298.7  8774.0
GR1301.1  8870.0  1300.8  8938.0  1297.9  8961.0  1301.1  8999.0  1301.3  9184.0
GR1297.6  9230.0  1300.8  9293.0  1298.8  9379.0  1300.1  9459.0  1299.0  9624.0
GR1295.3  9640.0  1295.4  9695.0  1301.1  9738.0  1301.6  9853.0  1295.7 10000.0
GR1294.7 10078.0  1310.2 10125.0  1310.7 10428.0  1311.8 10663.0  1305.9 10703.0
GR1312.1 10728.0  1309.4 10746.0  1311.0 10884.0  1330.0 10991.0  1330.2 11145.0
HD 27.68     10    8224   10125
X1 28.12    27.0    9108   10107    2360    2375    2355
GR1357.3  8340.0  1355.3  8384.0  1323.5  8506.0  1320.1  8630.0  1313.6  8697.0
GR1309.5  8719.0  1311.3  8878.0  1311.1  9108.0  1307.8  9129.0  1307.5  9182.0
GR1310.6  9258.0  1308.2  9300.0  1310.5  9411.0  1308.6  9524.0  1306.6  9675.0
GR1304.9  9906.0  1304.6 10000.0  1304.6 10076.0  1310.3 10107.0  1310.7 10411.0
GR1306.3 10527.0  1307.3 10680.0  1308.6 10781.0  1308.5 10866.0  1310.8 10916.0
GR1312.7 11051.0  1314.2 11435.0
HD 28.12     10    9108   10107
X1 28.67    36.0    9950   11203    2785    2925    2885
GR1372.7  9450.0  1371.0  9866.0  1311.5  9964.0  1312.2 10000.0  1312.2 10192.0
GR1319.8 10514.0  1316.1 10819.0  1318.6 10989.0  1315.2 11044.0  1320.5 11203.0
GR1321.6 11445.0  1322.3 11634.0  1319.8 11968.0  1318.7 12107.0  1322.5 12170.0
GR1321.3 12228.0  1325.2 12397.0  1326.4 12792.0  1328.9 12823.0  1324.8 12860.0
GR1327.4 12972.0  1345.8 13057.0  1345.8 13259.0  1339.7 13321.0  1341.1 13419.0
GR1352.8 13484.0  1356.1 13572.0  1358.7 13589.0  1358.8 13606.0  1348.0 13629.0
GR1348.2 13655.0  1363.9 13681.0  1363.8 13698.0  1355.7 13713.0  1356.7 13851.0
GR1373.9 13912.0
HD 28.67     10    9950   11203
NC  .042    .042    .035
X1 29.04    33.0    9808   10638    2100    1270    1975
GR1360.0    9770  1320.3  9815.0  1317.3  9828.0  1317.2  9859.0  1319.6  9940.0
GR1317.2 10000.0  1317.2 10048.0  1322.9 10073.0  1324.3 10239.0  1324.4 10414.0
GR1321.2 10499.0  1319.4 10584.0  1326.7 10638.0  1326.0 10868.0  1326.7 11104.0
GR1325.3 11444.0  1322.9 11472.0  1324.3 11521.0  1323.1 11750.0  1330.4 11802.0
GR1330.3 12323.0  1331.2 12554.0  1336.4 12706.0  1332.2 12882.0  1335.8 13217.0
GR1343.9 13578.0  1351.5 13599.0  1352.4 13621.0  1344.3 13633.0  1344.4 13654.0
GR1357.1 13668.0  1357.5 13697.0  1379.5 13780.0
HD 29.04     10    9808   10638
X1 29.54    29.0    9198   10150    2750    2235    2640
GR1378.7  9025.0  1375.5  9068.0  1350.7  9135.0  1348.6  9179.0  1332.4  9217.0
GR1333.5  9321.0  1333.9  9460.0  1331.2  9697.0  1328.7  9726.0  1328.4  9758.0
```

```
GR1332.9   9782.0   1332.2   9846.0   1327.0   9882.0   1326.7 10000.0   1326.7 10116.0
GR1340.7 10150.0   1343.0 10343.0   1346.5 10482.0   1348.3 10927.0   1347.8 11457.0
GR1349.2 11687.0   1354.2 11697.0   1354.2 11723.0   1345.8 11737.0   1345.8 11763.0
GR1355.3 11783.0   1355.4 11812.0   1352.6 11829.0   1378.3 11981.0
HD 29.54      10    9198    10150
X129.611    31.0    9052    10244     315     315     375
X3    10
GR1377.8   8825.0   1353.2   9052.0   1337.2   9136.0   1336.3   9285.0   1332.4   9541.0
GR1332.9   9713.0   1334.0   9791.0   1328.9   9812.0   1328.9   9849.0   1331.6 10000.0
GR1331.6 10094.0   1342.3 10133.0   1351.2 10244.0   1345.5 10331.0   1349.1 10528.0
GR1349.1 10688.0   1349.9 10923.0   1353.4 10966.0   1353.4 11037.0   1345.1 11072.0
GR1345.1 11124.0   1352.5 11156.0   1352.5 11163.0   1345.4 11178.0   1345.5 11204.0
GR1353.7 11221.0   1353.4 11251.0   1351.1 11259.0   1353.1 11405.0   1358.4 11533.0
GR1378.5  11635.0
HD29.611      10    9052    10244
X1 29.80    16.0    9347    10610     1295    1340    1400
GR1378.4   9270.0   1373.4   9347.0   1338.8   9419.0   1335.4   9475.0   1340.8   9512.0
GR1342.7   9656.0   1338.9   9882.0   1331.2   9924.0   1331.4 10000.0   1332.7 10180.0
GR1337.6 10205.0   1337.6 10215.0   1327.7 10335.0   1336.3 10521.0   1344.4 10610.0
GR1349.2  10676.0
HD 29.80      10    9347    10610
X1 30.07    17.0    9604    10306     1425    1440    1420
GR1369.4   9325.0   1363.9   9463.0   1360.9   9604.0   1341.5   9665.0   1343.1   9728.0
GR1340.8   9781.0   1340.4   9910.0   1344.6   9925.0   1334.4   9986.0   1334.4 10000.0
GR1335.0 10060.0   1344.5 10098.0   1343.6 10114.0   1336.6 10132.0   1334.0 10261.0
GR1365.9 10306.0   1365.0 10356.0
HD 30.07      10    9604    10306
X1 30.26    12.0    9711    10643     870     1090    1005
GR1357.2   9625.0   1361.9   9711.0   1342.1   9749.0   1338.9 10000.0   1339.3 10135.0
GR1341.7 10314.0   1347.9 10338.0   1348.7 10444.0   1341.6 10545.0   1341.7 10604.0
GR1363.6 10643.0   1389.4 10743.0
HD 30.26      10    9711    10643
NC 0.043    0.043    0.045
X1 30.82    12.0    9865    11244     2955    2840    2960
GR1378.3   9630.0   1379.5   9833.0   1375.4   9865.0   1345.2   9924.0   1346.7 10000.0
GR1352.0 10201.0   1347.0 10358.0   1353.5 10398.0   1358.1 10582.0   1357.9 10879.0
GR1354.5 11132.0   1399.1 11244.0
HD 30.82      10    9865    11244
NC 0.043    0.043    0.037
X1 31.39    17.0    9470    10633     2900    3165    2970
GR1397.8   9290.0   1386.7   9342.0   1392.7   9386.0   1393.4   9470.0   1356.5   9526.0
GR1354.7   9561.0   1361.2   9643.0   1363.1   9792.0   1359.4   9942.0   1356.8   9978.0
GR1356.9 10000.0   1357.4 10080.0   1361.5 10242.0   1360.1 10387.0   1368.0 10456.0
GR1368.6 10528.0   1407.9 10633.0
HD 31.39      10    9470    10633
X1 31.86    10.0    9490    10321     2550    2485    2505
GR1411.1   8955.0   1408.4   9155.0   1407.3   9490.0   1362.0   9604.0   1364.9   9727.0
GR1366.7   9894.0   1366.7 10000.0   1365.3 10261.0   1394.3 10321.0   1420.6 10419.0
HD 31.86      10    9490    10321
NC 0.043    0.052    0.040
X1 32.43    14.0    9438    10437     2885    2970    2980
GR1424.1   9340.0   1415.1   9438.0   1371.3   9508.0   1372.3   9554.0   1363.8   9607.0
GR1372.6   9692.0   1375.5   9852.0   1373.4   9965.0   1370.7 10000.0   1372.7 10073.0
GR1383.1 10112.0   1388.9 10373.0   1403.2 10437.0   1436.0 10487.0
```

```
HD 32.43      10    9438    10437
NC  .049     .049    .042
X1 32.86     12.0    9719    10564    2405    2135    2295
GR1423.4  9670.0   1424.3  9719.0   1386.4  9797.0   1381.2  9855.0   1380.4  9928.0
GR1374.9 10000.0   1380.6 10079.0   1386.5 10155.0   1382.6 10239.0   1386.6 10279.0
GR1385.4 10331.0   1421.4 10564.0
HD 32.86      10    9719    10564
NC  .047     .055    .032
X132.984      33    9750   10150    648     648     648
GR1427.7  9750.0   1425.2  9750.1   1391.6  9820.0   1391.6  9823.0   1391.6  9823.1
GR1389.7  9833.0   1389.7  9833.1   1389.7  9837.0   1385.5  9851.0   1384.0  9900.0
GR1385.8  9904.0   1385.8  9909.0   1385.8  9909.1   1386.6  9919.0   1386.6  9919.1
GR1386.6  9962.0   1380.0  9985.0   1380.0  9985.1   1380.0  9995.0   1380.0  9995.1
GR1378.4  9997.0   1380.2 10011.0   1382.2 10018.0   1384.2 10050.0   1386.8 10053.0
GR1387.9 10065.0   1387.9 10065.1   1390.7 10075.0   1390.7 10075.1   1392.3 10091.0
GR1423.8 10150.0   1426.0 10150.0   1427.0 10150.1
HD32.984      10    9750   10150
X132.998     9.0   9762   10164     72      72      72
GR1434.1  9610.0   1433.1  9762.0   1389.0  9851.0   1386.3  9920.0   1381.4 10000.0
GR1393.1 10108.0   1413.1 10164.0   1417.9 10358.0   1440.7 10405.0
HD32.998      10    9762   10164
NC  .060     .050    .050
X1 33.41     12.0    9750   10687    1880    2270    2170
GR1448.1  9750.0   1426.7  9864.0   1408.3  9944.0   1386.9 10000.0   1389.1 10157.0
GR1406.8 10366.0   1404.5 10483.0   1409.5 10576.0   1422.7 10626.0   1423.4 10668.0
GR1433.5 10685.0   1437.7 10687.0
HD 33.41      10    9750    10687
X1 33.82     20.0    9565   10600    2165    2220    2175
GR1454.2  9465.0   1454.2  9506.0   1434.5  9527.0   1434.5  9538.0   1450.5  9565.0
GR1408.8  9662.0   1402.1  9714.0   1409.2  9795.0   1417.1  9861.0   1387.4  9966.0
GR1387.4 10000.0   1387.4 10023.0   1405.9 10068.0   1408.6 10117.0   1426.7 10204.0
GR1425.4 10292.0   1433.9 10347.0   1428.1 10416.0   1427.2 10466.0   1450.9 10600.0
HD 33.82      10    9565    10600
EJ
T4    AGUA FRIA RIVER SEDIMENT TRANSPORT STUDY - SEPTEMBER-AUGUST 1992 PROJECT
T5                 RIVER COVERAGE [MILE 0.16 TO MILE 33.82]
T6                 PREPARED BY: CARLOS CORTEZ CARRIAGA
T7                    UPDATED ON:  MAY 15, 1992
T8    ************************************************************************
I1          10      0      0  0.999  32.174
I4           9      1     10  2.65      0      0      0      0      0
I5          .5     .5    .25    .5    .25      0    1.0
LQ       Q    0.01   4000.  20000.  40000.  60000.  85000.
LT      QS    0.01   3082.  26604.  56358.  97056. 155824.
LF     VFS 0.22029 0.22029 0.12021 0.13469 0.14318 0.15286
LF      FS 0.25878 0.25878 0.16975 0.17708 0.18245 0.19324
LF      MS 0.29170 0.29170 0.24375 0.24027 0.23890 0.24338
LF      CS 0.11476 0.11476 0.15675 0.15080 0.14942 0.14791
LF     VCS 0.07028 0.07028 0.11014 0.10377 0.09976 0.09368
LF     VFG 0.02171 0.02171 0.03701 0.03411 0.03186 0.02874
LF      FG 0.01800 0.01800 0.04091 0.03755 0.03478 0.03086
LF      MG 0.00371 0.00371 0.05344 0.04986 0.04666 0.04150
LF      CG 0.00053 0.00053 0.04486 0.04408 0.04277 0.03878
LF     VCG 0.00031 0.00031 0.02318 0.02779 0.03022 0.02905
```

N	0.160		0.20997	0.20997	0.88000		0.02466	0.12840	0.13531	0.25571	
N		0.18617	0.04051	0.03702	0.03594	0.03394	0.00000				
N	0.440		0.20997	0.04092	0.95000		0.00619	0.05233	0.26511	0.22718	
N		0.25582	0.04189	0.06446	0.04827	0.03000	0.00709				
N	0.730		0.20997	0.04092	0.95000		0.00619	0.05233	0.26511	0.22718	
N		0.25582	0.04189	0.06446	0.04827	0.03000	0.00709				
N	1.330		0.20997	0.04955	0.95000		0.00445	0.04807	0.21089	0.19967	
N		0.25404	0.07425	0.08617	0.07712	0.03894	0.00572				
N	1.710		0.20997	0.18396	0.95000		0.00700	0.04540	0.14795	0.11933	
N		0.15362	0.07149	0.12617	0.08131	0.08552	0.15721				
N	2.020		0.20997	0.18396	0.95000		0.00700	0.04540	0.14795	0.11933	
N		0.15362	0.07149	0.12617	0.08131	0.08552	0.15721				
N	2.600		0.20997	0.01908	0.95000		0.01569	0.12077	0.38478	0.21525	
N		0.16886	0.02633	0.02404	0.01785	0.01963	0.00396				
N	2.800		0.20997	0.01908	0.95000		0.01569	0.12077	0.38478	0.21525	
N		0.16886	0.02633	0.02404	0.01785	0.01963	0.00396				
N	3.270		0.20997	0.10348	0.95000		0.01346	0.07803	0.31326	0.16399	
N		0.14574	0.03833	0.14045	0.02120	0.02732	0.02528				
N	3.400		0.20997	0.10348	0.95000		0.01346	0.07803	0.31326	0.16399	
N		0.14574	0.03833	0.14045	0.02120	0.02732	0.02528				
N	3.430		0.20997	0.10348	0.95000		0.01346	0.07803	0.31326	0.16399	
N		0.14574	0.03833	0.14045	0.02120	0.02732	0.02528				
N	3.729		0.62991	0.41994	0.95000		0.00000	0.00000	0.00000	0.00000	
N		0.00000	0.00000	0.00000	0.00000	0.00000	1.00000				
N	3.734		0.62991	0.41994	0.95000		0.00000	0.00000	0.00000	0.00000	
N		0.00000	0.00000	0.00000	0.00000	0.00000	1.00000				
N	3.757		0.62991	0.41994	0.95000		0.00000	0.00000	0.00000	0.00000	
N		0.00000	0.00000	0.00000	0.00000	0.00000	1.00000				
N	3.767		0.62991	0.41994	0.95000		0.00000	0.00000	0.00000	0.00000	
N		0.00000	0.00000	0.00000	0.00000	0.00000	1.00000				
N	4.094		0.20997	0.12303	0.95000		0.00327	0.05913	0.08985	0.23156	
N		0.22609	0.09454	0.09019	0.10737	0.04570	0.00220				
N	4.270		0.20997	0.13909	0.95000		0.01473	0.06167	0.16542	0.10644	
N		0.11964	0.05433	0.23290	0.07108	0.07702	0.08097				
N	4.700		0.20997	0.12303	0.95000		0.03377	0.04570	0.10333	0.09115	
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927				
N	4.754		0.20997	0.12303	0.95000		0.03377	0.04570	0.10333	0.09115	
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927				
N	4.790		0.20997	0.12303	0.95000		0.03377	0.04570	0.10333	0.09115	
N		0.14615	0.06611	0.11566	0.13843	0.11113	0.06927				
N	5.150		0.20997	0.05963	0.95000		0.00650	0.08050	0.32636	0.20159	
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446				
N	5.290		0.20997	0.05963	0.95000		0.00650	0.08050	0.32636	0.20159	
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446				
N	5.380		0.20997	0.05963	0.95000		0.00650	0.08050	0.32636	0.20159	
N		0.20525	0.03644	0.04059	0.03787	0.03294	0.02446				
N	5.689		0.10499	0.04007	0.95000		0.09244	0.10394	0.16384	0.07407	
N		0.12482	0.03636	0.03411	0.05742	0.02210	0.00000				
N	5.750		0.20997	0.11371	0.95000		0.02514	0.02121	0.03410	0.05761	
N		0.13374	0.10182	0.14009	0.12020	0.21110	0.09680				
N	5.900		0.10499	0.04675	0.95000		0.00167	0.07000	0.11471	0.29051	
N		0.23478	0.07273	0.09569	0.07263	0.03895	0.00000				
N	6.430		0.20997	0.08439	0.95000		0.02065	0.09227	0.24746	0.14997	
N		0.18326	0.08153	0.05486	0.06285	0.05857	0.03609				

N	6.890	0.20997	0.20997	0.84606	0.05655	0.02661	0.04201	0.09060
N	0.05774	0.05564	0.06069	0.06744	0.08595	0.09895		
N	6.990	0.20997	0.20997	0.84606	0.05655	0.02661	0.04201	0.09060
N	0.05774	0.05564	0.06069	0.06744	0.08595	0.09895		
N	7.490	0.20997	0.18355	0.95000	0.00479	0.02873	0.10448	0.12958
N	0.20723	0.07724	0.10130	0.11629	0.10762	0.08706		
N	8.000	0.20997	0.20029	0.93000	0.00728	0.02929	0.11102	0.30828
N	0.11991	0.06713	0.05201	0.03858	0.09855	0.08010		
N	8.100	0.20997	0.20029	0.93000	0.00728	0.02929	0.11102	0.30828
N	0.11991	0.06713	0.05201	0.03858	0.09855	0.08010		
N	8.210	0.20669	0.20029	0.92000	0.02947	0.04843	0.11816	0.09260
N	0.13594	0.03971	0.06124	0.08775	0.09780	0.15346		
N	9.130	0.20997	0.13321	0.95000	0.00869	0.04600	0.12779	0.27413
N	0.16235	0.06298	0.06926	0.07354	0.08927	0.06065		
N	9.900	0.20997	0.20997	0.87760	0.01003	0.04333	0.06706	0.20555
N	0.21739	0.05091	0.06699	0.06316	0.06695	0.06960		
N	10.530	0.20997	0.20997	0.85647	0.00421	0.02127	0.02914	0.08658
N	0.09678	0.06727	0.09878	0.11776	0.14108	0.18527		
N	10.720	0.20997	0.17890	0.95000	0.01403	0.05790	0.06375	0.08512
N	0.15652	0.12291	0.12520	0.11966	0.12088	0.09563		
N	11.010	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N	0.15894	0.04993	0.08837	0.11297	0.12731	0.08802		
N	11.340	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N	0.15894	0.04993	0.08837	0.11297	0.12731	0.08802		
N	11.520	0.20997	0.14758	0.95000	0.02582	0.06943	0.13373	0.12004
N	0.15894	0.04993	0.08837	0.11297	0.12731	0.08802		
N	11.800	0.10998	0.00902	0.95000	0.00841	0.06483	0.42620	0.23369
N	0.19681	0.02778	0.02211	0.00930	0.00120	0.00000		
N	12.380	0.20997	0.16713	0.95000	0.10927	0.13597	0.22075	0.10297
N	0.11958	0.04334	0.05466	0.04851	0.03611	0.10827		
N	13.330	0.20997	0.10583	0.95000	0.05550	0.05080	0.07292	0.04479
N	0.09799	0.06870	0.10593	0.15285	0.13318	0.05245		
N	13.810	0.20997	0.09212	0.95000	0.00796	0.05914	0.15566	0.24666
N	0.20158	0.06531	0.06794	0.07400	0.05692	0.04363		
N	13.855	0.20997	0.09212	0.95000	0.00796	0.05914	0.15566	0.24666
N	0.20158	0.06531	0.06794	0.07400	0.05692	0.04363		
N	14.380	0.20997	0.98200	0.95000	0.00447	0.05807	0.15095	0.21462
N	0.19272	0.08524	0.09355	0.07203	0.08427	0.04232		
N	14.412	0.20997	0.98200	0.95000	0.00447	0.05807	0.15095	0.21462
N	0.19272	0.08524	0.09355	0.07203	0.08427	0.04232		
N	14.850	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N	0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	14.932	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N	0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	14.940	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N	0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	15.063	0.20997	0.11106	0.95000	0.00567	0.02743	0.10279	0.14192
N	0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	15.303	0.20997	0.13913	0.95000	0.00897	0.05446	0.12768	0.12385
N	0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		
N	15.320	0.20997	0.13913	0.95000	0.00897	0.05446	0.12768	0.12385
N	0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		
N	15.510	0.20997	0.13913	0.95000	0.00897	0.05446	0.12768	0.12385
N	0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		

N 15.980 0.20997 0.19271 0.95000 0.00665 0.01037 0.17808 0.06168
N 0.07674 0.05549 0.08591 0.10635 0.17505 0.20952
N 16.420 0.20997 0.06234 0.95000 0.09238 0.17593 0.16829 0.09484
N 0.11106 0.04836 0.09656 0.04790 0.02748 0.03420
N 16.446 0.20997 0.06234 0.95000 0.09238 0.17593 0.16829 0.09484
N 0.11106 0.04836 0.09656 0.04790 0.02748 0.03420
N 16.450 0.20997 0.06234 0.95000 0.09238 0.17593 0.16829 0.09484
N 0.11106 0.04836 0.09656 0.04790 0.02748 0.03420
N 16.910 0.20997 0.06703 0.95000 0.00640 0.02513 0.06149 0.07330
N 0.12291 0.07295 0.46914 0.08411 0.04922 0.00781
N 17.380 0.20997 0.06703 0.95000 0.00640 0.02513 0.06149 0.07330
N 0.12291 0.07295 0.46914 0.08411 0.04922 0.00781
N 17.760 0.20997 0.14885 0.95000 0.00437 0.02580 0.11721 0.12390
N 0.19929 0.08749 0.11800 0.06891 0.12493 0.12917
N 18.240 0.20997 0.10170 0.95000 0.00462 0.15220 0.22224 0.11813
N 0.12652 0.05265 0.07449 0.10737 0.09435 0.04624
N 18.920 0.10499 0.05946 0.95000 0.01821 0.08276 0.15116 0.12148
N 0.21800 0.06284 0.08761 0.14618 0.08897 0.00000
N 19.440 0.20997 0.19383 0.95000 0.00886 0.01300 0.39307 0.07674
N 0.06638 0.04247 0.06198 0.09086 0.10721 0.08295
N 19.890 0.20997 0.11515 0.95000 0.00647 0.04633 0.30735 0.17892
N 0.16653 0.04553 0.04777 0.06992 0.06989 0.06018
N 19.944 0.20997 0.11515 0.95000 0.00647 0.04633 0.30735 0.17892
N 0.16653 0.04553 0.04777 0.06992 0.06989 0.06018
N 19.953 0.20997 0.11515 0.95000 0.00647 0.04633 0.30735 0.17892
N 0.16653 0.04553 0.04777 0.06992 0.06989 0.06018
N 20.240 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.550 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.563 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.577 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.640 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.657 0.20997 0.08406 0.95000 0.01627 0.08943 0.29824 0.30511
N 0.09135 0.02313 0.02991 0.05439 0.06782 0.02326
N 20.920 0.20997 0.09533 0.95000 0.01051 0.04217 0.22588 0.24623
N 0.22979 0.03876 0.04121 0.05860 0.05910 0.04282
N 20.933 0.20997 0.09533 0.95000 0.01051 0.04217 0.22588 0.24623
N 0.22979 0.03876 0.04121 0.05860 0.05910 0.04282
N 21.010 0.20997 0.09533 0.95000 0.01051 0.04217 0.22588 0.24623
N 0.22979 0.03876 0.04121 0.05860 0.05910 0.04282
N 21.420 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.500 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.523 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.657 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.680 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276

N	21.760	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	21.773	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	21.818	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	21.850	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	22.107	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	22.130	0.20997	0.04146	0.95000	0.01327	0.08040	0.20053	0.33463
N		0.13927	0.09282	0.05630	0.03361	0.02822	0.01194	
N	22.320	0.20997	0.07723	0.95000	0.00642	0.05957	0.24449	0.17159
N		0.20383	0.07884	0.07927	0.07423	0.05525	0.02601	
N	22.365	0.20997	0.07723	0.95000	0.00642	0.05957	0.24449	0.17159
N		0.20383	0.07884	0.07927	0.07423	0.05525	0.02601	
N	22.790	0.20997	0.08817	0.95000	0.00295	0.08040	0.22208	0.27401
N		0.17304	0.05433	0.05972	0.05074	0.04780	0.03442	
N	23.350	0.20997	0.17333	0.95000	0.00669	0.05531	0.12720	0.18266
N		0.15313	0.06655	0.09027	0.09565	0.09806	0.09687	
N	23.365	0.20997	0.17333	0.95000	0.00669	0.05531	0.12720	0.18266
N		0.15313	0.06655	0.09027	0.09565	0.09806	0.09687	
N	23.571	0.20997	0.17333	0.95000	0.00669	0.05531	0.12720	0.18266
N		0.15313	0.06655	0.09027	0.09565	0.09806	0.09687	
N	23.694	0.20997	0.16437	0.95000	0.00102	0.01100	0.18103	0.17308
N		0.26319	0.08305	0.08766	0.07735	0.04680	0.05217	
N	23.851	0.20997	0.16437	0.95000	0.00102	0.01100	0.18103	0.17308
N		0.26319	0.08305	0.08766	0.07735	0.04680	0.05217	
N	23.874	0.20997	0.16437	0.95000	0.00102	0.01100	0.18103	0.17308
N		0.26319	0.08305	0.08766	0.07735	0.04680	0.05217	
N	24.070	0.20997	0.16437	0.95000	0.00102	0.01100	0.18103	0.17308
N		0.26319	0.08305	0.08766	0.07735	0.04680	0.05217	
N	24.085	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.170	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.193	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.350	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.365	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.468	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.491	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.540	0.20997	0.06172	0.95000	0.00944	0.00060	0.17255	0.15874
N		0.21901	0.12364	0.12097	0.08564	0.05219	0.01166	
N	24.900	0.20997	0.11878	0.95000	0.00923	0.04467	0.21324	0.14742
N		0.17234	0.05644	0.06754	0.10079	0.11634	0.06850	
N	25.370	0.20997	0.12678	0.95000	0.00149	0.00980	0.08434	0.12091
N		0.22085	0.10524	0.15080	0.11515	0.10960	0.08031	
N	25.590	0.20997	0.12678	0.95000	0.00149	0.00980	0.08434	0.12091
N		0.22085	0.10524	0.15080	0.11515	0.10960	0.08031	

```
N 25.860          0.20997 0.10795 0.95000        0.00538 0.03093 0.08500 0.21779
N        0.30391 0.10771 0.09192 0.03978 0.05572 0.03386
N 26.290          0.20997 0.18668 0.95000        0.00224 0.04115 0.11411 0.20318
N        0.20070 0.06822 0.08444 0.07735 0.08152 0.10243
N 26.730          0.20997 0.15103 0.95000        0.00054 0.00193 0.08266 0.13204
N        0.23227 0.10131 0.14684 0.14424 0.08659 0.07083
N 27.030          0.20997 0.19690 0.95000        0.00316 0.01357 0.06346 0.12297
N        0.22397 0.10727 0.13958 0.08334 0.10135 0.10213
N 27.680          0.20997 0.14198 0.95000        0.00292 0.02270 0.13383 0.11664
N        0.15213 0.06945 0.13230 0.13219 0.12590 0.10907
N 28.120          0.20997 0.20569 0.90000        0.00648 0.01875 0.05408 0.06661
N        0.17370 0.10358 0.10459 0.11172 0.11185 0.14004
N 28.670          0.20997 0.05813 0.95000        0.02020 0.07270 0.16705 0.19299
N        0.29376 0.07498 0.06550 0.04880 0.03996 0.01606
N 29.040          0.20997 0.17791 0.95000        0.00510 0.00977 0.02614 0.06339
N        0.12227 0.10953 0.11622 0.16800 0.19067 0.18308
N 29.540          0.20997 0.20519 0.90000        0.00024 0.00037 0.00154 0.00178
N        0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.611          0.20997 0.20519 0.90000        0.00024 0.00037 0.00154 0.00178
N        0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.800          0.20997 0.20519 0.90000        0.00024 0.00037 0.00154 0.00178
N        0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 30.070          0.20997 0.19118 0.95000        0.01550 0.03290 0.10062 0.13788
N        0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.260          0.20997 0.19118 0.95000        0.01550 0.03290 0.10062 0.13788
N        0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.820          0.20997 0.19285 0.95000        0.00421 0.00920 0.03670 0.07932
N        0.14957 0.08938 0.09220 0.11904 0.13559 0.27578
N 31.390          0.20997 0.07865 0.95000        0.00136 0.00317 0.04678 0.16566
N        0.32156 0.13746 0.15154 0.08637 0.05093 0.03300
N 31.860          0.20997 0.18391 0.95000        0.04180 0.03453 0.07407 0.10225
N        0.16518 0.07265 0.11009 0.06917 0.07639 0.15569
N 32.430          0.20997 0.16079 0.82061        0.00634 0.00913 0.01982 0.04061
N        0.07617 0.04604 0.20933 0.08932 0.14784 0.16079
N 32.860          0.20997 0.19086 0.95000        0.00264 0.00920 0.02984 0.04337
N        0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.984          0.20997 0.19086 0.95000        0.00264 0.00920 0.02984 0.04337
N        0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.998          0.20997 0.19086 0.95000        0.00264 0.00920 0.02984 0.04337
N        0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.410          0.20997 0.19086 0.95000        0.00264 0.00920 0.02984 0.04337
N        0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.820          0.20997 0.19086 0.95000        0.00264 0.00920 0.02984 0.04337
N        0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
$LOCAL
LQL    Q   000.1   1000.   5000.  10000.
LTL   QS   000.1   1094.   6855.  16015.
LFL  VFS 0.28256 0.28256 0.25945 0.28352
LFL   FS 0.43291 0.43291 0.40442 0.37836
LFL   MS 0.14372 0.14372 0.16223 0.16477
LFL   CS 0.10623 0.10623 0.11610 0.11564
LFL  VCS 0.03200 0.03200 0.04974 0.04723
LFL  VFG 0.00126 0.00126 0.00559 0.00589
LFL   FG 0.00076 0.00076 0.00197 0.00380
```

```
LFL    MG 0.00056 0.00056 0.00028  0.00067
LFL    CG 0.00000 0.00000 0.00022  0.00012
LFL   VCG 0.00000 0.00000 0.00000  0.00000
$HYD
$RATING
RC           19    5000    4000 913.885   0.000   1.086   2.048   2.896   3.638
RC        4.286   4.848   5.334   5.755   6.119   6.436   6.716   6.969   7.204
RC        7.432   7.661   7.902   8.164   8.456
$B          2
$KL
*    TIME DURATION 1 - HYDROGRAPH 1
Q  5875.   1250.
T   60.    60.
X        0.1   1.8
*    TIME DURATION 2 - HYDROGRAPH 1
Q  5875.   1250.
W   0.05
*    TIME DURATION 3 - HYDROGRAPH 1
Q 11750.   2500.
X        0.1   1.3
*    TIME DURATION 4 - HYDROGRAPH 1
Q 11750.   2500.
W   0.09
*    TIME DURATION 5 - HYDROGRAPH 1
Q 17625.   3750.
X        0.1   0.9
*    TIME DURATION 6 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*    TIME DURATION 7 - HYDROGRAPH 1
Q 23500.   5000.
X        0.1   0.4
*    TIME DURATION 8 - HYDROGRAPH 1
Q 23500.   5000.
W  0.0625
*    TIME DURATION 9 - HYDROGRAPH 1
Q 17625.   3750.
X        0.1   0.9
*    TIME DURATION 10 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*    TIME DURATION 11 - HYDROGRAPH 1
Q 11750.   2500.
X        0.1   1.3
*    TIME DURATION 12 - HYDROGRAPH 1
Q 11750.   2500.
W   0.09
*    TIME DURATION 13 - HYDROGRAPH 1
Q  5875.   1250.
X        0.1   1.8
*  B TIME DURATION 14 - HYDROGRAPH 1
Q  5875.   1250.
W   0.05
$$END
```

F.3 - Input Data File for Model III

```
T1     AGUA FRIA RIVER SEDIMENT TRANSPORT MODELING [HEC-6 DATA]
T2     LAST UPDATED JULY 5, 1993  - MODEL III
T3
NC 0.070   0.040   0.044     .1      .3
X1 0.160    47.0    8000   12725    470     460     465
GR 924.4  4925.0   924.2  5199.0   921.8  5600.0   919.5  5760.0   919.4  5959.0
GR 920.9  6245.0   920.8  6516.0   919.3  6554.0   919.8  6850.0   919.6  7271.0
GR 920.5  7535.0   917.6  8136.0   917.4  8339.0   912.3  8356.0   917.2  8376.0
GR 916.4  8991.0   914.0  9212.0   911.6  9231.0   913.2  9494.0   911.8  9720.0
GR 910.7 10000.0   909.6 10136.0   921.6 10167.0   923.0 10184.0   913.7 10213.0
GR 913.7 10477.0   917.1 10590.0   916.6 10873.0   910.5 10909.0   910.5 11042.0
GR 915.2 11068.0   912.1 11265.0   911.5 11516.0   908.3 11664.0   910.4 11830.0
GR 916.1 11911.0   914.1 12098.0   914.9 12628.0   922.1 12652.0   922.7 12725.0
GR 916.5 12758.0   916.8 13671.0   916.2 14363.0   917.2 14971.0   917.8 15391.0
GR 913.5 15403.0   920.3 15459.0
HD 0.160      10    8000   12725
NC 0.033   0.040   0.039
X1 0.440    40.0    8029   10420   1510    1465    1485
GR 927.5  3107.0   925.0  4575.0   922.8  5984.0   921.8  6974.0   920.3  7816.0
GR 923.1  7847.0   923.3  7915.0   919.1  7942.0   919.1  7995.0   923.7  8029.0
GR 919.5  8152.0   916.2  8640.0   915.1  8999.0   916.8  9023.0   916.7  9798.0
GR 913.9  9815.0   913.5  9842.0   912.8 10000.0   917.6 10016.0   916.2 10201.0
GR 917.0 10263.0   917.7 10313.0   917.7 10385.0   925.2 10420.0   917.7 10455.0
GR 917.8 11076.0   920.3 11103.0   916.9 11133.0   916.4 11365.0   919.1 11391.0
GR 918.7 12229.0   918.8 12650.0   920.6 12691.0   919.8 12785.0   919.6 13644.0
GR 920.4 14355.0   921.0 16110.0   921.8 16630.0   922.9 17240.0   924.0 17640.0
HD 0.440      10    8029   10420
NC 0.034   0.040   0.042
X1 0.730    36.0    8340   12394   1565    1475    1510
GR 926.5  3285.0   926.3  3986.0   925.6  4737.0   925.2  5415.0   925.6  5760.0
GR 925.6  5797.0   925.7  5889.0   925.7  5945.0   924.5  6306.0   924.5  7206.0
GR 924.3  8340.0   921.6  8530.0   921.1  8982.0   919.1  8999.0   918.6  9126.0
GR 921.0  9195.0   920.0  9917.0   917.8  9927.0   917.9 10000.0   916.9 10087.0
GR 928.8 10162.0   919.2 10205.0   917.0 10479.0   919.8 10521.0   918.9 10591.0
GR 928.7 10655.0   919.2 10697.0   919.2 10771.0   922.2 10794.0   921.6 11725.0
GR 922.6 11783.0   924.5 12394.0   924.5 13563.0   924.0 14000.0   924.3 15050.0
GR 926.0   15560
HD 0.730      10    8340   12394
NC 0.040   0.042   0.043
X1 1.330    29.0    8038   10456   3405    3325    3385
GR 934.6  6000.0   933.3  6025.0   932.9  6490.0   931.0  6748.0   931.3  7154.0
GR 931.8  7239.0   933.2  7837.0   934.0  8038.0   931.1  8083.0   929.8  8339.0
GR 931.4  8777.0   929.3  8916.0   931.1  8945.0   929.8  9282.0   929.1  9911.0
GR 927.0 10000.0   925.9 10122.0   925.5 10364.0   932.0 10456.0   925.5 10490.0
GR 931.1 10701.0   931.6 11006.0   930.4 11242.0   934.9 11261.0   931.9 11306.0
GR 933.2 11377.0   934.8 11409.0   936.3 12061.0   941.3 12490.0
HD 1.330      10    8038   10456
NC 0.041   0.040   0.035
X1 1.710      44    9091 10284.4   2000    2585    2480
GR 940.9  5684.9   943.3  5808.0   945.3  6004.6   945.1  6078.9   947.4  6100.1
```

