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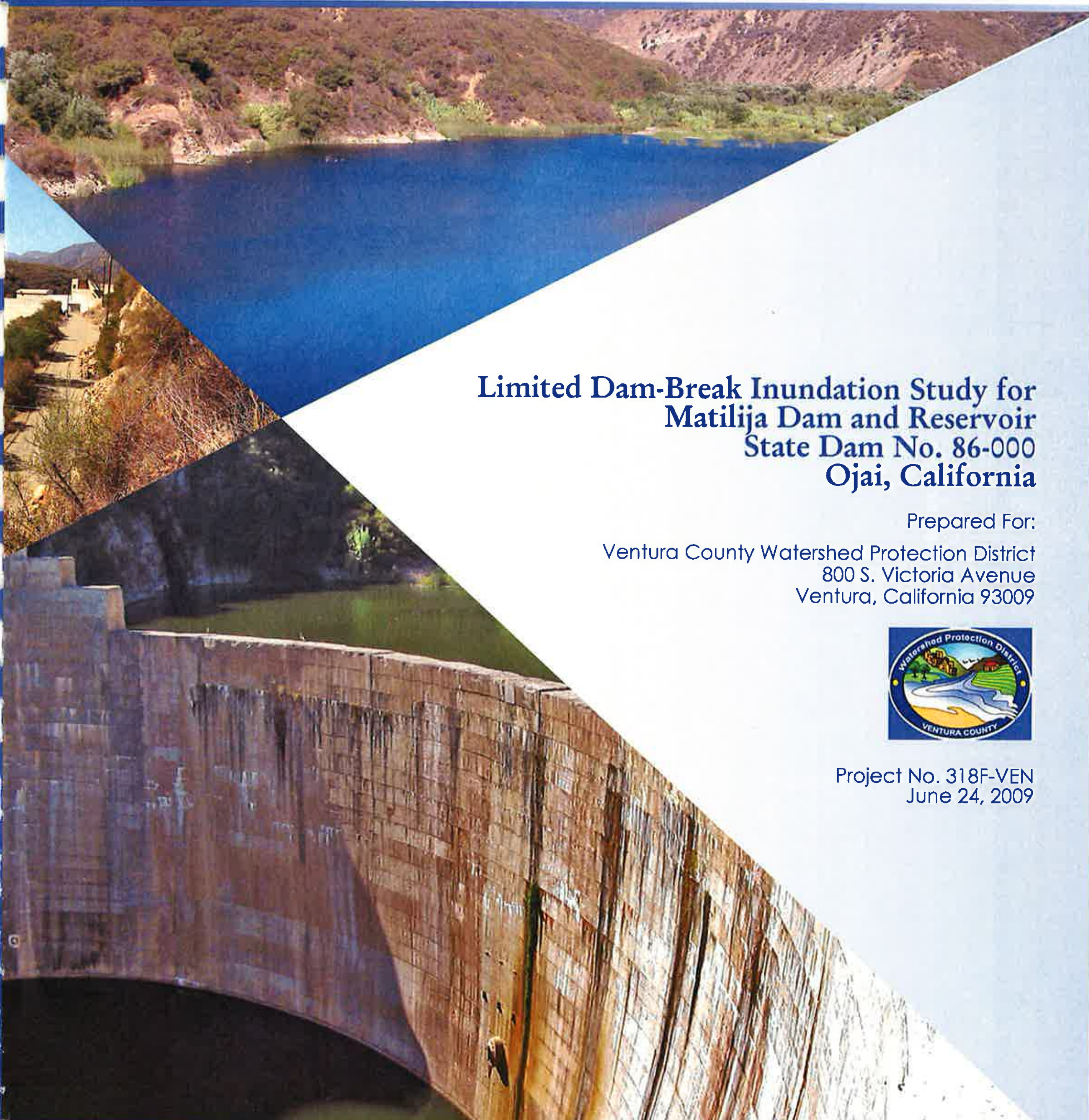

Limited Dam-Break Inundation Study for Matilija Dam and Reservoir State Dam No. 86-000 Ojai, California

Prepared For:

Ventura County Watershed Protection District
800 S. Victoria Avenue
Ventura, California 93009

Project No. 318F-VEN
June 24, 2009

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CONSULTANTS, INC.
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STATE DAM NO. 86-000

OJAI, CALIFORNIA

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Mr. Karl Novak
Ventura County Watershed Protection District
11251-B Riverbank Drive
Ventura, California 93004

Subject: Limited Dam-Break Inundation Study for Matilija Dam (No. 86-000)
Ojai, Ventura County, California

Dear Mr. Novak:

GENTERRA Consultants, Inc. (GENTERRA) is pleased to submit this report to the Ventura County Watershed Protection District (District) presenting the results of a limited dam-break flood inundation study for Matilija Dam and Reservoir, which is located in Ojai, Ventura County, California. The dam and reservoir are owned by the District. The District issued Contract No. AE09-F1, Work Order No. PW09-66, which was received on September 24, 2008 and authorized GENTERRA to perform this study based on the Fee Schedule presented in our 2008-09 Annual Consulting Agreement. Work commenced on October 1, 2008, and a draft of this report was submitted to the District on December 31, 2008. Review comments provided by the District have been incorporated into this final version of the report.

This report presents the results of a technical study based on a sudden breach failure of Matilija Dam. The failure scenario envisions the complete collapse of a 360-foot wide portion of the dam. It was assumed for the purposes of this study that this scenario could occur with or without an earthquake, during the time of a probable maximum flood (PMF) event. This report includes an inundation map depicting the extent of downstream flood inundation that would occur as a result of such a dam-breach failure. Upon acceptance by the District, a copy of the inundation map and this report can be submitted to the State of California Governor's Office of Emergency Services (OES). The inundation map and report can also be incorporated into the District's Emergency Action Plan for this dam.

We appreciate this opportunity to provide our services to the District, and we are grateful for the cooperation and assistance that was provided to us by the District. If you have any questions or require additional information, please call Douglas A. Harriman, PE or me at 949-753-8766.

Sincerely,
GENTERRA CONSULTANTS, INC.

Joseph J. Kulikowski, PE, GE
President/Senior Principal Engineer
RCE 17478, GE 491

REGISTERED PROFESSIONAL ENGINEER
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SECTION 1: INTRODUCTION

1.1 BACKGROUND

GENTERRA Consultants, Inc. (GENTERRA) has prepared this report to present the results of a limited dam-break flood inundation study for Matilija Dam and Reservoir (No. 86-000). The dam is located in Ojai, in Ventura County, California (Figure 1). The dam and reservoir are owned by the Ventura County Watershed Protection District (District), and operated by the District and Casitas Municipal Water District.

This study was conducted in accordance with regulatory requirements provided in the California Code of Regulations (2002) and guidance documents issued by the State of California Governor's Office of Emergency Services (OES). Upon acceptance by the District, this report along with the accompanying flood inundation map can be submitted to OES for review and approval.

The State of California Dam Safety Act (Government Code Section 8589.5) requires that owners of jurisdictional dams in the State develop flood inundation maps for their dams. The dam is under the Jurisdiction of the California Department of Water Resources, Division of Safety of Dams (DSOD). The mapping procedures that should be followed are presented in the California Code of Regulations (CCR), under Title 19, Division 2, Chapter 2, and Subchapter 4 (September 19, 2002). Inundation map preparation is to be based on analysis of a dam breach failure, even if the probability of such a failure is small. The inundation map accompanying this report can also be incorporated into the District's Emergency Action Plan for this dam, and is serviceable for use as part of the District's emergency response procedures for flood warnings and evacuations.

For this study, the breach failure mode selected as most appropriate for Matilija Dam was a complete collapse of a 360-foot wide portion of Matilija Dam. It was assumed that this scenario could occur with or without an earthquake during the time of a probable maximum flood (PMF) event. This scenario incorporated "worst-case" assumptions regarding the breaching process, in accordance with the requirements of the OES (CCR, 2002). The breach analysis made use of a maximum reservoir level based on the assumption of a PMF occurring at the same time as the failure of the dam. The computation of peak PMF runoff is based on the probable maximum precipitation (PMP) storm event, as presented in the report prepared by the California Department of Water Resources (1979).

The District is moving ahead with plans for the removal of Matilija Dam within the next 10 years. Accumulated silt and sediment in the reservoir would also be removed (or re-configured) in order to create a more natural, pre-dam streambed configuration in Matilija Creek. Removal of the dam would eliminate a barrier to the passage of fish on Matilija Creek. It is hoped that the dam project will lead to an increase in the population of endangered Southern Steelhead Trout, which migrate from the ocean to upstream spawning grounds (Ventura County Watershed Protection District, 2004a and 2004b).

1.2 SCOPE OF WORK

This inundation report for Matilija Dam was prepared in accordance with the scope of work authorized by the District under Contract No. AE09-F1, Work Order No. PW09-66 on August 26 2008 (received on September 24, 2009), based on the Fee Schedule presented in our 2008-09 Annual Consulting Agreement. Work started on October 1, 2008, with an approved schedule for completion of the draft report on December 31, 2008. GENTERRA conducted this inundation study for Matilija Dam to delineate the limits of downstream flooding in the unlikely event of a failure of the dam.

Included in this report is a list of selected abbreviations and acronyms, followed by tables, figures, photographs, appendices, and the Dam-Break Flood Inundation Map (Plate 1, in pocket). The plate provides a map that shows a delineation of the maximum extent of expected flooding based on a hypothetical dam-breach failure of Matilija Dam.

The performance of this inundation study involved the following steps:

1. Acquisition and review of existing data;
2. Reconnaissance of the dam, upstream, and downstream areas;
3. Assessment of the mode of dam breach failure;
4. Computer modeling and dam break analysis to determine the extent of inundation; and
5. Preparation of this report and the inundation map.

1.3 PROJECT PERSONNEL

GENTERRA employed computer modeling and other methods of analysis to process the data and generate the required results for this dam-break inundation study. The GENTERRA project team included the following employees of GENTERRA:

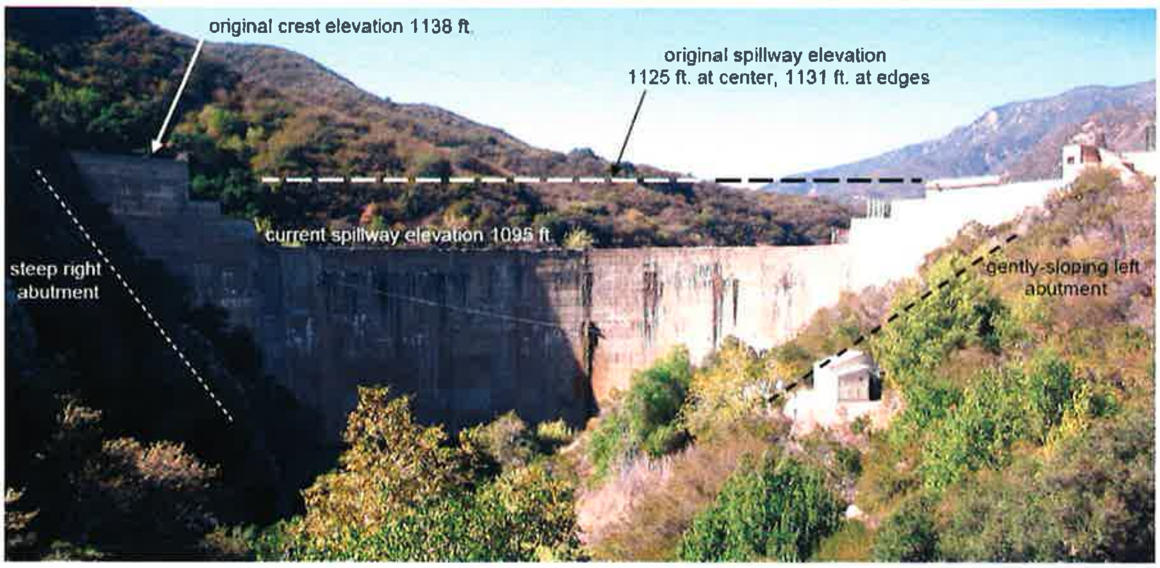
Joseph J. Kulikowski, PE, GE – Project Manager and Principal Engineer
Douglas A. Harriman, PE – Project Civil Engineer
Soma Balachandran, Ph.D., PE – Geotechnical Engineering
Shuyu Liu, PE – Engineering Support
Nicholas M. Josten, EIT – Computer Modeling, GIS Mapping, and Engineering Support
J. William Kulikowski –Mapping and Field/Technical Support
Kristina Mohos – Mapping, AutoCAD/Civil3D, and Field/Technical Support
Kim Olsen, Heather Hare, and Brittney Onken –Office and Administrative Support

1.4 SITE LOCATION

Matilija Dam is located near the City of Ojai in western Ventura County, California (Figure 1) at latitude 34° 29' 04" North and longitude 119° 18' 30" West. The dam lies within Section 29 of Township 5 North, Range 23 West, San Bernardino Base and Meridian. Matilija Dam and Reservoir are situated west of Maricopa Highway (California State Route 33) about 0.45 miles west of the intersection of Maricopa Highway and Matilija Hot Springs Road in Ojai. Matilija Dam can be accessed by vehicle by taking Matilija Hot Springs Road.

1.5 DESCRIPTION OF DAM AND RESERVOIR

Matilija Dam is a variable radius concrete arch dam located on Matilija Creek about five miles north of the town of Ojai in Ventura County, California. The map on Figure 1 shows the location of the dam. The dam is No. 86-000 in the DSOD listing of dams in the State of California, with a height of 163 feet, a dam crest at Elevation 1138, a freeboard of 43.0 feet, crest length of 620 feet, and a crest width of 8 feet. The thickness of the dam at the base is about 35 feet. Photo 1 below shows an overall view of the downstream face of the dam. The left and right designations are as viewed looking downstream.



Overall View of Matilija Dam – October 2007

Photo 1

The original construction of the dam was during the period 1946 to 1947; the DSOD lists the official completion date as 1949 in their files. The original height of the dam was approximately 190 feet, measured from the lowest foundation block at Elevation 935 feet, up to the original spillway crest, which varied from a low point at its center at Elevation 1125, to Elevation 1131 at the two ends of the spillway profile. The original dam crest was at Elevation 1138 feet. Due to the deterioration of the concrete, a portion of the crest of the dam was lowered by notching a new spillway section at Elevation 1095 in 1967.

Some of the information in this report has been taken from GENTERRA's prior reports on this dam prepared during the past two years. These prior reports are listed in the References in Section 6.

As shown in Photo 1, the dam is an asymmetrical arch, with a steep right abutment and a shallower left abutment. The original construction included gravity thrust blocks on each abutment, with the left (northeast) thrust block considerably larger than the one on the right end. A slip joint constructed at Elevation 960 between the arch and foundation blocks was included to prevent transmission of shear loads to the nearly vertical dipping bedrock, which strikes at an oblique angle to the axis of the dam.

The right (southwest) abutment is composed of sound sandstone with interbeds of shale oriented at approximately normal to the thrust of the dam. The left abutment is composed of fractured beds of sandstone and shale, generally oriented at an acute angle to the resultant thrust of the dam. Photo 2 below shows the steeply dipping beds of sandstone and shale in the right abutment. As seen in this photo, the direction of the arch thrust is approximately perpendicular to the strike of the beds, an inherently stable orientation.

Steeply-Dipping Rock in Right Abutment

Photo 2

By contrast, the rock in the left abutment appears significantly more fractured and therefore weaker than the rock in the right abutment. Previous studies of the dam have reported this finding. The direction of arch thrust in the left abutment is also at an acute angle to the strike of the bedding, instead of being perpendicular to the beds as it is in the right abutment. This orientation is inherently less stable than at the right abutment, because the arch thrust could result in differential slippage or creep along the weak shale beds. Photo 3 shows the orientation of rock beds in the left abutment.

Weak Rock in Left Abutment

Photo 3

1.6 DESCRIPTION OF METHODS AND RESULTS PRESENTATION

GENTERRA employed several methods of analysis to process data and generate the results needed for preparation of this technical report. No previous dam-break inundation report or data for Matilija Dam were identified by GENTERRA for this study. Table 1 provides general information and data about Matilija Dam and Reservoir.

The selected breach failure scenario is a complete collapse of a 360-foot wide portion of Matilija Dam. In accordance with OES (CCR 2002) guidelines, "worst-case" dam-breaching parameters were incorporated in the calculations and computer modeling. These parameters included a maximum credible inflow hydrograph based on the PMF, an initial reservoir water level set to the maximum expected elevation due to the PMF, a very short breach-failure time, and a wide breach opening through the dam.

Computer spreadsheet methods were used for performing calculations as part of the data analysis and for preparing some of the tables and figures. The tables in Appendix A present reservoir water-level elevation versus area, water elevation versus reservoir capacity, and water elevation versus spillway discharge. Figures A-1 and A-2 in Appendix A are graphs that depict the water elevation-surface area and water elevation-storage capacity data for the reservoir. Figure A-3 provides a graph of reservoir spillway discharge at various water-level elevations.

Analyses were performed to obtain a time-series of rainfall increments and cumulative rainfall depths due to the PMP, which is an extreme storm event. Relevant data extracted from the PMP analysis performed by the California Department of Water Resources (1979) are presented in Appendix B (Tables B-1 and B-2) of this report. The precipitation analyses methods that were used are described in Hydrometeorological Report No. 36 (NWS, 1961).

The results of the PMP analysis were subsequently used to determine the PMF for Matilija Reservoir and to develop an inflow hydrograph to the reservoir. Figure 2 is a map that shows the boundary line of the watershed that produces runoff that accumulates in Matilija Reservoir as a result of rainfall events. For this inundation study, GENTERRA made use of the PMP and PMF results presented by California Department of Water Resources (1979). Table C-1 in Appendix C presents a summary of the PMF inflow data, the peak spillway discharge, and the maximum reservoir water-level attained during the PMF event.

Several methods of analysis were used to obtain estimates of the peak outflow due to the dam-breach failure scenario. The NWS (Fread, 1991) Simplified Dam-Break Model (SMPDBK) was used to obtain a peak breach outflow for the purposes of this study. The peak outflow of 331,793 cfs obtained using this model is considered to be a maximum reasonable estimate, based on what are considered to be "worst-case" breaching parameters. A full print-out of the SMPDBK model output is presented in Appendix G. The model results were evaluated, adjusted as appropriate using spreadsheet methods, and used for preparation of the inundation map (Plate 1).

GENTERRA also made use of spreadsheet methods to calculate results for review and comparison with the SMPDBK model results. Table D-1 in Appendix D was developed as a modification of a computer spreadsheet template compiled by Dodson & Associates (2005). It presents peak outflow estimates based on several empirical relationships, includes two different estimates obtained using the SMPDBK model, along with some results based on the empirical relationships that were included. Figure 3 shows a bar graph that was prepared to facilitate comparison of peak outflow results from two SMPDBK model runs and from two of the empirical relationships.

For analysis of downstream flooding and delineation of the limits of inundation, GENTERRA made use of the Watershed Modeling System (WMS) software. WMS provides a comprehensive graphical modeling environment for watershed hydrology and hydraulics analysis. WMS was developed by the Environmental Modeling Research Laboratory (EMRL) of Brigham Young University in cooperation with the USACE Waterways Experiment Station. Version 8.0 of WMS (EMRL, 2006) was used with imported Digital Elevation Model (DEM) computer files that cover the project area. The DEM files contain a topographic representation of the ground surface in digital format.

The District provided raw LIDAR data files which could be converted into computer files that contain the spatial data needed to perform three-dimensional analysis of the downstream flow path of the dam-break flood wave. These data were compared to the DEM files which were imported into WMS, and the difference was considered to be negligible.

GENTERRA used other available maps and recent aerial photographs to supplement the evaluation of the DEM data. GENTERRA also made first-hand observations of conditions downstream of the dam during field reconnaissance visits. The NWS SMPDBK Model (Fread, Lewis, and Wiele, 1991) was run within the WMS computer operating environment to obtain the data needed in order to prepare an inundation map that shows a reasonable delineation of the downstream areas of potential flooding. The map shows the entire flowpath downstream of Matilija Dam. As appropriate, computer spreadsheet methods were used to refine and adjust the modeling results and to modify the flood inundation boundaries shown on the map.

The flow depth, peak flow, average velocity, and travel time results are presented in Table E-1 (Appendix E). Figures F-1 through F-9 (Appendix F) show width versus elevation plots at the mapped cross-sections downstream of Matilija Dam. The cross-sections are labeled on the inundation map that is shown on Plate 1.

Computer spreadsheets were used to estimate the maximum depths of flow and travel times in the downstream flood-inundation areas. The results were reviewed for reasonableness before they were used to delineate the flood inundation limits. The flood inundation map (Plate 1) was prepared in accordance with regulatory requirements provided in the California Code of Regulations (2002) and OES guidelines. Included on Plate 1 are data for each cross section downstream of Matilija Dam, including the cross section number, distance downstream from the dam, peak flow rate, flood wave arrival time, time to peak flow, deflood time, maximum elevation of the water surface, and maximum depth of water at the cross section.

SECTION 2:
RESERVOIR CHARACTERISTICS AND STORMWATER INFLOW

2.1 RESERVOIR DATA, SPILLWAY CAPACITY, AND ELEVATION DATUM

The crest of the dam is at an elevation of 1138 feet above sea level. The existing overflow spillway crest is at an elevation of 1095 feet. The surface area of the reservoir, when full to its normal pool elevation, is about 0.13 square miles (mi^2) or about 85.2 acres. The entire watershed upstream of Matilija Dam has a contributing drainage area of approximately 54.39 mi^2, or about 34,810 acres. The boundary line of the drainage basin is shown in Figure 2.

Appendix A presents the reservoir elevation, area, and capacity data, as well as a rating table of elevation versus discharge from the reservoir. Graphs are provided to illustrate these concepts. The data used to prepare these tables and graphs were obtained from the data presented on a topographic map prepared by the Ventura County Flood Control District (1948).

For this failure scenario, the initial water surface level was set at an elevation of 1111 feet. At this elevation, the reservoir has a surface area of 106.1 acres. The existing capacity at Elevation 1111 is estimated to be 3,893 acre-feet (ac-ft), after allowing for the silt deposits that have accumulated. In this report, silt deposits that have built-up in the reservoir are also referred to as sediment deposits.

The dam and reservoir elevation data used in this study were obtained from the Ventura County Flood Control District (1948) map and from Appendix 5 of the DSOD (1979) report. The elevation datum was the National Geodetic Vertical Datum of 1929 (NGVD 1929). The Digital Elevation Model mapping file is based on the North American Vertical Datum of 1988 (NAVD 1988). At Matilija Dam, the NAVD 1988 datum is 2.55 feet lower than the NGVD 1929 datum. This difference in elevations is relatively small, and was not considered to be significant for this project. Components of the dam and reservoir system referenced to NGVD 1929 included the elevation-surface area data and elevation-capacity data for the reservoir, the spillway crest elevation, the spillway discharge curve, and the probable maximum reservoir elevation associated with runoff from a hypothetical PMF storm event. The outflow hydrograph due to the dam breach scenario modeled was based on elevations associated with the NGVD 1929 datum. In contrast, elevations were referenced to the NAVD 1988 datum for the modeling of the downstream progression of the flood wave associated with the three-dimensional topographic information contained in the Digital Elevation Model used in this study. Since the breaching of the dam and the modeling of the flow downstream of the dam are treated independently, the analyses of these two aspects of the study were not dependent upon having a common reference elevation, and there was no need to correct for the minor differences associated with the elevation datum used.

2.2 PROBABLE MAXIMUM PRECIPITATION

The procedures outlined in NOAA in Hydrometeorological Report No. 36 (NWS, 1961) were used in the California Department of Water Resources (1979) report to estimate the PMP for Matilija Reservoir. The PMP is defined as "theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location at a certain time of the year" (HMR 58).

Using the procedures described in HMR 36, the PMP parameters for Matilija Dam were computed (California Department of Water Resources, 1979). Appendix B presents tables that show the PMP analysis results. Table B-1 shows a distribution of the incremental and cumulative rainfall amount for 72 consecutive hours. Table B-2 in Appendix B shows the cumulative precipitation depths for six different durations, ranging from 1 hour to 72 hours.

2.3 PROBABLE MAXIMUM FLOOD

The California Department of Water Resources (1979) presents drainage basin parameters and the PMP results for the determination of peak discharge and total runoff volume, representing the PMF inflow into Matilija Reservoir.

Table C-1 presents a summary of the PMF inflow data, the peak spillway discharge, and the maximum reservoir water-level attained during the PMF event.

After determining PMF inflow rates and runoff volumes, calculations indicated that application of reservoir routing methods were not needed because the effect of reservoir routing on the reservoir outflow rates would be negligible.

For the purposes of evaluating a breach failure of Matilija Dam using "worst-case" breaching parameters, GENTERRA assumed, as an initial condition (prior to failure), that no flow would pass through the low-level outlet. In the SMPDBK model runs, only flow over the spillway was considered as active discharge from the reservoir at the time of breach initiation. As indicated in the rating table and curve for the spillway (Table A-2 and Figure A-3 in Appendix A), the spillway carries no flow at its crest elevation of 1,095 feet, but is capable of discharging 73,700 cfs if the reservoir water should rise as high as its maximum level corresponding to the PMF event.

SECTION 3: DAM BREACH ANALYSIS

3.1 DAM SIZE AND HAZARD CLASSIFICATION

Hazard classification is based on criteria related to the size of a dam and an estimation of the potential structural damage and risk to human life that could occur if there was a catastrophic breach failure of the dam. The height of Matilija Dam, measured as the vertical elevation difference from the lowest point at the downstream toe of the dam to the top of the dam crest, is 163 feet. At the existing overflow spillway crest elevation of 1095 feet, Matilija Reservoir has a surface area of 84.8 acres, and originally had a capacity of approximately 3,950 acre-feet. Due to the build-up of silt and sediment deposits in the reservoir, the capacity to hold water has decreased considerably. For the purposes of this study, the anticipated capacity of the reservoir at the time of the hypothetical failure is assumed to be 2,382 acre-feet when the reservoir level is at an elevation of 1095 feet (Table A-1, Appendix A).

For the purposes of hazard classification, a dam is generally considered to be large in size if the dam has a height over 100 feet, or if the reservoir has a capacity over 50,000 ac-ft. Based on these criteria, Matilija Dam is considered to be a large-sized dam since its height is over 100 feet.

With respect to downstream impacts, Matilija Dam is considered to warrant a high-hazard classification since its failure could result in significant loss of life and major damage to property. Downstream areas located within one mile of Matilija Dam are developed with residential housing, and some of these dwellings would experience heavy flooding in the event of a rapid and complete dam-breach failure.

3.2 DAM BREACH FAILURE MODE

GENTERRA assessed possible dam-breach failure modes that may be possible for Matilija Dam. For the purposes of this study, the potential failure mode selected was a breach failure involving the complete collapse of the 360-foot-wide portion of the dam that underlies the existing overflow spillway. It was assumed that this scenario could occur with or without an earthquake, during the time of a PMF event. Concrete arch dams tend to fail completely and are assumed to require something less than 6 minutes (0.1 hours) for full breach formation to occur. The breach geometry is usually assumed to be rectangular in shape, with breach side slopes that are essentially vertical.

3.3 BREACH FAILURE ANALYSIS

In the selected breach-failure scenario for this study, the collapse of Matilija Dam would happen suddenly. The slip joint at Elevation 960, near the base of the dam, was assumed to be the location of the bottom of the breach. The two sides adjacent to the existing spillway would remain in-place.

The existing overflow spillway crest has an elevation of 1095, so the depth of the fully developed breach would be 135 feet. The breach would therefore have a vertical height of 135 feet and a width of 360 feet. Spreadsheet methods were used for analysis of breaching parameters for Matilija Dam (Table D-1 in Appendix D).

Inflow into the reservoir from the watershed occurs as a result of stormwater runoff generated within the 54.39 mi^2 drainage area (34,810 acres). Coincident with the assumed failure of the dam, the reservoir was modeled as being full to an elevation of 1,111 feet, which is 16 feet above the spillway elevation. The PMF peak inflow to the reservoir was estimated to be 76,100 cfs. The spillway outflow from the reservoir at the time of the breach failure would also be approximately the same, since the effect of reservoir routing is negligible. These data are presented in the California Department of Water Resources (1979) report, along with the calculations made and computer files used to generate the data.

