LA Department of
Transportation and Development

HYDRAULIC DESIGN GUIDELINES

OFF-SYSTEM BRIDGE REPLACEMENT AND REHABILITATION PROGRAM

2005

Front Cover:
Comite River
Off-System Bridge Replacement
East Baton Rouge Parish
Left – old timber pile bridge
Right – new concrete pile bridge

TABLE OF CONTENTS

PREFACE

The following is the Department's guidelines for the hydraulic design of off-system bridge replacements. This guideline and the "LA DOTD Hydraulics Manual" (located on LA DOTD's website) should be studied carefully prior to the design of any replacement structures.

The LA DOTD website is: www.dotd.louisiana.gov

Please direct any comments or questions to the Hydraulics Section at (225) 379-1306.

This page left blank

SECTION 1
INTRODUCTION

1.1 Purpose

The Federal-Aid Off-System Bridge Replacement and Rehabilitation Program is, as the name implies, intended to replace structurally deficient bridges which are not part of the State Highway System. While the primary reason for replacing qualified structures is to remedy structural deficiencies, replacement structures will also be hydraulically designed according to applicable LA DOTD design criteria. As with all engineering designs, the object of the hydraulic evaluation is to determine the structure or structures which most economically meet the minimum criteria for the site. It is the goal of the FHWA and the LA DOTD to replace as many bridges as possible with funds allocated to this program. The hydraulic design is essential to that goal; a dollar saved at enough sites can be used to finance additional sites.

1.2 Hydraulic Design Criteria

Standard hydraulic design criteria and procedures as documented in the "LA DOTD Hydraulics Manual" will apply to all evaluations, except as amended in this guideline.

1.3 Computer Programs

Computer programs that are available for use in the hydraulic calculations in the Off-System Bridge Replacement Program are: the LA DOTD HYDR program series, (includes programs to compute peak discharge and size standard culverts), FHWA's Water Surface Profile (WSPRO) modeling program, (to determine backwater and scour depths) and HEC-RAS.

One option for calculating the head losses and the hydraulic efficiency of a Precast 3 sided (P3S) structure is FHWA's culvert analysis program, HY-8. The program has predefined shapes which assumes the bottom to be open. HY-8 also gives the user the option to define points for the shape of a P3S structure.

LA DOTD HYDR programs are available on the LA DOTD website under the "Pre-Construction – Road Design" area. The accompanying "HYDR User's Manual" and the "LA DOTD Hydraulics Manual" are in a .PDF format on the website. They may also be purchased for a nominal fee through LA DOTD's General Files Office located at the Headquarters Building in Baton Rouge, LA.

WSPRO and HY-8 may be obtained from the FHWA website:
http://www.fhwa.dot.gov/engineering/hydraulics/software.cfm.

1.4 Evaluation of Alternates

The hydraulics designer will evaluate all feasible alternate design structures for a site, and tabulate the hydraulic design data for each acceptable alternate.

All alternates are to be compared to the existing structure.

If an alternate is considered not feasible for any reason, a recommendation in this regard shall be included in the Hydraulics Report for the project site.

The final decision on the required replacement structure will be made after the plan-in-hand inspection.

Alternate design structures are discussed further in this guideline.

SECTION 2
ROADWAY GRADES

2.1 Finished Grade Elevation of Roadway

As a rule, grades will not be raised to prevent overtopping unless there is documented evidence that the Parish or Local Government has both the intention and the funds to raise the affected roadway. LA DOTD must have a written statement in the project file from the governing body of the parish stating their intention to raise the elevation of the existing roadway. A copy of said letter should be provided with the hydraulics report.

If the overtopping occurs only at the structure, however, with the roadway elevation on either side being high enough to prevent overtopping, investigations should be made into the feasibility of raising the finished grade of the structure above the 25-year stage. (This usually applies only when the length of the roadway to be raised is small.)

2.2 Elevation of the Proposed Bridge Structure Alternate

Generally, finished grade elevations of proposed bridge structures will match the elevations of existing structures.

Should the plan-in-hand party suggest that the elevation of the proposed bridge be raised or lowered, the reason for the recommendation must be documented.

At no time would the designer decrease the elevation of the low concrete on the deck below the DWSE (Design Water Surface Elevation) or have the proposed low chord lower than the existing low chord without being able to justify it to the governing parish body and the LA DOTD Chief Engineer.

2.3 Elevation of Roadway for Culvert Structure Alternates

The grade at a culvert replacement site will normally be the same as the existing grade.

SECTION 3
DESIGN STORM

3.1 Design Frequency and Discharge

The design criterion is the lesser of the 25-year flood or the overtopping discharge.

If the overtopping discharge is associated with a storm frequency less than a 5-year return interval, use the 5-year storm discharge to design the structure.

3.2 Overtopping Discharge

The overtopping discharge is that flow which will produce a headwater elevation equal to the low point of the adjacent roadway or bridge, whichever is lower. This headwater elevation is the normal water surface elevation plus the backwater created by the existing structure.

The overtopping stage elevation is considered to be the water surface elevation taken at a distance one bridge opening upstream from the upstream side of the embankment. (In WSPRO, this is the "Approach Constricted" section, located at a distance upstream from the bridge opening that is approximately equal to the sum of the bridge width and bridge length. See Section 4.4 of these guidelines for further details.)

3.3 Alternate Comparison

The existing structure and all alternate design structures should be analyzed for the same discharge for comparison purposes.

Table 3-1 is to assist in the selection of the appropriate drainage structure to design for at a particular site. This table is a general guideline only! Other conditions at the site may govern the selection of an alternate.

STRUCTURE ALTERNATES		
DESIGN DISCHARGE		STRUCTURE TYPE
cfs	(m^3/s)	
Below 250	(< 7)	Pipe Only
250 – 750	(7 – 21)	Pipe or RCB
750 – 1000	(21 – 28)	Pipe, RCB, P3S or Bridge
1000 – 1600	(28 – 45)	P3S or Bridge
Above 1600	(> 45)	Bridge Only

Table 3-1

SECTION 4
BACKWATER

4.1 Alternates

Bridge hydraulics and culvert hydraulics are different in nature. The methods to compute the backwater or differential head are not the same for bridges and culverts. However, for economic comparisons, when choosing the size of alternates, the sizes should be based on the same area of opening, hydraulic equivalency, backwater limitations or allowable headwater elevation within the constraints of these guidelines.

4.2 Flood Zones

Neither a bridge nor a culvert should increase the headwater above the existing condition in a "Recognized Flood Zone".

"Recognized Flood Zone" is a subjective term, but generally refers to flood sensitive areas with insurable buildings. An area where even a slight increase in backwater or headwater elevation would impact residential or other developed property would be an area where it would be unadvisable to increase the backwater or headwater elevation over the existing conditions. It should be documented in the report whether or not a site is in a flood sensitive area.

4.3 Allowable Headwater Elevation

In flatter terrain, where full-flow conditions exist, backwater will depend upon the "Flood Sensitivity" of the site and its proximity to developed property.

In more hilly terrain, the allowable headwater elevation may be governed by local buildings or the roadway elevation.

All alternate design structures must conform to the design allowable headwater elevation.

4.4 Backwater Determination

LA DOTD uses the design principles specified by FHWA in their publication HDS 01, "Hydraulics of Bridge Waterways" and their research report no. FHWA/RD-86/108, "Bridge Waterways Analysis Model: Research Report". Both are available on the FHWA website.

The maximum backwater is considered to be produced by the water surface elevation taken at a distance one bridge opening upstream from the upstream side of the embankment. (In WSPRO, this is the "Approach" section, located upstream from the bridge opening at a distance approximately equivalent to the sum of the bridge width and bridge length.)

The quantity for the maximum backwater is the difference between the "Approach Constricted" and the "Approach Unconstricted" water surface elevations. That is, the water surface elevation

at the approach caused by the bridge in place minus the water surface elevation at the approach without the bridge. (In WSPRO this is automatically done when a bridge card is included. It is not necessary to run the program again without the bridge card.)

4.5 Allowable Backwater Ranges

Table 4-1 lists the allowed backwater range for the proposed structure for different site specific situations.

BACKWATER RANGES

	SITE LOCATION	BACKWATER RANGE
A.	Where the overtopping discharge governs	0.1′ – 0.5′ (0.030 m – 0.150 m)
B.	Developed areas or areas subject to development	0.5′ – 1.0′ (0.150 m – 0.300 m)
C.	Remote area, development not likely within 20 years	1.0′ – 1.5′ (0.300 m – 0.450 m)

Table 4-1

SECTION 5
ALTERNATE STRUCTURES

5.1 Area of Opening

Should the area of opening of the proposed structure below the Normal Water Surface Elevation (NWSE) be less than that provided by the existing structure, information must be provided in the hydraulics report that will justify this design to the governing parish body and the LA DOTD Chief Engineer.

5.2 Flow Line

Culverts are to be placed at approximately the same slope as the natural stream. In case of headroom problems, they may be buried up to 1 ft (0.300 m) maximum. For complete guidelines, see the "LA DOTD Hydraulics Manual".

5.3 Structures to Be Evaluated

The following alternate design structures should be compared in deciding which alternate will replace the existing structure.

a. Cross Drain Pipe or Cross Drain Pipe Arch (CDP or CDPA)
b. Reinforced Concrete Box (RCB)
c. Precast 3 Sided Structure (P3S)
d. Bridge

A maximum of 4 lines of pipe or a 4-barrel Reinforced Concrete Box should be used.

For designing any other structure, contact the LA DOTD Hydraulics Section Administrator.

5.4 Cross Drain Pipe (CDP)

By definition, a Cross Drain Pipe contains a concrete/plastic and metal pipe option. Plastic pipes are the same size as concrete pipes, whereas metal pipes are at least one size larger in order to achieve the same hydraulic performance.

Pipes smaller than 60″ (1500 mm) should have their metal alternates sized up 6″ (150 mm) and pipes 60″ (1500 mm) and above should have their metal alternates sized up 12″ (300 mm).

A Cross Drain Pipe item must have the same number of lines for each pipe material, even though the sizes for the metal and concrete/plastic alternates will be different.

5.5 Cross Drain Pipe Arch (CDPA)

In cases of limited headroom, a Cross Drain Pipe Arch may be used. Plastic pipe is not commercially available in the arch pipe; therefore, a Cross Drain Pipe Arch item contains only concrete and metal pipe options.

A Cross Drain Pipe Arch is specified by its round size equivalence. Metal pipes are at least one size larger in order to achieve the same hydraulic performance. Pipes smaller than 60″ (1500 mm) should have their metal alternates sized up 6″ (150 mm) and pipes 60″ (1500 mm) and above should have their metal alternates sized up 12″ (300 mm).

A Cross Drain Pipe Arch item must have the same number of lines for each pipe material, even though the sizes for the metal and concrete alternates will be different.

5.6 Reinforced Concrete Box (RCB)

LA DOTD has standard plans for various sizes of box culverts. The standard plans for these RCB culverts are on the LA DOTD website.

5.7 Precast 3-Sided Structure (P3S)

Under certain conditions this may be the only viable option. In other cases it may be recommended based on physical features such as debris problems, etc.

For Off-System projects, a P3S structure will mean that it has a bottom slab (much like a RCB), unless otherwise decided by the plan-in-hand party.

The size of a Precast–3–Sided structure will be based on the site's conditions as well as the manufacturer's lengths and LA DOTD's directives. Since the manufacturer will not be known at the time of preliminary design, a general approximation to the size required should be used in accordance with LA DOTD guidelines.

LA DOTD requires span lengths not to exceed 32 ft (9.75 m).

Further restrictions and guidance are in Engineering Directives and Standards, EDSM No. II.3.1.5, "Use of Precast Reinforced Concrete 3 Sided Structures, Metal Arch Structures, and Structural Plate Structures". A copy may be found on the LA DOTD website.

5.8 Bridge

Bridges are discussed in Section 6.

5.9 Culvert Scour

Determination of scour and necessity of erosion protection for culverts is discussed in the "LA DOTD Hydraulics Manual".

SECTION 6
BRIDGE ALTERNATE

6.1 Bridge Type

Bridges will be designed as a slab span with 20 ft. (6 m) span lengths unless special conditions arise.

6.2 Abutment Slope

A minimum abutment slope of 3:1 for fill sections and cut sections will be used unless the LA DOTD Geotechnical Section has reviewed the site and suggested otherwise.

6.3 Area of Opening

To ensure that the WSPRO "design mode" analysis is a true reflection of a site, the actual area of opening underneath the bridge should be calculated and compared to the area given in the WSPRO output at the bridge section. The two areas should be within 10% of each other. If they are not, it may be necessary to input cross section cards at the bridge section of WSPRO, taking into consideration any improvements of the channel at the site, that is, any cut or fill to take place.

For the WSPRO analysis of the existing bridge, it may be more accurate to use the "fixed geometry" mode, thus eliminating the need for a hand calculation.

6.4 Bridge Scour

After the Plan-in-Hand inspection, if the bridge alternate has been chosen as the new structure, an estimate of the scour at the bridge site must be performed and sent as a supplement to the Hydraulic Report. The latest version of the FHWA Publication HEC 18 entitled "Evaluating Scour at Bridges," will be used to determine the scour. This publication is available on FHWA's website or may be obtained through the Hydraulics Section.

Some versions of WSPRO have incorporated the scour equations from HEC 18, and the contraction, pier and abutment scour can be calculated using the appropriate cards. Using this method or working directly with the equations from HEC 18 is acceptable. Engineering judgment should be applied in either case.

When the abutment slopes are going to be armored with flexible revetment or rip rap, an abutment scour analysis is not required. The total scour value would equal the contraction scour plus the pier scour.

A minimum total scour depth of 5 ft (1.500 m) is required at all bridge sites.

6.5 Erosion Protection

The designer will recommend any erosion control feature necessary. Where needed, the appropriate size rip rap should be specified.

A minimum 12 ft (3.7 m) bottom width is recommended when applying revetment or rip rap on the abutments. In other cases, the plan-in-hand party will discuss the option of putting revetment across the bottom of the channel providing there are no adverse affects to the environment or hydraulics of the stream.

SECTION 7
ADDITIONAL DESIGN CONSIDERATIONS

7.1 General

Besides the hydrology for a project site, other factors can be just as important when deciding the best alternate structure to construct. Following in this section are design factors that should also be taken into consideration when deciding which proposed structure to recommend.

7.2 Historical Flood Information

Any and all flooding that has occurred in the past should be presented in the report. This information may come from published data obtained from the USGS or US Army Corps of Engineers, parish or city drainage officials or local residents.

