# DESIGN HYDRAULIC STUDY

## TENNESSEE CREEK

*Bridge No. 25C-38*

*Prepared for*

# ELDORADO COUNTY D.O.T.

*By: Keith Nelson*
*TRC Imbsen*

*May 2006*

# Table of Contents

# DESIGN HYDRAULIC STUDY
# Tennessee Creek Bridge No. 25C-38
# Rescue, California

## INTRODUCTION

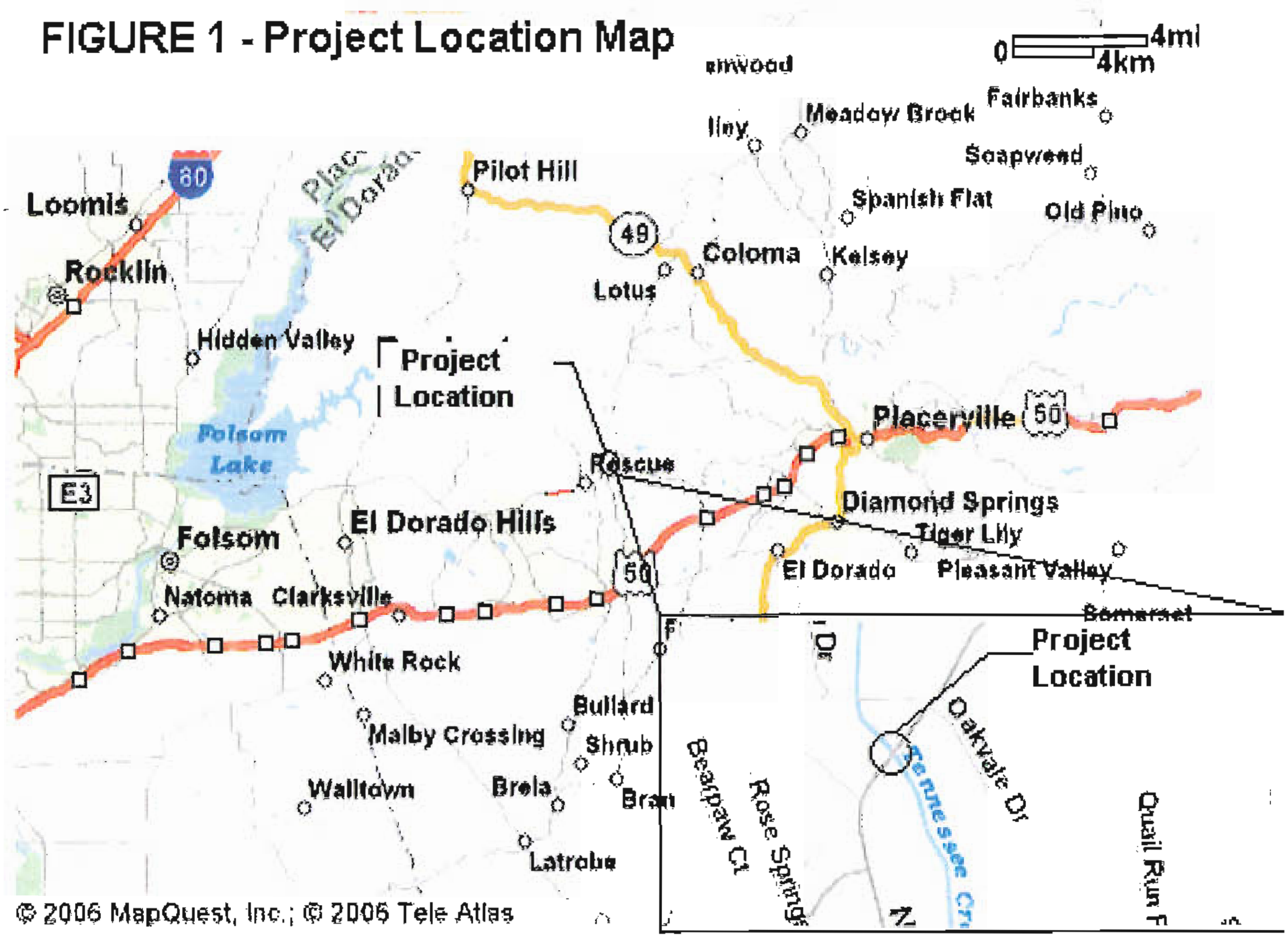
Bridge No. 25C-38 is located over Tennessee Creek on Green Valley Road approximately 0.2 miles north of intersection of North Shingle Road and Green Valley Road, see Figure 1. The bridge to be replaced is a reinforced concrete simple span T-beam, constructed in 1930, and is approximately 29 feet long with a traveled way width of 19.4 feet. The existing structure crosses the stream at a skew of 16 degrees left-hand-forward.

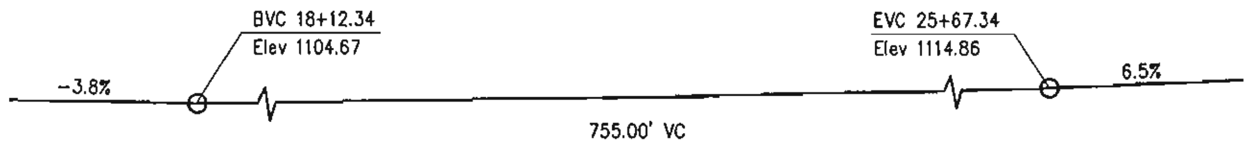
The proposed action is to replace the functionally obsolete bridge with either a simple span pre-cast pre-stressed voided slab (Alternative A) or a cast-in-place post tensioned slab (Alternative C) on seat abutments. The new structure will have an overall length of approximately 64 feet, and an overall width of 43 to 46 feet. The proposed replacement will involve staging the structure in order to minimize the impact to traffic during construction. See Figures 2 and 3 for a Bridge A.P.S.. The proposed replacement will have the following improvements:

- Widening the structure to accommodate 2-12 ft lanes and 2-8 ft. shoulders.
- Raising the profile to provide better stopping sight distance and to provide free board clearance for the base flood.
- Improving the horizontal alignment to meet the design speed designated.
- Increasing the hydraulic opening to decrease existing backwater and flow velocities.

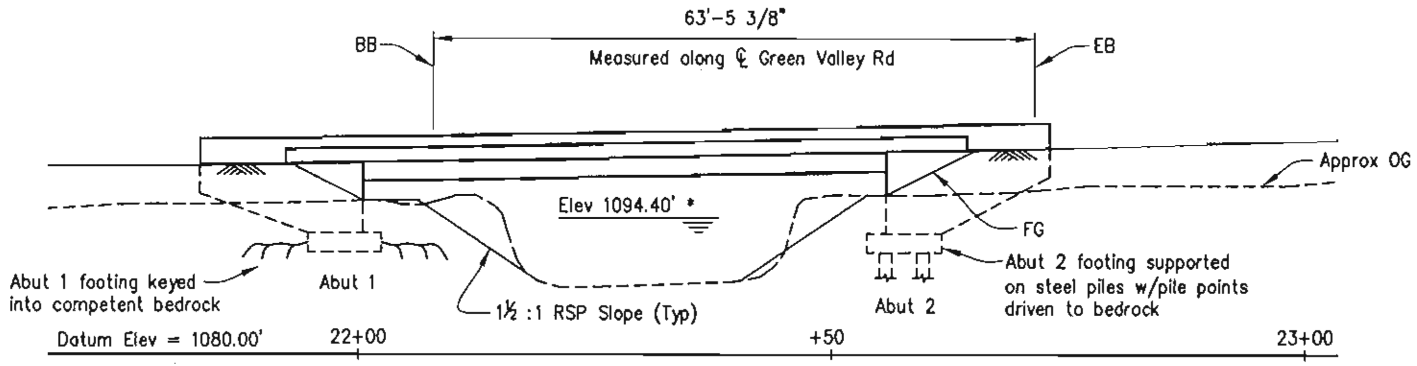
This report details the hydraulic effects of the proposed structure and approaches on the flow characteristics of the Tennessee Creek at the structure site. Included in this report is information concerning the magnitude and frequency of floods, stream stage relationships, backwater and high water elevation computations, scour effects and additional hydraulic related data.

# FIGURE 1 - Project Location Map



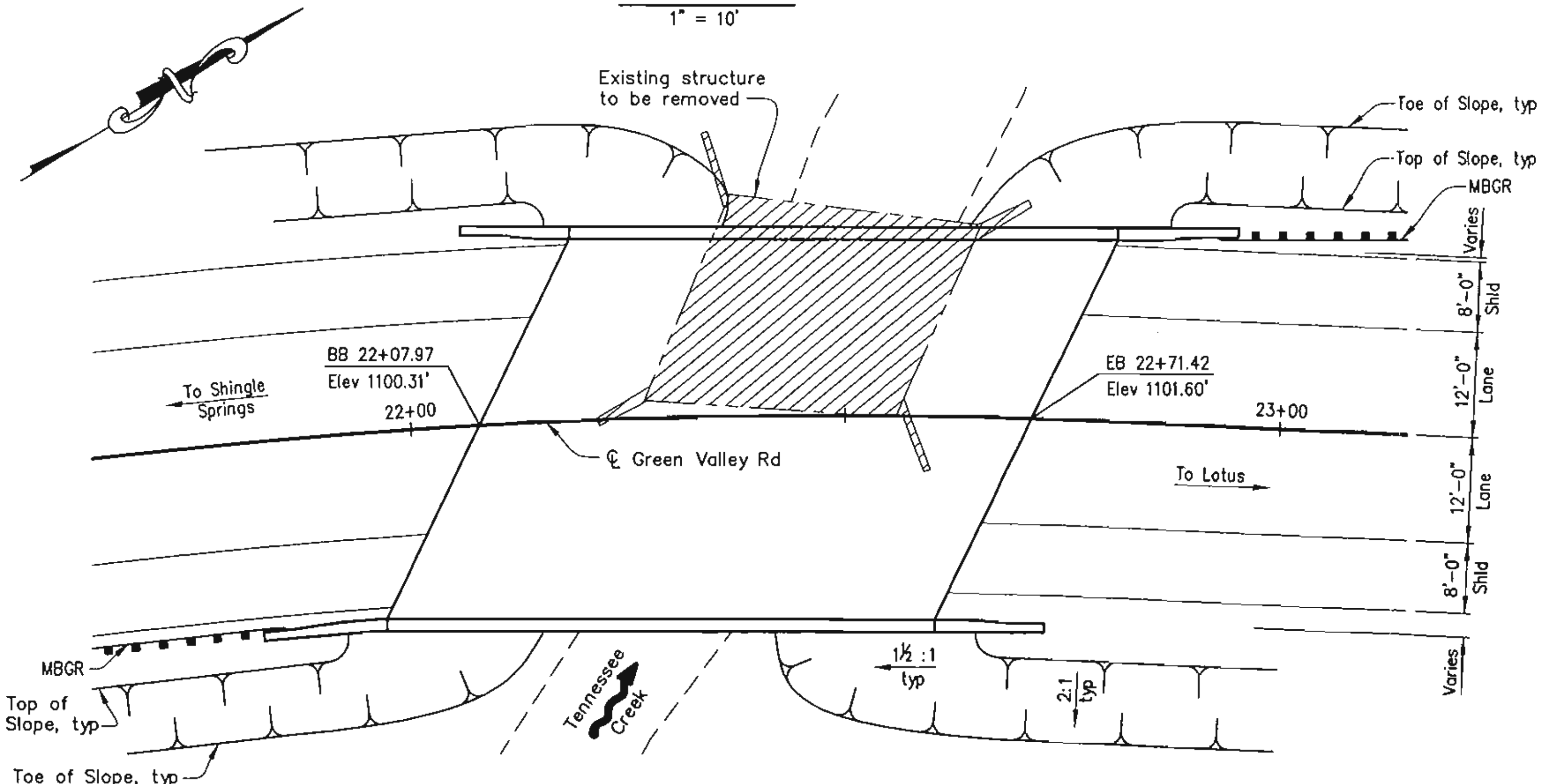



## PROFILE GRADE
Not to Scale

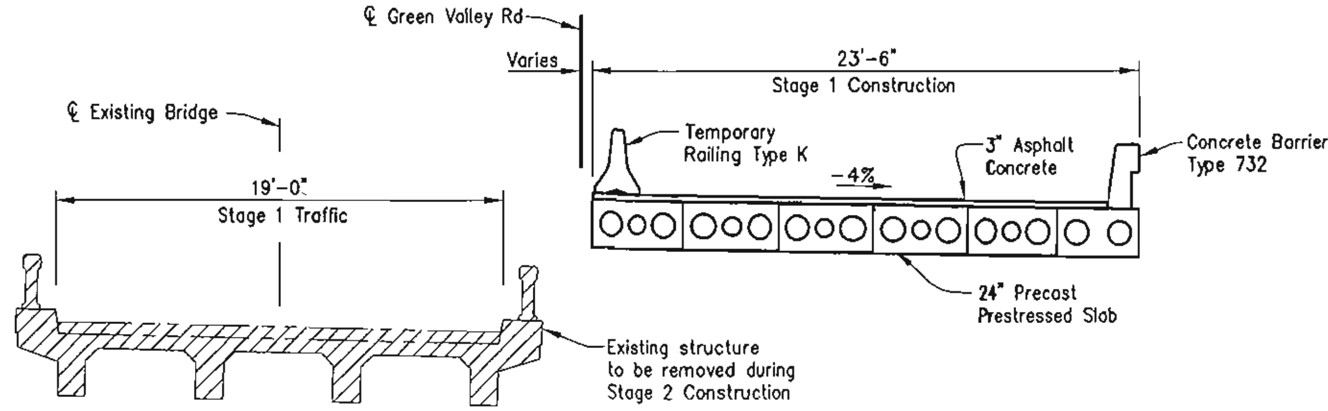



* High Water Elevation

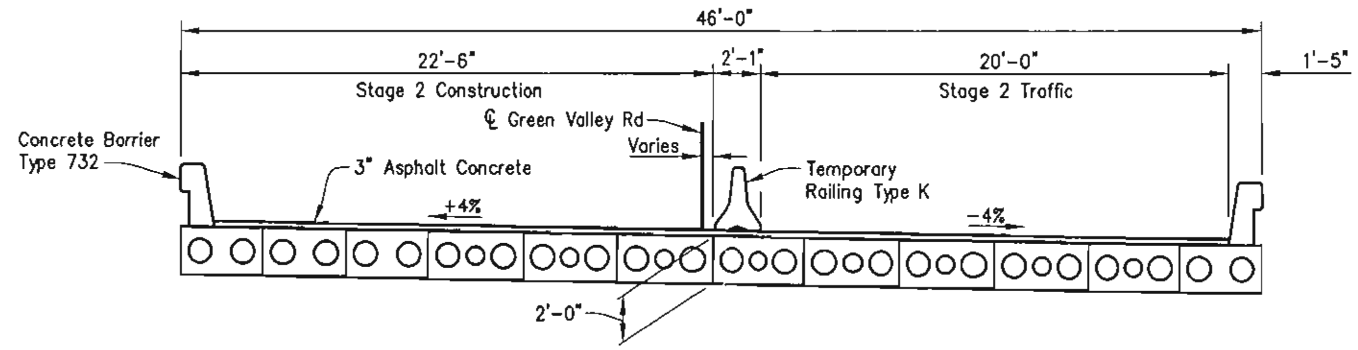
## ELEVATION
1" = 10'



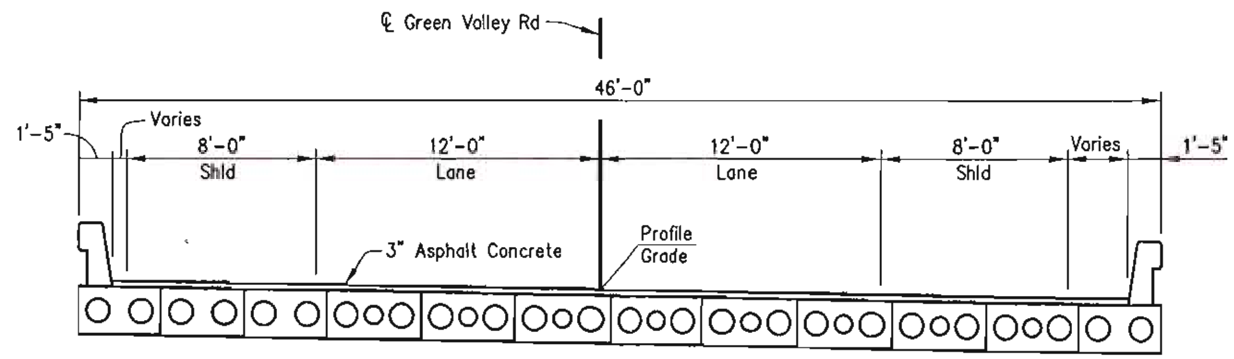

## PLAN
1" = 10'




## STAGE 1




## STAGE 2




## FINAL CONFIGURATION

## TYPICAL SECTIONS
1/4" = 1'-0"

LEGEND:

- Indicates Bridge Removal
- Indicates New Structure

# FIGURE 2

| REVISION | | | |
|---|---|---|---|
| NUMBER | DATE | DESCRIPTION | BY |

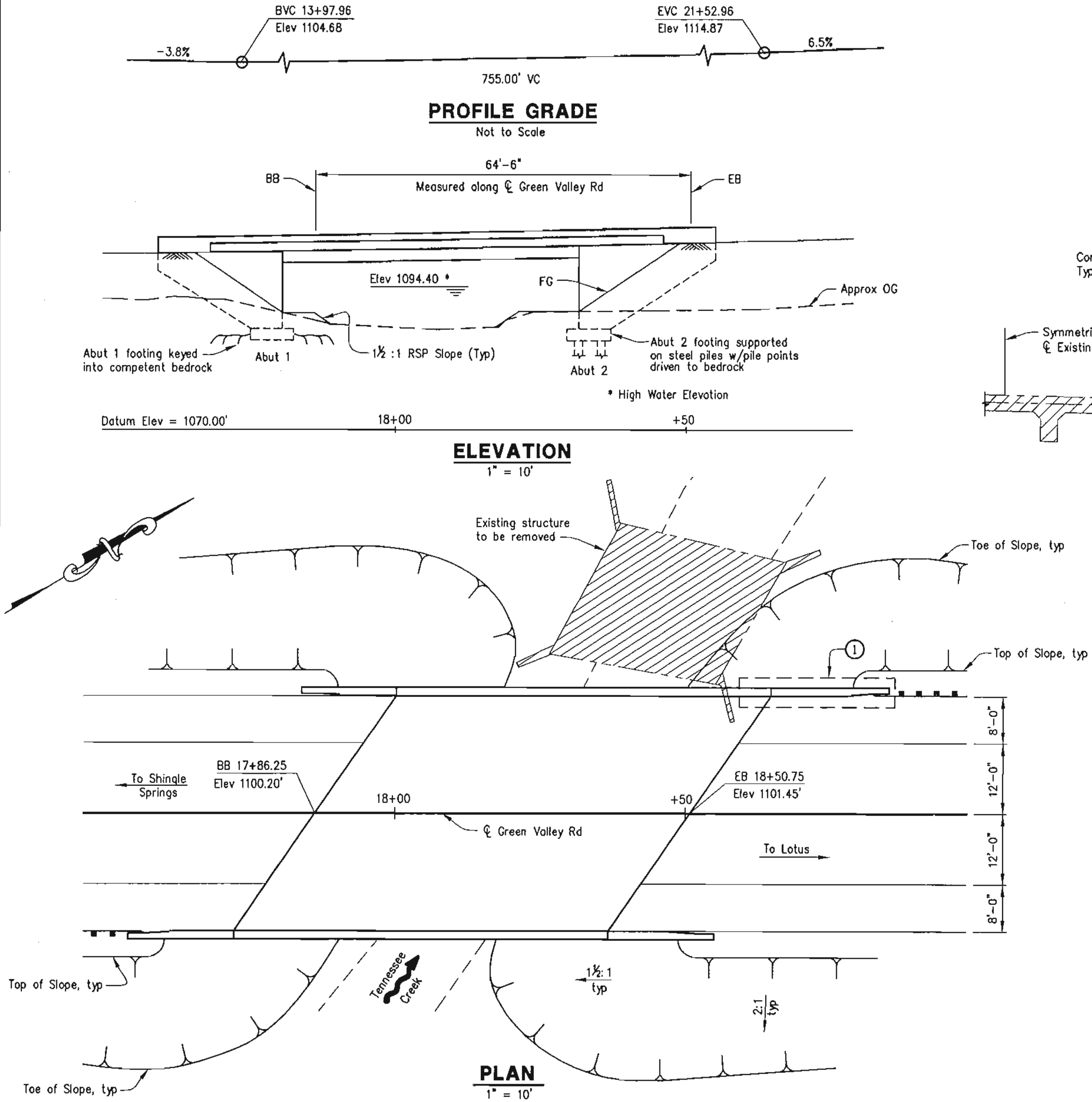
PREPARED UNDER THE SUPERVISION OF :
REGISTERED CIVIL ENGINEER
DATE:

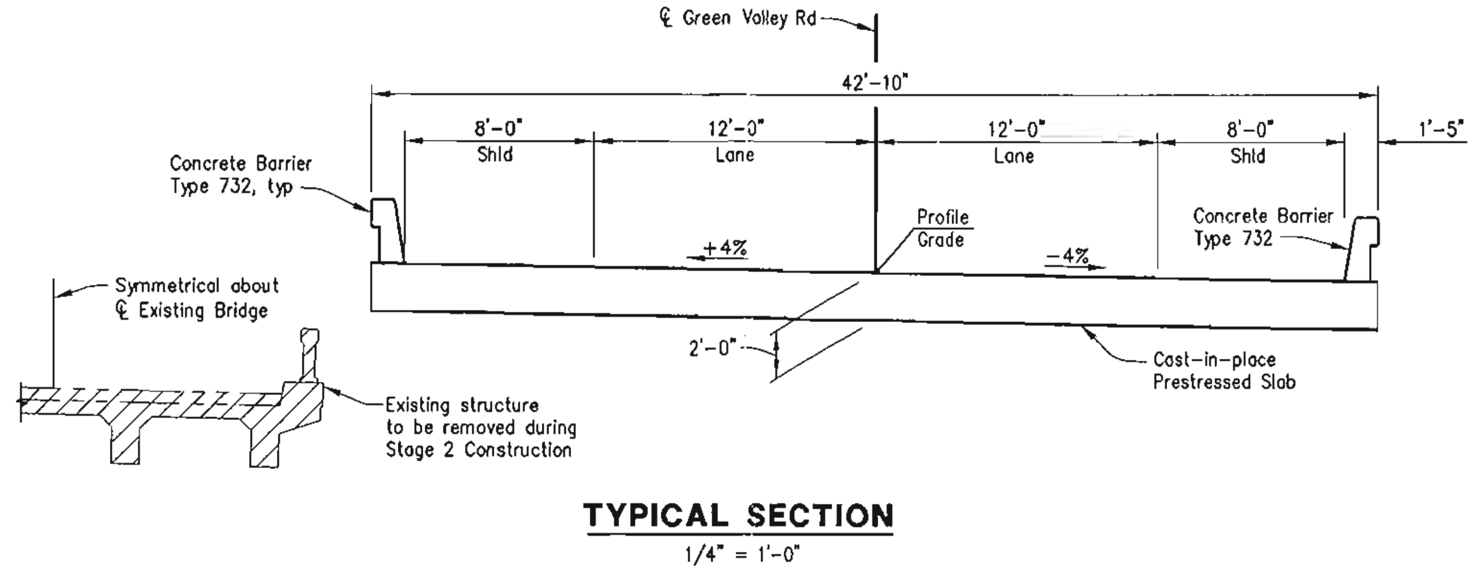
| DESIGNED: KN | DRAWN: KD |
|---|---|
| CHECKED: CHK | DATE: 04/02/06 |
| ROAD NUMBER: 000 | |

EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

GREEN VALLEY ROAD BRIDGE
OVER TENNESSEE CREEK
PLANNING STUDY - ALTERNATIVE A

SHEET S-01
1 OF 2
W.O. No. 00000




**NOTE:**

(1) Concrete Barrier and Wingwall to be constructed in Stage 2 Construction

**LEGEND:**

(hatched) Indicates Bridge Removal

(line) Indicates New Structure

# FIGURE 3

| REVISION | | | |
|---|---|---|---|
| NUMBER | DATE | DESCRIPTION | BY |

PREPARED UNDER THE SUPERVISION OF :

REGISTERED CIVIL ENGINEER DATE

| DESIGNED: KN | DRAWN: KD |
|---|---|
| CHECKED: CHK | DATE: 04/02/06 |
| ROAD NUMBER: 000 | |

EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

GREEN VALLEY ROAD BRIDGE
OVER TENNESSEE CREEK
PLANNING STUDY - ALTERNATIVE C

SHEET S-02
2 OF 2
W.O. No. 00000

## SITE DESCRIPTION

The site description of the proposed bridge replacement is illustrated in the following figures and attachments:

1. Bridge A.P.S. Sheets, see Figure 2 and 3.
2. Contour Maps, See Appendix C.
3. Project Location Map, see Figure 1
4. Photographs, see Appendix B.

The Tennessee Creek basin is approximately 4.5 square miles. The watershed is about 3 miles long and about 1.5 miles wide. The majority of the basin consists of hilly terrain with trees. The land use consists mostly of low-density residential with small areas of higher density. The basin is aligned in a generally north-south direction with Shingle Springs on the outer southern edge.