```
GR 947.4  6117.9   939.1  6148.7   948.7  6187.8   948.6  6226.4   934.0  6296.9
GR 936.8  6795.4   942.6  6807.8   942.6  6816.3   935.2  6833.2   933.6  7016.1
GR 935.7  7029.0   935.7  7052.6   932.4  7065.5   932.0  7135.0   934.3  7164.7
GR 934.3  7198.3   931.9  7209.5   934.6  7333.9   933.3  7541.5   933.4  7601.4
GR 936.1  7704.9   936.0  8010.3   935.3  8305.9   935.8  8591.1   935.4  8888.0
GR 935.8  9091.0   933.0  9104.6   933.1  9230.9   931.1  9247.7   929.7  9534.8
GR 928.2  9542.9   928.2  9966.4   928.2 10000.0   930.4 10058.7   930.5 10277.8
GR 935.9 10284.4   941.2 10511.3   951.5 11351.7   952.3 11442.6
HD 1.710      10    9091 10284.4
NC 0.041   0.035   0.035
X1 2.020      31  8839.4 10077.3     890    2065    1965
GR 950.0  5981.1   948.6  6066.6   951.6  6121.6   954.7  6293.7   955.1  6434.3
GR 940.7  6514.7   939.9  6533.9   937.1  6557.3   936.4  6934.6   937.1  7244.1
GR 944.6  7260.1   944.6  7278.4   937.0  7304.1   936.3  7340.1   938.6  7388.3
GR 938.4  7687.8   936.3  7711.0   938.5  7824.6   938.8  7961.0   937.2  8390.4
GR 938.4  8544.9   938.1  8839.4   935.2  8854.5   935.2  9121.5   935.4  9418.2
GR 934.2  9860.0   932.7  9918.6   933.3 10000.0   934.5 10062.4   944.8 10077.3
GR 944.8 10079.1
HD 2.020      10  8839.4 10077.3
NC 0.045   0.031   0.036
X1 2.600      26    9437 10580.6    2700    2945    3320
GR 967.1  7292.0   967.4  7442.4   961.7  7739.8   957.5  7927.3   953.0  8217.8
GR 947.7  8560.5   944.7  8730.1   944.9  9057.3   944.8  9437.0   940.5  9449.9
GR 941.9  9684.7   939.6  9951.4   939.6 10000.0   939.6 10090.3   941.7 10102.7
GR 943.1 10322.7   940.5 10500.3   946.6 10580.6   946.6 10625.8   945.8 10652.9
GR 942.2 10671.4   943.4 10811.0   943.6 10850.0   944.8 11140.9   954.6 11152.0
GR 954.6 11164.0
HD 2.600      10    9437 10580.6
X1 2.800      19    8817   11222    1250     655    1000
GR 956.4  8817.0   952.8  8856.3   944.9  9060.9   943.4  9200.0   943.2  9214.4
GR 943.5  9447.6   942.0 10000.0   943.9 10091.2   943.9 10170.9   942.8 10185.3
GR 943.0 10439.2   945.6 10464.6   945.8 10582.0   943.7 10628.0   945.8 10774.1
GR 945.7 10820.4   942.3 10890.9   945.9 11203.4   956.6 11222.0
HD 2.800      10    8817   11222
X1 3.270      17  9692.6 11130.5    2800    1995    2505
GR 961.5  7808.3   958.3  8137.4   956.3  8362.4   953.4  9316.6   950.7  9692.6
GR 945.5  9724.1   944.5  9770.5   944.8 10000.0   944.8 10158.6   951.4 10188.1
GR 947.8 10278.9   948.5 10405.5   944.5 10606.9   944.5 10822.2   945.7 10915.2
GR 948.5 11116.0   960.5 11130.5
HD 3.270      10  9692.6 11130.5
X1 3.400      23  9760.9 10928.5     760     635     685
GR 961.9  7939.2   957.7  8317.0   955.0  9117.3   952.3  9683.9   952.0  9760.9
GR 945.4  9784.1   945.4 10000.0   945.4 10039.4   950.7 10054.0   951.3 10107.8
GR 953.0 10116.4   953.1 10158.4   951.2 10170.2   951.1 10228.2   945.2 10238.1
GR 945.1 10277.1   950.5 10294.4   948.9 10485.8   946.0 10546.7   949.6 10607.8
GR 950.1 10703.8   952.3 10913.8   963.2 10928.5
HD 3.400      10  9760.9 10928.5
X1 3.430      12  9654.5 10873.4     165     160     165
GR 961.5  7958.9   957.8  8287.1   956.3  8796.5   955.8  9654.5   953.0  9684.2
GR 952.8  9758.5   946.2  9788.6   946.0 10000.0   946.0 10271.7   951.1 10293.1
GR 951.1 10849.9   963.7 10873.4
HD 3.430      10  9654.5 10928.5
X1 3.729     6.0    9420   10603    1575    1585    1580
GR 972.0  9405.0   968.0  9420.0   952.2  9425.0   952.2 10588.0   967.2 10603.0
```

```
GR  967.2  10613.0
HD 3.729      0      0      0
X1 3.734     63.0  9400.9 10599.3      25      25      25
GR  972.4   9400.8    967.5   9400.9    952.3   9416.0    952.3   9422.1    952.3   9474.5
GR  952.3   9474.6    952.3   9481.6    952.3   9481.7    952.3   9554.7    952.3   9554.8
GR  952.3   9561.8    952.3   9561.9    952.3   9634.6    952.3   9634.7    952.3   9641.7
GR  952.3   9641.8    952.3   9714.5    952.3   9714.6    952.3   9721.6    952.3   9721.7
GR  952.3   9794.7    952.3   9794.8    952.3   9801.8    952.3   9801.9    952.3   9874.9
GR  952.3   9875.0    952.3   9882.0    952.3   9882.1    952.3   9955.1    952.3   9955.2
GR  952.3   9962.2    952.3   9962.3    952.3  10034.9    952.3  10035.0    952.3  10042.0
GR  952.3  10042.1    952.3  10115.1    952.3  10115.2    952.3  10122.2    952.3  10122.3
GR  952.3  10194.8    952.3  10194.9    952.3  10201.9    952.3  10202.0    952.3  10275.0
GR  952.3  10275.1    952.3  10282.1    952.3  10282.2    952.3  10355.2    952.3  10355.3
GR  952.3  10362.3    952.3  10362.4    952.3  10434.9    952.3  10435.0    952.3  10442.0
GR  952.3  10442.1    952.3  10515.1    952.3  10515.2    952.3  10522.2    952.3  10522.3
GR  952.3  10585.2    967.6  10599.3    971.1  10599.4
HD 3.734      0      0      0
X1 3.757      7.0    9425    10555     120     120     120
GR  968.3   9400.0    966.5   9425.0    952.3   9454.0    952.4   9708.0    952.1  10000.0
GR  952.1  10538.0    967.7  10555.0
HD 3.757      0      0      0
X1 3.767       92  9428.1  10572.0      50      50      50
GR  970.9   9428.0    966.9   9428.1    952.9   9457.5    952.9   9457.6    952.9   9460.6
GR  952.9   9460.7    952.9   9492.4    952.9   9492.5    952.9   9498.5    952.9   9498.6
GR  952.9   9510.4    952.9   9510.5    952.9   9513.5    952.9   9513.6    952.9   9525.5
GR  952.9   9525.6    952.9   9528.6    952.9   9528.7    952.9   9540.4    952.9   9540.5
GR  952.9   9543.5    952.9   9543.6    952.9   9555.4    952.9   9555.5    952.9   9558.5
GR  952.9   9558.6    952.9   9570.4    952.9   9570.5    952.9   9573.5    952.9   9573.6
GR  952.9   9585.4    952.9   9585.5    952.9   9588.5    952.9   9588.6    952.9   9600.4
GR  952.9   9600.5    952.9   9625.0    952.9   9625.1    952.9   9761.9    966.1   9762.0
GR  966.1   9778.0    952.9   9778.1    952.9   9915.0    966.1   9915.1    966.1   9931.1
GR  952.9   9931.2    952.9  10068.9    966.1  10069.0    966.1  10085.0    952.9  10085.1
GR  952.9  10220.9    966.1  10221.0    966.1  10237.0    952.9  10237.1    952.9  10374.9
GR  952.9  10375.0    952.9  10400.2    952.9  10400.3    952.9  10410.9    952.9  10411.0
GR  952.9  10414.9    952.9  10415.0    952.9  10426.9    952.9  10427.0    952.9  10430.0
GR  952.9  10430.1    952.9  10441.8    952.9  10441.9    952.9  10444.9    952.9  10445.0
GR  952.9  10456.9    952.9  10457.0    952.9  10460.0    952.9  10460.1    952.9  10472.0
GR  952.9  10472.1    952.9  10475.1    952.9  10475.2    952.9  10486.9    952.9  10487.0
GR  952.9  10490.0    952.9  10490.1    952.9  10501.9    952.9  10502.0    952.9  10508.9
GR  952.9  10509.0    952.9  10540.8    952.9  10540.9    952.9  10543.9    952.9  10544.0
GR  967.2  10571.9    970.9  10572.0
HD 3.767      0      0      0
NC   .04    .045    .025
X1 4.094      7.0    9440    10578    1770    1760    1765
GR  973.3   9440.0    958.5   9465.0    958.5   9757.0    958.5  10000.0    958.5  10558.0
GR  973.0  10578.0    973.0  10582.0
HD 4.094       10    9440    10578
X1 4.270     15.0    9449    10588     925     925     925
GR  975.0   9440.0    974.9   9449.0    959.5   9466.0    958.0   9791.0    970.4   9807.0
GR  970.6   9818.0    968.3   9822.0    967.9   9877.0    971.5   9883.0    971.5   9891.0
GR  958.0   9910.0    957.1  10000.0    958.9  10317.0    959.7  10563.0    974.4  10588.0
HD 4.270       10    9449    10588
X1 4.700      9.0    9451    10579    2320    2180    2250
GR  978.4   9440.0    978.4   9451.0    961.5   9467.0    960.2   9774.0    959.1  10000.0
```

```
GR 961.1 10353.0   962.8 10562.0   978.8 10579.0   978.9 10595.0
HD 4.700      10    9451   10588
X1 4.754    53.0  9402.5 10572.4     150     310     225
X3    10
GR 973.0  7150.0   972.7  8115.0   973.6  8831.0   984.3  9296.0   988.1  9402.5
GR 988.1  9427.7   980.6  9427.8   960.3  9445.8   960.3  9525.5   960.3  9525.6
GR 960.3  9537.6   960.3  9537.7   960.3  9641.5   960.3  9641.6   960.3  9653.6
GR 960.3  9653.7   960.3  9757.4   960.3  9757.5   960.3  9769.5   960.3  9769.6
GR 960.3  9873.4   960.3  9873.5   960.3  9885.5   960.3  9885.6   960.3  9997.8
GR 960.3  9997.9   960.3 10009.9   960.3 10010.0   960.3 10105.8   960.3 10105.9
GR 960.3 10117.9   960.3 10118.0   960.3 10221.3   960.3 10221.4   960.3 10233.4
GR 960.3 10233.5   960.3 10337.9   960.3 10338.0   960.3 10349.0   960.3 10349.1
GR 960.3 10453.5   960.3 10453.6   960.3 10465.6   960.3 10465.7   960.3 10555.9
GR 981.2 10572.3   988.7 10572.4   988.7 10597.0   987.2 10612.0   978.1 11023.0
GR 978.7 11497.0   980.6 12014.0   982.4 12466.0
HD 4.754      10  9445.8 10555.9
X1 4.790     6.0    9440   10590     357     187     277
GR 980.2  9440.0   964.0  9466.0   961.1 10000.0   964.6 10568.0   980.8 10590.0
GR 980.8 10600.0
HD 4.790      10  9440.0   10590
X1 5.150     9.0    9291   10713    1780    1960    1873
GR 986.0  9275.0   986.0  9291.0   969.9  9310.0   968.1  9678.0   967.4 10000.0
GR 968.7 10469.0   968.9 10691.0   986.0 10713.0   986.0 10720.0
HD 5.150      10    9291   10713
NC  .040    .040    .022
X1 5.290      82  9250.8 10672.4     695     865     775
GR 994.5  9250.7   986.4  9250.8   971.5  9277.5   971.5  9318.7   971.5  9318.8
GR 971.5  9323.4   971.5  9323.5   971.5  9389.9   971.5  9390.0   971.5  9394.5
GR 971.5  9394.6   971.5  9460.9   971.5  9461.0   971.5  9465.6   971.5  9465.7
GR 971.5  9532.1   971.5  9532.2   971.5  9536.8   971.5  9536.9   971.5  9603.3
GR 971.5  9603.4   971.5  9608.0   971.5  9608.1   971.5  9674.5   971.5  9674.6
GR 971.5  9679.2   971.5  9679.3   971.5  9745.7   971.5  9745.8   971.5  9750.4
GR 971.5  9750.5   971.5  9816.9   971.5  9817.0   971.5  9821.6   971.5  9821.7
GR 971.5  9888.1   971.5  9888.2   971.5  9892.8   971.5  9892.9   971.5  9959.3
GR 971.5  9959.4   971.5  9964.0   971.5  9964.1   971.5 10030.0   971.5 10030.1
GR 971.5 10034.7   971.5 10034.8   971.5 10101.2   971.5 10101.3   971.5 10105.9
GR 971.5 10106.0   971.5 10172.3   971.5 10172.4   971.5 10177.0   971.5 10177.1
GR 971.5 10243.7   971.5 10243.8   971.5 10248.4   971.5 10248.5   971.5 10314.9
GR 971.5 10315.0   971.5 10319.6   971.5 10319.7   971.5 10386.0   971.5 10386.1
GR 971.5 10390.7   971.5 10390.8   971.5 10457.2   971.5 10457.3   971.5 10461.9
GR 971.5 10462.0   971.5 10528.4   971.5 10528.5   971.5 10533.0   971.5 10533.1
GR 971.5 10599.5   971.5 10599.6   971.5 10604.2   971.5 10604.3   971.5 10645.5
GR 989.4 10672.3   997.7 10672.4
HD 5.290      10  9250.8 10672.4
NC   .04     .04    .025
X1 5.380    20.0    9266   10656     305     645     465
GR 993.0  9214.0   987.7  9266.0   985.7  9342.0   972.8  9358.0   972.3  9413.0
GR 972.2  9565.0   972.2  9734.0   972.2  9889.0   972.2  9994.0   971.4 10000.0
GR 971.4 10062.0   971.4 10195.0   974.3 10208.0   974.2 10263.0   974.2 10420.0
GR 974.2 10582.0   974.2 10639.0   988.4 10656.0   988.6 10671.0   982.3 10702.0
HD 5.380      10    9266   10656
NC   .04     .04    .022      .3      .5
X1 5.689      42  9371.3 10552.8    1320    1740    1620
GR 996.9  9371.2   990.8  9371.3   973.9  9399.5   973.9  9488.7   973.9  9488.8
```

```
GR 973.9  9496.2   973.9  9496.3   973.9  9606.6   973.9  9606.7   973.9  9614.1
GR 973.9  9614.2   973.9  9725.8   973.9  9725.9   973.9  9733.3   973.9  9733.4
GR 973.9  9843.3   973.9  9843.4   973.9  9850.8   973.9  9850.9   973.9  9961.3
GR 973.9  9961.4   973.9  9968.8   973.9  9968.9   973.9 10078.9   973.9 10079.0
GR 973.9 10086.4   973.9 10086.5   973.9 10196.2   973.9 10196.3   973.9 10203.7
GR 973.9 10203.8   973.9 10314.4   973.9 10314.5   973.9 10321.9   973.9 10322.0
GR 973.9 10432.1   973.9 10432.2   973.9 10439.6   973.9 10439.7   973.9 10524.6
GR 990.8 10552.8   996.9 10552.9
HD 5.689      10  9371.3 10552.8
NC   .04     .04    .025
X1 5.750    22.0    9426   10579     370     370     370
GR 990.7  9287.0   990.7  9295.0   985.9  9330.0   983.9  9362.0   985.6  9388.0
GR 990.1  9416.0   990.3  9426.0   975.3  9477.0   975.3  9595.0   975.5  9715.0
GR 975.5  9864.0   975.5  9981.0   974.0  9994.0   973.7 10030.0   973.7 10095.0
GR 973.7 10244.0   975.6 10259.0   975.6 10349.0   975.7 10474.0   975.7 10565.0
GR 989.2 10579.0   989.6 10596.0
HD 5.750      10    9426   10579
X1 5.900    17.0  9429.0 10561.0     945     950     950
GR 993.0  9414.0   993.0  9429.0   977.5  9447.0   977.5  9506.0   977.5  9598.0
GR 977.5  9714.0   977.6  9829.0   977.4  9946.0   975.4  9958.0   975.5 10040.0
GR 975.5 10099.0   975.5 10230.0   977.4 10257.0   977.6 10344.0   977.6 10459.0
GR 977.6 10544.0   991.1 10561.0
HD 5.900      10    9429   10561
X1 6.430    20.0  9452.0 10537.0    2960    2755    2855
GR 996.1  9390.0   991.8  9409.0   991.6  9433.0   996.5  9443.0   996.5  9452.0
GR 984.1  9467.0   984.0  9528.0   984.3  9631.0   984.3  9768.0   984.1  9894.0
GR 983.2  9980.0   981.0 10000.0   981.0 10057.0   981.3 10156.0   981.9 10213.0
GR 983.2 10232.0   983.2 10359.0   982.5 10519.0   996.1 10537.0   996.1 10550.0
HD 6.430      10    9452   10537
X1 6.890    16.0  9439.0 10577.0    2510    2185    2345
GR1004.2  9428.0  1004.2  9439.0   989.9  9461.0   989.9  9574.0   989.9  9700.0
GR 989.8  9818.0   989.4  9954.0   989.4  9973.0   989.4 10000.0   989.4 10039.0
GR 989.4 10132.0   989.4 10266.0   989.4 10427.0   989.4 10558.0  1002.7 10577.0
GR1002.7 10588.0
HD 6.890      10    9439   10577
X1 6.990    19.0  9400.0 10559.0     525     575     550
GR1003.3  9393.0  1003.4  9400.0   997.4  9411.0   997.3  9418.0   991.4  9429.0
GR 991.4  9534.0   991.1  9695.0   991.1  9871.0   991.1 10000.0   991.1 10072.0
GR 991.2 10186.0   991.3 10300.0   998.4 10313.0   998.4 10323.0   998.4 10404.0
GR 990.2 10418.0   990.2 10540.0  1003.5 10559.0  1004.0 10574.0
HD 6.990      10    9400   10559
X1 7.490    13.0  9509.0 10525.0    2645    2610    2595
GR1009.5  9493.0  1009.5  9509.0   995.2  9526.0   995.4  9612.0   995.6  9736.0
GR 995.5  9871.0   995.3 10000.0   995.3 10064.0   995.4 10173.0   995.7 10289.0
GR 995.7 10474.0  1010.9 10525.0  1010.9 10541.0
HD 7.490      10    9509   10525
NC 0.022   0.022   0.022      .3      .5
X1 8.000      85  9235.5 10725.0    2865    2540    2685
X3    10
GR1014.4  7828.0  1015.5  8173.0  1016.3  8411.0  1017.9  8735.0  1018.7  9144.0
GR1018.6  9235.4  1013.3  9235.5   999.2  9263.1   999.2  9271.2   999.2  9271.3
GR 999.2  9285.3   999.2  9285.4   999.2  9362.9   999.2  9363.0   999.2  9377.0
GR 999.2  9377.1   999.2  9452.9   999.2  9453.0   999.2  9467.0   999.2  9467.1
GR 999.2  9542.9   999.2  9543.0   999.2  9557.0   999.2  9557.1   999.2  9632.9
```

```
GR 999.2  9633.0   999.2  9647.0   999.2  9647.1   999.2  9722.9   999.2  9723.0
GR 999.2  9737.0   999.2  9737.1   999.2  9812.9   999.2  9813.0   999.2  9827.0
GR 999.2  9827.1   999.2  9902.9   999.2  9903.0   999.2  9917.0   999.2  9917.1
GR 999.2  9992.9   999.2  9993.0   999.2 10007.0   999.2 10007.1   999.2 10082.9
GR 999.2 10083.0   999.2 10097.0   999.2 10097.1   999.2 10172.9   999.2 10173.0
GR 999.2 10187.0   999.2 10187.1   999.2 10262.9   999.2 10263.0   999.2 10277.0
GR 999.2 10277.1   999.2 10352.8   999.2 10352.9   999.2 10366.9   999.2 10367.0
GR 999.2 10442.9   999.2 10443.0   999.2 10457.0   999.2 10457.1   999.2 10532.9
GR 999.2 10533.0   999.2 10547.0   999.2 10547.1   999.2 10622.9   999.2 10623.0
GR 999.2 10637.0   999.2 10637.1   999.2 10697.5  1013.3 10725.0  1021.3 10725.1
GR1018.6 10725.2  1016.4 10735.0  1017.3 10914.0  1016.9 11234.0  1012.8 11759.0
GR1013.2 12195.0  1013.8 12510.0  1014.9 12742.0  1016.1 13028.0  1018.6 13458.0
HD 8.000      10  9235.5 10725.0
NC  .04     .04    .025     .1      .3
X1 8.100    33.0    9474   10526     195    1255     535
X3   10
GR1008.6  9134.0  1008.7  9204.0  1013.5  9350.0  1000.5  9366.0  1020.1  9474.0
GR1000.1  9500.0  1000.1  9975.0  1000.1 10000.0  1000.1 10500.0  1020.1 10526.0
GR1001.7 10867.0  1012.8 10883.0  1012.9 10896.0  1001.1 10947.0  1001.1 10996.0
GR1008.6 11040.0  1009.2 11183.0  1009.2 11417.0  1009.2 11573.0  1009.2 11879.0
GR1009.5 12097.0  1010.3 12365.0  1014.4 12451.0  1014.7 12485.0  1012.0 12572.0
GR1013.0 12715.0  1014.9 12885.0  1018.3 12923.0  1012.3 12938.0  1015.8 12949.0
GR1016.8 13044.0  1018.6 13064.0  1018.6 13079.0
HD 8.100      10    9500   10500
X1 8.210    41.0    9474   10526     470     800     600
X3   10
GR1009.9  8425.0  1009.9  8544.0  1007.2  8568.0  1004.7  8815.0  1002.0  9267.0
GR1001.9  9408.0  1015.5  9429.0  1015.5  9461.0  1020.8  9474.0  1000.8  9500.0
GR1000.8 10000.0  1000.8 10500.0  1020.8 10526.0  1001.8 10802.0  1001.8 10977.0
GR1014.9 10989.0  1015.0 11009.0  1009.8 11027.0  1008.8 11218.0  1010.1 11326.0
GR1007.2 11370.0  1006.9 11411.0  1012.8 11456.0  1011.2 11540.0  1012.2 11605.0
GR1012.3 11807.0  1012.3 12337.0  1014.3 12482.0  1017.8 12554.0  1015.0 12632.0
GR1016.5 12768.0  1018.1 12832.0  1019.0 13032.0  1022.9 13092.0  1013.2 13111.0
GR1020.6 13125.0  1018.6 13203.0  1023.6 13524.0  1028.1 13565.0  1024.4 13605.0
GR1025.3 13637.0
HD 8.210      10    9500   10500
X1 8.730    16.0    9474   10526    3140    2065    2640
X3   10
GR1015.8  8430.0  1016.3  8634.0  1017.8  9042.0  1015.9  9081.0  1017.5  9194.0
GR1012.3  9347.0  1014.9  9446.0  1029.3  9474.0  1009.3  9500.0  1009.3 10000.0
GR1009.3 10500.0  1029.3 10526.0  1015.2 10654.0  1014.4 10889.0  1014.2 11009.0
GR1011.8 11390.0
HD 8.730      10    9500   10500
NC .022     .022    .022      .3      .5
X1 9.130      60    9474   10526    2340    1775    2090
X3   10
GR1031.6  6963.0  1031.6  6964.0  1031.1  7630.0  1031.0  7901.0  1031.2  8217.0
GR1031.2  8482.0  1031.0  8698.0  1031.3  8928.0  1033.5  9101.0  1033.5  9101.1
GR1034.2  9137.4  1027.5  9137.5  1016.2  9172.6  1016.2  9249.0  1016.2  9249.1
GR1016.2  9255.1  1016.2  9255.2  1016.2  9364.1  1016.2  9364.2  1016.2  9370.2
GR1016.2  9370.3  1035.2  9474.0  1015.2  9500.0  1015.2  9600.0  1015.2  9900.0
GR1015.2 10000.0  1015.2 10300.0  1015.2 10450.0  1015.2 10500.0  1035.2 10526.0
GR1016.2 10628.9  1016.2 10629.0  1016.2 10635.0  1016.2 10635.1  1016.2 10744.4
GR1016.2 10744.5  1016.2 10750.5  1016.2 10750.6  1016.2 10827.1  1027.5 10860.0
```

```
GR1034.2 10860.1   1032.0 10986.0   1029.8 11176.0   1028.7 11374.0   1027.1 11579.0
GR1025.2 11859.0   1025.7 12067.0   1025.2 12326.0   1025.6 12556.0   1025.0 12785.0
GR1024.8 13071.0   1025.0 13319.0   1025.2 13557.0   1024.9 13797.0   1024.5 14035.0
GR1024.5 14296.0   1024.3 14582.0   1024.6 14807.0   1024.9 15012.0   1025.0 15173.0
HD 9.130      10    9500   10500
QT
NC     0       0   0.025    0.1     0.3
X1 9.900      67    8827    9879    4105    3720    3950
X3    10
GR1040.0    7390  1039.6    7453  1038.9    7535  1034.2    7570  1034.2    7587
GR1026.8    7620  1026.8    7643  1033.8    7677  1034.1    7725  1031.8    7787
GR1035.1    7816  1036.1    7835  1033.3    7853  1033.9    7874  1032.5    7918
GR1032.7    7981  1032.7    8110  1032.7    8217  1032.7    8347  1032.7    8471
GR1032.0    8578  1033.1    8663  1034.7    8742  1029.4    8801  1046.5    8827
GR1026.5    8853  1026.5    8870  1026.5    8880  1026.5    9600  1026.5    9853
GR1046.5    9879  1030.1    9941  1031.4   10000  1032.0   10125  1032.0   10257
GR1031.9   10377  1031.9   10518  1031.7   10660  1031.0   10812  1030.8   10956
GR1031.0   11086  1031.2   11234  1032.2   11320  1032.4   11422  1032.7   11547
GR1032.9   11677  1031.3   11738  1031.2   11879  1031.8   11986  1032.2   12101
GR1032.7   12227  1031.4   12357  1030.9   12468  1030.1   12530  1029.3   12653
GR1031.1   12731  1030.8   12846  1029.4   12987  1031.3   13072  1032.1   13163
GR1032.0   13318  1031.9   13400  1029.5   13447  1029.0   13528  1030.3   13594
GR1031.6   13782  1032.2   13950
HD 9.900      10    8853    9853
NC   .04     .04     .03
X1 10.53      54    9474   10526    3320    2680    3330
X3    10
GR1042.2    6900  1041.8    7011  1042.2    7133  1040.6    7170  1043.1    7244
GR1042.8    7347  1043.6    7427  1044.1    7552  1044.2    7681  1044.5    7780
GR1040.5    7806  1039.9    7941  1040.6    8043  1038.3    8073  1040.4    8148
GR1040.5    8308  1040.4    8447  1039.1    8510  1040.5    8598  1040.7    8716
GR1041.3    8842  1039.4    8903  1040.1    9042  1040.9    9141  1037.3    9172
GR1036.0    9318  1034.1    9465  1055.9    9474  1035.9    9500  1035.9   10500
GR1055.9   10526  1040.1   10559  1039.5   10812  1040.2   10890  1040.2   10984
GR1040.2   11096  1039.9   11242  1039.6   11405  1038.5   11508  1038.3   11589
GR1039.0   11686  1038.7   11812  1043.3   11883  1043.3   11928  1043.3   12093
GR1043.3   12139  1035.9   12173  1035.4   12240  1037.0   12361  1038.4   12386
GR1038.6   12476  1038.9   12641  1039.5   12816  1040.1   12900
HD 10.53      10    9500   10500
X1 10.72      51    9125   10177    1040     880     101
X3    10
GR1044.6    6959  1044.9    7103  1045.5    7231  1044.2    7323  1045.5    7425
GR1045.2    7514  1044.1    7664  1043.2    7804  1042.1    7920  1042.6    8159
GR1044.2    8280  1045.1    8434  1046.1    8560  1043.0    8611  1043.3    8733
GR1043.9    8851  1043.1    8941  1043.4    9086  1058.8    9125  1038.8    9151
GR1038.8   10000  1038.8   10151  1058.8   10177  1042.6   10179  1043.3   10280
GR1043.9   10386  1044.0   10537  1043.9   10672  1043.2   10833  1043.0   10986
GR1042.9   11179  1041.8   11394  1043.4   11430  1040.5   11473  1040.4   11514
GR1042.8   11560  1042.4   11684  1037.8   11718  1037.8   11745  1042.2   11798
GR1042.8   11943  1042.8   12086  1043.0   12218  1044.2   12321  1045.7   12508
GR1045.7   12561  1047.4   12619  1044.3   12722  1044.5   12768  1045.5   12788
GR1045.5   12855
HD 10.72      10    9151   10151
NC  .045    .045    .059      .1      .3
```

```
X1 11.01     48     8799    9851    1610    1320    1430
X3    10
GR1049.7     6400   1047.4   6457   1048.1   6533   1048.3   6651   1047.0   6742
GR1046.1     6822   1048.1   6893   1048.6   7019   1049.3   7141   1048.6   7259
GR1048.2     7375   1048.3   7481   1046.6   7595   1046.8   7741   1047.2   7866
GR1046.8     7991   1046.1   8135   1045.4   8248   1045.2   8375   1048.4   8429
GR1047.4     8461   1050.3   8515   1045.5   8604   1039.5   8661   1043.2   8720
GR1057.8     8799   1042.8   8825   1042.8   8830   1042.8   8880   1042.8   9800
GR1042.8     9825   1057.8   9851   1038.8   9937   1036.5   10000  1045.1   10102
GR1045.3     10148  1046.4   10178  1045.5   10236  1046.8   10287  1046.8   10389
GR1046.4     10522  1041.4   10589  1045.3   10634  1045.9   10739  1045.9   10835
GR1046.2     10977  1047.2   11138  1051.5   11275
HD 11.01     10     8825    9825
NC 0.045   0.055   0.035    0.4     0.6
X1 11.34     31     9095    10147    885    1855    1680
X3    10
GR1049.1     6097   1050.4   6114   1047.0   6152   1047.7   6201   1049.6   6389
GR1050.2     6573   1049.9   6724   1048.9   6894   1048.4   7061   1048.0   7226
GR1050.1     7357   1048.8   7509   1047.8   7702   1049.0   7871   1050.1   8017
GR1050.4     8177   1051.2   8348   1050.4   8493   1050.6   8658   1050.8   8828
GR1051.0     8974   1067.6   9095   1047.6   9121   1047.6   10000  1047.6   10121
GR1067.6     10147  1056.6   10178  1056.8   10295  1060.3   10368  1060.5   10482
GR1061.0     10597
HD 11.34     10     9121    10121
NC                  0.1     0.3
X1 11.52     31     9065    10117    980     980     980
X3    10
GR1052.4     5930   1052.0   5988   1055.4   6027   1050.7   6060   1051.7   6182
GR1051.2     6305   1051.9   6462   1050.8   6571   1050.9   6715   1051.0   6849
GR1051.8     6962   1048.2   7089   1050.0   7210   1050.4   7345   1050.6   7465
GR1050.4     7550   1050.8   7652   1052.4   7800   1052.6   7916   1051.9   7950
GR1051.9     8550   1049.5   8600   1070.4   9065   1050.4   9091   1050.4   10000
GR1050.4     10091  1070.4   10117  1062.5   10209  1063.8   10315  1065.6   10431
GR1066.9     10534
HD 11.52     10     9091    10091
X1 11.80     41     9181    10233    1415    1415    1415
X3    10
GR1067.1     5780   1059.5   5793   1056.6   5830   1056.5   5946   1059.8   5964
GR1051.8     5983   1051.7   5996   1056.2   6015   1056.2   6032   1056.5   6147
GR1054.7     6200   1054.7   7200   1054.6   7406   1059.6   7529   1058.4   7629
GR1054.9     7711   1054.7   7825   1054.1   7909   1054.2   8003   1063.1   8113
GR1061.9     8139   1065.5   8163   1066.5   8224   1056.7   8280   1051.6   8480
GR1051.6     8950   1064.5   8998   1072.8   9070   1061.9   9175   1074.4   9181
GR1054.4     9207   1054.4   9300   1054.4   9400   1054.4   9500   1054.4   10000
GR1054.4     10207  1074.4   10233  1076.2   10302  1075.0   10388  1072.1   10447
GR1074.2     10502
HD 11.80     10     9207    10207
X1 12.38     23.0   9250    10302    2885    2885    2885
X3    10
GR1064.9  6240.0   1064.9  7002.0   1064.9  7519.0   1058.8  7538.0   1059.1  7761.0
GR1064.6  7806.0   1063.0  8056.0   1057.9  8112.0   1062.6  8159.0   1057.8  8303.0
GR1057.8  8562.0   1065.0  8628.0   1066.3  9110.0   1077.0  9250.0   1057.0  9276.0
GR1057.0  9300.0   1057.0  9400.0   1057.0  9500.0   1057.0  9600.0   1057.0  10276.0
GR1077.0  10302.0   1072.6  10857.0   1078.2  11420.0
```