7.3 Interagency Coordination (Letters of Inquiry)

It is important to find out if any other agencies have work in progress or proposed that would affect the hydraulics of the stream for the project. "Letters of Inquiry" should be sent to the following agencies:

a) US Army Corps of Engineers
b) USGS (U. S. Dept. of the Interior, Geological Survey)
c) NRSC (Natural Resources Conservation Service)

7.4 Potential for Watershed Development

Whether or not the watershed is in a residentially or commercially developed area or has the potential to be so in 20 years future should be identified. This information is used to determine the acceptable backwater range for the proposed structure.

7.5 Utility Conflicts

Utility conflicts at the site can prohibit the use of a particular alternate. Any such conflicts should therefore be identified.

7.6 Detours

The length of an alternate route the traveling public has available to use when the road of the project site is under construction should be measured.

When a detour road is necessary to construct, the detour grade should be lower than the main road to provide relief should a large storm event occur. If however, the detour grade is the same as the main road, the drainage structure for the detour has to be the same size as the drainage structure for the main road.

7.7 Average Daily Traffic Count

The ADT should be determined for both the current and future conditions. Also, the road classification should be identified.

7.8 Structure Alignment

The alignment of the stream with both the existing structure and proposed alternates needs to be identified. When designing for a RCB culvert alternate, the standard plan list of RCB culverts should be reviewed. Most, but not all, of the standard RCB culverts have crossing options of 90°, 75°, 60°, and 45°.

7.9 Existing Erosion Problems/Scour Potential

Any existing evidence of erosion or scour should be identified. Any potential for erosion or scour problems should also be identified.

7.10 Debris

Many of the state's streams have various size debris floating down their waters. This can cause maintenance and scour problems if it is obstructed by the structure and not easily able to pass through. Therefore, any debris problems evident at the site should be noted and photographs showing the amount and size should be included in the Hydraulic Report.

7.11 Design Criteria

All hydrological and hydraulic criteria and design assumptions need to be documented.

SECTION 8
HYDRAULIC REPORT

8.1 General Requirements

Thorough documentation of all design assumptions and design decisions is critical. All factors, especially judgmental factors, governing the selection of such design parameters as allowable backwater, allowable headwater elevation, permissible velocity, etc., must be documented in the hydraulic report. The selection of the limiting design parameters is determined by the designer. However, the basis for the selection of the limiting factors must be defensible by sound engineering principle.

A "Hydraulic Report" for each site is required and must be stamped by the Professional Engineer in charge.

Each report should be bound, typed, properly indexed and neatly arranged. The pages of the report should be numbered for referencing purposes. Included in each report should be all the calculations contributing to the design of the proposed hydraulic structures. Brief commentary should also be included describing the conditions of the site, justification for the proposed structure, and the effect the proposed structure will have at the site.

When multiple reports are submitted for review, each individual report should be bound separately from the other reports.

8.2 Comparison of Alternates

A table comparing the existing structure to all alternates and a Hydraulic Data Table for each bridge site are required in the report. Blank forms are included in Appendices A & B. The information contained on the tables should be based on the calculations in the report.

8.3 Outline of the Hydraulic Report

Below is an outline of the contents that should be included in each Hydraulic Report. Any other information not listed on the outline that is pertinent and would facilitate the review of the report should also be included.

I. Summary Page

II. General Project Information
   A. Bridge Location
   B. Existing Structure
   C. Vicinity Map of the Bridge Site
   D. Existing Bridge Site Plan
   E. Existing Road Profile at Bridge Site

F. Photographs
   a) Color photographs of the existing bridge site should be in the report.
   b) The following views are to be included in the photographs:
      1. Downstream channel, taken from bridge
      2. Upstream channel, taken from bridge
      3. Typical view of the roadway, taken from bridge
      4. View of the opening provided by the structure

III. Design Considerations
   A. Historical Flood Information
   B. Interagency Coordination – Letters of Inquiry
   C. Potential for Watershed Development
   D. Utility Conflicts
   E. Detour Distance
   F. Average Daily Traffic Count
   G. Structure Alignment
   H. Existing Erosion Problems/Scour Potential
   I. Design Criteria

IV. Design Analysis
   A. Hydrology
      1. Drainage Area Map
         a) Include a readable color copy of the USGS quadrangle map with the drainage area drawn out. The name of the quadrangle map, scale, and the points used in determining the basin slope should be indicated on the map.
      2. Peak Discharge Information & Calculations
      3. Discharge – Frequency Curve
   B. Hydraulics
      1. Cross Sections at Existing Bridge
      2. Stage – Discharge Curve
      3. Bridge Hydraulic Calculations (WSPRO Input & Output)
         a) Existing Bridge
         b) Proposed Bridge(s)
      4. Culvert Calculations of All Alternates
   C. Recommendation
      1. Comparison Table of Structural Alternates to Existing Structure (See Appendix A)
      2. Cross Section of Proposed Alternates
      3. Hydraulic Data Table of Existing Structure and Proposed Structures (See Appendix B)

V. CD
   A. WSPRO (or HEC-RAS) Input and Output for the Existing and Proposed Structures on a CD.

8.4 Scour Supplement

The “Scour Supplement” is required after the plan-in-hand once it has been decided that the replacement structure is going to be a bridge.

It is to include the following:

A. Scour Calculations
B. Scour Recommendations
C. Updated Hydraulic Data Table with the appropriate scour information

8.5 Revisions

For most cases, revisions may be sent as a supplement to the original report with an explanation of what is being replaced and why.

8.6 Final Submittal

A CD containing the final revised hydraulic report addressing all comments is to be submitted with the Final Tracings. The report should be in .PDF format. The CD will be kept by the Hydraulics Section for reference if questions arise about the project at a later date.

This page left blank

APPENDICES

Off-System Bridge Rehabilitation & Replacement Program

COMPARISON TABLE OF STRUCTURAL ALTERNATES TO EXISTING STRUCTURE

	EXISTING STRUCT.	BRIDGE ALT.	P3S ALT.	RCP / PP ALT.	CMP ALT.	RCB ALT.
SIZE, TYPE & NO.						
DESIGN FREQUENCY						
DESIGN DISCHARGE						
FINISHED GRADE ELEVATION						
LOW ROADWAY ELEVATION						
DESIGN WATER SURFACE ELEVATION *						
OUTLET VELOCITY						
DEPTH OF SCOUR – SOIL TYPE (Culverts Only)						
AREA OF OPENING						
DIFFERENTIAL HEAD						

* Includes the differential head

Off-System Bridge Rehabilitation & Replacement Program
Bridge Hydraulic Data Form

STATE PROJECT NO.: **STREAM NAME:**

PARISH: **BEGINNING STATION:**

STRUCTURE NO.: **FINISH GRADE ELEV. (ft):**

PREPARED BY: **BRIDGE LENGTH (ft):**

DATE: **LOW ROADWAY ELEVATION (ft):**

NOTE: THE FOLLOWING HYDRAULIC DATA TABLE IS TO BE PLACED ON THE PLANS.

HYDRAULIC DATA TABLE

Drainage Area (mi^2):					
Basin Slope (ft/mi):				PREDICTED SCOUR	
Flood Frequency (years)	Design Year	Design Year	100	Flood Frequency (years)	
Discharge (ft^3/s)				Discharge (ft^3/s)	
Structure	Existing Bridge	Proposed Structure	Proposed Structure	Contraction Scour Depth (ft)	
Size & Type					
Design Water Surface Elev. (ft/MSL)				Maximum Local (Pier) Scour Depth (ft)	
Average Velocity (ft/s)					
Area of Opening (ft^2)				Abutment Scour Depth (ft)	
Backwater (ft)				Bridge Scour Elevation (ft)	

REMARKS:

SCOUR:

EXISTING BRIDGE:

DETOUR BRIDGE:

Off-System Bridge Rehabilitation & Replacement Program
Bridge Hydraulic Data Form (Metric)

STATE PROJECT NO.: **STREAM NAME:**

PARISH: **BEGINNING STATION:**

STRUCTURE NO.: **FINISH GRADE ELEV. (m):**

PREPARED BY: **BRIDGE LENGTH (m):**

DATE: **LOW ROADWAY ELEVATION (m):**

NOTE: THE FOLLOWING HYDRAULIC DATA TABLE IS TO BE PLACED ON THE PLANS.

HYDRAULIC DATA TABLE (METRIC)

Drainage Area (km^2):					
Basin Slope (m/km):				PREDICTED SCOUR	
Flood Frequency (years)	Design Year	Design Year	100	Flood Frequency (years)	
Discharge (m^3/s)				Discharge (m^3/s)	
Structure	Existing Bridge	Proposed Structure	Proposed Structure	Contraction Scour Depth (m)	
Size & Type					
Design Water Surface Elev. (m/MSL)				Maximum Local (Pier) Scour Depth (m)	
Average Velocity (m/s)					
Area of Opening (m^2)				Abutment Scour Depth (m)	
Backwater (m)				Bridge Scour Elevation (m)	

REMARKS:

SCOUR:

EXISTING BRIDGE:

DETOUR BRIDGE:

DISCHARGE/FREQUENCY GRAPH PAPER

ENGLISH & METRIC

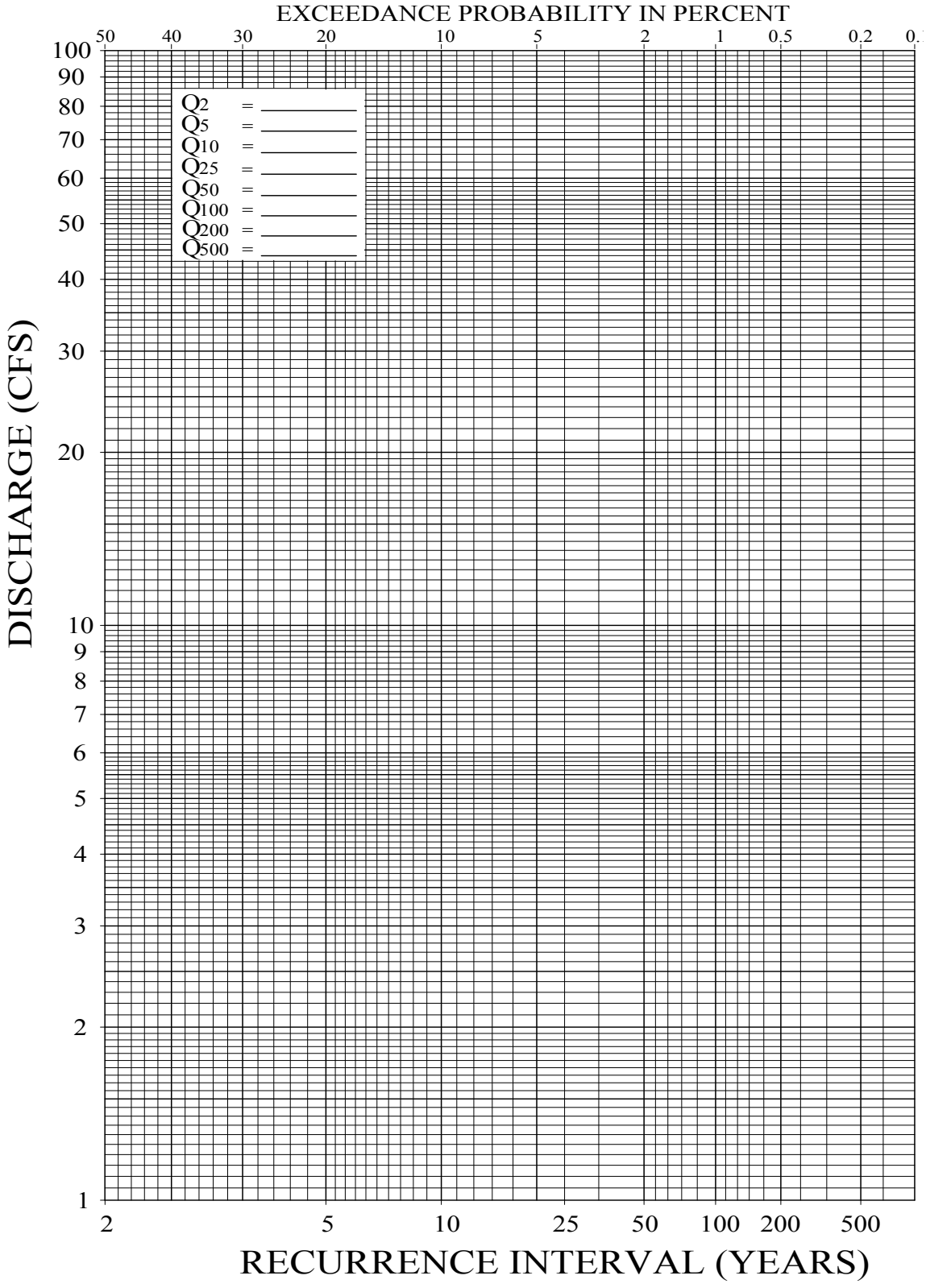
This page left blank.

DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

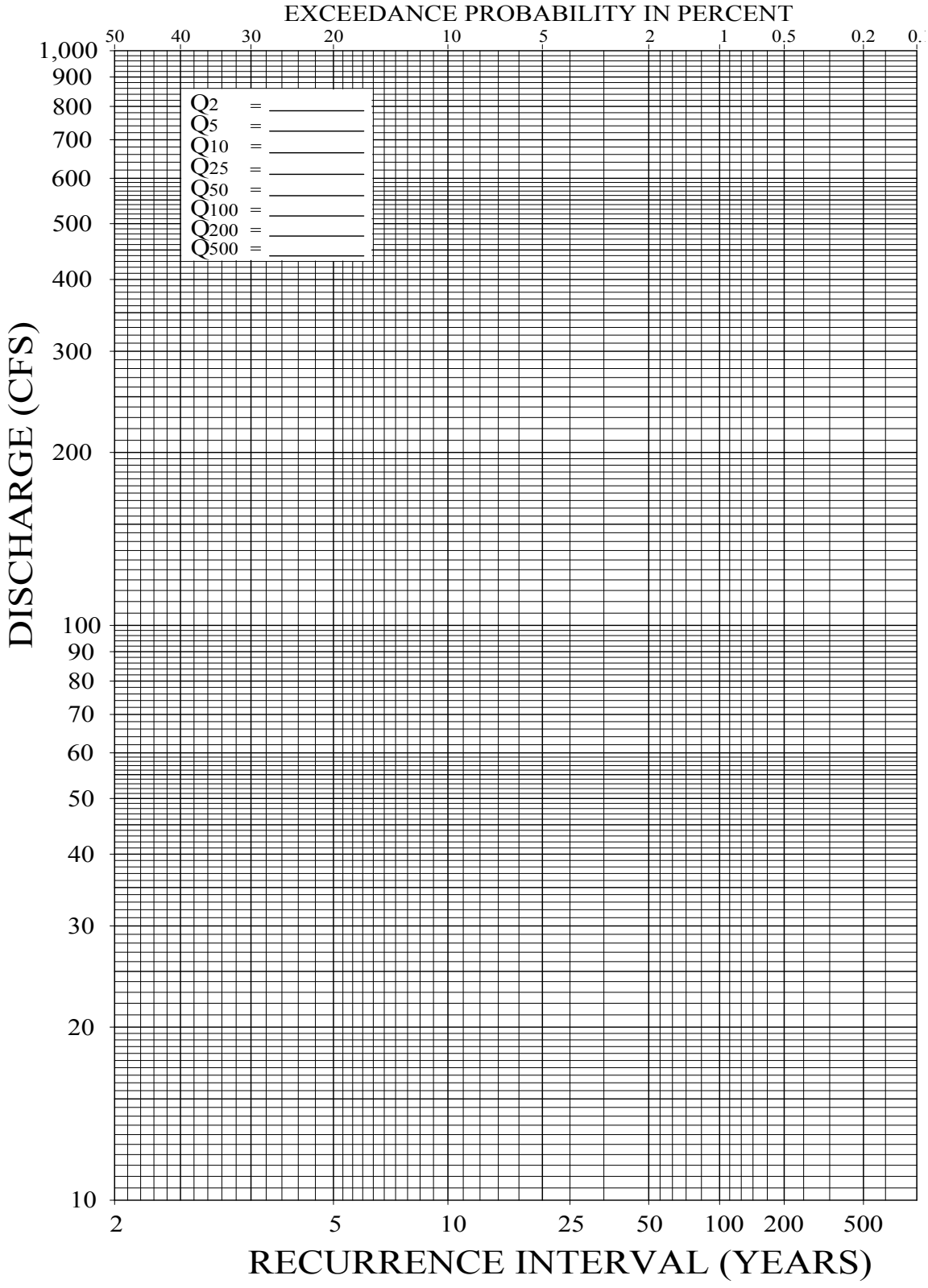


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

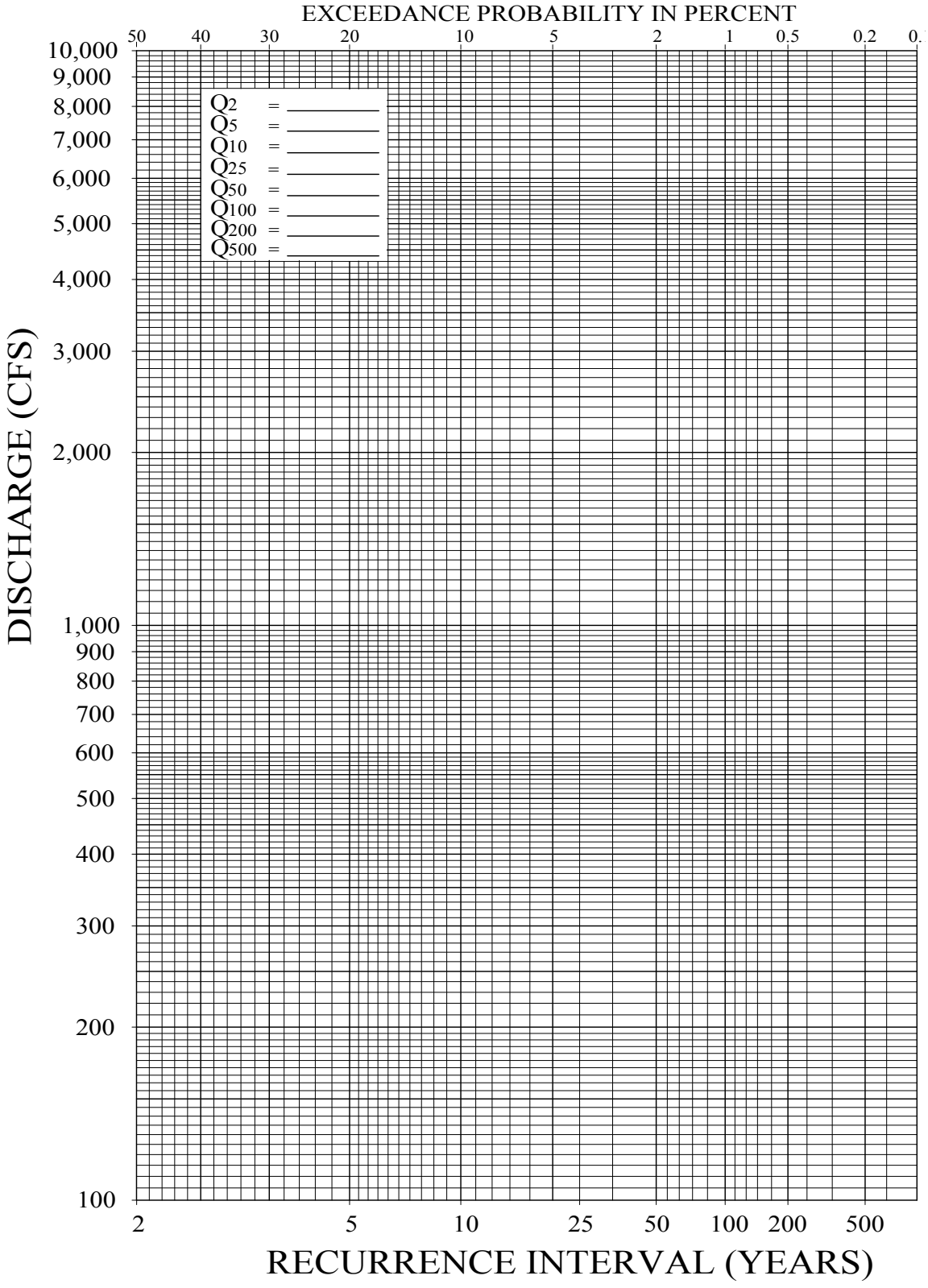


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

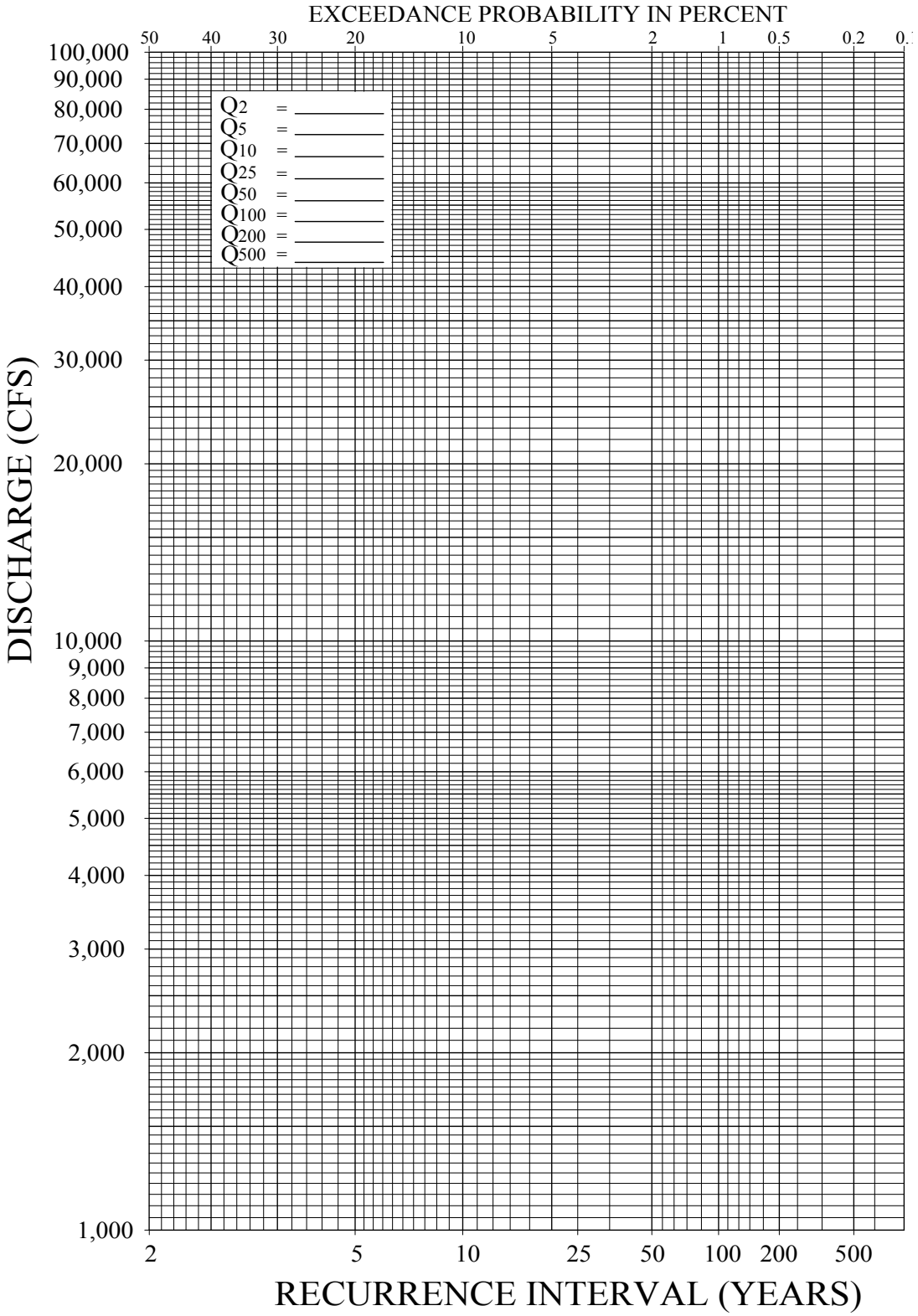


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

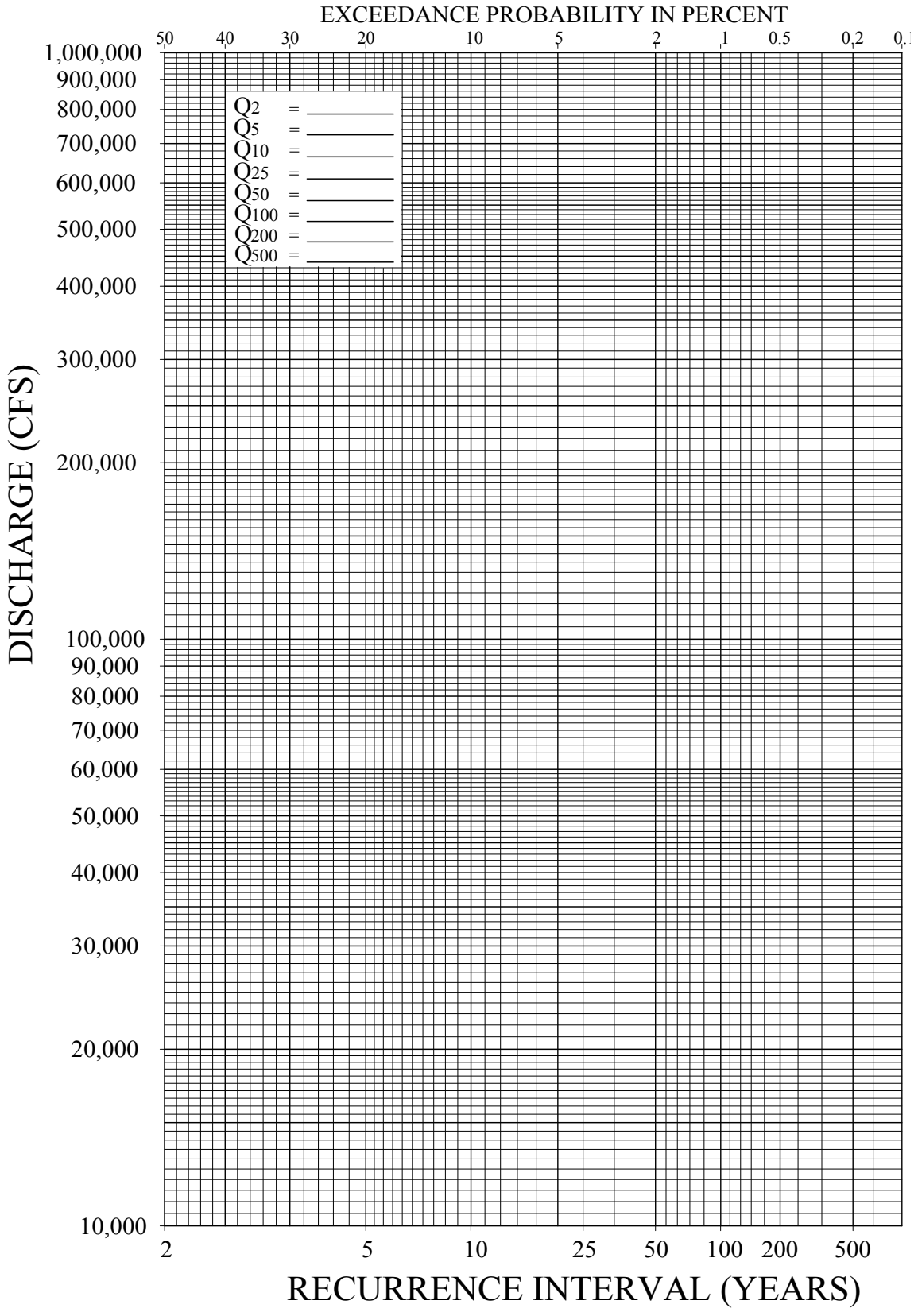


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

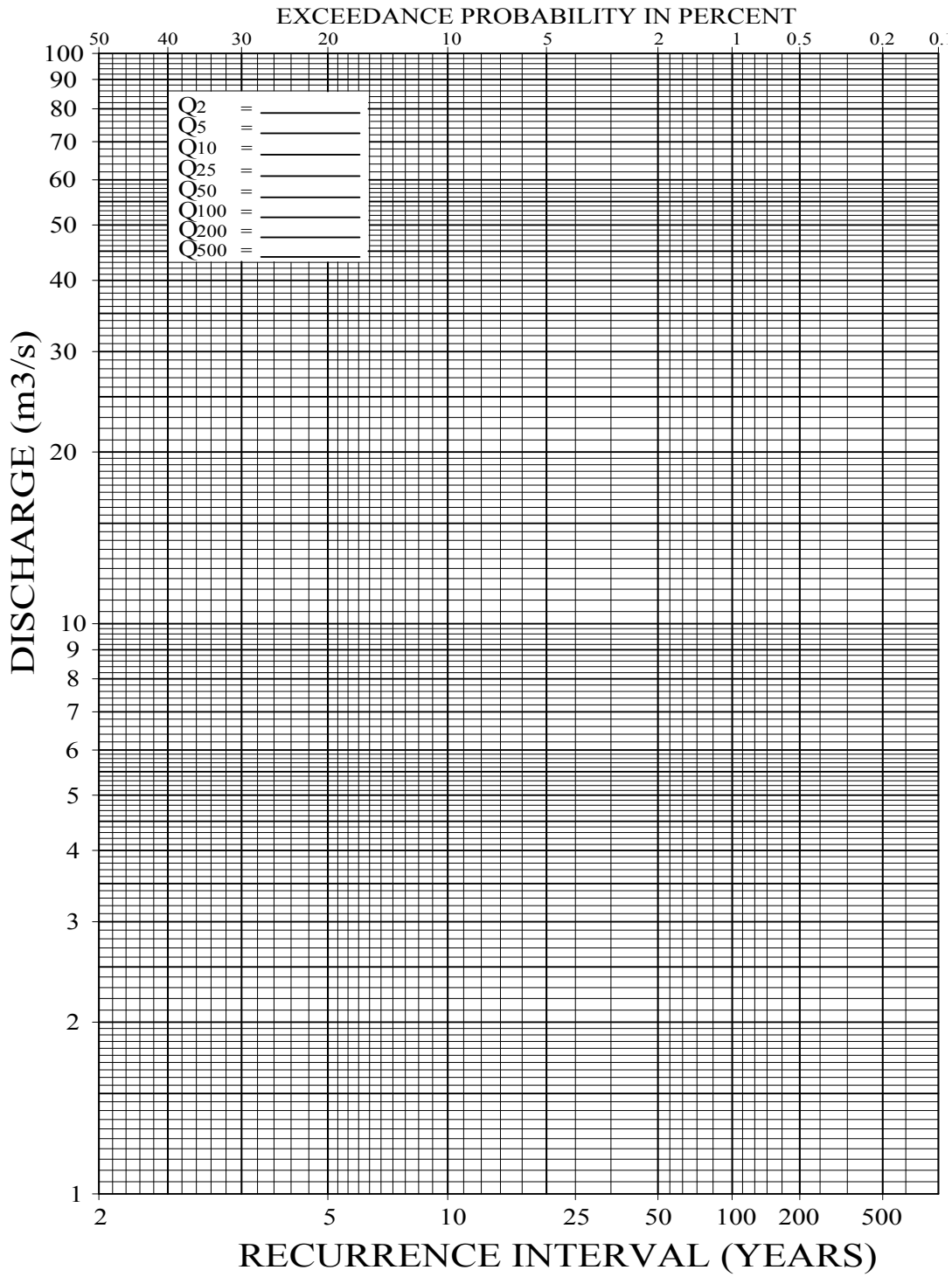
PARISH _____ BY: _____ DATE: _____



This page left blank.

DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____
ROUTE _____ STRUCTURE NO. _____
PARISH _____ BY: _____ DATE: _____