Because of the build-up of silt and sediment deposits in the reservoir, the depth of water in the reservoir at the time of the hypothetical failure was assumed to be 41 feet. For the purposes of the breach modeling, the upper layers of the silt were considered to be either in a semi-fluid state or were considered to be eroded easily. On this basis, the available volume of dischargeable water in the reservoir at the time of the breach is considered to be 3,893 acre-feet, which corresponds to a reservoir bottom-of-the-silt elevation of 1060 feet.

A set of outflow estimates for the failure of Matilija Dam were obtained by applying empirical relationships that relate the maximum expected discharge to estimates of the breaching parameters, and to certain dam and reservoir characteristics. A summary of the input parameters that were used and the peak outflows calculated using these methods is presented in Table D-1. Figure 3 presents a bar chart showing a comparison of breach estimates using four different methods.

In the NWS SMPDBK model, the geometry of the breach opening was represented as having a rectangular shape (i.e. vertical side slopes), and a final breach bottom width of 160 feet. The estimated peak outflow using this method was 331,793 cfs. Shown as the first bar in Figure 3, it is the highest one among the four that are plotted. This is the value that was selected as the peak breach outflow for this dam-break flood inundation study. It was based on "worst-case" dam breaching parameters, including a breach-failure time (time to peak outflow) of 3 minutes (0.05 hours).

The second bar shown in Figure 3 was based on the same input parameters being used in the NWS SMPDBK model, except for the breach-failure time which was set to 4.5 minutes (0.075 hours). It produces a much lower peak breach outflow. The other two bars in Figure 3 are based on empirical relationships. The third bar represents the results based on the Gundlach and Thomas (1977) equation, and the fourth bar represents the results based on the Hagan (1992) equation.

SECTION 4:

ANALYSIS OF INUNDATION AREAS

4.1 DAM-BREAK ANALYSIS

For the purposes of this inundation study of Matilija Dam, a collapse of the dam was analyzed as the failure scenario. In accordance with OES guidelines (CCR 2002), "worst-case" dam-breaching parameters were selected to generate a large peak outflow for use in the development of the flood inundation map. The outflow was then routed downstream to determine the extent of flooding due to the breach failure of Matilija Dam.

Table 2 presents cross-section descriptions and channel-bottom elevations for areas downstream of Matilija Dam. Because some relatively flat areas are located in the Ventura River channel and adjacent floodplain, some spreading of the flood wave would occur as the peak moves downstream. Where present, significant obstructions may cause the following effects on the flow: increased channel roughness, increased spreading of the flow, decreased average flow velocity, longer travel time, and additional attenuation of the peak discharge. For Matilija Dam, obstructions that might be encountered as the flow moves downstream could include motor vehicles, houses/buildings, block walls, and trees, brush, and other debris within the flow path.

After the breach outflow passes through a hydraulic jump downstream of the dam, the channel roughness encountered by the flood wave would tend to maintain subcritical flow velocities at all locations along the flow path downstream of the hydraulic jump. Prior to selecting a set of input parameters for the final run of the model, Manning's n values ranging from 0.05 to 0.10 were used in the modeling, and the results were evaluated for reasonableness. In the final accepted run of the model for this study, a somewhat conservative Manning's n of 0.10 was applied to the cross sections. This representative value for the roughness coefficient was selected because it provides sufficient flow attenuation such that subcritical flow velocities are maintained downstream of the hydraulic jump.

Table 3 presents a summary of the dam-break inundation study results. A discharge of 76,100 cfs was added as initial spillway flow in the SMPDBK model. This initial outflow represents the approximate maximum spillway discharge that would occur due to a PMF storm event.

The flood inundation limits were mapped in accordance with the OES guidelines (CCR 2002), and included adjustments based on reasonable assumptions and engineering judgment regarding the maximum flow depth, average flow velocity, and peak discharge at each cross section as the flood wave moves downstream from the dam. The computer model output provides peak flow travel time estimates, and these results were adjusted as appropriate using spreadsheet methods.

4.2 CROSS SECTIONS, CHANNEL PROFILE, AND PEAK FLOW

Cross-section data were obtained from the DEM computer files covering the project area. The DEM contains a topographic representation of the ground surface in digital format. GENTERRA supplemented the evaluation of DEM topographic data with information available on U.S. Geological Survey (USGS) quadrangle maps. Observations made during the field reconnaissance visits were also considered during the analysis of conditions downstream of the dam. Selected photographs of downstream areas are included in the section following the Tables and Figures. Captions are provided under each photograph to indicate its location and/or to provide brief descriptive information.

Matilija Dam and Reservoir are located in western Ventura County. Just downstream of the dam, water within Matilija Creek generally flows toward the east as it passes through the canyon. Downstream of its confluence with the North Fork of Matilija Creek, the watercourse becomes the Ventura River. The Ventura River continues flowing southward until it discharges into the Pacific Ocean, near the western boundary of the City of San Buenaventura, a little more than 16 miles downstream of the dam.

Distances downstream, channel-bottom elevations, and bed-slope data for the cross-sections downstream of Matilija Dam are presented in Table 3. The first cross section in the SMPDBK model was placed at the dam crest. Figure 4 presents a profile of the channel bottom, extending from Matilija Dam to the last cross section number located downstream of West Lewis Street and upstream of West Vince Street near the Pacific Ocean. Table E-1 in Appendix E is a tabulation of data that were used in the inundation analysis prior to creation of the inundation map. It was prepared from a spreadsheet that calculates the channel gradient, average velocity, flood wave travel times, and other parameters of interest. These data were used to check and adjust the potential limits of flood inundation as delineated by the mapping software. Graphical representations of the cross-sections used in the SMPDBK model are presented in Appendix F.

In Table 3, the peak flow column shows the expected peak discharge at each of the downstream cross sections. For example, the fourth cross section used in the model is located 0.88 miles downstream of Matilija Dam, and the peak flow at that location was calculated to be 279,158 cfs. This cross section was drawn to be perpendicular to the Ventura River channel, just downstream of Sandlewood Place near the City of Ojai.

The Robles Diversion Dam is located on the Ventura River approximately 1.5 miles downstream of the junction of Matilija Creek and the North Fork of Matilija Creek. Robles Diversion Dam is a rockfill embankment with a wooden sheet-piling cut-off wall and rolled earth core. It has a crest length of 598 feet, but its height is only 24 feet. The flood wave created due to a breach failure of Matilija Dam would pass over this structure and would continue flowing downstream along the Ventura River stream corridor.

Figure 5 is a plot that shows how the peak flow attenuates as the flood wave moves downstream. At the dam itself (the first cross section), the peak flow was calculated to be 331,793 cfs. At the last cross section, 16.24 miles downstream of the dam, the peak flow was 62,920 cfs. Table 3 also lists the maximum flood elevation and depth, the flood wave arrival time, the time to peak flow, and the de-flood time at each cross section.

4.3 FLOW DEPTH, VELOCITY, TRAVEL TIME, AND INUNDATION AREAS

Site reconnaissance visits were made by GENTERRA personnel to observe ground conditions along the flowpath downstream of Matilija Dam. In addition to these observations made during the field visits, aerial photographs and topographic maps were reviewed to obtain information about the flow path, land use, and other features downstream of the dam.

Figure 6 is a plot that displays the maximum depth of flow at each cross section. Figure 7 is a plot that shows how the average velocity of flow varies as the flood wave moves downstream. The average velocity tends to increase as the flow passes through narrower canyon-type areas, and slows down considerably where the flowpath spreads out over areas that are much flatter.

Figure 8 is a plot of the elapsed travel time of the flood wave at each cross section. It displays the following three time parameters: the flood wave arrival time, the time to the peak flow, and the deflood time. As indicated in Figure 8, it would take approximately two hours and 15 minutes for the peak flow to reach the Pacific Ocean.

The pathway of the flood wave and the estimated limits of flooding are shown on the inundation map (Plate 1). The down-gradient flow direction is generally from north to south. Maps used for this study included U.S. Geological Survey 7½-minute maps (Quadrangles identified as Matilija and Ventura, at a scale of 1 inch equals 2,000 feet). Aerial photographs of the study area were obtained from the Google Earth website (http://earth.google.com). The inundation map provides coverage of the entire length of the study area, from Matilija Dam to the Pacific Ocean.

SECTION 5: CONCLUSIONS AND LIMITATIONS

5.1 CONCLUSIONS

No previous dam-break inundation report or data for Matilija Dam were identified by GENTERRA for review or use as part of this study. GENTERRA has prepared this flood inundation map to delineate the potential dam-break inundation areas downstream of Matilija Dam. The analysis makes use of various data, including the existing reservoir and spillway capacities, the expected breach outflow due to a failure of the dam, the topography and physical characteristics of the flowpath, and the anticipated attenuation of the flood wave as it moves downstream.

A "worst-case" (conservative) dam-breach scenario was used to generate the peak outflow used to create the hypothetical flood wave. The potential failure mode selected is a breach failure involving the complete collapse of a 360-foot wide portion of Matilija Dam. It was assumed that this scenario could occur with or without an earthquake, during the time of a PMF event. The outflow through the breach was routed downstream for a distance of approximately 16 miles. Based on the breach analysis, the flow through the dam would generate a peak outflow of 331,793 cfs. The time to peak outflow at the dam was estimated to be 0.05 hours (3.0 minutes).

A catastrophic breach of Matilija Dam would cause flooding of specific downstream areas along both sides of the Ventura River. The flood inundation map developed for this study (Plate 1 on 2 sheets, in pocket) shows the estimated extent of flooding as a result of the dam-break scenario.

The actual probability of failure of the dam is considered to be extremely remote because of the following:

- The dam and reservoir are maintained by the District and are routinely inspected by the District, the District's Dam Safety Consultant (GENTERRA), and the DSOD.
- The dam and reservoir undergo regular monitoring and surveillance, and any conditions affecting the safety of the dam are documented, evaluated, and monitored.
- Matilija Dam and Reservoir have been provided with enough freeboard to accommodate the anticipated runoff from the watershed, for even the most extreme storm event (the PMF).

5.2 LIMITATIONS

The conclusions and professional opinions presented herein were developed by GENTERRA in accordance with generally accepted engineering principles and practices. We make no other warranty, either express or implied. The data, conclusions and recommendations contained herein should be considered to relate only to the specific project and location discussed herein.

GENTERRA is not responsible for any conclusions or recommendations that may be made by others, unless we have been given an opportunity to review such conclusions and recommendations, and to concur or disagree in writing. Furthermore, if changes are made in conditions at the site as comprehended in this report, then the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of this report are modified or approved in writing by GENTERRA.

The determination of potential dam breaching and flood wave movement through downstream areas is an inexact science and, therefore, the inundation areas and flood-wave travel times presented in this report must be considered approximate. The actual topography along the flow path is variable and the data collected at specific cross sections are not necessarily representative of the intervening area between cross sections. These and other limitations in the modeling assumptions contribute to the uncertainty that is inherent in predicting the dynamics of flood wave movement.

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LIST OF SELECTED ABBREVIATIONS AND ACRONYMS

EMRL – Environmental Modeling Research Laboratory, developers of the Watershed Modeling System software. [Version 8.0 was used for this study]

GIS – Geographic Information System

HEC – Hydrologic Engineering Center of the U.S. Army Corps of Engineers

NWS – National Weather Service (Part of the National Oceanic and Atmospheric Administration, Under the U.S. Department of Commerce)

OES – State of California Governor's Office of Emergency Services

PMF – Probable Maximum Flood

PMP – Probable Maximum Precipitation

SMPDBK – National Weather Service Simplified Dam-Break Model (SMPDBK) model developed by Dr. Daniel Fread of U.S. Dept of Commerce, National Oceanic and Atmospheric Admin.

USACE – United States Army Corps of Engineers

USGS – United States Geological Survey

WMS – Watershed Modeling System (version 8.0) by Environmental Modeling Research Laboratory (EMRL)

<u>Abbreviations of Measurement Units</u>:

ac-ft – acre-feet
cfs (or ft^3/s) – cubic feet per second
ft^2 – square feet
mi – miles
mi^2 – square miles

TABLES

Table 1
Matilija Dam and Reservoir Data

DSOD No.:	86-000	
Year Completed:	1949	
Drainage Area:	55 mi^2	
Location:		Ojai, Ventura County, California
Latitude/Longitude:		34° 29' 04" North and 119° 18' 30" West
Township, Range, Section:		Township 5 N, Range 23 W, Section 29, SB B&M
Type of Construction:		Concrete Arch Dam (variable radius)
D/S Toe Elev:	975 ft	Elevation of D/S toe of dam, per DSOD
DSOD Height of Dam:	163 ft	Vertical distance from D/S toe to dam crest
Silt Thickness (post-breach)	85 ft	Vertical distance from bottom of reservoir to top of remaining silt
Dam Crest Length:	620 ft	Total length along the crest of the dam
Dam Crest Width:	8 ft	Width of the dam crest
Freeboard:	43 ft	Vertical distance from existing spillway to dam crest
Existing Spillway Length:	360 ft	Estimated length of the crest of the existing spillway
Volume of Dam:	47,825 cy	Volume of materials (concrete) in dam, in cubic yards
Slope of U/S Face H:V:	0:1	Nearly Vertical Slope, U/S face of dam (Horizontal:Vertical)
Slope of D/S Face H:V:	0:1	Nearly Vertical Slope, D/S face of the dam (Horizontal:Vertical)
Reservoir Water-Level Elevations		
Remaining Silt (post-breach)	1,060 ft	Nominal top elevation of silt (equivalent rectangular area basis)
Normal Max. Water Pool Elev:	1,095 ft	Elevation at existing spillway
Maximum PMF Elev:	1,111 ft	Elevation at PMF (maximum flood surcharge)
Crest of Dam Elev:	1,138 ft	Elevation of the crest of the dam
Original Capacity of Reservoir (at Different Elevations)		
Normal Max. Water Pool Elev:	3,950 ac-ft	Original capacity at existing spillway elevation of 1095 ft
18 Feet Below Crest of Dam:	5,369 ac-ft	Original capacity at elev 1120 ft (25 ft above existing spillway)
Capacity Has Decreased Due to Build-Up of Silt Deposits (at Different Elevations)		
Normal Max. Water Pool Elev:	2,382 ac-ft	Existing capacity at existing spillway elevation of 1095 ft
Maximum PMF Elev:	3,893 ac-ft	Existing capacity at PMF surcharge elevation of 1111 ft
18 Feet Below Crest of Dam:	4,892 ac-ft	Existing capacity at elev 1120 ft (25 ft above existing spillway)
Reservoir Surface Area (at Different Elevations)		
Normal Max. Water Pool Elev:	85.2 ac	Surface Area at existing spillway elevation of 1095 ft
Maximum PMF Elev:	106.1 ac	Surface Area at maximum flood surcharge elevation of 1111 ft
18 Feet Below Crest of Dam:	120.0 ac	Surface Area at elevation 1120 ft (25 ft above existing spillway)

Note: In this report, silt deposits that have built-up in the reservoir are also referred to as sediment

Abbreviations:

DSOD = California Department of Water Resources Division of Safety of Dams
SB B&M = San Bernardino Base & Meridian; Cap = Capacity
Spwy = Spillway; Cap = Capacity; Max. = Maximum
Elev = Elevation; H:V = Ratio indicating slope: Horizontal to Vertical
U/S = Upstream; D/S = Downstream; PMF = Probable Maximum Flood
ft = feet; mi^2 = square miles; ac = acres; cy = cubic yards; ac-ft = acre-feet

Table 2
Distance, Channel Bottom Elevation, and Bed Slope Downstream of Matilija Dam

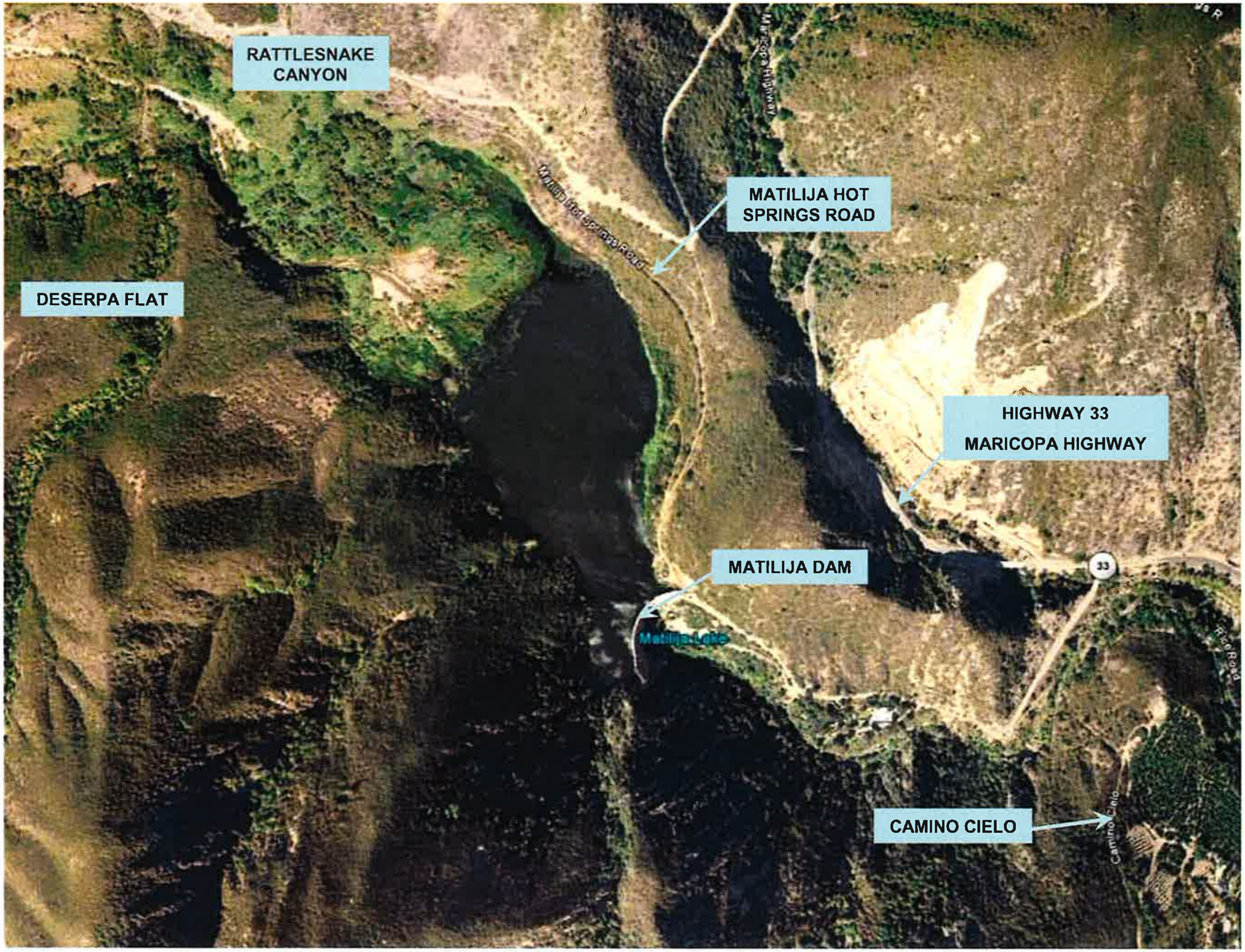
Cross Section[1]	Distance[2]		Channel Bottom[2]		Description of Cross Section
	ft	mi	Elev, ft	slope, ft/mi	
1	0	0	1060.0	--	Top of Silt Elev (post-breach, equivalent rectangular area basis)[3]
2	2,376	0.45	922.6	--	US of Jct of Matilija Hot Springs Rd and Hwy 33
3	4,066	0.77	919.7	9.1	DS of Jct of Matilija Hot Springs Rd and Hwy 33
4	4,646	0.88	883.0	333.6	US of Camino Cielo along Hwy 33
5	5,597	1.06	874.8	45.6	DS of Camino Cielo along Hwy 33
6	7,181	1.36	856.0	62.7	US of Kennedy Cyn (~0.5 mi US)
7	9,134	1.73	820.5	95.9	Nr Kennedy Cyn (~200 ft US)
8	10,718	2.03	782.8	125.7	DS of Kennedy Cyn (~1,000 ft DS)
9	12,408	2.35	763.6	60.0	Along Ventura River, north end of N. Rice Rd
10	15,154	2.87	724.4	75.4	Along Ventura River near Meyers Rd
11	17,899	3.39	682.8	80.0	US of Jct of Rice Rd and El Roblar Dr
12	20,434	3.87	650.2	67.9	Nr Jct of Rice Rd and Lomita Ave
13	23,021	4.36	624.9	51.6	Nr Jct of Moreno Dr and Camille Dr
14	25,080	4.75	591.0	86.9	US of Jct of Moreno Dr and Ferrara Dr
15	26,981	5.11	579.0	33.3	DS of Jct of Moreno Dr and Alviria Dr
16	28,776	5.45	554.7	71.5	DS of Jct of Old Baldwin Rd and Hwy 150
17	31,469	5.96	521.8	64.5	Nr Jct of Woodland Ave and Lake Ave
18	34,637	6.56	476.4	75.7	Nr Jct of Puesta del Sol and Willey St
19	39,178	7.42	420.4	65.1	DS of Jct of Sycamore Rd and Riverside Rd
20	43,032	8.15	364.2	77.0	DS of Santa Ana (upper) & Newman Ranch Rd
21	46,306	8.77	339.2	40.3	DS of Santa Ana (lower) & Newman Ranch Rd
22	51,110	9.68	295.4	48.1	US of Jct of Ventura Ave and Nye Rd
23	53,909	10.21	264.3	58.7	US of Jct of Ventura Ave and Ranch Rd
24	56,179	10.64	255.5	20.5	US of Jct of Hwy 33 and Park View Dr
25	60,826	11.52	219.6	40.8	US of Jct of Hwy 33 and Casitas Vista Rd
26	64,099	12.14	199.1	33.1	DS of Jct of Hwy 33 and N Ventura Ave
27	66,898	12.67	181.0	34.2	DS of Jct of Hwy 33 and Canada Larga Rd
28	71,386	13.52	158.9	26.0	Nr Jct of N Ventura Ave and Los Cabos Ln
29	74,870	14.18	135.9	34.8	US of Jct of N Ventura Ave and Orchard Dr
30	78,144	14.8	112.7	37.4	DS of Jct of Hwy 33 and Shell Rd
31	81,787	15.49	81.0	45.9	Nr Jct of Kehala Ave and Potawatome St
32	84,005	15.91	62.6	43.8	DS of Jct of Hwy 33 and Stanley Ave
33	85,747	16.24	52.1	31.8	Nr Jct of Riverside St and W Vince St

Notes: [1]The cross section column lists cross section numbers referred to in Table 3, Table E-1, and on Plate 1
[2]Distance and elevation data were obtained from Digital Elevation Model (DEM) mapping using WMS
Distance refers to the distance downstream of the dam, in feet (ft) and in miles (mi)
The channel bottom slope, also referred to as bed slope, is calculated from the previous cross section
[3]In this report, silt deposits that have built-up in the reservoir are also referred to as sediment deposits
Abbreviations: Elev = Elevation; US = Upstream; DS = Downstream

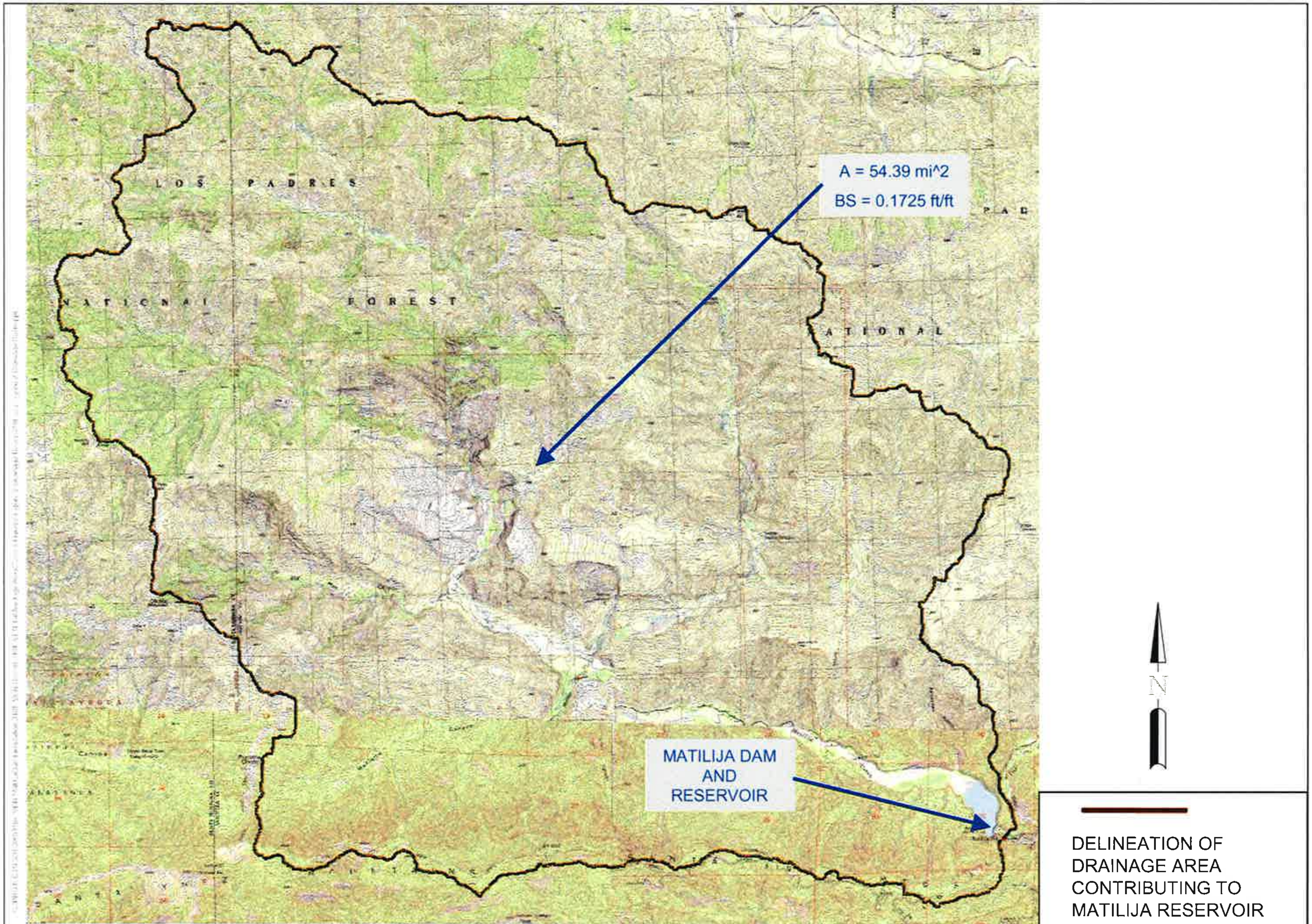
Table 3
Peak Flow, Maximum Depth, and Travel Time Downstream of Matilija Dam