The stream bottom at the project location consists of granular material with outcroppings of large boulders. The slope of the channel is steep and was determined from field measurements to be .007 feet/feet based on water elevations taken 620' downstream and 1000' upstream. The stream varies in width from 10 ft to 24 ft.

The over banks at the site vary from residential lawn use downstream to brush and trees upstream. The stream banks have deposits of brush from either runoff or from adjacent land owners. There is a structure located approximately 450 ft. downstream from the project site on a private drive. The structure consists of a series of 3 corrugated steel culvert pipes. Also, there is a structure located upstream approximately 1 mile south from the project site on a private drive. This structure is a single span steel truss.

## HYDROLOGIC ANALYSIS

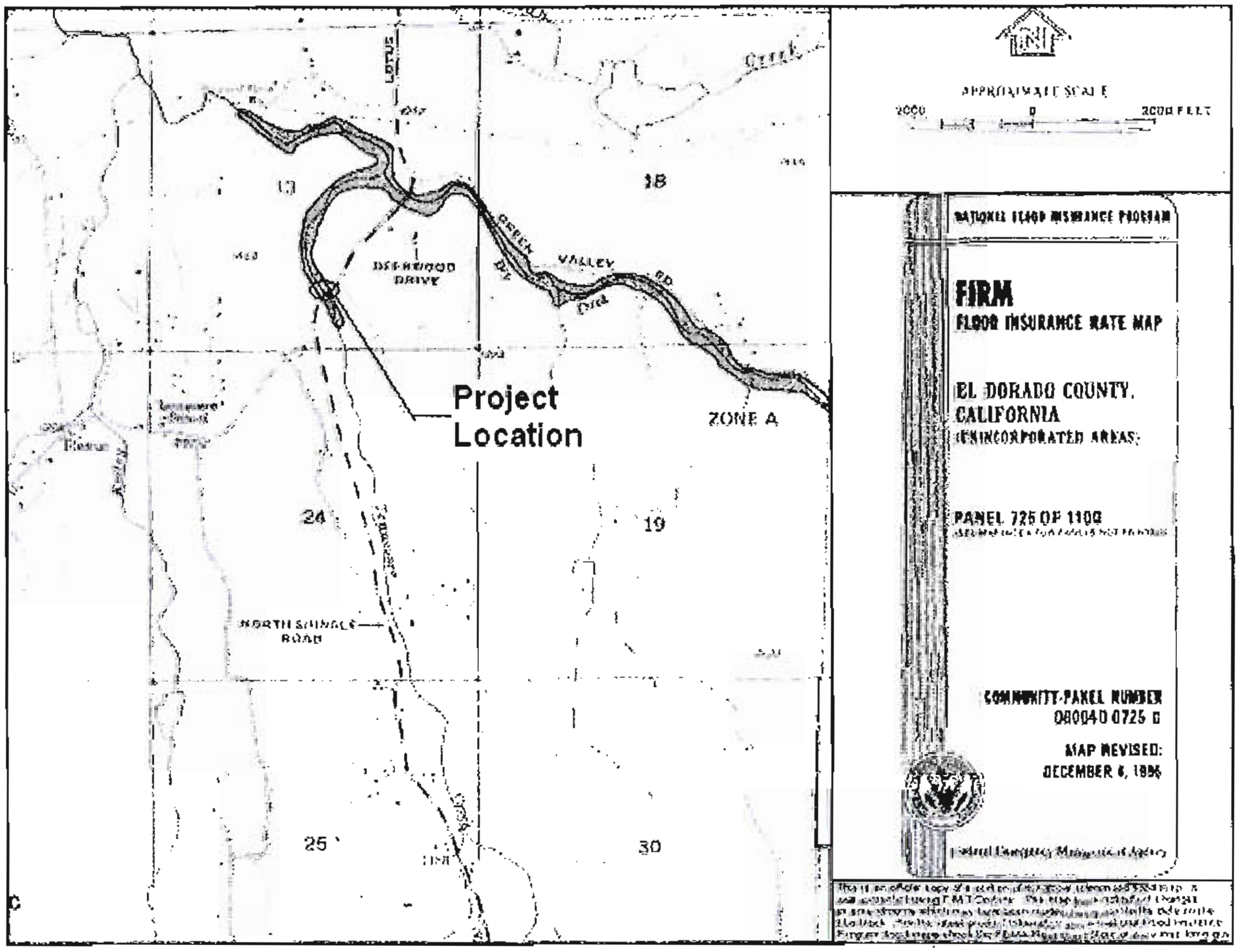
The project site location is mapped in Zone A on the Flood Insurance Rate Map. See Figure 4. Zone A is described as a zone of 100 year flood inundation with no corresponding flow values or elevations. Therefore, hydrologic computations are needed to estimate flow values. There is no information available as to the flood of record.

The design and base flood flows were calculated from two different methods. Method 1 used U.S.G.S regional regression equations while method 2 used a basin transfer comparison. Results of the calculations are summarized in Table 1. The basin transfer location is a recent nearby bridge replacement on Green Valley Road over Dry Creek (B25C-39). Tennessee Creek is a tributary to Dry Creek therefore it has similar basin characteristics. See Appendix D for hydrology calculations.

## TABLE 1. ESTIMATED PEAK DISCHARGES

| Design Criteria (CalTrans) | Return Period (years) | Flow (cfs) |
|---|---|---|
| **Design Flood** | 50 | 1300 |
| **Base Flood** | 100 | 1700 |

## FIGURE 4 – FLOOD INSURANCE RATE MAP



## HYDRAULIC ANALYSIS

A hydraulic analysis for both existing and proposed conditions was performed to determine the backwater and high-water elevations. The HEC-RAS water surface program was used to do the analysis. The limits of the analysis are from a distance 600 feet downstream to a distance 400 feet upstream. This includes the previously mentioned downstream structure. The upstream structure has no effect on the hydraulic analysis due its relative location to the project site.

The project site has no known detailed hydraulic study; therefore, the tail water elevations for both analyses were estimated from HEC-RAS normal water computation by giving an energy grade slope. The energy grade slope can be estimated from the measured water surface slope or the stream bottom slope. The slope was computed from up and downstream survey shots.

The downstream structure was determined to have an effect on the computation of the water surface profile at the project site therefore it was modeled in the HEC-RAS analysis for both conditions. The private drive has a relatively low profile grade elevation, therefore it has seen frequent overflow events as observed by local land owners. It is evident that the culvert pipes and private drive constrain the flood plain due to the observed downstream scour. The HEC-RAS analysis produced results that reflect what was observed. See Figure 5 for the water surface profile for existing conditions. The downstream stream structure produces approximately 3.5 feet of backwater, an overflow occurrence of about 3 years, and velocities in the range of 10-15 fps.

The existing structure was modeled to determine the existing, or base hydraulic condition of the channel. The existing structure that is being replaced is a simple span structure with a hydraulic clear span of 24.8 ft. with a low chord elevation of 1094.2. The constraint of the hydraulic clear span and the low chord elevation produced 2.5 feet of backwater with velocity of 11 fps through the structure. The water surface elevations determined for the design flood and base flood are presented in Table 2. The output of the HEC-RAS analyses for the design flood and base flood for the existing bridge is presented in Appendix E.

The proposed structure was sized by using the following criteria:

- Minimize fill slope encroachment into the stream. A 20 feet stream bottom width was used in the analysis.
- Minimize the backwater to 1 foot or less for the base flood as per the Local Assistance Procedures Manual.
- Provide at least 2 feet of freeboard for the design flood as per the Local Assistance Procedures Manual.
- If possible minimize the water velocities for the design and base flood.
- Incorporate construction staging constraints in determining the superstructure type and in abutment placement.
- Incorporate geological constraints in placing the abutments. Initial soil investigation reported high bedrock elevations in the vicinity of structure.

At the time of this report two different roadway alignment alternatives were being considered. The following are the type and size of structure that meets the above mention criteria for each roadway alignment:

1. **Alignment Alternative A:** 58 ft single span pre-cast/pre-stressed concrete 24" voided slab units supported on seat type abutments. The structure width is 46 ft and has a 25.8 degree left-hand-forward skew.
2. **Alignment Alternative C:** 59 ft single span cast-in-place/post-tensioned concrete 24" slab supported on seat type abutments. The structure width is 41.83 ft and has a 35 degree left-hand-forward skew.

**TABLE 2. WATER SURFACE ELEVATIONS**
**Tennessee Creek Bridge Site**

At Hydraulic Station 17.73

| **Design Criteria** (CalTrans) | **Return Period** (years) | **EXISTING BRIDGE** (ft) | **Alt A PROPOSED BRIDGE** (ft) | **Alt C PROPOSED BRIDGE** (ft) |
|---|---|---|---|---|
| **Design Flood** | 50 | 1095.21 | 1094.66 | 1094.77 |
| **Base Flood** | 100 | 1096.93 | 1095.70 | 1095.95 |

As shown in Table 2, the proposed bridge replacement structure has a positive impact by lowering the water surface elevation upstream from the structure of the proposed bridge for the design and base floods when compared to the existing (base) condition. Note that the upstream location used for comparisons is 150 ft upstream from the existing bridge due to the proposed roadway alignment shift to the south. See Figures 5, 6, and 7 for complete water surface profiles of the existing and proposed bridges.

In addition to lowering water surface elevations, the proposed bridge replacement has a positive impact in lowering stream velocities through the bridge. See Table 3 below.

**TABLE 3. MAXIMUM STREAM VELOCITIES**
**Tennessee Creek Bridge Site**

| Design Criteria (CalTrans) | Return Period (years) | EXISTING BRIDGE (fps) | Alt A PROPOSED BRIDGE (fps) | Alt C PROPOSED BRIDGE (fps) |
|---|---|---|---|---|
| **Design Flood** | 50 | 11.1 | 8.7 | 7.9 |
| **Base Flood** | 100 | 12.9 | 10.4 | 9.2 |

In Table 4 we illustrate the minimum freeboard available beneath the proposed bridge for each roadway alignment alternative and for the various floods investigated. In all cases the design criteria is met.

**TABLE 4. FREEBOARD FOR PROPOSED BRIDGE STRUCTURE**
**Tennessee Creek Bridge Site**

Alignment Alternative A

| DESIGN CRITERIA (CalTrans) | RETURN PERIOD (years) | MINIMUM SOFFIT ELEVATION (ft) | *WATER SURFACE ELEVATION (ft) | MINIMUM FREEBOARD (ft) |
|---|---|---|---|---|
| **Design Flood** | 50 | 1096.85 | 1093.79 | 3.06 |
| **Base Flood** | 100 | 1096.85 | 1094.61 | 2.24 |

Alignment Alternative C

| DESIGN CRITERIA (CalTrans) | RETURN PERIOD (years) | MINIMUM SOFFIT ELEVATION (ft) | *WATER SURFACE ELEVATION (ft) | MINIMUM FREEBOARD (ft) |
|---|---|---|---|---|
| **Design Flood** | 50 | 1097.14 | 1093.25 | 3.89 |
| **Base Flood** | 100 | 1097.14 | 1093.66 | 3.48 |

**Calculated at upstream face of bridge.*

The complete HEC-RAS analyses for the design flood and base flood for the proposed bridge for each alignment alternative is presented in Appendix F.

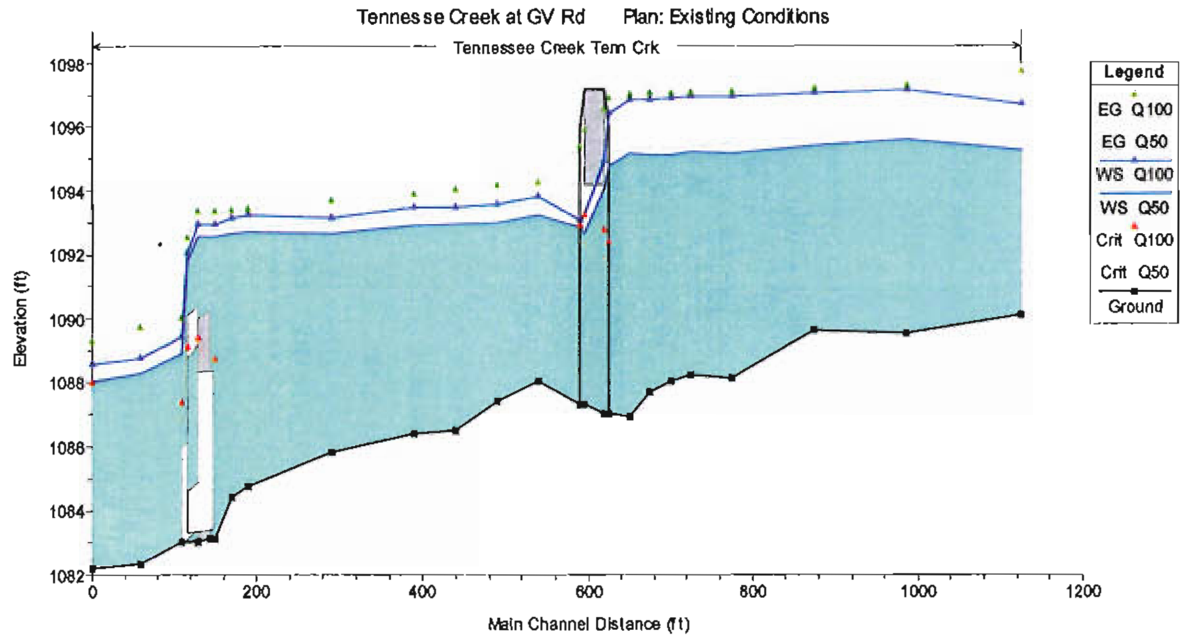
## SCOUR ANALYSIS

The total depth of scour includes three additive components; long term aggradation or degradation, contraction scour, and local scour. The values for the long term aggradation or degradation can only be quantified if a time history of the stream bed has been recorded. No information of the stream bed is known other then what is reported in the Caltrans. structure inspection reports. The inspection reports do not report any scour. The other two components were estimated using HEC-RAS and are only reported for information purposes since the abutments will be armored with rock slope protection and there will not be any piers in the stream. See Appendix G for scour calculations.

## CONCLUSIONS

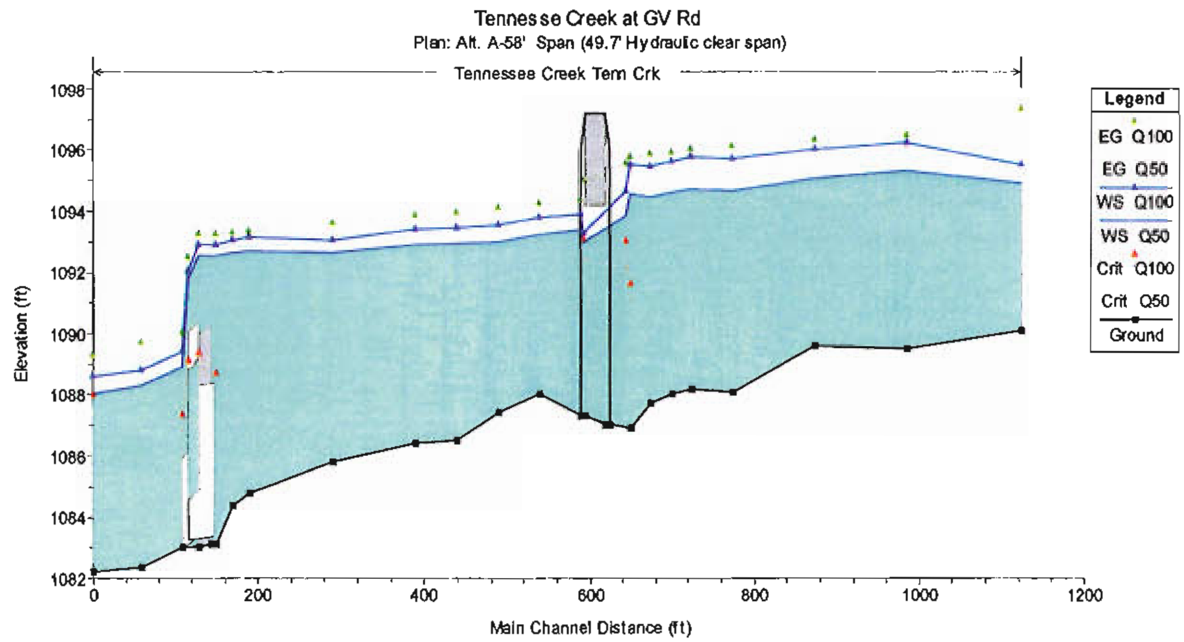
The proposed design reduces both water surface elevations and stream velocities, as shown in Tables 2 & 3 and in Figures 5-7. The proposed structure will clear span the stream with minimal infringement from embankment slopes on to the natural flow of the stream. The embankments around the abutments will be armored with rock slope protection to counter the effects of scour.

## FIGURE 5 – EXISTING 50+100 YEAR FLOOD WATER SURFACE PROFILE



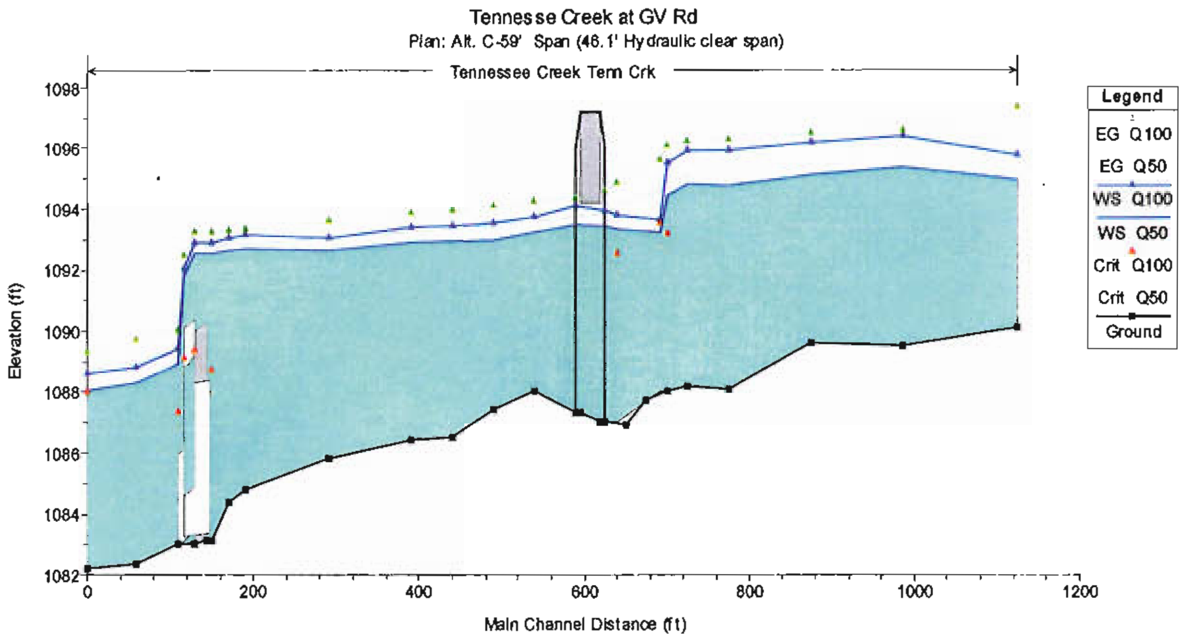

## FIGURE 6 – PROPOSED 50+100 YEAR FLOOD WATER SURFACE PROFILE

### Alternative A



## FIGURE 7 – PROPOSED 50+100 YEAR FLOOD WATER SURFACE PROFILE

### Alternative C




## References


U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System, Davis, California, version 3.1.3, May 2005

U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS Water Surface Profiles Users Manual, Davis, California, version 3.1., November 2002.

State of California, Department of Transportation, Local Assistance Procedures Manual, Chapter 11 Design Standards, October 2005

Federal Highway Administration, Office of Research and Development, Publication No. FHWA-IP-90-017, Hydraulic Engineering Circular No. 18 Evaluating Scour at Bridges, McLean, Virginia, February 1991.

U.S.G.S., Water Resources Division, Magnitude and Frequency of Floods in California, June 1977.

County of El Dorado, Drainage Manual, Resolution No.: 67-95, Adopted: March 14, 1995

# APPENDIX A

## Location Hydraulic Study

**Tennessee Creek Bridge Replacement**
**Green Valley Road**
**Town of Rescue, California**

# LOCATION HYDRAULIC STUDY

In accordance with Executive Order 11988 and the regulations promulgated by the Federal Highway Administration in its *Federal-Aid Highway Program Manual* (FHPM), Volume 6, Chapter 7, Section 3, Subsection 2, "Location and Hydraulic Design of Encroachments on Flood Plains," dated November 15, 1979, as revised in Title 23, Code of Federal Regulations, Part 650, Subpart A (23 CFR 650A), and in general conformance with the guidance from the State of California, Department of Transportation (Caltrans), *Standard Environmental Reference*, Chapter 17, "Floodplains," (downloaded from the web) last updated December 01, 2005 10:10 AM; *Local Assistance Procedures Manual*, Chapter 6, "Environmental Procedures," dated January 26, 2004, exhibit 6-N and Chapter 11, "Design Standards," dated October 7, 2005,; and *County of El Dorado Drainage Manual,* adopted March 14, 1995, resolution no. 67-95, the following documentation is provided.

## 1. Location

The proposed bridge replacement is located 0.2 miles north of intersection of North Shingle Road and Green Valley Road. See Exhibit 1 for the project site location.

## 2. Name of Stream

Tennessee Creek

## 3. Bridge Number

25C-0038

## 4. Geographical reference

Town of Rescue, County of El Dorado, State of California

## 5. Description of Proposed Action

The proposed action includes:

- Replacement of the functionally obsolete 2 lane 20 ft clear width existing bridge with a 2 lane 40 ft clear width bridge. The new bridge will increase the hydraulic opening which will reduce high existing flow velocities and decrease backwater.
- Widening of Green Valley road to accommodate 2-12 ft lanes and 2-8 ft shoulders.

- Raising the profile to provide better stopping sight distance and to provide free board clearance for the base flood.
- Improving the horizontal alignment to meet the design speed designated.
- Improving the intersection of Green Valley Road and North Shingle Road.

See Exhibit 2 for a plan of the proposed action.

**6. Hydraulic Data**

- Base Flood (Q100) Q = 1,700 cfs. Computed from U.S.G.S. regression equations.
- Water Surface elevation for base flood. Not-available. To be computed in HEC-RAS analysis.

**7. Map of Flood Plain, with Base Flood ($Q_{100}$) and Flood of Record (when available), or the information developed, if NFIP maps are not available, to determine whether an alternative will include an encroachment**

Exhibit 3 is the F.E.M.A. Flood Insurance Rate Map which shows the site mapped as Zone A. No base flood elevations have been determined.

**8. Base Flood ($Q_{100}$) Backwater Potential Impacts To:**

◊ **Residences:** minimal or no impact from the project site. Although, a structure located approximately 500 ft down stream has a direct impact to the downstream land owners. The structure is a series of 3 corrugated steel culvert pipes which creates approximately 3 feet of back water. The land owner reported a reduction in backwater when a 3rd culvert pipe was added 4 years ago.

◊ **Other Buildings** None from project site affected. Although the above noted downstream structure has an affect on the buildings located downstream.

◊ **Crops**

None

**9. Traffic**

◊ **Approximate Traffic Volume**

8900 (2004)

◊ **Emergency Supply or Evacuation Route**

Green Valley Road will be open as a emergency supply or evacuation route through the construction of the project.

◊ **Emergency Vehicle Access**

Green Valley Road will be open for emergency vehicle access through the construction of the project.

◊ **Practicable Detour Available**

A practicable detour is not available for this site. Closest detour would be Oakvale Drive which is impractical due to its length and function.

◊ **School Bus or Mail Route**

Green Valley Road will be open for school bus and mail route through the construction of the project.

**10. Approximate Duration of Traffic Interruption for Base Flood ($Q_{100}$)**

None anticipated

**11. Approximate Value Of Base Flood ($Q_{100}$) Damages**
******Required only for the rare situations of moderate or high risk******

◊ **Roadway**

None

◊ **Property**

None

◊ **Total**

None

# Location Hydraulic Study Evaluation

Commensurate with the significance of the risk or environmental impact and as perceived by a bridge engineer with hydrologic and hydraulic experience, the proposed action is evaluated as:

**1. The risk associated with implementation of the action**

The risks associated with the implementation of the proposed action are not significant. The proposed design does not increase water surface elevations for the base flood and any increase would be less than one foot allowed by the Federal Emergency Management Agency (FEMA).

**2. The impacts on natural and beneficial floodplain values**

The impact of the proposed design on the natural and beneficial flood-plain values is not significant. The proposed design will raise the backwater surface elevation by less than one foot for the 100 year event.

**3. The support of probable incompatible floodplain development**

The proposed design will not further support incompatible flood-plain development.

**4. The measures to minimize floodplain impacts associated with the action**

Routine construction procedures to minimize impacts to the flood-plain will be required. Access to the channel area during construction will require permits for working within the streambed.

**5. The measures to restore and preserve the natural and beneficial floodplain values impacted by the action**

Routine construction procedures to minimize impacts to the flood-plain will be required. Access to the channel area during construction will require permits for working within the streambed and implementation of sediment control techniques. These permits will require measures to restore and preserve the natural and beneficial floodplain values and will be made a part of the construction contract work

**6. The practicability of alternatives to any significant encroachment**

The proposed design does not have a significant potential for interruption or termination of a transportation facility which is needed for emergency vehicles or provides a community's only evacuation route. It is not a significant risk and it will not have a significant adverse impact on natural and beneficial flood-plain values. Therefore, the proposed action does not constitute a significant floodplain encroachment as defined in

FHPM 6-7-3-2, paragraph 4q and revised in Title 23, Code of Federal Regulations, Part 650, Subpart A, Section 650.105, "Definitions," paragraph (q), and the Federal-Aid Policy Guide in Transmittal 12, dated December 7, 1994 (23 CFR 650A, § 650.105, "Definitions," paragraph (q)).