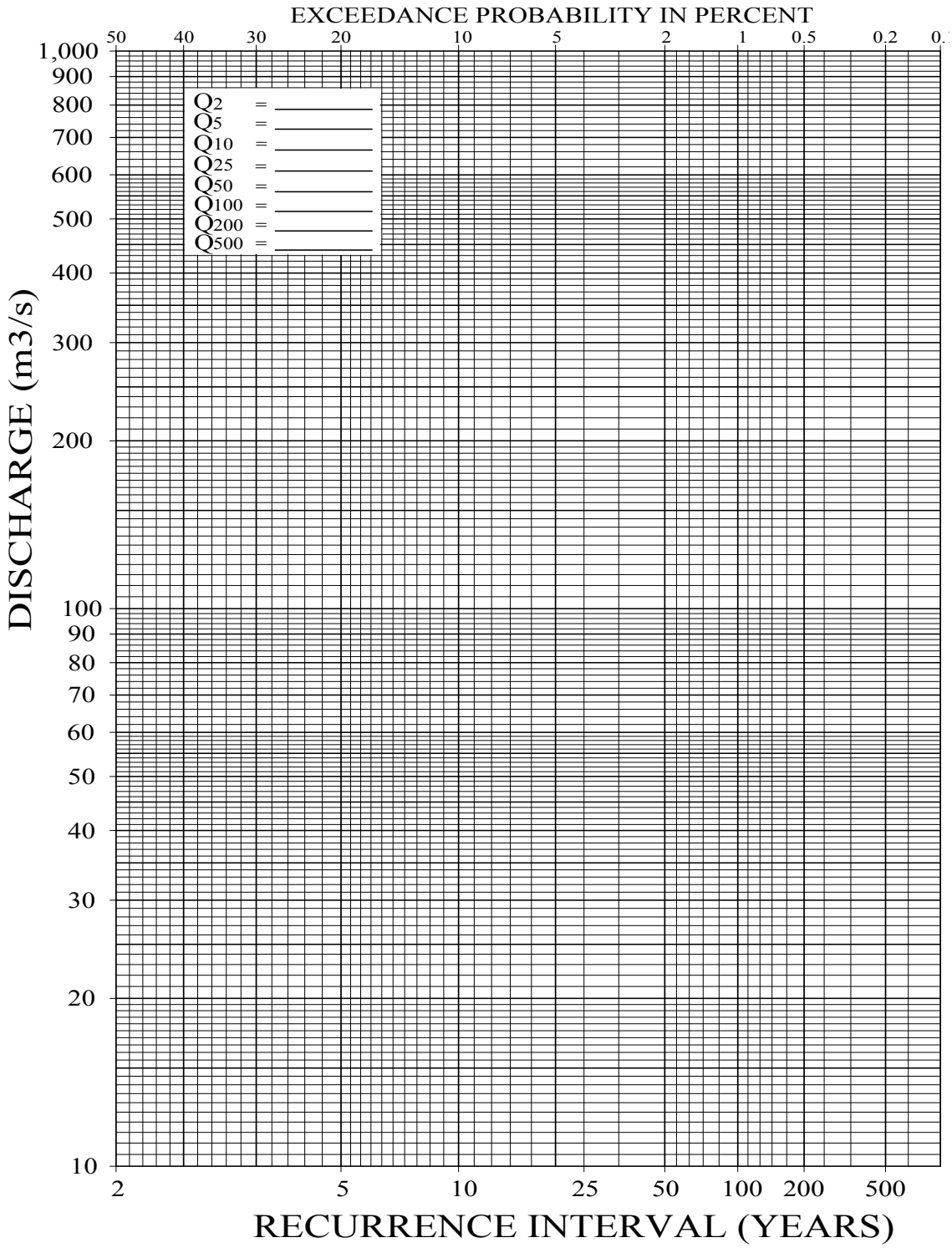


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

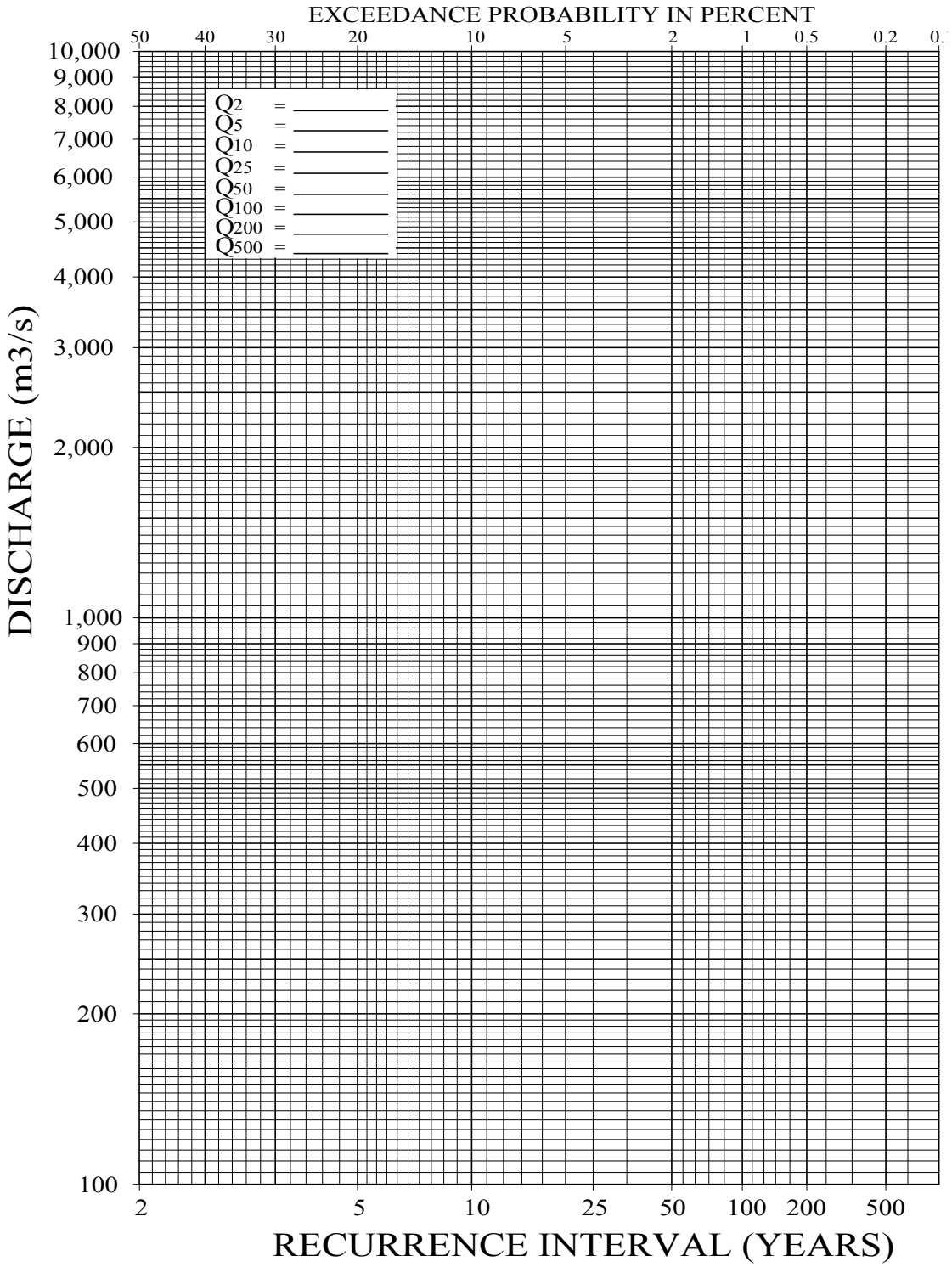


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

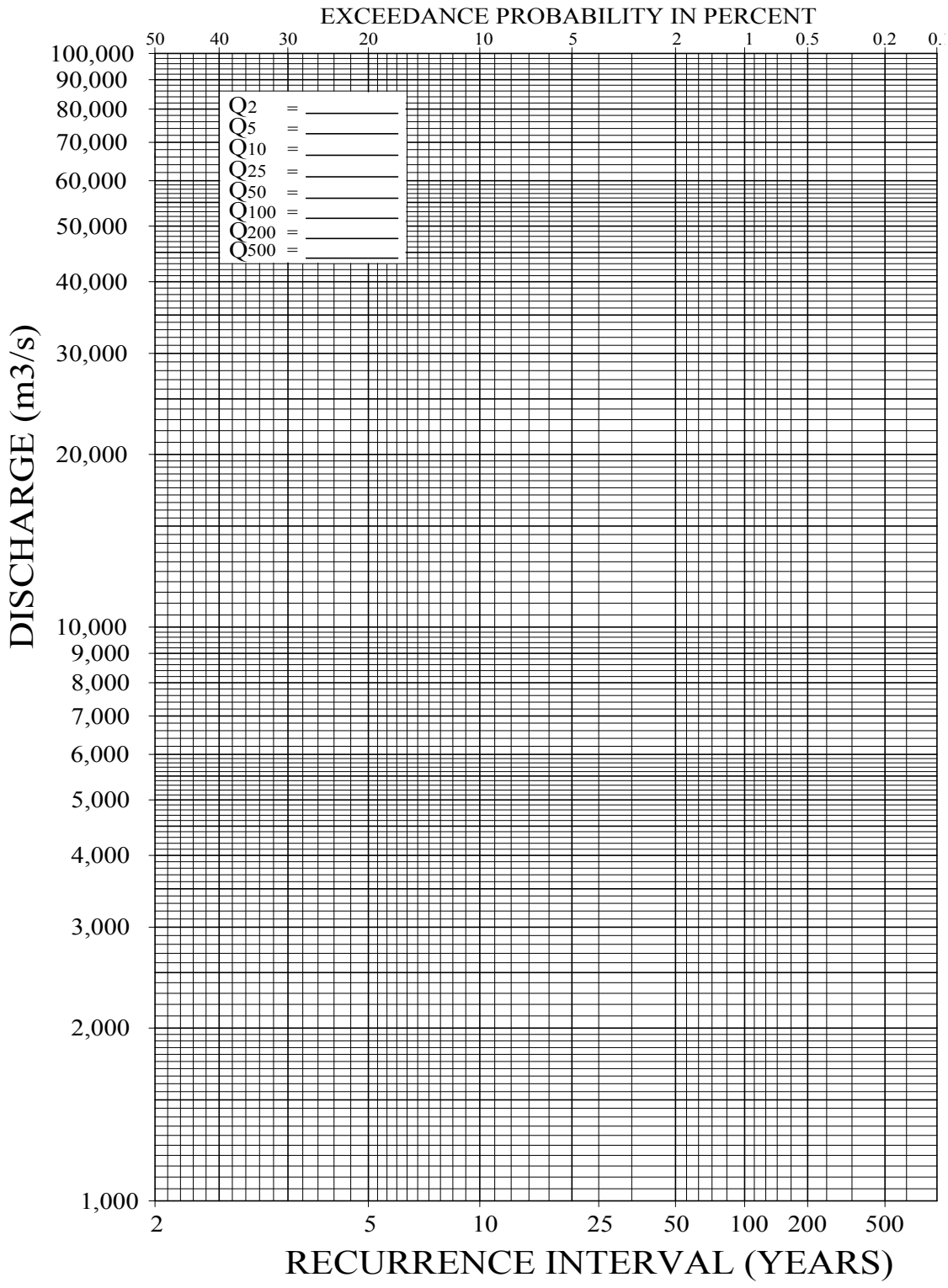


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____

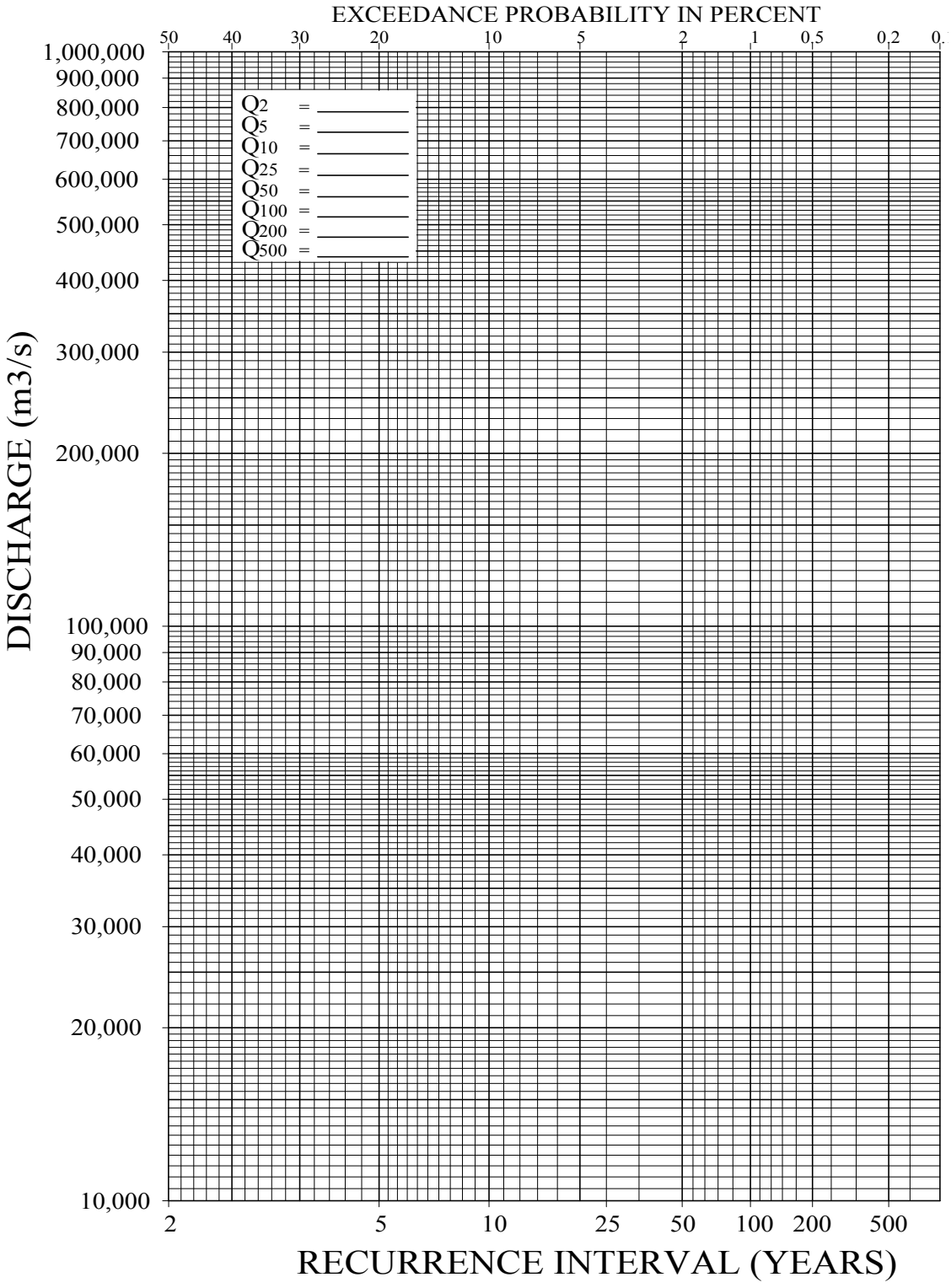


DISCHARGE - FREQUENCY CURVE

STATE PROJECT _____ STREAM NAME _____

ROUTE _____ STRUCTURE NO. _____

PARISH _____ BY: _____ DATE: _____



This page left blank.

SAMPLE

HYDRAULIC REPORT

The following is a sample hydraulic report. The intent of providing the sample report is for general format only. **This sample report is not for setting policy. (For policy see the first portion of the guidelines.)** The methods, assumptions, and design criteria used in the calculations were considered appropriate for this particular bridge site. Each bridge site is unique and variations in the WSPRO models and culvert analyses may be appropriate and acceptable as long as they follow sound hydraulic reasoning.

Note: This report is a modification of an actual report submitted for review prior to this guideline publication.

For reproduction and cost considerations in publishing this manual, pages originally submitted on 11" × 17" paper have been reduced to an 8½ " × 11" sheet instead, and color photographs have been photocopied in black and white.

This page left blank.

HYDRAULIC REPORT

STATE PROJECT NO. 713-42-0000 (CONST.)
STATE PROJECT NO. 700-42-0000 (ENGR.)
F.A.P. NO. BRO-002S(000)
STRUCTURE NO. P42-32196-91474-1

LITTLE CREEK BRIDGE
ON TARVER ROAD

RICHLAND PARISH

PREPARED BY:

FIRM NAME
MAILING
ADDRESS
PHONE NUMBER:

DATE OF REPORT

CONTENTS:

I. SUMMARY

LITTLE CREEK BRIDGE
STATE PROJECT NO. 713-42-0000
RICHLAND PARISH
STRUCTURE NO. P42-32196-91474-1

This report serves to document design investigations, computations, and decisions relative to the selection of a hydraulically suitable replacement for the existing 4-span, 52 ft long timber bridge on Tarver Road over Little Creek located at about 1.55 miles north of Mangham in Richland Parish. It is also intended to fulfill the requirements of the Federal Highway Administration FHPM 6-7-3-2, "Location and Hydraulic Design of Encroachments on Flood Plains."

The structural alternates considered to replace the existing 52 ft long timber bridge are:

One 80 ft (four 20 ft spans) Long Reinforced Concrete Bridge
With 3:1 Spill through Abutments
Proposed Finished Grade at Stream Crossing: 66.93 ft

or

Four 96″ equiv. RCPA / 108″ equiv. CMPA
Cross Drain Pipe Arch
Proposed Finished Grade at Stream Crossing: 66.93

or

Four 8 ft × 7 ft
Reinforced Concrete Box Culverts
Proposed Finished Grade at Stream Crossing: 66.93 ft

or

Two 28 ft × 7 ft
Precast 3 Sided Structure
Proposed Finished Grade at Stream Crossing: 66.93 ft.

Considering the project feasibility, area of opening, effective width of creek, discharge, and backwater created by the proposed structure for the design discharge of 1000 cfs for the 5-year frequency, the 4-span, 80 ft long concrete bridge at the existing grade is recommended.