Cross Section No.	Distance DS of Dam (mi)	Channel Bottom Elev (ft)	Peak Flow SMPDBK (cfs)	Peak Flow Spreadsheet (cfs)	Flood Elevation (ft)	Maximum Depth (ft)	Maximum Top Width (ft)	Flood Wave Arrival Time SMPDBK (hr)	Flood Wave Arrival Time Spreadsheet (hr)	Time to Peak SMPDBK (hr)	Time to Peak Spreadsheet (hr)	Deflood Time SMPDBK (hr)	Deflood Time Spreadsheet (hr)
1	0.00	1060.0	331,793	331,793	--	--	--	0.00	0.000	0.05	0.05	0.00	0.46
2	0.45	922.6	285,215	301,581	958.54	35.92	352.5	0.00	0.009	0.06	0.06	0.00	0.49
3	0.77	919.7	279,631	283,579	958.54	38.80	506.5	0.00	0.018	0.08	0.07	0.00	0.52
4	0.88	883.0	279,158	279,768	929.67	46.66	436.3	0.00	0.021	0.08	0.08	0.00	0.55
5	1.06	874.8	277,446	273,633	927.46	52.64	485.2	0.00	0.025	0.09	0.09	0.00	0.58
6	1.36	856.0	272,820	263,687	892.98	36.97	781.2	0.00	0.033	0.11	0.11	0.00	0.62
7	1.73	820.5	272,615	256,860	862.22	41.76	503.4	0.00	0.045	0.13	0.13	0.00	0.66
8	2.03	782.8	268,827	250,969	830.13	47.33	433.9	0.00	0.070	0.16	0.16	0.00	0.71
9	2.35	763.6	264,761	244,808	797.46	33.82	1081.7	0.00	0.090	0.20	0.20	0.00	0.77
10	2.87	724.4	262,113	233,446	749.32	24.90	1331.9	0.00	0.11	0.21	0.21	0.00	0.80
11	3.39	682.8	259,492	222,936	706.97	24.13	1274.9	0.00	0.14	0.24	0.24	0.00	0.85
12	3.87	650.2	256,897	214,203	671.17	20.95	1647.5	0.00	0.18	0.29	0.29	0.00	0.92
13	4.36	624.9	234,146	205,885	643.97	19.09	1959.2	0.00	0.23	0.35	0.35	0.00	1.00
14	4.75	591.0	201,496	200,399	608.06	17.07	2007.5	0.00	0.28	0.45	0.40	0.00	1.07
15	5.11	579.1	199,481	195,933	593.81	14.74	2504.5	0.00	0.33	0.45	0.45	0.00	1.14
16	5.45	554.7	198,397	190,530	569.81	15.14	2594.6	0.00	0.38	0.48	0.48	0.00	1.19
17	5.96	521.8	185,647	183,759	539.56	17.76	1684.7	0.00	0.42	0.56	0.54	0.00	1.27
18	6.56	476.4	183,791	175,941	491.83	15.42	8195.8	0.00	0.47	0.56	0.59	0.00	1.34
19	7.42	420.4	174,808	162,919	436.30	15.92	1769.2	0.00	0.53	0.67	0.67	0.00	1.44
20	8.15	364.2	156,287	153,205	383.88	19.68	1178.3	0.00	0.60	0.81	0.75	0.00	1.54
21	8.77	339.2	154,724	144,268	364.17	24.95	869.4	0.00	0.68	0.83	0.83	0.00	1.64
22	9.68	295.4	132,778	132,251	323.09	27.70	840.9	0.00	0.84	1.13	1.00	0.00	1.83
23	10.21	264.3	131,450	125,810	284.59	20.33	1118.8	0.00	0.98	1.14	1.14	0.00	1.99
24	10.64	255.5	117,781	120,864	275.85	20.37	1288.4	0.00	1.09	1.36	1.26	0.00	2.13
25	11.52	219.6	116,603	111,475	250.24	30.60	715.0	0.00	1.20	1.37	1.37	0.00	2.26
26	12.14	199.1	115,437	105,407	225.86	26.78	768.6	0.00	1.30	1.38	1.48	0.00	2.39
27	12.67	181.0	114,283	98,892	203.76	22.72	992.2	0.00	1.42	1.40	1.60	0.00	2.53
28	13.52	158.9	113,140	90,038	185.94	27.02	2345.0	0.00	1.52	1.41	1.71	0.00	2.66
29	14.18	135.9	100,895	83,258	159.07	23.13	1030.1	0.00	1.65	1.84	1.84	0.00	2.81
30	14.80	112.7	99,886	77,129	133.18	20.46	3574.2	0.00	1.70	1.86	1.90	0.00	2.89
31	15.49	81.0	98,887	70,856	97.14	16.14	1403.6	0.00	1.80	1.91	2.00	0.00	3.01
32	15.91	62.6	97,898	66,562	80.90	18.35	1070.4	0.00	1.91	1.93	2.12	0.00	3.15
33	16.24	52.1	89,587	62,920	68.26	16.20	1536.1	0.00	2.00	2.23	2.23	0.00	3.28

FIGURES

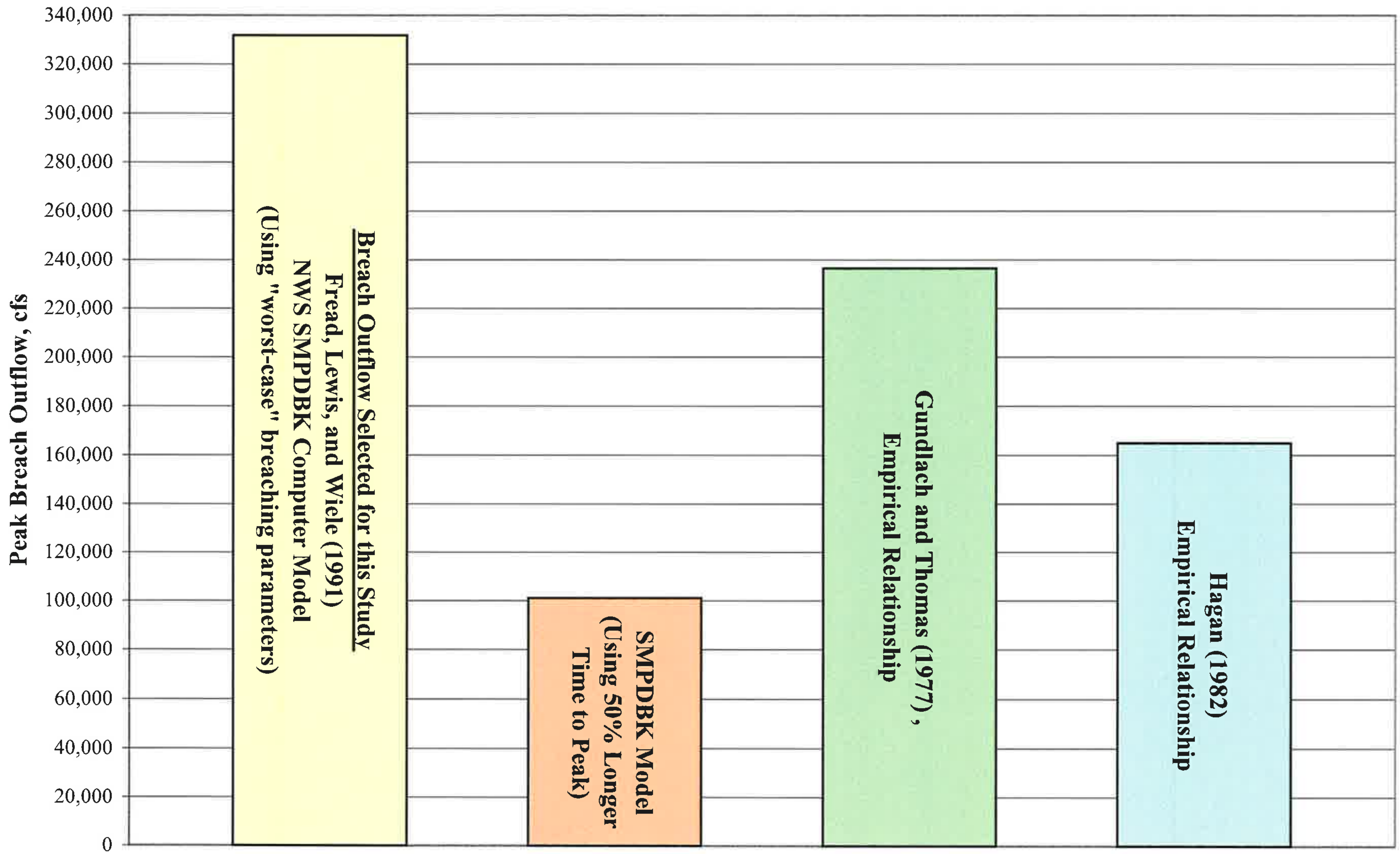


VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	SITE LOCATION MAP JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE 1



VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	DRAINAGE BASIN MAP JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE 2

Comparison of Matilija Dam Breach Outflow Estimates



Comparison of Breach Outflow Estimates based on Two NWS SMPDBK Model Runs and Two Empirical Relationships (Data Summarized in Table D-1, Appendix D)

Figure 4
Channel Profile Downstream of Matilija Dam

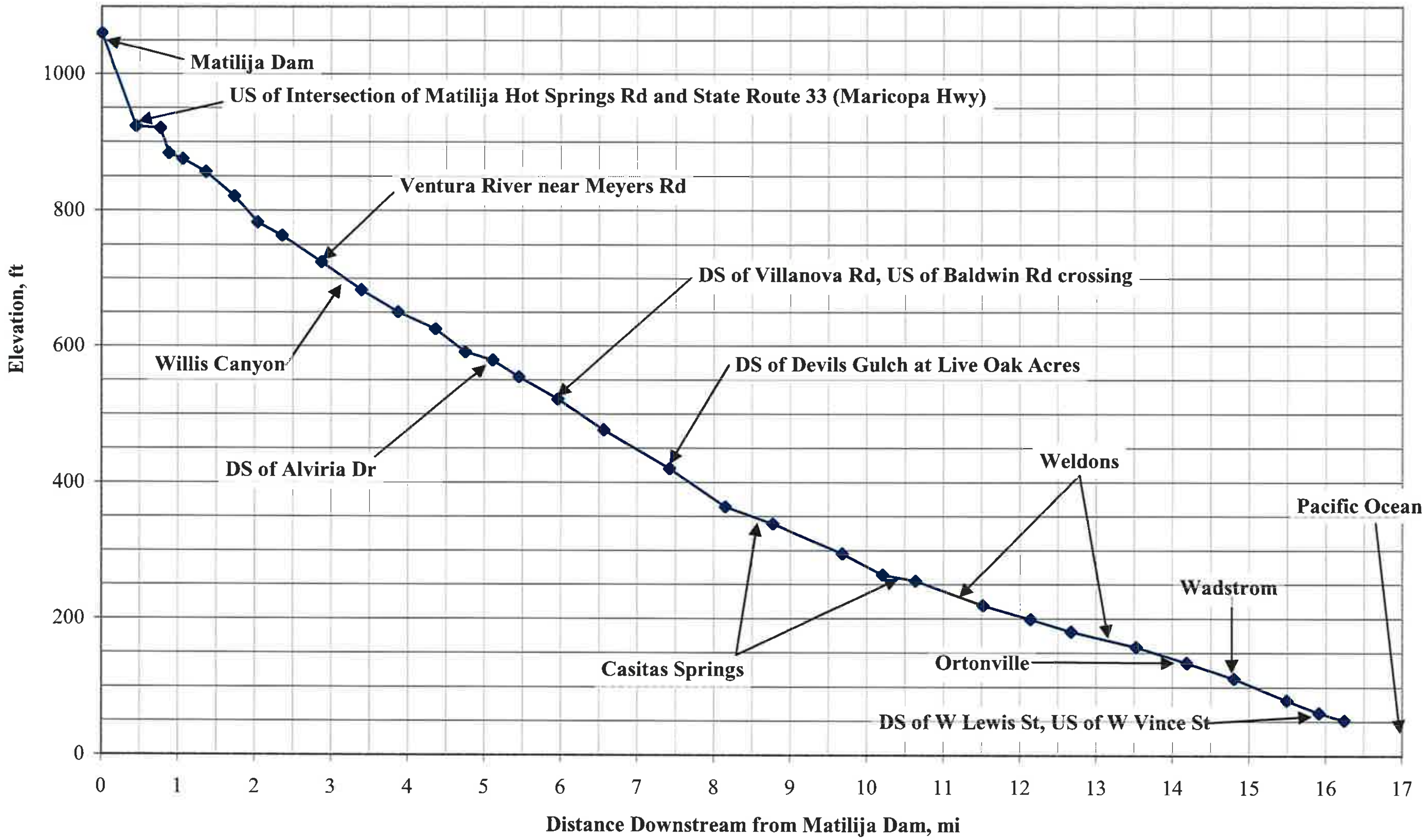


Figure 5
Peak Flow Downstream of Matilija Dam

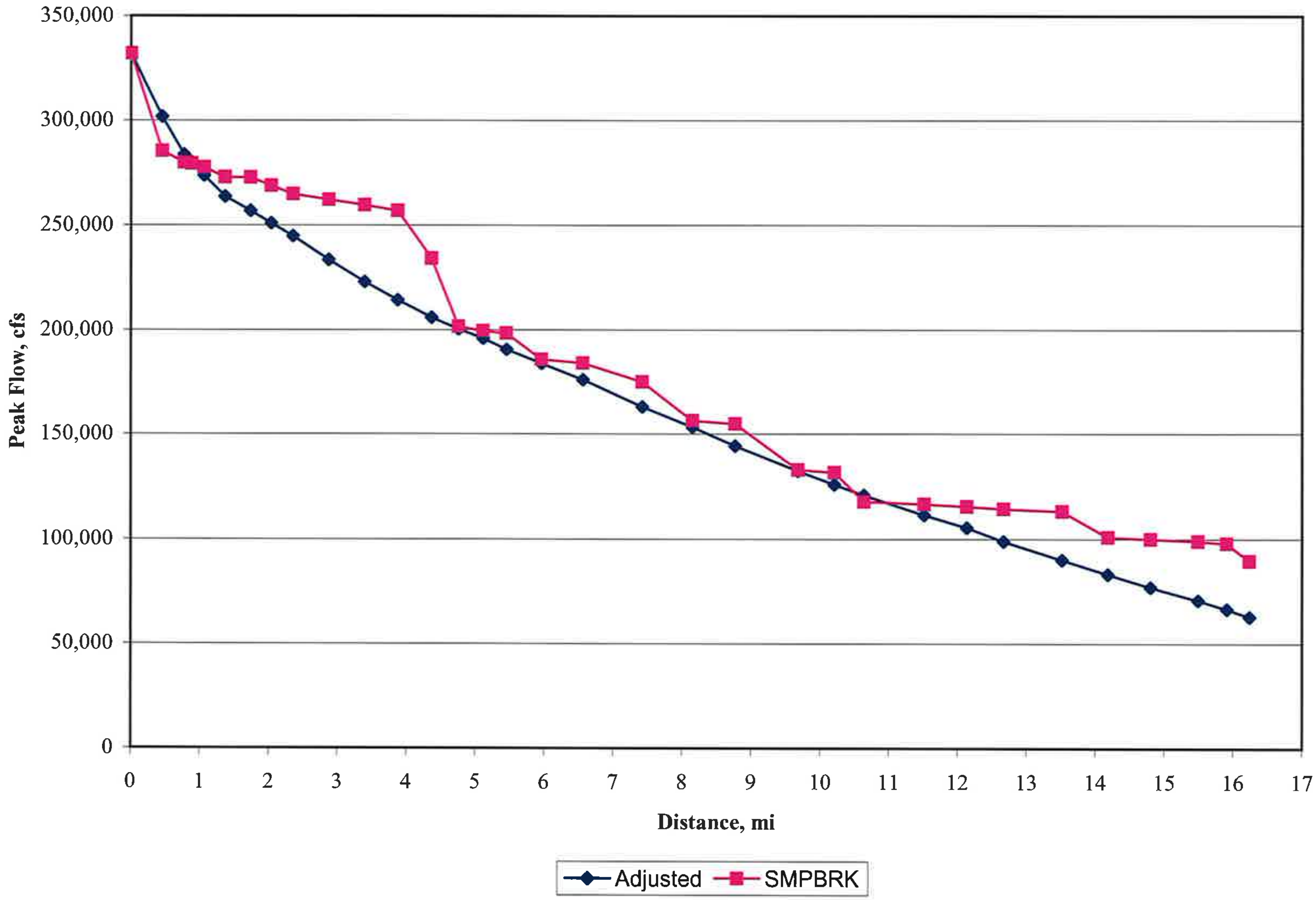


Figure 6
Maximum Depth of Flow Downstream of Matilija Dam

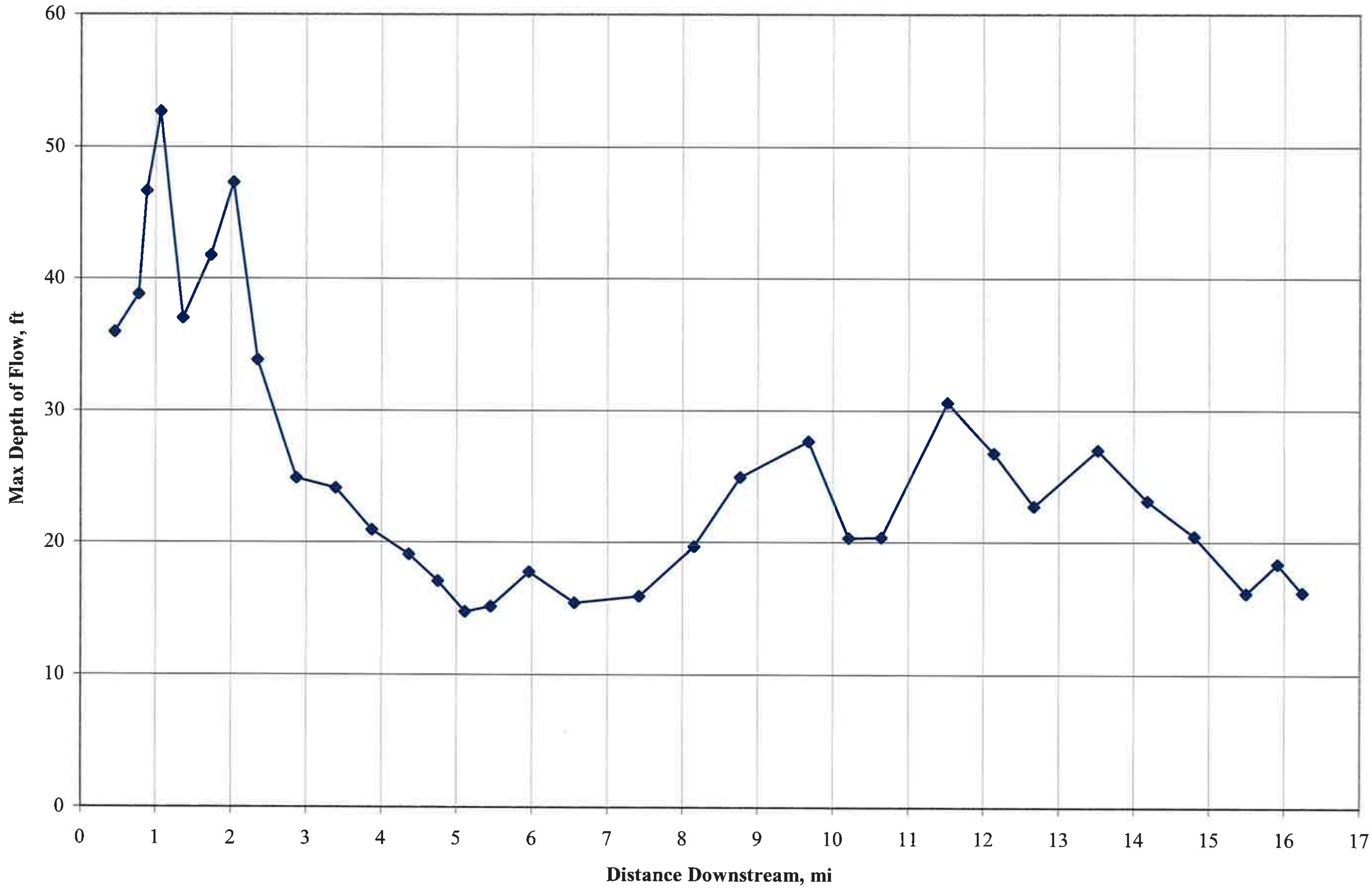


Figure 7
Average Velocity of Flood Wave Downstream of Matilija Dam

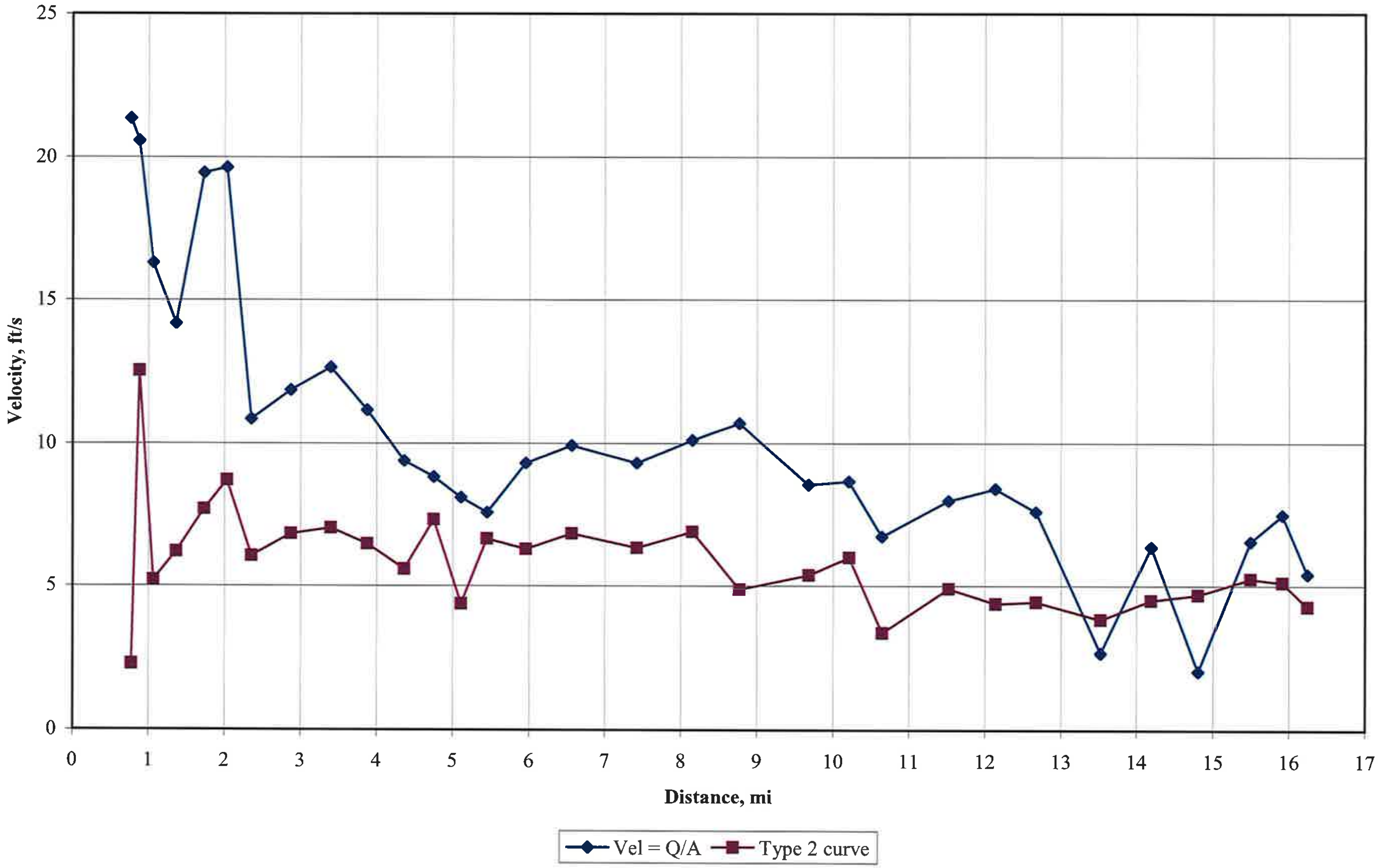
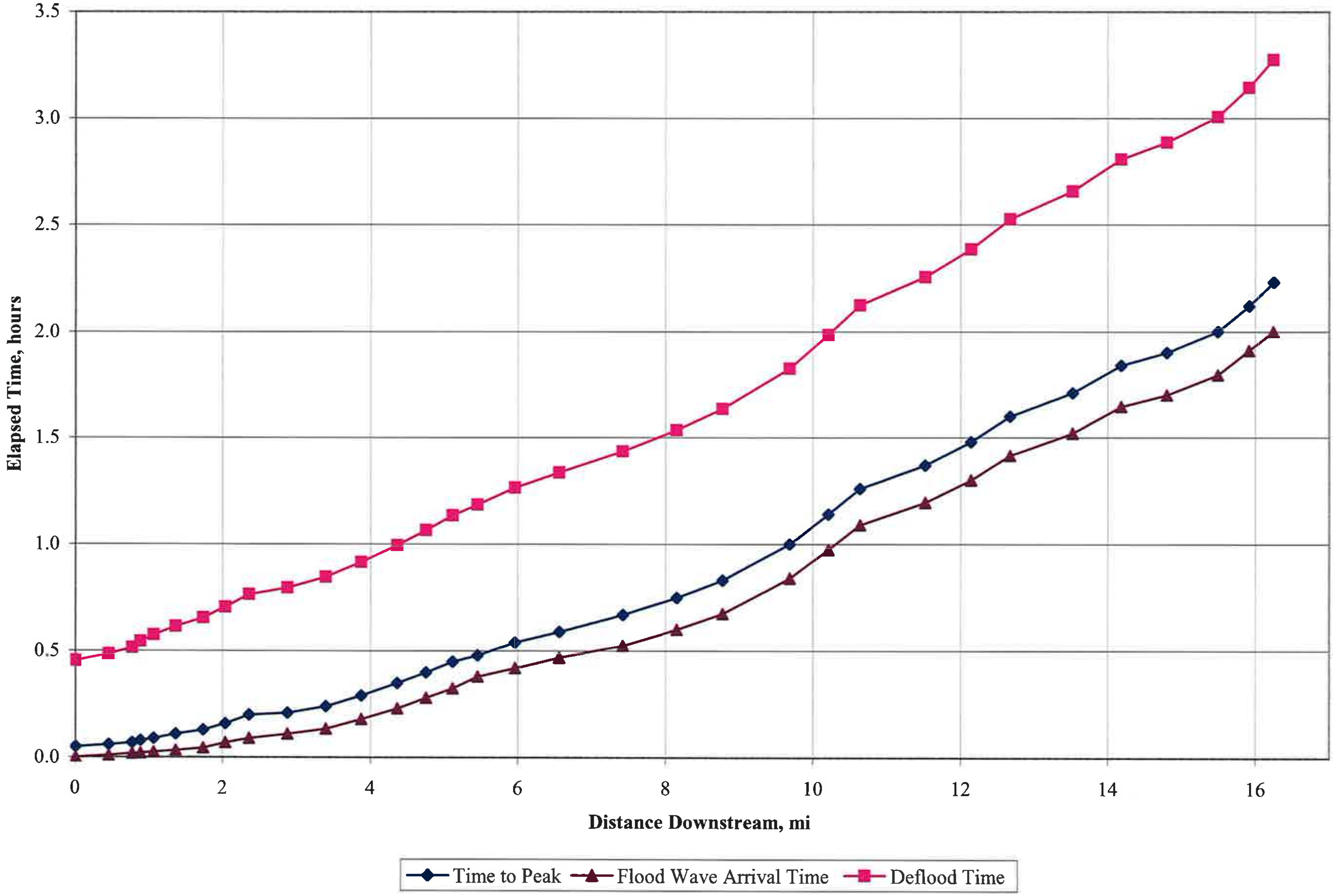
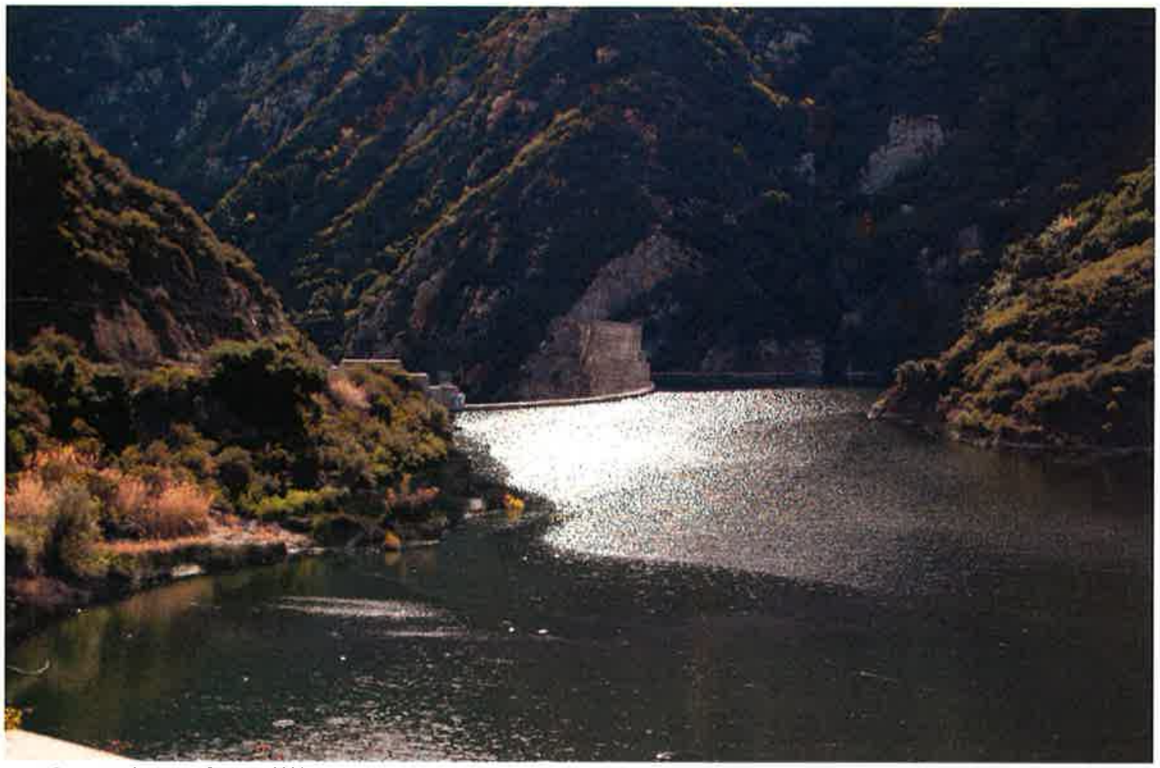