```
HD 12.38      10     9276   10276
X1 12.84      21.0   9156   10208    2490    2480    2485
X3   10
GR1068.0   8090.0   1068.0   8098.0   1069.8   8172.0   1064.2   8206.0   1069.0   8232.0
GR1065.1   8256.0   1070.1   8308.0   1073.8   8390.0   1070.0   8436.0   1070.9   8659.0
GR1071.7   8922.0   1068.8   8957.0   1084.1   9156.0   1064.1   9182.0   1064.1  10182.0
GR1084.1  10208.0   1082.2  10255.0   1072.0  10289.0   1072.0  10425.0   1072.0  10999.0
GR1075.7  11200.0
HD 12.84      10     9182   10182
X1 13.33      72     9474   10526    2585    2585    2585
X3   10
GR1104.9   5540.0   1099.6   5578.0   1107.5   5891.0   1109.7   6222.0   1105.2   6522.0
GR1095.7   6809.0   1091.5   6880.0   1089.0   7130.0   1090.0   7510.0   1090.5   7760.0
GR1088.5   8360.0   1090.0   8660.0   1092.8   9228.2   1093.0   9251.0   1086.4   9251.1
GR1071.5   9268.5   1071.5   9370.4   1071.5   9370.5   1071.5   9379.5   1071.5   9379.6
GR1091.5   9474.0   1071.5   9500.0   1071.5   9507.5   1071.5   9507.6   1071.5   9623.4
GR1071.5   9623.5   1071.5   9632.5   1071.5   9632.6   1071.5   9748.4   1071.5   9748.5
GR1071.5   9757.5   1071.5   9757.6   1071.5   9873.4   1071.5   9873.5   1071.5   9882.5
GR1071.5   9882.6   1071.5   9995.4   1071.5   9995.5   1071.5  10004.5   1071.5  10004.6
GR1071.5  10117.4   1071.5  10117.5   1071.5  10126.5   1071.5  10126.6   1071.5  10245.9
GR1071.5  10246.0   1071.5  10255.0   1071.5  10255.1   1071.5  10376.4   1071.5  10376.5
GR1071.5  10385.5   1071.5  10485.6   1071.5  10490.4   1071.5  10495.0   1071.5  10500.0
GR1091.5  10526.0   1071.5  10630.0   1071.5  10630.1   1071.5  10639.1   1071.5  10639.2
GR1071.5  10741.1   1086.4  10758.5   1093.0  10758.6   1092.8  10784.0   1090.0  10910.0
GR1090.1  11080.0   1088.0  11380.0   1090.4  11740.0   1096.7  12172.0   1097.3  12475.0
GR1099.6  12607.0   1100.0  13232.0
HD 13.33      10     9500   10500
NC  0.04     0.04    0.03
X1 13.81      30.0   7867   10525    2560    2560    2560
X3   10
GR1099.0   6280.0   1088.1   6333.0   1083.9   6543.0   1085.6   6895.0   1085.6   7105.0
GR1082.3   7145.0   1085.1   7198.0   1080.5   7254.0   1085.4   7285.0   1083.6   7601.0
GR1084.8   7867.0   1080.5   8265.0   1080.5   8365.0   1080.5   8485.0   1080.5   9315.0
GR1080.5   9435.0   1080.5   9535.0   1081.5   9580.0   1078.6   9597.0   1078.6  10000.0
GR1078.4  10183.0   1082.8  10226.0   1080.2  10454.0   1085.1  10525.0   1087.0  10634.0
GR1099.6  10738.0   1095.4  10896.0   1096.7  11458.0   1099.1  11517.0   1099.1  11575.0
HD 13.81      10.0   8265   10454
X113.855      30.0   7867   10525     240     240     240
X3   10
GR1099.5   6280.0   1088.6   6333.0   1084.4   6543.0   1086.1   6895.0   1086.1   7105.0
GR1082.8   7145.0   1085.6   7198.0   1081.0   7254.0   1085.9   7285.0   1084.1   7601.0
GR1085.3   7867.0   1081.0   8265.0   1081.0   8365.0   1041.0   8485.0   1041.0   9315.0
GR1081.0   9435.0   1081.0   9535.0   1082.0   9580.0   1079.1   9597.0   1079.1  10000.0
GR1078.9  10183.0   1083.3  10226.0   1080.7  10454.0   1085.6  10525.0   1087.5  10634.0
GR1100.1  10738.0   1095.9  10896.0   1097.2  11458.0   1099.6  11517.0   1099.6  11575.0
HD13.855      10.0   8265   10454
X1 14.38      36.0   8125   10691    2170    3125    2725
X3   10
GR1114.0   6715.0   1112.0   6750.0   1104.0   6765.0   1100.0   6790.0   1092.0   6830.0
GR1091.0   6950.0   1092.0   7095.0   1093.3   7380.0   1092.0   7990.0   1092.0   8125.0
GR1085.4   8140.0   1085.4   8240.0   1045.4   8360.0   1045.4   9190.0   1085.4   9310.0
GR1085.4   9320.0   1085.4   9350.0   1085.4   9400.0   1085.4   9410.0   1089.1   9458.0
GR1088.0   9838.0   1084.4  10000.0   1084.4  10065.0   1092.0  10085.0   1092.6  10234.0
GR1090.5  10369.0   1086.9  10445.0   1087.3  10571.0   1097.0  10691.0   1098.7  11028.0
```

```
GR1096.0 11319.0   1096.0 11605.0   1098.6 11704.0   1102.9 12300.0   1105.5 12986.0
GR1107.2  13055.0
HD 14.38    10.0    8140   10571
X114.412    36.0    8125   10691    240     240     240
X3    10
GR1114.5   6715.0   1112.5   6750.0   1104.5   6765.0   1100.5   6790.0   1092.5   6830.0
GR1091.5   6950.0   1092.5   7095.0   1093.8   7380.0   1092.5   7990.0   1092.5   8125.0
GR1085.9   8140.0   1085.9   8240.0   1085.9   8360.0   1085.9   9190.0   1085.9   9310.0
GR1085.9   9350.0   1085.9   9375.0   1085.9   9400.0   1085.9   9410.0   1089.6   9458.0
GR1088.5    9838.0   1084.9 10000.0   1084.9 10065.0   1092.5 10085.0   1093.1 10234.0
GR1091.0 10369.0   1087.4 10445.0   1087.8 10571.0   1097.5 10691.0   1099.2 11028.0
GR1096.5 11319.0   1096.5 11605.0   1099.1 11704.0   1103.4 12300.0   1106.0 12986.0
GR1107.7  13055.0
HD14.412    10.0    8140    10571
X1 14.85    37.0    9106   10454    2050    2150    2190
GR1126.8   7870.0   1130.3   8231.0   1131.5   8555.0   1129.3   8905.0   1109.1   8978.0
GR1109.1   9053.0   1109.1   9106.0   1096.7   9197.0   1096.6   9259.0   1098.5   9354.0
GR1093.6   9431.0   1093.5   9545.0   1095.7   9695.0   1094.3   9862.0   1090.5 10000.0
GR1090.5 10077.0   1095.6 10178.0   1092.8 10404.0   1100.9 10454.0   1100.0 10870.0
GR1100.4 11172.0   1099.7 11409.0   1095.9 11456.0   1096.9 11575.0   1099.9 11720.0
GR1098.0 12018.0   1098.8 12225.0   1104.1 12350.0   1104.3 12771.0   1106.2 12981.0
GR1104.0 13275.0   1104.0 13521.0   1104.0 13777.0   1111.1 13842.0   1109.6 13895.0
GR1112.3  14491.0    1113.0  14537.0
HD 14.85     10.0    9106   10454
X114.932    44.0    9140   11341     425     425     425
X3    10
GR1128.7   7130.0   1129.3   7664.0   1130.0   8199.0   1126.5   8655.0   1125.4   8818.0
GR1127.8   9140.0   1099.0   9207.0   1097.7   9308.0   1093.3   9327.0   1093.4   9428.0
GR1097.9   9604.0   1094.8   9921.0   1090.1 10000.0   1090.9 10107.0   1096.1 10127.0
GR1095.5 10430.0   1095.0 10475.0   1095.0 10575.0   1095.0 10665.0   1095.0 11020.0
GR1095.0 11030.0   1095.0 11060.0   1095.0 11065.0   1095.0 11115.0   1100.5 11341.0
GR1096.8 11486.0   1101.8 11664.0   1101.7 11970.0   1098.1 12274.0   1100.3 12471.0
GR1103.1 12548.0   1103.6 12714.0   1099.9 12761.0   1099.9 12839.0   1101.6 12862.0
GR1104.5 13038.0   1105.8 13298.0   1107.9 13844.0   1108.1 14020.0   1108.1 14322.0
GR1108.1 14521.0   1110.6 14669.0   1109.0 14693.0   1114.4 14821.0
HD14.932     10.0    9207    10475
X1 14.94    44.0    9140   11341     45      45      45
X3    10
GR1128.8   7130.0   1129.4   7664.0   1130.1   8199.0   1126.6   8655.0   1125.5   8818.0
GR1127.9   9140.0   1099.1   9207.0   1097.8   9308.0   1093.4   9327.0   1093.5   9428.0
GR1098.0   9604.0   1094.9   9921.0   1091.0 10000.0   1091.0 10107.0   1096.2 10127.0
GR1095.5 10430.0   1095.1 10480.0   1095.1 10580.0   1080.1 10670.0   1080.1 11025.0
GR1095.1 11070.0   1095.1 11100.0   1095.1 11110.0   1095.1 11120.0   1100.6 11341.0
GR1096.9 11486.0   1101.9 11664.0   1101.8 11970.0   1098.2 12274.0   1100.4 12471.0
GR1103.2 12548.0   1103.7 12714.0   1100.0 12761.0   1100.0 12839.0   1101.7 12862.0
GR1104.6 13038.0   1105.9 13298.0   1108.0 13844.0   1108.2 14020.0   1108.2 14322.0
GR1108.2 14521.0   1110.7 14669.0   1109.1 14693.0   1114.5 14821.0
HD 14.94     10.0    9207    10475
X115.063    40.0    9277   11399     650     650     650
X3    10
GR1129.5   7425.0   1131.5   8149.0   1131.2   8614.0   1130.8   8893.0   1130.3   9277.0
GR1103.1   9332.0   1104.7   9426.0   1094.3   9498.0   1094.3   9541.0   1097.4   9644.0
GR1097.9   9772.0   1095.3   9968.0   1092.1 10000.0   1092.1 10060.0   1100.6 10106.0
GR1098.2 10337.0   1096.4 10590.0   1096.4 10690.0   1081.4 10735.0   1081.4 11135.0
```

```
GR1096.4 11180.0   1096.4 11190.0   1096.4 11200.0   1096.4 11230.0   1102.2 11399.0
GR1099.4 11631.0   1102.5 11691.0   1105.0 12248.0   1108.8 12275.0   1107.9 12321.0
GR1100.9 12497.0   1098.7 12533.0   1106.0 12753.0   1106.4 13055.0   1100.1 13184.0
GR1107.9 13490.0   1110.0 13772.0   1112.3 14455.0   1115.0 14926.0   1115.6 15017.0
HD15.063    10.0    9332    10590
X115.303     41    9681    11192    1175    1175    1175
X3   10
GR1130.6   8550.0   1130.0   8960.0   1122.9   9017.0   1122.9   9350.0   1129.8   9421.0
GR1130.1   9681.0   1097.0   9832.0   1096.5   9930.0   1093.3 10000.0   1101.3 10078.0
GR1098.8 10111.0   1101.7 10262.0   1102.0 10464.0   1098.8 10540.0   1098.8 10640.0
GR1083.8 10685.0   1083.8 11085.0   1098.8 11130.0   1098.8 11150.0   1098.8 11170.0
GR1098.8 11180.0   1101.4 11192.0   1101.5 11269.0   1103.4 11329.0   1103.6 11469.0
GR1100.8 11607.0   1105.8 11762.0   1105.8 12259.0   1108.6 12799.0   1108.2 13228.0
GR1110.5 13486.0   1114.2 13529.0   1114.4 13551.0   1110.8 13578.0   1110.8 13644.0
GR1112.3 13701.0   1111.8 14045.0   1114.8 14555.0   1113.6 14647.0   1116.5 15208.0
GR1120.1  15704.0
HD15.303    10.0    9832    10540
X1 15.32     41    9681   11192     90     90     90
X3   10
GR1130.8   8550.0   1130.2   8960.0   1123.1   9017.0   1123.1   9350.0   1130.0   9421.0
GR1130.3   9681.0   1097.2   9832.0   1096.7   9930.0   1093.5 10000.0   1101.5 10078.0
GR1099.0 10111.0   1101.9 10262.0   1102.2 10464.0   1099.0 10540.0   1099.0 10640.0
GR1099.0 10685.0   1099.0 11085.0   1099.0 11130.0   1099.0 11150.0   1099.0 11160.0
GR1099.0 11180.0   1101.6 11192.0   1101.7 11269.0   1103.6 11329.0   1103.8 11469.0
GR1101.0 11607.0   1106.0 11762.0   1106.0 12259.0   1108.8 12799.0   1108.4 13228.0
GR1110.7 13486.0   1114.4 13529.0   1114.6 13551.0   1111.0 13578.0   1111.0 13644.0
GR1112.5 13701.0   1112.0 14045.0   1115.0 14555.0   1113.8 14647.0   1116.7 15208.0
GR1120.3  15704.0
HD 15.32    10.0    9832   10540
NC   .04     .04     .03     .1     .3
X1 15.51     26.0    9756   11854     955    1015     985
X3   10
GR1132.5   8225.0   1133.5   8731.0   1134.5   9204.0   1135.8   9756.0   1099.6   9807.0
GR1097.3 10000.0   1097.3 10089.0   1106.7 10175.0   1106.9 10257.0   1105.4 10533.0
GR1103.3 10702.0   1107.7 10757.0   1109.1 11151.0   1108.7 11527.0   1103.5 11559.0
GR1106.9 11700.0   1103.8 11808.0   1110.9 11854.0   1107.5 11935.0   1110.1 12774.0
GR1110.3 13006.0   1112.8 13696.0   1114.1 14347.0   1117.2 15047.0   1122.8 15652.0
GR1124.4  15898.0
HD 15.51      10    9756    11854
X1 15.98     14.0    9825   10836    2425    2365    2395
X3   10
GR1139.6   8040.0   1139.5   8983.0   1139.6   9505.0   1135.9   9825.0   1106.8   9884.0
GR1108.1   9954.0   1108.6 10000.0   1106.3 10158.0   1103.9 10238.0   1106.2 10332.0
GR1106.0 10456.0   1106.0 10684.0   1160.3 10836.0   1163.1 10929.0
HD 15.98      10    9825   10836
NC                        .3     .5
X1 16.42       28  9776.8 10225.4    2185    2225    2215
X3   10
GR1147.6   8340.0   1143.6   8975.0   1136.5   9604.0   1134.9   9754.0   1135.8   9776.7
GR1130.3   9776.8   1108.7   9798.4   1108.7   9859.0   1108.7   9859.1   1108.7   9865.0
GR1108.7   9865.1   1108.7   9950.9   1108.7   9951.0   1108.7   9957.0   1108.7   9957.1
GR1108.7 10046.0   1108.7 10046.1   1108.7 10051.9   1108.7 10052.0   1108.7 10052.1
GR1108.7 10138.1   1108.7 10138.2   1108.7 10144.2   1108.7 10144.3   1108.7 10203.8
GR1124.8 10225.3   1130.3 10225.4   1130.0 10282.0
```

```
HD 16.42        10  9776.8 10225.4
X116.446        64  9768.4 10241.0      95      95      95
X3    10
GR1149.6  7650.0  1147.3  8109.0  1144.8  8614.0  1141.7  9172.0  1136.7  9700.0
GR1139.0  9766.0  1132.0  9768.4  1110.0  9768.5  1110.0  9787.4  1110.0  9871.4
GR1110.0  9882.3  1110.0  9882.4  1110.0  9888.4  1110.0  9888.5  1110.0  9894.3
GR1110.0  9894.4  1110.0  9984.4  1110.0  9984.5  1110.0  9996.5  1110.0  9996.6
GR1110.0 10080.4  1110.0 10080.5  1110.0 10092.5  1118.0 10092.6  1118.0 10100.9
GR1118.0 10101.0  1118.0 10103.7  1118.0 10104.1  1118.0 10116.9  1118.0 10117.0
GR1118.0 10119.4  1118.0 10119.5  1118.0 10132.3  1118.0 10132.4  1118.0 10134.9
GR1118.0 10135.0  1118.0 10147.4  1118.0 10147.5  1118.0 10149.9  1118.0 10150.0
GR1118.0 10162.8  1118.0 10162.9  1118.0 10165.3  1118.0 10165.4  1118.0 10177.9
GR1118.0 10178.0  1118.0 10180.7  1118.0 10180.8  1118.0 10193.9  1118.0 10194.0
GR1118.0 10196.4  1118.0 10196.5  1118.0 10209.3  1118.0 10209.4  1118.0 10211.9
GR1118.0 10212.0  1118.0 10225.2  1118.0 10225.3  1121.6 10227.9  1121.6 10228.0
GR1131.7 10241.0  1134.7 10241.1  1133.9 10259.0  1132.0 10330.0
HD16.446        10  9768.4 10241.0
X1 16.45        31  9768.4 10820.4      20      20      20
X3    10
GR1149.6  7650.0  1147.3  8109.0  1144.8  8614.0  1141.7  9172.0  1136.7  9700.0
GR1139.0  9766.0  1130.0  9768.4  1110.0  9794.4  1110.0  9800.4  1110.0  9871.4
GR1110.0  9882.3  1110.0  9882.4  1110.0  9888.4  1110.0  9888.5  1110.0  9894.3
GR1110.0  9894.4  1110.0  9984.4  1110.0  9984.5  1110.0  9996.5  1110.0  9996.6
GR1110.0 10212.0  1110.0 10225.2  1110.0 10225.3  1110.0 10227.9  1110.0 10228.0
GR1110.0 10241.0  1110.0 10241.1  1110.0 10259.0  1110.0 10330.0  1110.0 10794.4
GR1130.0 10820.4
HD 16.45        10  9794.4 10794.4
NC          .040      0.1     0.3
X1 16.91     22.0    9758   10810    2515    2200    2440
X3    10
GR1157.2  8940.0  1156.2  9371.0  1149.0  9481.0  1137.0  9504.0  1153.3  9525.0
GR1154.0  9567.0  1131.4  9634.0  1153.1  9684.0  1137.1  9758.0  1117.1  9784.0
GR1117.1 10000.0  1117.1 10784.0  1137.1 10810.0  1126.5 11022.0  1126.6 11856.0
GR1127.0 12659.0  1127.0 12926.0  1124.0 12946.0  1124.0 13447.0  1124.0 13483.0
GR1121.7 13509.0  1131.2 13564.0
HD 16.91        10    9784   10784
NC  .045      .04
X1 17.38     30.0    9271   10323    2930    2140    2455
X3    10
GR1173.3  7910.0  1172.6  8368.0  1171.1  8528.0  1166.4  8562.0  1171.3  8593.0
GR1169.3  8760.0  1140.8  8931.0  1133.6  9233.0  1144.3  9271.0  1124.3  9297.0
GR1124.3  9845.0  1124.3  9863.0  1124.3 10000.0  1124.3 10297.0  1144.3 10323.0
GR1127.7 10427.0  1135.1 10670.0  1132.9 10799.0  1132.0 10805.0  1132.0 11178.0
GR1132.0 11531.0  1132.0 11610.0  1134.1 11796.0  1134.6 12108.0  1133.8 12513.0
GR1134.4 13146.0  1134.1 13870.0  1133.0 14530.0  1131.6 14592.0  1137.5 14638.0
HD 17.38        10    9297   10297
X1 17.76     33.0    9295   10347    2140    1900    1980
X3    10
GR1141.1  8240.0  1139.6  8320.0  1137.6  8483.0  1138.7  8742.0  1132.8  8767.0
GR1132.5  8796.0  1137.5  8819.0  1134.8  8919.0  1134.0  8995.0  1128.0  9034.0
GR1129.8  9054.0  1132.8  9095.0  1132.8  9158.0  1128.0  9273.0  1150.1  9295.0
GR1130.1  9321.0  1130.1  9539.0  1130.1  9703.0  1130.1  9724.0  1130.1  9779.0
GR1130.1  9833.0  1130.1 10000.0  1130.1 10109.0  1130.1 10321.0  1150.1 10347.0
GR1138.3 10431.0  1132.2 10463.0  1134.4 10767.0  1137.8 10792.0  1139.4 11097.0
```

```
GR1139.9  11982.0    1139.0  12635.0    1137.5  13350.0
HD 17.76       10     9321    10321
X1 18.24     28.0     9781    10843     2335     2690     2525
X3   10
GR1139.7   8800.0   1147.0   8886.0   1147.3   8934.0   1151.0   8949.0   1144.6   8972.0
GR1143.2   9072.0   1138.0   9076.0   1138.0   9198.0   1145.4   9204.0   1144.3   9676.0
GR1140.1   9693.0   1157.5   9781.0   1137.5   9817.0   1137.5  10000.0   1137.5  10046.0
GR1137.5  10063.0   1137.5  10302.0   1137.5  10346.0   1137.5  10430.0   1137.5  10817.0
GR1157.5  10843.0   1144.8  10869.0   1144.8  10927.0   1146.9  10964.0   1147.2  11153.0
GR1142.7  11242.0   1145.5  11290.0   1145.8  11340.0
HD 18.24       10     9817    10817
X1 18.92       27   9524.9  10576.9     3620     3800     3595
X3   10
GR1163.0   8060.0   1163.7   8254.0   1163.8   8693.0   1164.2   9148.0   1166.9   9325.0
GR1168.4   9434.5   1168.8   9447.5   1160.5   9447.6   1149.2   9457.6   1168.0   9524.9
GR1148.0   9550.9   1148.0   9573.3   1148.0   9573.4   1148.0   9691.8   1148.0  10000.0
GR1148.0  10455.1   1148.0  10550.9   1168.0  10576.9   1172.0  10577.0   1171.9  10590.0
GR1169.2  10727.0   1173.6  11160.0   1176.2  11672.0   1178.3  12466.0   1178.9  12918.0
GR1179.6  13066.0   1178.6  13305.0
HD 18.92       10   9550.9  10550.9
NC  0.04     0.04     0.03       .1       .3
X1 19.44     40.0     9088    10140     2805     2795     2800
X3   10
GR1172.9   7491.0   1165.9   7506.0   1166.9   7595.0   1159.6   7627.0   1161.4   7731.0
GR1162.5   7859.0   1160.9   8000.0   1163.0   8172.0   1159.3   8229.0   1162.8   8307.0
GR1157.0   8510.0   1158.5   8795.0   1163.0   8849.0   1164.8   9063.0   1176.2   9088.0
GR1156.2   9114.0   1156.2   9574.0   1156.2   9628.0   1156.2   9684.0   1156.2   9781.0
GR1156.2   9881.0   1156.2  10114.0   1176.2  10140.0   1183.1  10174.0   1183.2  10319.0
GR1179.6  10437.0   1181.5  10531.0   1180.7  10572.0   1183.5  10645.0   1186.5  10961.0
GR1190.0  11422.0   1191.7  11525.0   1189.6  11691.0   1191.4  11816.0   1191.7  11982.0
GR1188.2  12154.0   1189.6  12309.0   1191.6  12445.0   1191.1  12623.0   1193.2  12818.0
HD 19.44       10     9114    10114
X1 19.89     33.0     8142    10997     2375     2375     2375
X3   10
GR1179.6   8142.0   1167.7   8170.0   1167.7   8313.0   1171.9   8461.0   1170.7   8537.0
GR1170.9   8940.0   1165.4   8978.0   1166.4   9173.0   1168.5   9498.0   1167.9   9844.0
GR1163.3   9930.0   1164.7  10000.0   1168.5  10067.0   1168.5  10231.0   1166.9  10267.0
GR1167.1  10344.0   1171.3  10381.0   1170.1  10742.0   1168.4  10791.0   1187.0  10886.0
GR1198.6  10997.0   1197.7  11072.0   1190.8  11136.0   1198.8  11190.0   1201.5  11346.0
GR1202.2  11679.0   1203.7  12153.0   1202.6  12468.0   1204.1  12707.0   1199.6  12868.0
GR1202.5  13091.0   1200.4  13148.0   1202.2  13477.0
HD 19.89       10     8142    10997
NC  0.04     0.04     0.03
X119.944     33.0     9474    10526      285      285      285
X3   10
GR1180.5   8142.0   1172.0   8142.0   1172.0   8259.0   1172.0   8304.0   1172.0   8839.0
GR1172.0   8884.0   1172.0   9400.0   1183.3   9474.0   1163.3   9500.0   1163.3   9844.0
GR1163.3   9930.0   1163.3  10000.0   1163.3  10067.0   1163.3  10231.0   1163.3  10267.0
GR1163.3  10500.0   1183.3  10526.0   1171.0  10742.0   1169.3  10791.0   1187.9  10886.0
GR1199.5  10997.0   1198.6  11072.0   1191.7  11136.0   1199.7  11190.0   1202.4  11346.0
GR1203.1  11679.0   1204.6  12153.0   1203.5  12468.0   1205.0  12707.0   1200.5  12868.0
GR1203.4  13091.0   1201.3  13148.0   1203.1  13477.0
HD19.944     10.0     9500    10500
X119.953     33.0   8141.9    10997       45       45       45
```

```
X3    10
GR1180.7   8142.0   1172.1   8142.0   1172.1   8259.0   1142.1   8304.0   1142.1   8837.0
GR1172.1   8884.0   1172.1   9610.0   1172.1   9620.0   1172.1   9626.0   1169.0   9844.0
GR1164.4   9930.0   1165.8 10000.0   1169.6 10067.0   1169.6 10231.0   1168.0 10267.0
GR1168.2 10344.0   1172.4 10381.0   1171.2 10742.0   1169.5 10791.0   1188.1 10886.0
GR1199.7 10997.0   1198.8 11072.0   1191.9 11136.0   1199.9 11190.0   1202.5 11346.0
GR1203.3 11679.0   1204.8 12153.0   1203.7 12468.0   1205.2 12707.0   1200.7 12868.0
GR1203.6 13091.0   1201.5 13148.0   1203.3 13477.0
HD19.953     10.0     8142     10886
X120.240     20.0     7901     10136   1565.0   1565.0   1565.0
X3    10
GR1185.7   7901.0   1177.3   7910.0   1177.3   8027.0   1147.3   8072.0   1147.3   9091.0
GR1177.3   9136.0   1177.3   9216.0   1174.5   9217.0   1171.9   9228.0   1172.7   9635.0
GR1170.9   9822.0   1173.2   9850.0   1172.5   9993.0   1171.0 10000.0   1175.4 10136.0
GR1174.1 10165.0   1172.8 10197.0   1172.9 10248.0   1175.8 10273.0   1176.0 10370.0
HD20.240     10.0     7910     10000
X1 20.55     18.0     8038     10218   1650.0   1650.0   1650.0
X3    10
GR1190.5   8038.0   1182.7   8045.0   1182.7   8162.0   1152.7   8207.0   1152.7   9200.0
GR1152.7   9226.0   1182.7   9271.0   1182.7   9351.0   1178.9   9447.0   1178.4   9499.0
GR1179.7   9571.0   1179.5   9733.0   1177.0   9845.0   1174.7   9860.0   1174.3 10000.0
GR1175.8 10133.0   1232.3 10218.0   1232.8 10334.0
HD 20.55     10.0     8045     10133
X120.563     18.0     8038     10218     70.0     70.0     70.0
X3    10
GR1190.7   8038.0   1182.9   8045.0   1182.9   8162.0   1182.9   8207.0   1182.9   9200.0
GR1182.9   9226.0   1182.9   9271.0   1182.9   9351.0   1179.1   9447.0   1178.6   9499.0
GR1179.9   9571.0   1179.7   9733.0   1177.2   9845.0   1174.9   9860.0   1174.5 10000.0
GR1176.0 10133.0   1232.5 10218.0   1233.0 10334.0
HD20.563     10.0     8045     10133
X120.577     18.0     8038     10218     70.0     70.0     70.0
X3    10
GR1191.0   8038.0   1183.1   8040.0   1183.1   8157.0   1153.1   8202.0   1153.1   9221.0
GR1153.1   9221.0   1183.1   9266.0   1183.1   9346.0   1179.4   9447.0   1178.9   9499.0
GR1180.4   9571.0   1180.0   9733.0   1177.5   9845.0   1175.2   9860.0   1174.8 10000.0
GR1176.3 10133.0   1232.8 10218.0   1233.3 10334.0
HD20.577     10.0     8045     10133
X1 20.64     19.0     7780     10100    373.0    373.0    373.0
X3    10
GR1192.7   7780.0   1184.3   8000.0   1184.3   8117.0   1154.3   8162.0   1154.3   8500.0
GR1154.3   9100.0   1154.3   9181.0   1184.3   9226.0   1184.3   9306.0   1180.7   9342.0
GR1177.5   9353.0   1177.5   9415.0   1179.3   9582.0   1175.5   9686.0   1177.4   9835.0
GR1174.8 10000.0   1174.8 10037.0   1231.5 10100.0   1230.1 10302.0
HD 20.64     10.0     8000     10037
X120.657     24.0     7780     10100     90.0     90.0     90.0
X3    10
GR1193.0   7780.0   1181.1   8036.0   1186.4   8154.0   1184.7   8460.0   1184.6   8640.0
GR1184.6   8741.0   1154.6   8801.0   1154.6   8900.0   1154.6   8950.0   1154.6   9000.0
GR1154.6   9170.0   1154.6   9172.0   1184.6   9217.0   1184.6   9297.0   1181.0   9342.0
GR1177.8   9353.0   1177.8   9415.0   1179.6   9582.0   1175.8   9686.0   1177.7   9835.0
GR1175.1 10000.0   1175.1 10037.0   1231.8 10100.0   1230.4 10302.0
HD20.657     10.0     8000     10037
X1 20.92     27.0     8990     10707     1096     1096     1096
X3    10
```

```
GR1193.7   7924.0   1186.0   7956.0   1182.0   8088.0   1182.0   8276.0   1186.4   8301.0
GR1186.4   8561.0   1186.0   8587.0   1186.0   8811.0   1186.3   8931.0   1188.2   8990.0
GR1188.2   9091.0   1158.2   9151.0   1158.2   9300.0   1158.2   9522.0   1188.2   9567.0
GR1188.2   9647.0   1180.3   9704.0   1182.0   9870.0   1179.5  10000.0   1179.5  10060.0
GR1185.1  10092.0   1183.8  10370.0   1186.8  10452.0   1186.5  10542.0   1183.3  10586.0
GR1240.9  10707.0   1240.7  10888.0
HD 20.92     10.0     9091    10586
X120.933     27.0     8990    10707      70      70      70
X3    10
GR1193.9   7924.0   1186.2   7956.0   1182.2   8088.0   1182.2   8276.0   1186.6   8301.0
GR1186.6   8561.0   1186.2   8587.0   1186.2   8811.0   1186.5   8931.0   1188.4   8990.0
GR1188.4   9091.0   1188.4   9151.0   1188.4   9522.0   1188.4   9560.0   1188.4   9567.0
GR1188.4   9647.0   1180.4   9704.0   1182.2   9870.0   1179.7  10000.0   1179.7  10060.0
GR1185.3  10092.0   1184.0  10370.0   1187.0  10452.0   1186.7  10542.0   1183.5  10586.0
GR1241.1  10707.0   1240.9  10888.0
HD20.933     10.0     9091    10586
X1 21.01     26.0   8125.0 10446.0     110     380     360
GR1194.1   8125.0   1186.0   8152.0   1183.0   8281.0   1183.0   8354.0   1183.0   8562.0
GR1186.1   8610.0   1186.0   8713.0   1186.0   8842.0   1186.0   8920.0   1188.6   9289.0
GR1187.1   9531.0   1180.1   9576.0   1179.8   9709.0   1179.3   9822.0   1181.8   9861.0
GR1182.1  10000.0   1182.1  10156.0   1185.3  10172.0   1185.8  10339.0   1183.7  10394.0
GR1189.0  10446.0   1185.7  10615.0   1188.3  10647.0   1186.1  11010.0   1243.3  11107.0
GR1242.4  11265.0
HD 21.01       10     8125    10446
X1 21.42     49.0   9359.0 10853.0    2190    2140    2165
GR1224.5   7114.0   1225.2   7218.0   1218.2   7416.0   1211.3   7456.0   1211.8   7527.0
GR1219.5   7559.0   1219.7   7707.0   1208.7   7951.0   1204.6   8154.0   1208.1   8189.0
GR1208.1   8209.0   1208.0   8232.0   1208.0   8599.0   1209.1   8617.0   1209.1   8642.0
GR1199.3   8734.0   1198.5   8868.0   1195.0   8887.0   1194.6   9028.0   1190.5   9053.0
GR1194.6   9239.0   1194.7   9359.0   1193.8   9582.0   1187.7   9597.0   1187.0  10000.0
GR1189.8  10017.0   1189.9  10056.0   1189.9  10192.0   1193.6  10204.0   1188.3  10227.0
GR1190.7  10561.0   1193.3  10574.0   1194.5  10853.0   1192.5  10888.0   1194.0  10931.0
GR1194.0  11080.0   1190.1  11202.0   1193.2  11246.0   1192.0  11311.0   1194.8  11366.0
GR1194.6  11690.0   1194.8  12000.0   1192.4  12026.0   1193.9  12051.0   1194.0  12458.0
GR1195.6  12730.0   1257.3  12864.0   1258.2  12903.0   1258.3  12958.0
HD 21.42       10   9359.0    10853
X121.500     40.0     8950    13033   450.0   470.0   460.0
X3    10
GR1226.8   7378.0   1227.3   7718.0   1213.9   7781.0   1215.0   7876.0   1212.3   8052.0
GR1208.6   8092.0   1205.7   8305.0   1203.6   8422.0   1209.3   8501.0   1209.3   8509.0
GR1209.3   8530.0   1209.7   8917.0   1209.7   8931.0   1209.7   8950.0   1197.1   9068.0
GR1197.0   9221.0   1192.6   9271.0   1195.2   9407.0   1189.2   9496.0   1188.4   9661.0
GR1190.7   9704.0   1190.9   9871.0   1188.2   9900.0   1188.2  10000.0   1188.1  10205.0
GR1195.6  10365.0   1195.6  10665.0   1195.7  10953.0   1195.0  11267.0   1191.5  11296.0
GR1193.8  11464.0   1198.2  11615.0   1198.2  11760.0   1198.2  12685.0   1198.2  12805.0
GR1196.2  12929.0   1199.0  12976.0   1220.6  13033.0   1258.7  13215.0   1259.5  13298.0
HD21.500     10.0     9068    12976
X121.523     40.0     8950    13033   120.0   120.0   120.0
X3    10
GR1227.0   7378.0   1227.5   7718.0   1214.1   7781.0   1215.2   7876.0   1212.5   8052.0
GR1208.8   8092.0   1205.9   8305.0   1203.8   8422.0   1209.5   8501.0   1209.5   8509.0
GR1209.5   8530.0   1209.9   8917.0   1209.9   8931.0   1209.9   8950.0   1197.3   9068.0
GR1197.2   9221.0   1192.8   9271.0   1195.4   9407.0   1189.4   9496.0   1188.6   9661.0
GR1190.9   9704.0   1191.1   9871.0   1188.4   9900.0   1188.4  10000.0   1188.3  10205.0
```