LITTLE CREEK BRIDGE

STATE PROJECT NO. 713-42-0000
RICHLAND PARISH
STRUCTURE NO. P42-32196-91474-1

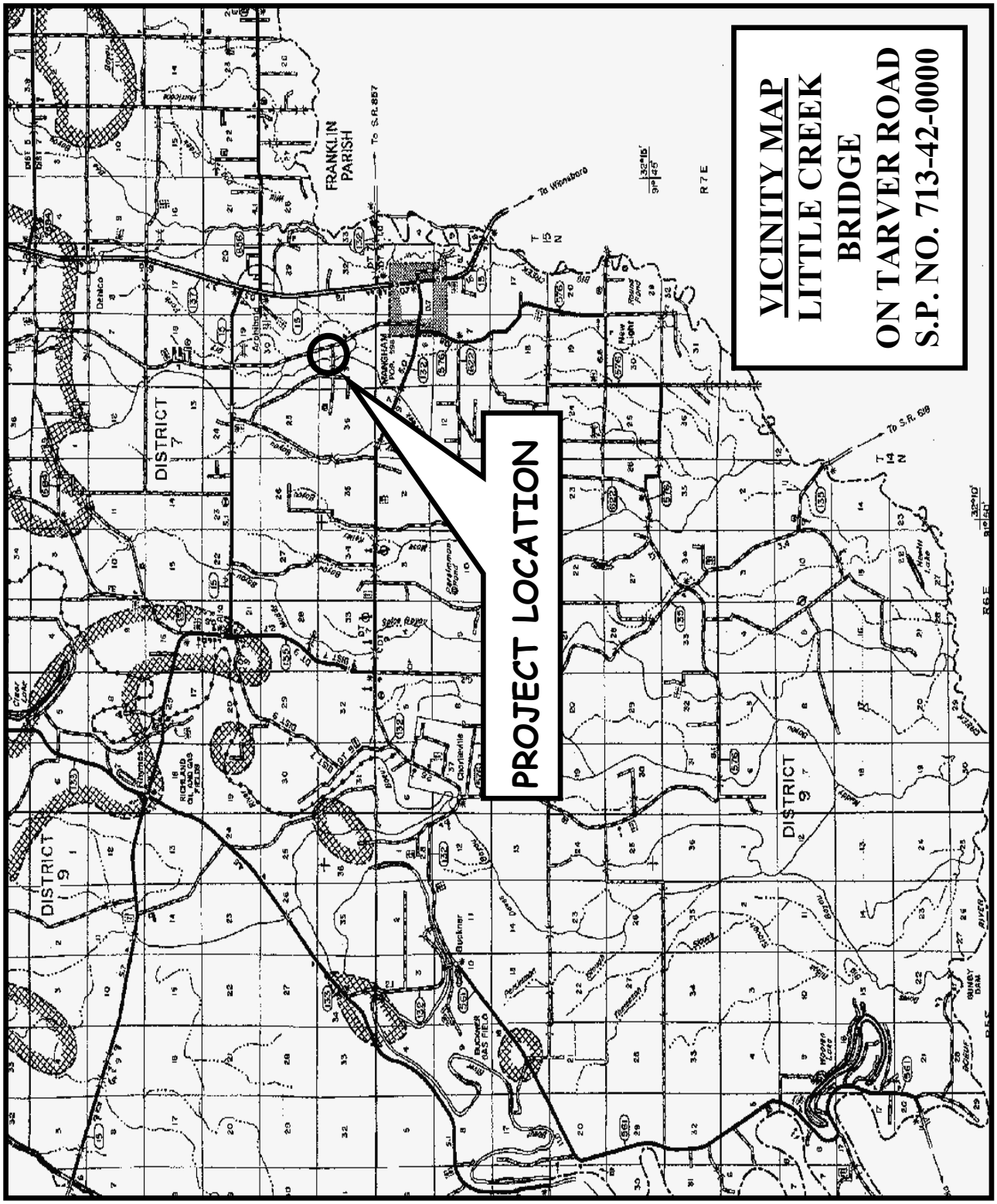
II. GENERAL PROJECT INFORMATION

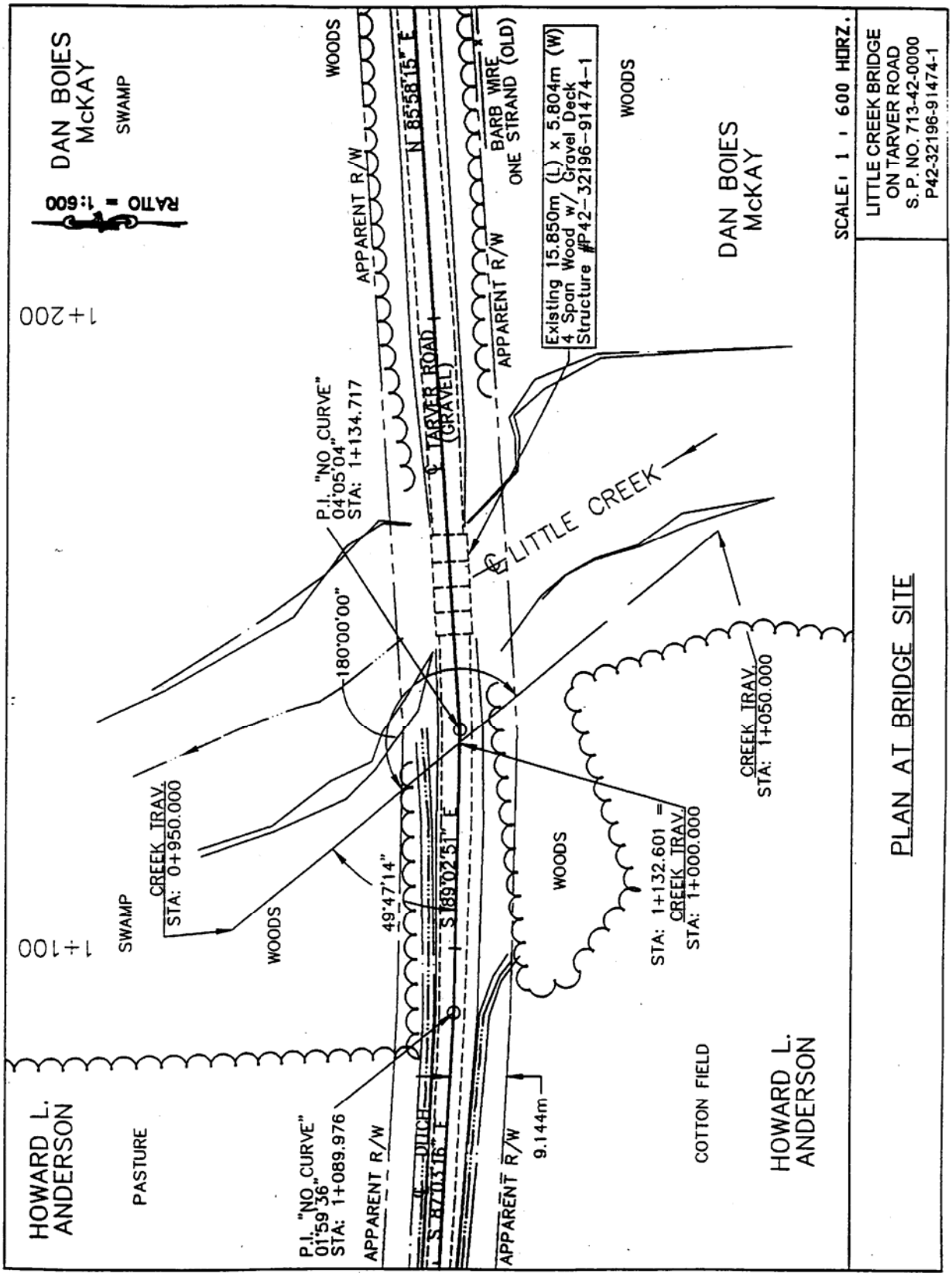
A. Bridge Location

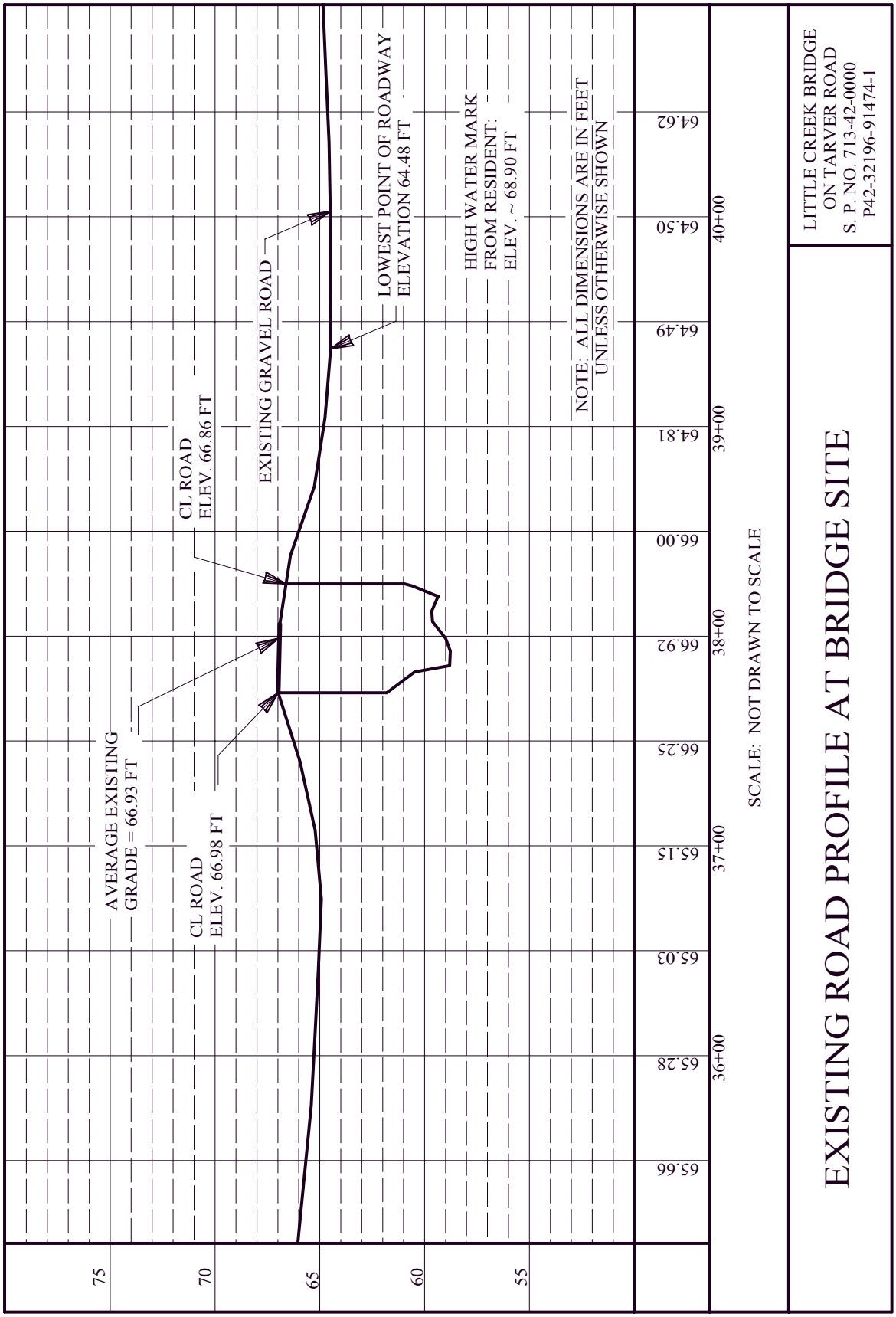
The subject bridge site is located about 1.55 miles north of Mangham in Richland Parish, where Tarver Road (a gravel road) crosses Little Creek at about a 60° angle. The location is more precisely shown on the vicinity map that follows.

B. Existing Structure

The existing structure is a 4-span, 52 ft long and 20 ft wide timber bridge. The structure is recommended for replacement by the Louisiana Department of Transportation and Development (LA DOTD). Accumulation of driftwood or scouring does not appear to be significant at this site. The existing bridge site plan and profile are shown in this section. The lowest point of the roadway is at 64.48 ft elevation.


VICINITY MAP
LITTLE CREEK
BRIDGE
ON TARVER ROAD
S.P. NO. 713-42-0000
PROJECT LOCATION
FRANKLIN PARISH
DISTRICT 7
DISTRICT 9
DISTRICT 9
To Winnsboro
To S.R. 857
To S.R. 68
R7E
R6E
T15N
T14N


PLAN AT BRIDGE SITE
SCALE: 1 " 600 HORZ.
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1
HOWARD L. ANDERSON
PASTURE
DAN BOIES McKAY
SWAMP
WOODS
COTTON FIELD
RATIO = 1:600
1+200
1+100
TARVER ROAD (GRAVEL)
LITTLE CREEK
APPARENT R/W
BARB WIRE ONE STRAND (OLD)
Existing 15.850m (L) x 5.804m (W) 4 Span Wood w/ Gravel Deck Structure #P42-32196-91474-1
P.I. "NO CURVE" 04°05'04" STA: 1+134.717
P.I. "NO CURVE" 01°59'36" STA: 1+089.976
180°00'00"
49°47'14"
N 85°58'15" E
S 87°01'16" E
S 89°02'51" E
CREEK TRAV. STA: 0+950.000
CREEK TRAV. STA: 1+050.000
STA: 1+132.601 = CREEK TRAV. STA: 1+000.000
9.144m
DITCH


EXISTING ROAD PROFILE AT BRIDGE SITE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-914474-1
SCALE: NOT DRAWN TO SCALE
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
HIGH WATER MARK
FROM RESIDENT:
ELEV. ~ 68.90 FT
LOWEST POINT OF ROADWAY
ELEVATION 64.48 FT
EXISTING GRAVEL ROAD
CL ROAD
ELEV. 66.86 FT
CL ROAD
ELEV. 66.98 FT
AVERAGE EXISTING
GRADE = 66.93 FT
75
70
65
60
55
65.66
65.28
65.03
65.15
66.25
66.92
66.00
64.81
64.49
64.50
64.62
36+00
37+00
38+00
39+00
40+00

PHOTOGRAPH 1: ROADWAY VIEW, LOOKING WEST FROM BRIDGE

PHOTOGRAPH 2: ROADWAY VIEW, LOOKING EAST FROM BRIDGE

PHOTOGRAPH 3: CHANNEL UPSTREAM, LOOKING SOUTH FROM BRIDGE

PHOTOGRAPH 4: CHANNEL DOWNSTREAM, LOOKING NORTH FROM BRIDGE

PHOTOGRAPH 5: BRIDGE UPSTREAM SIDE, LOOKING FROM CHANNEL BANK

PHOTOGRAPH 6: BRIDE DOWNSTREAM SIDE, LOOKING FROM CHANNEL BANK

III. DESIGN CONSIDERATIONS

A. Historical Flood Information

No recorded data was found for the subject bridge by searching the U.S. Geological Survey and U.S. Army Corps of Engineers published stage-discharge records. Local residents have indicated that the high water mark is about 69 feet. The bridge is inside the 100-year flood hazard area (zone A) according to the "Flood Hazard Boundary Map" published by the Federal Insurance Administration of the Department of Housing and Urban Development.

B. Interagency Coordination – Letters of Inquiry

In order to determine if any planned or proposed improvements by other agencies will affect this site, letters of inquiry were sent to the U.S. Army Corps of Engineers, Natural Resource Conservation Service (NRCS), and U.S. Geological Survey (USGS). These letters requested that they notify us of any potential work that may have impact on this bridge replacement project. Copies of these letters and the responses received are included in Appendix A of this report. Response from the U.S. Army Corps of Engineers indicates that this project crosses the Corps of Engineers' project, streams Big and Colewa Creeks. The Corps of Engineers will need to review the plans and specifications for this structure. Response from the USGS indicates no significant improvements would be impacted by this project. To date, no response has been received from the NRCS; however, once the response is received, it will be included in the report. The letters and responses follow.

McMANUS CONSULTING ENGINEERS

KENNETH C. MCMANUS, P.E.

P.O. Box 4318
MONROE, LOUISIANA 71211
PHONE: (318) 343-5600, 343-5460
FAX: (318) 343-5717

September 2, 1997

Department of the Army
Vicksburg District, Corps of Engineers
2101 North Frontage Road
Vicksburg, MS 39180-5191

Attn: Mr. Roy O. Smith, Deputy District Engineer
for Project Management

Re: SPN 713-42-01(13-21)(Const.)
SPN 700-42-0103 (Engr.)
FAP No. BRO-002S(622-630)
Off-System Bridge Replacement
Richland Parish, Louisiana

Dear Mr. Smith:

The Louisiana Department of Transportation and Development intends to replace the following bridges as a part of the State of Louisiana Off-System Bridge Replacement Program. Inquiries are being mailed to all agencies who may have planned or pending improvements that could be affected by the proposed work.

	Project No.	Name of Bridge	Structure No.
1.	S.P. 713-42-0113	Little Creek Bridge	P42-32196-91474-1
2.	S.P. 713-42-0114	Jones Cutoff Road Bridge	P42-32146-91470-1
3.	S.P. 713-42-0115	Brown Road Bridge	P42-32201-91506-1
4.	S.P. 713-42-0116	Bee Bayou Road Bridge	P42-32240-91418-1
5.	S.P. 713-42-0117	Little Road Bridge	P42-32252-91385-1
6.	S.P. 713-42-0118	Snider Road Bridge	P42-32264-91310-1