Figure 8
Travel Time of Floodwave Downstream of Matilija Dam



SITE PHOTOGRAPHS

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS



1. View of Matilija Dam from upstream. Water level is just below crest of overflow spillway.

2. View looking upstream at Matilija Creek watershed.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

3. Downstream face of dam near the right abutment.

4. Downstream face of dam near the left abutment.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

5. Close-up view of the left abutment.

6. View of dam access road looking downstream from left abutment.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

7. View of the left abutment, stairway and structure.

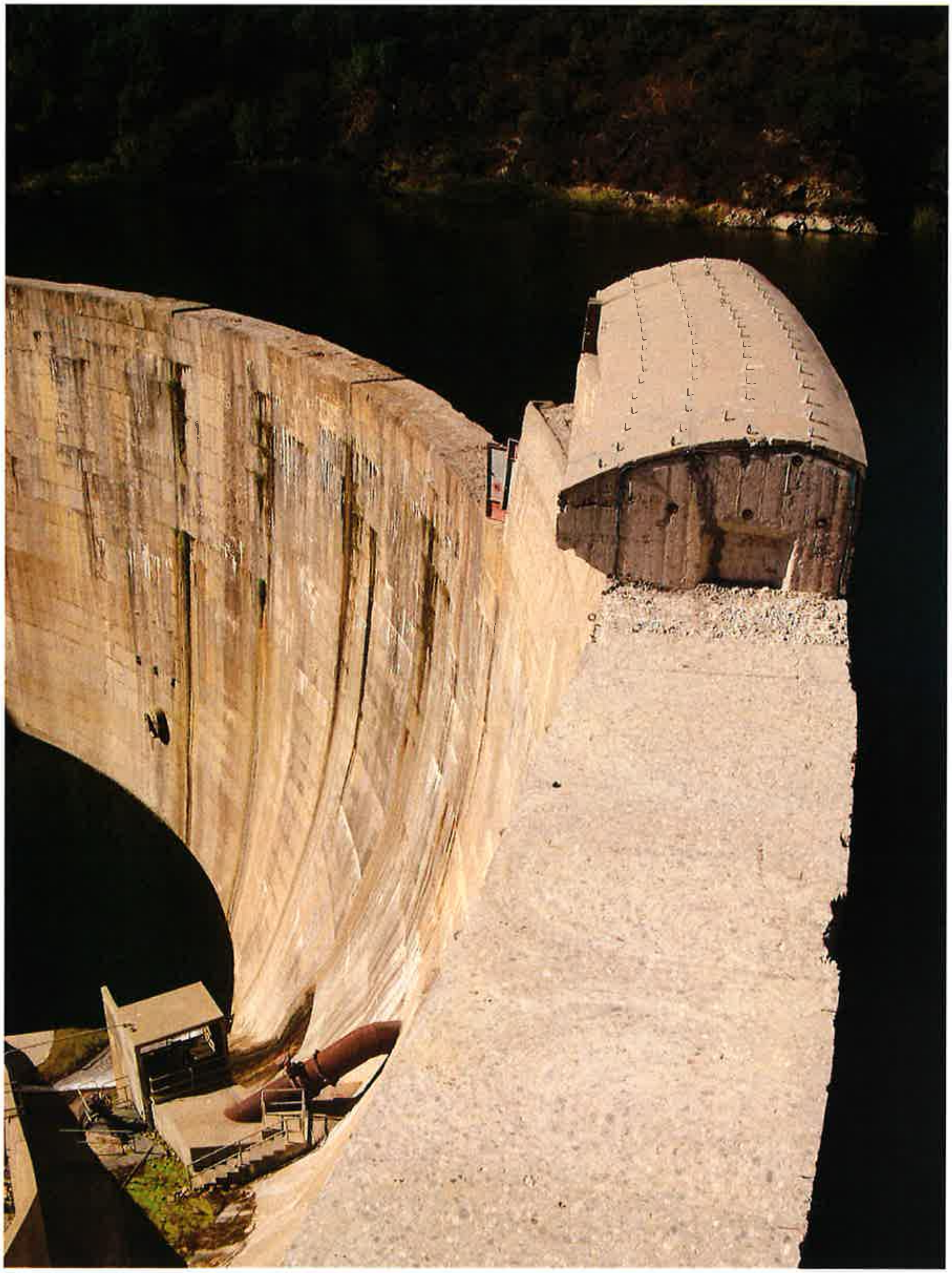
8. View of cracking in Matilija Dam near right abutment.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

9. View of Survey Pillar #5 located near right abutment of Matilija Dam.

10. View of Survey Target L on downstream face of Matilija Dam.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS



11. Top view of the left and center portions of the crest of Matilija Dam.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

12. View of the outlet works at downstream toe of dam.

13. View of Matilija Creek immediately downstream of Matilija Dam.

MATILIJA DAM INUNDATION STUDY PHOTOGRAPHS

14. View of the flood path at the intersection of Matilija Creek with Matilija Hot Springs Road, approximately 0.5 miles downstream (east) of Matilija Dam.

15. View of flood path along Maricopa Highway, north of Foothill Trail.

APPENDIX A

RESERVOIR AREA AND CAPACITY DATA

Table A-1
Matilija Reservoir Elevation-Area-Capacity Data

Height Above Toe (ft)	Elevation[1] Above Sea Level (ft)	Surface Area of Reservoir[2] (acres)	Original Capacity[2] (acre-ft)	Capacity, with Silt Deposits[3] (acre-ft)
Toe[4]	**975**	0.0	0	0.0
25	1000	2.2	68	0.0
35	1010	5.2	114	0.0
45	1020	13.0	205	0.0
55	1030	24.1	364	0.0
60	1035	29.6	477	0.0
65	1040	34.7	682	0.0
70	1045	38.9	886	0.0
75	1050	43.5	1,091	0.0
80	1055	48.1	1,318	0.0
85	**1060**	53.2	1,568	0.0
90	1065	56.5	1,841	273
95	1070	61.1	2,140	572
100	1075	64.1	2,400	832
105	1080	67.6	2,740	1,172
110	1085	72.0	3,110	1,542
120	**1095**	85.2	3,950	2,382
125	1100	90.7	4,410	2,842
135	1110	104.6	5,350	3,782
136	**1111**	106.1	5,461	3,893
145	**1120**	120.0	6,460	4,892

Reference: Matilija Reservoir elevation-area-volume data from Appendix 5 of report by DSOD (1979)

[1]Elevation **1025** ft is at the invert of the outlet conduit

[1]Elevation **1060** ft is at the nominal top elevation of silt (post-breach, equivalent rectangular area basis)

Note: In this report, silt deposits that have built-up in the reservoir are also referred to as sediment

[1]Elevation **1095** ft is at the crest of the existing overflow spillway

[1]Elevation **1111** ft is at the maximum elevation due to the PMF inflow

[1]Elevation **1120** ft is 18 ft below the crest of the dam (25 ft above the existing overflow spillway)

[2]Surface Area and Original Capacity of reservoir (all capacity values are considered approximate)

[3]Capacity, with Silt Deposits: Reservoir capacity has decreased due to the accumulation of sediment

[4]Toe Elevation **975** ft, at the downstream toe of the dam (Bulletin 17, CA Dept of Water Resources, 2000)

Table A-2
Matilija Dam Spillway Discharge Data

Elevation[3] ft	Outlet Conduit Head ft	Outlet Conduit [1]Discharge cfs	Existing Spillway Head ft	Existing Spillway [1]Discharge cfs	[1,2]Total Discharge cfs	[1]Original Capacity, ac-ft
975	0.0	0			0	0
1000	0.0	0			0	68
1020	20.0	0			0	205
1025	25.0	0	Invert of outlet conduit		0	280
1050	50.0	--			0	1,091
1075	75.0	--			0	2,400
1085	85.0	--			0	3,110
1095	95.0	--	0.0	0.0	0	3,950
1100	100.0	--	5.0	12900	12,900	4,410
1104	104.0	--	9.0	31100	31,100	4,786
1106	106.0	--	11.0	42000	42,000	4,974
1108	108.0	--	13.0	54000	54,000	5,162
1110	110.0	--	15.0	66900	66,900	5,350
1111	111.0	--	16.0	73700	73,700	5,461
1120	120.0	--	25.0	144000	148,000	6,460
1138	138.0	--	43.0	--	--	--

Notes: Spillway rating curve data obtained from report by DSOD (1979)

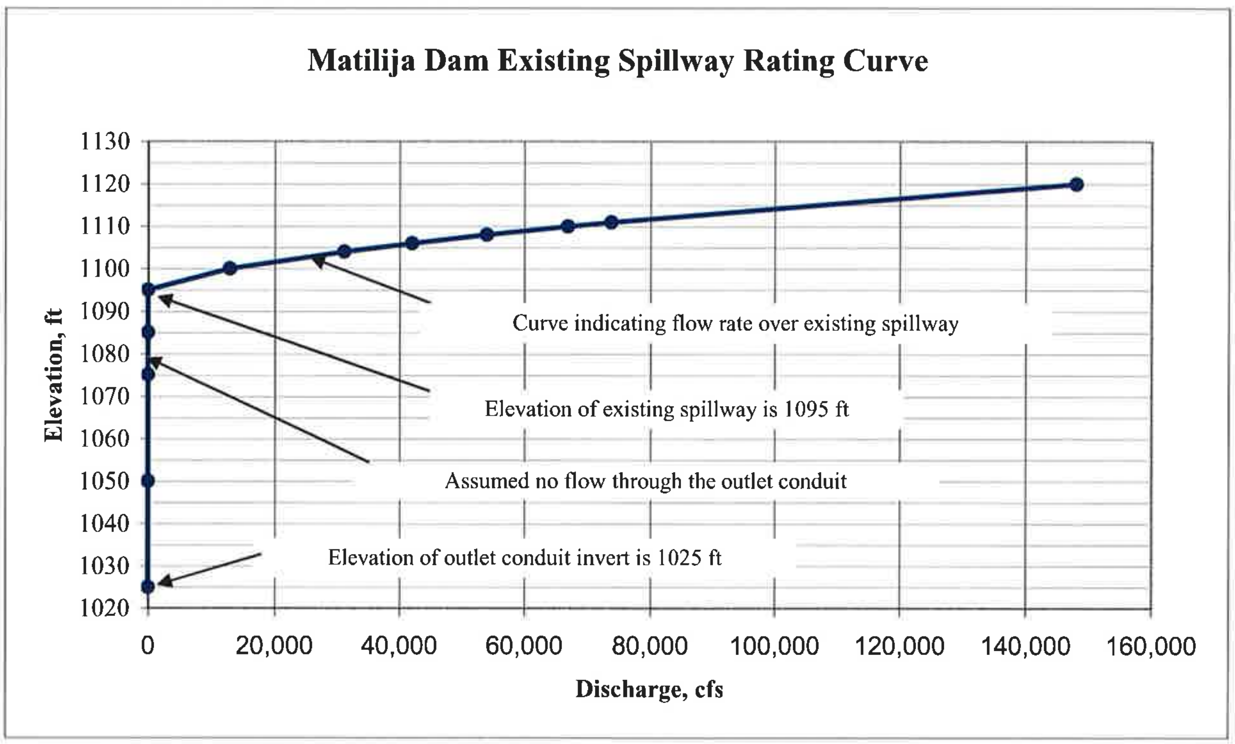
[1]Listed discharges and original reservoir capacity values are considered approximate

[2]Invert elevation of outlet conduit: **1025** ft. For breach analysis, conduit assumed to carry no flow

[3]Elevation **1095** is at the crest of the existing overflow spillway

[3]Elevation **1111** is at the maximum elevation due to the PMF inflow

[3]Elevation **1138** is at the crest of the dam



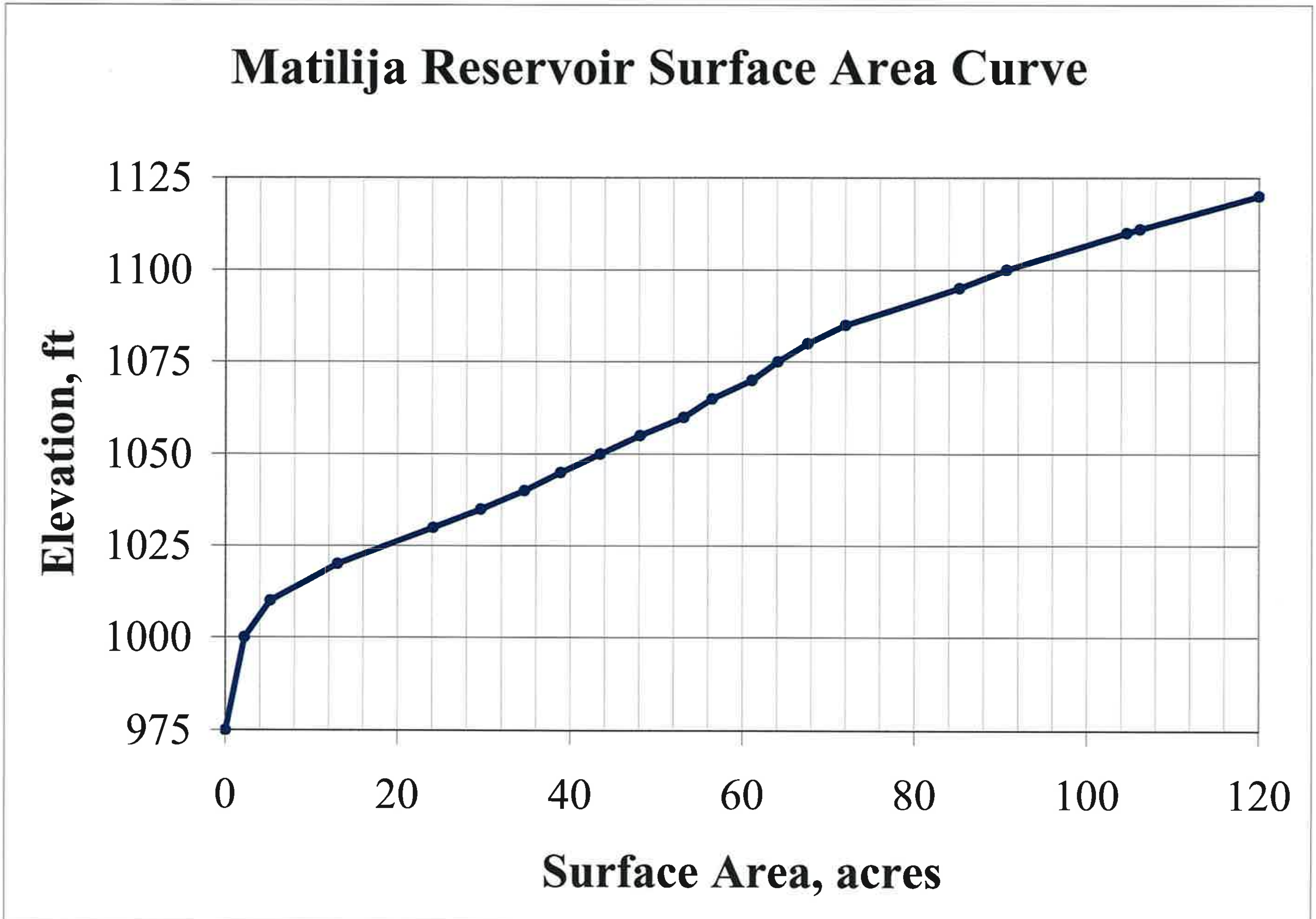
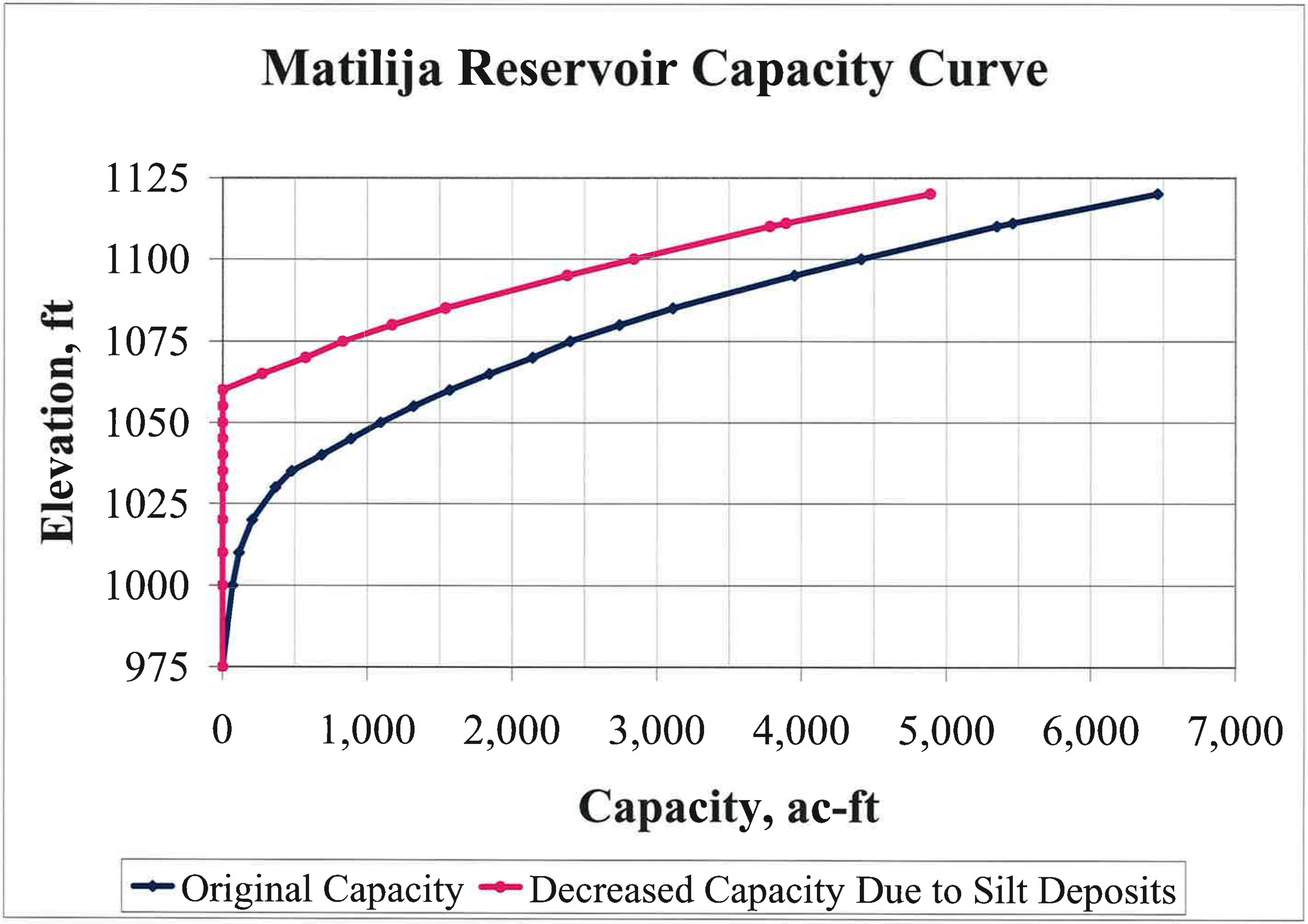
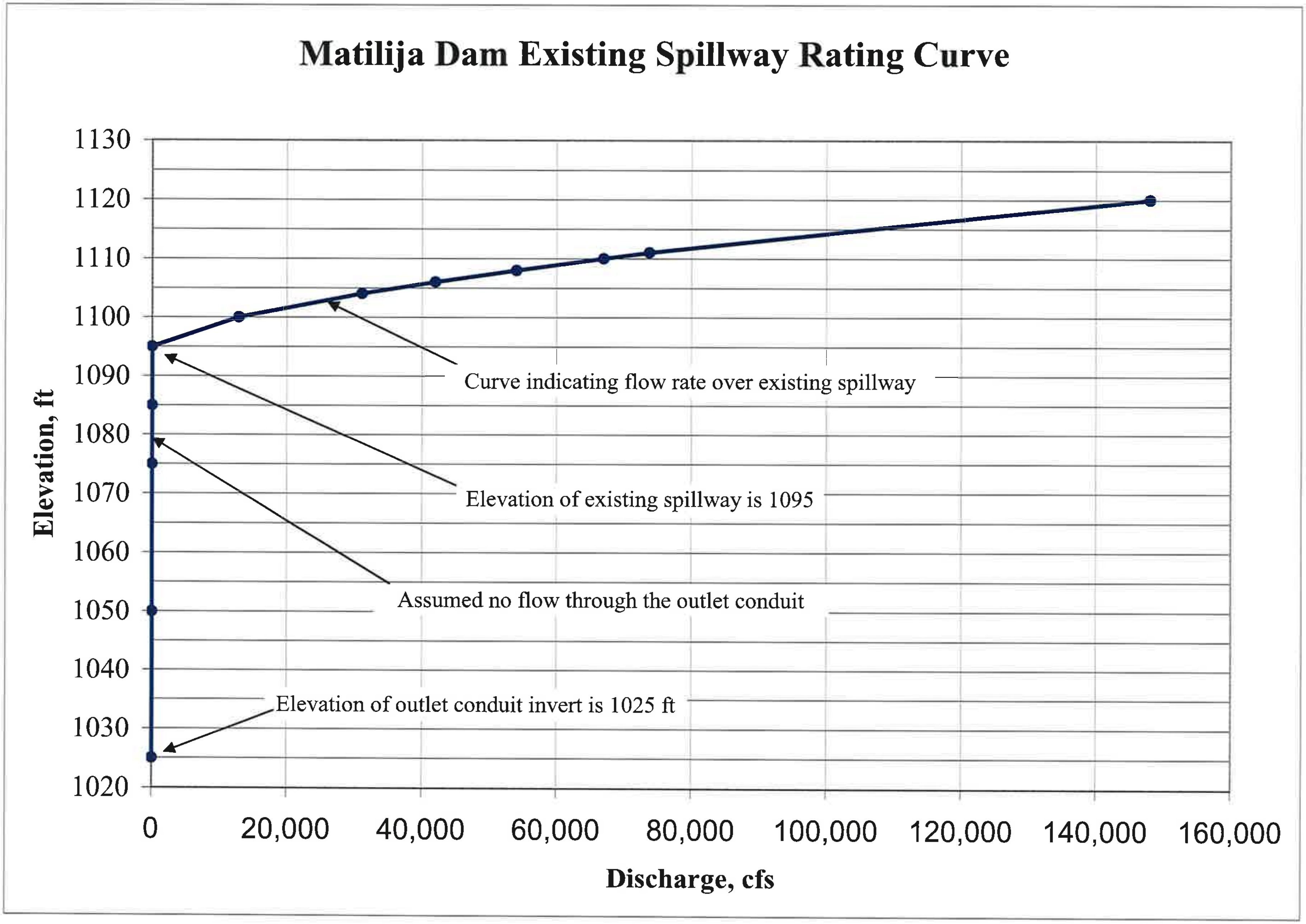

Matilija Reservoir Surface Area Curve
Elevation, ft
1125
1100
1075
1050
1025
1000
975
0
20
40
60
80
100
120
Surface Area, acres

Figure A-1


Matilija Reservoir Capacity Curve
Elevation, ft
1125
1100
1075
1050
1025
1000
975
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
Capacity, ac-ft
Original Capacity
Decreased Capacity Due to Silt Deposits


Matilija Dam Existing Spillway Rating Curve
Elevation, ft
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
Discharge, cfs
Curve indicating flow rate over existing spillway
Elevation of existing spillway is 1095
Assumed no flow through the outlet conduit
Elevation of outlet conduit invert is 1025 ft

APPENDIX B

PROBABLE MAXIMUM PRECIPITATION ANALYSIS

Table B-1

PMP Rainfall Data in One-Hour Increments[1]

Elapsed Time, Hours	Rainfall, Inches	
	Incremental	Cumulative
1	0.29	0.29
2	0.29	0.58
3	0.30	0.88
4	0.31	1.19
5	0.31	1.50
6	0.32	1.82
7	0.33	2.15
8	0.33	2.48
9	0.34	2.82
10	0.35	3.17
11	0.36	3.53
12	0.37	3.90
13	0.76	4.66
14	0.77	5.43
15	0.79	6.22
16	0.80	7.02
17	0.81	7.83
18	0.83	8.66
19	0.84	9.50
20	0.86	10.36
21	0.87	11.23
22	0.89	12.12
23	0.91	13.03
24	0.94	13.97
25	0.96	14.93
26	0.99	15.92
27	1.02	16.94
28	1.06	18.00
29	1.10	19.10
30	1.15	20.25
31	1.18	21.43
32	1.30	22.73
33	1.40	24.13
34	1.76	25.89
35	1.95	27.84
36	2.38	30.22

Elapsed Time, Hours	Rainfall, Inches	
	Incremental	Cumulative
37	3.38	33.60
38	2.16	35.76
39	1.84	37.60
40	1.47	39.07
41	1.34	40.41
42	1.25	41.66
43	1.16	42.82
44	1.13	43.95
45	1.08	45.03
46	1.04	46.07
47	1.01	47.08
48	0.98	48.06
49	0.95	49.01
50	0.92	49.93
51	0.90	50.83
52	0.88	51.71
53	0.86	52.57
54	0.85	53.42
55	0.83	54.25
56	0.82	55.07
57	0.80	55.87
58	0.79	56.66
59	0.78	57.44
60	0.77	58.21
61	0.37	58.58
62	0.36	58.94
63	0.35	59.29
64	0.35	59.64
65	0.34	59.98
66	0.33	60.31
67	0.32	60.63
68	0.32	60.95
69	0.31	61.26
70	0.30	61.56
71	0.30	61.86
72	0.29	62.15

[1]Data from California Department of Water Resources (1979) "Phase I Inspection Report for Matilija Dam," Division of Safety of Dams, prepared for USACE, Sacramento District, June 1979

Table B-2

PMP Depth-Duration Rainfall Data[1]

Duration	Cumulative Depth (Inches)
1-Hour	3.38
6-Hour	13.47
12-Hour	21.41
24-Hour	34.09
48-Hour	54.31
72-Hour	62.15

[1]Data from California Department of Water Resources (1979) "Phase I Inspection Report for Matilija Dam," Division of Safety of Dams, prepared for USACE, Sacramento District, June 1979

APPENDIX C

PROBABLE MAXIMUM FLOOD ANALYSIS

Table C-1

PMF Inflow and Reservoir Outflow Results[1]

Parameter	Value
Peak Inflow to Reservoir, cfs	76,100
Time of Peak Inflow, hours	38
Total Rainfall, inches	62.1500
Total Losses, inches	15.0253
Excess (Runoff), inches	47.1247
Runoff Volume, acre-feet	138,219
Peak Spillway Discharge, cfs	76,100
Maximum Reservoir Elevation, ft	1,111

[1]Data from California Department of Water Resources (1979) "Phase I Inspection Report for Matilija Dam," Division of Safety of Dams, prepared for USACE, Sacramento District, June 1979

APPENDIX D

BREACH ANALYSIS

Table D-1
Comparison of Matilija Dam Breach Outflow Estimates[1]

Initial parameter estimation: Average breach width and breach failure time for Matilija Dam