**7. The practicability of alternatives to any longitudinal encroachment**

The proposed action is a structure replacement over Tennessee Creek; therefore, the proposed action is not a longitudinal encroachment of the base flood-plain.

Discussion of Alternatives

In addition to engineering considerations, non-engineering constraints may severely limit the alternatives available. Some items which may limit the design are:

* **Prescribed minimum design standard**

  Current Caltrans standards require the design flood or flood of record, whichever is greater, to pass beneath the structure with two feet of freeboard, and the base flood to be conveyed. The calculated backwater increase is less than the 1.0-foot allowed by FEMA.

* **Limitations imposed by roadway geometrics such as maximum or minimum grade lines, sight distance, vertical curvature, etc.** The existing grade will be raised to meet minimum stopping sight distance and the horizontal geometrics will be modified to meet the 45 m.p.h. design speed for Green Valley Road.

* **Limitations imposed by existing road grade**

  The existing grade does not create any limitations to the alternatives available.

* **Clearance requirements for navigation, ice, and debris**

  Ice is not an issue and the stream is not navigable at this site. With regards to debris, the natural channel banks have areas of brush that is piled up. Increased waterway opening and freeboard will only help pass any debris buildup.

* **Overtopping of the adjoining roadway; in particular, will this affect alternative selection**

  No overtopping of roadway expected.

- **Topographical features such as stream levees, elevation of the watershed divide, and clearances for highways or railroads which are bridged**

None.

- **Flood-plain ordinances or other legislative mandates limiting allowable backwater or encroachment on the flood plain**

Current Caltrans standards require the design flood or flood of record, whichever is greater, to pass beneath the structure with two feet of freeboard, and the base flood to be conveyed.

Based on the current computer model, it is believed that the FEMA requirement of increased backwater no greater than one foot can be met.

- **Channel considerations which would influence the location or type of structure to be selected**

N/A

- **Ecological considerations such as wetlands or other sensitive environments**

Construction will take place near the channel and within the floodplain. Construction best management practices will be implemented to mitigate construction activities. Sycamore Environmental Consultants, Inc. is preparing the environmental documentation for this project that will address these practices. Impacts on wetlands and other ecologically sensitive areas, and mitigation measures will be evaluated at that time. Appropriate mitigations will be incorporated into the project.

- **Geologic or geomorphic conditions or constraints including subsurface conditions**

No subsurface investigation has been done yet at this site. The As-Built Log of Test Borings for the Green Valley Road across Dry Creek shows a mixture of clay, sand and rock fragments to a depth of 1044 feet elevation above Mean Sea Level (MSL) below that there is metamorphic bedrock.

The site is located within zone of natural occurring asbestos which is shown on NOA maps see Exhibit 4. The site will require an "Asbestos Hazard Dust Mitigation Plan" according to enacted ordinance.

- **Social considerations including the importance of the facility as an evacuation route**

It is anticipated that the structure will be constructed in phases, thus two lanes of traffic will remain open for emergency supply or evacuation.

Emergency vehicles for fire, police, and ambulance services will have local access and access through the site during the construction period. Even if the site is subject to short-term closures during construction, it could be made passable for emergency vehicles with very short notice.

A principal objective of the proposed action is to replace the functionally obsolete structure at the site and to improve the roadway approaches.

* **Availability of funds to construct the facility--This item may or may not be a consideration in a first appraisal but could ultimately govern the design selection**

Federal, State and local funding will be used for this project. Funding is obligated for the design phase and reserved for the construction phase.

**This Location Hydraulic Study was prepared by or under the direction of the following Registered Person:**

Keith T. Nelson, P.E.; Registration Expires 06/30/06

## SUMMARY OF FLOODPLAIN ENCROACHMENT REPORT

District 02 County El Dorado Route Green Valley Rd. M.P. 45
Project No.: 77109 Bridge No. 25C-0038
Limits: North Shingle Road to Oakvale Road
Floodplain Description: Upstream-moderate standing trees with medium brush
Downstream – Light to moderate standing tress with bare ground to short grass

| | No | Yes |
|---|---|---|
| 1. Is the proposed action a longitudinal encroachment of the base floodplain? | X | |
| 2. Are the risks associated with the implementation of the proposed action significant? | X | |
| 3. Will the proposed action support probable incompatible floodplain development? | X | |
| 4. Are there any significant impacts on natural and beneficial floodplain values? | X | |
| 5. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain. | X | |
| 6. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q). | X | |
| 7. Are Location Hydraulic Studies that document the above answers on file? If not, explain. | | X |

#5 Reference measures in the Natural Environmental Study.

PREPARED BY:

Keith T Nelson (signature) 4/14/06

Consultant: Keith T. Nelson, P.E. Date

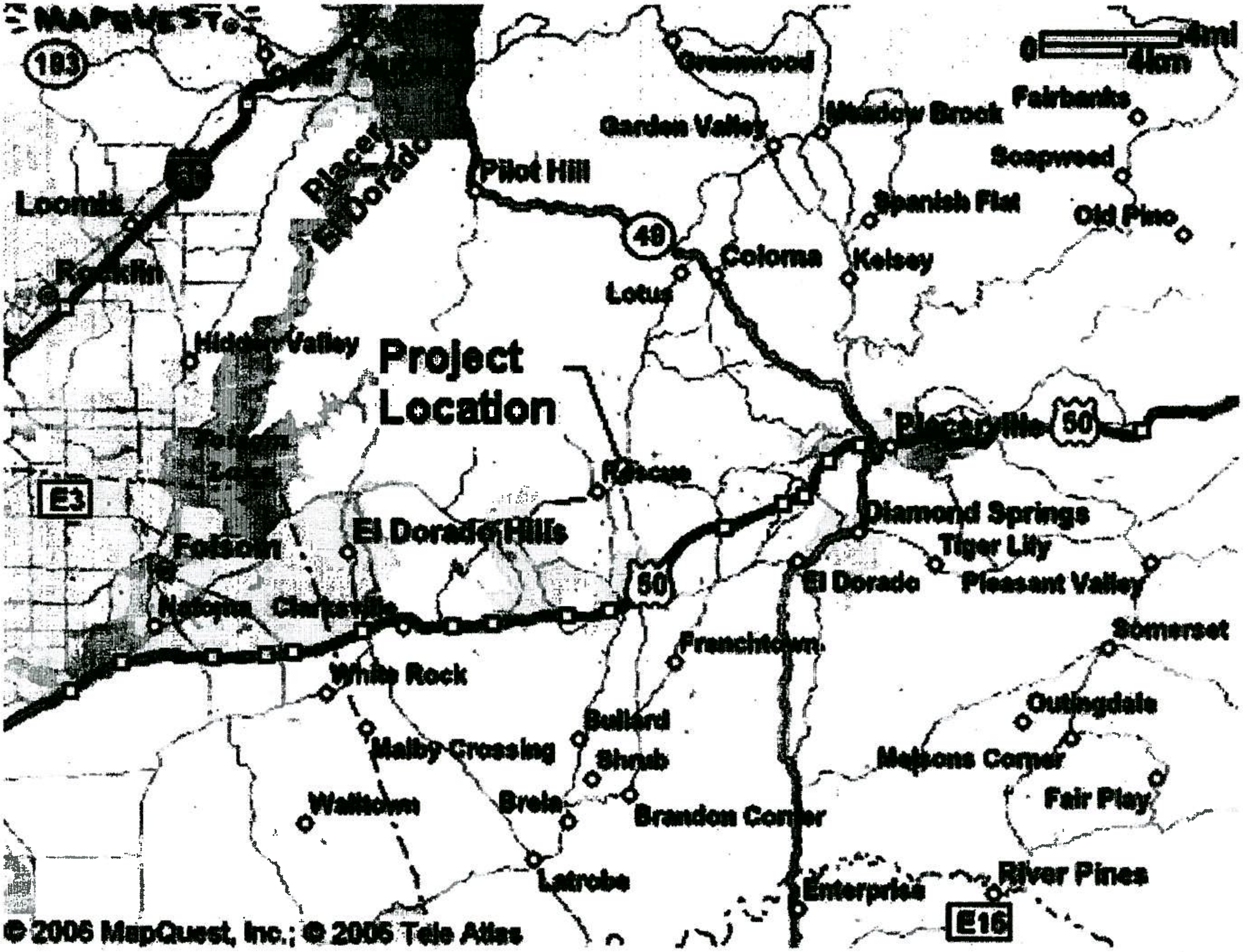
El Dorado County, Project Engineer Date

Concur: Caltrans DLAE Date

Concur: FHWA Transportation Engineer Date

# EXHIBIT 1

# PROJECT SITE LOCATION MAP



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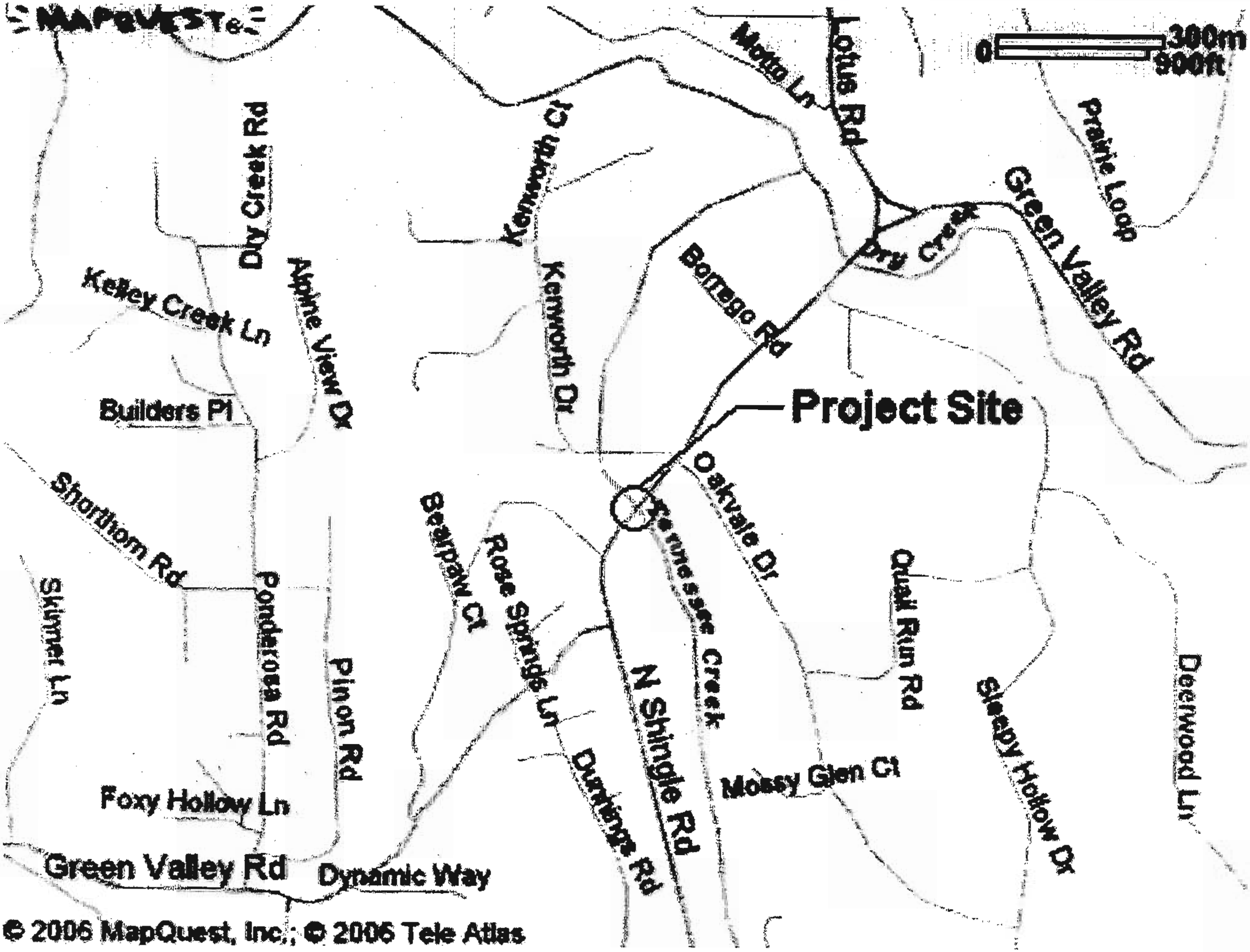
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300m
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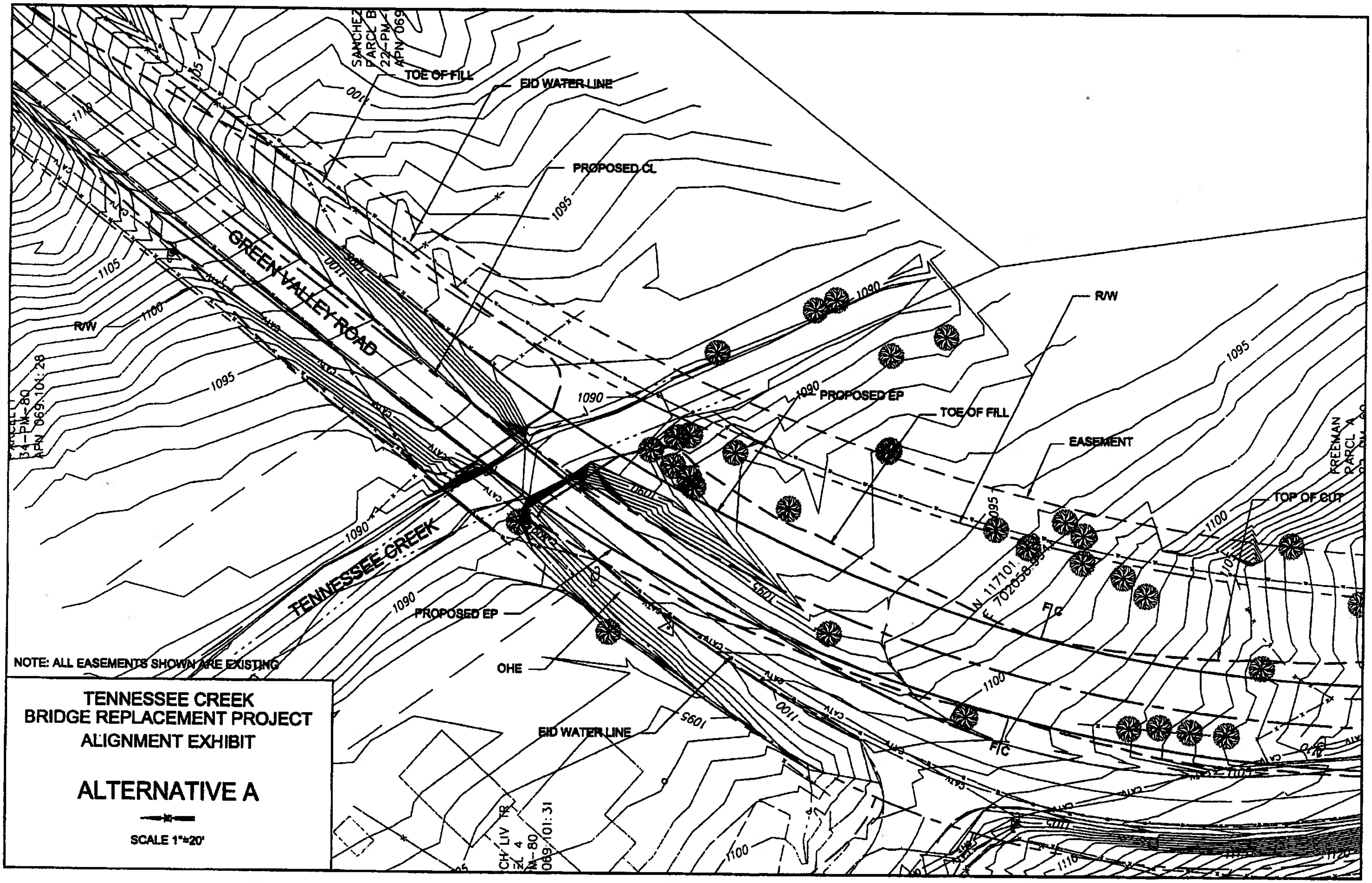
Lotus Rd
Motto Ln
Prairie Loop
Green Valley Rd
Dry Creek
Kenworth Ct
Kenworth Dr
Borrego Rd
Project Site
Dry Creek Rd
Kelley Creek Ln
Alpine View Dr
Builders Pl
Shorthorn Rd
Ponderosa Rd
Pinon Rd
Bearpaw Ct
Rose Springs Ln
Oakvale Dr
Tennessee Creek
N Shingle Rd
Dunnings Rd
Quail Run Rd
Mossy Glen Ct
Sleepy Hollow Dr
Deerwood Ln
Skinner Ln
Foxy Hollow Ln
Green Valley Rd
Dynamic Way

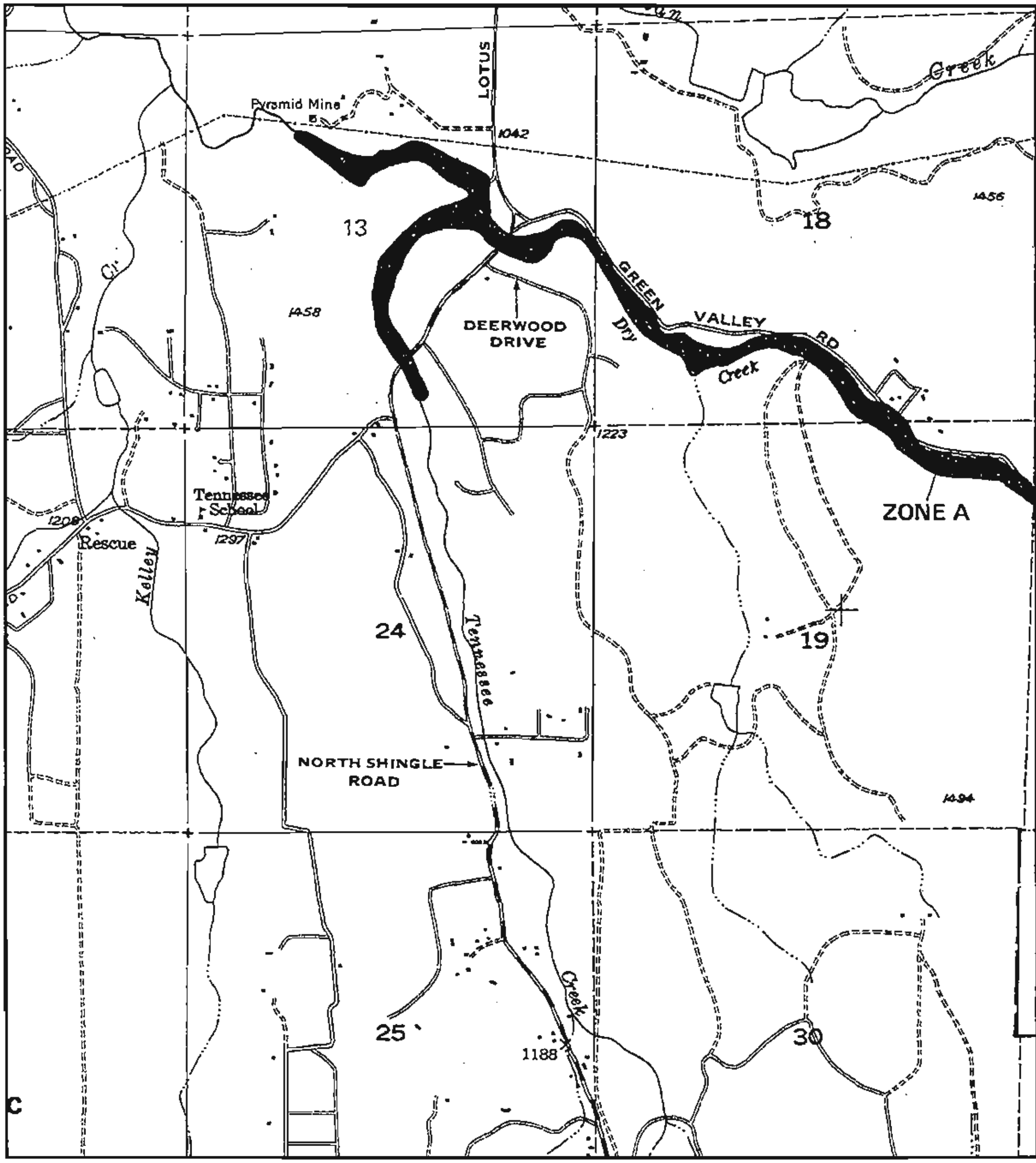
# EXHIBIT 2

# PROPOSED ACTION


TOE OF FILL
EID WATER LINE
PROPOSED CL
GREEN VALLEY ROAD
TENNESSEE CREEK
R/W
PROPOSED EP
EASEMENT
TOP OF CUT
F/C
OHE
1090
1095
1100
1105
1110
SANCHEZ
PARCL B
APN 069:101:28
FREEMAN
PARCL A
N 117101
E 702058
NOTE: ALL EASEMENTS SHOWN ARE EXISTING
TENNESSEE CREEK
BRIDGE REPLACEMENT PROJECT
ALIGNMENT EXHIBIT
ALTERNATIVE A
SCALE 1"=20'

# EXHIBIT 3

# F.I.R.M. MAP




APPROXIMATE SCALE

2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM
## FLOOD INSURANCE RATE MAP

EL DORADO COUNTY, CALIFORNIA
(UNINCORPORATED AREAS)

PANEL 725 OF 1100
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
060040 0725 C

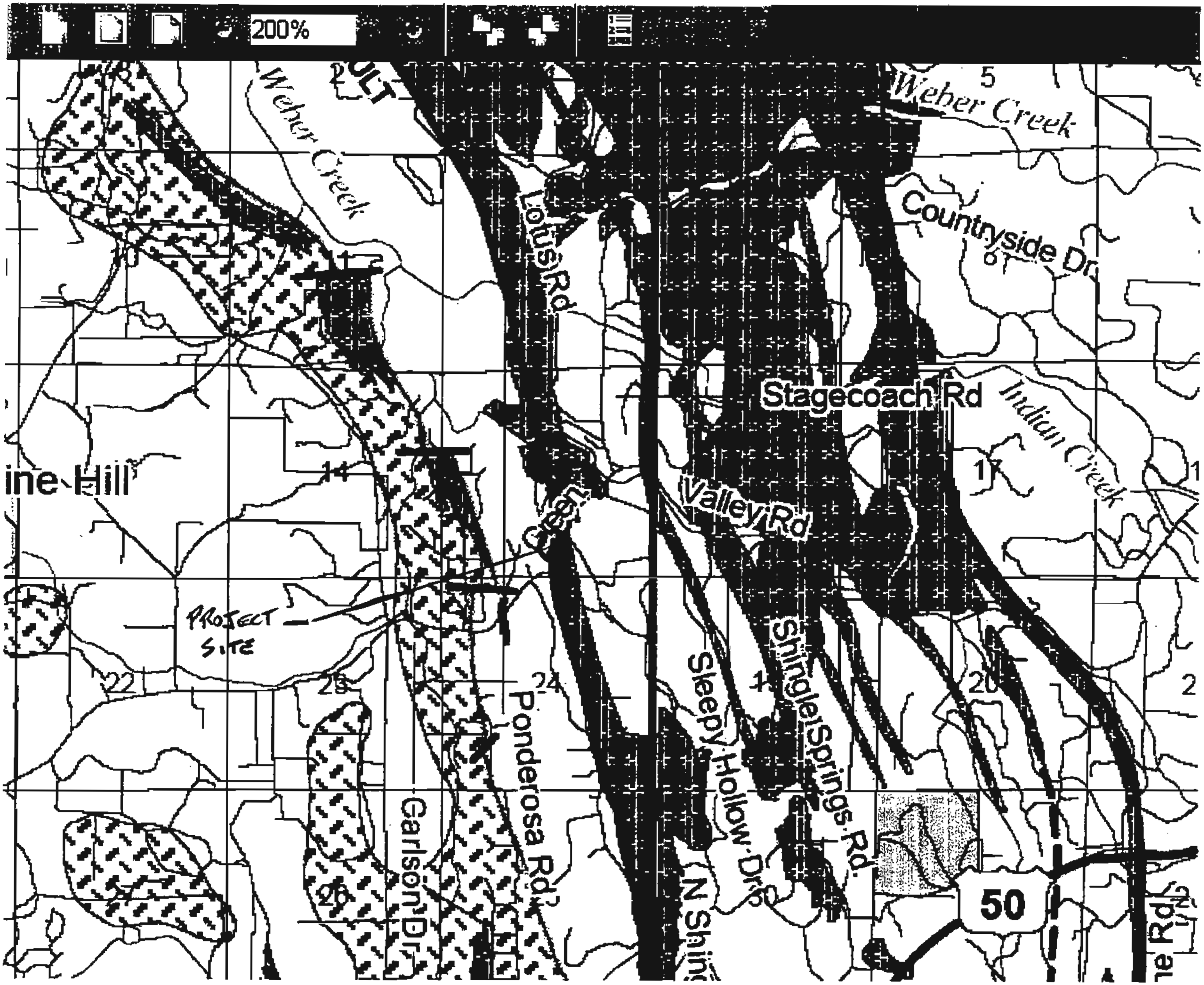
MAP REVISED:
DECEMBER 4, 1986

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

# EXHIBIT 4

# N.O.A. MAP



200%
Weber Creek
Weber Creek
Countryside Dr
Lotus Rd
Stagecoach Rd
Indian Creek
ine Hill
Green
Valley Rd
PROJECT SITE
Ponderosa Rd
Sleepy Hollow Dr
Shingle Springs Rd.
N Shing
Garlson Dr
50

# HYDRAULIC ASSESSMENT
## GREEN VALLEY BRIDGE OVER TENNESSEE CREEK
## BETWEEN N SHINGLE RD AND LOTUS ROAD
## THE TOWN OF RESCUE

### INTRODUCTION

The subject structure currently has the status of functionally obsolete due to the narrow travel width and the condition of the deck. The roadway alignment will be upgraded with the replacement of the structure. The Tennessee Creek basin is approximately 4.5 square miles. The watershed is about 3 miles long and about 1.5 miles wide. Majority of the basin consists of hilly terrain with trees. The land use consists mostly of low-density residential with small areas of higher density. The basin is aligned in a generally north-south direction with Shingle Springs on the outer southern edge.