```
GR1195.8 10365.0   1195.8 10665.0   1195.9 10953.0   1195.2 11267.0   1191.7 11296.0
GR1198.4 11420.0   1198.4 11775.0   1158.4 11895.0   1158.4 12745.0   1198.4 12865.0
GR1198.4 12975.0   1199.2 12976.0   1220.8 13033.0   1258.9 13215.0   1259.7 13298.0
HD21.523    10.0    9068    12976
X121.657    40.0    8453    13966   710.0   710.0   710.0
X3   10
GR1228.9   8245.0  1228.5   8369.0  1222.9   8453.0  1206.8   8546.0  1204.1   8656.0
GR1202.5   8881.0  1204.0   8960.0  1204.0   8970.0  1204.0   8980.0  1204.0   8985.0
GR1204.0   9725.0   1191.2   9725.0   1191.2 10000.0   1191.2 10485.0   1191.2 10595.0
GR1193.6 10768.0   1198.6 10831.0   1198.0 11046.0   1198.1 11312.0   1197.2 11482.0
GR1193.8 11520.0   1196.5 11645.0   1199.8 11735.0   1199.8 11895.0   1159.8 12015.0
GR1159.8 13200.0   1199.8 13320.0   1199.8 13330.0   1199.8 13340.0   1199.8 13350.0
GR1199.8 13360.0   1199.8 13410.0   1197.6 13424.0   1211.6 13471.0   1207.7 13489.0
GR1215.6 13552.0   1215.7 13730.0   1256.7 13966.0   1261.2 14034.0   1262.6 14154.0
HD21.657      10    8546    13730
X121.680    35.0    8453    13966   120.0   120.0   120.0
X3   10
GR1230.3   8245.0  1229.9   8369.0  1224.3   8453.0  1208.2   8546.0  1205.5   8656.0
GR1203.9   8881.0  1204.2   9040.0  1204.2   9698.0  1204.2   9735.0  1191.4   9735.0
GR1151.4   9855.0   1151.4 10000.0   1151.4 10455.0   1191.4 10575.0   1191.4 10685.0
GR1195.0 10768.0   1200.0 10831.0   1199.4 11046.0   1199.5 11312.0   1198.6 11482.0
GR1195.2 11520.0   1200.0 11575.0   1200.0 11915.0   1160.0 12035.0   1160.0 12500.0
GR1160.5 13000.0   1160.0 13100.0   1160.0 13200.0   1160.0 13220.0   1200.0 13340.0
GR1200.0 13690.0   1217.1 13730.0   1258.1 13966.0   1262.6 14034.0   1264.0 14154.0
HD21.680      10    8546    13730
X1 21.76    32.0    8805    14570   460.0   460.0   460.0
X3   10
GR1228.1   8805.0  1209.5   8922.0  1206.3   9217.0  1205.1   9495.0  1205.1   9905.0
GR1192.3   9905.0   1152.3 10025.0   1152.3 10975.0   1192.3 11095.0   1192.3 11097.0
GR1192.3 11100.0   1192.3 11150.0   1192.3 11205.0   1196.1 11280.0   1200.8 11304.0
GR1201.2 11468.0   1198.4 11495.0   1196.6 11568.0   1199.8 11592.0   1200.9 11625.0
GR1200.9 12075.0   1160.9 12195.0   1160.9 13380.0   1200.9 13500.0   1200.9 13600.0
GR1200.9 13700.0   1200.9 14000.0   1200.9 14100.0   1212.1 14121.0   1217.0 14284.0
GR1266.1 14570.0   1266.3 14870.0
HD 21.76    10.0    8922    14284
X121.773    32.0    8805    14570    70.0    70.0    70.0
X3   10
GR1228.2   8805.0  1209.6   8922.0  1206.4   9217.0  1205.2   9570.0  1205.2   9887.0
GR1205.2   9925.0   1192.4   9925.0   1152.4 10045.0   1152.4 10100.0   1152.4 11030.0
GR1152.4 11040.0   1192.4 11160.0   1192.4 11270.0   1196.2 11280.0   1200.9 11304.0
GR1201.3 11468.0   1198.5 11495.0   1196.7 11568.0   1199.9 11592.0   1201.0 11695.0
GR1201.0 12095.0   1161.0 12215.0   1161.0 12500.0   1161.0 12600.0   1161.0 13000.0
GR1161.0 13400.0   1201.0 13520.0   1201.0 14080.0   1212.2 14121.0   1217.1 14284.0
GR1266.2 14570.0   1266.4 14870.0
HD21.773    10.0    8922    14284
X121.818    32.0    8805    14570   240.0   240.0   240.0
X3   10
GR1228.7   8805.0  1210.1   8922.0  1206.9   9217.0  1204.5   9660.0  1205.7   9750.0
GR1205.7   9887.0  1205.7   9955.0  1192.9   9955.0  1192.9 10000.0   1192.9 11405.0
GR1201.8 11468.0   1199.0 11495.0   1197.2 11568.0   1200.4 11592.0   1200.8 11813.0
GR1198.5 11871.0   1201.5 11930.0   1201.5 12155.0   1161.5 12275.0   1161.5 13460.0
GR1201.5 13580.0   1201.5 13600.0   1201.5 13650.0   1201.5 13700.0   1201.5 13800.0
GR1201.5 13860.0   1213.0 13935.0   1208.3 13964.0   1212.7 14121.0   1217.6 14284.0
GR1266.7 14570.0   1266.9 14870.0
```

```
HD21.818      10    8922   14284
X121.850    38.0    9103   14171   240.0   240.0   240.0
X3   10
GR1228.5   8864.0   1228.8   9103.0   1209.4   9236.0   1203.1   9631.0   1198.5   9642.0
GR1203.2   9657.0   1205.8   9889.0   1200.1   9897.0   1205.2   9912.0   1195.2   9929.0
GR1195.0  10000.0   1196.0  10233.0   1197.3  10589.0   1194.6  10792.0   1194.2  10911.0
GR1199.4  10957.0   1199.4  11055.0   1194.5  11148.0   1195.0  11307.0   1199.6  11368.0
GR1198.5  11501.0   1197.1  11565.0   1200.1  11584.0   1198.9  11922.0   1202.3  11936.0
GR1202.0  12115.0   1202.0  12225.0   1202.0  13645.0   1205.4  14048.0   1207.3  14059.0
GR1204.2  14073.0   1206.6  14116.0   1221.1  14171.0   1218.8  14273.0   1219.8  14518.0
GR1222.8  14881.0   1266.6  15134.0   1269.1  15377.0
HD21.850    10.0    9236   14116
X122.107    36.0    9978   14136  1230.0  1130.0  1380.0
X3   10
GR1237.5   9912.0   1236.3   9978.0   1198.6  10000.0   1198.7  10062.0   1203.4  10250.0
GR1204.2  10362.0   1201.7  10521.0   1204.3  10547.0   1201.7  10988.0   1198.2  11001.0
GR1199.0  11154.0   1200.8  11170.0   1200.8  12605.0   1200.8  12610.0   1200.8  12630.0
GR1200.8  12660.0   1206.8  13003.0   1206.0  13654.0   1206.4  14096.0   1215.2  14136.0
GR1210.7  14196.0   1219.7  14246.0   1216.7  14354.0   1221.4  14552.0   1222.4  14646.0
GR1217.1  14805.0   1222.4  14848.0   1220.2  15061.0   1221.8  15279.0   1228.4  15415.0
GR1222.0  15582.0   1231.0  15653.0   1234.4  15743.0   1222.4  15855.0   1235.0  15980.0
GR1237.5  16037.0
HD22.107      10   10000   14096
X122.130    36.0    9978   14136   120.0   120.0   120.0
X3   10
GR1237.7   9912.0   1236.5   9978.0   1198.8  10000.0   1198.9  10062.0   1203.6  10250.0
GR1204.4  10362.0   1201.9  10521.0   1204.5  10547.0   1201.9  10988.0   1198.4  11001.0
GR1199.2  11154.0   1201.0  11280.0   1161.0  11555.0   1161.0  12545.0   1201.0  12640.0
GR1201.0  12770.0   1207.0  13003.0   1206.2  13654.0   1206.6  14096.0   1215.4  14136.0
GR1210.9  14196.0   1219.9  14246.0   1216.9  14354.0   1221.6  14552.0   1222.6  14646.0
GR1217.3  14805.0   1222.6  14848.0   1220.4  15061.0   1222.0  15279.0   1228.6  15415.0
GR1222.2  15582.0   1231.2  15653.0   1234.6  15743.0   1222.6  15855.0   1235.2  15980.0
GR1237.7  16037.0
HD22.130      10   10000   14096
X1 22.32    29.0    9946   13430    1005    1005    1005
X3   10
GR1241.3   9793.0   1238.4   9946.0   1201.1  10000.0   1201.2  10023.0   1202.2  10044.0
GR1206.6  10368.0   1206.6  10615.0   1203.2  10989.0   1201.0  10999.0   1201.1  11063.0
GR1203.0  11080.0   1202.0  11264.0   1207.5  11286.0   1207.6  11421.0   1204.2  11488.0
GR1205.5  11529.0   1203.0  11625.0   1203.0  11740.0   1163.0  12015.0   1163.0  12520.0
GR1203.0  12615.0   1203.0  12700.0   1203.0  12800.0   1203.0  12900.0   1203.0  13000.0
GR1203.0  13185.0   1208.9  13430.0   1208.0  14025.0   1217.2  14068.0
HD 22.32      10   10000   13185
X122.365    29.0    9946   13430     240     240     240
X3   10
GR1241.8   9793.0   1238.9   9946.0   1201.6  10000.0   1201.7  10023.0   1202.7  10044.0
GR1207.1  10368.0   1207.1  10615.0   1203.7  10989.0   1201.5  10999.0   1201.6  11063.0
GR1203.5  11080.0   1202.5  11264.0   1208.0  11286.0   1208.1  11421.0   1204.7  11488.0
GR1206.0  11529.0   1204.7  11586.0   1206.0  11657.0   1203.5  11700.0   1203.5  11815.0
GR1203.5  11900.0   1203.5  12000.0   1203.5  12500.0   1203.5  12575.0   1203.5  13000.0
GR1203.5  13255.0   1209.4  13430.0   1208.5  14025.0   1217.7  14068.0
HD22.365      10   10000   13255
NC 0.040   0.031   0.030
X1 22.79    27.0  9941.0 13467.0    2510    2335    2510
```

```
GR1251.9   9874.0   1251.2   9941.0   1209.1  10000.0   1209.1  10014.0   1209.9  10117.0
GR1211.7  10136.0   1212.4  10314.0   1210.0  10336.0   1214.5  10427.0   1214.0  10515.0
GR1215.9  10524.0   1215.4  10737.0   1215.1  11031.0   1211.7  11045.0   1212.9  11344.0
GR1214.9  11538.0   1213.6  11747.0   1215.3  12059.0   1214.6  12405.0   1211.6  12427.0
GR1212.7  12591.0   1213.1  12892.0   1212.6  13139.0   1215.3  13290.0   1219.1  13408.0
GR1224.9  13467.0   1229.4  13648.0
HD 22.79       10     9941    13467
NC 0.040    0.034    0.030
X1 23.35     43.0     9495    13860   2970.0   2570.0   2930.0
X3     10
GR1262.8   9454.0   1260.9   9495.0   1226.5   9564.0   1220.9   9575.0   1220.9   9775.0
GR1220.9   9800.0   1220.9   9900.0   1220.9   9950.0   1220.9   9960.0   1220.9   9980.0
GR1220.9  10000.0   1220.9  11265.0   1220.9  11315.0   1222.6  11442.0   1220.5  11450.0
GR1221.1  11694.0   1222.4  11718.0   1223.4  11842.0   1221.2  11990.0   1221.2  12330.0
GR1218.9  12354.0   1218.3  12523.0   1220.0  12540.0   1220.0  12590.0   1222.4  12612.0
GR1222.2  12920.0   1221.5  13110.0   1219.0  13123.0   1219.2  13202.0   1223.9  13219.0
GR1228.0  13780.0   1232.0  13850.0   1236.0  13860.0   1244.3  14238.0   1241.8  14464.0
GR1242.7  14758.0   1244.0  14959.0   1249.1  15014.0   1251.0  15184.0   1248.8  15245.0
GR1250.9  15333.0   1253.7  15578.0   1253.8  15753.0
HD 23.35       10     9564    13780
X123.365     43.0     9495    13860     80.0     80.0     80.0
X3     10
GR1263.0   9454.0   1261.1   9495.0   1226.7   9564.0   1221.1   9590.0   1221.1   9790.0
GR1181.1   9870.0   1181.1   9967.0   1181.1  10000.0   1181.1  10400.0   1181.1  10500.0
GR1181.1  11160.0   1221.1  11280.0   1221.1  11300.0   1222.8  11442.0   1220.7  11450.0
GR1221.3  11694.0   1222.6  11718.0   1223.6  11842.0   1221.4  11990.0   1221.4  12330.0
GR1219.1  12354.0   1218.5  12523.0   1220.2  12540.0   1220.2  12590.0   1222.6  12612.0
GR1222.4  12920.0   1221.7  13110.0   1219.2  13123.0   1219.4  13202.0   1224.1  13219.0
GR1228.2  13780.0   1232.2  13850.0   1236.2  13860.0   1244.5  14238.0   1242.0  14464.0
GR1242.9  14758.0   1244.2  14959.0   1249.3  15014.0   1251.2  15184.0   1249.0  15245.0
GR1251.1  15333.0   1253.9  15578.0   1254.0  15753.0
HD23.365       10     9564    13780
X123.571     46.0     9401    13619   1085.0   1085.0   1085.0
X3     10
GR1266.0   9000.0   1268.4   9137.0   1257.4   9193.0   1266.9   9217.0   1267.2   9401.0
GR1227.0   9469.0   1225.8   9632.0   1223.7   9646.0   1224.4   9670.0   1224.4   9720.0
GR1224.4   9925.0   1184.4  10005.0   1184.4  10895.0   1224.4  11015.0   1224.4  11016.0
GR1224.4  11050.0   1224.4  11060.0   1224.4  11065.0   1224.5  11225.0   1225.5  11243.0
GR1222.0  11532.0   1225.5  11576.0   1223.9  11706.0   1221.8  11727.0   1223.0  11843.0
GR1222.7  11975.0   1224.5  11997.0   1225.2  12337.0   1225.6  12764.0   1222.0  12925.0
GR1222.0  12984.0   1226.8  13011.0   1228.2  13154.0   1234.7  13235.0   1234.7  13341.0
GR1239.9  13531.0   1246.7  13619.0   1245.8  13940.0   1246.0  14269.0   1249.9  14417.0
GR1247.4  14505.0   1249.0  14539.0   1247.2  14595.0   1251.2  14744.0   1255.0  14937.0
GR1255.5  15413.7
HD23.571       10     9469    13531
X123.694     51.0     8893    12851    650.0    650.0    650.0
X3     10
GR1265.2   8775.0   1264.5   8815.0   1256.5   8864.0   1259.1   8893.0   1229.1   8951.0
GR1227.9   9031.0   1228.1   9348.0   1228.0   9472.0   1226.0   9481.0   1226.0   9491.0
GR1229.2   9503.0   1226.4   9575.0   1226.4   9630.0   1186.4   9710.0   1186.4  10000.0
GR1186.4  10730.0   1226.4  10850.0   1226.4  10860.0   1226.4  10870.0   1226.4  10880.0
GR1226.4  10900.0   1228.5  11054.0   1226.0  11090.0   1226.1  11287.0   1228.9  11309.0
GR1228.3  11399.0   1227.0  11508.0   1228.1  11578.0   1225.4  11591.0   1225.6  11676.0
GR1227.0  11709.0   1224.6  11893.0   1228.3  11971.0   1228.3  12173.0   1227.3  12336.0
```

```
GR1224.3 12399.0 1224.1 12448.0 1226.2 12472.0 1225.3 12522.0 1237.9 12572.0
GR1238.2 12681.0 1241.5 12851.0 1237.2 12913.0 1248.3 13081.0 1245.1 13173.0
GR1253.6 13363.0 1254.9 13478.0 1252.6 13698.0 1250.9 14006.0 1255.5 14138.0
GR1255.7 14355.0
HD23.694 10 8951 12681
X123.851 39.0 8023 12101 830.0 830.0 830.0
X3 10
GR1266.2 7830.0 1269.7 7975.0 1256.0 8004.0 1260.7 8023.0 1231.6 8081.0
GR1229.9 8170.0 1231.8 8230.0 1230.0 8450.0 1230.0 8803.0 1232.3 8953.0
GR1228.9 9255.0 1228.9 9310.0 1228.9 9350.0 1228.9 9360.0 1228.9 9370.0
GR1188.9 9390.0 1188.9 10410.0 1228.9 10530.0 1228.9 10580.0 1231.1 10672.0
GR1230.7 10890.0 1227.7 10935.0 1227.8 11039.0 1231.3 11071.0 1231.3 11221.0
GR1229.7 11304.0 1229.6 11634.0 1228.4 11788.0 1231.5 11920.0 1235.6 11972.0
GR1234.8 12009.0 1251.9 12101.0 1249.5 12152.0 1251.1 12229.0 1248.5 12295.0
GR1253.8 12406.0 1258.1 12485.0 1258.9 12817.0 1258.6 12913.0
HD23.851 10 8081 12009
X123.874 39.0 8023 12101 120.0 120.0 120.0
X3 10
GR1266.5 7830.0 1270.0 7975.0 1256.3 8004.0 1261.0 8023.0 1231.9 8081.0
GR1230.2 8170.0 1232.1 8230.0 1230.3 8450.0 1230.3 8803.0 1232.6 8953.0
GR1229.3 9210.0 1229.3 9359.0 1229.3 9453.0 1229.3 9526.0 1229.3 9649.0
GR1229.3 9829.0 1229.3 10000.0 1229.3 10139.0 1229.3 10535.0 1231.7 10672.0
GR1231.0 10890.0 1228.0 10935.0 1228.1 11039.0 1231.6 11071.0 1231.6 11221.0
GR1230.3 11304.0 1230.2 11634.0 1229.0 11788.0 1232.1 11920.0 1236.2 11972.0
GR1235.1 12009.0 1252.2 12101.0 1249.8 12152.0 1251.4 12229.0 1248.8 12295.0
GR1254.1 12406.0 1258.4 12485.0 1259.2 12817.0 1259.2 12913.0
HD23.874 10 8081 12009
NC 0.039 0.035 0.030
X124.070 38.0 7412 11352 1190.0 1190.0 1190.0
X3 10
GR1271.5 6780.0 1271.5 6834.0 1278.6 6951.0 1274.1 7084.0 1266.1 7294.0
GR1269.1 7360.0 1257.8 7389.0 1261.1 7412.0 1237.4 7448.0 1237.6 7632.0
GR1236.4 7917.0 1234.0 7951.0 1234.0 8168.0 1235.5 8321.0 1233.1 8484.0
GR1236.2 8719.0 1232.9 9065.0 1232.9 9195.0 1232.9 9275.0 1232.9 9500.0
GR1232.9 10000.0 1232.9 10215.0 1232.9 10335.0 1232.9 10385.0 1231.6 10523.0
GR1235.1 10578.0 1235.0 10867.0 1232.6 10889.0 1234.0 11244.0 1256.4 11352.0
GR1258.1 11503.0 1255.3 11711.0 1259.1 11799.0 1259.1 11910.0 1264.0 12010.0
GR1261.5 12338.0 1266.2 12431.0 1266.3 12513.0
HD24.070 10 7448 11244
X124.085 38.0 7412 11352 80.0 80.0 80.0
X3 10
GR1271.7 6780.0 1271.7 6834.0 1278.8 6951.0 1274.3 7084.0 1266.3 7294.0
GR1269.3 7360.0 1258.0 7389.0 1261.3 7412.0 1237.6 7448.0 1237.8 7632.0
GR1236.6 7917.0 1234.2 7951.0 1234.2 8168.0 1235.7 8321.0 1233.3 8484.0
GR1236.4 8719.0 1233.1 9035.0 1233.1 9165.0 1233.1 9170.0 1233.1 9200.0
GR1193.1 9245.0 1193.1 10185.0 1233.1 10305.0 1233.1 10355.0 1231.8 10523.0
GR1235.3 10578.0 1235.2 10867.0 1232.8 10889.0 1234.2 11244.0 1256.6 11352.0
GR1258.3 11503.0 1255.5 11711.0 1259.3 11799.0 1259.3 11910.0 1264.2 12010.0
GR1261.7 12338.0 1266.4 12431.0 1266.5 12513.0
HD24.085 10 7448 11244
X1 24.17 22.0 7030 11239 280.0 280.0 280.0
X3 10
GR1275.7 6980.0 1273.8 7030.0 1244.2 7139.0 1238.7 7349.0 1239.8 7578.0
GR1236.5 7944.0 1236.3 8335.0 1236.8 8612.0 1233.9 8970.0 1233.9 9100.0
```

```
GR1193.9   9180.0   1193.9 10000.0   1193.9 10120.0   1233.9 10240.0   1233.9 10250.0
GR1233.9  10290.0   1233.1 10461.0   1233.8 10753.0   1235.2 11028.0   1235.3 11193.0
GR1240.4  11239.0   1240.6 11279.0
HD 24.17      10     7139   11193
X124.193    22.0     7030   11239    120.0    120.0    120.0
X3    10
GR1276.1   6980.0   1274.2  7030.0   1244.6  7139.0   1239.1  7349.0   1240.2  7578.0
GR1236.9   7944.0   1236.7  8335.0   1237.2  8612.0   1234.3  8970.0   1234.3  9100.0
GR1234.3   9180.0   1234.3 10000.0   1234.3 10120.0   1234.3 10240.0   1234.3 10250.0
GR1234.3  10290.0   1233.5 10461.0   1234.2 10753.0   1235.6 11028.0   1235.7 11193.0
GR1240.8  11239.0   1241.0 11279.0
HD24.193      10     7139   11193
NC 0.040   0.034    0.030
X1 24.35    32.0     7383   11392      945      945      945
X3    10
GR1280.9   7170.0   1276.9  7277.0   1256.6  7383.0   1264.0  7450.0   1246.8  7565.0
GR1247.2   7627.0   1244.2  7704.0   1247.3  7800.0   1243.9  7939.0   1239.6  7961.0
GR1238.3   8358.0   1239.2  8768.0   1241.1  9067.0   1241.0  9317.0   1237.1  9475.0
GR1237.1   9605.0   1237.1  9685.0   1237.1  9893.0   1237.1 10000.0   1237.1 10174.0
GR1237.1  10201.0   1237.1 10300.0   1237.1 10795.0   1238.7 10825.0   1237.1 11179.0
GR1236.3  11345.0   1264.9 11392.0   1264.2 11635.0   1263.8 11839.0   1273.2 11913.0
GR1273.1  12061.0   1269.2 12083.0
HD 24.35      10     7450   11345
X124.365    32.0     7383   11392       80       80       80
X3    10
GR1281.1   7170.0   1277.1  7277.0   1256.8  7383.0   1264.2  7450.0   1247.0  7565.0
GR1247.4   7627.0   1244.4  7704.0   1247.5  7800.0   1244.1  7939.0   1239.8  7961.0
GR1238.5   8358.0   1239.4  8768.0   1241.3  9067.0   1241.2  9317.0   1237.3  9470.0
GR1237.3   9600.0   1197.3  9680.0   1197.3  9893.0   1197.3 10000.0   1197.3 10174.0
GR1197.3  10620.0   1237.3 10740.0   1237.3 10790.0   1238.9 10825.0   1237.3 11179.0
GR1236.5  11345.0   1265.1 11392.0   1264.4 11635.0   1264.0 11839.0   1273.4 11913.0
GR1273.3  12061.0   1269.4 12083.0
HD24.365      10     7450   11345
X124.468    33.0     7430   11477    545.0    545.0    545.0
X3    10
GR1289.3   6781.0   1285.1  6824.0   1259.6  6899.0   1260.2  7000.0   1258.5  7099.0
GR1263.1   7113.0   1259.2  7127.0   1263.5  7145.0   1254.3  7192.0   1255.3  7240.0
GR1250.7   7387.0   1255.5  7430.0   1248.7  7784.0   1242.7  7806.0   1241.8  8182.0
GR1239.8   8201.0   1240.8  8227.0   1242.2  8577.0   1243.3  9103.0   1240.5  9202.0
GR1242.7   9277.0   1238.9  9350.0   1238.9  9480.0   1198.9  9560.0   1198.9 10500.0
GR1238.9  10620.0   1238.9 10670.0   1240.6 10799.0   1241.7 11004.0   1238.6 11184.0
GR1236.8  11422.0   1265.0 11477.0   1265.3 11540.0
HD24.468      10     7784   11422
X124.491    33.0     7430   11477    120.0    120.0    120.0
X3    10
GR1289.6   6781.0   1285.4  6824.0   1259.9  6899.0   1260.5  7000.0   1258.8  7099.0
GR1263.4   7113.0   1259.5  7127.0   1263.8  7145.0   1254.6  7192.0   1255.6  7240.0
GR1251.0   7387.0   1255.8  7430.0   1249.0  7784.0   1243.0  7806.0   1242.1  8182.0
GR1240.1   8201.0   1241.1  8227.0   1242.5  8577.0   1243.6  9103.0   1240.8  9202.0
GR1243.0   9277.0   1239.3  9350.0   1239.3  9480.0   1239.3  9560.0   1239.3 10500.0
GR1239.3  10620.0   1239.3 10670.0   1240.9 10799.0   1242.0 11004.0   1238.9 11184.0
GR1237.1  11422.0   1265.3 11477.0   1265.6 11540.0
HD24.491      10     7784   11422
X1 24.54    36.0   9240.0 10227.0      135      395      235
```

```
GR1282.4   7259.0   1277.8   7423.0   1258.4   7466.0   1263.6   7490.0   1246.5   7527.0
GR1245.6   7636.0   1243.2   7946.0   1243.5   8106.0   1243.4   8353.0   1243.6   8697.0
GR1244.5   8990.0   1244.5   9240.0   1242.9   9311.0   1241.6   9485.0   1242.9   9550.0
GR1242.1   9879.0   1240.3   9989.0   1238.3  10000.0   1238.3  10014.0   1242.7  10058.0
GR1244.6  10227.0   1240.8  10491.0   1242.8  10616.0   1240.2  10736.0   1243.1  10847.0
GR1240.6  11132.0   1239.2  11150.0   1238.8  11312.0   1241.5  11351.0   1239.8  11413.0
GR1243.1  11501.0   1241.6  11750.0   1239.2  11764.0   1239.1  11816.0   1276.1  11876.0
GR1278.6  12013.0
HD 24.54     10    9240    10227
NC 0.030    0.030    0.030
X1 24.90     43.0   9334.0  11529.0    2055    1850    1905
GR1258.9   7820.0   1255.0   7838.0   1251.6   8006.0   1249.7   8269.0   1253.4   8308.0
GR1250.9   8530.0   1252.2   8594.0   1251.2   8738.0   1252.8   8845.0   1252.5   9147.0
GR1251.6   9334.0   1248.0   9359.0   1248.2   9467.0   1250.8   9482.0   1252.3   9813.0
GR1248.6   9839.0   1249.7   9933.0   1246.8   9959.0   1246.6  10000.0   1246.6  10037.0
GR1251.0  10053.0   1251.1  10206.0   1247.0  10559.0   1251.4  10684.0   1249.5  10806.0
GR1246.5  10832.0   1246.5  10895.0   1249.8  10918.0   1248.1  11176.0   1249.9  11194.0
GR1250.2  11328.0   1249.2  11417.0   1252.5  11529.0   1251.5  11894.0   1247.3  11933.0
GR1250.3  12174.0   1247.5  12200.0   1248.9  12432.0   1249.5  12596.0   1249.5  12718.0
GR1253.6  12781.0   1250.2  13053.0   1267.8  13098.0
HD 24.90     10    9334    11529
NC 0.040    0.040    0.030
X1 25.37     41.0   9459.0  11916.0    2420    2365    2485
GR1364.9   9300.0   1263.8   9366.0   1265.3   9414.0   1264.5   9459.0   1260.5   9477.0
GR1260.3   9509.0   1261.7   9524.0   1261.8   9638.0   1255.1   9673.0   1256.0   9890.0
GR1255.1   9896.0   1255.0  10000.0   1258.4  10016.0   1256.9  10326.0   1259.4  10451.0
GR1260.2  10717.0   1260.5  10976.0   1260.3  11222.0   1260.8  11504.0   1258.1  11553.0
GR1259.9  11613.0   1259.9  11663.0   1257.2  11706.0   1260.9  11754.0   1259.0  11833.0
GR1282.4  11916.0   1285.6  12047.0   1279.8  12169.0   1289.6  12311.0   1289.6  12356.0
GR1293.3  12435.0   1288.6  12562.0   1293.2  12628.0   1293.1  12768.0   1285.7  12846.0
GR1286.6  12867.0   1286.0  12884.0   1295.4  12994.0   1287.3  13095.0   1291.8  13151.0
GR1293.1  13301.0
HD 25.37     10    9459    11916
X1 25.59     14    9685    11070    1065    1230    1125
GR1300.0   9640.0   1280.0   9685.0   1264.0   9725.0   1260.0   9790.0   1260.0   9840.0
GR1256.5  10000.0   1260.0  10100.0   1261.5  10530.0   1261.0  10875.0   1264.0  11025.0
GR1272.0  11070.0   1276.0  11100.0   1280.0  11120.0   1283.4  11270.0
HD 25.59     10    9685    11070
NC  .040    .040    .030
X1 25.86     25    8220    10215    1425    1495    1455
GR1300.0   7650.0   1280.0   7740.0   1276.0   7750.0   1272.0   8220.0   1268.0   8300.0
GR1267.5   8340.0   1268.0   8395.0   1270.8   8500.0   1268.0   8615.0   1267.6   8690.0
GR1268.0   8795.0   1268.0   8960.0   1269.0   9060.0   1268.0   9190.0   1265.6   9335.0
GR1266.0   9600.0   1268.0   9740.0   1268.0   9820.0   1264.0   9940.0   1260.0   9950.0
GR1260.0  10055.0   1264.0  10200.0   1280.0  10215.0   1280.0  10300.0   1284.0  10340.0
HD 25.86     10    8220    10215
NC  .041    .041    .033
X1 26.29     26.0    8722    11227    2090    2295    2240
GR1307.9   8275.0   1279.3   8338.0   1278.4   8722.0   1275.7   8754.0   1276.5   8962.0
GR1277.4   9349.0   1273.2   9372.0   1276.7   9696.0   1274.9   9925.0   1271.6   9943.0
GR1271.6  10000.0   1273.7  10084.0   1278.8  10120.0   1278.2  10393.0   1278.4  10757.0
GR1275.0  11021.0   1273.9  11201.0   1279.2  11227.0   1276.8  11724.0   1278.8  11784.0
GR1280.5  12462.0   1281.9  12794.0   1279.6  12804.0   1312.6  12882.0   1311.4  13079.0
GR1312.6  13190.0
```

```
HD 26.29     10     8722    11227
X1 26.73     30.0   9720    11263    2320    2310    2330
GR1312.2  9355.0   1313.9   9457.0   1289.8   9540.0   1287.5   9720.0   1282.4   9755.0
GR1285.6  9834.0   1280.7   9898.0   1279.8  10000.0   1279.9  10364.0   1283.4  10385.0
GR1283.4 10521.0   1280.9  10543.0   1283.2  10628.0   1285.7  11057.0   1287.2  11263.0
GR1286.8 11621.0   1286.8  13292.0   1287.3  13590.0   1290.5  13648.0   1286.3  13673.0
GR1302.5 13759.0   1293.3  13811.0   1295.0  13870.0   1317.7  13944.0   1310.7  13981.0
GR1332.7 14126.0   1350.7  14161.0   1350.7  14176.0   1346.0  14188.0   1346.0  14190.0
HD 26.73     10     9720    11263
NC  .048    .043    .035
X1 27.03     23.0   9679    10553    1660    1020    1590
GR1307.8  9627.0   1301.5   9679.0   1283.2   9723.0   1281.2   9814.0   1282.6   9900.0
GR1287.2  9922.0   1283.5   9949.0   1283.4  10000.0   1283.4  10054.0   1286.2  10079.0
GR1288.9 10450.0   1290.7  10553.0   1288.0  10732.0   1291.0  10749.0   1291.0  11081.0
GR1291.4 12573.0   1293.7  12649.0   1291.4  12657.0   1301.2  12783.0   1303.3  12821.0
GR1300.5 12889.0   1319.6  12961.0   1330.8  13050.0
HD 27.03     10     9679    10553
NC  .040    .040    .035
X1 27.68     35.0   8224    10125    4120    3200    3430
GR1310.1  7060.0   1305.9   7509.0   1301.3   7550.0   1302.2   7781.0   1301.9   8224.0
GR1297.0  8243.0   1298.6   8317.0   1299.3   8587.0   1302.4   8679.0   1298.7   8774.0
GR1301.1  8870.0   1300.8   8938.0   1297.9   8961.0   1301.1   8999.0   1301.3   9184.0
GR1297.6  9230.0   1300.8   9293.0   1298.8   9379.0   1300.1   9459.0   1299.0   9624.0
GR1295.3  9640.0   1295.4   9695.0   1301.1   9738.0   1301.6   9853.0   1295.7  10000.0
GR1294.7 10078.0   1310.2  10125.0   1310.7  10428.0   1311.8  10663.0   1305.9  10703.0
GR1312.1 10728.0   1309.4  10746.0   1311.0  10884.0   1330.0  10991.0   1330.2  11145.0
HD 27.68     10     8224    10125
X1 28.12     27.0   9108    10107    2360    2375    2355
GR1357.3  8340.0   1355.3   8384.0   1323.5   8506.0   1320.1   8630.0   1313.6   8697.0
GR1309.5  8719.0   1311.3   8878.0   1311.1   9108.0   1307.8   9129.0   1307.5   9182.0
GR1310.6  9258.0   1308.2   9300.0   1310.5   9411.0   1308.6   9524.0   1306.6   9675.0
GR1304.9  9906.0   1304.6  10000.0   1304.6  10076.0   1310.3  10107.0   1310.7  10411.0
GR1306.3 10527.0   1307.3  10680.0   1308.6  10781.0   1308.5  10866.0   1310.8  10916.0
GR1312.7 11051.0   1314.2  11435.0
HD 28.12     10     9108    10107
X1 28.67     36.0   9950    11203    2785    2925    2885
GR1372.7  9450.0   1371.0   9866.0   1311.5   9964.0   1312.2  10000.0   1312.2  10192.0
GR1319.8 10514.0   1316.1  10819.0   1318.6  10989.0   1315.2  11044.0   1320.5  11203.0
GR1321.6 11445.0   1322.3  11634.0   1319.8  11968.0   1318.7  12107.0   1322.5  12170.0
GR1321.3 12228.0   1325.2  12397.0   1326.4  12792.0   1328.9  12823.0   1324.8  12860.0
GR1327.4 12972.0   1345.8  13057.0   1345.8  13259.0   1339.7  13321.0   1341.1  13419.0
GR1352.8 13484.0   1356.1  13572.0   1358.7  13589.0   1358.8  13606.0   1348.0  13629.0
GR1348.2 13655.0   1363.9  13681.0   1363.8  13698.0   1355.7  13713.0   1356.7  13851.0
GR1373.9 13912.0
HD 28.67     10     9950    11203
NC  .042    .042    .035
X1 29.04     33.0   9808    10638    2100    1270    1975
GR1360.0     9770  1320.3   9815.0   1317.3   9828.0   1317.2   9859.0   1319.6   9940.0
GR1317.2 10000.0   1317.2  10048.0   1322.9  10073.0   1324.3  10239.0   1324.4  10414.0
GR1321.2 10499.0   1319.4  10584.0   1326.7  10638.0   1326.0  10868.0   1326.7  11104.0
GR1325.3 11444.0   1322.9  11472.0   1324.3  11521.0   1323.1  11750.0   1330.4  11802.0
GR1330.3 12323.0   1331.2  12554.0   1336.4  12706.0   1332.2  12882.0   1335.8  13217.0
GR1343.9 13578.0   1351.5  13599.0   1352.4  13621.0   1344.3  13633.0   1344.4  13654.0
GR1357.1 13668.0   1357.5  13697.0   1379.5  13780.0
```