Froehlich (1987) estimate for average breach width: B=9.5k_o*(S*H)^0.25

(Not applicable at this dam)	B (for piping failure) =	140 ft	k_o for piping failure=	0.7
(Not applicable at this dam)	B (for overtopping) =	201 ft	k_o for overtopping =	1.0

Froehlich (1987) estimate for breach failure time: τ=0.59*(S^0.47)/(H^0.9)

τ = 0.835 hr, 50.08 min

Input parameters for peak outflow (Qp) estimates

average WIDTH of downstream channel section	b =	135.00	ft
DEPTH of water behind dam	Hw =	41.00	ft
average WIDTH of breach section	B =	360.00	ft
nominal DEPTH of breach (deposited silt not included in depth calc)	H =	51.00	ft
OUTFLOW immediately prior to failure	Qo =	76,100	cfs
reservoir STORAGE at time of failure	S =	3,893	ac-ft
cross sectional AREA of dam at location of breach	Ax =	10,800	ft²
LENGTH of dam crest	L =	620.00	ft
reservoir SURFACE AREA at time of failure	As =	106.10	ac
failure TIME	Tf =	3.00	min

Flow Models and Spreadsheet Methods	Q_p (cfs)	W_{br} ft	z:1.0 (H:V)	T_p (min)	T_p (hr)
SMPDBK model with worst-case breaching parameters:	331,793	360	0.00	3.00	0.050
SMPDBK model using 50% longer time to peak (Tp):	100,989	360	0.00	4.50	0.075

Peak breach outflow (Qp) comparison values obtained using empirical relationships

Gundlach and Thomas, 1977	236,509 cfs	
USACE-WES	230,331 cfs	
Froehlich, David C.	60,210 cfs	
MacDonald and Langridge-Monopolis (1984)	70,156 cfs	
Costa, J.E. (1985) USGS Open-File Report 85-560	54,574 cfs	
Hagan (1982) method	164,865 cfs	Qp = 370 * (S * H)^0.5

SCS (TR-60) maximum "upper envelope" empirical relationships, valid only if specified condition is met:

If Hw is greater than or equal to 103 ft	62,598 cfs	(Not applicable at this dam)
If Hw is less than 103 ft	514,065 cfs	(Not applicable at this dam)
If L < 65(H)^0.35/0.416	93,938 cfs	(Not applicable at this dam)

[1]This table was developed as a modification of a computer spreadsheet template provided by Dodson & Associates (2005)

APPENDIX E

RESULTS OF FLOW AND TRAVEL TIME ANALYSIS

Table E-1
Flow Depth, Peak Flow, Average Velocity, and Travel Time

Matilija Reservoir Inundation Study Project No. 318F-VEN June 2009

Hydraulic profile, flood attenuation, travel time, and inundation depth

Cross Section No.	Distance DS of Dam (ft)	(mi)	Channel Btm Elev (ft)	Max Depth of Flow (ft)	Max Top Width of Flow, ft	Flow Area at Cross-Section, ft²	General Description of Landmark, Road, or Geographic Feature Nr Cross Section Location
1	0	0.00	1060.0	--	--	--	Erosion to 1060ft (Equivalent Rectangular Bottom)
2	2,376	0.45	922.6	35.92	353	8,442	US of Jct of Matilija Hot Springs Rd and Hwy 33
3	4,066	0.77	919.7	38.80	507	13,102	DS of Jct of Matilija Hot Springs Rd and Hwy 33
4	4,646	0.88	883.0	46.66	436	13,571	US of Camino Cielo along Hwy 33
5	5,597	1.06	874.8	52.64	485	17,028	DS of Camino Cielo along Hwy 33
6	7,181	1.36	856.0	36.97	781	19,254	US of Kennedy Cyn (~0.5 mi US)
7	9,134	1.73	820.5	41.76	503	14,014	Nr Kennedy Cyn (~200 ft US)
8	10,718	2.03	782.8	47.33	434	13,690	DS of Kennedy Cyn (~1,000 ft DS)
9	12,408	2.35	763.6	33.82	1082	24,388	Along Ventura River, north end of N. Rice Rd
10	15,154	2.87	724.4	24.90	1332	22,109	Along Ventura River near Meyers Rd
11	17,899	3.39	682.8	24.13	1275	20,508	US of Jct of Rice Rd and El Roblar Dr
12	20,434	3.87	650.2	20.95	1648	23,010	Nr Jct of Rice Rd and Lomita Ave
13	23,021	4.36	624.9	19.09	1959	24,934	Nr Jct of Moreno Dr and Camille Dr
14	25,080	4.75	591.0	17.07	2008	22,846	US of Jct of Moreno Dr and Ferrara Dr
15	26,981	5.11	579.1	14.74	2505	24,611	DS of Jct of Moreno Dr and Alviria Dr
16	28,776	5.45	554.7	15.14	2595	26,188	DS of Jct of Old Baldwin Rd and Hwy 150
17	31,469	5.96	521.8	17.76	1685	19,947	Nr Jct of Woodland Ave and Lake Ave
18	34,637	6.56	476.4	15.42	1800	18,504	Nr Jct of Puesta del Sol and Willey St
19	39,178	7.42	420.4	15.92	1769	18,777	DS of Jct of Sycamore Rd and Riverside Rd
20	43,032	8.15	364.2	19.68	1178	15,459	DS of Santa Ana (upper) & Newman Ranch Rd
21	46,306	8.77	339.2	24.95	869	14,461	DS of Santa Ana (lower) & Newman Ranch Rd
22	51,110	9.68	295.4	27.70	841	15,528	US of Jct of Ventura Ave and Nye Rd
23	53,909	10.21	264.3	20.33	1119	15,164	US of Jct of Ventura Ave and Ranch Rd
24	56,179	10.64	255.5	20.37	1288	17,496	US of Jct of Hwy 33 and Park View Dr
25	60,826	11.52	219.6	30.60	715	14,585	US of Jct of Hwy 33 and Casitas Vista Rd
26	64,099	12.14	199.1	26.78	769	13,722	DS of Jct of Hwy 33 and N Ventura Ave
27	66,898	12.67	181.0	22.72	992	15,029	DS of Jct of Hwy 33 and Canada Larga Rd
28	71,386	13.52	158.9	27.02	2345	42,241	Nr Jct of N Ventura Ave and Los Cabos Ln
29	74,870	14.18	135.9	23.13	1030	15,884	US of Jct of N Ventura Ave and Orchard Dr
30	78,144	14.80	112.7	20.46	3574	48,752	DS of Jct of Hwy 33 and Shell Rd
31	81,787	15.49	81.0	16.14	1404	15,103	Nr Jct of Kehala Ave and Potawatome St
32	84,005	15.91	62.6	18.35	1070	13,095	DS of Jct of Hwy 33 and Stanley Ave
33	85,747	16.24	52.1	16.20	1536	16,590	Nr Jct of Riverside St and W Vince St

Notes Distances and Elevations obtained from Digital Elevation Model (DEM) mapping using WMS software
Cross-section top width and estimated flow area calculated from results of SMPDBK modeling
Inundation areas mapped with WMS software, based on spreadsheets and SMPDBK modeling results
Spreadsheet analysis based on Walther (2000) method (Reference 2) using Flood-2.xls template

Abbreviations:

US = Upstream	Elev = Elevation	ft² = square feet	mi = miles
DS = Downstream	Btm = Bottom	ft/s = feet per second	ft = feet
Max = Maximum	Nr = Near	cfs = cubic feet per second	Jct = Junction
Hwy 33 = State Route 33 (Maricopa Highway)		~ = Approximately	Cyn = Canyon

Table E-1
Flow Depth, Peak Flow, Average Velocity, and Travel Time

Matilija Reservoir Inundation Study Project No. 318F-VEN June 2009

Hydraulic profile, flood attenuation, travel time, and inundation depth

Failure scenario : **Sudden Collapse**

Initial reservoir volume =	3,893	ac-ft
Spillway crest elev =	1,095	ft
Peak inflow (PMF Local Storm) =	76,100	cfs
Breach development time =	3	min
Peak outflow: SMPBRK model =	331,793	cfs

Distance from Dam (ft,	and mi)	Elev. (ft)	Channel Gradient (ft/ft)	(ft/mi)	Type 2 curve Velocity[1] (ft/s)	Vel = Q/A Velocity (ft/s)	Adjusted Peak Flow (Qp, cfs)	SMPBRK Peak Flow (Qp, cfs)	Attenuation Factor: Adjusted Values[2]	Results from SMPDBK
0	0.00	1060.0			(Type 2 curve)	#VALUE!	331,793	331,793	1.000	1.000
2376	0.45	922.6	0.0578	305	12.20	33.78	301,581	285,215	0.909	0.860
4066	0.77	919.7	0.0017	9	2.30	21.34	283,579	279,631	0.855	0.843
4646	0.88	883.0	0.0632	334	12.54	20.57	279,768	279,158	0.843	0.841
5597	1.06	874.8	0.0086	45	5.21	16.29	273,633	277,446	0.825	0.836
7181	1.36	856.0	0.0119	62.7	6.20	14.17	263,687	272,820	0.795	0.822
9134	1.73	820.5	0.0182	96	7.69	19.45	256,860	272,615	0.774	0.822
10718	2.03	782.8	0.0238	126	8.71	19.64	250,969	268,827	0.756	0.810
12408	2.35	763.6	0.0113	59.9	6.05	10.86	244,808	264,761	0.738	0.798
15154	2.87	724.4	0.0143	75	6.82	11.86	233,446	262,113	0.704	0.790
17899	3.39	682.8	0.0151	80	7.03	12.65	222,936	259,492	0.672	0.782
20434	3.87	650.2	0.0129	68	6.46	11.16	214,203	256,897	0.646	0.774
23021	4.36	624.9	0.0098	52	5.59	9.39	205,885	234,146	0.621	0.706
25080	4.75	591.0	0.0165	87	7.32	8.82	200,399	201,496	0.604	0.607
26981	5.11	579.1	0.0063	33	4.37	8.11	195,933	199,481	0.591	0.601
28776	5.45	554.7	0.0136	72	6.65	7.58	190,530	198,397	0.574	0.598
31469	5.96	521.8	0.0122	64	6.29	9.31	183,759	185,647	0.554	0.560
34637	6.56	476.4	0.0143	76	6.83	9.93	175,941	183,791	0.530	0.554
39178	7.42	420.4	0.0123	65	6.32	9.31	162,919	174,808	0.491	0.527
43032	8.15	364.2	0.0146	77	6.89	10.11	153,205	156,287	0.462	0.471
46306	8.77	339.2	0.0076	40	4.87	10.70	144,268	154,724	0.435	0.466
51110	9.68	295.4	0.0091	48	5.38	8.55	132,251	132,778	0.399	0.400
53909	10.21	264.3	0.0111	59	5.98	8.67	125,810	131,450	0.379	0.396
56179	10.64	255.5	0.0039	20	3.37	6.73	120,864	117,781	0.364	0.355
60826	11.52	219.6	0.0077	41	4.90	7.99	111,475	116,603	0.336	0.351
64099	12.14	199.1	0.0063	33	4.38	8.41	105,407	115,437	0.318	0.348
66898	12.67	181.0	0.0064	34	4.44	7.60	98,892	114,283	0.298	0.344
71386	13.52	158.9	0.0049	26	3.83	2.68	90,038	113,140	0.271	0.341
74870	14.18	135.9	0.0066	35	4.50	6.35	83,258	100,895	0.251	0.304
78144	14.80	112.7	0.0071	37	4.68	2.05	77,129	99,886	0.232	0.301
81787	15.49	81.0	0.0087	46	5.24	6.55	70,856	98,887	0.214	0.298
84005	15.91	62.6	0.0083	44	5.11	7.48	66,562	97,898	0.201	0.295
85747	16.24	52.1	0.0060	32	4.28	5.40	62,920	89,587	0.190	0.270

[1]Reference: Schaefer, 1992, Table 7 (velocity); [2]Reference: Schaefer, 1992, Figure 5 (Peak attenuation estimate)

(1) Schaefer, M.G., 1992, Dam Break Inundation Analysis and Downstream Hazard Classification

(2) Walther, Martin, 2000, Appropriate Technology: Simplified Dam Failure Analyses Using Spreadsheet Computations, 2000 ASDSO Western Regional Conference, May 15-17, 2000. (Spreadsheet template: "Flood-2")

Table E-1
Flow Depth, Peak Flow, Average Velocity, and Travel Time

Matilija Reservoir Inundation Study Project No. 318F-VEN June 2009

Hydraulic profile, flood attenuation, travel time, and inundation depth

Estimate of flood travel time from beginning of dam breach = travel distance / flood velocity.

Breach development time = 3.0 min Collapse due to earthquake: 3 min

Estimate of time to flood = time to flooding at dam + cumulative travel time

(Increment for flooding time est: 3 minutes

Estimate of time to peak = time to peak of outflow hydrograph + cumulative travel time.

(Estimated time to peak of outflow hydrograph is: 3 minutes (SMPDBK model: time of peak)

Estimate of deflooding time = time base of outflow hydrograph + (cumulative travel time / attenuation factor).

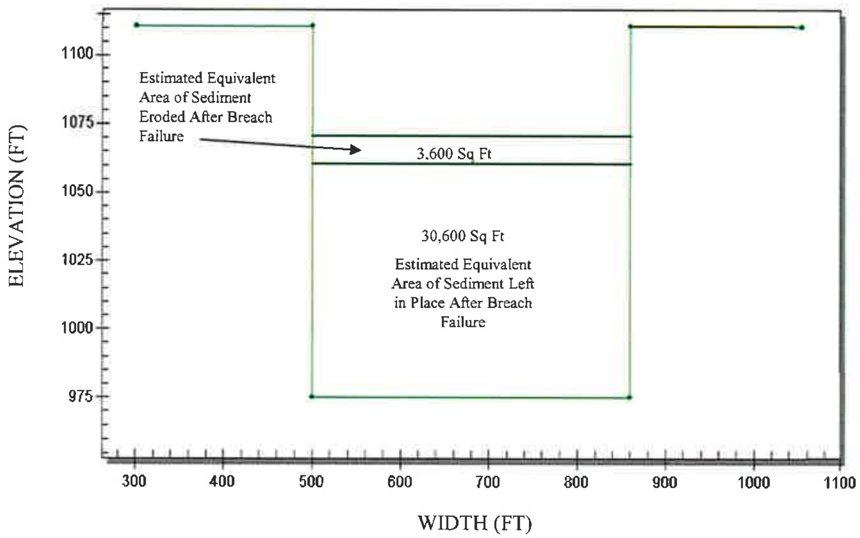
(Estimated time base of outflow hydrograph is: 60 minutes

(Travel time is divided by the attenuation factor to account for the broadening of the hydrograph time base.)

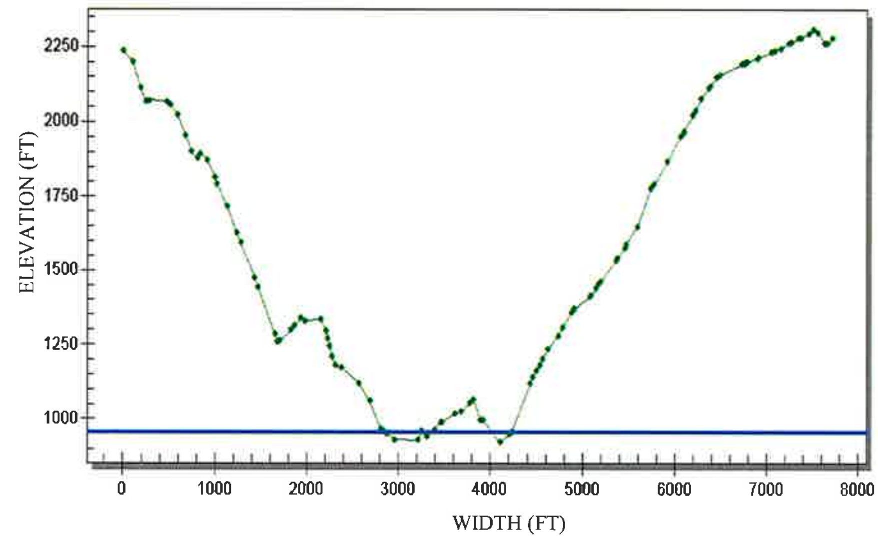
Distance from Dam (ft)	Distance from Dam (mi)	Channel Gradient ft/mile	Average Velocity (ft/s)	Flood travel time Distance/Vel (min)	Flood travel time SMPDBK (min)	Floodwave Arrival Time (min)	Time to Peak Spreadsheet (min)	Time to Peak SMPDBK (min)	Time of Deflooding (min)
0	0.00	Initial Time Value:		0.0	3.0	0.00	3.0	3.0	27.3
2376	0.45	305	33.78	1.17	3.6	0.54	3.6	3.6	29.1
4066	0.77	9	21.34	2.19	4.8	1.08	4.2	4.8	30.9
4646	0.88	334	20.57	2.66	4.8	1.26	4.8	4.8	32.7
5597	1.06	45	16.29	3.52	5.4	1.50	5.4	5.4	34.5
7181	1.36	63	14.17	5.25	6.6	1.98	6.6	6.6	36.9
9134	1.73	96	19.45	7.19	7.8	2.70	7.8	7.8	39.3
10718	2.03	126	19.64	8.54	9.6	4.20	9.6	9.6	42.3
12408	2.35	60	10.86	10.38	12.0	5.40	12.0	12.0	45.9
15154	2.87	75	11.86	14.41	12.6	6.60	12.6	12.6	47.7
17899	3.39	80	12.65	18.15	14.4	8.10	14.4	14.4	50.7
20434	3.87	68	11.16	21.69	17.4	10.8	17.4	17.4	54.9
23021	4.36	52	9.39	25.89	21.0	13.8	21.0	21.0	59.7
25080	4.75	87	8.82	29.66	27.0	16.8	24.0	27.0	63.9
26981	5.11	33	8.11	33.40	27.0	19.5	27.0	27.0	68.1
28776	5.45	72	7.58	37.22	28.8	22.8	28.8	28.8	71.1
31469	5.96	64	9.31	42.53	33.6	25.2	32.4	33.6	75.9
34637	6.56	76	9.93	48.02	33.6	28.2	35.4	33.6	80.1
39178	7.42	65	9.31	55.89	40.2	31.5	40.2	40.2	86.1
43032	8.15	77	10.11	62.51	48.6	36.0	45.0	48.6	92.1
46306	8.77	40	10.70	67.75	49.8	40.5	49.8	49.8	98.1
51110	9.68	48	8.55	76.07	67.8	50.4	60.0	67.8	109.5
53909	10.21	59	8.67	81.49	68.4	58.5	68.4	68.4	119.1
56179	10.64	20	6.73	86.40	81.6	65.4	75.6	81.6	127.5
60826	11.52	41	7.99	96.92	82.2	71.7	82.2	82.2	135.3
64099	12.14	33	8.41	103.57	82.8	78.0	88.8	82.8	143.1
66898	12.67	34	7.60	109.39	84.0	84.9	96.0	84.0	151.5
71386	13.52	26	3.83	122.47	84.6	91.2	102.6	84.6	159.3
74870	14.18	35	6.35	133.87	110.4	98.7	110.4	110.4	168.3
78144	14.80	37	4.68	143.76	111.6	102.0	114.0	111.6	173.1
81787	15.49	46	6.55	154.58	114.6	107.7	120.0	114.6	180.3
84005	15.91	44	7.48	159.85	115.8	114.6	127.2	115.8	188.7
85747	16.24	32	5.40	164.36	133.8	120.0	133.8	133.8	196.5

APPENDIX F

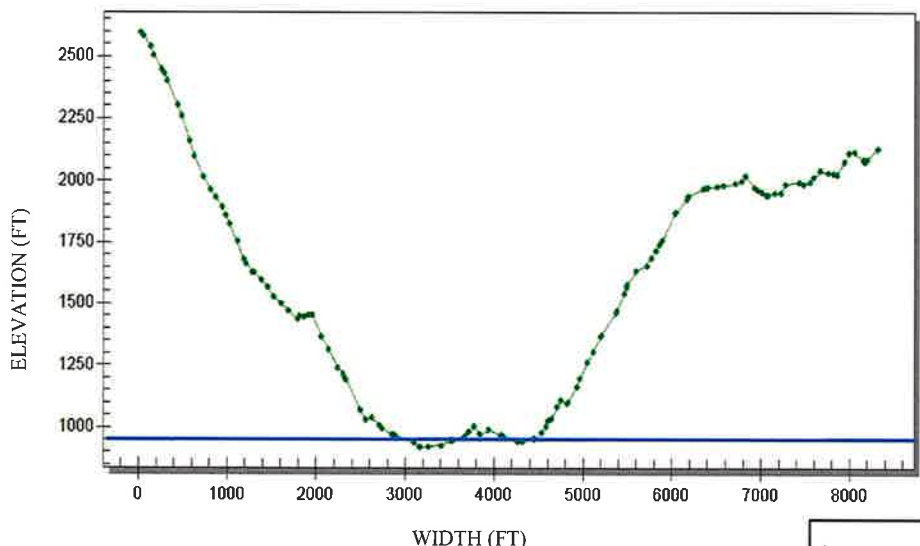
CROSS SECTION PLOTS



CROSS SECTION AT DAM
SECTION NO. 1

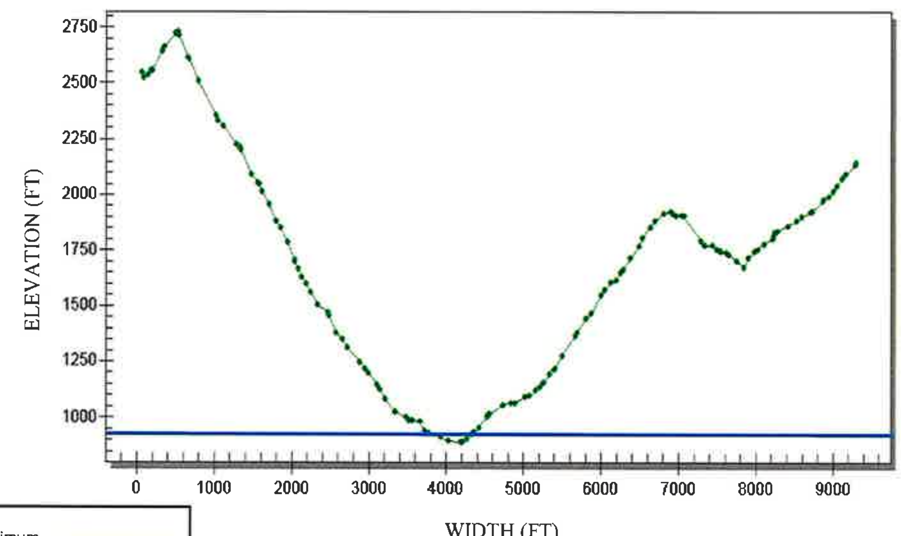


CROSS SECTION .45 mi DOWNSTREAM OF DAM
SECTION NO. 2



CROSS SECTION .77 mi DOWNSTREAM OF DAM
SECTION NO. 3

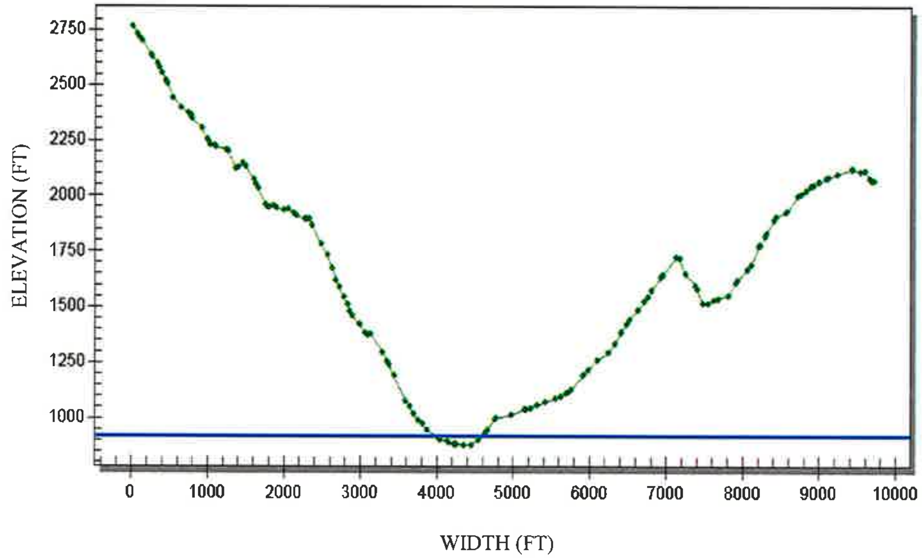
Approximate Maximum
Flood Elevation



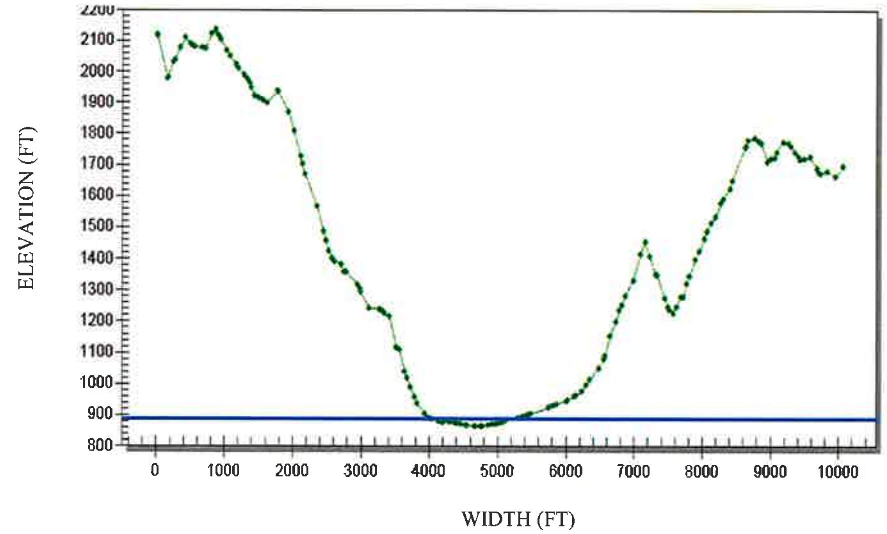
CROSS SECTION .88 mi DOWNSTREAM OF DAM
SECTION NO. 4

VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-1

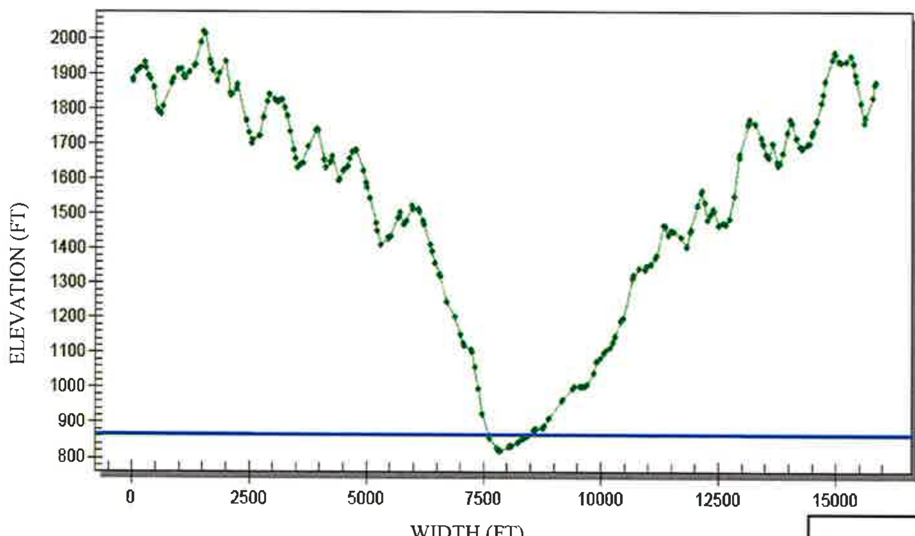
G:\PROJECTS 300-399\318F-VEN-MatilijaDamInundation\318F-VEN Report\318F-VEN Tables Figs Apxs\Apx F Cross Section Figs\Figure F-1 through F-9.ppt