7.	S.P. 713-42-0119	Brimberry Road Bridge	P42-32285-91530-1
8.	S.P. 713-42-0120	Smalling Road Bridge	P42-32313-91413-1
9.	S.P. 713-42-0121	Futch Road Bridge	P42-32331-91401-1

Corps of Engineers
Vicksburg District
Page 2
September 2, 1997

As a necessary part of the design, we are requesting all, if any, recorded hydrologic data published by your agency with regard to the channels at the location of the above referenced bridges.

Please review the enclosed map which shows the locations of bridge crossings and respond by letter as to whether or not your agency has a potential project that would be impacted by the proposed construction activities.

We appreciate your assistance in this matter. Should you require any additional information, please do not hesitate to contact our office.

I remain sincerely,

McMANUS CONSULTING ENGINEERS

SALAM A. KNAN, E.I.T.

SAK:jb
xc: Richland Parish Police Jury
File

Mailed 9/3

DEPARTMENT OF THE ARMY
VICKSBURG DISTRICT, CORPS OF ENGINEERS
4155 CLAY STREET
VICKSBURG, MISSISSIPPI 39180-3435

REPLY TO ATTENTION OF:

Richland
Bridges

September 25, 1997

Programs and Project Management Division

Mr. Kenneth C. McManus, P.E.
McManus Consulting Engineers
P.O. Box 4318
Monroe, Louisiana 71211

Dear Mr. McManus:

9-29-97
K

The following information is provided in response to your letter of September 2, 1997, concerning State Project No. 713-42-01 (13-21), Off System Bridge Replacement Program, Richland Parish, Louisiana.

We have reviewed our project files, and it appears that one structure, No. P42-32252-91385-1, Little Road Bridge crosses a project stream, Big and Colewa Creeks. Therefore, we will need to review the Plans and Specifications for this structure. The proposed construction of the other eight bridges do not appear to adversely impact any of our current or planned projects.

Based on the information furnished, it appears that Department of the Army permit requirements for the proposed bridge construction projects may be authorized by Nationwide Permit No. 23 for categorically excluded Department of Transportation actions as specified in the December 13, 1996, Federal Register, Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits (61 FR 65874), provided the bridge projects are determined to be categorical exclusions by the Federal Highway Administration. Proof that these projects have been determined to be categorical exclusions must be provided to our office prior to authorization under this Nationwide Permit. The documentation should be sent to the following address: U.S. Army Corps of Engineers, Vicksburg District, 4155 Clay Street, Vicksburg, Mississippi, 39180, Attention: Mr. Michael F. McNair, R.F., Chief, Permit Section, Regulatory Branch.

Printed on Recycled Paper

Thank you for advising us of these projects. Please contact Mr. McNair if you have any questions specific to our permit related comments. You may also wish to contact Mrs. Susan Smith, Louisiana, Ouachita River, and Red River Backwater Project Manager, if you have any questions of a general nature. The telephone numbers of Mr. McNair and Mrs. Smith are (601) 631-5721 and (601) 631-5494, respectively.

Sincerely,

for Joe D. Smith

Roy O. Smith, P.E.
Deputy District Engineer
for Project Management

United States Department of the Interior

GEOLOGICAL SURVEY
514 East Georgia Street
Ruston, Louisiana 71270
(318) 251-9630

TAKE PRIDE IN AMERICA

September 24,, 1997

Salam A. Khan, EIT
McManus Consulting Engineers
P.O. Box 4318
Monroe, Louisiana 71211

RE: Louisiana Department of Transportation and Development
Off-System Bridge Replacement Program
Richland Parish, Louisiana
SPN: 713-42-01 (Const.)
SPN: 700-42-0103 (Engr.)
FAP: BRO-002S (622-630)

9-26-97

Dear Mr. Khan:

I have reviewed the documents sent from your office. At this time, the U.S. Geological Survey, Louisiana District does not have any proposed or existing projects that would be affected by these bridge replacements. Furthermore, we do not have any historical records pertaining to these sites. Thank you for your inquiry.

Sincerely,

Benton D. McGee,
Supervisory Hydrologist

#212

C. Potential for Watershed Development

Based on the present rural nature of the contributing watershed and its considerable distance from any existing large metropolitan area, no significant urban development is expected to take place within the watershed boundaries during the next 20 years.

D. Utility Conflicts

No major utility conflicts are anticipated when constructing the new bridge.

E. Detour Distance

The Little Creek Bridge is located on a parish gravel road with low ADT which precludes the creation of any serious detour problems for the area residents should this road be temporarily closed. The shortest detour route by interconnecting gravel roads is approximately 4.97 miles. Therefore, a detour structure may not be required during the construction of this project.

F. Average Daily Traffic

According to Traffic Data collected as of January 07, 2005, the estimated current (2005) and future (2025) Average Daily Traffic volume is 100 and 150 vehicles per day respectively. The Functional Class of this road is Rural Minor Collector, and the traffic volume makes this road an RL-1 Type Rural Road. The Traffic Data is included in Appendix B.