```
HD 29.04      10     9808    10638
X1 29.54     29.0    9198    10150    2750    2235    2640
GR1378.7   9025.0   1375.5   9068.0   1350.7   9135.0   1348.6   9179.0   1332.4   9217.0
GR1333.5   9321.0   1333.9   9460.0   1331.2   9697.0   1328.7   9726.0   1328.4   9758.0
GR1332.9   9782.0   1332.2   9846.0   1327.0   9882.0   1326.7  10000.0   1326.7  10116.0
GR1340.7  10150.0   1343.0  10343.0   1346.5  10482.0   1348.3  10927.0   1347.8  11457.0
GR1349.2  11687.0   1354.2  11697.0   1354.2  11723.0   1345.8  11737.0   1345.8  11763.0
GR1355.3  11783.0   1355.4  11812.0   1352.6  11829.0   1378.3  11981.0
HD 29.54      10     9198    10150
X129.611     31.0    9052    10244     315     315     375
X3    10
GR1377.8   8825.0   1353.2   9052.0   1337.2   9136.0   1336.3   9285.0   1332.4   9541.0
GR1332.9   9713.0   1334.0   9791.0   1328.9   9812.0   1328.9   9849.0   1331.6  10000.0
GR1331.6  10094.0   1342.3  10133.0   1351.2  10244.0   1345.5  10331.0   1349.1  10528.0
GR1349.1  10688.0   1349.9  10923.0   1353.4  10966.0   1353.4  11037.0   1345.1  11072.0
GR1345.1  11124.0   1352.5  11156.0   1352.5  11163.0   1345.4  11178.0   1345.5  11204.0
GR1353.7  11221.0   1353.4  11251.0   1351.1  11259.0   1353.1  11405.0   1358.4  11533.0
GR1378.5  11635.0
HD29.611      10     9052    10244
X1 29.80     16.0    9347    10610    1295    1340    1400
GR1378.4   9270.0   1373.4   9347.0   1338.8   9419.0   1335.4   9475.0   1340.8   9512.0
GR1342.7   9656.0   1338.9   9882.0   1331.2   9924.0   1331.4  10000.0   1332.7  10180.0
GR1337.6  10205.0   1337.6  10215.0   1327.7  10335.0   1336.3  10521.0   1344.4  10610.0
GR1349.2  10676.0
HD 29.80      10     9347    10610
X1 30.07     17.0    9604    10306    1425    1440    1420
GR1369.4   9325.0   1363.9   9463.0   1360.9   9604.0   1341.5   9665.0   1343.1   9728.0
GR1340.8   9781.0   1340.4   9910.0   1344.6   9925.0   1334.4   9986.0   1334.4  10000.0
GR1335.0  10060.0   1344.5  10098.0   1343.6  10114.0   1336.6  10132.0   1334.0  10261.0
GR1365.9  10306.0   1365.0  10356.0
HD 30.07      10     9604    10306
X1 30.26     12.0    9711    10643     870    1090    1005
GR1357.2   9625.0   1361.9   9711.0   1342.1   9749.0   1338.9  10000.0   1339.3  10135.0
GR1341.7  10314.0   1347.9  10338.0   1348.7  10444.0   1341.6  10545.0   1341.7  10604.0
GR1363.6  10643.0   1389.4  10743.0
HD 30.26      10     9711    10643
NC 0.043    0.043    0.045
X1 30.82     12.0    9865    11244    2955    2840    2960
GR1378.3   9630.0   1379.5   9833.0   1375.4   9865.0   1345.2   9924.0   1346.7  10000.0
GR1352.0  10201.0   1347.0  10358.0   1353.5  10398.0   1358.1  10582.0   1357.9  10879.0
GR1354.5  11132.0   1399.1  11244.0
HD 30.82      10     9865    11244
NC 0.043    0.043    0.037
X1 31.39     17.0    9470    10633    2900    3165    2970
GR1397.8   9290.0   1386.7   9342.0   1392.7   9386.0   1393.4   9470.0   1356.5   9526.0
GR1354.7   9561.0   1361.2   9643.0   1363.1   9792.0   1359.4   9942.0   1356.8   9978.0
GR1356.9  10000.0   1357.4  10080.0   1361.5  10242.0   1360.1  10387.0   1368.0  10456.0
GR1368.6  10528.0   1407.9  10633.0
HD 31.39      10     9470    10633
X1 31.86     10.0    9490    10321    2550    2485    2505
GR1411.1   8955.0   1408.4   9155.0   1407.3   9490.0   1362.0   9604.0   1364.9   9727.0
GR1366.7   9894.0   1366.7  10000.0   1365.3  10261.0   1394.3  10321.0   1420.6  10419.0
HD 31.86      10     9490    10321
NC 0.043    0.052    0.040
```

```
X1 32.43     14.0    9438   10437    2885    2970    2980
GR1424.1   9340.0   1415.1   9438.0   1371.3   9508.0   1372.3   9554.0   1363.8   9607.0
GR1372.6   9692.0   1375.5   9852.0   1373.4   9965.0   1370.7  10000.0   1372.7  10073.0
GR1383.1  10112.0   1388.9  10373.0   1403.2  10437.0   1436.0  10487.0
HD 32.43       10    9438   10437
NC .049     .049     .042
X1 32.86     12.0    9719   10564    2405    2135    2295
GR1423.4   9670.0   1424.3   9719.0   1386.4   9797.0   1381.2   9855.0   1380.4   9928.0
GR1374.9  10000.0   1380.6  10079.0   1386.5  10155.0   1382.6  10239.0   1386.6  10279.0
GR1385.4  10331.0   1421.4  10564.0
HD 32.86       10    9719   10564
NC .047     .055     .032
X132.984       33    9750   10150     648     648     648
GR1427.7   9750.0   1425.2   9750.1   1391.6   9820.0   1391.6   9823.0   1391.6   9823.1
GR1389.7   9833.0   1389.7   9833.1   1389.7   9837.0   1385.5   9851.0   1384.0   9900.0
GR1385.8   9904.0   1385.8   9909.0   1385.8   9909.1   1386.6   9919.0   1386.6   9919.1
GR1386.6   9962.0   1380.0   9985.0   1380.0   9985.1   1380.0   9995.0   1380.0   9995.1
GR1378.4   9997.0   1380.2  10011.0   1382.2  10018.0   1384.2  10050.0   1386.8  10053.0
GR1387.9  10065.0   1387.9  10065.1   1390.7  10075.0   1390.7  10075.1   1392.3  10091.0
GR1423.8  10150.0   1426.0  10150.0   1427.0  10150.1
HD32.984       10    9750   10150
X132.998      9.0    9762   10164      72      72      72
GR1434.1   9610.0   1433.1   9762.0   1389.0   9851.0   1386.3   9920.0   1381.4  10000.0
GR1393.1  10108.0   1413.1  10164.0   1417.9  10358.0   1440.7  10405.0
HD32.998       10    9762   10164
NC .060     .050     .050
X1 33.41     12.0    9750   10687    1880    2270    2170
GR1448.1   9750.0   1426.7   9864.0   1408.3   9944.0   1386.9  10000.0   1389.1  10157.0
GR1406.8  10366.0   1404.5  10483.0   1409.5  10576.0   1422.7  10626.0   1423.4  10668.0
GR1433.5  10685.0   1437.7  10687.0
HD 33.41       10    9750   10687
X1 33.82     20.0    9565   10600    2165    2220    2175
GR1454.2   9465.0   1454.2   9506.0   1434.5   9527.0   1434.5   9538.0   1450.5   9565.0
GR1408.8   9662.0   1402.1   9714.0   1409.2   9795.0   1417.1   9861.0   1387.4   9966.0
GR1387.4  10000.0   1387.4  10023.0   1405.9  10068.0   1408.6  10117.0   1426.7  10204.0
GR1425.4  10292.0   1433.9  10347.0   1428.1  10416.0   1427.2  10466.0   1450.9  10600.0
HD 33.82       10    9565   10600
EJ
T4   AGUA FRIA RIVER SEDIMENT TRANSPORT STUDY - SEPTEMBER-AUGUST 1992
PROJECT
T5                RIVER COVERAGE [MILE 0.16 TO MILE 33.82]
T6                PREPARED BY: CARLOS CORTEZ CARRIAGA
T7                     UPDATED ON:  MAY 15, 1992
T8   ***********************************************************************
I1          10       0       0   0.999  32.174
I4           9       1      10    2.65       0       0       0       0       0
I5          .5      .5     .25      .5     .25       0     1.0
LQ      Q    0.01   4000.  20000.  40000.  60000.  85000.
LT      QS   0.01   3082.  26604.  56358.  97056.  155824.
LF      VFS 0.22029 0.22029 0.12021 0.13469 0.14318 0.15286
LF       FS 0.25878 0.25878 0.16975 0.17708 0.18245 0.19324
LF       MS 0.29170 0.29170 0.24375 0.24027 0.23890 0.24338
LF       CS 0.11476 0.11476 0.15675 0.15080 0.14942 0.14791
LF      VCS 0.07028 0.07028 0.11014 0.10377 0.09976 0.09368
```

```
LF    VFG 0.02171 0.02171 0.03701 0.03411 0.03186 0.02874
LF     FG 0.01800 0.01800 0.04091 0.03755 0.03478 0.03086
LF     MG 0.00371 0.00371 0.05344 0.04986 0.04666 0.04150
LF     CG 0.00053 0.00053 0.04486 0.04408 0.04277 0.03878
LF    VCG 0.00031 0.00031 0.02318 0.02779 0.03022 0.02905
N  0.160          0.20997 0.20997 0.88000         0.02466 0.12840 0.13531 0.25571
N         0.18617 0.04051 0.03702 0.03594 0.03394 0.00000
N  0.440          0.20997 0.04092 0.95000         0.00619 0.05233 0.26511 0.22718
N         0.25582 0.04189 0.06446 0.04827 0.03000 0.00709
N  0.730          0.20997 0.04092 0.95000         0.00619 0.05233 0.26511 0.22718
N         0.25582 0.04189 0.06446 0.04827 0.03000 0.00709
N  1.330          0.20997 0.04955 0.95000         0.00445 0.04807 0.21089 0.19967
N         0.25404 0.07425 0.08617 0.07712 0.03894 0.00572
N  1.710          0.20997 0.18396 0.95000         0.00700 0.04540 0.14795 0.11933
N         0.15362 0.07149 0.12617 0.08131 0.08552 0.15721
N  2.020          0.20997 0.18396 0.95000         0.00700 0.04540 0.14795 0.11933
N         0.15362 0.07149 0.12617 0.08131 0.08552 0.15721
N  2.600          0.20997 0.01908 0.95000         0.01569 0.12077 0.38478 0.21525
N         0.16886 0.02633 0.02404 0.01785 0.01963 0.00396
N  2.800          0.20997 0.01908 0.95000         0.01569 0.12077 0.38478 0.21525
N         0.16886 0.02633 0.02404 0.01785 0.01963 0.00396
N  3.270          0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N         0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N  3.400          0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N         0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N  3.430          0.20997 0.10348 0.95000         0.01346 0.07803 0.31326 0.16399
N         0.14574 0.03833 0.14045 0.02120 0.02732 0.02528
N  3.729          0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N         0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N  3.734          0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N         0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N  3.757          0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N         0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N  3.767          0.62991 0.41994 0.95000         0.00000 0.00000 0.00000 0.00000
N         0.00000 0.00000 0.00000 0.00000 0.00000 1.00000
N  4.094          0.20997 0.12303 0.95000         0.00327 0.05913 0.08985 0.23156
N         0.22609 0.09454 0.09019 0.10737 0.04570 0.00220
N  4.270          0.20997 0.13909 0.95000         0.01473 0.06167 0.16542 0.10644
N         0.11964 0.05433 0.23290 0.07108 0.07702 0.08097
N  4.700          0.20997 0.12303 0.95000         0.03377 0.04570 0.10333 0.09115
N         0.14615 0.06611 0.11566 0.13843 0.11113 0.06927
N  4.754          0.20997 0.12303 0.95000         0.03377 0.04570 0.10333 0.09115
N         0.14615 0.06611 0.11566 0.13843 0.11113 0.06927
N  4.790          0.20997 0.12303 0.95000         0.03377 0.04570 0.10333 0.09115
N         0.14615 0.06611 0.11566 0.13843 0.11113 0.06927
N  5.150          0.20997 0.05963 0.95000         0.00650 0.08050 0.32636 0.20159
N         0.20525 0.03644 0.04059 0.03787 0.03294 0.02446
N  5.290          0.20997 0.05963 0.95000         0.00650 0.08050 0.32636 0.20159
N         0.20525 0.03644 0.04059 0.03787 0.03294 0.02446
N  5.380          0.20997 0.05963 0.95000         0.00650 0.08050 0.32636 0.20159
N         0.20525 0.03644 0.04059 0.03787 0.03294 0.02446
N  5.689          0.10499 0.04007 0.95000         0.09244 0.10394 0.16384 0.07407
N         0.12482 0.03636 0.03411 0.05742 0.02210 0.00000
N  5.750          0.20997 0.11371 0.95000         0.02514 0.02121 0.03410 0.05761
```

N 0.13374 0.10182 0.14009 0.12020 0.21110 0.09680
N 5.900 0.10499 0.04675 0.95000 0.00167 0.07000 0.11471 0.29051
N 0.23478 0.07273 0.09569 0.07263 0.03895 0.00000
N 6.430 0.20997 0.08439 0.95000 0.02065 0.09227 0.24746 0.14997
N 0.18326 0.08153 0.05486 0.06285 0.05857 0.03609
N 6.890 0.20997 0.20997 0.84606 0.05655 0.02661 0.04201 0.09060
N 0.05774 0.05564 0.06069 0.06744 0.08595 0.09895
N 6.990 0.20997 0.20997 0.84606 0.05655 0.02661 0.04201 0.09060
N 0.05774 0.05564 0.06069 0.06744 0.08595 0.09895
N 7.490 0.20997 0.18355 0.95000 0.00479 0.02873 0.10448 0.12958
N 0.20723 0.07724 0.10130 0.11629 0.10762 0.08706
N 8.000 0.20997 0.20029 0.93000 0.00728 0.02929 0.11102 0.30828
N 0.11991 0.06713 0.05201 0.03858 0.09855 0.08010
N 8.100 0.20997 0.20029 0.93000 0.00728 0.02929 0.11102 0.30828
N 0.11991 0.06713 0.05201 0.03858 0.09855 0.08010
N 8.210 0.20669 0.20029 0.92000 0.02947 0.04843 0.11816 0.09260
N 0.13594 0.03971 0.06124 0.08775 0.09780 0.15346
N 8.730 0.20669 0.20029 0.92000 0.02947 0.04843 0.11816 0.09260
N 0.13594 0.03971 0.06124 0.08775 0.09780 0.15346
N 9.130 0.20997 0.13321 0.95000 0.00869 0.04600 0.12779 0.27413
N 0.16235 0.06298 0.06926 0.07354 0.08927 0.06065
N 9.900 0.20997 0.20997 0.87760 0.01003 0.04333 0.06706 0.20555
N 0.21739 0.05091 0.06699 0.06316 0.06695 0.06960
N 10.530 0.20997 0.20997 0.85647 0.00421 0.02127 0.02914 0.08658
N 0.09678 0.06727 0.09878 0.11776 0.14108 0.18527
N 10.720 0.20997 0.17890 0.95000 0.01403 0.05790 0.06375 0.08512
N 0.15652 0.12291 0.12520 0.11966 0.12088 0.09563
N 11.010 0.20997 0.14758 0.95000 0.02582 0.06943 0.13373 0.12004
N 0.15894 0.04993 0.08837 0.11297 0.12731 0.08802
N 11.340 0.20997 0.14758 0.95000 0.02582 0.06943 0.13373 0.12004
N 0.15894 0.04993 0.08837 0.11297 0.12731 0.08802
N 11.520 0.20997 0.14758 0.95000 0.02582 0.06943 0.13373 0.12004
N 0.15894 0.04993 0.08837 0.11297 0.12731 0.08802
N 11.800 0.10998 0.00902 0.95000 0.00841 0.06483 0.42620 0.23369
N 0.19681 0.02778 0.02211 0.00930 0.00120 0.00000
N 12.380 0.20997 0.16713 0.95000 0.10927 0.13597 0.22075 0.10297
N 0.11958 0.04334 0.05466 0.04851 0.03611 0.10827
N 12.840 0.20997 0.20499 0.95000 0.00359 0.01537 0.05671 0.05540
N 0.05928 0.11856 0.11280 0.14032 0.16642 0.22642
N 13.330 0.20997 0.10583 0.95000 0.05550 0.05080 0.07292 0.04479
N 0.09799 0.06870 0.10593 0.15285 0.13318 0.05245
N 13.810 0.20997 0.09212 0.95000 0.00796 0.05914 0.15566 0.24666
N 0.20158 0.06531 0.06794 0.07400 0.05692 0.04363
N 13.855 0.20997 0.09212 0.95000 0.00796 0.05914 0.15566 0.24666
N 0.20158 0.06531 0.06794 0.07400 0.05692 0.04363
N 14.380 0.20997 0.98200 0.95000 0.00447 0.05807 0.15095 0.21462
N 0.19272 0.08524 0.09355 0.07203 0.08427 0.04232
N 14.412 0.20997 0.98200 0.95000 0.00447 0.05807 0.15095 0.21462
N 0.19272 0.08524 0.09355 0.07203 0.08427 0.04232
N 14.850 0.20997 0.11106 0.95000 0.00567 0.02743 0.10279 0.14192
N 0.25589 0.10218 0.09875 0.10644 0.10064 0.05619
N 14.932 0.20997 0.11106 0.95000 0.00567 0.02743 0.10279 0.14192
N 0.25589 0.10218 0.09875 0.10644 0.10064 0.05619
N 14.940 0.20997 0.11106 0.95000 0.00567 0.02743 0.10279 0.14192

N		0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	15.063	0.20997	0.11106	0.95000		0.00567	0.02743	0.10279	0.14192
N		0.25589	0.10218	0.09875	0.10644	0.10064	0.05619		
N	15.303	0.20997	0.13913	0.95000		0.00897	0.05446	0.12768	0.12385
N		0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		
N	15.320	0.20997	0.13913	0.95000		0.00897	0.05446	0.12768	0.12385
N		0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		
N	15.510	0.20997	0.13913	0.95000		0.00897	0.05446	0.12768	0.12385
N		0.13632	0.08684	0.12677	0.10791	0.11463	0.10576		
N	15.980	0.20997	0.19271	0.95000		0.00665	0.01037	0.17808	0.06168
N		0.07674	0.05549	0.08591	0.10635	0.17505	0.20952		
N	16.420	0.20997	0.06234	0.95000		0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420		
N	16.446	0.20997	0.06234	0.95000		0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420		
N	16.450	0.20997	0.06234	0.95000		0.09238	0.17593	0.16829	0.09484
N		0.11106	0.04836	0.09656	0.04790	0.02748	0.03420		
N	16.910	0.20997	0.06703	0.95000		0.00640	0.02513	0.06149	0.07330
N		0.12291	0.07295	0.46914	0.08411	0.04922	0.00781		
N	17.380	0.20997	0.06703	0.95000		0.00640	0.02513	0.06149	0.07330
N		0.12291	0.07295	0.46914	0.08411	0.04922	0.00781		
N	17.760	0.20997	0.14885	0.95000		0.00437	0.02580	0.11721	0.12390
N		0.19929	0.08749	0.11800	0.06891	0.12493	0.12917		
N	18.240	0.20997	0.10170	0.95000		0.00462	0.15220	0.22224	0.11813
N		0.12652	0.05265	0.07449	0.10737	0.09435	0.04624		
N	18.920	0.10499	0.05946	0.95000		0.01821	0.08276	0.15116	0.12148
N		0.21800	0.06284	0.08761	0.14618	0.08897	0.00000		
N	19.440	0.20997	0.19383	0.95000		0.00886	0.01300	0.39307	0.07674
N		0.06638	0.04247	0.06198	0.09086	0.10721	0.08295		
N	19.890	0.20997	0.11515	0.95000		0.00647	0.04633	0.30735	0.17892
N		0.16653	0.04553	0.04777	0.06992	0.06989	0.06018		
N	19.944	0.20997	0.11515	0.95000		0.00647	0.04633	0.30735	0.17892
N		0.16653	0.04553	0.04777	0.06992	0.06989	0.06018		
N	19.953	0.20997	0.11515	0.95000		0.00647	0.04633	0.30735	0.17892
N		0.16653	0.04553	0.04777	0.06992	0.06989	0.06018		
N	20.240	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.550	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.563	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.577	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.640	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.657	0.20997	0.08406	0.95000		0.01627	0.08943	0.29824	0.30511
N		0.09135	0.02313	0.02991	0.05439	0.06782	0.02326		
N	20.920	0.20997	0.09533	0.95000		0.01051	0.04217	0.22588	0.24623
N		0.22979	0.03876	0.04121	0.05860	0.05910	0.04282		
N	20.933	0.20997	0.09533	0.95000		0.01051	0.04217	0.22588	0.24623
N		0.22979	0.03876	0.04121	0.05860	0.05910	0.04282		
N	21.010	0.20997	0.09533	0.95000		0.01051	0.04217	0.22588	0.24623
N		0.22979	0.03876	0.04121	0.05860	0.05910	0.04282		
N	21.420	0.20997	0.05955	0.95000		0.01704	0.08013	0.20148	0.35467

N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.500 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.523 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.657 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.680 0.20997 0.05955 0.95000 0.01704 0.08013 0.20148 0.35467
N 0.12095 0.07181 0.04617 0.04132 0.03584 0.02276
N 21.760 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 21.773 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 21.818 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 21.850 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 22.107 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 22.130 0.20997 0.04146 0.95000 0.01327 0.08040 0.20053 0.33463
N 0.13927 0.09282 0.05630 0.03361 0.02822 0.01194
N 22.320 0.20997 0.07723 0.95000 0.00642 0.05957 0.24449 0.17159
N 0.20383 0.07884 0.07927 0.07423 0.05525 0.02601
N 22.365 0.20997 0.07723 0.95000 0.00642 0.05957 0.24449 0.17159
N 0.20383 0.07884 0.07927 0.07423 0.05525 0.02601
N 22.790 0.20997 0.08817 0.95000 0.00295 0.08040 0.22208 0.27401
N 0.17304 0.05433 0.05972 0.05074 0.04780 0.03442
N 23.350 0.20997 0.17333 0.95000 0.00669 0.05531 0.12720 0.18266
N 0.15313 0.06655 0.09027 0.09565 0.09806 0.09687
N 23.365 0.20997 0.17333 0.95000 0.00669 0.05531 0.12720 0.18266
N 0.15313 0.06655 0.09027 0.09565 0.09806 0.09687
N 23.571 0.20997 0.17333 0.95000 0.00669 0.05531 0.12720 0.18266
N 0.15313 0.06655 0.09027 0.09565 0.09806 0.09687
N 23.694 0.20997 0.16437 0.95000 0.00102 0.01100 0.18103 0.17308
N 0.26319 0.08305 0.08766 0.07735 0.04680 0.05217
N 23.851 0.20997 0.16437 0.95000 0.00102 0.01100 0.18103 0.17308
N 0.26319 0.08305 0.08766 0.07735 0.04680 0.05217
N 23.874 0.20997 0.16437 0.95000 0.00102 0.01100 0.18103 0.17308
N 0.26319 0.08305 0.08766 0.07735 0.04680 0.05217
N 24.070 0.20997 0.16437 0.95000 0.00102 0.01100 0.18103 0.17308
N 0.26319 0.08305 0.08766 0.07735 0.04680 0.05217
N 24.085 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.170 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.193 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.350 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.365 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.468 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874
N 0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.491 0.20997 0.06172 0.95000 0.00944 0.00060 0.17255 0.15874

```
N          0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.540           0.20997 0.06172 0.95000         0.00944 0.00060 0.17255 0.15874
N          0.21901 0.12364 0.12097 0.08564 0.05219 0.01166
N 24.900           0.20997 0.11878 0.95000         0.00923 0.04467 0.21324 0.14742
N          0.17234 0.05644 0.06754 0.10079 0.11634 0.06850
N 25.370           0.20997 0.12678 0.95000         0.00149 0.00980 0.08434 0.12091
N          0.22085 0.10524 0.15080 0.11515 0.10960 0.08031
N 25.590           0.20997 0.12678 0.95000         0.00149 0.00980 0.08434 0.12091
N          0.22085 0.10524 0.15080 0.11515 0.10960 0.08031
N 25.860           0.20997 0.10795 0.95000         0.00538 0.03093 0.08500 0.21779
N          0.30391 0.10771 0.09192 0.03978 0.05572 0.03386
N 26.290           0.20997 0.18668 0.95000         0.00224 0.04115 0.11411 0.20318
N          0.20070 0.06822 0.08444 0.07735 0.08152 0.10243
N 26.730           0.20997 0.15103 0.95000         0.00054 0.00193 0.08266 0.13204
N          0.23227 0.10131 0.14684 0.14424 0.08659 0.07083
N 27.030           0.20997 0.19690 0.95000         0.00316 0.01357 0.06346 0.12297
N          0.22397 0.10727 0.13958 0.08334 0.10135 0.10213
N 27.680           0.20997 0.14198 0.95000         0.00292 0.02270 0.13383 0.11664
N          0.15213 0.06945 0.13230 0.13219 0.12590 0.10907
N 28.120           0.20997 0.20569 0.90000         0.00648 0.01875 0.05408 0.06661
N          0.17370 0.10358 0.10459 0.11172 0.11185 0.14004
N 28.670           0.20997 0.05813 0.95000         0.02020 0.07270 0.16705 0.19299
N          0.29376 0.07498 0.06550 0.04880 0.03996 0.01606
N 29.040           0.20997 0.17791 0.95000         0.00510 0.00977 0.02614 0.06339
N          0.12227 0.10953 0.11622 0.16800 0.19067 0.18308
N 29.540           0.20997 0.20519 0.90000         0.00024 0.00037 0.00154 0.00178
N          0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.611           0.20997 0.20519 0.90000         0.00024 0.00037 0.00154 0.00178
N          0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 29.800           0.20997 0.20519 0.90000         0.00024 0.00037 0.00154 0.00178
N          0.00248 0.00436 0.01344 0.04891 0.22294 0.61864
N 30.070           0.20997 0.19118 0.95000         0.01550 0.03290 0.10062 0.13788
N          0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.260           0.20997 0.19118 0.95000         0.01550 0.03290 0.10062 0.13788
N          0.20511 0.07374 0.08796 0.06193 0.07095 0.18332
N 30.820           0.20997 0.19285 0.95000         0.00421 0.00920 0.03670 0.07932
N          0.14957 0.08938 0.09220 0.11904 0.13559 0.27578
N 31.390           0.20997 0.07865 0.95000         0.00136 0.00317 0.04678 0.16566
N          0.32156 0.13746 0.15154 0.08637 0.05093 0.03300
N 31.860           0.20997 0.18391 0.95000         0.04180 0.03453 0.07407 0.10225
N          0.16518 0.07265 0.11009 0.06917 0.07639 0.15569
N 32.430           0.20997 0.16079 0.82061         0.00634 0.00913 0.01982 0.04061
N          0.07617 0.04604 0.20933 0.08932 0.14784 0.16079
N 32.860           0.20997 0.19086 0.95000         0.00264 0.00920 0.02984 0.04337
N          0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.984           0.20997 0.19086 0.95000         0.00264 0.00920 0.02984 0.04337
N          0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 32.998           0.20997 0.19086 0.95000         0.00264 0.00920 0.02984 0.04337
N          0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.410           0.20997 0.19086 0.95000         0.00264 0.00920 0.02984 0.04337
N          0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
N 33.820           0.20997 0.19086 0.95000         0.00264 0.00920 0.02984 0.04337
N          0.07199 0.04487 0.08026 0.16603 0.24082 0.30771
$LOCAL
```

```
LQL    Q   000.1    1000.    5000.  10000.
LTL   QS   000.1    1094.    6855.  16015.
LFL  VFS 0.28256 0.28256 0.25945 0.28352
LFL   FS 0.43291 0.43291 0.40442 0.37836
LFL   MS 0.14372 0.14372 0.16223 0.16477
LFL   CS 0.10623 0.10623 0.11610 0.11564
LFL  VCS 0.03200 0.03200 0.04974 0.04723
LFL  VFG 0.00126 0.00126 0.00559 0.00589
LFL   FG 0.00076 0.00076 0.00197 0.00380
LFL   MG 0.00056 0.00056 0.00028 0.00067
LFL   CG 0.00000 0.00000 0.00022 0.00012
LFL  VCG 0.00000 0.00000 0.00000 0.00000
$HYD
$RATING
RC          19    5000    4000 913.885   0.000   1.086   2.048   2.896   3.638
RC       4.286   4.848   5.334   5.755   6.119   6.436   6.716   6.969   7.204
RC       7.432   7.661   7.902   8.164   8.456
$B           2
$KL
*     TIME DURATION 1 - HYDROGRAPH 1
Q  5875.   1250.
T    60.     60.
X         0.1     1.8
*     TIME DURATION 2 - HYDROGRAPH 1
Q  5875.   1250.
W   0.05
*     TIME DURATION 3 - HYDROGRAPH 1
Q 11750.   2500.
X         0.1     1.3
*     TIME DURATION 4 - HYDROGRAPH 1
Q 11750.   2500.
W   0.09
*     TIME DURATION 5 - HYDROGRAPH 1
Q 17625.   3750.
X         0.1     0.9
*     TIME DURATION 6 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*     TIME DURATION 7 - HYDROGRAPH 1
Q 23500.   5000.
X         0.1     0.4
*     TIME DURATION 8 - HYDROGRAPH 1
Q 23500.   5000.
W 0.0625
*     TIME DURATION 9 - HYDROGRAPH 1
Q 17625.   3750.
X         0.1     0.9
*     TIME DURATION 10 - HYDROGRAPH 1
Q 17625.   3750.
W  0.025
*     TIME DURATION 11 - HYDROGRAPH 1
Q 11750.   2500.
X         0.1     1.3
*     TIME DURATION 12 - HYDROGRAPH 1
```