### HYDRAULIC MODE

The project site location is mapped in Zone A on the Flood Insurance Rate Map. Zone A is described as a zone of 100 year flood with no corresponding flow values or elevations. Therefore, hydrologic computations are needed to estimate flow values.

The base flood flow of 1700 cfs was estimated from U.S.G.S regional regression equations. A basin transfer of a recent nearby bridge replacement on Dry Creek (B25C-39) gave a base flow value that was similar. Tennessee Creek is a tributary to Dry Creek therefore it has similar drainage basin characteristics.

Tail water elevations were estimated from HEC-RAS normal water computation by giving an energy grade slope. The energy grade slope can be estimated from the measured water surface slope or the stream bottom slope. The slope was computed from up and downstream survey shots.

The downstream structure was determined to have an effect on the computation of the water surface profile at the project site and needs to be modeled in the HEC-RAS analysis. The structure is located 500 feet downstream on a private drive and consists of series of 3 steel corrugated culvert pipes. The private drive has a relative low profile grade elevation, therefore it has seen frequent overflow events as observed by local land owners. It is evident that the culvert pipes and private drive constrain the flood plain due to the observed downstream scour. However this structure is outside the scope of this project.

Given the above mentioned information a HEC-RAS analysis was done for both existing and proposed conditions. The limits of the analysis are from a distance 600 feet downstream to a distance 400 feet upstream from project site.

## CONCLUSION AND RECOMMENDATIONS

The work to date has generated areas of concern and recommendation:

1. The hydraulics on the downstream stream structure produced high velocities (10-15 fps) through the existing culverts and a 3 year overtopping frequency. Furthermore, the infringement of the private drive and culverts on the flood plain produced a backwater of approximately 3.5 feet for the 50 and 100 year event. Improvements to this location are beyond the limits of this project and only can be mentioned as a concern for the owners of the private drive.
2. The effects of the proposed improvement will have minimal effect on the downstream structure. Proposed conditions may increase debris flow due to an increase in waterway opening. No other effects are foreseen with this project.
3. The new bridge should have a waterway opening large enough to produce acceptable stream velocities. Existing conditions produce stream velocities of 10-13 fps which creates a concern for scour.
4. The proposed roadway profile should be set high enough to provide 2 feet of free board during 50 year event and be able to convey a 100 year event.
5. Measures to minimize the impact of natural flowing stream during normal water should be implemented with the proposed work. Rock slope protection and piers if needed should be placed outside of the stream banks.

## DESIGN PRINCIPLES

There are several fundamental elements to designing a bridge over water that should be discussed to provide an understanding of the nature of such an undertaking.

### Hydraulics

1. FLOW—The basic equation of the movement of water in a river is flow (usually denoted as "Q") which is equal to the area of the waterway ("A") times the velocity of the flowing water ("V") or $Q = A \times V$. This means that to get the same amount of water passed any point in the river, the velocity will increase as the area is made smaller or, conversely, if the area is made larger, the flow will slow down. The area can be thought of as height times width; if the river becomes wider, the depth of flow will decrease or, as with most bridge sites, if the width is constricted, the height is increased for the same velocity. Part of the hydraulic "Catch 22" is that an increased height increases the potential (elevation) energy of the water. This normally is changed back to kinetic (movement) energy since that water is now higher than the water downstream and thus it wants to "fall" faster. River flow is not much more than many very short waterfalls.
2. VELOCITY—In a relatively straight section of river, flow velocity is the highest at the center of the river. Since the velocity is lowest at the edges, some obstruction at the foundations at the ends of the bridge (abutments) is not as critical as another pier at the center of the river; but such an obstruction still reduces waterway area and there may be regulatory problems as well.
3. SCOUR—Any time an obstruction to flow is placed in a waterway, the water immediately around that obstruction must accommodate the decrease in waterway area available. When the obstruction is as large as a bridge pier, the water flowing on the sides forces the water that is aligned with the pier to go in all directions. The surface of this water at the upstream "nose" of the pier rises a little to increase the area and some flow is forced down the pier face. If the materials on the stream bottom cannot resist this increased "vertical" flow velocity, those materials are washed away; this process is commonly called scour. The two major factors in scour are the water flow velocity and the width of the obstruction.
4. DRIFT AND DEBRIS—The piers collect drift and debris which then try to "push" the bridge over and block the waterway (decreasing the flow area and increasing the velocity). The higher velocity and larger obstruction also increase the likelihood of scour.

### Structures

1. SEISMIC—Earthquake loads may govern the lateral (horizontal) design, therefore it should be evaluated for bridges in El Dorado County.
2. CONTINUITY—The most "efficient" multi-span bridge is where the horizontal part (superstructure) is "continuous," or has no joints, over several supports (piers).
3. SPANS—The superstructure lengths between supports. The best span arrangement is where the first and last spans (end spans) are about three-fourths (75%) as long as the adjacent spans. When the end spans get shorter than half the length of the adjacent spans, the continuity causes uplift at the abutments due to loads placed in the adjacent spans. Costs also increase with inefficient span arrangements.
4. PIERS—Piers should not be placed at the center of the river where the flow velocity is the highest. Therefore, a bridge with an odd number of spans is usually best. For scour problem areas, a single span bridge (no piers) is outstanding.
5. LOADS—About 75 percent of the average bridge is used just to hold itself up; the longer the spans, the more it takes to hold itself up (more or less in proportion with the square of the span length). A bridge can be loaded near the bottom—like the Golden Gate—or on the top—like a typical freeway bridge. In this case, we should try to place loads as close to the bottom as possible to provide as much "freeboard" (vertical distance between the water and the lowest part of bridge) as possible.
6. STRENGTH—The ability of a superstructure to carry load is more or less in proportion with the cube of the dimension in the direction of the load. A 40-foot wide road bridge is over twenty times as strong as a 14-foot wide pedestrian and bicycle bridge when resisting water flow and drift and debris loads.

# APPENDIX B

## Site Photos

# Project Site

**Looking Upstream (South East)**

**Looking South toward southeast quadrant of existing structure**

# Project Site

Looking Downstream (Northwest)

Looking Downstream (Northeast corner of exist. Bridge)

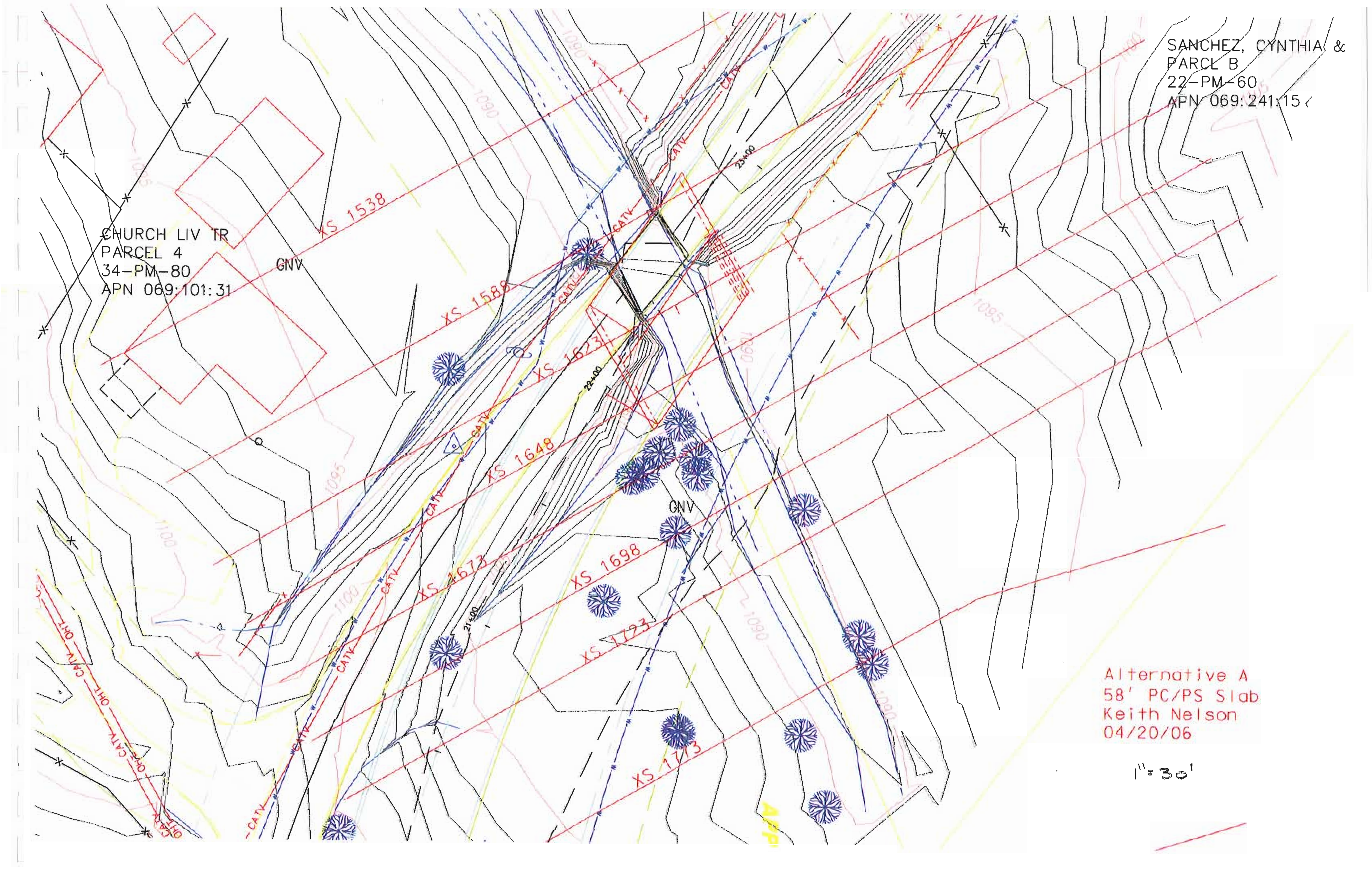
# Downstream Structure

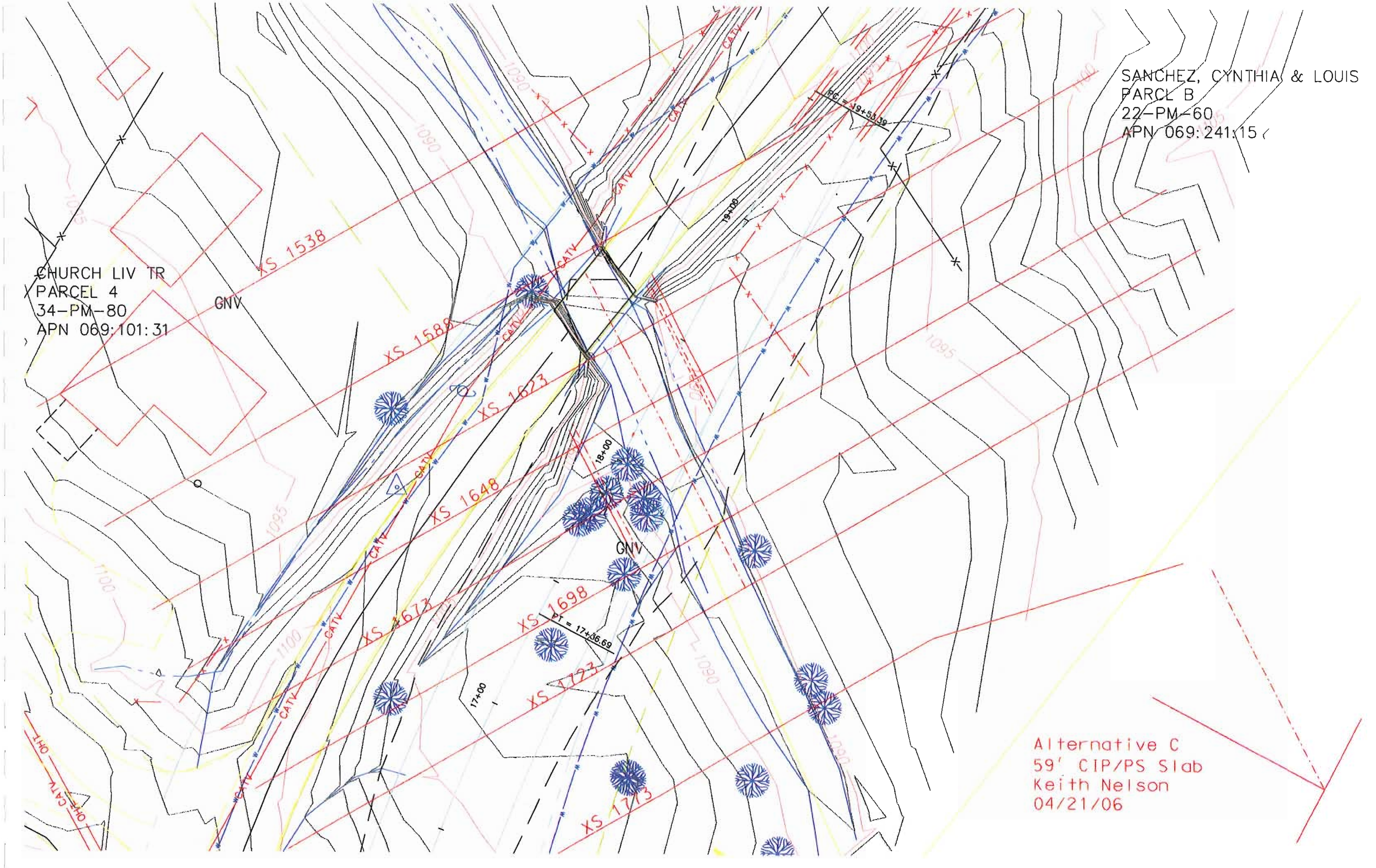
Looking toward downstream end

Looking toward upstream end

# APPENDIX C

**Contour Map (Proposed Work And Hydraulic Sections)**


SANCHEZ, CYNTHIA &
PARCL B
22-PM-60
APN 069:241:15
CHURCH LIV TR
PARCEL 4
34-PM-80
APN 069:101:31
GNV
XS 1538
XS 1588
XS 1623
XS 1648
XS 1673
XS 1698
XS 1723
XS 1773
GNV
Alternative A
58' PC/PS Slab
Keith Nelson
04/20/06
1"=30'


SANCHEZ, CYNTHIA & LOUIS
PARCEL B
22-PM-60
APN 069:241:15
CHURCH LIV TR
PARCEL 4
34-PM-80
APN 069:101:31
GNV
XS 1538
XS 1588
XS 1623
XS 1648
XS 1673
XS 1698
XS 1723
XS 1773
GNV
CATV
BC = 19+55.39
19+00
18+00
PT = 17+36.69
17+00
1090
1095
1100
OHL
Alternative C
59' CIP/PS Slab
Keith Nelson
04/21/06

# APPENDIX D

## Hydrologic Calculations

# Hydrology for Tennessee Creek Bridge

**Method 1 -Regional Regression Equations(USGS 77-21)**

Input: Drainage Area $A := 4.5$ sq. miles *(measured by planimeter)*

Mean Annual Precipitation $P := 33$ inches *(from Eldorado Co. Drainage Manual pg. 2-35)*

Altitude Index measured along main channel: *(interpolated from USGS Map)*

at 10% from Site to divide $A_{10} := 1094$ ft

at 85% from Site to divide $A_{85} := 1160$ ft

Compute: Altitude index $H := .001\,\text{mean}(A_{10}, A_{85})$ $H = 1.127$ thousand feet

Flow Values from Sierra Region Regression Eq.:

$Q_2 := 0.24 \cdot A^{.88} \cdot P^{1.58} \cdot H^{-.8}$ $Q_2 = 205$ cfs

$Q_5 := 1.20 \cdot A^{.82} \cdot P^{1.37} \cdot H^{-.64}$ $Q_5 = 459$ cfs

$Q_{10} := 2.63 \cdot A^{.80} \cdot P^{1.25} \cdot H^{-.58}$ $Q_{10} = 646$ cfs

$Q_{25} := 6.55 \cdot A^{.79} \cdot P^{1.12} \cdot H^{-.52}$ $Q_{25} = 1014$ cfs

$Q_{50} := 10.4 \cdot A^{.78} \cdot P^{1.06} \cdot H^{-.48}$ $Q_{50} = 1292$ cfs

$Q_{100} := 15.7 \cdot A^{.77} \cdot P^{1.02} \cdot H^{-.43}$ $Q_{100} = 1680$ cfs

Evaluation of Urbanization Effect on Stream Flows:

Estimate the effect of urbanization on subject site. Use tables from USGS 77-21 figure 4 pg. 29 and input for Q2 through Q100, percentages of basin developed and channels sewered can be estimated from the El Dorado County land use diagram (See Exhibit 1):

$$\text{urban} := \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}$$

Revised Values with effects of urbanization

$Q_2 := Q_2 \cdot \text{urban}_0$ $Q_2 = 205$ cfs

$Q_5 := Q_5 \cdot \text{urban}_1$ $Q_5 = 459$ cfs

$Q_{10} := Q_{10} \cdot \text{urban}_2$ $Q_{10} = 646$ cfs

$Q_{25} := Q_{25} \cdot \text{urban}_3$ $Q_{25} = 1014$ cfs

$Q_{50} := Q_{50} \cdot \text{urban}_4$ $Q_{50} = 1292$ cfs

$Q_{100} := Q_{100} \cdot \text{urban}_5$ $Q_{100} = 1680$ cfs

**Method 2 Basin Transfer of Gage Data**

Comparison No. 1 Gage #11335650 Deer Creek near Shingle Springs

Basin Data: $A_{g1} := 6.62$ sq. miles

$P_{g1} := 29$ inches

$H_{g1} := 1.4$ thousand feet

Flow Values:

$Q_{2g1} := 608$ cfs

$Q_{5g1} := 992$ cfs

$Q_{10g1} := 1280$ cfs

$Q_{25g1} := 1700$ cfs

$Q_{50g1} := 2040$ cfs

$Q_{100g1} := 2400$ cfs

Transfer to site:

$$Q_{2T1} := \left(\frac{A}{A_{g1}}\right)^{.88} \cdot \left(\frac{P}{P_{g1}}\right)^{1.58} \cdot \left(\frac{H}{H_{g1}}\right)^{-.8} \cdot Q_{2g1}$$

$Q_{2T1} = 632$ cfs

$$Q_{5T1} := \left(\frac{A}{A_{g1}}\right)^{.82} \cdot \left(\frac{P}{P_{g1}}\right)^{1.37} \cdot \left(\frac{H}{H_{g1}}\right)^{-.64} \cdot Q_{5g1}$$

$Q_{5T1} = 991$ cfs

$$Q_{10T1} := \left(\frac{A}{A_{g1}}\right)^{.80} \cdot \left(\frac{P}{P_{g1}}\right)^{1.25} \cdot \left(\frac{H}{H_{g1}}\right)^{-.58} \cdot Q_{10g1}$$

$Q_{10T1} = 1253$ cfs

$$Q_{25T1} := \left(\frac{A}{A_{g1}}\right)^{.79} \cdot \left(\frac{P}{P_{g1}}\right)^{1.12} \cdot \left(\frac{H}{H_{g1}}\right)^{-.52} \cdot Q_{25g1}$$

$Q_{25T1} = 1621$ cfs

$$Q_{50T1} := \left(\frac{A}{A_{g1}}\right)^{.78} \cdot \left(\frac{P}{P_{g1}}\right)^{1.06} \cdot \left(\frac{H}{H_{g1}}\right)^{-.48} \cdot Q_{50g1}$$

$Q_{50T1} = 1921$ cfs

$$Q_{100T1} := \left(\frac{A}{A_{g1}}\right)^{.77} \cdot \left(\frac{P}{P_{g1}}\right)^{1.02} \cdot \left(\frac{H}{H_{g1}}\right)^{-.43} \cdot Q_{100g1}$$

$Q_{100T1} = 2233$ cfs

**Method 3 Basin Transfer of Nearby Bridge Replacement (B25C-39)**

The site is a tributary to Dry Creek in which a recent bridge replacement was done at Dry Creek.

Comparison B25C-39 Dry Creek Bridge

Basin Data: $A_{br} := 12.9$ sq. miles

$P_{br} := 33$ inches

$H_{br} := 1.3$ thousand feet

Design Values from As-Built

$Q_{50br} := 2730$ cfs

$Q_{100br} := 3550$ cfs

$$Q_{50T} := \left(\frac{A}{A_{br}}\right)^{.78} \cdot \left(\frac{P}{P_{br}}\right)^{1.06} \cdot \left(\frac{H}{H_{br}}\right)^{-.48} \cdot Q_{50br}$$

$Q_{50T} = 1286$ cfs

$$Q_{100T} := \left(\frac{A}{A_{br}}\right)^{.77} \cdot \left(\frac{P}{P_{br}}\right)^{1.02} \cdot \left(\frac{H}{H_{br}}\right)^{-.43} \cdot Q_{100br}$$

$Q_{100T} = 1678$ cfs

**Summary and Design Values**

Use values computed by the U.S.G.S regression equations in method 1 since the values compared closely to the values in method 3 which is close to the site and is in the same stream confluence.