CROSS SECTION 1.06 mi DOWNSTREAM OF DAM
SECTION NO. 5

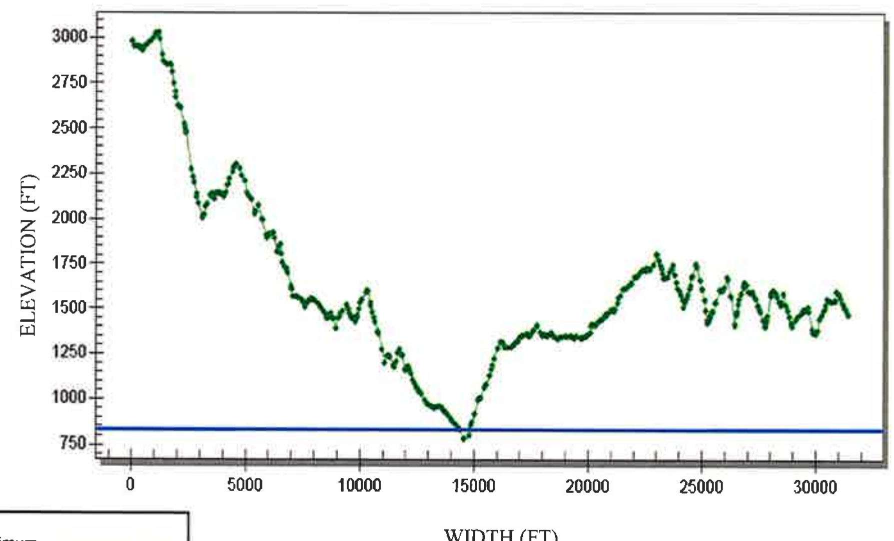


CROSS SECTION 1.36 mi DOWNSTREAM OF DAM
SECTION NO. 6



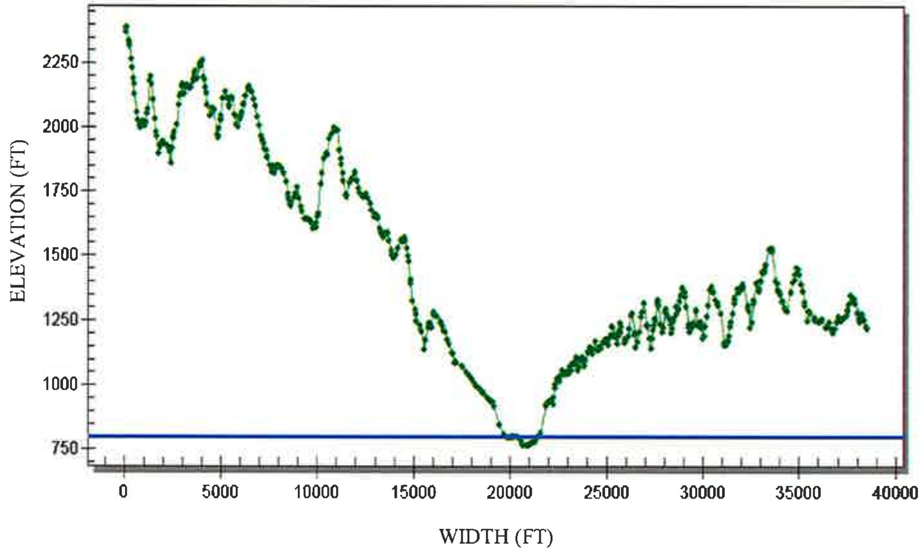
CROSS SECTION 1.73 mi DOWNSTREAM OF DAM
SECTION NO. 7

Approximate Maximum Flood Elevation

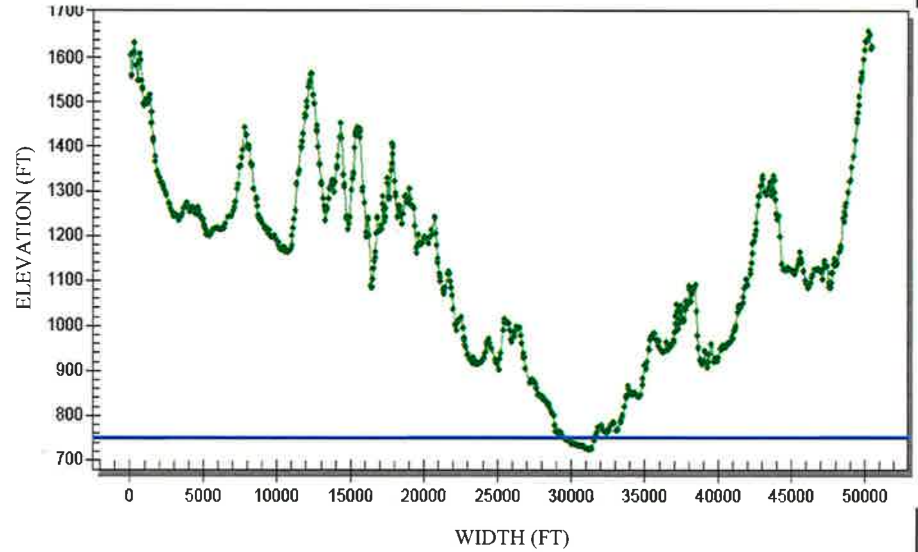


CROSS SECTION 2.03 mi DOWNSTREAM OF DAM
SECTION NO. 8

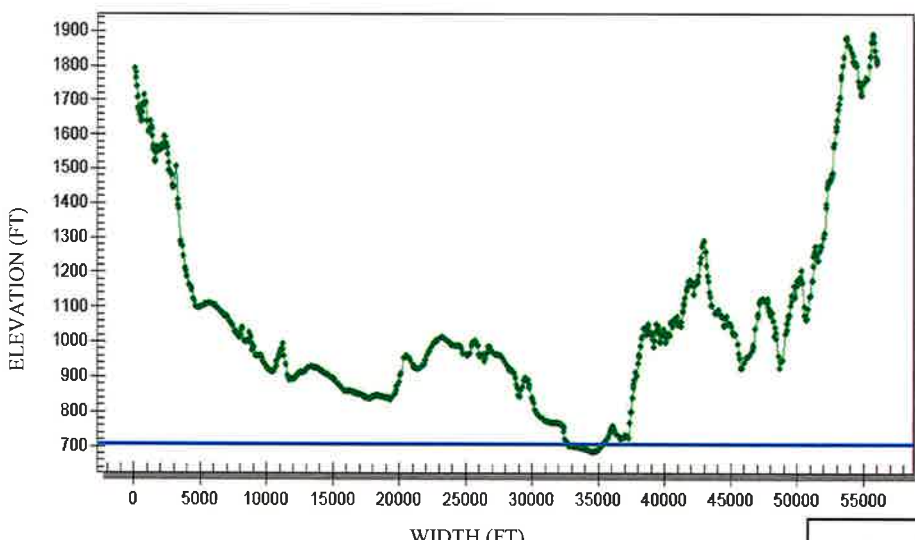
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-2



CROSS SECTION 2.35 mi DOWNSTREAM OF DAM
SECTION NO. 9

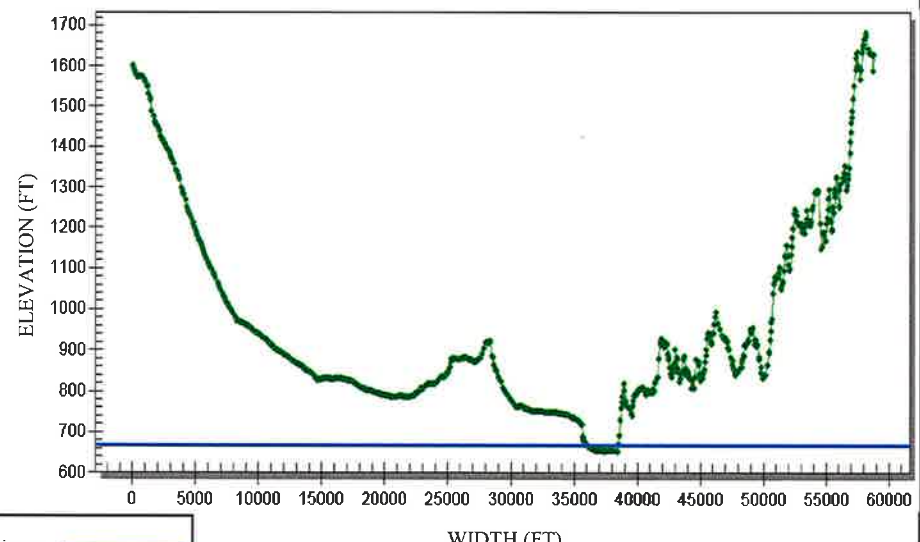


CROSS SECTION 2.87 mi DOWNSTREAM OF DAM
SECTION NO. 10



CROSS SECTION 3.39 mi DOWNSTREAM OF DAM
SECTION NO. 11

Approximate Maximum Flood Elevation



CROSS SECTION 3.87 mi DOWNSTREAM OF DAM
SECTION NO. 12

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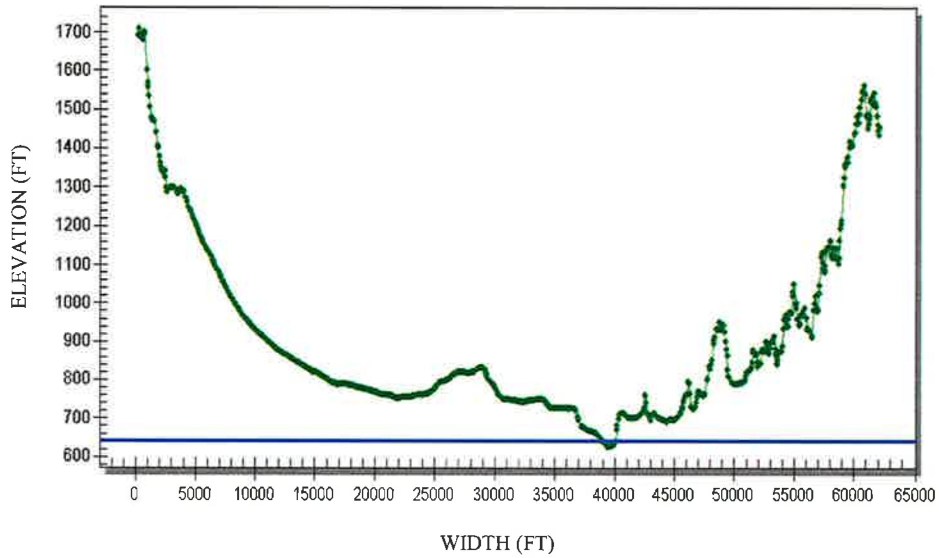
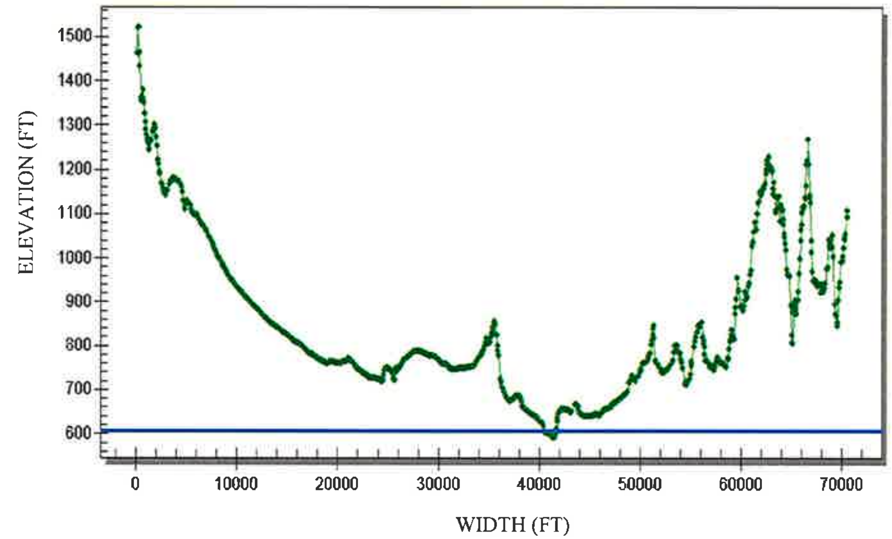
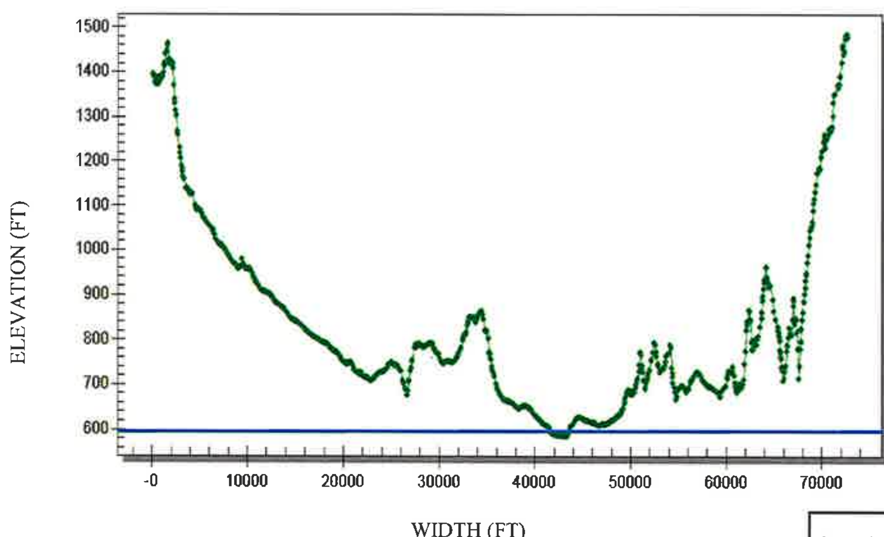
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-3



CROSS SECTION 4.36 mi DOWNSTREAM OF DAM
SECTION NO. 13

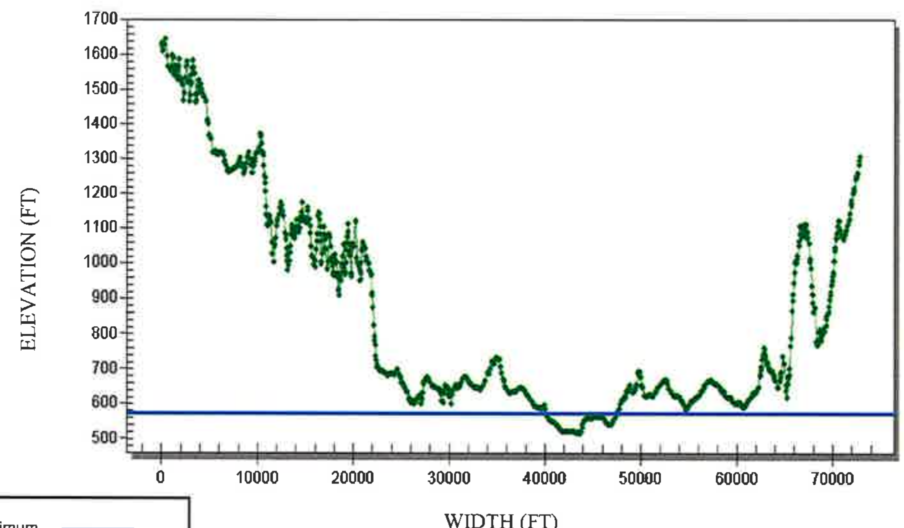


CROSS SECTION 4.75 mi DOWNSTREAM OF DAM
SECTION NO. 14



CROSS SECTION 5.11 mi DOWNSTREAM OF DAM
SECTION NO. 15

Approximate Maximum Flood Elevation



CROSS SECTION 5.45 mi DOWNSTREAM OF DAM
SECTION NO. 16

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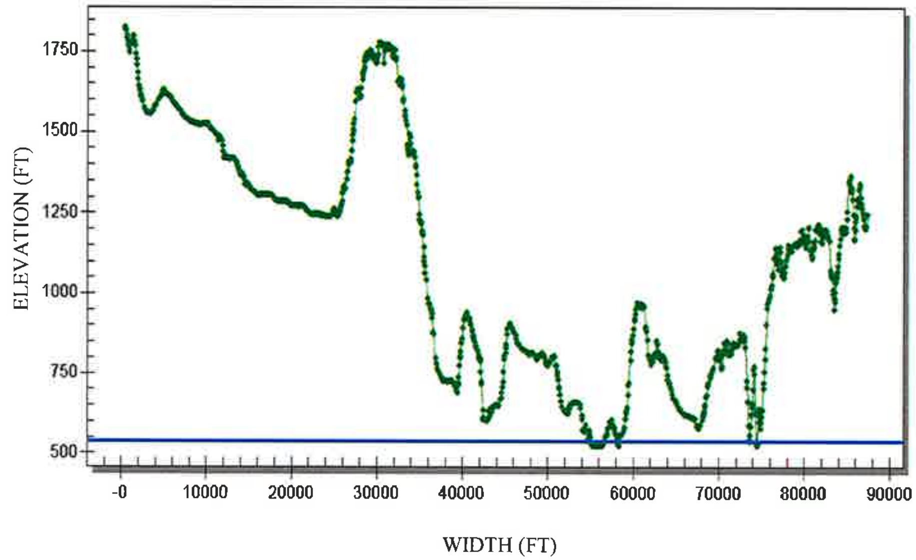
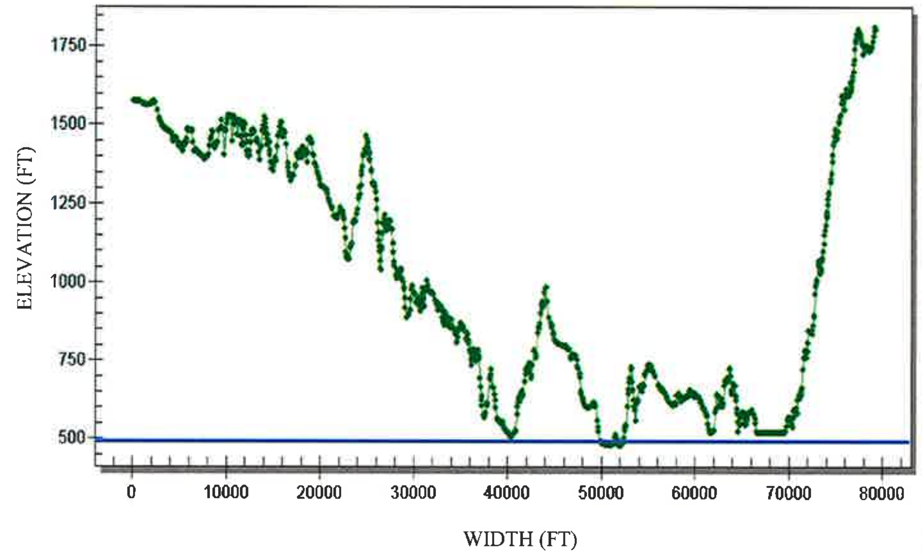
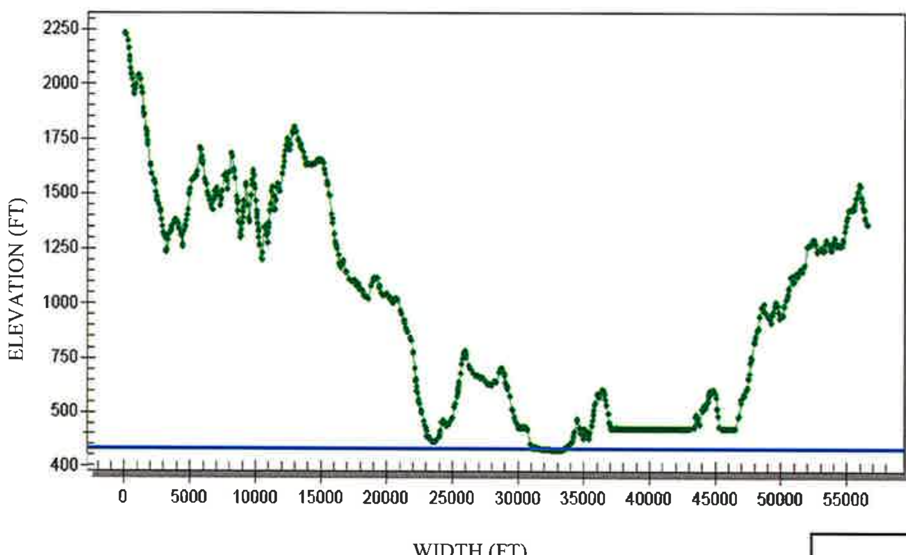
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-4



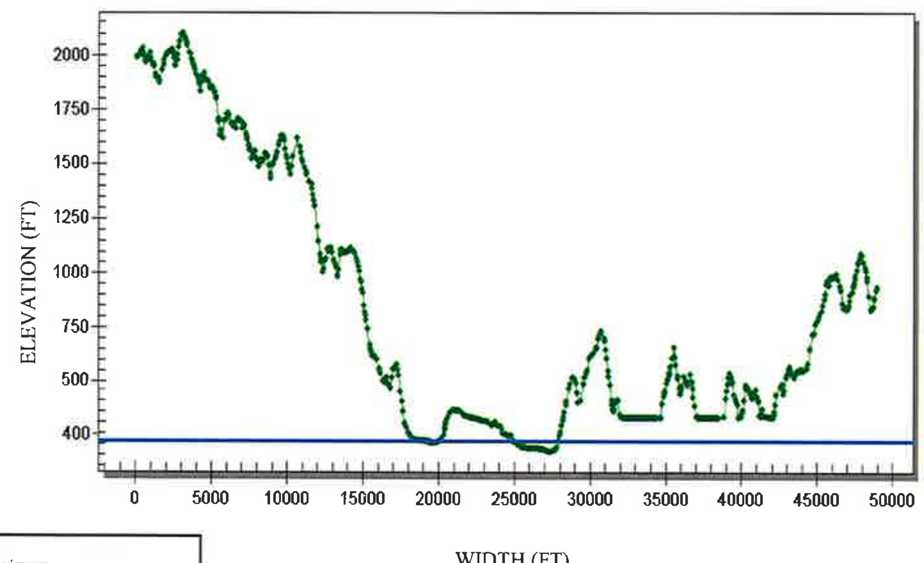
CROSS SECTION 5.96 mi DOWNSTREAM OF DAM
SECTION NO. 17



CROSS SECTION 6.56 mi DOWNSTREAM OF DAM
SECTION NO. 18



CROSS SECTION 7.42 mi DOWNSTREAM OF DAM
SECTION NO. 19



CROSS SECTION 8.15 mi DOWNSTREAM OF DAM
SECTION NO. 20

Approximate Maximum Flood Elevation

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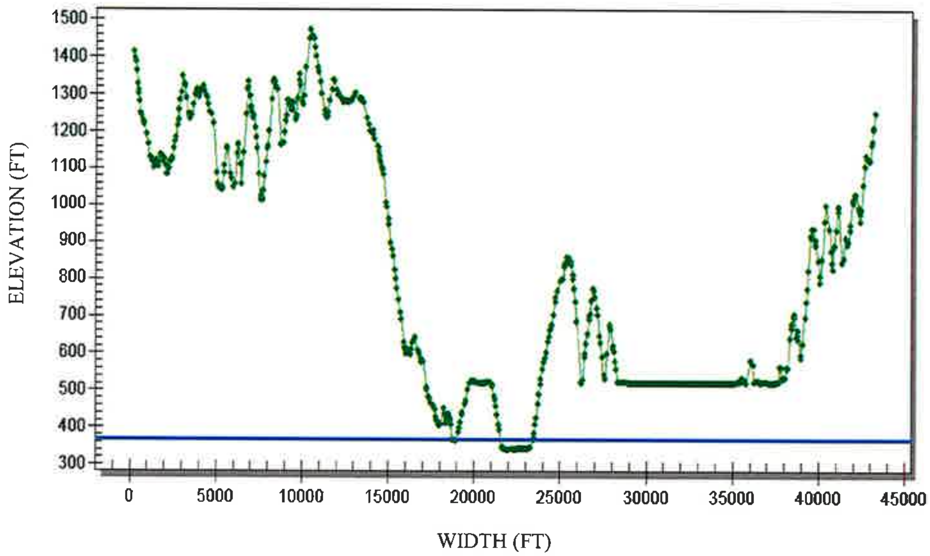
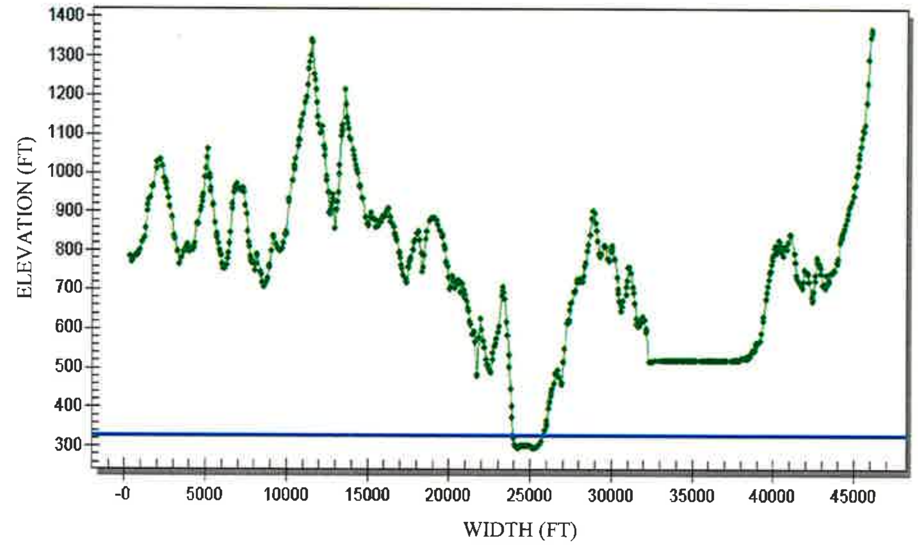
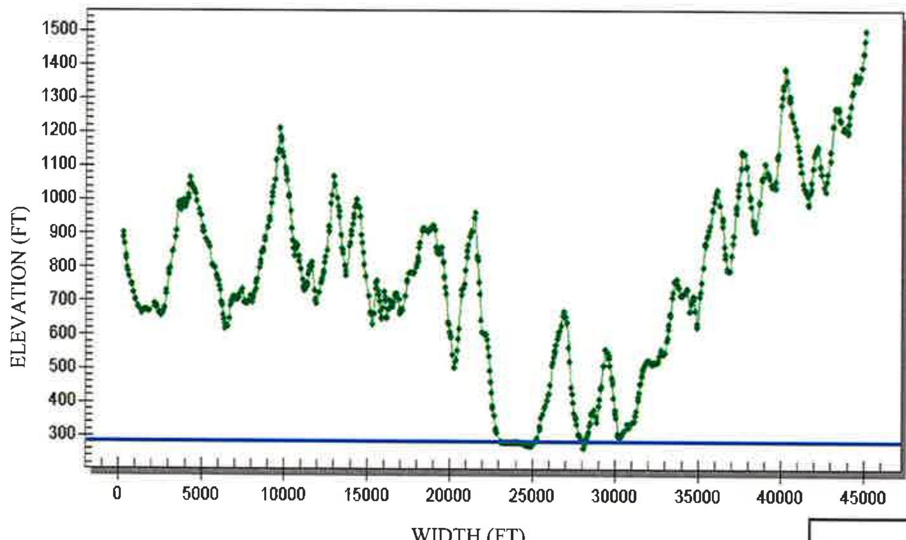
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-5