```
Q 11750.    2500.
W   0.09
*      TIME DURATION 13 - HYDROGRAPH 1
Q  5875.   1250.
X          0.1    1.8
*   B  TIME DURATION 14 - HYDROGRAPH 1
Q  5875.    1250.
W   0.05
$$END
```

APPENDIX G - Tabulated Results of Model Output

G.1 - Model I Output

Table G.1.1 - Net Change of Bed Profile Under Model I

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
1	33.820	1087.500	1011.300	-1.210	-2.520	-4.380	-3.820
2	33.410	2172.500	895.300	-0.610	-0.730	-1.150	-2.210
3	32.998	1121.000	689.900	-5.050	-6.540	-6.900	-8.900
4	32.984	360.000	546.700	-4.660	-4.640	-5.340	-7.820
5	32.860	1471.500	887.900	1.130	1.200	1.200	2.070
6	32.430	2637.500	1038.600	0.220	0.310	0.430	0.570
7	31.860	2742.500	1076.000	0.070	0.210	0.470	0.730
8	31.390	2737.500	1215.300	-0.670	-1.200	-1.520	-0.190
9	30.820	2965.000	1301.700	0.050	0.120	0.200	-0.450
10	30.260	1982.500	1097.800	-0.130	-0.110	-0.100	-0.100
11	30.070	1212.500	933.700	-0.210	-0.280	-0.450	-0.350
12	29.800	1410.000	1246.700	1.340	1.700	1.280	0.150
13	29.611	887.500	1324.600	-0.160	-0.420	-0.930	-0.680
14	29.540	1507.500	1042.600	-0.270	-0.440	-0.270	-0.190
15	29.040	2307.500	1046.400	0.070	0.230	0.500	0.340
16	28.670	2430.000	1325.000	-0.180	-0.140	-0.120	-0.010
17	28.120	2620.000	1444.500	-0.150	-0.330	-0.830	-1.310
18	27.680	2892.500	1883.300	-0.190	-0.230	-0.170	-0.110
19	27.030	2510.000	1368.800	-0.080	-0.120	-0.100	-0.100
20	26.730	1960.000	1925.300	0.010	-0.060	-0.130	-0.540
21	26.290	2285.000	2642.900	-0.220	-0.180	-0.160	-0.140
22	25.860	1847.500	2296.900	-0.920	-0.460	-0.180	-0.110
23	25.590	1290.000	1745.400	0.590	0.320	0.300	0.570
24	25.370	1805.000	2411.400	-0.060	-0.050	-0.120	-0.530
25	24.900	2195.000	2307.400	0.100	0.120	0.170	0.410
26	24.540	1442.500	1642.800	0.700	1.140	1.080	0.060
27	24.350	1712.500	2183.600	-0.170	-0.230	-1.810	-2.730
28	23.890	2652.500	2368.100	-0.200	-0.210	-0.080	0.830
29	23.350	2895.000	3409.500	-0.050	-0.070	-0.010	-0.100
30	22.790	2720.000	3582.400	-0.160	-0.170	-0.170	-0.110
31	22.320	2725.000	2955.600	-0.060	-0.090	0.180	0.170
32	21.760	2377.500	1925.800	0.010	0.000	0.280	0.230
33	21.420	1990.000	1728.900	-0.040	-0.020	0.120	0.080
34	21.010	1297.500	2199.400	0.800	1.000	1.160	1.140
35	20.920	1460.000	2722.400	0.200	0.160	0.180	0.140
36	20.450	2722.500	2576.600	-1.070	-1.250	-1.580	-1.300
37	19.890	2665.000	2785.300	-0.320	-0.880	-0.930	-0.870
38	19.440	2587.500	485.500	-0.100	-0.030	0.060	-0.090
39	18.920	3197.500	1535.700	-0.170	-0.180	-0.800	0.100
40	18.240	3060.000	1772.500	-0.100	-0.050	0.770	-1.950
41	17.760	2252.500	1705.900	0.470	0.750	0.780	2.120
42	17.380	2217.500	1464.300	0.700	0.230	-0.200	-0.230
43	16.910	2447.500	783.600	-0.920	-2.020	-3.230	-4.000
44	16.450	1230.000	529.700	-8.430	-3.930	-4.790	-5.300
45	16.446	57.500	474.700	1.710	-8.540	-8.120	-8.830

Table G.1.1 - Net Change of Bed Profile Under Model I (continued...)

No	Station Number	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
46	16.420	1155.000	713.600	3.110	2.770	2.260	1.480
47	15.980	2305.000	1306.100	1.070	1.160	2.970	2.690
48	15.510	1690.000	2136.100	-0.170	2.050	0.740	-0.260
49	15.320	1467.500	2338.300	0.670	-0.750	-0.730	0.440
50	14.940	1210.000	2053.000	0.380	0.860	0.220	1.060
51	14.850	1450.000	1911.400	-0.190	-0.570	-0.930	-0.070
52	14.380	2697.500	2315.500	-0.190	-0.180	0.850	-1.070
53	13.810	2770.000	1744.800	-0.060	-0.110	-0.640	0.680
54	13.330	3822.500	1448.500	-0.080	-0.080	-0.040	0.380
55	12.380	3977.500	1394.300	-0.110	-0.010	0.860	1.200
56	11.800	2150.000	1741.000	-2.300	-2.350	-3.420	-1.930
57	11.520	1197.500	728.400	-3.800	-4.390	-5.980	-3.550
58	11.340	1330.000	917.700	1.730	1.850	1.010	-2.600
59	11.010	1555.000	1545.100	2.790	3.040	3.600	3.190
60	10.720	1220.000	1286.900	0.770	0.320	0.470	0.250
61	10.530	2170.000	1070.400	-0.080	-0.160	-0.400	-0.940
62	9.900	3640.000	1188.700	-0.220	-0.220	-0.230	-0.080
63	9.130	4340.000	1551.300	-0.190	-0.210	-0.610	-1.260
64	8.210	2665.000	1451.000	-0.050	-0.060	0.030	0.180
65	8.100	567.500	1541.900	0.730	1.120	2.170	2.330
66	8.000	1610.000	1369.200	0.840	0.980	1.170	1.500
67	7.490	2640.000	1132.100	0.330	0.440	0.630	1.290
68	6.990	1572.500	1130.800	-0.460	-0.910	-1.220	-1.820
69	6.890	1447.500	1136.000	-0.620	-0.580	-0.810	-0.950
70	6.430	2600.000	1111.900	-0.190	-0.170	-0.150	-0.110
71	5.900	1902.500	1130.800	0.130	0.270	0.260	0.400
72	5.750	660.000	1161.400	-0.040	-0.250	0.290	-0.540
73	5.689	995.000	1246.300	-0.070	-0.020	-0.190	-1.590
74	5.380	1042.500	1360.700	-2.330	-1.570	-1.790	-1.400
75	5.290	620.000	1424.300	-3.190	-1.730	-2.840	-3.280
76	5.150	1324.000	1366.600	-0.120	-0.190	0.280	0.820
77	4.790	1075.000	1234.600	0.450	0.690	-0.650	-1.200
78	4.754	251.000	1134.500	2.530	2.650	3.160	4.380
79	4.700	1237.500	1141.600	1.490	1.500	1.650	2.630
80	4.270	1587.500	1142.600	0.910	0.550	1.150	1.410
81	4.094	1345.000	1141.200	-0.920	-1.900	-1.480	-2.170
82	3.767	907.500	1142.800	0.000	0.000	0.000	0.000
83	3.757	85.000	1164.100	0.000	0.010	0.030	0.040
84	3.734	72.500	1187.100	0.040	0.080	0.050	0.080
85	3.729	802.500	1352.300	0.000	0.000	0.000	0.010
86	3.430	872.500	1501.200	-4.030	-6.800	-9.490	-9.490
87	3.400	425.000	1347.400	0.940	2.580	3.340	2.420
88	3.270	1595.000	1799.700	0.850	1.590	1.410	2.290
89	2.800	1752.500	2119.600	0.270	0.720	1.210	1.640
90	2.600	2160.000	1444.600	-0.210	-0.170	-0.170	-0.220

Table G.1.1 - Net Change of Bed Profile Under Model I (continued...)

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
91	2.020	2642.500	1382.500	-0.100	-0.160	-0.240	0.600
92	1.710	2222.500	1614.600	0.500	0.680	1.100	0.670
93	1.330	2932.500	2890.200	-0.050	-0.090	-0.170	-0.130
94	0.730	2447.500	4304.102	-0.240	-0.270	-0.320	-0.230
95	0.440	1497.500	3313.900	-0.210	-0.200	-0.130	0.550
96	0.160	742.500	4124.500	0.000	0.000	0.000	0.000

Table G.1.2-Accumulated Volume Entering and Leaving the River Reach, Model I

Model No.	Entry Points	Inflow	Exit Points	Outflow	Trap Efficiency	Return Period
	Sta. No.	(Acre-ft)	Sta No.	(Acre-ft)	(%)	Year
I1	33.820*	38.360				50-year
	9.130**	12.900				
		51.260				
			0.160***	297.12	-480.0	
I2	33.820*	79.080				100-year
	9.130**	12.900				
		91.980				
			0.160***	425.94	-363.0	
I3	33.820*	149.160				200-year
	9.130**	12.900				
		162.060				
			0.160***	603.82	-273.0	
I4	33.820*	267.590				500-year
	9.130**	12.900				
		280.490				
			0.160***	799.60	-185.0	

Note: * Most upstream station.
** Confluence station with New River
*** Most downstream station.

G.2 - Model II Output

Table G.2.1 - Net Change of Bed Profile Under Model II

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
1	33.820	1087.500	1011.300	-1.350	-2.650	-4.220	-5.130
2	33.410	2172.500	895.300	-0.630	-0.810	-1.140	-1.750
3	32.998	1121.000	689.900	-5.570	-6.390	-7.110	-8.680
4	32.984	360.000	546.700	-4.690	-5.220	-5.480	-7.550
5	32.860	1471.500	887.900	1.190	1.560	1.380	1.970
6	32.430	2637.500	1038.600	0.210	0.210	0.400	0.630
7	31.860	2742.500	1076.000	0.070	0.230	0.470	0.760
8	31.390	2737.500	1215.300	-0.660	-1.130	-1.520	-0.150
9	30.820	2965.000	1301.700	0.050	0.070	0.180	-0.440
10	30.260	1982.500	1097.800	-0.130	-0.110	-0.100	-0.100
11	30.070	1212.500	933.700	-0.200	-0.320	-0.450	-0.340
12	29.800	1410.000	1246.700	1.360	1.630	1.240	0.160
13	29.611	887.500	1324.600	-0.140	-0.420	-0.940	-0.680
14	29.540	1507.500	1042.600	-0.260	-0.450	-0.270	-0.200
15	29.040	2307.500	1046.400	0.060	0.240	0.510	0.340
16	28.670	2430.000	1325.000	-0.180	-0.140	-0.120	-0.010
17	28.120	2620.000	1444.500	-0.150	-0.330	-0.830	-1.300
18	27.680	2892.500	1883.300	-0.190	-0.240	-0.170	-0.110
19	27.030	2510.000	1368.800	-0.080	-0.110	-0.100	-0.100
20	26.730	1960.000	1925.300	0.000	-0.060	-0.130	-0.560
21	26.290	2285.000	2642.900	-0.200	-0.190	-0.160	-0.140
22	25.860	1847.500	2296.900	-0.870	-0.460	-0.180	-0.110
23	25.590	1290.000	1745.400	0.550	0.320	0.240	0.380
24	25.370	1805.000	2411.400	-0.110	-0.180	-0.400	-1.050
25	24.900	2195.000	2307.400	-1.740	-1.990	-1.410	-1.610
26	24.540	1070.000	1703.200	-9.500	-9.500	-9.500	-9.500
27	24.491	177.500	3269.100	-9.370	-9.490	-9.490	-9.490
28	24.468	332.500	3872.400	30.170	24.830	21.360	25.670
29	24.365	312.500	3920.100	7.260	6.070	1.710	6.990
30	24.350	512.500	4007.100	-5.000	-5.480	-3.950	-5.230
31	24.193	532.500	4078.400	-7.490	-6.520	-6.930	-6.970
32	24.170	200.000	4070.000	14.900	32.800	29.150	29.630
33	24.085	180.000	3936.300	25.480	32.420	32.830	21.550
34	24.070	635.000	3910.100	-4.650	-5.780	-4.760	-5.180
35	23.874	655.000	3962.100	-9.500	-9.500	-9.500	-9.470
36	23.851	475.000	3956.600	7.010	10.220	-7.440	29.280
37	23.694	740.000	3917.000	17.140	18.970	30.990	25.110
38	23.571	867.500	4133.301	0.000	0.060	-2.830	11.290
39	23.365	582.500	4240.301	0.000	0.000	19.840	0.130
40	23.350	1505.000	4079.300	-1.060	-0.850	-1.470	-2.120
41	22.790	2720.000	3720.900	-1.120	-1.690	-2.370	-3.960
42	22.365	1375.000	3453.800	-9.310	-9.480	-9.480	-9.390
43	22.320	622.500	3549.900	13.050	15.990	26.650	28.560
44	22.130	562.500	3891.000	34.510	31.960	30.170	26.170
45	22.107	750.000	4386.699	-5.060	-6.020	-8.480	-6.690

Table G.2.1 - Net Change of Bed Profile Under Model II (continued...)

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
46	21.850	810.000	4762.602	-9.500	-9.500	-9.500	-8.400
47	21.818	240.000	5465.199	-9.500	-9.480	17.370	27.760
48	21.773	155.000	5563.500	20.560	13.200	9.020	-7.550
49	21.760	265.000	5501.301	-9.000	-8.920	-3.010	-7.240
50	21.680	290.000	5405.301	31.600	13.750	27.780	-9.170
51	21.657	415.000	4962.699	-3.050	-9.010	0.950	-6.180
52	21.523	415.000	4381.301	7.790	24.400	-0.060	7.560
53	21.500	290.000	3354.600	-6.630	-6.080	-8.270	-7.390
54	21.420	1312.500	1942.300	-4.750	-3.360	-4.380	2.590
55	21.010	1262.500	2129.100	-8.760	-9.460	-9.470	-9.470
56	20.933	215.000	1829.100	-9.490	-9.490	-9.490	-9.490
57	20.920	583.000	1779.700	-9.490	-9.480	-9.490	-9.490
58	20.657	593.000	1990.100	-7.820	-4.150	12.010	3.560
59	20.640	231.500	2150.000	-8.250	-8.910	-6.080	-8.270
60	20.577	221.500	2108.400	12.200	24.870	-9.500	7.280
61	20.563	70.000	2124.500	-9.500	-9.500	-9.500	-9.460
62	20.550	860.000	2143.100	-9.500	-9.500	-9.500	-9.500
63	20.240	1607.500	2260.900	15.960	13.840	18.610	19.440
64	19.953	805.000	2593.100	-0.200	-0.320	-1.140	-2.770
65	19.944	165.000	2826.200	-6.170	-5.840	-1.500	-2.950
66	19.890	1330.000	2848.400	-1.490	-1.560	-2.160	-1.740
67	19.440	2587.500	2485.500	-0.190	-0.770	-0.440	-0.770
68	18.920	3197.500	1535.700	-0.210	-1.630	-1.170	-1.920
69	18.240	3060.000	1772.500	-0.160	-0.120	-0.090	0.020
70	17.760	2252.500	1705.900	-0.080	-0.120	-0.120	0.530
71	17.380	2217.500	1464.300	0.180	0.520	0.310	0.550
72	16.910	2447.500	783.600	-0.640	-2.890	-3.580	-4.570
73	16.450	1230.000	529.700	-4.290	-2.020	-4.670	-5.730
74	16.446	57.500	474.700	-0.220	-3.120	-6.790	-8.850
75	16.420	1155.000	713.600	1.790	2.320	1.480	0.760
76	15.980	2305.000	1306.100	0.150	0.640	1.520	2.130
77	15.510	1690.000	1978.200	-1.290	-2.860	-1.340	-2.100
78	15.320	537.500	1316.300	-6.880	-6.380	1.840	0.990
79	15.303	632.500	988.900	6.840	9.040	16.050	18.360
80	15.063	912.500	1221.300	12.220	17.420	6.860	19.790
81	14.940	347.500	1299.800	8.810	-1.130	9.510	8.320
82	14.932	235.000	1418.800	-2.020	0.120	-3.320	-4.830
83	14.850	1307.500	1825.700	-2.270	-3.970	-3.890	-5.100
84	14.412	1215.000	2223.300	-8.540	-8.880	-9.490	-9.360
85	14.380	1482.500	2475.500	1.710	7.980	9.150	17.520
86	13.855	1482.500	2446.400	7.060	7.000	8.120	9.880
87	13.810	1400.000	2144.300	-0.880	-2.070	-2.080	-2.550
88	13.330	3815.000	1546.400	-0.100	-0.090	-1.070	-0.730
89	12.380	3977.500	1394.300	-0.150	-0.100	-0.120	-0.010
90	11.800	2150.000	1741.000	-2.620	-3.490	-2.620	-2.420

Table G.2.1 - Net Change of Bed Profile Under Model II (continued...)

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
91	11.520	1197.500	728.400	-3.860	-4.030	-7.610	-7.090
92	11.340	1330.000	917.700	0.800	0.780	0.500	-0.530
93	11.010	1555.000	1545.100	2.350	3.110	3.000	1.320
94	10.720	1220.000	1286.900	0.590	0.320	0.280	0.290