Final Design Values:

$Q_2 = 205$ cfs ***say 210 cfs***

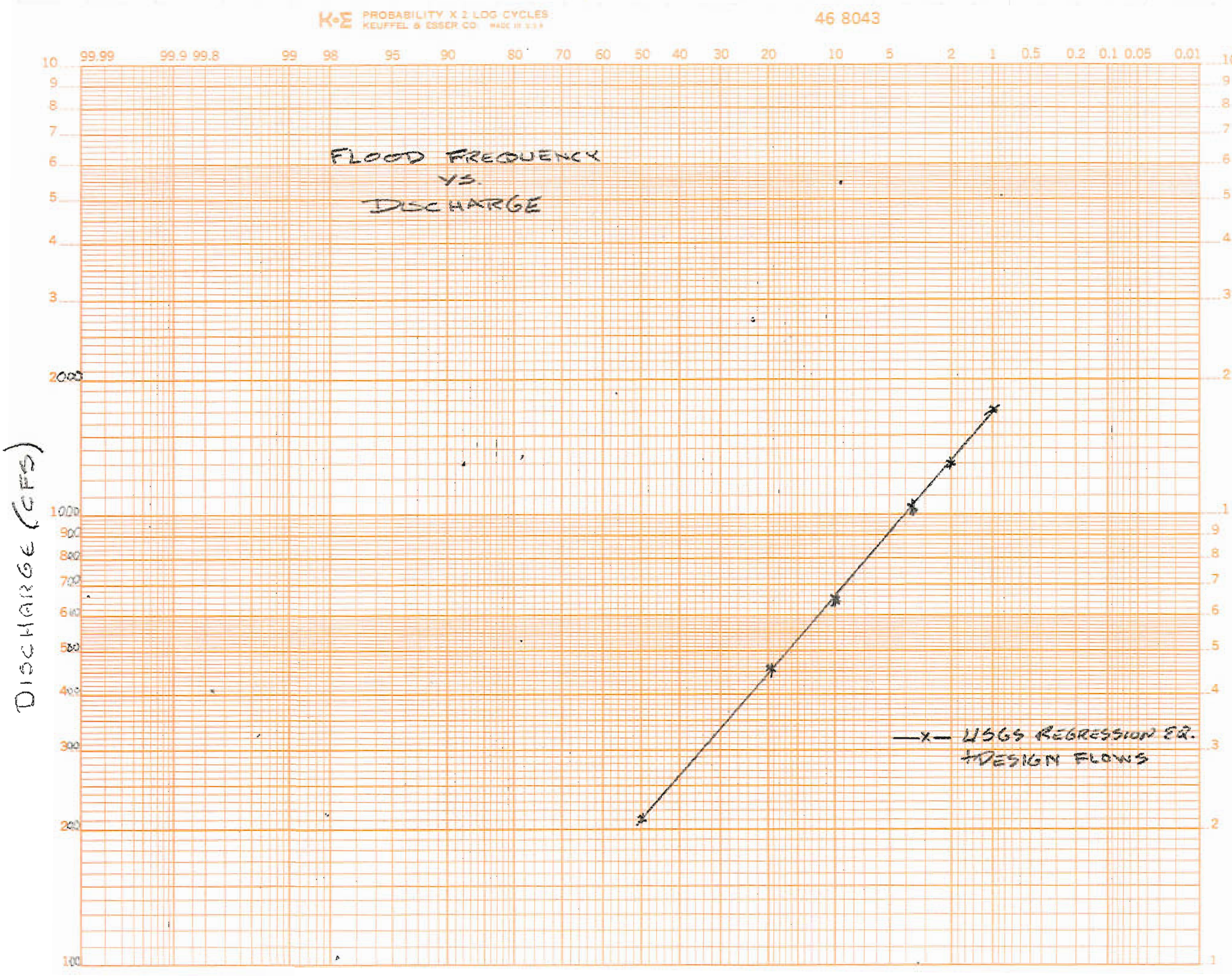
$Q_5 = 459$ cfs ***say 460 cfs***

$Q_{10} = 646$ cfs ***say 650 cfs***

$Q_{25} = 1014$ cfs ***say 1020 cfs***

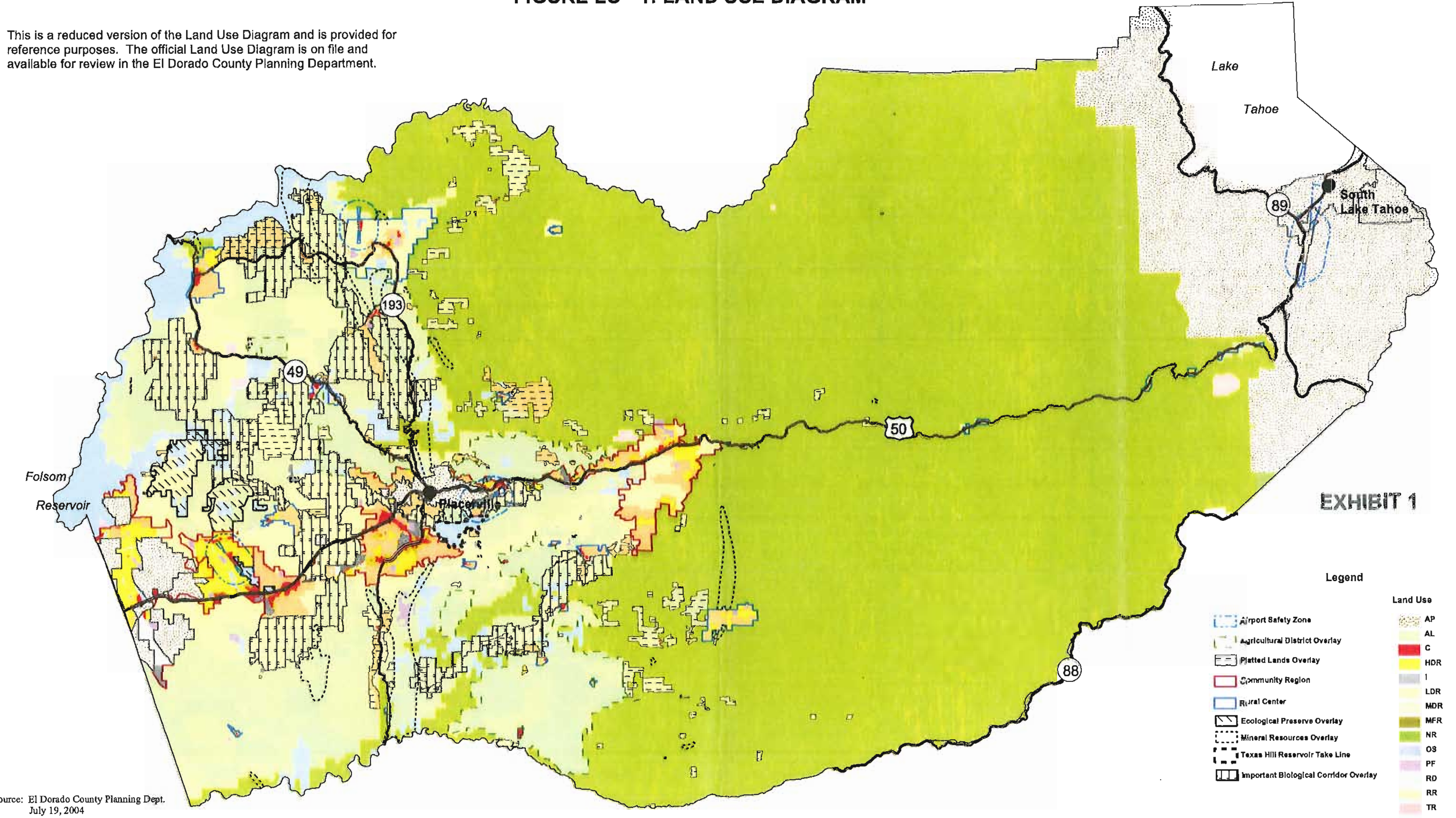
$Q_{50} = 1292$ cfs ***say 1300 cfs***

$Q_{100} = 1680$ cfs ***say 1700 cfs***


K•E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8043
FLOOD FREQUENCY
VS.
DISCHARGE
DISCHARGE (CFS)
—x— USGS REGRESSION EQ.
+DESIGN FLOWS

# FIGURE LU - 1: LAND USE DIAGRAM

This is a reduced version of the Land Use Diagram and is provided for reference purposes. The official Land Use Diagram is on file and available for review in the El Dorado County Planning Department.




Source: El Dorado County Planning Dept.
July 19, 2004

# APPENDIX E

## HEC-RAS Output Files-Existing Bridge Structure

```
HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California
```

```
X     X  XXXXXX   XXXX        XXXX      XX     XXXX
X     X  X       X    X       X   X    X  X   X
X     X  X       X            X   X   X    X  X
XXXXXXX  XXXX    X      XXX   XXXX    XXXXXX   XXXX
X     X  X       X            X  X    X    X       X
X     X  X       X    X       X   X   X    X       X
X     X  XXXXXX   XXXX        X    X  X    X  XXXXX
```

*******************************************************************************

PROJECT DATA
Project Title: Tennesse Creek at GV Rd
Project File : TennesseCreek.prj
Run Date and Time: 4/20/2006 1:24:53 PM

Project in English units

Project Description:
Green Valley Rd. over Tennessee Creek

*******************************************************************************

PLAN DATA

Plan Title: Existing Conditions
Plan File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.p01

Geometry Title: Existing Conditions
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g01

Flow Title : Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

```
Plan Summary Information:
Number of:  Cross Sections =   21    Multiple Openings  =   0
            Culverts       =    1    Inline Structures  =   0
            Bridges        =    1    Lateral Structures =   0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

*******************************************************************************

FLOW DATA

Flow Title: Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

Flow Data (cfs)

| River | Reach | RS | Q2 | Q5 | Q10 | Q25 | Q50 | Q100 |
|---|---|---|---|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | 20.043 | 210 | 460 | 650 | 1020 | 1300 | 1700 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | Q2 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q5 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q10 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q25 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q50 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q100 | | Normal S = 0.007 |

*******************************************************************************

GEOMETRY DATA

Geometry Title: Existing Conditions
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g01

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 20.043

INPUT
Description: XS2043
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 958 | 1098.45 | 980 | 1096.91 | 985 | 1090.84 |
| 997 | 1090.66 | 1000 | 1090.1 | 1010 | 1090.7 | 1013 | 1092 | 1022 | 1093.31 |
| 1042 | 1094.1 | 1047 | 1097.4 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 985 | .035 | 1013 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1013 | 120 | 140 | 140 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 19.03

INPUT
Description: XS1903
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1090 |
| 1000 | 1089.5 | 1003 | 1090 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1017 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1017 | 100 | 110 | 120 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 18.73

INPUT
Description: XS1873
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1090 |
| 1000 | 1089.6 | 1003 | 1090 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1017 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1017 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 17.73

INPUT
Description: XS1773
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1089 |
| 1000 | 1088.1 | 1003 | 1089 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1004 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1004 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 17.23

INPUT
Description: XS1723
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 800 | 1100 | 895 | 1094 | 925 | 1093 | 981 | 1089 |
| 1000 | 1088.2 | 1005 | 1089 | 1007 | 1090 | 1017 | 1091 | 1040 | 1092 |
| 1085 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 981 | .035 | 1007 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 981 | 1007 | 25 | 25 | 25 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.98

INPUT
Description: XS1698
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|

```
     775     1102      815     1100      865     1095      895     1094      950     1093
     962     1092      980     1089     1000     1088     1003     1088     1007     1090
    1014     1091     1063     1092     1159     1099     1200     1104

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
     775       .1      980     .035     1007       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
           980     1007               25       25      25                .1        .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk             RS: 16.73

INPUT
Description: XS1673
Station Elevation Data      num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*****************************************************************************************
     775     1102      800     1100      843     1100      895     1096      923     1091
     950     1092      966     1092      983     1088     1000   1087.7     1003     1088
    1007     1090     1023     1091     1057     1092     1159     1099     1200     1104

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
     775       .1      983     .035     1007       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
           983     1007               25       25      25                .1        .3
Ineffective Flow       num=        2
   Sta L    Sta R     Elev  Permanent
     775      933   1097.1       T
    1074     1200   1097.1       T

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk             RS: 16.48

INPUT
Description: XS1648(upstream xs to exist bridge)
Station Elevation Data      num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*****************************************************************************************
     790     1100      825     1097      875     1099      897     1098      935     1097
     965     1089      980     1088     1002   1086.9     1006     1088     1010     1090
    1035     1091     1070     1092     1133     1097     1190     1102

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
     790       .1      965     .035     1010       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
           965     1010               25       25      25                .3        .5
Ineffective Flow       num=        2
   Sta L    Sta R     Elev  Permanent
     790      958   1097.1       T
    1049     1190   1097.1       T

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk             RS: 16.23

INPUT
Description: XS1623(Upstream Boundary of Exist Bridge )
Station Elevation Data      num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*****************************************************************************************
     755     1103      790     1100      860     1095      880     1093      903     1096
     925     1097      983     1097    987.5     1087     1000   1087.2     1009     1088
    1016     1090     1042     1091     1135     1095     1200     1100

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
     755      .05      983     .035     1016      .05

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
           983     1016               35       35      35                .3        .5
Ineffective Flow       num=        2
   Sta L    Sta R     Elev  Permanent
     755      983   1097.1       T
    1024     1200   1097.1       T

BRIDGE


RIVER: Tennessee Creek
REACH: Tenn Crk             RS: 16.05

INPUT
Description: Existing Structure at GV
Distance from Upstream XS =         5
Deck/Roadway Width        =        25
Weir Coefficient          =       2.6
Upstream  Deck/Roadway Coordinates
     num=       10
     Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord
*******************************************************************************
     800    1100    1080       834    1099    1080       900  1097.2    1080
   987.5  1097.2    1080     987.5  1097.2  1094.2   1012.34  1097.2  1094.2
 1012.34  1097.2    1080      1100  1099.2    1080      1125  1100.9    1080
    1210    1106    1080
```

Upstream Bridge Cross Section Data
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 755 | 1103 | 790 | 1100 | 860 | 1095 | 880 | 1093 | 903 | 1096 |
| 925 | 1097 | 983 | 1097 | 987.5 | 1087 | 1000 | 1087.2 | 1009 | 1088 |
| 1016 | 1090 | 1042 | 1091 | 1135 | 1095 | 1200 | 1100 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 755 | .05 | 983 | .035 | 1016 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 983 | 1016 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 755 | 983 | 1097.1 | T |
| 1024 | 1200 | 1097.1 | T |

Downstream Deck/Roadway Coordinates
num= 10

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 800 | 1100 | 1080 | 834 | 1099 | 1080 | 900 | 1097.2 | 1080 |
| 987.5 | 1097.2 | 1080 | 987.5 | 1097.2 | 1094.2 | 1012.34 | 1097.2 | 1094.2 |
| 1012.34 | 1097.2 | 1080 | 1100 | 1099.2 | 1080 | 1125 | 1100.9 | 1080 |
| 1210 | 1106 | 1080 | | | | | | |

Downstream Bridge Cross Section Data
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1099 | 822 | 1097 | 837 | 1096 | 866 | 1095 |
| 892 | 1094 | 906 | 1094 | 946 | 1093 | 950 | 1091 | 975 | 1090 |
| 1000 | 1087.3 | 1011 | 1088 | 1017 | 1097.7 | 1018 | 1097.7 | 1040 | 1099 |
| 1067 | 1099 | 1115 | 1095 | 1210 | 1100 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .05 | 975 | .035 | 1011 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 975 | 1011 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 984 | 1097.2 | T |
| 1012 | 1210 | 1097.2 | T |

Upstream Embankment side slope = 4 horiz. to 1.0 vertical
Downstream Embankment side slope = 4 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.88

INPUT
Description: XS1588 (Downstream Existing Bridge Boundary)
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1099 | 822 | 1097 | 837 | 1096 | 866 | 1095 |
| 892 | 1094 | 906 | 1094 | 946 | 1093 | 950 | 1091 | 975 | 1090 |
| 1000 | 1087.3 | 1011 | 1088 | 1017 | 1097.7 | 1018 | 1097.7 | 1040 | 1099 |
| 1067 | 1099 | 1115 | 1095 | 1210 | 1100 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .05 | 975 | .035 | 1011 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 975 | 1011 | 50 | 50 | 50 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 984 | 1097.2 | T |
| 1012 | 1210 | 1097.2 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.38

INPUT
Description: XS1538
Station Elevation Data num= 17

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 992 | 1088 | 1004 | 1088.15 | 1011 | 1088 |
| 1013 | 1089 | 1017 | 1090 | 1032 | 1091 | 1060 | 1092 | 1075 | 1093 |
| 1090 | 1094 | 1200 | 1105 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .06 | 972 | .035 | 1013 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1013 | 50 | 50 | 50 | .1 | .3 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 959 | 1097.2 | T |
| 1062 | 1200 | 1097.2 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 14.88

INPUT
Description: XS1488
Station Elevation Data num= 17

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 993 | 1088 | 1006 | 1087.4 | 1008 | 1088 |
| 1009 | 1089 | 1014 | 1090 | 1021 | 1091 | 1072 | 1092 | 1086 | 1093 |
| 1097 | 1094 | 1200 | 1107 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .06 | 972 | .035 | 1009 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1009 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 14.38

INPUT
Description: XS1438
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 983 | 1088 | 1000 | 1086.5 | 1002 | 1087 |
| 1004 | 1088 | 1009 | 1089 | 1016 | 1090 | 1034 | 1091 | 1082 | 1092 |
| 1102 | 1093 | 1119 | 1094 | 1200 | 1106 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .08 | 972 | .035 | 1009 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1009 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 13.88

INPUT
Description: XS1388
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1105 | 885 | 1094 | 902 | 1093 | 960 | 1092 | 985 | 1088 |
| 1000 | 1086.4 | 1006 | 1087 | 1020 | 1089 | 1028 | 1090 | 1066 | 1091 |
| 1100 | 1092 | 1140 | 1095 | 1200 | 1105 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .08 | 985 | .035 | 1020 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1020 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 12.88

INPUT
Description: XS1288
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1105 | 885 | 1094 | 902 | 1093 | 960 | 1092 | 985 | 1088 |
| 1000 | 1085.8 | 1006 | 1086 | 1020 | 1089 | 1028 | 1090 | 1066 | 1091 |
| 1100 | 1092 | 1140 | 1095 | 1200 | 1105 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 985 | .035 | 1020 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1020 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.89

INPUT
Description: XS1189
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 995 | 1085 | 999 | 1084.77 | 1005 | 1085 |
| 1010 | 1085 | 1017 | 1086 | 1030 | 1087 | 1055 | 1090 | 1100 | 1090 |
| 1360 | 1115 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 995 | .035 | 1005 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 995 | 1005 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.69

INPUT
Description: XS1169
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 990 | 1085 | 991 | 1084.75 | 1008 | 1084.4 |
| 1010 | 1085 | 1014 | 1087 | 1023 | 1088 | 1030 | 1089 | 1055 | 1090 |
| 1100 | 1090 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 990 | .035 | 1014 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 990 | 1014 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.49

INPUT
Description: Upstream Culvert XS1149
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 984 | 1017 | 40 | 40 | 40 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 970 | 1091 | T |
| 1017 | 1360 | 1091 | T |

CULVERT

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.29

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 15
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 9

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 940 | 1090.9 | 1084 | 950 | 1090.6 | 1084 | 970 | 1091.2 | 1084 |
| 990 | 1091.5 | 1083 | 1005 | 1091.6 | 1083 | 1025 | 1091.1 | 1083 |
| 1060 | 1090.5 | 1083 | 1090 | 1090.1 | 1084 | 2000 | 1115 | 1084 |

Upstream Bridge Cross Section Data
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 984 | 1017 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 970 | 1091 | T |
| 1017 | 1360 | 1091 | T |

Downstream Deck/Roadway Coordinates
num= 9

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 940 | 1090.9 | 1084 | 950 | 1090.6 | 1084 | 970 | 1091.2 | 1084 |
| 990 | 1091.5 | 1083 | 1005 | 1091.6 | 1083 | 1025 | 1091.1 | 1083 |
| 1060 | 1090.5 | 1083 | 1090 | 1090.1 | 1084 | 2000 | 1115 | 1084 |

Downstream Bridge Cross Section Data
Station Elevation Data num= 15

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 900 | 1093 | 925 | 1090 | 960 | 1091 | 983 | 1091 |
| 983 | 1084.35 | 1000 | 1084.57 | 1013 | 1084.82 | 1013 | 1083 | 1017 | 1083 |
| 1028 | 1083.92 | 1042 | 1084 | 1055 | 1089 | 1084 | 1089 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 983 | .035 | 1042 | .05 |

Bank Sta: Left Right Coeff Contr. Expan.
983 1042 .3 .5
Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 983 | 1091 | T |
| 1035 | 1360 | 1091 | F |

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 3

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #1 | Ellipse | 5.5 | 6 |

FHWA Chart # 29- Horizontal Ellipse; Concrete
FHWA Scale # 1 - Square edge with headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 20 | 13 | .024 | .024 | 0 | .5 | 1 |

Upstream Elevation = 1084.87
Centerline Station = 992
Downstream Elevation = 1084.6
Centerline Station = 997

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #2 | Circular | 3 | |

FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 1 - Headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 2 | 38 | .024 | .024 | 0 | .9 | 1 |

Upstream Elevation = 1083.9
Centerline Station = 1005
Downstream Elevation = 1082.93
Centerline Station = 1016

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #3 | Circular | 5 | |

FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 2 | 32 | .024 | .024 | 0 | .9 | 1 |

Upstream Elevation = 1083.38
Centerline Station = 1010
Downstream Elevation = 1083.29
Centerline Station = 1021

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.09

INPUT
Description: XS1109 Boundary Culvert Downstream Section
Station Elevation Data num= 15

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 900 | 1093 | 925 | 1090 | 960 | 1091 | 983 | 1091 |
| 983 | 1084.35 | 1000 | 1084.57 | 1013 | 1084.82 | 1013 | 1083 | 1017 | 1083 |
| 1028 | 1083.92 | 1042 | 1084 | 1055 | 1089 | 1084 | 1089 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 983 | .035 | 1042 | .05 |

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
983 1042 50 50 50 .3 .5
Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 983 | 1091 | T |
| 1035 | 1360 | 1091 | F |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10.59

INPUT
Description: XS1059
Station Elevation Data num= 20

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 920 | 1093.88 | 926 | 1093 | 934 | 1092 | 947 | 1091 |
| 961 | 1090 | 967 | 1089 | 968 | 1089 | 970 | 1088 | 973 | 1087 |
| 976 | 1086 | 984 | 1085 | 991 | 1084 | 997 | 1083 | 1000 | 1082.36 |
| 1004 | 1083 | 1010 | 1084 | 1015 | 1085 | 1055 | 1088.15 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 991 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 991 | 1010 | 60 | 60 | 60 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10

INPUT
Description: XS1000 (Surveyed x-section)
Station Elevation Data num= 22

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 947 | 1094 | 949 | 1093.65 | 952 | 1092.95 | 954 | 1091.18 |
| 958 | 1091.9 | 970 | 1091.23 | 990 | 1088.65 | 997 | 1085.38 | 1000 | 1082.18 |
| 1010 | 1083.31 | 1027 | 1083.22 | 1033 | 1086.45 | 1049 | 1085.97 | 1075 | 1087.86 |
| 1082 | 1084.04 | 1098 | 1083.58 | 1122 | 1084.71 | 1148 | 1088.66 | 1152 | 1086.59 |
| 1167 | 1088.78 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 990 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 990 | 1010 | .1 | .3 |

Ineffective Flow num= 1

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 1075 | 1170 | 1088.7 | T |

SUMMARY OF MANNING'S N VALUES

River:Tennessee Creek

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .035 | .1 |
| Tenn Crk | 19.03 | .1 | .035 | .1 |
| Tenn Crk | 18.73 | .1 | .035 | .1 |
| Tenn Crk | 17.73 | .1 | .035 | .1 |
| Tenn Crk | 17.23 | .1 | .035 | .1 |
| Tenn Crk | 16.98 | .1 | .035 | .1 |
| Tenn Crk | 16.73 | .1 | .035 | .1 |
| Tenn Crk | 16.48 | .1 | .035 | .1 |
| Tenn Crk | 16.23 | .05 | .035 | .05 |
| Tenn Crk | 16.05 | Bridge | | |
| Tenn Crk | 15.88 | .05 | .035 | .05 |
| Tenn Crk | 15.38 | .06 | .035 | .08 |
| Tenn Crk | 14.88 | .06 | .035 | .08 |
| Tenn Crk | 14.38 | .08 | .035 | .08 |
| Tenn Crk | 13.88 | .08 | .035 | .08 |
| Tenn Crk | 12.88 | .1 | .035 | .1 |
| Tenn Crk | 11.89 | .1 | .035 | .06 |
| Tenn Crk | 11.69 | .1 | .035 | .06 |
| Tenn Crk | 11.49 | .1 | .035 | .06 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | .05 | .035 | .05 |
| Tenn Crk | 10.59 | .05 | .035 | .05 |
| Tenn Crk | 10 | .05 | .035 | .05 |

SUMMARY OF REACH LENGTHS

River: Tennessee Creek

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Tenn Crk | 20.043 | 120 | 140 | 140 |
| Tenn Crk | 19.03 | 100 | 110 | 120 |
| Tenn Crk | 18.73 | 100 | 100 | 100 |
| Tenn Crk | 17.73 | 50 | 50 | 50 |
| Tenn Crk | 17.23 | 25 | 25 | 25 |
| Tenn Crk | 16.98 | 25 | 25 | 25 |
| Tenn Crk | 16.73 | 25 | 25 | 25 |
| Tenn Crk | 16.48 | 25 | 25 | 25 |
| Tenn Crk | 16.23 | 35 | 35 | 35 |
| Tenn Crk | 16.05 | Bridge | | |
| Tenn Crk | 15.88 | 50 | 50 | 50 |
| Tenn Crk | 15.38 | 50 | 50 | 50 |
| Tenn Crk | 14.88 | 50 | 50 | 50 |
| Tenn Crk | 14.38 | 50 | 50 | 50 |
| Tenn Crk | 13.88 | 100 | 100 | 100 |
| Tenn Crk | 12.88 | 100 | 100 | 100 |
| Tenn Crk | 11.89 | 20 | 20 | 20 |
| Tenn Crk | 11.69 | 20 | 20 | 20 |
| Tenn Crk | 11.49 | 40 | 40 | 40 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | 50 | 50 | 50 |
| Tenn Crk | 10.59 | 60 | 60 | 60 |
| Tenn Crk | 10 | | | |

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Tennessee Creek

| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .3 |
| Tenn Crk | 19.03 | .1 | .3 |
| Tenn Crk | 18.73 | .1 | .3 |
| Tenn Crk | 17.73 | .1 | .3 |
| Tenn Crk | 17.23 | .1 | .3 |
| Tenn Crk | 16.98 | .1 | .3 |
| Tenn Crk | 16.73 | .1 | .3 |
| Tenn Crk | 16.48 | .3 | .5 |
| Tenn Crk | 16.23 | .3 | .5 |
| Tenn Crk | 16.05 | Bridge | |
| Tenn Crk | 15.88 | .3 | .5 |
| Tenn Crk | 15.38 | .1 | .3 |
| Tenn Crk | 14.88 | .1 | .3 |
| Tenn Crk | 14.38 | .1 | .3 |
| Tenn Crk | 13.88 | .1 | .3 |
| Tenn Crk | 12.88 | .1 | .3 |
| Tenn Crk | 11.89 | .3 | .5 |
| Tenn Crk | 11.69 | .3 | .5 |
| Tenn Crk | 11.49 | .3 | .5 |
| Tenn Crk | 11.29 | Culvert | |
| Tenn Crk | 11.09 | .3 | .5 |
| Tenn Crk | 10.59 | .1 | .3 |
| Tenn Crk | 10 | .1 | .3 |

HEC-RAS Plan: Existing River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Tenn Crk | 20.043 | Q50 | 1300.00 | 1090.10 | 1095.25 | | 1096.48 | 0.006317 | 9.26 | 192.08 | 62.38 | 0.76 |
| Tenn Crk | 20.043 | Q100 | 1700.00 | 1090.10 | 1096.68 | | 1097.73 | 0.003977 | 8.80 | 283.50 | 65.71 | 0.63 |
| Tenn Crk | 19.03 | Q50 | 1300.00 | 1089.50 | 1095.61 | | 1095.84 | 0.001304 | 4.79 | 686.53 | 256.43 | 0.36 |
| Tenn Crk | 19.03 | Q100 | 1700.00 | 1089.50 | 1097.12 | | 1097.27 | 0.000713 | 4.16 | 1117.50 | 302.38 | 0.28 |
| Tenn Crk | 18.73 | Q50 | 1300.00 | 1089.60 | 1095.42 | | 1095.68 | 0.001531 | 5.05 | 638.73 | 245.73 | 0.39 |
| Tenn Crk | 18.73 | Q100 | 1700.00 | 1089.60 | 1097.03 | | 1097.19 | 0.000762 | 4.25 | 1089.68 | 300.51 | 0.28 |
| Tenn Crk | 17.73 | Q50 | 1300.00 | 1088.10 | 1095.18 | | 1095.51 | 0.001750 | 6.10 | 634.92 | 231.96 | 0.42 |
| Tenn Crk | 17.73 | Q100 | 1700.00 | 1088.10 | 1096.92 | | 1097.10 | 0.000857 | 5.00 | 1111.81 | 298.30 | 0.31 |
| Tenn Crk | 17.23 | Q50 | 1300.00 | 1088.20 | 1095.21 | | 1095.40 | 0.000952 | 4.54 | 764.14 | 246.67 | 0.31 |
| Tenn Crk | 17.23 | Q100 | 1700.00 | 1088.20 | 1096.93 | | 1097.05 | 0.000534 | 3.98 | 1232.76 | 295.78 | 0.24 |
| Tenn Crk | 16.98 | Q50 | 1300.00 | 1088.00 | 1095.13 | | 1095.37 | 0.001075 | 4.84 | 678.77 | 242.15 | 0.33 |
| Tenn Crk | 16.98 | Q100 | 1700.00 | 1088.00 | 1096.89 | | 1097.04 | 0.000576 | 4.15 | 1141.24 | 283.85 | 0.25 |
| Tenn Crk | 16.73 | Q50 | 1300.00 | 1087.70 | 1095.11 | | 1095.34 | 0.000976 | 4.82 | 603.98 | 202.34 | 0.32 |
| Tenn Crk | 16.73 | Q100 | 1700.00 | 1087.70 | 1096.83 | | 1097.02 | 0.000650 | 4.55 | 846.24 | 243.13 | 0.27 |
| Tenn Crk | 16.48 | Q50 | 1300.00 | 1086.90 | 1095.16 | | 1095.31 | 0.000481 | 3.44 | 532.22 | 167.68 | 0.23 |
| Tenn Crk | 16.48 | Q100 | 1700.00 | 1086.90 | 1096.83 | | 1097.00 | 0.000386 | 3.55 | 685.80 | 195.28 | 0.21 |
| Tenn Crk | 16.23 | Q50 | 1300.00 | 1087.00 | 1094.76 | 1091.66 | 1095.20 | 0.001637 | 5.50 | 250.82 | 176.41 | 0.37 |
| Tenn Crk | 16.23 | Q100 | 1700.00 | 1087.00 | 1096.43 | 1092.36 | 1096.89 | 0.001359 | 5.64 | 318.29 | 242.77 | 0.35 |
| Tenn Crk | 16.05 | | Bridge | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1300.00 | 1087.30 | 1092.86 | | 1094.30 | 0.006310 | 9.70 | 136.39 | 67.72 | 0.77 |
| Tenn Crk | 15.88 | Q100 | 1700.00 | 1087.30 | 1093.09 | 1092.88 | 1095.34 | 0.009242 | 12.11 | 142.90 | 71.70 | 0.94 |
| Tenn Crk | 15.38 | Q50 | 1300.00 | 1088.00 | 1093.23 | | 1093.61 | 0.001892 | 5.33 | 345.97 | 196.34 | 0.42 |
| Tenn Crk | 15.38 | Q100 | 1700.00 | 1088.00 | 1093.79 | | 1094.26 | 0.002134 | 6.07 | 402.74 | 211.30 | 0.46 |
| Tenn Crk | 14.88 | Q50 | 1300.00 | 1087.40 | 1093.00 | | 1093.48 | 0.002568 | 6.08 | 337.45 | 140.99 | 0.49 |
| Tenn Crk | 14.88 | Q100 | 1700.00 | 1087.40 | 1093.58 | | 1094.13 | 0.002657 | 6.67 | 457.75 | 214.40 | 0.51 |
| Tenn Crk | 14.38 | Q50 | 1300.00 | 1086.50 | 1092.92 | | 1093.35 | 0.002096 | 5.74 | 372.65 | 154.21 | 0.45 |
| Tenn Crk | 14.38 | Q100 | 1700.00 | 1086.50 | 1093.48 | | 1094.00 | 0.002288 | 6.42 | 492.88 | 231.00 | 0.47 |
| Tenn Crk | 13.88 | Q50 | 1300.00 | 1086.40 | 1092.88 | | 1093.24 | 0.001682 | 5.36 | 454.82 | 202.84 | 0.41 |
| Tenn Crk | 13.88 | Q100 | 1700.00 | 1086.40 | 1093.46 | | 1093.86 | 0.001777 | 5.90 | 579.91 | 225.29 | 0.42 |
| Tenn Crk | 12.88 | Q50 | 1300.00 | 1085.80 | 1092.64 | | 1093.06 | 0.001767 | 5.62 | 423.32 | 185.27 | 0.42 |
| Tenn Crk | 12.88 | Q100 | 1700.00 | 1085.80 | 1093.11 | | 1093.65 | 0.002123 | 6.50 | 519.36 | 214.70 | 0.46 |
| Tenn Crk | 11.89 | Q50 | 1300.00 | 1084.77 | 1092.71 | | 1092.85 | 0.000899 | 5.01 | 690.57 | 193.32 | 0.32 |
| Tenn Crk | 11.89 | Q100 | 1700.00 | 1084.77 | 1093.21 | | 1093.40 | 0.001085 | 5.74 | 791.93 | 205.22 | 0.35 |
| Tenn Crk | 11.69 | Q50 | 1300.00 | 1084.40 | 1092.64 | | 1092.82 | 0.000678 | 4.28 | 644.36 | 191.80 | 0.27 |
| Tenn Crk | 11.69 | Q100 | 1700.00 | 1084.40 | 1093.13 | | 1093.36 | 0.000847 | 4.98 | 740.01 | 203.13 | 0.30 |
| Tenn Crk | 11.49 | Q50 | 1300.00 | 1083.09 | 1092.53 | 1087.95 | 1092.79 | 0.000688 | 4.31 | 474.93 | 166.76 | 0.27 |
| Tenn Crk | 11.49 | Q100 | 1700.00 | 1083.09 | 1092.94 | 1088.71 | 1093.31 | 0.000937 | 5.20 | 540.75 | 176.82 | 0.31 |
| Tenn Crk | 11.29 | | Culvert | | | | | | | | | |
| Tenn Crk | 11.09 | Q50 | 1300.00 | 1083.00 | 1088.88 | 1086.81 | 1089.31 | 0.002247 | 5.26 | 246.99 | 71.67 | 0.43 |
| Tenn Crk | 11.09 | Q100 | 1700.00 | 1083.00 | 1089.40 | 1087.34 | 1090.00 | 0.002740 | 6.20 | 274.33 | 105.25 | 0.48 |
| Tenn Crk | 10.59 | Q50 | 1300.00 | 1082.36 | 1088.27 | | 1089.05 | 0.004681 | 8.49 | 239.56 | 86.94 | 0.66 |
| Tenn Crk | 10.59 | Q100 | 1700.00 | 1082.36 | 1088.77 | | 1089.71 | 0.005220 | 9.55 | 284.47 | 93.58 | 0.71 |
| Tenn Crk | 10 | Q50 | 1300.00 | 1082.18 | 1088.02 | 1087.38 | 1088.67 | 0.007001 | 8.23 | 230.41 | 164.96 | 0.73 |
| Tenn Crk | 10 | Q100 | 1700.00 | 1082.18 | 1088.56 | 1087.98 | 1089.28 | 0.006998 | 8.64 | 276.09 | 174.46 | 0.74 |

HEC-RAS Plan: Existing River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | E.G. Elev | W.S. Elev | Crit W.S. | Frctn Loss | C & E Loss | Top Width | Q Left | Q Channel | Q Right | Vel Chnl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft/s) |
| Tenn Crk | 16.48 | Q50 | 1095.31 | 1095.15 | | 0.02 | 0.08 | 167.68 | 34.93 | 1115.35 | 149.73 | 3.44 |
| Tenn Crk | 16.48 | Q100 | 1097.00 | 1096.83 | | 0.02 | 0.09 | 195.28 | 49.96 | 1419.38 | 230.66 | 3.55 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.23 | Q50 | 1095.20 | 1094.76 | 1091.68 | 0.01 | 0.16 | 176.41 | | 1177.49 | 122.51 | 5.50 |
| Tenn Crk | 16.23 | Q100 | 1096.89 | 1096.43 | 1092.36 | 0.02 | 0.34 | 242.77 | | 1512.96 | 187.04 | 5.64 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.05 BR U | Q50 | 1095.03 | 1094.04 | 1091.88 | 0.12 | 0.30 | 24.84 | | 1300.00 | | 7.96 |
| Tenn Crk | 16.05 BR U | Q100 | 1096.54 | 1094.93 | 1092.74 | 0.31 | 0.32 | | | 1700.00 | | 10.16 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.05 BR D | Q50 | 1094.61 | 1092.63 | 1092.36 | 0.04 | 0.27 | 24.84 | | 1282.97 | 17.03 | 11.37 |
| Tenn Crk | 16.05 BR D | Q100 | 1095.90 | 1093.23 | 1093.23 | 0.05 | 0.21 | 24.84 | | 1676.67 | 23.33 | 13.21 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1094.30 | 1092.86 | | 0.16 | 0.54 | 67.72 | | 1284.18 | 15.82 | 9.70 |
| Tenn Crk | 15.88 | Q100 | 1095.34 | 1093.09 | 1092.88 | 0.19 | 0.89 | 71.70 | | 1678.99 | 21.01 | 12.11 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.38 | Q50 | 1093.61 | 1093.23 | | 0.11 | 0.01 | 196.34 | 78.42 | 1076.84 | 144.74 | 5.33 |
| Tenn Crk | 15.38 | Q100 | 1094.26 | 1093.79 | | 0.12 | 0.01 | 211.30 | 111.85 | 1364.37 | 223.77 | 6.07 |

# APPENDIX F

## HEC-RAS Output Files-Proposed Bridge Structure

# Proposed Bridge Structure-Alt A
# (50+100-Year Flood)

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX      XX      XXXX
X     X  X        X    X       X   X    X  X    X
X     X  X        X            X   X   X    X   X
XXXXXXX  XXXX     X      XXX   XXXX    XXXXXX    XXXX
X     X  X        X            X X     X    X        X
X     X  X        X    X       X  X    X    X        X
X     X  XXXXXX    XXXX        X   X   X    X   XXXXX
```