CROSS SECTION 8.77 mi DOWNSTREAM OF DAM
SECTION NO. 21

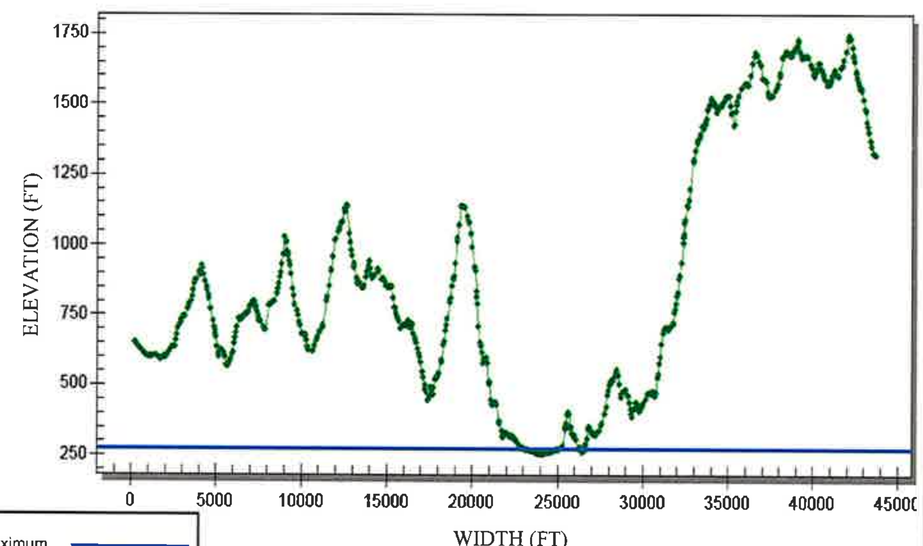


CROSS SECTION 9.68 mi DOWNSTREAM OF DAM
SECTIOPN NO. 22



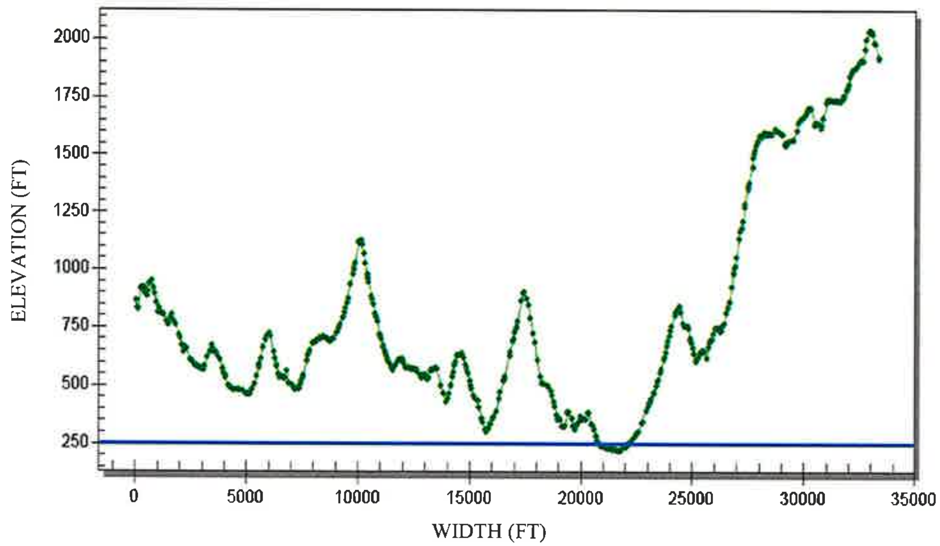
CROSS SECTION 10.21 mi DOWNSTREAM OF DAM
SECTION NO. 23

Approximate Maximum Flood Elevation

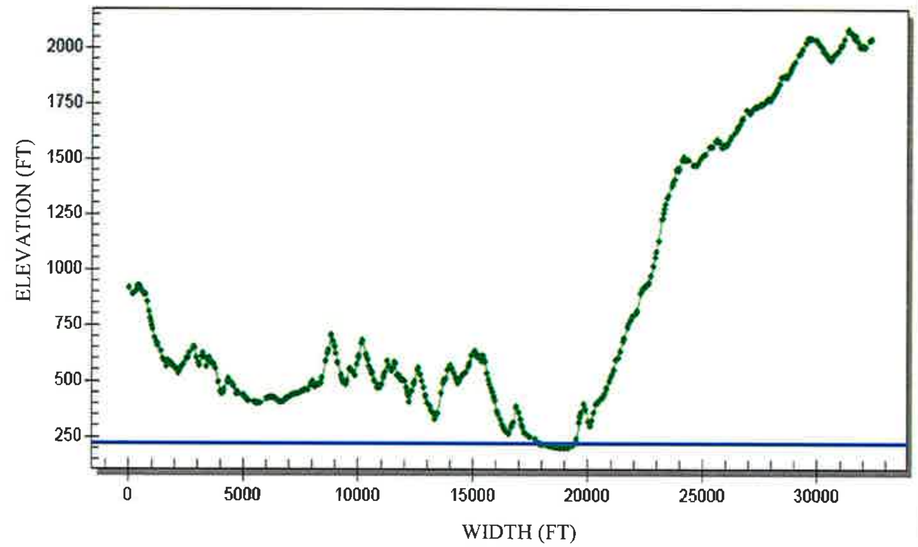


CROSS SECTION 10.64 mi DOWNSTREAM OF DAM
SECTION NO. 24

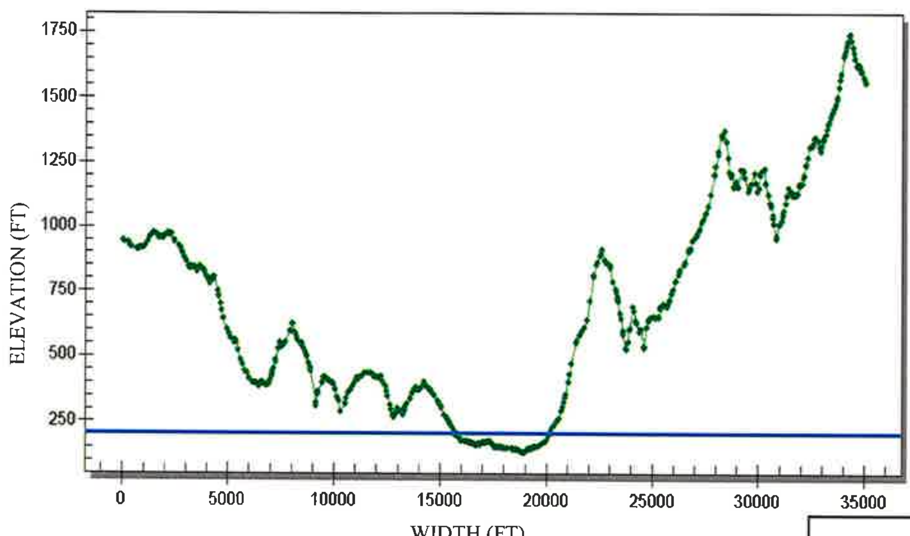
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-6



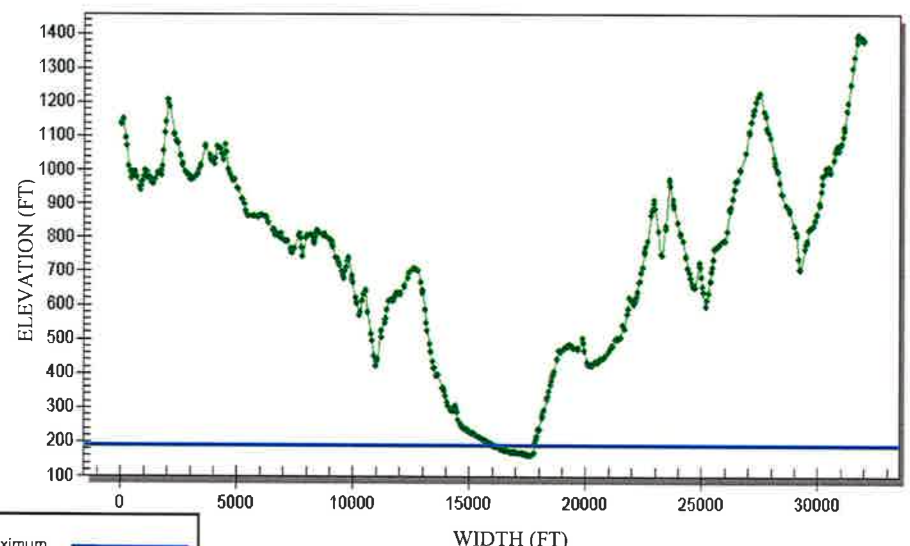
CROSS SECTION 11.52 mi DOWNSTREAM OF DAM
SECTION NO. 25



CROSS SECTION 12.14 mi DOWNSTREAM OF DAM
SECTION NO. 26



CROSS SECTION 12.67 mi DOWNSTREAM OF DAM
SECTION NO. 27



CROSS SECTION 13.52 mi DOWNSTREAM OF DAM
SECTION NO. 28

Approximate Maximum Flood Elevation

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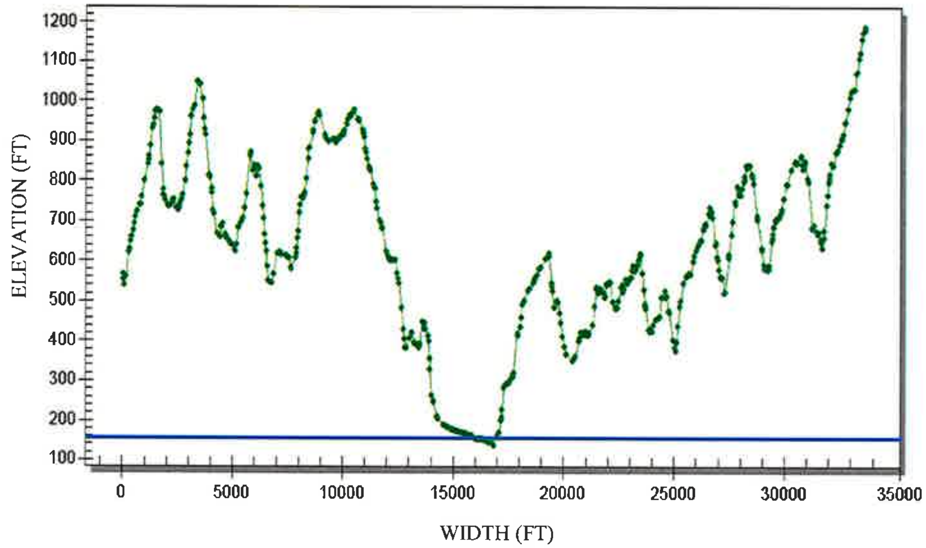
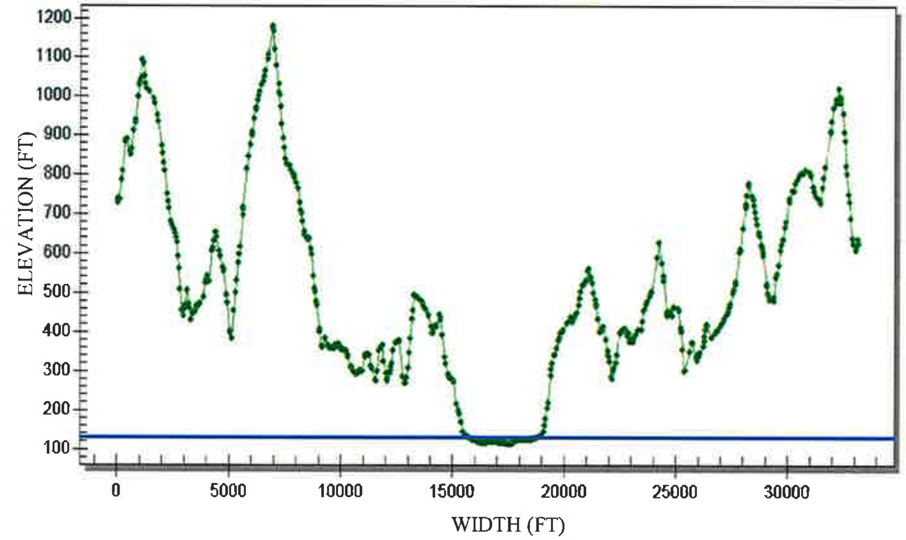
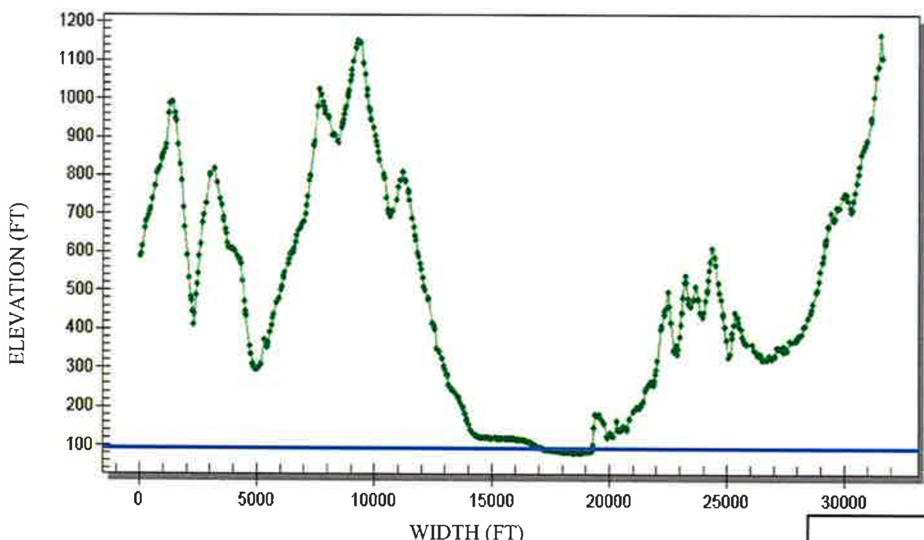
VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-7



CROSS SECTION 14.18 mi DOWNSTREAM OF DAM
SECTION NO. 29

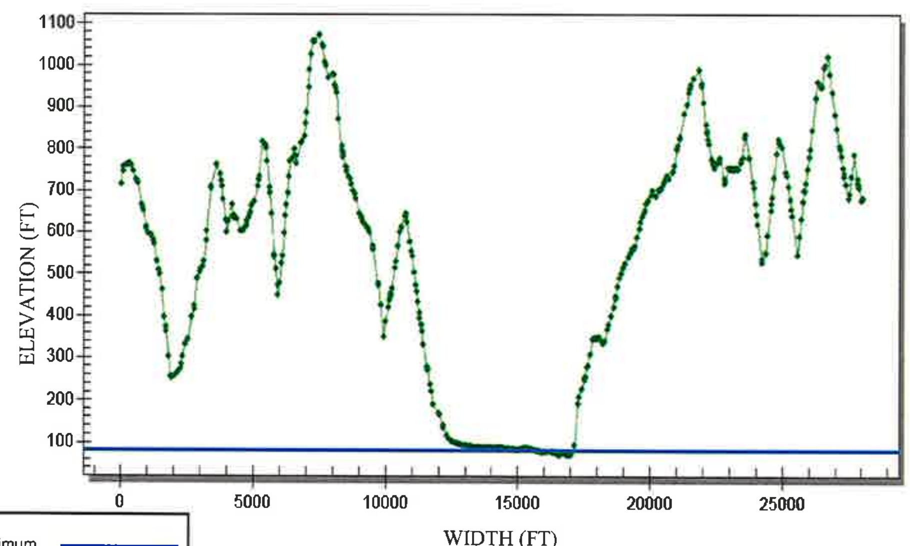


CROSS SECTION 14.80 mi DOWNSTREAM OF DAM
SECTION NO. 30



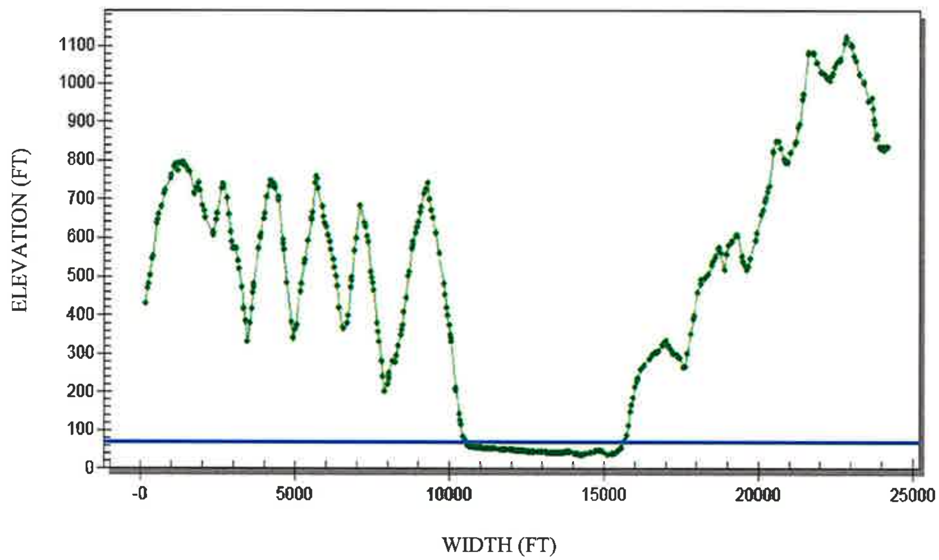
CROSS SECTION 15.49 mi DOWNSTREAM OF DAM
SECTION NO. 31

Approximate Maximum Flood Elevation



CROSS SECTION 15.91 mi DOWNSTREAM OF DAM
SECTION NO. 32

VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC.	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-8



CROSS SECTION 16.24 mi DOWNSTREAM OF DAM

SECTION NO. 33

Approximate Maximum Flood Elevation

G:\PROJECTS 300-399\318F-VEN-MatilijaDamInundation\318F-VEN Report\318F-VEN Tables Figs Apxs\Apx F Cross Section Figs\Figure F-1 through F-9.ppt

VENTURA COUNTY WATERSHED PROTECTION DISTRICT	PROJECT NO. 318F-VEN	GENTERRA CONSULTANTS, INC. ENGINEERING & GEOTECHNICAL SERVICES	CROSS SECTIONS JUNE 2009	MATILIJA DAM AND RESERVOIR	FIGURE F-9

APPENDIX G

NWS SMPDBK COMPUTER PRINTOUT FOR BREACH FAILURE OF MATILIJA DAM

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SIMPLIFIED DAMBREAK MODEL (SMPDBK) VERSION: 9/91
BY D.L. FREAD, J.M. LEWIS, & J.N. WETMORE - PHONE: (301) 427-7640
NWS HYDROLOGIC RESEARCH LAB W/OH3, 1325 EAST-WEST HIGHWAY,
SILVER SPRING, MD 20910


     C1      Matilija Dam
     C2      Ventura River
                     IBC      ISH       JNK     IDAM    IPLT     IREC
     C3                1        0         0        2       0        0
                     HDE      BME       VOL       SA      BW      TFM      QO
     C4           1111.0   1070.0     3893.   106.1    360.0      3.0  76100.
     C5        NS= 33     NCS= 8      CMS=.50      DISTTN=21.00
               X-S NO.    1
     C6- 1     D=       .00     FLD=    10.00
     C7-1      HS= 1083.72       BS=       0.     BSS=        0.      CM= .000
     C7-2      HS= 1193.46       BS=    1333.     BSS=        0.      CM= .100
     C7-3      HS= 1303.20       BS=    2162.     BSS=        0.      CM= .100
     C7-4      HS= 1412.94       BS=    2924.     BSS=        0.      CM= .100
     C7-5      HS= 1522.68       BS=    3263.     BSS=        0.      CM= .100
     C7-6      HS= 1632.42       BS=    3671.     BSS=        0.      CM= .100
     C7-7      HS= 1742.16       BS=    4029.     BSS=        0.      CM= .100
     C7-8      HS= 1851.90       BS=    4368.     BSS=        0.      CM= .100
               X-S NO.    2
     C6- 2     D=       .45     FLD=    10.00
     C7-1      HS=  922.62       BS=       0.     BSS=        0.      CM= .000
     C7-2      HS= 1109.94       BS=    1838.     BSS=        0.      CM= .100
     C7-3      HS= 1297.26       BS=    2761.     BSS=        0.      CM= .100
     C7-4      HS= 1484.57       BS=    3830.     BSS=        0.      CM= .100
     C7-5      HS= 1671.89       BS=    4437.     BSS=        0.      CM= .100
     C7-6      HS= 1859.21       BS=    4966.     BSS=        0.      CM= .100
     C7-7      HS= 2046.52       BS=    5699.     BSS=        0.      CM= .100
     C7-8      HS= 2233.84       BS=    7061.     BSS=        0.      CM= .100
               X-S NO.    3
     C6- 3     D=       .77     FLD=    10.00
     C7-1      HS=  919.74       BS=       0.     BSS=        0.      CM= .000
     C7-2      HS= 1092.59       BS=    2257.     BSS=        0.      CM= .100
     C7-3      HS= 1265.45       BS=    2847.     BSS=        0.      CM= .100
     C7-4      HS= 1438.30       BS=    3371.     BSS=        0.      CM= .100
     C7-5      HS= 1611.16       BS=    4227.     BSS=        0.      CM= .100
     C7-6      HS= 1784.02       BS=    4857.     BSS=        0.      CM= .100
     C7-7      HS= 1956.87       BS=    5693.     BSS=        0.      CM= .100
     C7-8      HS= 2129.73       BS=    7713.     BSS=        0.      CM= .100
               X-S NO.    4
     C6- 4     D=       .88     FLD=    10.00
     C7-1      HS=  883.01       BS=       0.     BSS=        0.      CM= .000
     C7-2      HS= 1061.76       BS=    1672.     BSS=        0.      CM= .100
     C7-3      HS= 1240.50       BS=    2581.     BSS=        0.      CM= .100
     C7-4      HS= 1419.25       BS=    3264.     BSS=        0.      CM= .100
     C7-5      HS= 1597.99       BS=    3976.     BSS=        0.      CM= .100
     C7-6      HS= 1776.74       BS=    5401.     BSS=        0.      CM= .100
     C7-7      HS= 1955.48       BS=    7147.     BSS=        0.      CM= .100
     C7-8      HS= 2134.23       BS=    7882.     BSS=        0.      CM= .100
               X-S NO.    5
     C6- 5     D=      1.06     FLD=    10.00
     C7-1      HS=  874.82       BS=       0.     BSS=        0.      CM= .000
     C7-2      HS= 1045.12       BS=    1570.     BSS=        0.      CM= .100
     C7-3      HS= 1215.42       BS=    2580.     BSS=        0.      CM= .100
     C7-4      HS= 1385.73       BS=    3361.     BSS=        0.      CM= .100
     C7-5      HS= 1556.03       BS=    4411.     BSS=        0.      CM= .100
     C7-6      HS= 1726.33       BS=    5586.     BSS=        0.      CM= .100
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C7-7      HS= 1896.63    BS=   6165.    BSS=      0.     CM= .100
C7-8      HS= 2066.93    BS=   7423.    BSS=      0.     CM= .100
          X-S NO.   6
C6- 6     D=    1.36     FLD=   10.00
C7-1      HS=  856.01    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  974.91    BS=   2513.    BSS=      0.     CM= .100
C7-3      HS= 1093.82    BS=   3004.    BSS=      0.     CM= .100
C7-4      HS= 1212.72    BS=   3382.    BSS=      0.     CM= .100
C7-5      HS= 1331.63    BS=   4576.    BSS=      0.     CM= .100
C7-6      HS= 1450.53    BS=   5529.    BSS=      0.     CM= .100
C7-7      HS= 1569.44    BS=   5935.    BSS=      0.     CM= .100
C7-8      HS= 1688.35    BS=   6774.    BSS=      0.     CM= .100
          X-S NO.   7
C6- 7     D=    1.73     FLD=   10.00
C7-1      HS=  820.46    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  971.15    BS=   1817.    BSS=      0.     CM= .100
C7-3      HS= 1121.85    BS=   3145.    BSS=      0.     CM= .100
C7-4      HS= 1272.54    BS=   3944.    BSS=      0.     CM= .100
C7-5      HS= 1423.23    BS=   5151.    BSS=      0.     CM= .100
C7-6      HS= 1573.92    BS=   7839.    BSS=      0.     CM= .100
C7-7      HS= 1724.61    BS=  10703.    BSS=      0.     CM= .100
C7-8      HS= 1875.30    BS=  13535.    BSS=      0.     CM= .100
          X-S NO.   8
C6- 8     D=    2.03     FLD=   10.00
C7-1      HS=  782.80    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  880.96    BS=    900.    BSS=      0.     CM= .100
C7-3      HS=  979.13    BS=   2228.    BSS=      0.     CM= .100
C7-4      HS= 1077.30    BS=   3103.    BSS=      0.     CM= .100
C7-5      HS= 1175.47    BS=   3793.    BSS=      0.     CM= .100
C7-6      HS= 1273.64    BS=   5013.    BSS=      0.     CM= .100
C7-7      HS= 1371.81    BS=   9118.    BSS=      0.     CM= .100
C7-8      HS= 1469.97    BS=  12912.    BSS=      0.     CM= .100
          X-S NO.   9
C6- 9     D=    2.35     FLD=   10.00
C7-1      HS=  763.64    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  828.79    BS=   2085.    BSS=      0.     CM= .100
C7-3      HS=  893.93    BS=   2559.    BSS=      0.     CM= .100
C7-4      HS=  959.07    BS=   3552.    BSS=      0.     CM= .100
C7-5      HS= 1024.22    BS=   4568.    BSS=      0.     CM= .100
C7-6      HS= 1089.36    BS=   6411.    BSS=      0.     CM= .100
C7-7      HS= 1154.51    BS=   7986.    BSS=      0.     CM= .100
C7-8      HS= 1219.65    BS=  11559.    BSS=      0.     CM= .100
          X-S NO.  10
C6-10     D=    2.87     FLD=   10.00
C7-1      HS=  724.42    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  850.40    BS=   6740.    BSS=      0.     CM= .100
C7-3      HS=  976.39    BS=  15429.    BSS=      0.     CM= .100
C7-4      HS= 1102.37    BS=  21473.    BSS=      0.     CM= .100
C7-5      HS= 1228.36    BS=  32208.    BSS=      0.     CM= .100
C7-6      HS= 1354.34    BS=  43978.    BSS=      0.     CM= .100
C7-7      HS= 1480.33    BS=  47467.    BSS=      0.     CM= .100
C7-8      HS= 1606.31    BS=  49739.    BSS=      0.     CM= .100
          X-S NO.  11
C6-11     D=    3.39     FLD=   10.00
C7-1      HS=  682.84    BS=      0.    BSS=      0.     CM= .000
C7-2      HS=  841.32    BS=   8374.    BSS=      0.     CM= .100
C7-3      HS=  999.81    BS=  30025.    BSS=      0.     CM= .100
C7-4      HS= 1158.30    BS=  44880.    BSS=      0.     CM= .100
C7-5      HS= 1316.78    BS=  48619.    BSS=      0.     CM= .100
C7-6      HS= 1475.27    BS=  49691.    BSS=      0.     CM= .100
C7-7      HS= 1633.75    BS=  51979.    BSS=      0.     CM= .100
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C7-8      HS= 1792.24   BS=  54294.   BSS=      0.     CM= .100
          X-S NO.  12
C6-12     D=     3.87   FLD=   10.00
C7-1      HS=  650.22   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  785.81   BS=  10664.   BSS=      0.     CM= .100
C7-3      HS=  921.40   BS=  37666.   BSS=      0.     CM= .100
C7-4      HS= 1056.99   BS=  44074.   BSS=      0.     CM= .100
C7-5      HS= 1192.58   BS=  47889.   BSS=      0.     CM= .100
C7-6      HS= 1328.16   BS=  53017.   BSS=      0.     CM= .100
C7-7      HS= 1463.75   BS=  55250.   BSS=      0.     CM= .100
C7-8      HS= 1599.34   BS=  57635.   BSS=      0.     CM= .100
          X-S NO.  13
C6-13     D=     4.36   FLD=   10.00
C7-1      HS=  624.88   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  743.31   BS=  12152.   BSS=      0.     CM= .100
C7-3      HS=  861.74   BS=  38107.   BSS=      0.     CM= .100
C7-4      HS=  980.16   BS=  47425.   BSS=      0.     CM= .100
C7-5      HS= 1098.59   BS=  50771.   BSS=      0.     CM= .100
C7-6      HS= 1217.02   BS=  54089.   BSS=      0.     CM= .100
C7-7      HS= 1335.44   BS=  56750.   BSS=      0.     CM= .100
C7-8      HS= 1453.87   BS=  58674.   BSS=      0.     CM= .100
          X-S NO.  14
C6-14     D=     4.75   FLD=   10.00
C7-1      HS=  590.99   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  664.91   BS=   8691.   BSS=      0.     CM= .100
C7-3      HS=  738.82   BS=  17057.   BSS=      0.     CM= .100
C7-4      HS=  812.74   BS=  41714.   BSS=      0.     CM= .100
C7-5      HS=  886.66   BS=  48377.   BSS=      0.     CM= .100
C7-6      HS=  960.58   BS=  54811.   BSS=      0.     CM= .100
C7-7      HS= 1034.49   BS=  58303.   BSS=      0.     CM= .100
C7-8      HS= 1108.41   BS=  61872.   BSS=      0.     CM= .100
          X-S NO.  15
C6-15     D=     5.11   FLD=   10.00
C7-1      HS=  579.07   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  694.96   BS=  19693.   BSS=      0.     CM= .100
C7-3      HS=  810.85   BS=  46177.   BSS=      0.     CM= .100
C7-4      HS=  926.74   BS=  57248.   BSS=      0.     CM= .100
C7-5      HS= 1042.63   BS=  62674.   BSS=      0.     CM= .100
C7-6      HS= 1158.51   BS=  66243.   BSS=      0.     CM= .100
C7-7      HS= 1274.40   BS=  68487.   BSS=      0.     CM= .100
C7-8      HS= 1390.29   BS=  70794.   BSS=      0.     CM= .100
          X-S NO.  16
C6-16     D=     5.45   FLD=   10.00
C7-1      HS=  554.67   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  667.89   BS=  19399.   BSS=      0.     CM= .100
C7-3      HS=  781.12   BS=  43018.   BSS=      0.     CM= .100
C7-4      HS=  894.35   BS=  44980.   BSS=      0.     CM= .100
C7-5      HS= 1007.58   BS=  46991.   BSS=      0.     CM= .100
C7-6      HS= 1120.80   BS=  54798.   BSS=      0.     CM= .100
C7-7      HS= 1234.03   BS=  61241.   BSS=      0.     CM= .100
C7-8      HS= 1347.26   BS=  65331.   BSS=      0.     CM= .100
          X-S NO.  17
C6-17     D=     5.96   FLD=   10.00
C7-1      HS=  521.80   BS=      0.   BSS=      0.     CM= .000
C7-2      HS=  625.14   BS=   9799.   BSS=      0.     CM= .100
C7-3      HS=  728.49   BS=  19395.   BSS=      0.     CM= .100
C7-4      HS=  831.83   BS=  31298.   BSS=      0.     CM= .100
C7-5      HS=  935.17   BS=  38075.   BSS=      0.     CM= .100
C7-6      HS= 1038.51   BS=  40931.   BSS=      0.     CM= .100
C7-7      HS= 1141.86   BS=  44610.   BSS=      0.     CM= .100
C7-8      HS= 1245.20   BS=  52888.   BSS=      0.     CM= .100
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	X-S NO.	18						
C6-18	D=	6.56	FLD=	10.00				
C7-1	HS=	476.41	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	633.47	BS=	19879.	BSS=	0.	CM=	.100
C7-3	HS=	790.53	BS=	32834.	BSS=	0.	CM=	.100
C7-4	HS=	947.59	BS=	41694.	BSS=	0.	CM=	.100
C7-5	HS=	1104.65	BS=	46525.	BSS=	0.	CM=	.100
C7-6	HS=	1261.71	BS=	51326.	BSS=	0.	CM=	.100
C7-7	HS=	1418.77	BS=	59932.	BSS=	0.	CM=	.100
C7-8	HS=	1575.83	BS=	75286.	BSS=	0.	CM=	.100
	X-S NO.	19						
C6-19	D=	7.42	FLD=	10.00				
C7-1	HS=	420.38	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	568.51	BS=	16459.	BSS=	0.	CM=	.100
C7-3	HS=	716.64	BS=	21497.	BSS=	0.	CM=	.100
C7-4	HS=	864.77	BS=	25592.	BSS=	0.	CM=	.100
C7-5	HS=	1012.89	BS=	27011.	BSS=	0.	CM=	.100
C7-6	HS=	1161.02	BS=	31872.	BSS=	0.	CM=	.100
C7-7	HS=	1309.15	BS=	35647.	BSS=	0.	CM=	.100
C7-8	HS=	1457.28	BS=	41515.	BSS=	0.	CM=	.100
	X-S NO.	20						
C6-20	D=	8.15	FLD=	10.00				
C7-1	HS=	364.20	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	472.40	BS=	6478.	BSS=	0.	CM=	.100
C7-3	HS=	580.60	BS=	17322.	BSS=	0.	CM=	.100
C7-4	HS=	688.80	BS=	22359.	BSS=	0.	CM=	.100
C7-5	HS=	797.00	BS=	27206.	BSS=	0.	CM=	.100
C7-6	HS=	905.20	BS=	29137.	BSS=	0.	CM=	.100
C7-7	HS=	1013.39	BS=	30176.	BSS=	0.	CM=	.100
C7-8	HS=	1121.59	BS=	32094.	BSS=	0.	CM=	.100
	X-S NO.	21						
C6-21	D=	8.77	FLD=	10.00				
C7-1	HS=	339.22	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	469.40	BS=	4537.	BSS=	0.	CM=	.100
C7-3	HS=	599.59	BS=	18296.	BSS=	0.	CM=	.100
C7-4	HS=	729.78	BS=	22137.	BSS=	0.	CM=	.100
C7-5	HS=	859.97	BS=	24678.	BSS=	0.	CM=	.100
C7-6	HS=	990.16	BS=	27063.	BSS=	0.	CM=	.100
C7-7	HS=	1120.34	BS=	30647.	BSS=	0.	CM=	.100
C7-8	HS=	1250.53	BS=	36018.	BSS=	0.	CM=	.100
	X-S NO.	22						
C6-22	D=	9.68	FLD=	10.00				
C7-1	HS=	295.39	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	365.36	BS=	2125.	BSS=	0.	CM=	.100
C7-3	HS=	435.33	BS=	2479.	BSS=	0.	CM=	.100
C7-4	HS=	505.30	BS=	3531.	BSS=	0.	CM=	.100
C7-5	HS=	575.27	BS=	11632.	BSS=	0.	CM=	.100
C7-6	HS=	645.24	BS=	13843.	BSS=	0.	CM=	.100
C7-7	HS=	715.21	BS=	17231.	BSS=	0.	CM=	.100
C7-8	HS=	785.18	BS=	24495.	BSS=	0.	CM=	.100
	X-S NO.	23						
C6-23	D=	10.21	FLD=	10.00				
C7-1	HS=	264.26	BS=	0.	BSS=	0.	CM=	.000
C7-2	HS=	355.27	BS=	5008.	BSS=	0.	CM=	.100
C7-3	HS=	446.28	BS=	6975.	BSS=	0.	CM=	.100
C7-4	HS=	537.29	BS=	9322.	BSS=	0.	CM=	.100
C7-5	HS=	628.31	BS=	11740.	BSS=	0.	CM=	.100
C7-6	HS=	719.32	BS=	19315.	BSS=	0.	CM=	.100
C7-7	HS=	810.33	BS=	25678.	BSS=	0.	CM=	.100
C7-8	HS=	901.34	BS=	30187.	BSS=	0.	CM=	.100
	X-S NO.	24						