G. Structure Alignment

As shown in the plan view of the bridge site, the existing structure crosses the channel at approximately a 60° angle. The upstream and downstream channel is not well defined. It is assumed that the water will get out of the channel banks at a low discharge; therefore, a skewed bridge is not necessary.

H. Existing Erosion Problems/Scour Potential

There was no evidence of any existing or potential scouring from the site visit. The depth of scour for the culvert alternates calculated in the HYDR1120 run was less than what is required for headwalls.

I. Design Criteria

The lowest point of the roadway is at an elevation of 64.48 ft and is overtopped at a frequency less than two years. Therefore, all proposed alternates will be designed to pass a 5-year frequency discharge.

The backwater range of 0.1′ to 0.5′ for when the overtopping (or the 5-year) discharge governs the design will be used. However, investigating the upstream watershed, which is mainly covered with farmland and woods, it is assumed that the backwater would not be a significant problem should a higher backwater value be considered for the overtopping year discharge.

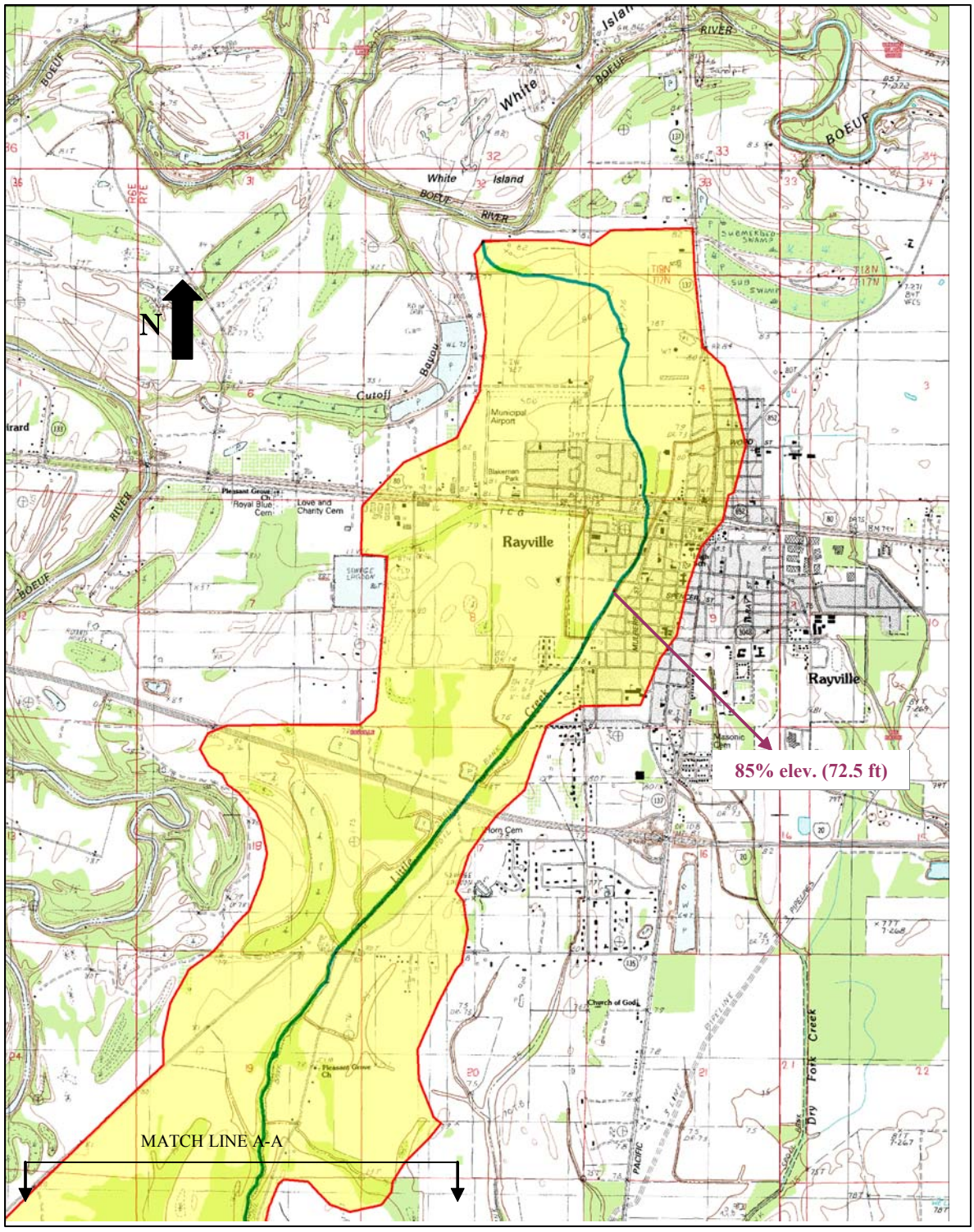
IV. DESIGN ANALYSIS

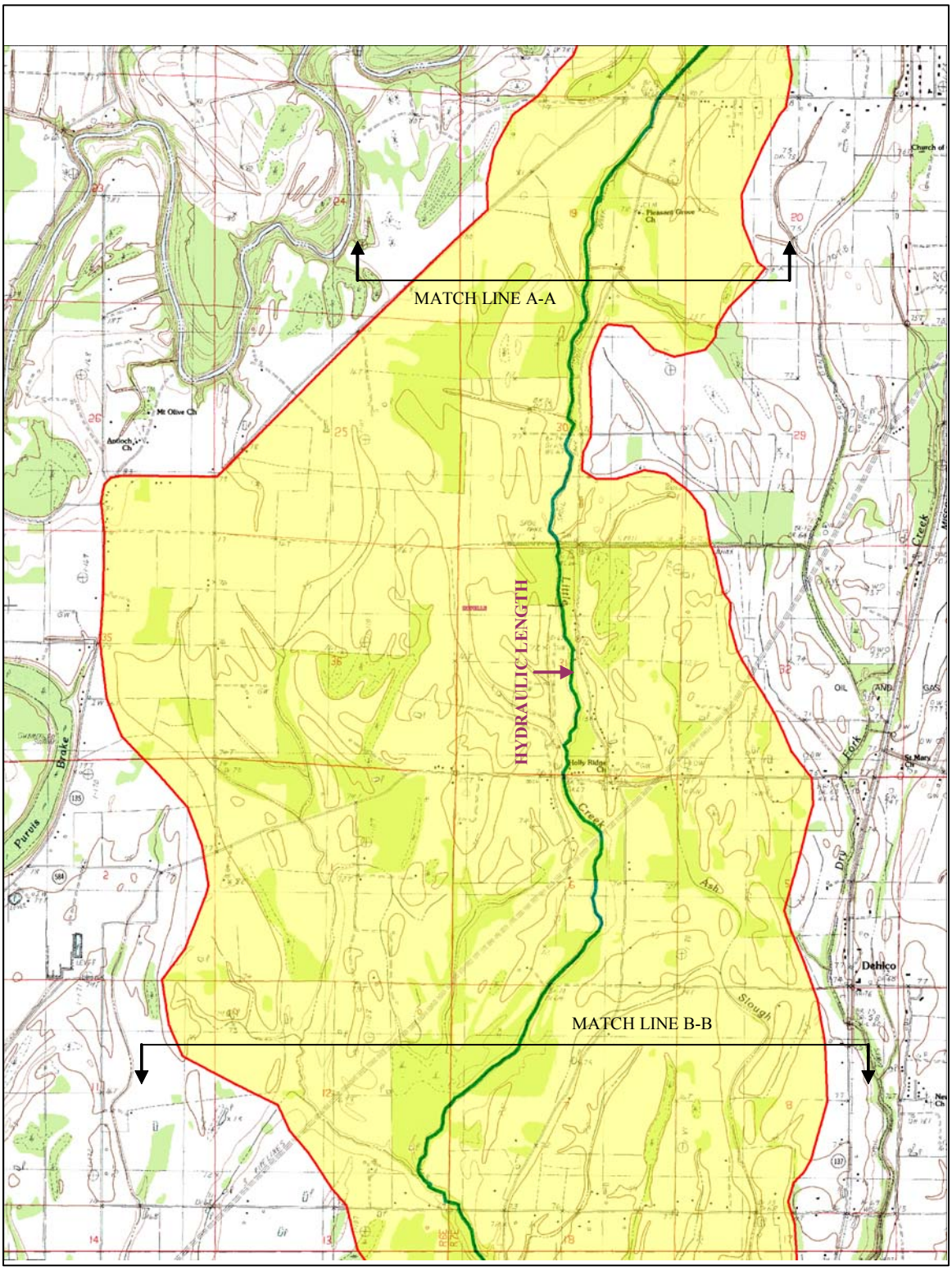
A. Hydrology

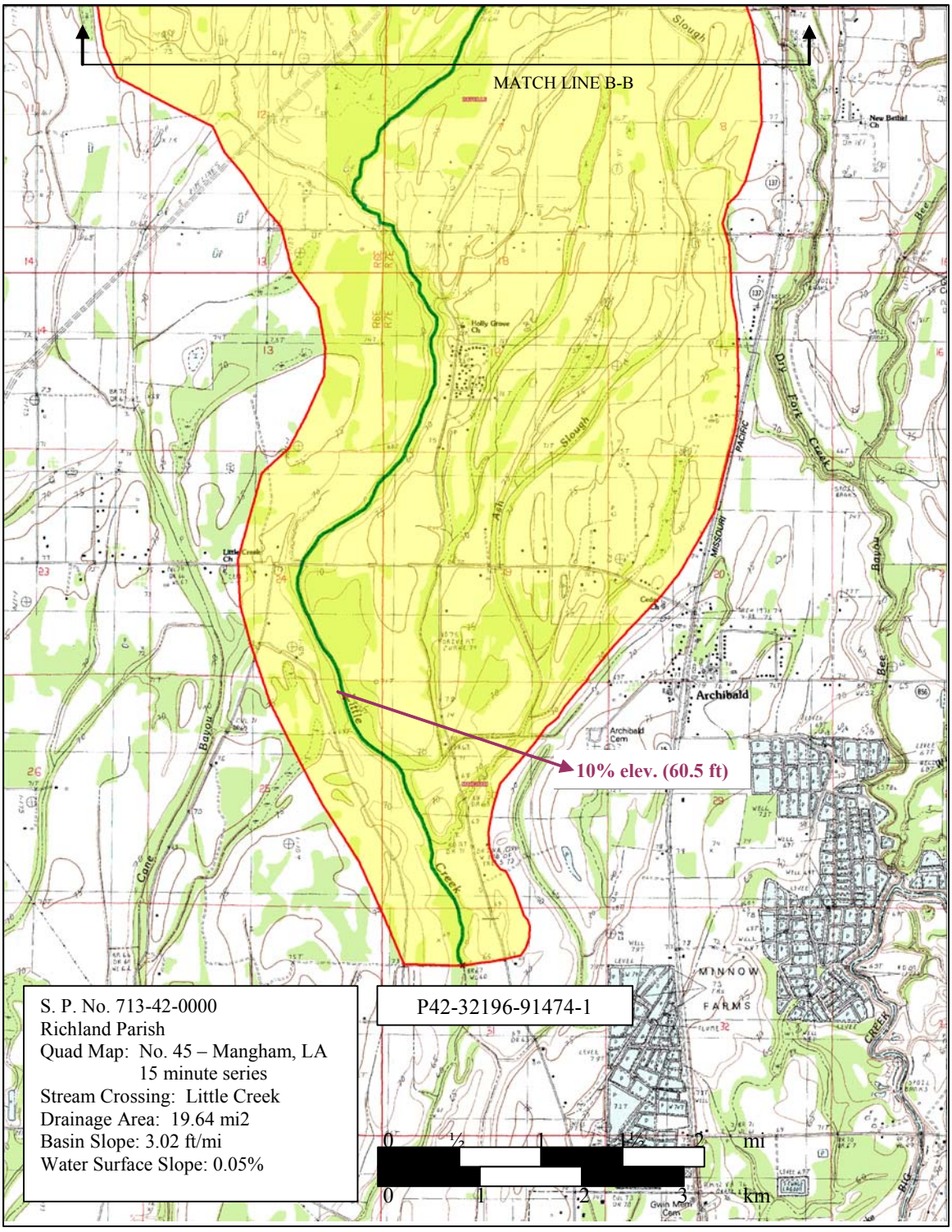
The contributing watershed of the bridge site consists of almost flat terrain with agricultural lands, forests, pastures and scattered home sites. The total drainage area is 19.64 mi^2. The basin slope was calculated to be 3.02 ft/mi. The hydraulic length is 27400 ft; the 10% elevation is equal to 72.5 ft, and the 85% elevation is equal to 60.5 ft. The effect of urbanization on the watershed is considered to be negligible.

The USGS method in HYDR1130 was used to determine the peak discharges for the bridge site, and the data then plotted on probability paper for discharge versus frequency. The final results are shown on the following table. The drainage area map, output from HDYR1130 and the discharge - frequency curve are included in this section.