*******************************************************************************

PROJECT DATA
Project Title: Tennesse Creek at GV Rd
Project File : TennesseCreek.prj
Run Date and Time: 4/20/2006 3:23:26 PM

Project in English units

Project Description:
Green Valley Rd. over Tennessee Creek

*******************************************************************************

PLAN DATA

Plan Title: Alt A-58' Span
Plan File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.p05

Geometry Title: Proposed Conditions(20' Stream)
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g03

Flow Title : Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

Plan Summary Information:

| Number of: | | | | |
|---|---|---|---|---|
| Cross Sections = | 20 | Multiple Openings = | 0 |
| Culverts = | 1 | Inline Structures = | 0 |
| Bridges = | 1 | Lateral Structures = | 0 |

Computational Information
- Water surface calculation tolerance = 0.01
- Critical depth calculation tolerance = 0.01
- Maximum number of iterations = 20
- Maximum difference tolerance = 0.3
- Flow tolerance factor = 0.001

Computation Options
- Critical depth computed only where necessary
- Conveyance Calculation Method: At breaks in n values only
- Friction Slope Method: Average Conveyance
- Computational Flow Regime: Subcritical Flow

*******************************************************************************

FLOW DATA

Flow Title: Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

Flow Data (cfs)

| River | Reach | RS | Q2 | Q5 | Q10 | Q25 | Q50 | Q100 |
|---|---|---|---|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | 20.043 | 210 | 460 | 650 | 1020 | 1300 | 1700 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | Q2 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q5 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q10 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q25 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q50 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q100 | | Normal S = 0.007 |

*******************************************************************************

GEOMETRY DATA

Geometry Title: Proposed Conditions(20' Stream)
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g03

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 20.043

INPUT
Description: XS2043
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 958 | 1098.45 | 980 | 1096.91 | 985 | 1090.84 |
| 997 | 1090.66 | 1000 | 1090.1 | 1010 | 1090.7 | 1013 | 1092 | 1022 | 1093.31 |
| 1042 | 1094.1 | 1047 | 1097.4 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 985 | .035 | 1013 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1013 | 120 | 140 | 140 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 19.03

INPUT
Description: XS1903
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1090 |
| 1000 | 1089.5 | 1003 | 1090 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1017 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1017 | 100 | 110 | 120 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 18.73

INPUT
Description: XS1873
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1090 |
| 1000 | 1089.6 | 1003 | 1090 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1017 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1017 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 17.73

INPUT
Description: XS1773
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 857 | 1096 | 922 | 1094 | 986 | 1089 |
| 1000 | 1088.1 | 1003 | 1089 | 1004 | 1090 | 1017 | 1091 | 1036 | 1092 |
| 1062 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 986 | .035 | 1004 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 986 | 1004 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 17.23

INPUT
Description: XS1723
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 800 | 1100 | 895 | 1094 | 925 | 1093 | 981 | 1089 |
| 1000 | 1088.2 | 1005 | 1089 | 1007 | 1090 | 1017 | 1091 | 1040 | 1092 |
| 1085 | 1093 | 1136 | 1096 | 1200 | 1103 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 981 | .035 | 1007 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 981 | 1007 | 25 | 25 | 25 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 775 | 895 | 1100 | T |
| 1105 | 1200 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.98

INPUT

Description: XS1698
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 815 | 1100 | 865 | 1095 | 895 | 1094 | 950 | 1093 |
| 962 | 1092 | 980 | 1089 | 1000 | 1088 | 1003 | 1088 | 1007 | 1090 |
| 1014 | 1091 | 1063 | 1092 | 1159 | 1099 | 1200 | 1104 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 980 | .035 | 1007 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 980 | 1007 | 25 | 25 | 25 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 775 | 920 | 1100 | T |
| 1080 | 1200 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.73

INPUT
Description: XS1673
Station Elevation Data num= 15

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 800 | 1100 | 843 | 1100 | 895 | 1096 | 923 | 1091 |
| 950 | 1092 | 966 | 1092 | 983 | 1088 | 1000 | 1087.7 | 1003 | 1088 |
| 1007 | 1090 | 1023 | 1091 | 1057 | 1092 | 1159 | 1099 | 1200 | 1104 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 983 | .035 | 1007 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 983 | 1007 | 25 | 25 | 25 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 775 | 945 | 1100 | T |
| 1055 | 1200 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.48

INPUT
Description: XS1648(upstream boundary of Proposed bridge)
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 790 | 1100 | 825 | 1097 | 875 | 1099 | 897 | 1098 | 935 | 1097 |
| 965 | 1089 | 980 | 1088 | 1002 | 1086.9 | 1006 | 1088 | 1010 | 1090 |
| 1035 | 1091 | 1070 | 1092 | 1133 | 1097 | 1190 | 1102 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 790 | .1 | 965 | .035 | 1035 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 965 | 1035 | 60 | 60 | 60 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 790 | 970 | 1100 | T |
| 1030 | 1190 | 1100 | T |

BRIDGE

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.05

INPUT
Description: Proposed Structure at GV
Distance from Upstream XS = 7
Deck/Roadway Width = 46
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 10

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 800 | 1100 | 1080 | 834 | 1100 | 1080 | 900 | 1100 | 1080 |
| 976 | 1101.3 | 1080 | 976 | 1101.3 | 1096.85 | 1025.7 | 1102.3 | 1097.86 |
| 1025.7 | 1102.3 | 1080 | 1100 | 1104 | 1080 | 1125 | 1104.4 | 1080 |
| 1210 | 1106 | 1080 | | | | | | |

Upstream Bridge Cross Section Data
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 790 | 1100 | 825 | 1097 | 875 | 1099 | 897 | 1098 | 935 | 1097 |
| 965 | 1089 | 980 | 1088 | 1002 | 1086.9 | 1006 | 1088 | 1010 | 1090 |
| 1035 | 1091 | 1070 | 1092 | 1133 | 1097 | 1190 | 1102 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 790 | .1 | 965 | .035 | 1035 | .1 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 965 | 1035 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 790 | 970 | 1100 | T |

| | | | |
|---|---|---|---|
| 1030 | 1190 | 1100 | T |

Downstream Deck/Roadway Coordinates
num= 10

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 800 | 1100 | 1080 | 834 | 1100 | 1080 | 900 | 1100 | 1080 |
| 976 | 1101.3 | 1080 | 976 | 1101.3 | 1096.85 | 1025.7 | 1102.3 | 1097.86 |
| 1025.7 | 1102.3 | 1080 | 1100 | 1104 | 1080 | 1125 | 1104.4 | 1080 |
| 1210 | 1106 | 1080 | | | | | | |

Downstream Bridge Cross Section Data
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1099 | 822 | 1097 | 837 | 1096 | 866 | 1095 |
| 892 | 1094 | 906 | 1094 | 946 | 1093 | 950 | 1091 | 975 | 1090 |
| 1000 | 1087.3 | 1011 | 1088 | 1030 | 1090 | 1030 | 1100 | 1040 | 1102 |
| 1067 | 1102 | 1115 | 1100 | 1210 | 1100 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .05 | 975 | .035 | 1030 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 975 | 1030 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 967 | 1100 | T |
| 1030 | 1210 | 1100 | T |

Upstream Embankment side slope = 4 horiz. to 1.0 vertical
Downstream Embankment side slope = 4 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Abutments = 2

Abutment Data
Upstream num= 3

| Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|
| 976 | 1092.35 | 981 | 1092.35 | 990 | 1087 |

Downstream num= 3

| Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|
| 976 | 1092.35 | 981 | 1092.35 | 990 | 1087 |

Abutment Data
Upstream num= 3

| Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|
| 1010 | 1088.8 | 1019.84 | 1095.36 | 1025.7 | 1095.36 |

Downstream num= 3

| Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|
| 1010 | 1088.8 | 1019.84 | 1095.36 | 1025.7 | 1095.36 |

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.88

INPUT
Description: XS1588 (Downstream Proposed Bridge Boundary)
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1099 | 822 | 1097 | 837 | 1096 | 866 | 1095 |
| 892 | 1094 | 906 | 1094 | 946 | 1093 | 950 | 1091 | 975 | 1090 |
| 1000 | 1087.3 | 1011 | 1088 | 1030 | 1090 | 1030 | 1100 | 1040 | 1102 |
| 1067 | 1102 | 1115 | 1100 | 1210 | 1100 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .05 | 975 | .035 | 1030 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 975 | 1030 | 50 | 50 | 50 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 967 | 1100 | T |
| 1030 | 1210 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.38

```
INPUT
Description: XS1538
Station Elevation Data    num=      17
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************************
     760     1105      800     1100      885     1093      945     1093      960     1092
     966     1090      972     1089      992     1088     1004  1088.15     1011     1088
    1013     1089     1017     1090     1032     1091     1060     1092     1075     1093
    1090     1094     1200     1105

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
     760      .06      972     .035     1013      .08

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.     Expan.
            972     1013                 50      50      50                .3         .5
Ineffective Flow       num=       2
   Sta L    Sta R     Elev  Permanent
     760      942     1100       T
    1055     1200     1100       T

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk               RS: 14.88

INPUT
Description: XS1488
Station Elevation Data    num=      17
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************************
     760     1105      800     1100      885     1093      945     1093      960     1092
     966     1090      972     1089      993     1088     1006   1087.4     1008     1088
    1009     1089     1014     1090     1021     1091     1072     1092     1086     1093
    1097     1094     1200     1107

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
     760      .06      972     .035     1009      .08

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.     Expan.
            972     1009                 50      50      50                .1         .3
Ineffective Flow       num=       2
   Sta L    Sta R     Elev  Permanent
     760      892     1100       T
    1105     1200     1100       T

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk               RS: 14.38

INPUT
Description: XS1438
Station Elevation Data    num=      18
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************************
     760     1105      800     1100      885     1093      945     1093      960     1092
     966     1090      972     1089      983     1088     1000   1086.5     1002     1087
    1004     1088     1009     1089     1016     1090     1034     1091     1082     1092
    1102     1093     1119     1094     1200     1106

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
     760      .08      972     .035     1009      .08

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.     Expan.
            972     1009                 50      50      50                .1         .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk               RS: 13.88

INPUT
Description: XS1388
Station Elevation Data    num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************************
     775     1105      885     1094      902     1093      960     1092      985     1088
    1000   1086.4     1006     1087     1020     1089     1028     1090     1066     1091
    1100     1092     1140     1095     1200     1105

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
     775      .08      985     .035     1020      .08

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.     Expan.
            985     1020                100     100     100                .1         .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk               RS: 12.88

INPUT
Description: XS1288
Station Elevation Data    num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************************
     775     1105      885     1094      902     1093      960     1092      985     1088
    1000   1085.8     1006     1086     1020     1089     1028     1090     1066     1091
    1100     1092     1140     1095     1200     1105
```

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 985 | .035 | 1020 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1020 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.89

INPUT
Description: XS1189
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 995 | 1085 | 999 | 1084.77 | 1005 | 1085 |
| 1010 | 1085 | 1017 | 1086 | 1030 | 1087 | 1055 | 1090 | 1100 | 1090 |
| 1360 | 1115 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 995 | .035 | 1005 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 995 | 1005 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.69

INPUT
Description: XS1169
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 990 | 1085 | 991 | 1084.75 | 1008 | 1084.4 |
| 1010 | 1085 | 1014 | 1087 | 1023 | 1088 | 1030 | 1089 | 1055 | 1090 |
| 1100 | 1090 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 990 | .035 | 1014 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 990 | 1014 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.49

INPUT
Description: Upstream Culvert XS1149
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 984 | 1017 | 40 | 40 | 40 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 970 | 1091 | T |
| 1017 | 1360 | 1091 | T |

CULVERT

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.29

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 15
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 9

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 940 | 1090.9 | 1084 | 950 | 1090.6 | 1084 | 970 | 1091.2 | 1084 |
| 990 | 1091.5 | 1083 | 1005 | 1091.6 | 1083 | 1025 | 1091.1 | 1083 |
| 1060 | 1090.5 | 1083 | 1090 | 1090.1 | 1084 | 2000 | 1115 | 1084 |

Upstream Bridge Cross Section Data
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

```
Bank Sta: Left    Right    Coeff Contr.    Expan.
            984    1017              .3        .5
Ineffective Flow     num=        2
   Sta L    Sta R    Elev   Permanent
    840      970     1091       T
   1017     1360     1091       T

Downstream  Deck/Roadway Coordinates
    num=         9
     Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord
**************************************************************************
     940  1090.9    1084       950  1090.6    1084       970  1091.2    1084
     990  1091.5    1083      1005  1091.6    1083      1025  1091.1    1083
    1060  1090.5    1083      1090  1090.1    1084      2000    1115    1084

Downstream Bridge Cross Section Data
Station Elevation Data     num=       15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
**********************************************************************************
     840    1100     900    1093     925    1090     960    1091     983    1091
     983 1084.35    1000 1084.57    1013 1084.82    1013    1083    1017    1083
    1028 1083.92    1042    1084    1055    1089    1084    1089    1360    1115

Manning's n Values          num=        3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
     840      .05     983     .035    1042      .05

Bank Sta: Left    Right    Coeff Contr.    Expan.
            983    1042              .3        .5
Ineffective Flow     num=        2
   Sta L    Sta R    Elev   Permanent
    840      983     1091       T
   1035     1360     1091       F

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  3

Culvert Name      Shape       Rise     Span
Culvert #1        Ellipse      5.5        6
FHWA Chart # 29- Horizontal Ellipse; Concrete
FHWA Scale # 1 - Square edge with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 20       13     .024      .024      0                        .5                 1
Upstream    Elevation =  1084.87
            Centerline Station =  992
Downstream Elevation =  1084.6
            Centerline Station =  997

Culvert Name      Shape       Rise     Span
Culvert #2      Circular         3
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 1 - Headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                  2       38     .024      .024      0                        .9                 1
Upstream    Elevation =  1083.9
            Centerline Station =  1005
Downstream Elevation =  1082.93
            Centerline Station =  1016

Culvert Name      Shape       Rise     Span
Culvert #3      Circular         5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                  2       32     .024      .024      0                        .9                 1
Upstream    Elevation =  1083.38
            Centerline Station =  1010
Downstream Elevation =  1083.29
            Centerline Station =  1021

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk            RS: 11.09

INPUT
Description: XS1109 Boundary Culvert Downstream Section
Station Elevation Data     num=       15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
**********************************************************************************
     840    1100     900    1093     925    1090     960    1091     983    1091
     983 1084.35    1000 1084.57    1013 1084.82    1013    1083    1017    1083
    1028 1083.92    1042    1084    1055    1089    1084    1089    1360    1115

Manning's n Values          num=        3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
     840      .05     983     .035    1042      .05

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
            983    1042               50      50      50              .3        .5
Ineffective Flow     num=        2
   Sta L    Sta R    Elev   Permanent
    840      983     1091       T
   1035     1360     1091       F

CROSS SECTION
```

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10.59

INPUT
Description: XS1059
Station Elevation Data num= 20

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 920 | 1093.88 | 926 | 1093 | 934 | 1092 | 947 | 1091 |
| 961 | 1090 | 967 | 1089 | 968 | 1089 | 970 | 1088 | 973 | 1087 |
| 976 | 1086 | 984 | 1085 | 991 | 1084 | 997 | 1083 | 1000 | 1082.36 |
| 1004 | 1083 | 1010 | 1084 | 1015 | 1085 | 1055 | 1088.15 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 991 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 991 | 1010 | 60 | 60 | 60 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10