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C6-24      D=   10.64      FLD=   10.00
C7-1       HS=  255.48      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  312.05      BS=   3574.    BSS=       0.      CM=  .100
C7-3       HS=  368.61      BS=   5770.    BSS=       0.      CM=  .100
C7-4       HS=  425.17      BS=   6910.    BSS=       0.      CM=  .100
C7-5       HS=  481.74      BS=   9289.    BSS=       0.      CM=  .100
C7-6       HS=  538.30      BS=  10718.    BSS=       0.      CM=  .100
C7-7       HS=  594.86      BS=  12112.    BSS=       0.      CM=  .100
C7-8       HS=  651.43      BS=  16127.    BSS=       0.      CM=  .100
           X-S NO.   25
C6-25      D=   11.52      FLD=   10.00
C7-1       HS=  219.64      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  311.48      BS=   2147.    BSS=       0.      CM=  .100
C7-3       HS=  403.32      BS=   4943.    BSS=       0.      CM=  .100
C7-4       HS=  495.16      BS=   8051.    BSS=       0.      CM=  .100
C7-5       HS=  587.00      BS=  13431.    BSS=       0.      CM=  .100
C7-6       HS=  678.84      BS=  18146.    BSS=       0.      CM=  .100
C7-7       HS=  770.68      BS=  22060.    BSS=       0.      CM=  .100
C7-8       HS=  862.52      BS=  24474.    BSS=       0.      CM=  .100
           X-S NO.   26
C6-26      D=   12.14      FLD=   10.00
C7-1       HS=  199.08      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  301.70      BS=   2945.    BSS=       0.      CM=  .100
C7-3       HS=  404.33      BS=   5331.    BSS=       0.      CM=  .100
C7-4       HS=  506.95      BS=  12175.    BSS=       0.      CM=  .100
C7-5       HS=  609.57      BS=  18368.    BSS=       0.      CM=  .100
C7-6       HS=  712.19      BS=  20562.    BSS=       0.      CM=  .100
C7-7       HS=  814.82      BS=  21280.    BSS=       0.      CM=  .100
C7-8       HS=  917.44      BS=  22326.    BSS=       0.      CM=  .100
           X-S NO.   27
C6-27      D=   12.67      FLD=   10.00
C7-1       HS=  181.04      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  297.20      BS=   5075.    BSS=       0.      CM=  .100
C7-3       HS=  413.35      BS=   8406.    BSS=       0.      CM=  .100
C7-4       HS=  529.51      BS=  14055.    BSS=       0.      CM=  .100
C7-5       HS=  645.67      BS=  17094.    BSS=       0.      CM=  .100
C7-6       HS=  761.83      BS=  19859.    BSS=       0.      CM=  .100
C7-7       HS=  877.98      BS=  21683.    BSS=       0.      CM=  .100
C7-8       HS=  994.14      BS=  25642.    BSS=       0.      CM=  .100
           X-S NO.   28
C6-28      D=   13.52      FLD=   10.00
C7-1       HS=  158.92      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  298.26      BS=   3992.    BSS=       0.      CM=  .100
C7-3       HS=  437.60      BS=   6035.    BSS=       0.      CM=  .100
C7-4       HS=  576.94      BS=   9604.    BSS=       0.      CM=  .100
C7-5       HS=  716.28      BS=  14120.    BSS=       0.      CM=  .100
C7-6       HS=  855.62      BS=  20245.    BSS=       0.      CM=  .100
C7-7       HS=  994.96      BS=  26100.    BSS=       0.      CM=  .100
C7-8       HS= 1134.30      BS=  30074.    BSS=       0.      CM=  .100
           X-S NO.   29
C6-29      D=   14.18      FLD=   10.00
C7-1       HS=  135.94      BS=      0.    BSS=       0.      CM=  .000
C7-2       HS=  197.42      BS=   2739.    BSS=       0.      CM=  .100
C7-3       HS=  258.89      BS=   3217.    BSS=       0.      CM=  .100
C7-4       HS=  320.37      BS=   3768.    BSS=       0.      CM=  .100
C7-5       HS=  381.84      BS=   4568.    BSS=       0.      CM=  .100
C7-6       HS=  443.31      BS=   7260.    BSS=       0.      CM=  .100
C7-7       HS=  504.79      BS=   9232.    BSS=       0.      CM=  .100
C7-8       HS=  566.26      BS=  12803.    BSS=       0.      CM=  .100
           X-S NO.   30
C6-30      D=   14.80      FLD=   10.00
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C7-1        HS=  112.72     BS=       0.    BSS=        0.      CM= .000
C7-2        HS=  186.00     BS=    3849.    BSS=        0.      CM= .100
C7-3        HS=  259.27     BS=    4231.    BSS=        0.      CM= .100
C7-4        HS=  332.55     BS=    7248.    BSS=        0.      CM= .100
C7-5        HS=  405.83     BS=   12881.    BSS=        0.      CM= .100
C7-6        HS=  479.11     BS=   17759.    BSS=        0.      CM= .100
C7-7        HS=  552.39     BS=   21054.    BSS=        0.      CM= .100
C7-8        HS=  625.67     BS=   23046.    BSS=        0.      CM= .100
            X-S NO.  31
C6-31       D=    15.49    FLD=    10.00
C7-1        HS=   81.00     BS=       0.    BSS=        0.      CM= .000
C7-2        HS=  153.57     BS=    6314.    BSS=        0.      CM= .100
C7-3        HS=  226.14     BS=    7923.    BSS=        0.      CM= .100
C7-4        HS=  298.72     BS=    9151.    BSS=        0.      CM= .100
C7-5        HS=  371.29     BS=   13065.    BSS=        0.      CM= .100
C7-6        HS=  443.86     BS=   15667.    BSS=        0.      CM= .100
C7-7        HS=  516.43     BS=   18240.    BSS=        0.      CM= .100
C7-8        HS=  589.01     BS=   19835.    BSS=        0.      CM= .100
            X-S NO.  32
C6-32       D=    15.91    FLD=    10.00
C7-1        HS=   62.55     BS=       0.    BSS=        0.      CM= .000
C7-2        HS=  150.06     BS=    5110.    BSS=        0.      CM= .100
C7-3        HS=  237.56     BS=    5817.    BSS=        0.      CM= .100
C7-4        HS=  325.07     BS=    7008.    BSS=        0.      CM= .100
C7-5        HS=  412.58     BS=    8772.    BSS=        0.      CM= .100
C7-6        HS=  500.09     BS=   10265.    BSS=        0.      CM= .100
C7-7        HS=  587.59     BS=   12837.    BSS=        0.      CM= .100
C7-8        HS=  675.10     BS=   16846.    BSS=        0.      CM= .100
            X-S NO.  33
C6-33       D=    16.24    FLD=    10.00
C7-1        HS=   52.06     BS=       0.    BSS=        0.      CM= .000
C7-2        HS=  108.42     BS=    5338.    BSS=        0.      CM= .100
C7-3        HS=  164.78     BS=    5526.    BSS=        0.      CM= .100
C7-4        HS=  221.14     BS=    5787.    BSS=        0.      CM= .100
C7-5        HS=  277.49     BS=    6336.    BSS=        0.      CM= .100
C7-6        HS=  333.85     BS=    7994.    BSS=        0.      CM= .100
C7-7        HS=  390.21     BS=    9072.    BSS=        0.      CM= .100
C7-8        HS=  446.56     BS=   10024.    BSS=        0.      CM= .100


***** DISTANCE TO PRIMARY POINT OF INTEREST MOVED TO THE CROSS SECTION
***** CLOSEST TO THIS LOCATION (MI  16.24)


THE DATA FOR THIS DAM IS AS FOLLOWS:

TYPE OF DAM    (IDAM)            CONCRETE ARCH
DAM BREACH ELEVATION  (HDE)                   1111.00 FT
FINAL BREACH ELEVATION  (BME)                 1070.00 FT
VOLUME OF RESERVOIR  (VOL)                       3893. ACRE-FT
SURFACE AREA OF RESERVOIR  (SA)                106.10 ACRES
FINAL BREACH WIDTH  (BW)                       360.00 FT
TIME OF DAM FAILURE  (TFM)                       3.00 MINUTES
NON-BREACH FLOW  (QO)                        76100.00 CFS
DISTANCE TO PRIMARY PT OF INTEREST (DISTTN)     16.24 MILES
DEAD STORAGE EQUIV. MANN. N (CMS)                 .50


CROSS SECTION NO.  1
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FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)          1083.7  1193.5  1303.2  1412.9  1522.7  1632.4  1742.2  1851.9
TWIDTHS(FT) (BS)            .0  1333.4  2161.7  2924.1  3262.8  3670.9  4029.3  4368.4
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  2
REACH LENGTH  (D)          .45 MI
FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)           922.6  1109.9  1297.3  1484.6  1671.9  1859.2  2046.5  2233.8
TWIDTHS(FT) (BS)            .0  1838.3  2761.0  3829.5  4436.9  4966.3  5699.5  7060.8
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  3
REACH LENGTH  (D)          .77 MI
FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)           919.7  1092.6  1265.4  1438.3  1611.2  1784.0  1956.9  2129.7
TWIDTHS(FT) (BS)            .0  2257.2  2847.4  3370.6  4226.6  4856.9  5693.2  7713.3
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  4
REACH LENGTH  (D)          .88 MI
FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)           883.0  1061.8  1240.5  1419.3  1598.0  1776.7  1955.5  2134.2
TWIDTHS(FT) (BS)            .0  1671.8  2580.9  3263.9  3976.0  5400.7  7147.5  7881.5
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  5
REACH LENGTH  (D)         1.06 MI
FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)           874.8  1045.1  1215.4  1385.7  1556.0  1726.3  1896.6  2066.9
TWIDTHS(FT) (BS)            .0  1569.8  2579.7  3360.7  4410.5  5585.9  6164.6  7422.5
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  6
REACH LENGTH  (D)         1.36 MI
FLOOD DEPTH  (FLD)        10.00 FT

ELEV.(FT) (HS)           856.0   974.9  1093.8  1212.7  1331.6  1450.5  1569.4  1688.3
TWIDTHS(FT) (BS)            .0  2512.5  3004.3  3382.2  4576.4  5528.9  5934.6  6774.4
INACTIVE TW(FT) (BSS)       .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  7
REACH LENGTH  (D)         1.73 MI
FLOOD DEPTH  (FLD)        10.00 FT
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ELEV.(FT) (HS)          820.5   971.2  1121.8  1272.5  1423.2  1573.9  1724.6  1875.3
TWIDTHS(FT) (BS)           .0  1816.6  3144.7  3943.9  5151.0  7839.0 10703.4 13534.5
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  8
REACH LENGTH   (D)       2.03 MI
FLOOD DEPTH   (FLD)     10.00 FT

ELEV.(FT) (HS)          782.8   881.0   979.1  1077.3  1175.5  1273.6  1371.8  1470.0
TWIDTHS(FT) (BS)           .0   900.2  2228.4  3102.8  3792.8  5012.7  9118.2 12912.3
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO.  9
REACH LENGTH   (D)       2.35 MI
FLOOD DEPTH   (FLD)     10.00 FT

ELEV.(FT) (HS)          763.6   828.8   893.9   959.1  1024.2  1089.4  1154.5  1219.7
TWIDTHS(FT) (BS)           .0  2085.3  2558.6  3552.4  4567.6  6411.0  7985.5 11559.3
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 10
REACH LENGTH   (D)       2.87 MI
FLOOD DEPTH   (FLD)     10.00 FT

ELEV.(FT) (HS)          724.4   850.4   976.4  1102.4  1228.4  1354.3  1480.3  1606.3
TWIDTHS(FT) (BS)           .0  6739.5 15428.8 21472.6 32208.4 43978.3 47467.0 49739.3
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 11
REACH LENGTH   (D)       3.39 MI
FLOOD DEPTH   (FLD)     10.00 FT

ELEV.(FT) (HS)          682.8   841.3   999.8  1158.3  1316.8  1475.3  1633.8  1792.2
TWIDTHS(FT) (BS)           .0  8374.1 30025.5 44880.3 48619.1 49690.8 51978.8 54294.0
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 12
REACH LENGTH   (D)       3.87 MI
FLOOD DEPTH   (FLD)     10.00 FT

ELEV.(FT) (HS)          650.2   785.8   921.4  1057.0  1192.6  1328.2  1463.8  1599.3
TWIDTHS(FT) (BS)           .0 10663.7 37665.9 44074.5 47889.1 53017.3 55249.5 57634.6
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 13
REACH LENGTH   (D)       4.36 MI
FLOOD DEPTH   (FLD)     10.00 FT
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ELEV.(FT) (HS)          624.9   743.3   861.7   980.2  1098.6  1217.0  1335.4  1453.9
TWIDTHS(FT) (BS)           .0 12151.5 38107.4 47425.5 50771.5 54088.6 56749.6 58674.3
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 14
REACH LENGTH  (D)         4.75 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          591.0   664.9   738.8   812.7   886.7   960.6  1034.5  1108.4
TWIDTHS(FT) (BS)           .0  8691.1 17056.7 41713.9 48377.3 54810.8 58303.4 61871.5
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 15
REACH LENGTH  (D)         5.11 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          579.1   695.0   810.8   926.7  1042.6  1158.5  1274.4  1390.3
TWIDTHS(FT) (BS)           .0 19692.8 46177.4 57248.4 62673.5 66242.8 68487.0 70793.7
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 16
REACH LENGTH  (D)         5.45 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          554.7   667.9   781.1   894.3  1007.6  1120.8  1234.0  1347.3
TWIDTHS(FT) (BS)           .0 19399.2 43018.2 44979.6 46991.3 54797.6 61240.5 65330.7
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 17
REACH LENGTH  (D)         5.96 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          521.8   625.1   728.5   831.8   935.2  1038.5  1141.9  1245.2
TWIDTHS(FT) (BS)           .0  9799.1 19395.5 31298.0 38075.4 40931.2 44610.5 52888.2
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 18
REACH LENGTH  (D)         6.56 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          476.4   633.5   790.5   947.6  1104.7  1261.7  1418.8  1575.8
TWIDTHS(FT) (BS)           .0 19879.2 32834.2 41693.9 46524.9 51326.0 59932.0 75286.3
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 19
REACH LENGTH  (D)         7.42 MI
FLOOD DEPTH  (FLD)       10.00 FT

ELEV.(FT) (HS)          420.4   568.5   716.6   864.8  1012.9  1161.0  1309.2  1457.3
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TWIDTHS(FT) (BS)             .0 16458.5 21497.2 25591.8 27011.3 31871.9 35647.3 41514.5
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 20
REACH LENGTH  (D)          8.15 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            364.2   472.4   580.6   688.8   797.0   905.2  1013.4  1121.6
TWIDTHS(FT) (BS)             .0  6478.3 17322.1 22358.6 27205.9 29137.5 30176.0 32093.8
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 21
REACH LENGTH  (D)          8.77 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            339.2   469.4   599.6   729.8   860.0   990.2  1120.3  1250.5
TWIDTHS(FT) (BS)             .0  4536.9 18295.5 22136.6 24678.5 27062.6 30646.9 36018.3
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 22
REACH LENGTH  (D)          9.68 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            295.4   365.4   435.3   505.3   575.3   645.2   715.2   785.2
TWIDTHS(FT) (BS)             .0  2125.0  2479.5  3530.9 11631.5 13843.3 17231.5 24495.0
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 23
REACH LENGTH  (D)         10.21 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            264.3   355.3   446.3   537.3   628.3   719.3   810.3   901.3
TWIDTHS(FT) (BS)             .0  5008.1  6974.5  9321.8 11740.3 19315.1 25678.3 30187.0
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 24
REACH LENGTH  (D)         10.64 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            255.5   312.0   368.6   425.2   481.7   538.3   594.9   651.4
TWIDTHS(FT) (BS)             .0  3573.6  5769.7  6909.6  9288.8 10717.5 12112.4 16127.4
INACTIVE TW(FT) (BSS)        .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)         *   .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 25
REACH LENGTH  (D)         11.52 MI
FLOOD DEPTH   (FLD)       10.00 FT

ELEV.(FT) (HS)            219.6   311.5   403.3   495.2   587.0   678.8   770.7   862.5
TWIDTHS(FT) (BS)             .0  2147.2  4943.2  8051.5 13430.5 18146.1 22059.9 24473.8
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INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 26
REACH LENGTH  (D)        12.14 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)          199.1   301.7   404.3   507.0   609.6   712.2   814.8   917.4
TWIDTHS(FT) (BS)           .0  2944.7  5331.2 12175.4 18368.3 20562.3 21279.7 22326.4
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 27
REACH LENGTH  (D)        12.67 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)          181.0   297.2   413.4   529.5   645.7   761.8   878.0   994.1
TWIDTHS(FT) (BS)           .0  5074.6  8405.6 14054.9 17094.3 19858.7 21683.3 25641.6
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 28
REACH LENGTH  (D)        13.52 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)          158.9   298.3   437.6   576.9   716.3   855.6   995.0  1134.3
TWIDTHS(FT) (BS)           .0  3992.0  6035.0  9604.4 14120.3 20244.8 26099.8 30074.2
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 29
REACH LENGTH  (D)        14.18 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)          135.9   197.4   258.9   320.4   381.8   443.3   504.8   566.3
TWIDTHS(FT) (BS)           .0  2738.9  3216.9  3767.8  4568.5  7259.7  9232.1 12803.2
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 30
REACH LENGTH  (D)        14.80 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)          112.7   186.0   259.3   332.5   405.8   479.1   552.4   625.7
TWIDTHS(FT) (BS)           .0  3849.4  4231.2  7248.4 12880.9 17759.4 21054.4 23045.7
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
MANNING N (CM)        *  .050    .100    .100    .100    .100    .100    .100    .100


CROSS SECTION NO. 31
REACH LENGTH  (D)        15.49 MI
FLOOD DEPTH   (FLD)      10.00 FT

ELEV.(FT) (HS)           81.0   153.6   226.1   298.7   371.3   443.9   516.4   589.0
TWIDTHS(FT) (BS)           .0  6313.8  7923.3  9150.7 13064.8 15666.8 18239.6 19835.4
INACTIVE TW(FT) (BSS)      .0      .0      .0      .0      .0      .0      .0      .0
```

MANNING N (CM) *	.050	.100	.100	.100	.100	.100	.100	.100

CROSS SECTION NO. 32
REACH LENGTH (D) 15.91 MI
FLOOD DEPTH (FLD) 10.00 FT

ELEV.(FT) (HS)	62.5	150.1	237.6	325.1	412.6	500.1	587.6	675.1
TWIDTHS(FT) (BS)	.0	5110.0	5817.3	7007.9	8772.4	10265.5	12837.2	16845.7
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.100	.100	.100	.100	.100	.100	.100

CROSS SECTION NO. 33
REACH LENGTH (D) 16.24 MI
FLOOD DEPTH (FLD) 10.00 FT

ELEV.(FT) (HS)	52.1	108.4	164.8	221.1	277.5	333.9	390.2	446.6
TWIDTHS(FT) (BS)	.0	5338.3	5526.2	5786.6	6335.5	7994.2	9071.5	10024.1
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.100	.100	.100	.100	.100	.100	.100

AN ASTERISK (*) BESIDE A PARAMETER IMPLIES THAT A DEFAULT VALUE WAS COMPUTED

NAME OF DAM: Matilija Dam NAME OF RIVER: Ventura River

RVR MILE FROM DAM	MAX FLOW (CFS)	MAX ELEV (FT-MSL)	MAX DEPTH (FT)	TIME(HR) MAX DEPTH	TIME(HR) FLOOD	TIME(HR) DEFLOOD	FLOOD DEPTH(FT)
********	********	********	********	********	********	********	********
.00	331793.	1120.26	36.54	.05	.00	.00	10.00
.45	285215.	958.54	35.92	.06	.00	.00	10.00
.77	279631.	958.54	38.80	.08	.00	.00	10.00
.88	279158.	929.67	46.66	.08	.00	.00	10.00
1.06	277446.	927.46	52.64	.09	.00	.00	10.00
1.36	272820.	892.98	36.97	.11	.00	.00	10.00
1.73	272615.	862.22	41.76	.13	.00	.00	10.00
2.03	268827.	830.13	47.33	.16	.00	.00	10.00
2.35	264761.	797.46	33.82	.20	.00	.00	10.00
2.87	262113.	749.32	24.90	.21	.00	.00	10.00
3.39	259492.	706.97	24.13	.24	.00	.00	10.00
3.87	256897.	671.17	20.95	.29	.00	.00	10.00
4.36	234146.	643.97	19.09	.35	.00	.00	10.00
4.75	201496.	608.06	17.07	.45	.00	.00	10.00
5.11	199481.	593.81	14.74	.45	.00	.00	10.00
5.45	198397.	569.81	15.14	.48	.00	.00	10.00
5.96	185647.	539.56	17.76	.56	.00	.00	10.00
6.56	183791.	491.83	15.42	.56	.00	.00	10.00
7.42	174808.	436.30	15.92	.67	.00	.00	10.00
8.15	156287.	383.88	19.68	.81	.00	.00	10.00
8.77	154724.	364.17	24.95	.83	.00	.00	10.00
9.68	132778.	323.09	27.70	1.13	.00	.00	10.00
10.21	131450.	284.59	20.33	1.14	.00	.00	10.00
10.64	117781.	275.85	20.37	1.36	.00	.00	10.00
11.52	116603.	250.24	30.60	1.37	.00	.00	10.00
12.14	115437.	225.86	26.78	1.38	.00	.00	10.00
12.67	114283.	203.76	22.72	1.40	.00	.00	10.00
13.52	113140.	185.94	27.02	1.41	.00	.00	10.00
14.18	100895.	159.07	23.13	1.84	.00	.00	10.00

14.80	99886.	133.18	20.46	1.86	.00	.00	10.00
15.49	98887.	97.14	16.14	1.91	.00	.00	10.00
15.91	97898.	80.90	18.35	1.93	.00	.00	10.00
16.24	89587.	68.26	16.20	2.23	.00	.00	10.00

ANALYSIS IS COMPLETE

PLATE

Flood Inundation Map