95	10.530	2170.000	1070.400	-0.100	-0.130	-0.340	-0.670
96	9.900	3640.000	1188.700	-0.680	-0.390	-0.170	-0.120
97	9.130	4340.000	1551.300	-0.170	-0.220	-0.550	-1.570
98	8.210	2665.000	1451.000	0.010	0.000	-0.020	0.320
99	8.100	567.500	1541.900	0.540	0.600	1.920	2.170
100	8.000	1610.000	1369.200	0.770	0.960	1.150	1.290
101	7.490	2640.000	1132.100	0.250	0.240	0.390	0.830
102	6.990	1572.500	1130.800	-0.330	-0.890	-1.120	-1.660
103	6.890	1447.500	1136.000	-0.720	-0.550	-0.870	-1.220
104	6.430	2600.000	1111.900	-0.180	-0.170	-0.150	-0.090
105	5.900	1902.500	1130.800	0.030	-0.090	0.250	0.240
106	5.750	660.000	1161.400	0.020	0.200	0.060	0.260
107	5.689	995.000	1246.300	-0.060	-0.060	-0.720	0.360
108	5.380	1042.500	1360.700	-2.110	-1.470	-2.140	-1.900
109	5.290	620.000	1424.300	-2.940	-1.940	-3.930	-3.490
110	5.150	1324.000	1366.600	-0.140	-0.210	0.700	0.650
111	4.790	1075.000	1234.600	-0.080	-0.330	-0.710	0.780
112	4.754	251.000	1134.500	2.630	2.710	2.750	3.030
113	4.700	1237.500	1141.600	1.490	1.450	1.780	1.800
114	4.270	1587.500	1142.600	0.970	0.780	1.300	0.380
115	4.094	1345.000	1141.200	-0.830	-1.920	-1.370	-2.850
116	3.767	907.500	1142.800	0.000	0.000	0.000	0.000
117	3.757	85.000	1164.100	0.000	0.010	0.010	0.050
118	3.734	72.500	1187.100	0.040	0.090	0.030	0.070
119	3.729	802.500	1352.300	0.000	0.000	0.000	0.010
120	3.430	872.500	1501.200	-4.860	-7.070	-9.500	-9.490
121	3.400	425.000	1347.400	2.170	2.910	3.010	1.520
122	3.270	1595.000	1799.700	1.090	1.290	1.100	1.200
123	2.800	1752.500	2119.600	0.350	0.880	1.350	1.700
124	2.600	2160.000	1444.600	-0.220	-0.170	-0.160	-0.220
125	2.020	2642.500	1382.500	-0.090	-0.140	-0.170	0.440
126	1.710	2222.500	1614.600	0.480	0.660	1.000	0.540
127	1.330	2932.500	2890.200	-0.030	-0.080	-0.750	-0.800
128	0.730	2447.500	4304.102	-0.270	-0.300	-0.480	-0.240
129	0.440	1497.500	3313.900	-0.220	-0.190	0.520	0.640
130	0.160	742.500	4124.500	0.000	0.000	0.000	0.000

Table G.2.2-Accumulated Volume Entering and Leaving the River Reach, Model II

Model No.	Entry Points	Inflow	Exit Points	Outflow	Trap Efficiency	Return Period
	Sta. No.	(Acre-ft)	Sta No.	(Acre-ft)	(%)	Year
II1	33.820*	38.360				50-year
	9.130**	12.900				
		51.260				
			0.160***	263.46	-414.0	
II2	33.820*	79.080				100-year
	9.130**	12.900				
		91.980				
			0.160***	372.14	-305.0	
II3	33.820*	149.160				200-year
	9.130**	12.900				
		162.060				
			0.160***	551.96	-241.0	
II4	33.820*	267.590				500-year
	9.130**	12.900				
		280.490				
			0.160***	747.77	-167.00	

Note: * Most upstream station.
** Confluence station with New River
*** Most downstream station.

G.3 - Model III Output

Table G.3.1 - Net Change of Bed Profile Under Model III

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
1	33.820	1087.500	1011.300	-1.220	-2.580	-4.220	-5.140
2	33.410	2172.500	895.300	-0.550	-0.840	-1.140	-1.640
3	32.998	1121.000	689.900	-5.220	-6.300	-7.110	-8.700
4	32.984	360.000	546.700	-4.750	-5.100	-5.480	-7.530
5	32.860	1471.500	887.900	1.220	1.470	1.380	1.850
6	32.430	2637.500	1038.600	0.200	0.230	0.400	0.700
7	31.860	2742.500	1076.000	0.070	0.220	0.470	0.740
8	31.390	2737.500	1215.300	-0.690	-1.130	-1.520	-0.140
9	30.820	2965.000	1301.700	0.050	0.080	0.180	-0.440
10	30.260	1982.500	1097.800	-0.130	-0.110	-0.100	-0.100
11	30.070	1212.500	933.700	-0.210	-0.310	-0.450	-0.350
12	29.800	1410.000	1246.700	1.320	1.650	1.250	0.160
13	29.611	887.500	1324.600	-0.140	-0.410	-0.940	-0.690
14	29.540	1507.500	1042.600	-0.260	-0.510	-0.270	-0.200
15	29.040	2307.500	1046.400	0.060	0.270	0.510	0.350
16	28.670	2430.000	1325.000	-0.180	-0.150	-0.120	-0.010
17	28.120	2620.000	1444.500	-0.150	-0.330	-0.830	-1.300
18	27.680	2892.500	1883.300	-0.190	-0.250	-0.170	-0.110
19	27.030	2510.000	1368.800	-0.080	-0.110	-0.100	-0.100
20	26.730	1960.000	1925.300	0.010	-0.060	-0.130	-0.560
21	26.290	2285.000	2642.900	-0.210	-0.190	-0.160	-0.140
22	25.860	1847.500	2296.900	-0.840	-0.440	-0.180	-0.110
23	25.590	1290.000	1745.400	0.530	0.310	0.240	0.380
24	25.370	1805.000	2411.400	-0.110	-0.180	-0.400	-1.070
25	24.900	2195.000	2307.400	-1.730	-2.030	-1.420	-1.770
26	24.540	1070.000	1703.200	-9.500	-9.500	-9.500	-9.500
27	24.491	177.500	3269.100	-9.370	-9.490	-9.490	-9.490
28	24.468	332.500	3872.400	29.950	25.030	21.360	28.170
29	24.365	312.500	3920.100	7.260	5.340	1.970	6.660
30	24.350	512.500	4007.100	-5.190	-5.450	-3.860	-5.100
31	24.193	532.500	4078.400	-7.450	-6.510	-5.630	-7.550
32	24.170	200.000	4070.000	15.440	32.570	31.430	25.810
33	24.085	180.000	3936.300	25.480	31.980	24.000	23.050
34	24.070	635.000	3910.100	-4.810	-5.630	-4.710	-4.680
35	23.874	655.000	3962.100	-9.500	-9.500	-9.490	-9.440
36	23.851	475.000	3956.600	7.380	10.540	16.130	29.750
37	23.694	740.000	3917.000	17.140	18.970	32.390	26.450
38	23.571	867.500	4133.301	0.000	0.060	0.290	10.560
39	23.365	582.500	4240.301	0.000	0.000	0.100	0.170
40	23.350	1505.000	4079.300	-1.050	-0.840	-1.450	-2.130
41	22.790	2720.000	3720.900	-1.120	-1.650	-2.380	-3.980
42	22.365	1375.000	3453.800	-9.440	-9.490	-9.500	-9.380
43	22.320	622.500	3549.900	13.360	15.580	11.830	28.380
44	22.130	562.500	3891.000	34.100	31.970	31.010	24.200
45	22.107	750.000	4386.699	-4.720	-6.030	-7.270	-6.800

Table G.3.1 - Net Change of Bed Profile Under Model III (contiued...)

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
46	21.850	810.000	4762.602	-9.500	-9.490	-5.270	-8.490
47	21.818	240.000	5465.199	16.400	-9.480	-9.000	23.310
48	21.773	155.000	5563.500	32.110	11.740	33.730	-8.390
49	21.760	265.000	5501.301	-3.050	-8.750	-9.380	4.660
50	21.680	290.000	5405.301	12.760	38.840	-4.990	-9.270
51	21.657	415.000	4962.699	0.060	-6.120	-6.170	-6.160
52	21.523	415.000	4381.301	-0.010	21.680	29.810	28.180
53	21.500	290.000	3354.600	-5.700	-7.350	-6.120	-6.320
54	21.420	1312.500	1942.300	-3.130	-4.590	4.190	4.210
55	21.010	1262.500	2129.100	-9.120	-9.500	-9.490	-9.500
56	20.933	215.000	1829.100	-9.490	-9.490	-9.490	-9.480
57	20.920	583.000	1779.700	-9.500	-9.490	-9.500	-9.470
58	20.657	593.000	1990.100	-8.540	-5.320	12.190	9.230
59	20.640	231.500	2150.000	-8.800	-8.960	-9.330	-9.240
60	20.577	221.500	2108.400	30.660	8.220	-7.130	1.270
61	20.563	70.000	2124.500	-9.500	-9.500	-9.490	-9.500
62	20.550	860.000	2143.100	-9.500	-9.500	-9.500	-9.500
63	20.240	1607.500	2260.900	13.900	15.940	17.350	17.010
64	19.953	805.000	2576.500	-0.020	-0.090	1.450	-2.310
65	19.944	165.000	1643.900	-1.640	-1.730	0.100	-1.010
66	19.890	1330.000	2270.300	-1.570	-2.710	-2.510	-3.750
67	19.440	2587.500	1311.500	-1.300	-1.210	-1.830	0.770
68	18.920	3197.500	1026.900	-0.060	-0.180	0.440	0.400
69	18.240	3060.000	1029.300	-0.070	-0.160	-0.130	0.050
70	17.760	2252.500	1026.900	-0.010	-0.160	-1.020	-1.450
71	17.380	2217.500	1026.000	0.000	-0.020	0.580	0.860
72	16.910	2447.500	1026.000	0.120	0.320	-0.510	-0.480
73	16.450	1230.000	1024.500	0.040	-1.060	-8.960	-8.850
74	16.446	57.500	506.700	-2.610	-2.210	2.300	-8.250
75	16.420	1155.000	713.600	0.910	1.070	-8.630	2.020
76	15.980	2305.000	1306.100	-0.050	0.080	6.980	1.350
77	15.510	1690.000	1978.200	-1.200	-2.410	-3.940	-2.520
78	15.320	537.500	1316.300	-3.410	1.230	-5.790	-8.270
79	15.303	632.500	988.900	8.060	12.220	10.260	14.230
80	15.063	912.500	1221.300	7.350	7.040	18.880	37.850
81	14.940	347.500	1299.800	16.820	14.240	-0.400	-3.990
82	14.932	235.000	1418.800	-2.050	-4.780	1.680	-5.950
83	14.850	1307.500	1825.700	-2.450	-4.380	-3.470	-5.420
84	14.412	1215.000	2223.300	-8.680	-9.430	-8.350	-9.230
85	14.380	1482.500	2475.500	1.820	5.220	13.150	19.720
86	13.855	1482.500	2446.400	7.690	6.940	8.200	9.320
87	13.810	1400.000	1997.600	-1.010	-1.070	-2.120	-2.610
88	13.330	2572.500	1257.700	-0.130	-1.070	-0.660	-1.790
89	12.840	2535.000	1026.000	-0.030	-0.050	-0.040	-0.030
90	12.380	2685.000	1026.000	-0.070	-0.010	0.090	0.220

Table G.3.1 - Net Change of Bed Profile Under Model III (continued...)

N	Station No.	Reach Length (ft)	Movable Bed (ft)	Simulated Results			
				50-year	100-year	200-year	500-year
91	11.800	2150.000	1026.000	-0.230	-0.230	-0.220	-0.200
92	11.520	1197.500	1026.000	-0.770	-0.810	-1.860	-3.590
93	11.340	1330.000	1026.000	-0.140	-0.390	-0.340	-0.480
94	11.010	1555.000	1026.000	-1.100	-1.480	-1.870	-3.440
95	10.720	765.500	1026.000	-2.060	-1.900	-2.090	-2.160
96	10.530	1715.500	1026.000	-0.020	-0.100	-0.090	-0.020
97	9.900	3640.000	1026.000	0.040	0.080	0.170	0.270
98	9.130	3020.000	1026.000	-0.120	-0.090	-0.030	0.070
99	8.730	2365.000	1026.000	-0.040	-0.030	-0.080	-0.230
100	8.210	1620.000	1026.000	0.260	0.400	0.070	1.260
101	8.100	567.500	1098.800	0.750	0.940	0.960	1.230
102	8.000	1610.000	1336.700	0.440	0.560	0.870	0.950
103	7.490	2640.000	1132.100	0.330	0.380	0.480	0.450
104	6.990	1572.500	1130.800	-0.560	-0.880	-0.930	-1.690
105	6.890	1447.500	1136.000	-0.790	-0.580	-0.470	-0.760
106	6.430	2600.000	1111.900	-0.180	-0.170	-0.160	-0.130
107	5.900	1902.500	1130.800	0.090	0.010	-0.130	-0.150
108	5.750	660.000	1161.400	-0.060	0.010	-0.250	0.460
109	5.689	995.000	1246.300	-0.060	0.020	-2.120	-0.060
110	5.380	1042.500	1360.700	-2.310	-1.480	-2.020	-1.750
111	5.290	620.000	1424.300	-2.940	-1.670	-3.560	-3.070
112	5.150	1324.000	1366.600	0.140	-0.220	1.120	0.380
113	4.790	1075.000	1234.600	0.130	-0.300	-0.710	0.700
114	4.754	251.000	1134.500	2.560	2.710	3.080	2.870
115	4.700	1237.500	1141.600	1.510	1.480	1.690	1.430
116	4.270	1587.500	1142.600	0.850	0.810	1.330	0.380
117	4.094	1345.000	1141.200	-1.080	-1.910	-1.370	-2.380
118	3.767	907.500	1142.800	0.000	0.000	0.000	0.000
119	3.757	85.000	1164.100	0.000	0.010	0.010	0.020
120	3.734	72.500	1187.100	0.050	0.090	0.020	0.050
121	3.729	802.500	1352.300	0.000	0.000	0.000	0.000
122	3.430	872.500	1501.200	-4.720	-6.870	-9.500	-9.500
123	3.400	425.000	1347.400	1.470	2.900	2.960	1.070
124	3.270	1595.000	1799.700	1.060	1.540	1.080	0.850
125	2.800	1752.500	2119.600	0.380	0.780	1.340	1.470
126	2.600	2160.000	1444.600	-0.180	-0.170	-0.160	-0.200
127	2.020	2642.500	1382.500	-0.100	-0.140	-0.170	0.430
128	1.710	2222.500	1614.600	0.500	0.680	0.970	0.480
129	1.330	2932.500	2890.200	-0.040	-0.090	-0.690	-0.690
130	0.730	2447.500	4304.102	-0.250	-0.280	-0.570	-0.230
131	0.440	1497.500	3313.900	-0.220	-0.190	0.480	0.420
132	0.160	742.500	4124.500	0.000	0.000	0.000	0.000

Table G.3.2 Accumulated Volume Entering and Leaving the River Reach, Model III

Model No.	Entry Points	Inflow	Exit Points	Outflow	Trap Efficiency	Return Period
	Sta. No.	(Acre-ft)	Sta No.	(Acre-ft)	(%)	Year
III1	33.820*	38.360				50-year
	9.130**	12.900				
		51.260				
			0.160***	264.34	-416.0	
III2	33.820*	79.080				100-year
	9.130**	12.900				
		91.980				
			0.160***	376.45	-309.0	
III3	33.820*	149.160				200-year
	9.130**	12.900				
		162.060				
			0.160***	536.31	-231.0	
III4	33.820*	267.590				500-year
	9.130**	12.900				
		280.490				
			0.160***	750.43	-168.0	

Note: * Most upstream station.
** Confluence station with New River
*** **Most downstream station.**

APPENDIX H - Compilation of Photos Taken During Data Collection and Field Survey

Fig. H-1 - The river channel is comprised mainly of very fine sediments which have been largely transported from upstream. Looking upstream.
[**Location:** About 0.7 mile from Gila Confluence; **Photo taken:** October, 1991]

Fig. H-2 - The river channel is comprised mainly of very fine sediments which have been largely transported from upstream. Looking downstream.
[**Location:** About 0.7 mile from Gila Confluence; **Photo taken:** October, 1991]

Fig. H-3 - The immediate floodplain east of the river channel are sediment deposits of very fine grains.
[Location: About 0.7 mile from Gila Confluence; **Photo taken:** October, 1991**]**

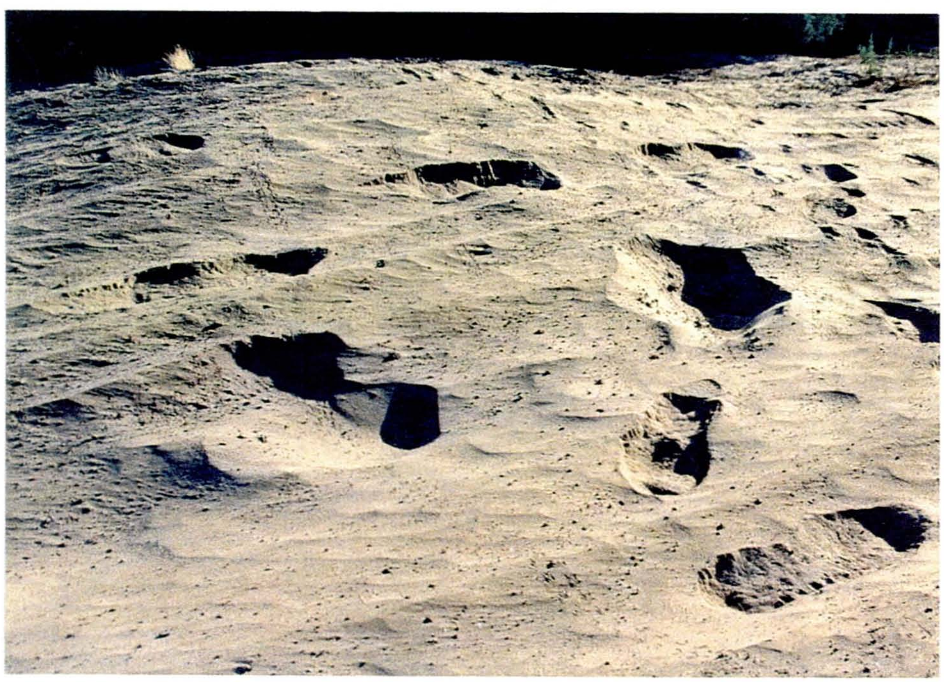

Fig. H-4 - The close-up of the sediment deposits.
[**Location:** About 0.7 mile from Gila Confluence; **Photo taken:** October, 1991]

Fig. H-5 - **Upstream of the Gila Confluence, there are isolated patches of armored layer.**
[Location: About 0.8 mile from Gila Confluence; **Photo taken:** October, 1991]