INPUT
Description: XS1000 (Surveyed x-section)
Station Elevation Data num= 22

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 947 | 1094 | 949 | 1093.65 | 952 | 1092.95 | 954 | 1091.18 |
| 958 | 1091.9 | 970 | 1091.23 | 990 | 1088.65 | 997 | 1085.38 | 1000 | 1082.18 |
| 1010 | 1083.31 | 1027 | 1083.22 | 1033 | 1086.45 | 1049 | 1085.97 | 1075 | 1087.86 |
| 1082 | 1084.04 | 1098 | 1083.58 | 1122 | 1084.71 | 1148 | 1088.66 | 1152 | 1086.59 |
| 1167 | 1088.78 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 990 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 990 | 1010 | .1 | .3 |

Ineffective Flow num= 1

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 1075 | 1170 | 1088.7 | T |

SUMMARY OF MANNING'S N VALUES

River:Tennessee Creek

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .035 | .1 |
| Tenn Crk | 19.03 | .1 | .035 | .1 |
| Tenn Crk | 18.73 | .1 | .035 | .1 |
| Tenn Crk | 17.73 | .1 | .035 | .1 |
| Tenn Crk | 17.23 | .1 | .035 | .1 |
| Tenn Crk | 16.98 | .1 | .035 | .1 |
| Tenn Crk | 16.73 | .1 | .035 | .1 |
| Tenn Crk | 16.48 | .1 | .035 | .1 |
| Tenn Crk | 16.05 | Bridge | | |
| Tenn Crk | 15.88 | .05 | .035 | .05 |
| Tenn Crk | 15.38 | .06 | .035 | .08 |
| Tenn Crk | 14.88 | .06 | .035 | .08 |
| Tenn Crk | 14.38 | .08 | .035 | .08 |
| Tenn Crk | 13.88 | .08 | .035 | .08 |
| Tenn Crk | 12.88 | .1 | .035 | .1 |
| Tenn Crk | 11.89 | .1 | .035 | .06 |
| Tenn Crk | 11.69 | .1 | .035 | .06 |
| Tenn Crk | 11.49 | .1 | .035 | .06 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | .05 | .035 | .05 |
| Tenn Crk | 10.59 | .05 | .035 | .05 |
| Tenn Crk | 10 | .05 | .035 | .05 |

SUMMARY OF REACH LENGTHS

River: Tennessee Creek

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Tenn Crk | 20.043 | 120 | 140 | 140 |
| Tenn Crk | 19.03 | 100 | 110 | 120 |
| Tenn Crk | 18.73 | 100 | 100 | 100 |
| Tenn Crk | 17.73 | 50 | 50 | 50 |
| Tenn Crk | 17.23 | 25 | 25 | 25 |
| Tenn Crk | 16.98 | 25 | 25 | 25 |
| Tenn Crk | 16.73 | 25 | 25 | 25 |
| Tenn Crk | 16.48 | 60 | 60 | 60 |
| Tenn Crk | 16.05 | Bridge | | |
| Tenn Crk | 15.88 | 50 | 50 | 50 |
| Tenn Crk | 15.38 | 50 | 50 | 50 |
| Tenn Crk | 14.88 | 50 | 50 | 50 |
| Tenn Crk | 14.38 | 50 | 50 | 50 |
| Tenn Crk | 13.88 | 100 | 100 | 100 |
| Tenn Crk | 12.88 | 100 | 100 | 100 |
| Tenn Crk | 11.89 | 20 | 20 | 20 |
| Tenn Crk | 11.69 | 20 | 20 | 20 |
| Tenn Crk | 11.49 | 40 | 40 | 40 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | 50 | 50 | 50 |
| Tenn Crk | 10.59 | 60 | 60 | 60 |
| Tenn Crk | 10 | | | |

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Tennessee Creek

| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .3 |
| Tenn Crk | 19.03 | .1 | .3 |
| Tenn Crk | 18.73 | .1 | .3 |
| Tenn Crk | 17.73 | .1 | .3 |
| Tenn Crk | 17.23 | .3 | .5 |
| Tenn Crk | 16.98 | .3 | .5 |
| Tenn Crk | 16.73 | .3 | .5 |
| Tenn Crk | 16.48 | .3 | .5 |
| Tenn Crk | 16.05 | Bridge | |
| Tenn Crk | 15.88 | .3 | .5 |
| Tenn Crk | 15.38 | .3 | .5 |
| Tenn Crk | 14.88 | .1 | .3 |
| Tenn Crk | 14.38 | .1 | .3 |
| Tenn Crk | 13.88 | .1 | .3 |
| Tenn Crk | 12.88 | .1 | .3 |
| Tenn Crk | 11.89 | .3 | .5 |
| Tenn Crk | 11.69 | .3 | .5 |
| Tenn Crk | 11.49 | .3 | .5 |
| Tenn Crk | 11.29 | Culvert | |
| Tenn Crk | 11.09 | .3 | .5 |
| Tenn Crk | 10.59 | .1 | .3 |
| Tenn Crk | 10 | .1 | .3 |

HEC-RAS Plan: AltA-58 River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | E.G. Elev | W.S. Elev | Vel Head | Frctn Loss | C & E Loss | Q Left | Q Channel | Q Right | Top Width |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft) |
| Tenn Crk | 20.043 | Q50 | 1096.40 | 1094.87 | 1.53 | 0.45 | 0.37 | 10.93 | 1212.34 | 76.73 | 61.48 |
| Tenn Crk | 20.043 | Q100 | 1097.33 | 1095.51 | 1.82 | 0.39 | 0.47 | 16.30 | 1543.70 | 140.00 | 62.98 |
| | | | | | | | | | | | |
| Tenn Crk | 19.03 | Q50 | 1095.57 | 1095.29 | 0.28 | 0.21 | 0.01 | 248.00 | 845.44 | 206.56 | 238.55 |
| Tenn Crk | 19.03 | Q100 | 1096.47 | 1096.21 | 0.26 | 0.17 | 0.00 | 368.29 | 1006.41 | 325.29 | 283.29 |
| | | | | | | | | | | | |
| Tenn Crk | 18.73 | Q50 | 1095.36 | 1095.03 | 0.34 | 0.23 | 0.01 | 241.43 | 864.04 | 194.53 | 223.32 |
| Tenn Crk | 18.73 | Q100 | 1096.30 | 1095.99 | 0.31 | 0.18 | 0.01 | 355.94 | 1031.54 | 312.52 | 278.51 |
| | | | | | | | | | | | |
| Tenn Crk | 17.73 | Q50 | 1095.12 | 1094.66 | 0.46 | 0.09 | 0.06 | 286.26 | 764.51 | 249.24 | 202.18 |
| Tenn Crk | 17.73 | Q100 | 1096.11 | 1095.70 | 0.40 | 0.07 | 0.05 | 406.42 | 888.74 | 404.84 | 261.86 |
| | | | | | | | | | | | |
| Tenn Crk | 17.23 | Q50 | 1094.97 | 1094.71 | 0.26 | 0.04 | 0.02 | 265.25 | 801.84 | 232.92 | 230.27 |
| Tenn Crk | 17.23 | Q100 | 1095.98 | 1095.76 | 0.22 | 0.03 | 0.03 | 396.84 | 927.74 | 375.42 | 264.63 |
| | | | | | | | | | | | |
| Tenn Crk | 16.98 | Q50 | 1094.90 | 1094.56 | 0.34 | 0.04 | 0.02 | 139.70 | 905.67 | 254.62 | 220.10 |
| Tenn Crk | 16.98 | Q100 | 1095.92 | 1095.60 | 0.32 | 0.04 | 0.03 | 238.08 | 1075.39 | 386.53 | 253.40 |
| | | | | | | | | | | | |
| Tenn Crk | 16.73 | Q50 | 1094.85 | 1094.46 | 0.39 | 0.03 | 0.09 | 173.22 | 912.19 | 214.59 | 189.13 |
| Tenn Crk | 16.73 | Q100 | 1095.85 | 1095.43 | 0.42 | 0.03 | 0.08 | 257.28 | 1122.03 | 320.68 | 208.81 |
| | | | | | | | | | | | |
| Tenn Crk | 16.48 | Q50 | 1094.73 | 1094.52 | 0.21 | 0.01 | 0.17 | | 1300.00 | | 157.40 |
| Tenn Crk | 16.48 | Q100 | 1095.75 | 1095.48 | 0.27 | 0.01 | 0.20 | | 1700.00 | | 173.16 |
| | | | | | | | | | | | |
| Tenn Crk | 16.05 | | Bridge | | | | | | | | |
| | | | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1093.73 | 1093.41 | 0.32 | 0.09 | 0.02 | 67.47 | 1232.53 | | 100.46 |
| Tenn Crk | 15.88 | Q100 | 1094.37 | 1093.92 | 0.44 | 0.10 | 0.01 | 95.34 | 1604.66 | | 120.91 |
| | | | | | | | | | | | |
| Tenn Crk | 15.38 | Q50 | 1093.63 | 1093.25 | 0.38 | 0.11 | 0.03 | 70.29 | 1088.86 | 140.85 | 196.70 |
| Tenn Crk | 15.38 | Q100 | 1094.26 | 1093.78 | 0.47 | 0.12 | 0.03 | 120.63 | 1369.06 | 210.31 | 211.27 |
| | | | | | | | | | | | |
| Tenn Crk | 14.88 | Q50 | 1093.48 | 1093.00 | 0.48 | 0.12 | 0.02 | 65.87 | 1085.78 | 148.35 | 140.99 |
| Tenn Crk | 14.88 | Q100 | 1094.11 | 1093.53 | 0.57 | 0.13 | 0.01 | 111.03 | 1343.83 | 245.15 | 213.37 |
| | | | | | | | | | | | |
| Tenn Crk | 14.38 | Q50 | 1093.35 | 1092.92 | 0.43 | 0.09 | 0.02 | 42.07 | 1092.02 | 165.90 | 154.21 |
| Tenn Crk | 14.38 | Q100 | 1093.97 | 1093.43 | 0.53 | 0.10 | 0.04 | 64.73 | 1364.18 | 271.09 | 229.60 |
| | | | | | | | | | | | |
| Tenn Crk | 13.88 | Q50 | 1093.24 | 1092.88 | 0.36 | 0.17 | 0.01 | 82.98 | 1022.50 | 194.52 | 202.84 |
| Tenn Crk | 13.88 | Q100 | 1093.83 | 1093.41 | 0.42 | 0.20 | 0.02 | 148.96 | 1251.40 | 299.65 | 223.81 |
| | | | | | | | | | | | |
| Tenn Crk | 12.88 | Q50 | 1093.06 | 1092.64 | 0.42 | 0.12 | 0.08 | 56.14 | 1114.50 | 129.36 | 185.27 |
| Tenn Crk | 12.88 | Q100 | 1093.61 | 1093.04 | 0.57 | 0.15 | 0.11 | 88.97 | 1407.70 | 203.33 | 212.59 |
| | | | | | | | | | | | |
| Tenn Crk | 11.89 | Q50 | 1092.85 | 1092.71 | 0.15 | 0.02 | 0.01 | 161.90 | 391.86 | 746.25 | 193.32 |
| Tenn Crk | 11.89 | Q100 | 1093.34 | 1093.15 | 0.19 | 0.02 | 0.02 | 218.29 | 482.29 | 999.42 | 203.72 |
| | | | | | | | | | | | |
| Tenn Crk | 11.69 | Q50 | 1092.82 | 1092.64 | 0.18 | 0.01 | 0.02 | 110.88 | 801.50 | 387.62 | 191.80 |
| Tenn Crk | 11.69 | Q100 | 1093.30 | 1093.06 | 0.25 | 0.02 | 0.04 | 152.37 | 998.04 | 549.59 | 201.54 |
| | | | | | | | | | | | |
| Tenn Crk | 11.49 | Q50 | 1092.79 | 1092.53 | 0.26 | | | 59.11 | 1156.38 | 84.51 | 166.76 |
| Tenn Crk | 11.49 | Q100 | 1093.25 | 1092.87 | 0.38 | | | 83.89 | 1473.56 | 142.56 | 175.04 |
| | | | | | | | | | | | |
| Tenn Crk | 11.29 | | Culvert | | | | | | | | |
| | | | | | | | | | | | |
| Tenn Crk | 11.09 | Q50 | 1089.31 | 1088.88 | 0.43 | 0.16 | 0.10 | | 1300.00 | | 71.67 |
| Tenn Crk | 11.09 | Q100 | 1090.00 | 1089.40 | 0.60 | 0.18 | 0.10 | | 1700.00 | | 105.25 |
| | | | | | | | | | | | |
| Tenn Crk | 10.59 | Q50 | 1089.05 | 1088.27 | 0.77 | 0.34 | 0.04 | 213.72 | 818.92 | 267.35 | 86.94 |
| Tenn Crk | 10.59 | Q100 | 1089.71 | 1088.77 | 0.94 | 0.36 | 0.07 | 293.76 | 1010.81 | 395.43 | 93.56 |
| | | | | | | | | | | | |
| Tenn Crk | 10 | Q50 | 1088.67 | 1088.02 | 0.65 | | | | 599.70 | 700.30 | 164.96 |
| Tenn Crk | 10 | Q100 | 1089.28 | 1088.56 | 0.72 | | | | 719.76 | 980.24 | 174.46 |

HEC-RAS Plan: AltA-58 River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | E.G. Elev | W.S. Elev | Crit W.S. | Frctn Loss | C & E Loss | Top Width | Q Left | Q Channel | Q Right | Vel Chnl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft/s) |
| Tenn Crk | 16.73 | Q50 | 1094.85 | 1094.46 | | 0.03 | 0.09 | 189.13 | 173.22 | 912.19 | 214.59 | 5.93 |
| Tenn Crk | 16.73 | Q100 | 1095.85 | 1095.43 | | 0.03 | 0.08 | 208.81 | 257.28 | 1122.03 | 320.68 | 6.33 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.48 | Q50 | 1094.73 | 1094.52 | 1091.11 | 0.01 | 0.17 | 157.40 | | 1300.00 | | 3.71 |
| Tenn Crk | 16.48 | Q100 | 1095.75 | 1095.48 | 1091.60 | 0.01 | 0.20 | 173.16 | | 1700.00 | | 4.17 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.05 BR U | Q50 | 1094.55 | 1093.79 | 1092.19 | 0.26 | 0.12 | 41.48 | | 1300.00 | | 7.03 |
| Tenn Crk | 16.05 BR U | Q100 | 1095.54 | 1094.61 | 1093.03 | 0.30 | 0.23 | 42.72 | | 1700.00 | | 7.74 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.05 BR D | Q50 | 1094.17 | 1093.02 | 1092.45 | 0.02 | 0.42 | 40.32 | | 1300.00 | | 8.64 |
| Tenn Crk | 16.05 BR D | Q100 | 1095.01 | 1093.33 | 1093.09 | 0.03 | 0.62 | 40.80 | | 1700.00 | | 10.41 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1093.73 | 1093.41 | | 0.09 | 0.02 | 100.46 | 67.47 | 1232.53 | | 4.63 |
| Tenn Crk | 15.88 | Q100 | 1094.37 | 1093.92 | | 0.10 | 0.01 | 120.91 | 95.34 | 1604.66 | | 5.45 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.38 | Q50 | 1093.63 | 1093.25 | | 0.11 | 0.03 | 196.70 | 70.29 | 1088.86 | 140.85 | 5.37 |
| Tenn Crk | 15.38 | Q100 | 1094.26 | 1093.78 | | 0.12 | 0.03 | 211.27 | 120.63 | 1369.06 | 210.31 | 6.09 |

# Proposed Bridge Structure-Alt C
# (50+100-Year Flood)

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX      XX      XXXX
X     X  X        X    X       X   X    X  X    X
X     X  X        X            X   X   X    X   X
XXXXXXX  XXXX     X      XXX   XXXX    XXXXXX    XXXX
X     X  X        X            X  X    X    X        X
X     X  X        X    X       X   X   X    X        X
X     X  XXXXXX    XXXX        X    X  X    X   XXXXX
```

********************************************************************************

PROJECT DATA
Project Title: Tennesse Creek at GV Rd
Project File : TennesseCreek.prj
Run Date and Time: 4/21/2006 1:19:07 PM

Project in English units

Project Description:
Green Valley Rd. over Tennessee Creek

********************************************************************************

PLAN DATA

Plan Title: Alt C-59' Span
Plan File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.p11

Geometry Title: Proposed Conditions AltC
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g04

Flow Title : Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

Plan Summary Information:

| Number of: | | | | |
|---|---|---|---|---|
| Cross Sections = | 19 | Multiple Openings = | 0 |
| Culverts = | 1 | Inline Structures = | 0 |
| Bridges = | 1 | Lateral Structures = | 0 |

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

********************************************************************************

FLOW DATA

Flow Title: Tennesse Crk Flow
Flow File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.f01

Flow Data (cfs)

| River | Reach | RS | Q2 | Q5 | Q10 | Q25 | Q50 | Q100 |
|---|---|---|---|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | 20.043 | 210 | 460 | 650 | 1020 | 1300 | 1700 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Tennessee Creek | Tenn Crk | Q2 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q5 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q10 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q25 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q50 | | Normal S = 0.007 |
| Tennessee Creek | Tenn Crk | Q100 | | Normal S = 0.007 |

********************************************************************************

GEOMETRY DATA

Geometry Title: Proposed Conditions AltC
Geometry File : C:\Documents and Settings\knelson\My Documents\Tennessee Creek\Hydraulics\TennesseCreek.g04

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 20.043

INPUT
Description: XS2043
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1102 | 810 | 1100 | 958 | 1098.45 | 980 | 1096.91 | 985 | 1090.84 |
| 997 | 1090.66 | 1000 | 1090.1 | 1010 | 1090.7 | 1013 | 1092 | 1022 | 1093.31 |
| 1042 | 1094.1 | 1047 | 1097.4 | 1200 | 1103 | | | | |

```
Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      985     .035     1013       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           985     1013                 120      140      140                 .1        .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk              RS: 19.03

INPUT
Description: XS1903
Station Elevation Data     num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
******************************************************************************************
     775     1102      810     1100      857     1096      922     1094      986     1090
    1000   1089.5     1003     1090     1004     1090     1017     1091     1036     1092
    1062     1093     1136     1096     1200     1103

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      986     .035     1017       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           986     1017                 100      110      120                 .1        .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk              RS: 18.73

INPUT
Description: XS1873
Station Elevation Data     num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
******************************************************************************************
     775     1102      810     1100      857     1096      922     1094      986     1090
    1000   1089.6     1003     1090     1004     1090     1017     1091     1036     1092
    1062     1093     1136     1096     1200     1103

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      986     .035     1017       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           986     1017                 100      100      100                 .1        .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk              RS: 17.73

INPUT
Description: XS1773
Station Elevation Data     num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
******************************************************************************************
     775     1102      810     1100      857     1096      922     1094      986     1089
    1000   1088.1     1003     1089     1004     1090     1017     1091     1036     1092
    1062     1093     1136     1096     1200     1103

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      986     .035     1004       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           986     1004                  50       50       50                 .1        .3

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk              RS: 17.23

INPUT
Description: XS1723
Station Elevation Data     num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
******************************************************************************************
     775     1102      800     1100      895     1094      925     1093      981     1089
    1000   1088.2     1005     1089     1007     1090     1017     1091     1040     1092
    1085     1093     1136     1096     1200     1103

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      981     .035     1007       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           981     1007                  25       25       25                 .3        .5
Ineffective Flow       num=       2
   Sta L    Sta R     Elev  Permanent
     775      932   1099.4      T
    1060     1200     1100      T

CROSS SECTION


RIVER: Tennessee Creek
REACH: Tenn Crk              RS: 16.98

INPUT
```

```
Description: XS1698 (Upstream Boundary of Proposed Structure)
Station Elevation Data    num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
     775     1102      815     1100      865     1095      895     1094      950     1093
     962     1092      980     1089     1000     1088     1003     1088     1007     1090
    1014     1091     1063     1092     1159     1099     1200     1104

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      980     .035     1007       .1

Bank Sta: Left    Right    Lengths: Left Channel    Right       Coeff Contr.    Expan.
           980     1007                 75      75      75                .3        .5
Ineffective Flow      num=        2
   Sta L    Sta R     Elev   Permanent
     775      957   1099.4       T
    1034     1200   1099.4       T

BRIDGE


RIVER: Tennessee Creek
REACH: Tenn Crk             RS: 16.55

INPUT
Description: Proposed Structure
Distance from Upstream XS =          9
Deck/Roadway Width        =         51
Weir Coefficient          =        2.6
Upstream  Deck/Roadway Coordinates
     num=       12
     Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord
****************************************************************************
     800    1100     980       855 1099.43     980       895 1099.42     980
     940 1099.75     980       973 1100.47     980       973 1100.47  1097.2
    1019 1101.44 1098.16      1019 1101.44     980      1065 1102.79     980
    1110 1104.49     980      1150    1107     980      1200    1109     980

Upstream Bridge Cross Section Data
Station Elevation Data    num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
     775     1102      815     1100      865     1095      895     1094      950     1093
     962     1092      980     1089     1000     1088     1003     1088     1007     1090
    1014     1091     1063     1092     1159     1099     1200     1104

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     775       .1      980     .035     1007       .1

Bank Sta: Left    Right     Coeff Contr.    Expan.
           980     1007             .3         .5
Ineffective Flow      num=        2
   Sta L    Sta R     Elev   Permanent
     775      957   1099.4       T
    1034     1200   1099.4       T

Downstream  Deck/Roadway Coordinates
     num=       12
     Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord       Sta Hi Cord Lo Cord
****************************************************************************
     800    1100     980       855 1099.43     980       895 1099.42     980
     940 1099.75     980       973 1100.47     980       973 1100.47  1097.2
    1019 1101.44 1098.16      1019 1101.44     980      1065 1102.79     980
    1110 1104.49     980      1150    1107     980      1200    1109     980

Downstream Bridge Cross Section Data
Station Elevation Data    num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
     755     1103      790     1100      860     1095      880     1093      903     1092
     925     1091      983     1090    987.5     1087     1000   1087.2     1009     1088
    1016     1090     1042     1091     1135     1095     1200     1100

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
     755      .05      983     .035     1016      .05

Bank Sta: Left    Right     Coeff Contr.    Expan.
           983     1016             .3         .5
Ineffective Flow      num=        2
   Sta L    Sta R     Elev   Permanent
     755      968   1099.4       T
    1024     1200     1100       T

Upstream Embankment side slope               =      2 horiz. to 1.0 vertical
Downstream Embankment side slope             =      2 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow  =     .95
Elevation at which weir flow begins          = 1099.44
Energy head used in spillway design          =
Spillway height used in design               =
Weir crest shape                             = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream      num=        3
     Sta     Elev      Sta     Elev      Sta     Elev
*************************************************
     973   1091.5    979.2   1091.5      986     1088
Downstream      num=        3
     Sta     Elev      Sta     Elev      Sta     Elev
*************************************************
     973   1091.5    979.2   1091.5      986     1088

Abutment Data
Upstream      num=        3
     Sta     Elev      Sta     Elev      Sta     Elev
```

| | | | | | |
|---|---|---|---|---|---|
| 1010 | 1089 | 1013.1 | 1091.1 | 1019 | 1091.1 |

Downstream num= 3

| Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|
| 1010 | 1089 | 1013.1 | 1091.1 | 1019 | 1091.1 |

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 16.23

INPUT
Description: XS1623(Downstream Boundary of Proposed Bridge )
Station Elevation Data num= 14

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 755 | 1103 | 790 | 1100 | 860 | 1095 | 880 | 1093 | 903 | 1092 |
| 925 | 1091 | 983 | 1090 | 987.5 | 1087 | 1000 | 1087.2 | 1009 | 1088 |
| 1016 | 1090 | 1042 | 1091 | 1135 | 1095 | 1200 | 1100 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 755 | .05 | 983 | .035 | 1016 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 983 | 1016 | 35 | 35 | 35 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 755 | 968 | 1099.4 | T |
| 1024 | 1200 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.88

INPUT
Description: XS1588
Station Elevation Data num= 16

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1099 | 822 | 1097 | 837 | 1096 | 866 | 1095 |
| 892 | 1094 | 906 | 1094 | 946 | 1093 | 950 | 1091 | 975 | 1090 |
| 1000 | 1087.3 | 1030 | 1088 | 1070 | 1102 | 1080 | 1102 | 1150 | 1102 |
| 1210 | 1100 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .05 | 975 | .035 | 1030 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 975 | 1030 | 50 | 50 | 50 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 960 | 1099.4 | T |
| 1037 | 1210 | 1100 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 15.38

INPUT
Description: XS1538
Station Elevation Data num= 17

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 992 | 1088 | 1004 | 1088.15 | 1011 | 1088 |
| 1013 | 1089 | 1017 | 1090 | 1032 | 1091 | 1060 | 1092 | 1075 | 1093 |
| 1090 | 1094 | 1200 | 1105 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .06 | 972 | .035 | 1013 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1013 | 50 | 50 | 50 | .1 | .3 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 760 | 947 | 1099.4 | T |
| 1050 | 1200 | 1100.2 | T |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 14.88

INPUT
Description: XS1488
Station Elevation Data num= 17

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 993 | 1088 | 1006 | 1087.4 | 1008 | 1088 |
| 1009 | 1089 | 1014 | 1090 | 1021 | 1091 | 1072 | 1092 | 1086 | 1093 |
| 1097 | 1094 | 1200 | 1107 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .06 | 972 | .035 | 1009 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1009 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 14.38

INPUT
Description: XS1438
Station Elevation Data num= 18

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 1105 | 800 | 1100 | 885 | 1093 | 945 | 1093 | 960 | 1092 |
| 966 | 1090 | 972 | 1089 | 983 | 1088 | 1000 | 1086.5 | 1002 | 1087 |
| 1004 | 1088 | 1009 | 1089 | 1016 | 1090 | 1034 | 1091 | 1082 | 1092 |
| 1102 | 1093 | 1119 | 1094 | 1200 | 1106 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 760 | .08 | 972 | .035 | 1009 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 972 | 1009 | 50 | 50 | 50 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 13.88

INPUT
Description: XS1388
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1105 | 885 | 1094 | 902 | 1093 | 960 | 1092 | 985 | 1088 |
| 1000 | 1086.4 | 1006 | 1087 | 1020 | 1089 | 1028 | 1090 | 1066 | 1091 |
| 1100 | 1092 | 1140 | 1095 | 1200 | 1105 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .08 | 985 | .035 | 1020 | .08 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1020 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 12.88

INPUT
Description: XS1288
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 1105 | 885 | 1094 | 902 | 1093 | 960 | 1092 | 985 | 1088 |
| 1000 | 1085.8 | 1006 | 1086 | 1020 | 1089 | 1028 | 1090 | 1066 | 1091 |
| 1100 | 1092 | 1140 | 1095 | 1200 | 1105 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 775 | .1 | 985 | .035 | 1020 | .1 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 985 | 1020 | 100 | 100 | 100 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.89

INPUT
Description: XS1189
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 995 | 1085 | 999 | 1084.77 | 1005 | 1085 |
| 1010 | 1085 | 1017 | 1086 | 1030 | 1087 | 1055 | 1090 | 1100 | 1090 |
| 1360 | 1115 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 995 | .035 | 1005 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 995 | 1005 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.69

INPUT
Description: XS1169
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 990 | 1085 | 991 | 1084.75 | 1008 | 1084.4 |
| 1010 | 1085 | 1014 | 1087 | 1023 | 1088 | 1030 | 1089 | 1055 | 1090 |
| 1100 | 1090 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 990 | .035 | 1014 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 990 | 1014 | 20 | 20 | 20 | .3 | .5 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.49

INPUT
Description: Upstream Culvert XS1149
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 984 | 1017 | 40 | 40 | 40 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 970 | 1091 | T |
| 1017 | 1360 | 1091 | T |

CULVERT

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.29

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 15
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 9

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 940 | 1090.9 | 1084 | 950 | 1090.6 | 1084 | 970 | 1091.2 | 1084 |
| 990 | 1091.5 | 1083 | 1005 | 1091.6 | 1083 | 1025 | 1091.1 | 1083 |
| 1060 | 1090.5 | 1083 | 1090 | 1090.1 | 1084 | 2000 | 1115 | 1084 |

Upstream Bridge Cross Section Data
Station Elevation Data num= 13

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 970 | 1090 | 984 | 1085 | 999 | 1084 | 1006 | 1083.09 |
| 1010 | 1083.37 | 1012 | 1084 | 1017 | 1089 | 1019 | 1090 | 1034 | 1091 |
| 1060 | 1090.6 | 1075 | 1090 | 1360 | 1115 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .1 | 984 | .035 | 1017 | .06 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 984 | 1017 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 970 | 1091 | T |
| 1017 | 1360 | 1091 | T |

Downstream Deck/Roadway Coordinates
num= 9

| Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord | Sta | Hi Cord | Lo Cord |
|---|---|---|---|---|---|---|---|---|
| 940 | 1090.9 | 1084 | 950 | 1090.6 | 1084 | 970 | 1091.2 | 1084 |
| 990 | 1091.5 | 1083 | 1005 | 1091.6 | 1083 | 1025 | 1091.1 | 1083 |
| 1060 | 1090.5 | 1083 | 1090 | 1090.1 | 1084 | 2000 | 1115 | 1084 |

Downstream Bridge Cross Section Data
Station Elevation Data num= 15

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 900 | 1093 | 925 | 1090 | 960 | 1091 | 983 | 1091 |
| 983 | 1084.35 | 1000 | 1084.57 | 1013 | 1084.82 | 1013 | 1083 | 1017 | 1083 |
| 1028 | 1083.92 | 1042 | 1084 | 1055 | 1089 | 1084 | 1089 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 983 | .035 | 1042 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 983 | 1042 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 983 | 1091 | T |
| 1035 | 1360 | 1091 | F |

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 3

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #1 | Ellipse | 5.5 | 6 |

FHWA Chart # 29- Horizontal Ellipse; Concrete
FHWA Scale # 1 - Square edge with headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 20 | 13 | .024 | .024 | 0 | .5 | 1 |

Upstream Elevation = 1084.87
Centerline Station = 992
Downstream Elevation = 1084.6
Centerline Station = 997

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #2 | Circular | 3 | |

FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 1 - Headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 2 | 38 | .024 | .024 | 0 | .9 | 1 |

Upstream Elevation = 1083.9
Centerline Station = 1005
Downstream Elevation = 1082.93
Centerline Station = 1016

| Culvert Name | Shape | Rise | Span |
|---|---|---|---|
| Culvert #3 | Circular | 5 | |

FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG

| Culvert Upstrm Dist | Length | Top n | Bottom n | Depth Blocked | Entrance Loss Coef | Exit Loss Coef |
|---|---|---|---|---|---|---|
| 2 | 32 | .024 | .024 | 0 | .9 | 1 |

Upstream Elevation = 1083.38
Centerline Station = 1010
Downstream Elevation = 1083.29
Centerline Station = 1021

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 11.09

INPUT
Description: XS1109 Boundary Culvert Downstream Section
Station Elevation Data num= 15

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 900 | 1093 | 925 | 1090 | 960 | 1091 | 983 | 1091 |
| 983 | 1084.35 | 1000 | 1084.57 | 1013 | 1084.82 | 1013 | 1083 | 1017 | 1083 |
| 1028 | 1083.92 | 1042 | 1084 | 1055 | 1089 | 1084 | 1089 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 983 | .035 | 1042 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 983 | 1042 | 50 | 50 | 50 | .3 | .5 |

Ineffective Flow num= 2

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 840 | 983 | 1091 | T |
| 1035 | 1360 | 1091 | F |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10.59

INPUT
Description: XS1059
Station Elevation Data num= 20

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 920 | 1093.88 | 926 | 1093 | 934 | 1092 | 947 | 1091 |
| 961 | 1090 | 967 | 1089 | 968 | 1089 | 970 | 1088 | 973 | 1087 |
| 976 | 1086 | 984 | 1085 | 991 | 1084 | 997 | 1083 | 1000 | 1082.36 |
| 1004 | 1083 | 1010 | 1084 | 1015 | 1085 | 1055 | 1088.15 | 1360 | 1115 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 991 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Lengths: Left | Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|---|
| 991 | 1010 | 60 | 60 | 60 | .1 | .3 |

CROSS SECTION

RIVER: Tennessee Creek
REACH: Tenn Crk RS: 10

INPUT
Description: XS1000 (Surveyed x-section)
Station Elevation Data num= 22

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 840 | 1100 | 947 | 1094 | 949 | 1093.65 | 952 | 1092.95 | 954 | 1091.18 |
| 958 | 1091.9 | 970 | 1091.23 | 990 | 1088.65 | 997 | 1085.38 | 1000 | 1082.18 |
| 1010 | 1083.31 | 1027 | 1083.22 | 1033 | 1086.45 | 1049 | 1085.97 | 1075 | 1087.86 |
| 1082 | 1084.04 | 1098 | 1083.58 | 1122 | 1084.71 | 1148 | 1088.66 | 1152 | 1086.59 |
| 1167 | 1088.78 | 1360 | 1115 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 840 | .05 | 990 | .035 | 1010 | .05 |

| Bank Sta: Left | Right | Coeff Contr. | Expan. |
|---|---|---|---|
| 990 | 1010 | .1 | .3 |

Ineffective Flow num= 1

| Sta L | Sta R | Elev | Permanent |
|---|---|---|---|
| 1075 | 1170 | 1088.7 | T |

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SUMMARY OF MANNING'S N VALUES

River:Tennessee Creek

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .035 | .1 |
| Tenn Crk | 19.03 | .1 | .035 | .1 |
| Tenn Crk | 18.73 | .1 | .035 | .1 |
| Tenn Crk | 17.73 | .1 | .035 | .1 |
| Tenn Crk | 17.23 | .1 | .035 | .1 |
| Tenn Crk | 16.98 | .1 | .035 | .1 |
| Tenn Crk | 16.55 | Bridge | | |
| Tenn Crk | 16.23 | .05 | .035 | .05 |
| Tenn Crk | 15.88 | .05 | .035 | .05 |
| Tenn Crk | 15.38 | .06 | .035 | .08 |
| Tenn Crk | 14.88 | .06 | .035 | .08 |
| Tenn Crk | 14.38 | .08 | .035 | .08 |
| Tenn Crk | 13.88 | .08 | .035 | .08 |
| Tenn Crk | 12.88 | .1 | .035 | .1 |
| Tenn Crk | 11.89 | .1 | .035 | .06 |
| Tenn Crk | 11.69 | .1 | .035 | .06 |
| Tenn Crk | 11.49 | .1 | .035 | .06 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | .05 | .035 | .05 |
| Tenn Crk | 10.59 | .05 | .035 | .05 |
| Tenn Crk | 10 | .05 | .035 | .05 |

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SUMMARY OF REACH LENGTHS

River: Tennessee Creek

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Tenn Crk | 20.043 | 120 | 140 | 140 |
| Tenn Crk | 19.03 | 100 | 110 | 120 |
| Tenn Crk | 18.73 | 100 | 100 | 100 |
| Tenn Crk | 17.73 | 50 | 50 | 50 |
| Tenn Crk | 17.23 | 25 | 25 | 25 |
| Tenn Crk | 16.98 | 75 | 75 | 75 |
| Tenn Crk | 16.55 | Bridge | | |
| Tenn Crk | 16.23 | 35 | 35 | 35 |
| Tenn Crk | 15.88 | 50 | 50 | 50 |
| Tenn Crk | 15.38 | 50 | 50 | 50 |
| Tenn Crk | 14.88 | 50 | 50 | 50 |
| Tenn Crk | 14.38 | 50 | 50 | 50 |
| Tenn Crk | 13.88 | 100 | 100 | 100 |
| Tenn Crk | 12.88 | 100 | 100 | 100 |
| Tenn Crk | 11.89 | 20 | 20 | 20 |
| Tenn Crk | 11.69 | 20 | 20 | 20 |
| Tenn Crk | 11.49 | 40 | 40 | 40 |
| Tenn Crk | 11.29 | Culvert | | |
| Tenn Crk | 11.09 | 50 | 50 | 50 |
| Tenn Crk | 10.59 | 60 | 60 | 60 |
| Tenn Crk | 10 | | | |

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SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Tennessee Creek

| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| Tenn Crk | 20.043 | .1 | .3 |
| Tenn Crk | 19.03 | .1 | .3 |
| Tenn Crk | 18.73 | .1 | .3 |
| Tenn Crk | 17.73 | .1 | .3 |
| Tenn Crk | 17.23 | .3 | .5 |
| Tenn Crk | 16.98 | .3 | .5 |
| Tenn Crk | 16.55 | Bridge | |
| Tenn Crk | 16.23 | .3 | .5 |
| Tenn Crk | 15.88 | .3 | .5 |
| Tenn Crk | 15.38 | .1 | .3 |
| Tenn Crk | 14.88 | .1 | .3 |
| Tenn Crk | 14.38 | .1 | .3 |
| Tenn Crk | 13.88 | .1 | .3 |
| Tenn Crk | 12.88 | .1 | .3 |
| Tenn Crk | 11.89 | .3 | .5 |
| Tenn Crk | 11.69 | .3 | .5 |
| Tenn Crk | 11.49 | .3 | .5 |
| Tenn Crk | 11.29 | Culvert | |
| Tenn Crk | 11.09 | .3 | .5 |
| Tenn Crk | 10.59 | .1 | .3 |
| Tenn Crk | 10 | .1 | .3 |

HEC-RAS Plan: Alt C-59 River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Tenn Crk | 20.043 | Q50 | 1300.00 | 1090.10 | 1094.96 | | 1096.41 | 0.008078 | 10.02 | 173.78 | 61.69 | 0.85 |
| Tenn Crk | 20.043 | Q100 | 1700.00 | 1090.10 | 1095.75 | | 1097.36 | 0.007357 | 10.71 | 223.71 | 63.55 | 0.84 |
| | | | | | | | | | | | | |
| Tenn Crk | 19.03 | Q50 | 1300.00 | 1089.50 | 1095.36 | | 1095.63 | 0.001594 | 5.13 | 624.42 | 242.18 | 0.39 |
| Tenn Crk | 19.03 | Q100 | 1700.00 | 1089.50 | 1096.37 | | 1096.61 | 0.001224 | 5.05 | 896.28 | 288.68 | 0.36 |
| | | | | | | | | | | | | |
| Tenn Crk | 18.73 | Q50 | 1300.00 | 1089.60 | 1095.11 | | 1095.43 | 0.001980 | 5.52 | 565.56 | 228.08 | 0.43 |
| Tenn Crk | 18.73 | Q100 | 1700.00 | 1089.60 | 1096.19 | | 1096.46 | 0.001419 | 5.33 | 844.87 | 282.98 | 0.38 |
| | | | | | | | | | | | | |
| Tenn Crk | 17.73 | Q50 | 1300.00 | 1088.10 | 1094.77 | | 1095.20 | 0.002362 | 6.60 | 546.02 | 208.90 | 0.48 |
| Tenn Crk | 17.73 | Q100 | 1700.00 | 1088.10 | 1095.95 | | 1096.29 | 0.001729 | 6.53 | 830.25 | 275.93 | 0.42 |
| | | | | | | | | | | | | |
| Tenn Crk | 17.23 | Q50 | 1300.00 | 1088.20 | 1094.79 | | 1095.07 | 0.001348 | 5.18 | 527.52 | 233.06 | 0.37 |
| Tenn Crk | 17.23 | Q100 | 1700.00 | 1088.20 | 1095.93 | | 1096.20 | 0.001150 | 5.35 | 672.36 | 270.22 | 0.35 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.98 | Q50 | 1300.00 | 1088.00 | 1094.45 | 1092.63 | 1094.96 | 0.002164 | 6.39 | 334.83 | 214.99 | 0.46 |
| Tenn Crk | 16.98 | Q100 | 1700.00 | 1088.00 | 1095.53 | 1093.21 | 1096.08 | 0.001963 | 6.80 | 417.84 | 251.61 | 0.45 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.55 | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | |
| Tenn Crk | 16.23 | Q50 | 1300.00 | 1087.00 | 1093.43 | | 1093.89 | 0.001988 | 5.83 | 260.69 | 222.90 | 0.43 |
| Tenn Crk | 16.23 | Q100 | 1700.00 | 1087.00 | 1093.97 | | 1094.60 | 0.002415 | 6.83 | 290.90 | 240.84 | 0.49 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1300.00 | 1087.30 | 1093.52 | | 1093.72 | 0.000863 | 3.84 | 375.83 | 120.36 | 0.29 |
| Tenn Crk | 15.88 | Q100 | 1700.00 | 1087.30 | 1094.09 | | 1094.38 | 0.001033 | 4.49 | 420.18 | 157.77 | 0.32 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.38 | Q50 | 1300.00 | 1088.00 | 1093.22 | | 1093.61 | 0.001968 | 5.42 | 337.06 | 195.90 | 0.43 |
| Tenn Crk | 15.38 | Q100 | 1700.00 | 1088.00 | 1093.74 | | 1094.24 | 0.002243 | 6.19 | 391.31 | 210.20 | 0.47 |
| | | | | | | | | | | | | |
| Tenn Crk | 14.88 | Q50 | 1300.00 | 1087.40 | 1093.00 | | 1093.48 | 0.002568 | 6.08 | 337.45 | 140.99 | 0.49 |
| Tenn Crk | 14.88 | Q100 | 1700.00 | 1087.40 | 1093.54 | | 1094.11 | 0.002764 | 6.77 | 448.72 | 213.42 | 0.52 |
| | | | | | | | | | | | | |
| Tenn Crk | 14.38 | Q50 | 1300.00 | 1086.50 | 1092.92 | | 1093.35 | 0.002096 | 5.74 | 372.85 | 154.21 | 0.45 |
| Tenn Crk | 14.38 | Q100 | 1700.00 | 1086.50 | 1093.44 | | 1093.97 | 0.002379 | 6.51 | 482.33 | 229.67 | 0.48 |
| | | | | | | | | | | | | |
| Tenn Crk | 13.88 | Q50 | 1300.00 | 1086.40 | 1092.88 | | 1093.24 | 0.001682 | 5.36 | 454.82 | 202.84 | 0.41 |
| Tenn Crk | 13.88 | Q100 | 1700.00 | 1086.40 | 1093.41 | | 1093.83 | 0.001845 | 5.98 | 569.46 | 223.88 | 0.43 |
| | | | | | | | | | | | | |
| Tenn Crk | 12.88 | Q50 | 1300.00 | 1085.80 | 1092.64 | | 1093.06 | 0.001767 | 5.62 | 423.32 | 185.27 | 0.42 |
| Tenn Crk | 12.88 | Q100 | 1700.00 | 1085.80 | 1093.05 | | 1093.61 | 0.002231 | 6.62 | 505.29 | 212.70 | 0.47 |
| | | | | | | | | | | | | |
| Tenn Crk | 11.89 | Q50 | 1300.00 | 1084.77 | 1092.71 | | 1092.85 | 0.000899 | 5.01 | 690.57 | 193.32 | 0.32 |
| Tenn Crk | 11.89 | Q100 | 1700.00 | 1084.77 | 1093.15 | | 1093.34 | 0.001130 | 5.83 | 779.44 | 203.79 | 0.36 |
| | | | | | | | | | | | | |
| Tenn Crk | 11.69 | Q50 | 1300.00 | 1084.40 | 1092.64 | | 1092.82 | 0.000678 | 4.28 | 644.36 | 191.80 | 0.27 |
| Tenn Crk | 11.69 | Q100 | 1700.00 | 1084.40 | 1093.06 | | 1093.31 | 0.000882 | 5.05 | 726.94 | 201.62 | 0.31 |
| | | | | | | | | | | | | |
| Tenn Crk | 11.49 | Q50 | 1300.00 | 1083.09 | 1092.53 | 1087.95 | 1092.79 | 0.000688 | 4.31 | 474.93 | 166.76 | 0.27 |
| Tenn Crk | 11.49 | Q100 | 1700.00 | 1083.09 | 1092.87 | 1088.71 | 1093.25 | 0.000973 | 5.27 | 529.38 | 175.13 | 0.32 |
| | | | | | | | | | | | | |
| Tenn Crk | 11.29 | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | |
| Tenn Crk | 11.09 | Q50 | 1300.00 | 1083.00 | 1088.88 | 1086.81 | 1089.31 | 0.002247 | 5.26 | 246.99 | 71.67 | 0.43 |
| Tenn Crk | 11.09 | Q100 | 1700.00 | 1083.00 | 1089.40 | 1087.34 | 1090.00 | 0.002742 | 6.20 | 274.27 | 105.24 | 0.48 |
| | | | | | | | | | | | | |
| Tenn Crk | 10.59 | Q50 | 1300.00 | 1082.36 | 1088.27 | | 1089.05 | 0.004681 | 8.49 | 239.56 | 86.94 | 0.66 |
| Tenn Crk | 10.59 | Q100 | 1700.00 | 1082.36 | 1088.77 | | 1089.71 | 0.005235 | 9.56 | 284.14 | 93.54 | 0.71 |
| | | | | | | | | | | | | |
| Tenn Crk | 10 | Q50 | 1300.00 | 1082.18 | 1088.02 | 1087.38 | 1088.67 | 0.007001 | 8.23 | 230.41 | 164.96 | 0.73 |
| Tenn Crk | 10 | Q100 | 1700.00 | 1082.18 | 1088.56 | 1087.98 | 1089.28 | 0.006998 | 8.64 | 276.09 | 174.46 | 0.74 |

HEC-RAS Plan: Alt C-59 River: Tennessee Creek Reach: Tenn Crk

| Reach | River Sta | Profile | E.G. Elev | W.S. Elev | Crit W.S. | Frctn Loss | C & E Loss | Top Width | Q Left | Q Channel | Q Right | Vel Chnl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft/s) |
| Tenn Crk | 17.23 | Q50 | 1095.07 | 1094.79 | | 0.04 | 0.07 | 233.06 | 273.94 | 824.27 | 201.79 | 5.18 |
| Tenn Crk | 17.23 | Q100 | 1096.20 | 1095.93 | | 0.04 | 0.08 | 270.22 | 381.73 | 1009.96 | 308.31 | 5.35 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.98 | Q50 | 1094.96 | 1094.45 | 1092.63 | 0.03 | 0.27 | 214.99 | 131.93 | 1023.05 | 145.02 | 6.39 |
| Tenn Crk | 16.98 | Q100 | 1096.08 | 1095.53 | 1093.21 | 0.03 | 0.42 | 251.61 | 194.93 | 1287.16 | 217.91 | 6.80 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.55 BR U | Q50 | 1094.65 | 1093.25 | 1092.63 | 0.25 | 0.33 | 46.00 | 19.95 | 1210.48 | 69.57 | 9.85 |
| Tenn Crk | 16.55 BR U | Q100 | 1095.63 | 1093.66 | 1093.53 | 0.31 | 0.46 | 46.00 | 30.80 | 1568.31 | 100.89 | 11.69 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.55 BR D | Q50 | 1094.08 | 1093.33 | 1091.86 | 0.04 | 0.15 | 46.00 | 55.44 | 1230.95 | 13.61 | 7.12 |
| Tenn Crk | 16.55 BR D | Q100 | 1094.86 | 1093.81 | 1092.51 | 0.05 | 0.21 | 46.00 | 84.40 | 1595.69 | 19.91 | 8.45 |
| | | | | | | | | | | | | |
| Tenn Crk | 16.23 | Q50 | 1093.89 | 1093.43 | | 0.04 | 0.13 | 222.90 | 145.66 | 1077.64 | 76.70 | 5.83 |
| Tenn Crk | 16.23 | Q100 | 1094.60 | 1093.97 | | 0.05 | 0.17 | 240.84 | 206.58 | 1384.46 | 108.96 | 6.83 |
| | | | | | | | | | | | | |
| Tenn Crk | 15.88 | Q50 | 1093.72 | 1093.52 | | 0.06 | 0.05 | 120.36 | 91.67 | 1141.73 | 66.61 | 3.84 |
| Tenn Crk | 15.88 | Q100 | 1094.38 | 1094.09 | | 0.07 | 0.06 | 157.77 | 131.96 | 1478.17 | 89.88 | 4.49 |

# APPENDIX G

# SCOUR CALCULATIONS

Contraction Scour

| | | Left | Channel | Right |
|---|---|---|---|---|
| Input Data | | | | |
| | Average Depth (ft): | 4.37 | 7.42 | 4.32 |
| | Approach Velocity (ft/s): | 1.55 | 6.29 | 1.55 |
| | Br Average Depth (ft): | | 5.19 | |
| | BR Opening Flow (cfs): | | 1700.00 | |
| | BR Top WD (ft): | | 42.80 | |
| | Grain Size D50 (mm): | 2 | 20 | 2 |
| | Approach Flow (cfs): | 258.12 | 1120.11 | 321.77 |
| | Approach Top WD (ft): | 38.00 | 24.00 | 48.00 |
| | K1 Coefficient: | 0.690 | 0.640 | 0.690 |
| Results | | | | |
| | Scour Depth Ys (ft): | | 0.78 | |
| | Critical Velocity (ft/s): | | 6.30 | |
| | Equation: | | Clear | |

Abutment Scour

| | | Left | Right |
|---|---|---|---|
| Input Data | | | |
| | Station at Toe (ft): | 989.08 | 1011.92 |
| | Toe Sta at appr (ft): | 1007.08 | 983.91 |
| | Abutment Length (ft): | 109.07 | 123.54 |
| | Depth at Toe (ft): | 7.96 | 5.43 |
| | K1 Shape Coef: | 0.55 - Spill-through abutment | |
| | Degree of Skew (degrees): | 90.00 | 90.00 |
| | K2 Skew Coef: | 1.00 | 1.00 |
| | Projected Length L' (ft): | 109.07 | 123.54 |
| | Avg Depth Obstructed Ya (ft): | 4.49 | 3.83 |
| | Flow Obstructed Qe (cfs): | 1378.77 | 1398.10 |
| | Area Obstructed Ae (sq ft): | 489.45 | 472.70 |
| Results | | | |
| | Scour Depth Ys (ft): | 13.61 | 13.33 |
| | Qe/Ae = Ve: | 2.82 | 2.96 |
| | Froude #: | 0.23 | 0.27 |
| | Equation: | Froehlich | Froehlich |

Combined Scour Depths

| | |
|---|---|
| Left abutment scour + contraction scour (ft): | 14.39 |
| Right abutment scour + contraction scour (ft): | 14.11 |

Note: Bedrock is approximately 3' to 9' Below stream bed therefore scour will not reach the calculated depths. Also, rock slope protection will be used as a countermeasure.

Keith Nelson
5/2/06