Fig. H-6 - The 2" x 2" grid laid over the surface where the samples have been taken.
[Location: 0.5 Mile South of Broadway Road; Mile Designation: 0.92;
Photo taken: Feb. 22, 1992]

Fig. H-7 - The river channel around the Broadway Road.
[Location: Broadway Road; **Mile Designation:** 1.33; **Photo taken:** February 22,1992]

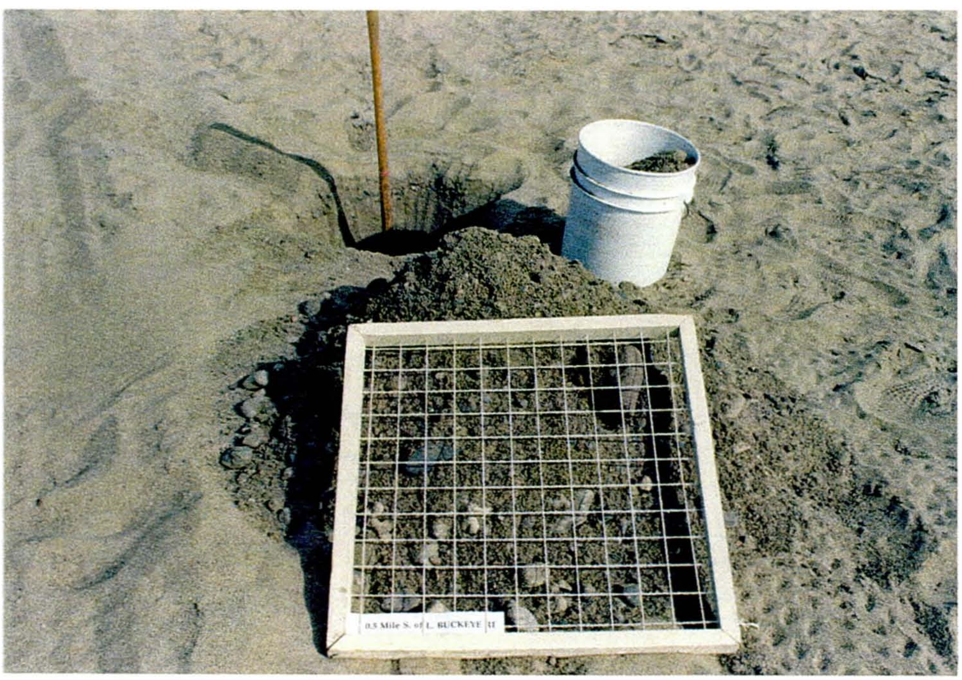

Fig. H-8 - The 2" x 2" grid laid over the aggregates drawn out from the sample pit. Samples were collected over the entire 3-foot deep column.
[Location: 0.5 Mile South of Lower Buckeye Road; **Mile Designation:** 1.71;
Photo taken: Feb. 22, 1992]

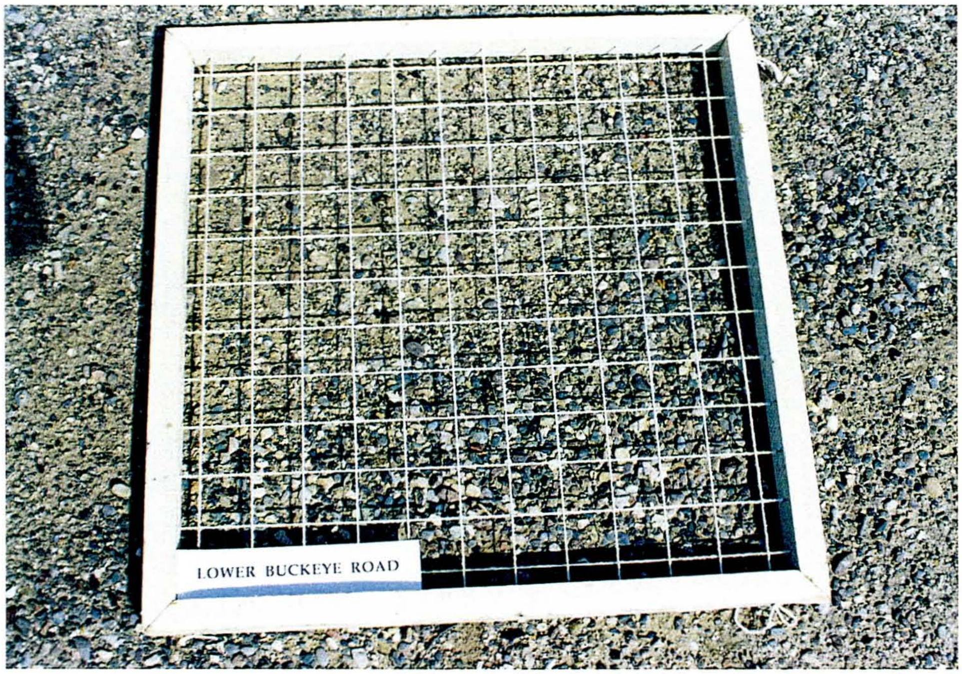

Fig. H-9 - The 2" x 2" grid laid over the surface where samples have been taken.
[Location: Lower Buckeye Road; **Mile Designation**: 2.60;**Photo taken:** February 22, 1992]

Fig. H -10 - The Lower Buckeye road across the river.
[Location: Lower Buckeye Road, **Mile Designation:** 2.60; **Photo taken:** Feb. 22, 1992]

Fig. H-11 - The bank protection (levee) runs from Lower Buckeye Road to Indian School Road.
[Location: Lower Buckeye Road, **Mile Designation:** 2.60; **Photo taken:** Feb. 22, 1992]

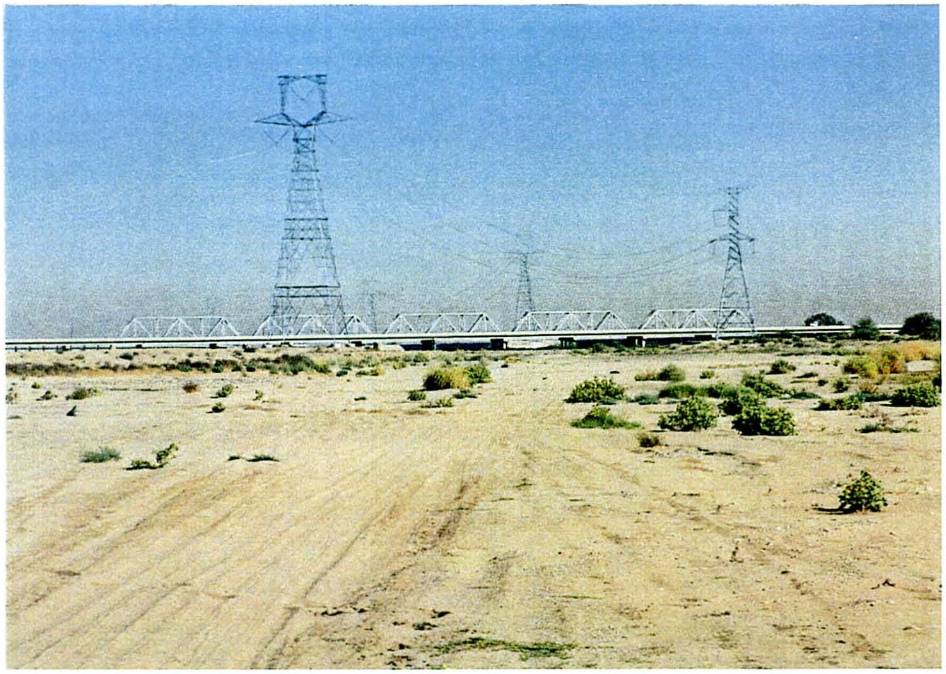

Fig. H-12 - The sediment aggregates are predominantly medium to fine sands along the reach from Lower Buckeye Road to Buckeye Road Bridge.
[**Background:** Buckeye Road Bridge; **Photo taken:** Feb. 22, 1992]

Fig. H-13 - The boulder aggregates under the Buckeye Road Bridge.
[**Location:** Buckeye Road Bridge; Mile Designation: 3.757; **Photo taken:** Feb. 22, 1992]

Fig. H-14 - The sediment aggregates along the river channel around the Buckeye Road Bridge.
[Location: About 0.1 mile north of Buckeye Road; **Mile Designation**: 3.80;
Photo taken: February 22, 1992]

Fig. H-15 - The concrete drop running across the river channel.
[Location: About 0.4 mile north of Buckeye Road; Mile Designation: 4.157;
Photo taken: February 22, 1992]

Fig. H-16 - The concrete weir running across the river channel.
[Location: 0.4 mile north of Buckeye Road; **Photo taken:** October, 1991]

Fig. H-17 - Downstream of the concrete weir is heavily scoured from 2 to 2.5 ft deep after four months.
[Location: About 0.4 mile north of Buckeye Road; **Photo taken:** Feb. 22, 1992]

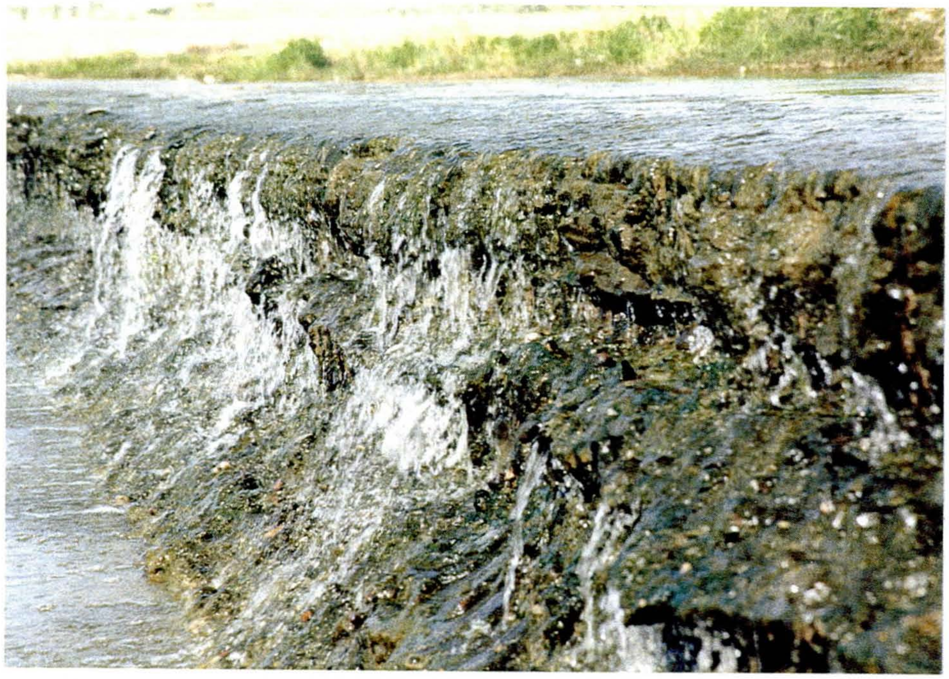

Fig. H-18 - Downstream of the concrete weir with the Buckeye Road in the background.
[Location: About 0.4 mile north Buckeye Road; **Photo taken:** February 22, 1992**]**

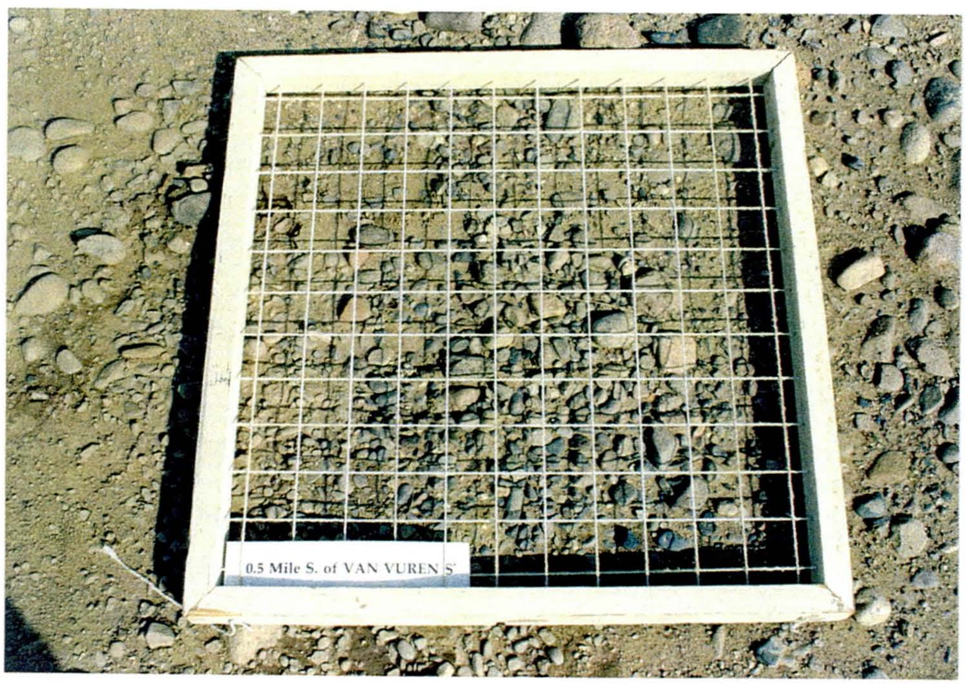

Fig. H-19 - The 2" x 2" grid laid over the surface where samples have been collected.
[Location: About 0.5 mile south of Van Buren; **Mile Designation**: 4.30;
Photo taken: February 22, 1992**]**

Fig. H-20 -**The Van Buren Bridge with the river channel.**
[Location: About 0.15 mile south of Van Buren Bridge; **Mile Designation**: 4.759; **Photo taken:** February 22, 1992]

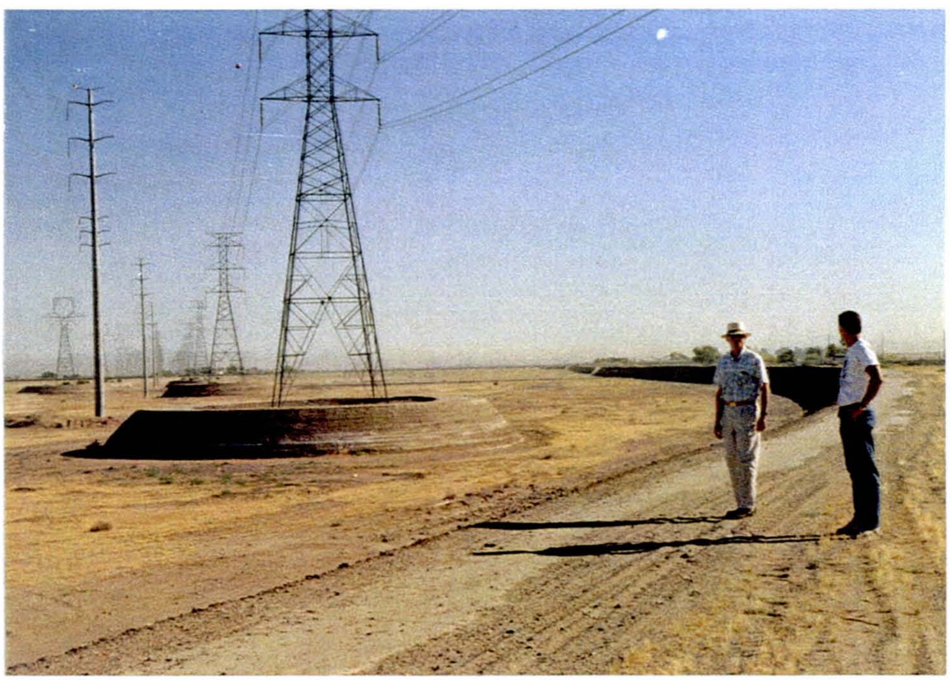

Fig. H-21 - **The side levee which runs from Lower Buckeye Road to Indian School Road. As shown, the in-stream power lines are also protected by levees.**
[Location: 0.1 mile north of McDowell Road; **Photo taken:** May, 1992]

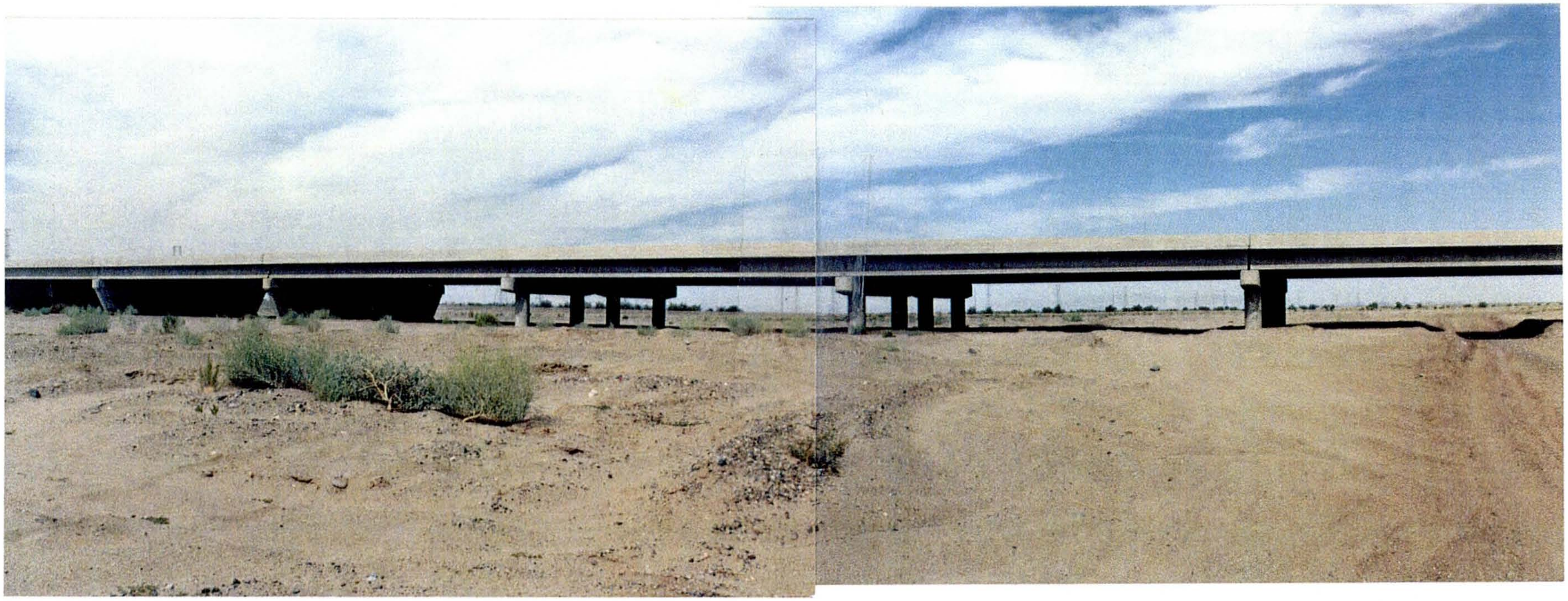

Fig. H-22 - The Camelback Road Bridge.
[Location: Camelback Road; **Mile Designation:** 8.01; **Photo taken:** October, 1991]

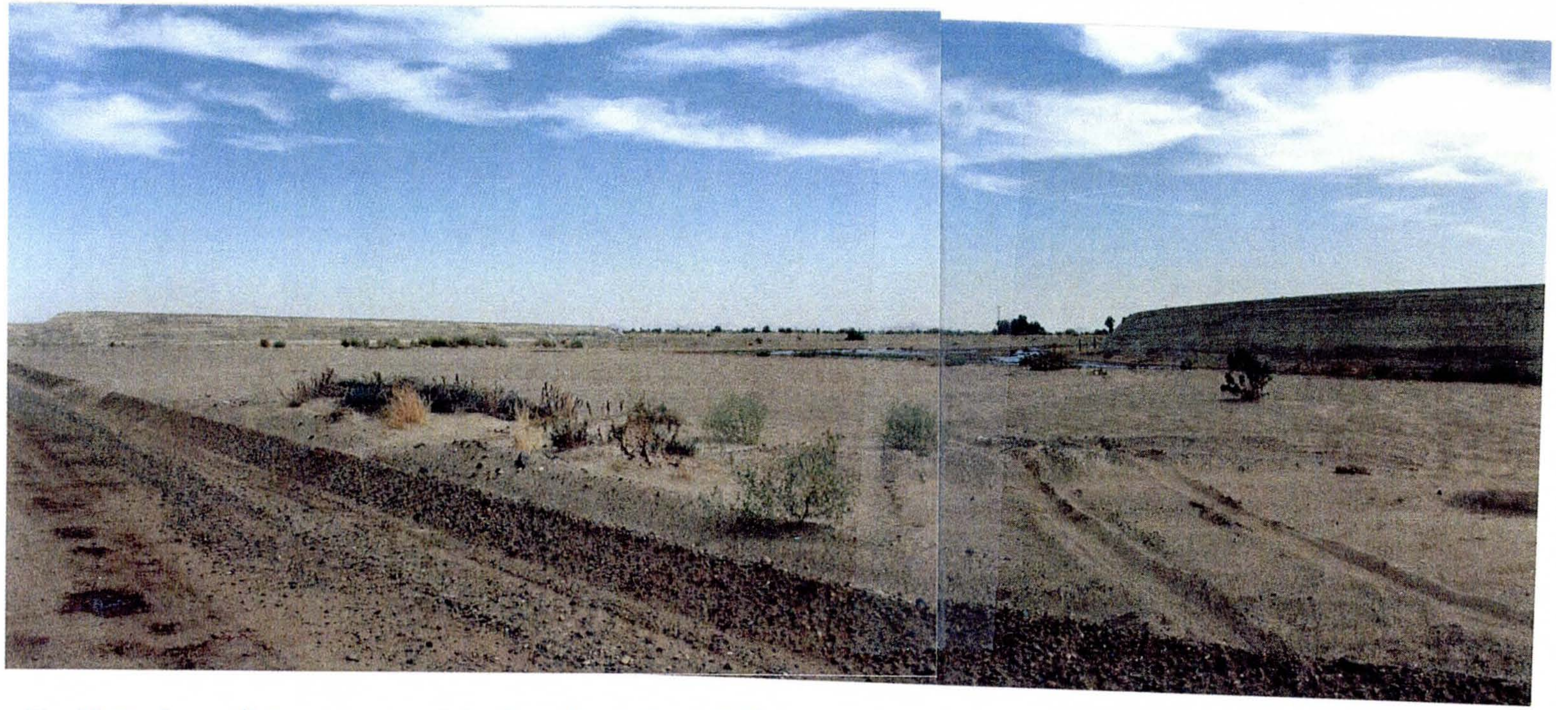

Fig. H-23 - Immediate upstream of the Camelback Road Bridge.
[Location: Camelback Road; **Mile Designation:** 8.01; **Photo taken:** October, 1991]

Fig. H-24 - The bank protection at the west bank side of Agua Fria River.
[**Location:** Olive Avenue; **Photo taken:** October, 1991]

Fig. H-25 - The same bank protection made up of boulders near a mining site.
[**Location:** Olive Avenue; **Photo taken:** October, 1991]

Fig. H-26 - The heavily armored layer along the thalweg.
[Location: Peoria Road; **Mile Designation:** 14.38; **Photo taken:** October, 1991]

Fig. H-27 - The 2"x 2" grid over the armored layer of the river reach.
[Location: Peoria Road; **Mile Designation:** 14.38; **Photo taken:** October, 1991]

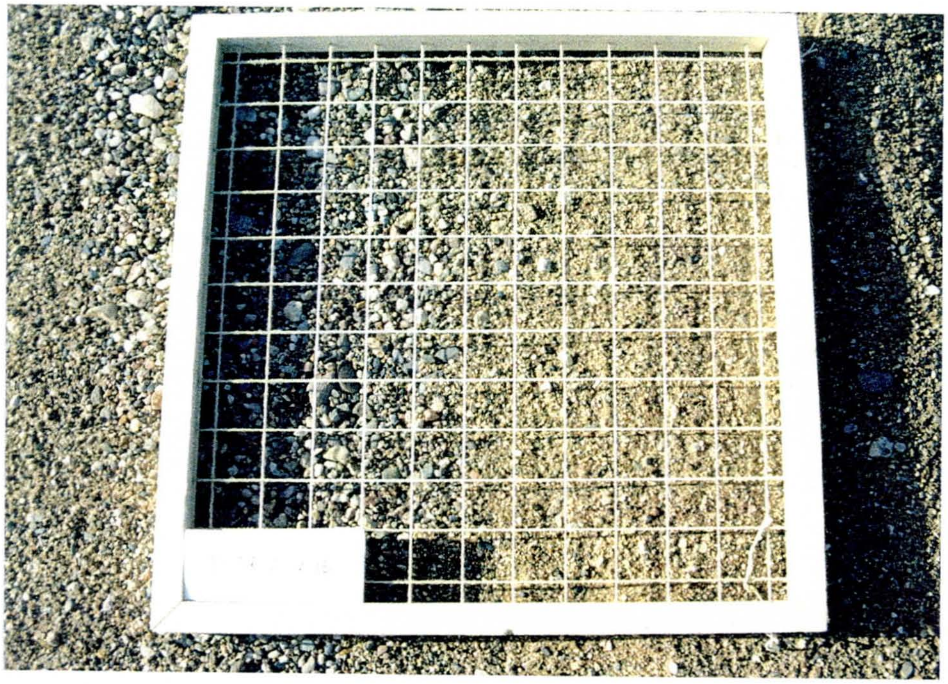

Fig. H-28 - **Another location shows a relatively uniform soil aggregates ranging from medium sand to fine gravel.**
[Location: Peoria Avenue; **Mile Designation:** 14.38; **Photo taken:** January 18, 1992**]**

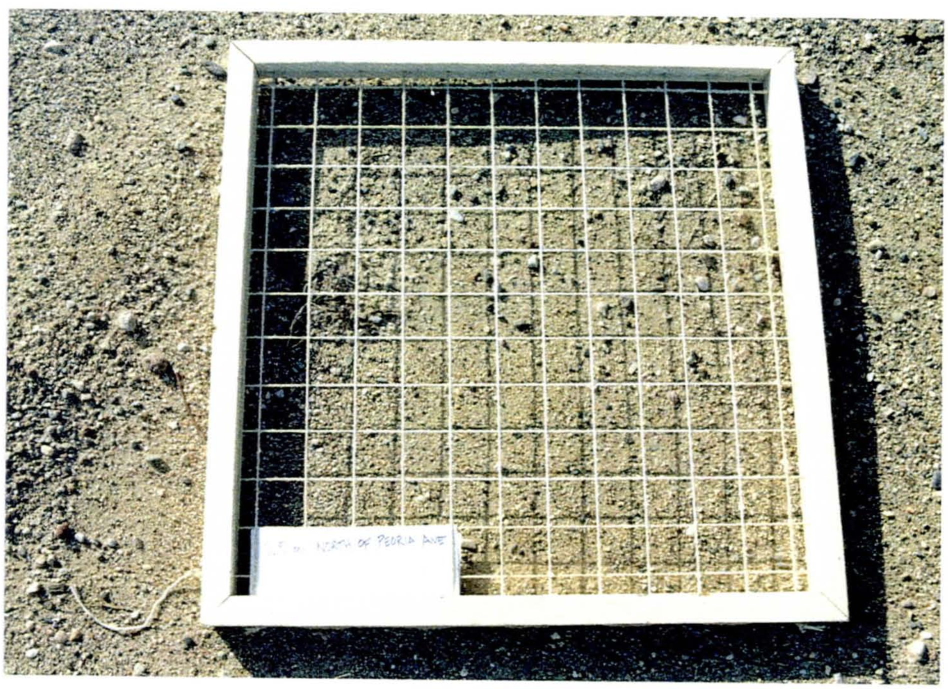

Fig. H-29 - **The 2"x 2" grid over the site where the sediment sample was taken.**
[Location: 0.5 north of Peoria Avenue; **Mile Designation:** 14.94;
Photo taken: January 18, 1992**]**

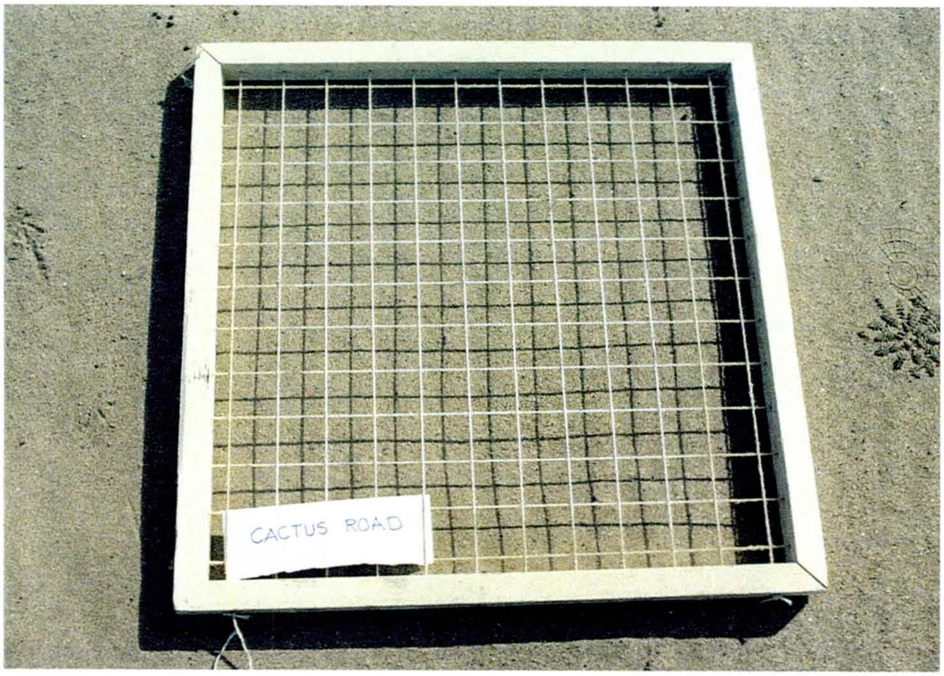

Fig. H-30 - The 2"x 2" grid over the surface aggregates at the sampling site.
[Location: Cactus Road; **Mile Designation:** 15.51; **Photo taken:** Jan. 18, 1992]

Fig. H-31 - The Thalweg is armored heavily downstream with plume of fine sediments moving from upstream.
[Location: 0.4 mile south of Thunderbird Road; **Mile Designation:** 16.06; **Photo taken:** Feb. 8, 1992]

Fig. H-32 - **The Grand Avenue Bridge (Highway 60).**
[**Location:** Thunderbird Road; **Mile Designation:** 16.46; **Photo taken:** October, 1991]

Fig. H-33 - Landfill developed into a levee at the immediate downstream of Grand Avenue Bridge.
[**Location:** Thunderbird Road; **Photo taken:** October, 1991]

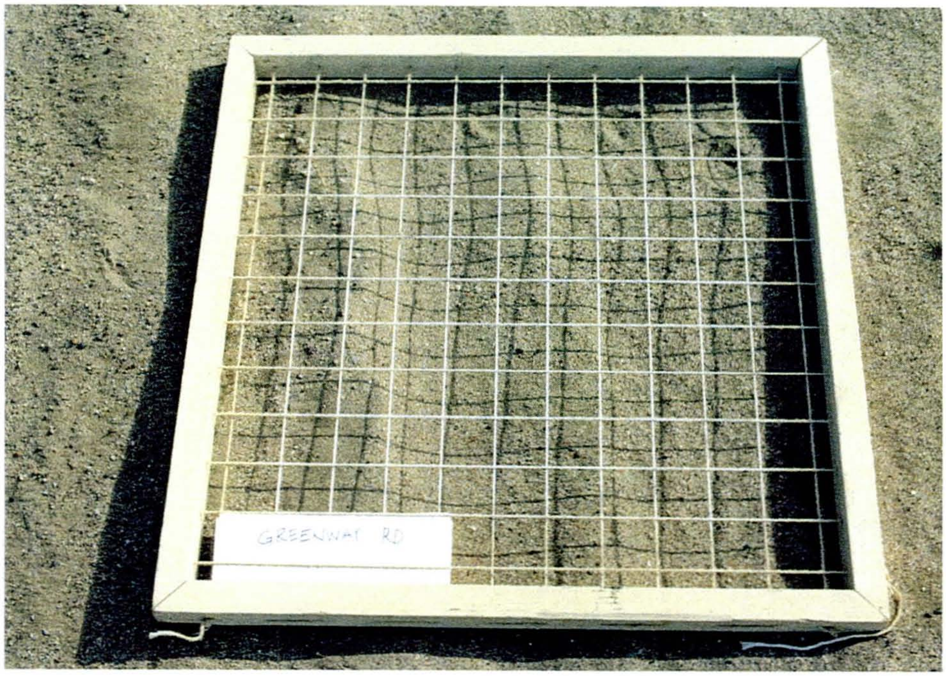

Fig. H-34 - The 2"x 2" grid over the surface aggregates at the sampling site.
[Location: GreenwayRoad; **Mile Designation:** 17.76; **Photo taken:** Jan. 18, 1992**]**

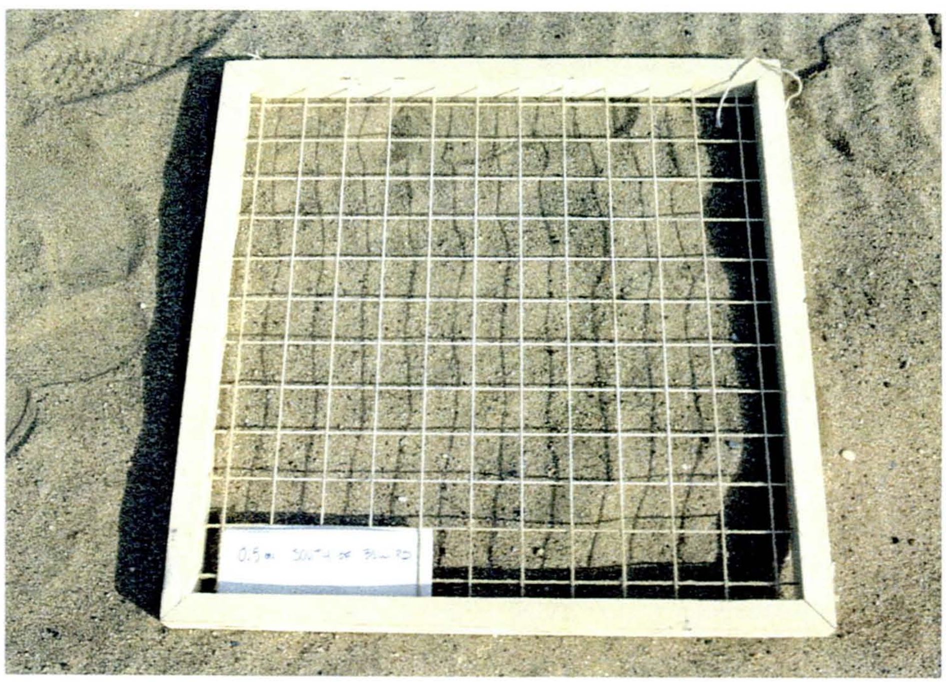

Fig. H-35 - The 2"x 2" grid against the surface aggregates at the sampling site.
[Location: 0.5 mile south of Bell Road; **Mile Designation:** 18.42;
Photo taken: January.18, 1992**]**

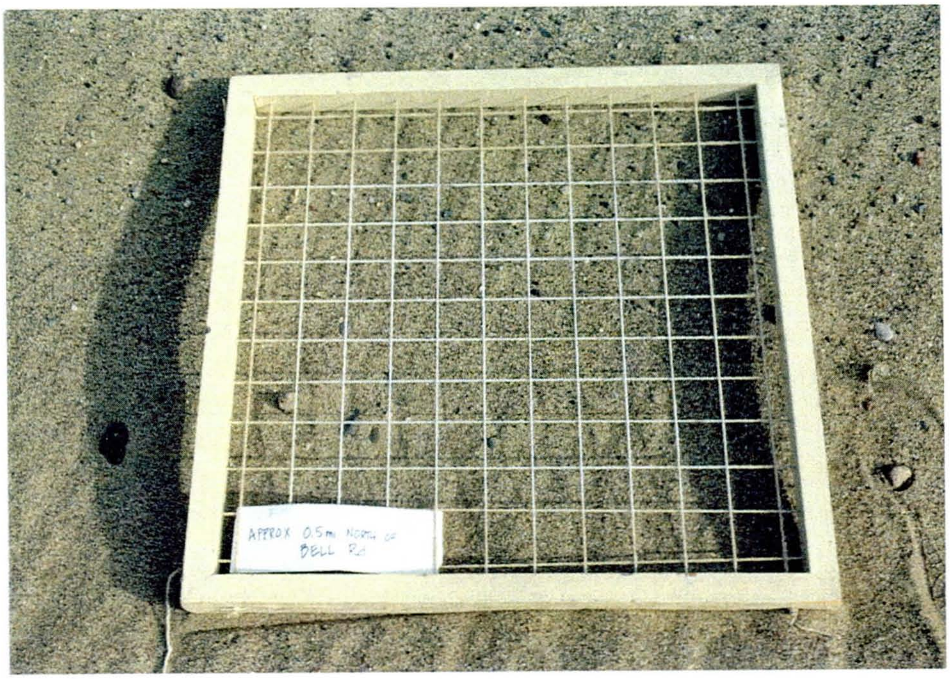

Fig. H-36 - The 2"x 2" grid over the surface aggregates at the sampling location.
[Location: 0.5 mile north of Bell Road; **Mile Designation:** 19.44;
Photo taken: Jan. 18, 1992]

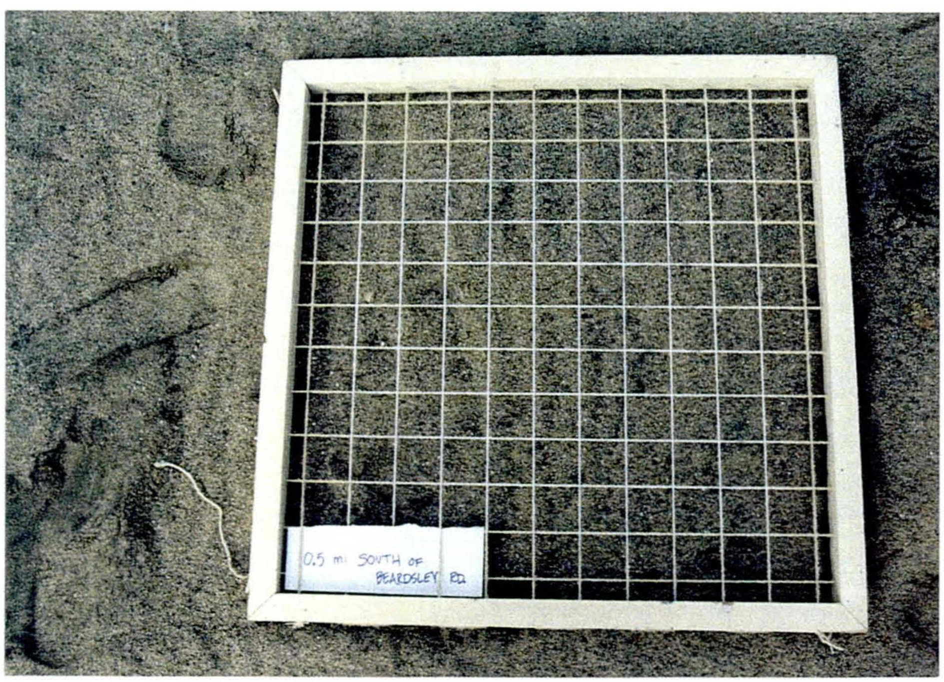

Fig. H-37 - The 2"x 2" grid over the surface aggregates at the sampling site.
[Location: Beardsley Road; **Mile Designation:** 20.45; **Photo taken:** Jan. 20, 1992]

Fig. H-38 - Commercial gravel and sand companies mine the aggregates of the river.
[Location: Rose Garden Lane; **Photo taken:** October, 1991]

Fig. H-39 - The very dry bed of the river during summer.
[Location: Rose Garden; **Mile Designation:** 21.68; **Photo taken:** May, 1991]

Fig. H-40 - Semi-armored layer along the thalweg of the river.
[**Location:** Deer Valley Road; **Mile Designation:** 22.32; **Photo taken:** October, 1991]

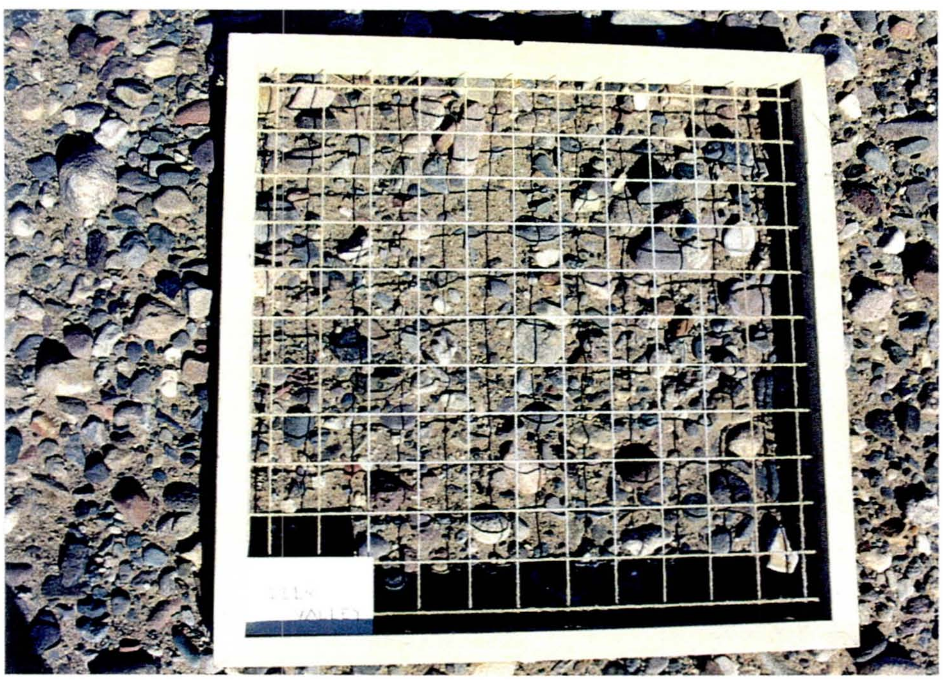

Fig. H-41 - The 2"x 2" grid over the semi-armored surface layer of the river.
[**Location:** Deer Valley Road; **Mile Designation:** 22:32; **Photo taken:** October, 1991]

Fig. H-42 - At another location where the surface is not armored.
[Location: Deer ValleyRoad; **Mile Designation:** 22.32; **Photo taken:** Jan. 20, 1992]

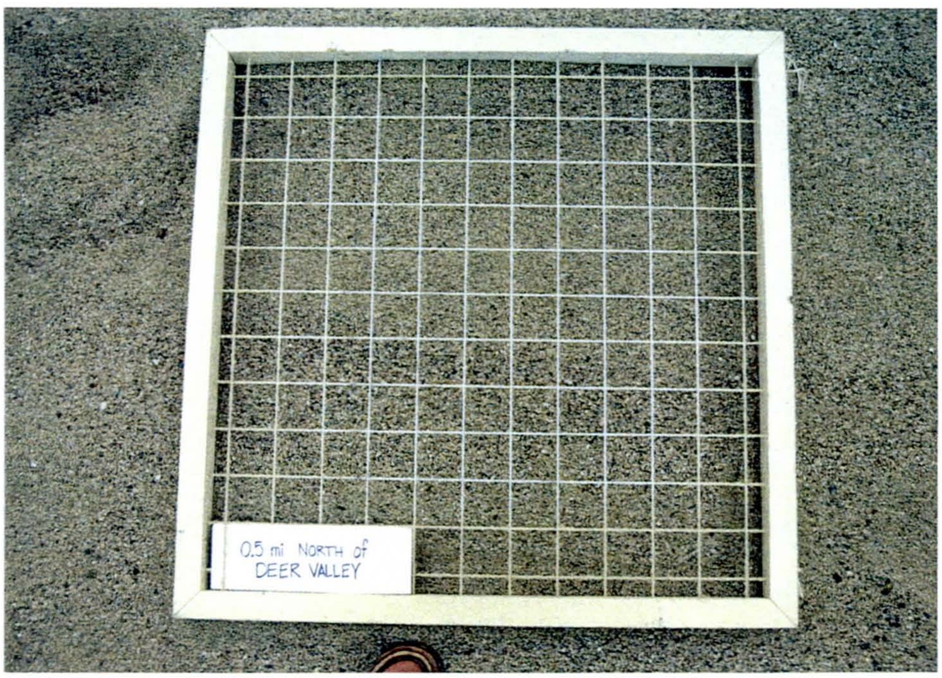

Fig. H-43 - The 2"x 2" grid over the surface aggregates.
[Location: 0.5 mile northDeer Valley Road; **Mile Designation:** 22.79;
Photo **taken:** Jan. 20, 1992]

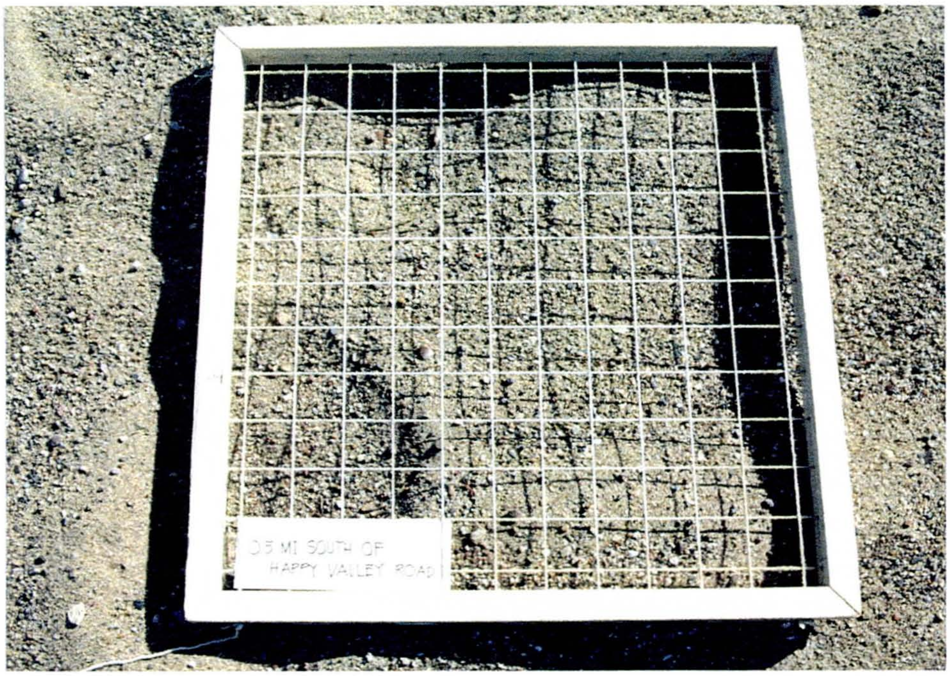

Fig. H-44 - **The 2"x 2" grid over the surface aggregates at the sample site.**
[Location: 0.5 mile south of Happey Valley Road; **Mile Designation:** 23.89;
Photo taken: Jan. 25, 1992]

Fig. H-45 - **The 2"x 2" grid over the surface aggregates at the sampling site.**
[Location: 0.5 mile South of Happy Valley Road; **Mile Designation:** 23.89;
Photo taken: Jan. 25, 1992]

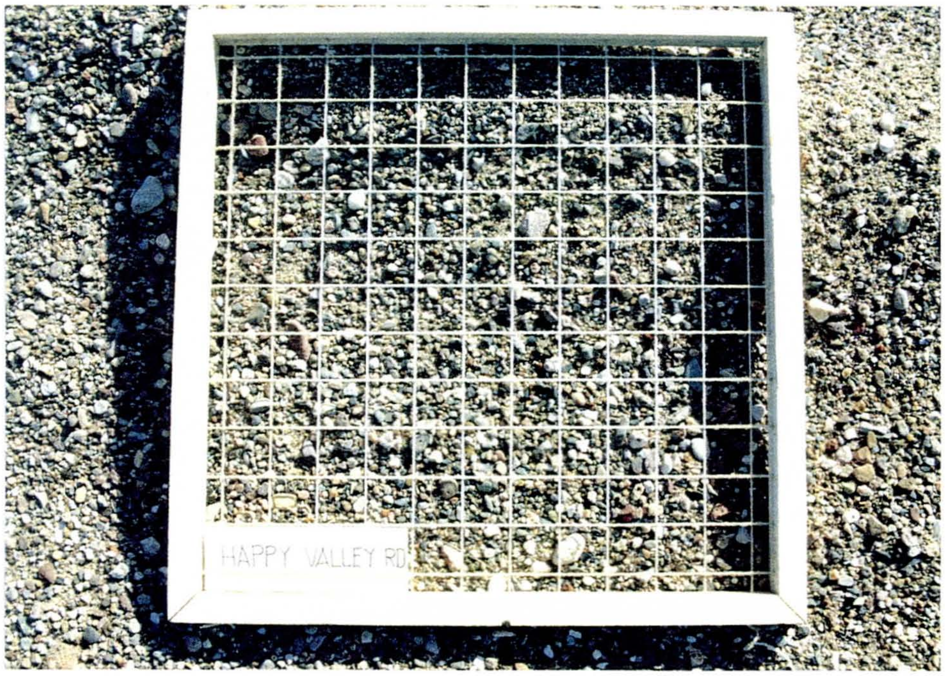

Fig. H-46 - The 2"x 2" grid over the surface aggregate of the sampling site.
[Location: Happy Valley Road; **Mile Designation:** 24.35; **Photo taken:** Jan. 25, 1992]

Fig. H-47 - The river channel at Happy Valley Road.
[Location: Happy Valley Road; **Mile Designation:** 24.35; **Photo taken:** Jan. 25, 1992]

Fig. H-48 - **Sampling site showing finer aggregates below the surface.**
[Location: Happy Valley Road; **Mile Designation:** 24.35; **Photo taken:** Jan. 25, 1992]

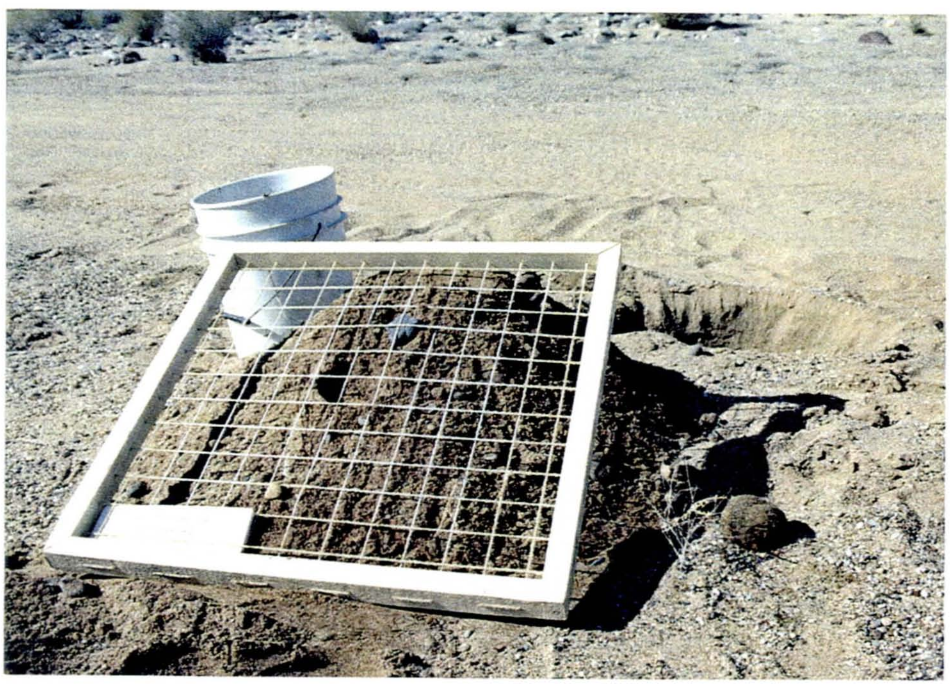

Fig. H-49 - **The 2"x 2" grid over the sediment pile from the sampling location.**
[Location: 0.5 mile south of Jomax Road; **Mile Designation:** 24.90;
Photo taken: Jan. 25, 1992]

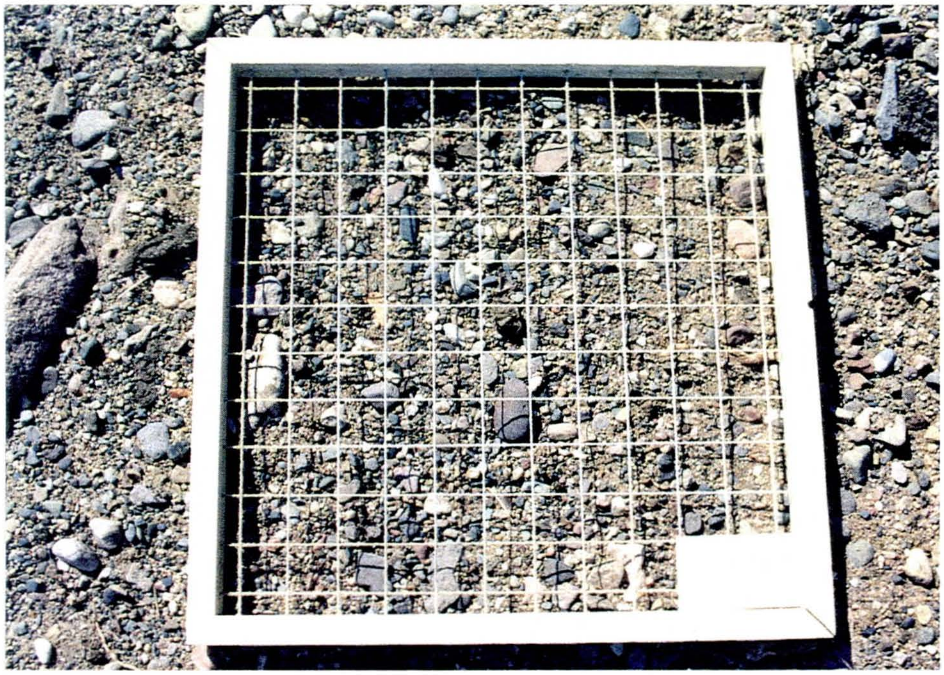

Fig. H-50 - **The 2" x 2" grid over the surface aggregates at Jomax Road.**
[Location: Jomax Road; **Mile Designation:** 25.37; **Photo taken:** Jan. 25, 1992**]**

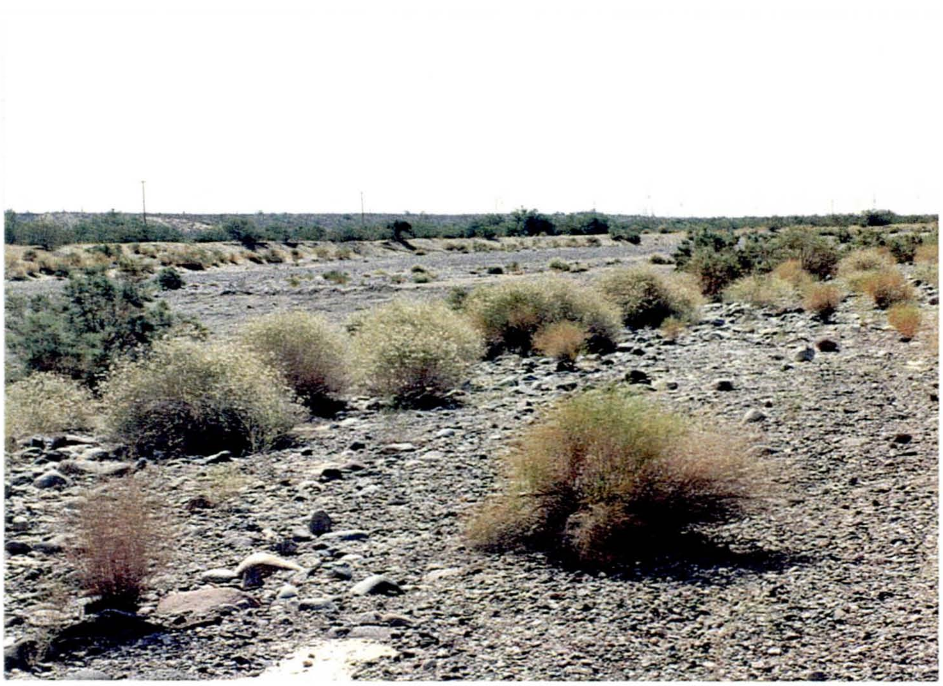

Fig. H-51 - The island on the right foreground. The river bed is covered by coarse aggregates.
[Location: Jomax Road; **Mile Designation:** 25.37; **Photo taken:** Jan. 25, 1992**]**

Fig. H-52 - At the thalweg, the sub-surface layer is comprised of sand deposits.
[**Location:** 0.5 north of Jomax Road; **Mile Designation:** 25.86; **Photo taken:** Jan. 25, 1992]

Fig. H-53 - The river channel upstream of the Jomax Road.
[**Location:** 0.5 north of Jomax Road; **Mile Designation:** 25.86; **Photo taken:** Jan. 25, 1992]

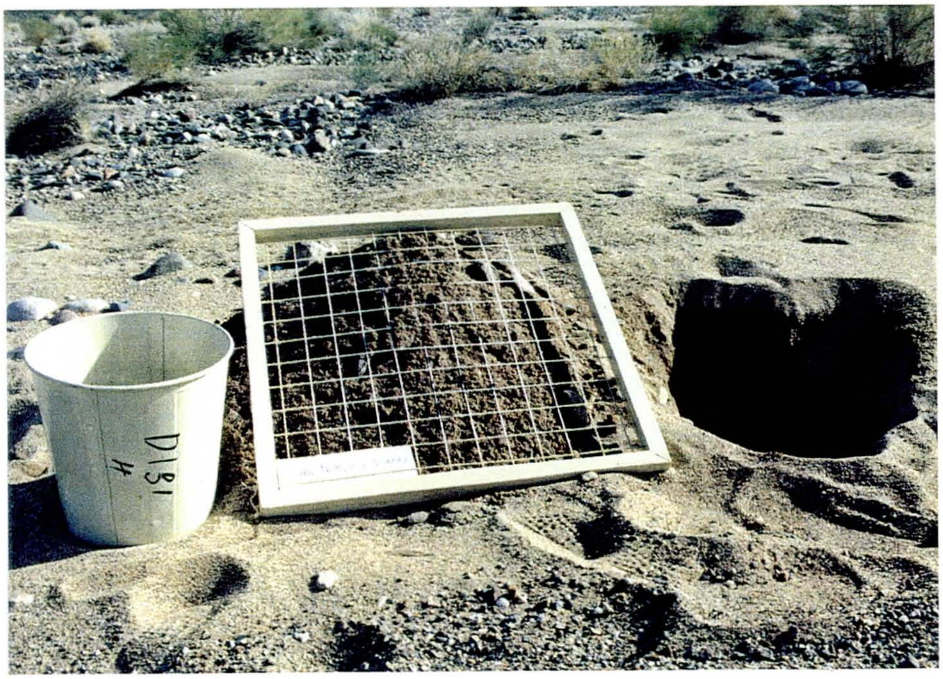

Fig. H-54 - **Sand deposits where sediment sample was taken.**
[Location: 0.75 mile north of Jomax Road; **Mile Designation:** 26.29;
Photo taken: Jan. 25, 1992**]**

Fig. H-55 - **A significant range of aggregate sizes exist along the river channel. The photo shows the location where samples have been collected.**
[Location: 0.8 mile south of Dixileta Drive; **Mile Designation:** 26.73;
Photo taken: Jan. 25, 1992**]**

Fig. H-56 - **The sediment samples were taken generally at the thalweg.**
[Location: 0.35 mile south of Dixileta Drive; **Mile Designation:** 27.30;
Photo taken: Jan. 25, 1992]

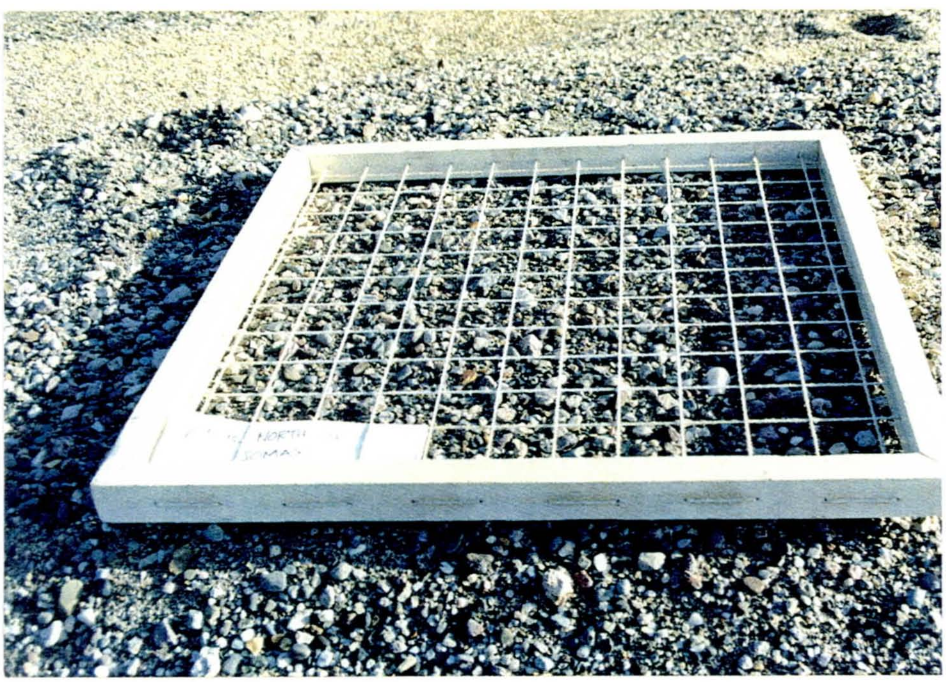

Fig. H-57 - **The 2"x 2" grid over the surface aggregate near the sampling site.**
[Location: 0.35 mile south of Dixileta Drive; **Mile Designation:** 27.30;
Photo taken: Jan. 25, 1992]

Fig. H-58 - Representative sediment samples are collected from the surface to a depth of 3.0 feet.
[Location: 0.35 mile south of Dixileta Drive **Mile Designation:** 27.30;
Photo taken: Jan. 25, 1992]

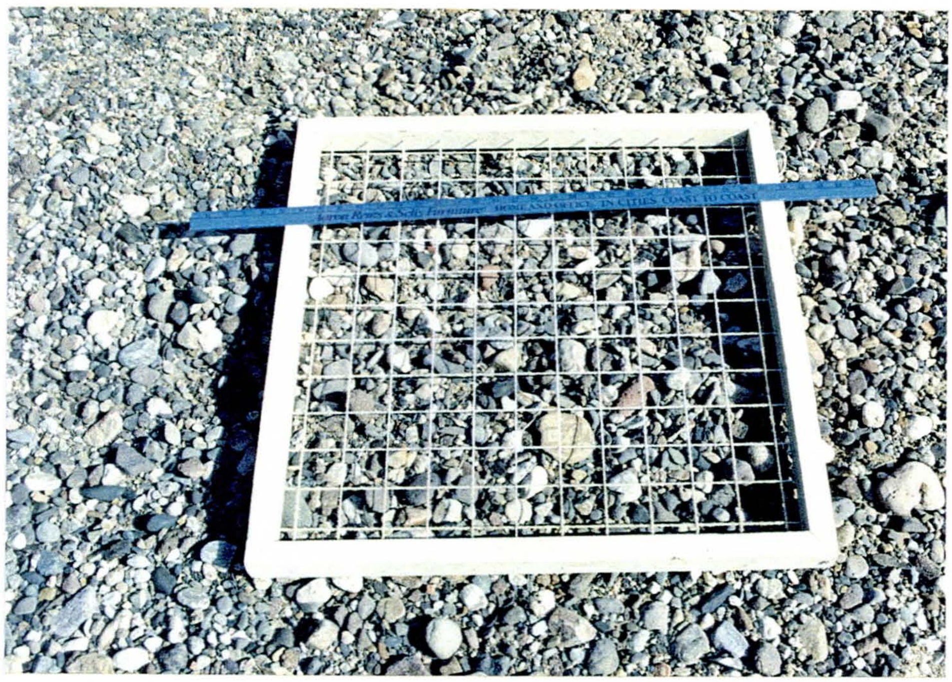

Fig. H-59 - The 2" x 2" grid over the armored layer near the thalweg.
[Location: Dixileta Drive; **Mile Designation:** 27.68; **Photo taken:** Feb. 1, 1992]

Fig. H-60 - **The surface aggregates are much coarser than those in the sub-surface.**
[**Location:** Dixileta Drive; **Mile Designation:** 27.68; **Photo taken:** Feb. 1, 1992]

Fig. H-61 - **Collection of samples is usually made at or around the thalweg.**
[**Location:** Dixileta Drive; **Mile Designation:** 27.68; **Photo taken:** Feb. 1, 1992]

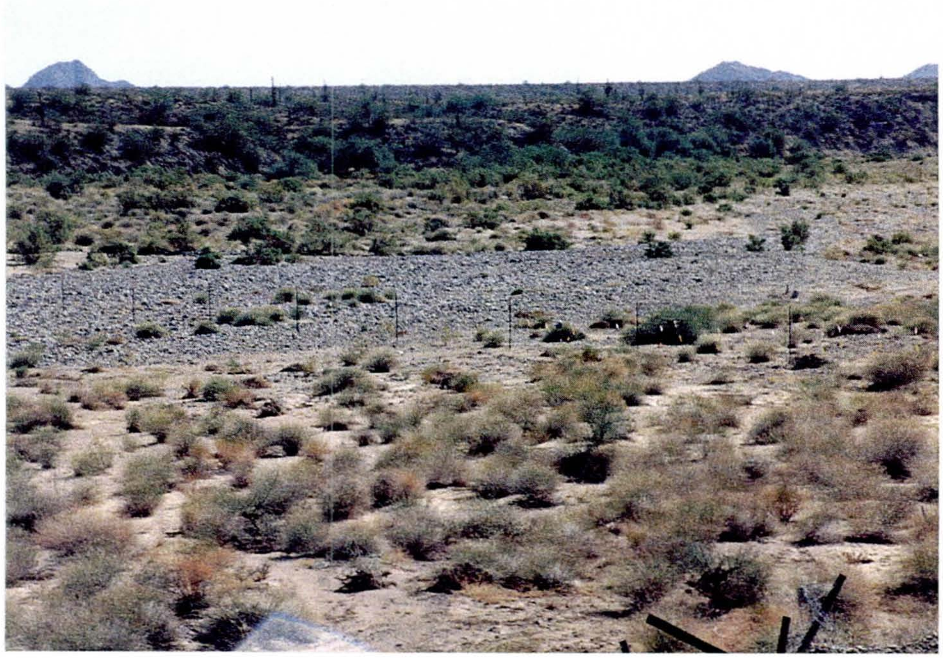

Fig. H-62 - The river channel is armored near the Beardsley Canal.
[Location: C.A.P. Canal; **Photo taken:** October, 1991]

Fig. H-63 - The semi-armored surface layer 0.50 ft downstream of the Beardsley Canal.
[Location: CAP Canal; **Photo taken:** October, 1991]

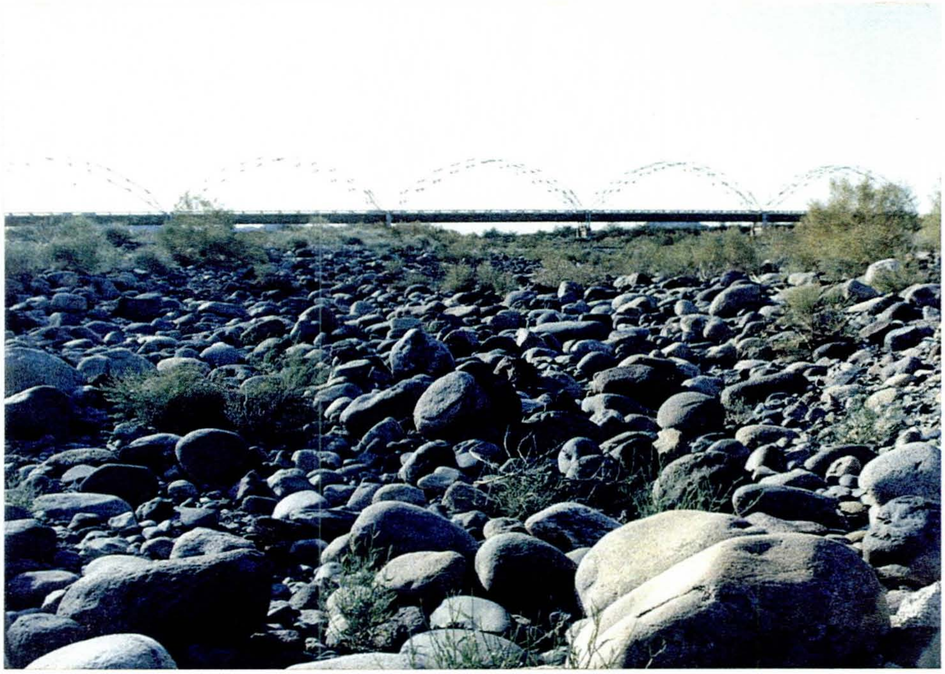

Fig. H-64 - The heavily armored reach of the Agua Fria River. The Beardsley Canal is in the background.
[Location: CAP Canal; **Mile Designation:** 29.80; **Photo taken:** Feb. 1, 1992]

Fig. H-65 - Sediments for analysis are sampled over a 3.0-foot deep hole.
[Location: 0.5 mile north of Carefree Road; **Mile Designation:** 31.29;
Photo taken: Feb. 1, 1992]

Fig. H-66 - The armored layer of the bed located at about 1.25 miles south of Highway 70.
[Photo taken: Feb. 1, 1992]

Fig. H-67 - The river bed exhibits a range of sizes for the aggregates.
[**Location:** 1.1 mile south of Highway 70; **Photo taken:** Feb. 1, 1992]

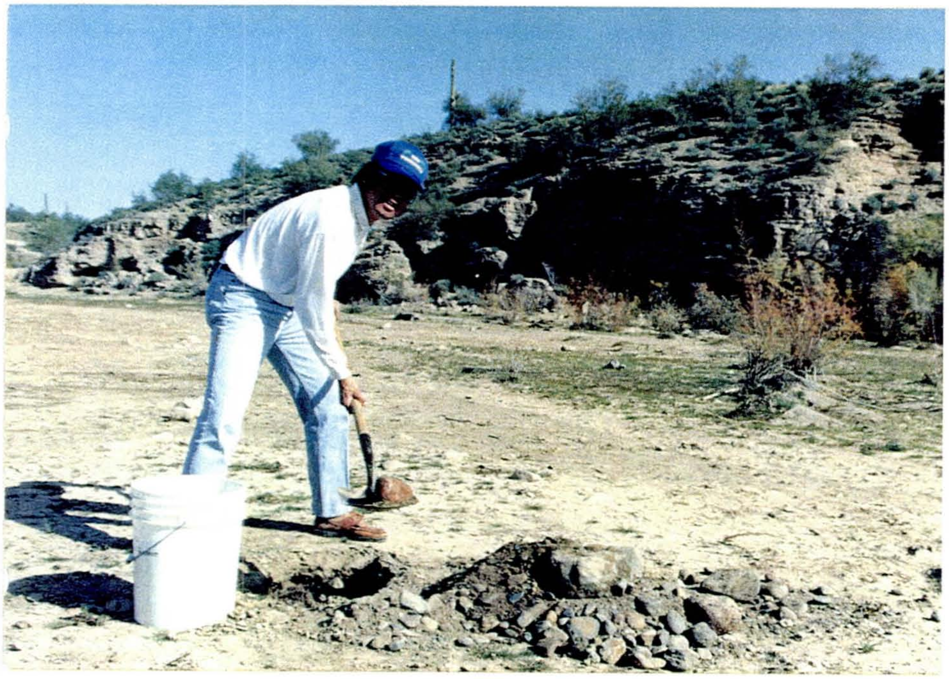

Fig. H-68 - The sediment samples collected upstream are generally coarser.
[Location: 0.5 mile south of Highway 70; **Mile Designation:** 32.43;
Photo taken: Feb. 1, 1992]