FREQUENCY	DISCHARGE
2-year	660 cfs
5-year	1000 cfs
10-year	1250 cfs
25-year	1600 cfs
50-year	1850 cfs
100-year	2100 cfs
500-year	2800 cfs


N
Rayville
Rayville
85% elev. (72.5 ft)
MATCH LINE A-A
White Island
Cutoff
Bayou
BOEUF
RIVER
Dry Fork Creek
Little Creek


MATCH LINE A-A
HYDRAULIC LENGTH
MATCH LINE B-B
Little
Creek
Ash
Slough
Dehlco
Mt Olive Ch
Antioch Ch
Holly Ridge Ch
St Mary
Church of
Pleasant Grove Ch
Brake
Purvis
Dry
Fork
OIL
AND
GAS


MATCH LINE B-B
10% elev. (60.5 ft)
S. P. No. 713-42-0000
Richland Parish
Quad Map: No. 45 – Mangham, LA
15 minute series
Stream Crossing: Little Creek
Drainage Area: 19.64 mi2
Basin Slope: 3.02 ft/mi
Water Surface Slope: 0.05%
P42-32196-91474-1
0 ½ 1 1½ 2 mi
0 1 2 3 km

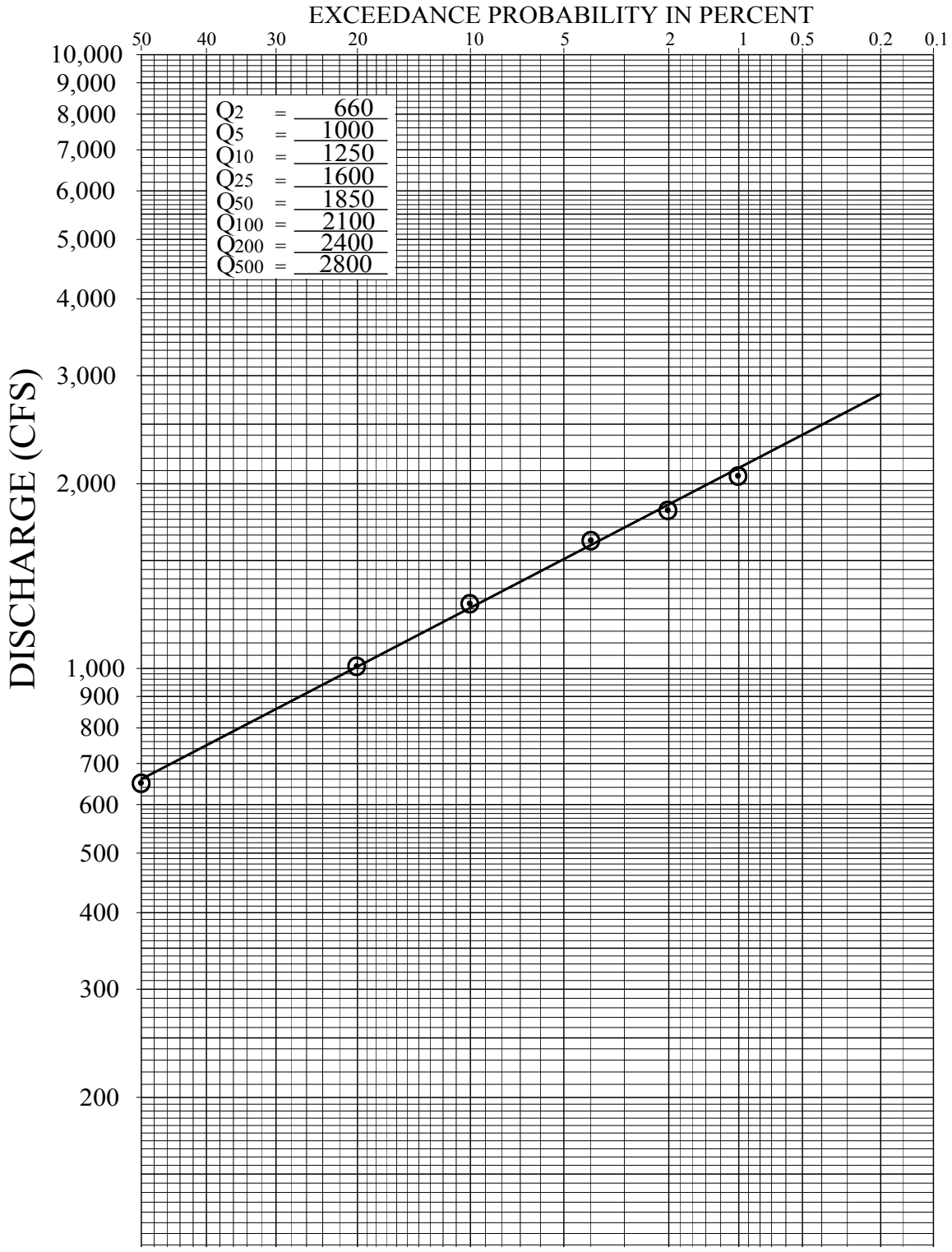
```
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT      HYDR1130-071498
HYDRAULICS SECTION
DESIGNER: Designer Name               DATE: 04-08-2005
REMARKS: RICHLAND PARISH - LITTLE CREEK BRIDGE ON TARVER ROAD

                 STATE PROJECT NUMBER  713-42-0000

                          USGS PEAK DISCHARGE
*********************************************************************
         STATION                                 Lit_Creek
         DRAINAGE AREA (SQ. MI.)                      19.64
         URBAN ADJUSTMENT RATIO                        1.00
         SLOPE (FT./MI.)                               3.02
         MEAN ANNUAL PRECIPITATION (IN.)              52.00
*********************************************************************
         Q2 (CFS)                                      651.
         Q5 (CFS)                                     1008.
         Q10 (CFS)                                    1286.
         Q25 (CFS)                                    1616.
         Q50 (CFS)                                    1820.
         Q100 (CFS)                                   2067.
*********************************************************************
```

DISCHARGE - FREQUENCY CURVE

STATE PROJECT 713-42-0000 STREAM NAME Little Creek

ROUTE Tarver Road STRUCTURE NO. P42-32196-91474-1

PARISH Richland BY: Name DATE: July 2004



B. Hydraulics

The FHWA's Computer Program "WSPRO - A Computer Model for Water Surface Profile Computations" (HYDRAIN 6.0 version) was used to determine the water surface elevations for the 2, 5, 10, 25, 50, and 100 year discharges. (The September 1990 publication of the *User's Manual for WSPRO* was also consulted for background information of the program.) A representative floodplain cross-section was constructed utilizing field survey information and the USGS topographic maps. The floodplain roughness coefficients were estimated from the USGS quadrangle maps, the *LA DOTD Hydraulics Manual*, and the FHWA publication, *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains*. The water surface slope was determined from the USGS quadrangle map. The average water surface slope of the channel was determined to be 0.05 % (percent). To calculate the water surface profile, fixed geometry mode was considered for the existing bridge and design mode was considered for the proposed bridge.

A stage-discharge curve was plotted using the stage values from the WSPRO output for the existing bridge. WSPRO was run without the roadway card because the overtopping was in such excess the program did not calculate the amount of discharge going through the bridge for all frequencies. The water surface elevation and the backwater represent all the flow going through the bridge opening. A linear relationship was assumed to find the overtopping frequency. The lowest point of the roadway, 64.48 ft was lower than the 2-year stage; therefore, the 5-year discharge was used in the design for the proposed structure alternates.

For the bridge options, the area of opening for the design year discharge was hand-calculated considering the required excavation at the bridge. The water surface elevation in this hand-calculation was assumed as the unconstricted water surface at the approach section or the low chord elevation, whichever was lower. The hand-calculated area was compared to the area given by WSPRO to make sure they were within 10% of each other.

The hand-calculated area value was put on the Hydraulic Data Table. The velocity on the Hydraulic Data Table was determined by dividing the design discharge by the hand-calculated area of opening. The calculated velocity is based on the assumption that all the design discharge would pass through the bridge without considering any road overflow. However, in the actual field situation, this may not be true because of overtopping of a portion of discharge over the road. For the proposed bridge alternate, there is pressure flow through the bridge. The area of opening calculation follows the WSPRO output of the proposed bridge alternate.

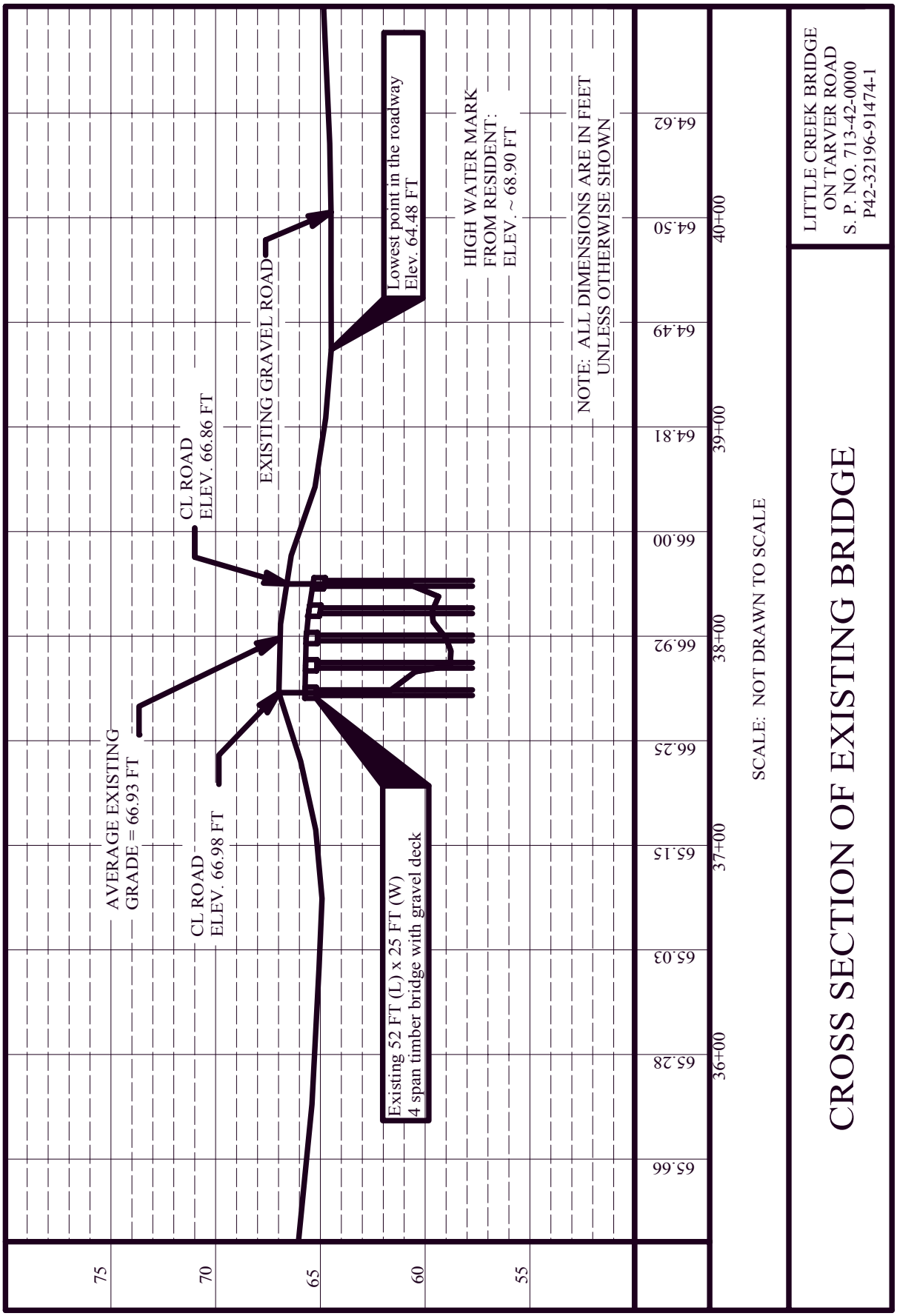
A 3-span (60 ft long) bridge and a 4-span (80 ft long) bridge were both considered. Because of the amount of fill that would be required for the 3-span bridge, the 4-span bridge was considered as the preferable alternate. Only the analysis for the 4-span bridge is included in the report.

B. Hydraulics Contd.

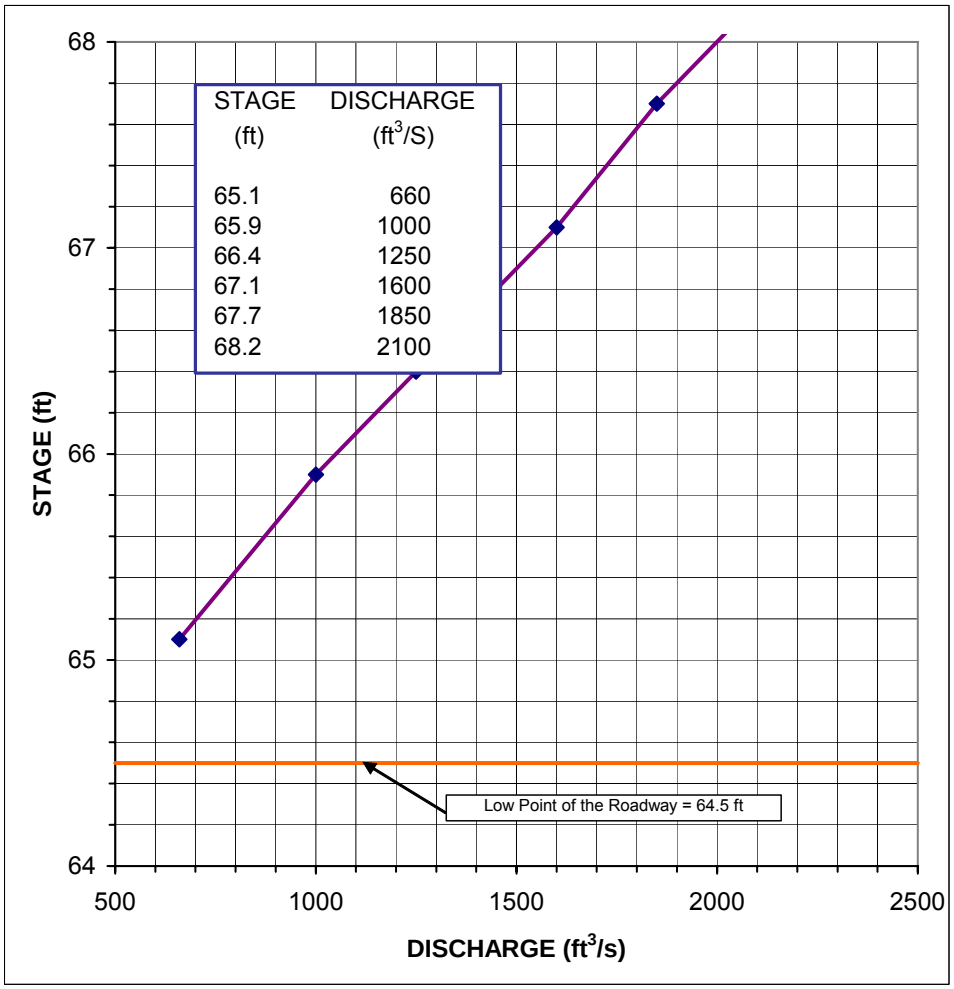
To investigate culvert alternates, LA DOTD's HYDR1120 (July 1997 version) was used to calculate the backwater. To meet the construction clearance requirement, the maximum size round pipe had to be less than 6.5′ or 7.5′ if the pipe were buried. Because of headroom clearance limitations, arch pipe was used for the analysis. The tailwater depth was determined using the output from the WSPRO analysis for the existing bridge. HYDR1120 computations follow the WSPRO calculations.

The slope used in the HYDR1120 program was determined from the survey of the natural channel slope for the length of the pipe.

For the Precast 3 Sided Structure, a size was determined from a manufacturer's listing and WSPRO was used to analyze the structure. A 2 – 28′ × 7′ was chosen. However, the size used in WSPRO was based on an equivalent area of opening of 167 ft^2 per barrel taken from the manufacturer's size list. In WSPRO, the size is 2 – 27.6′ × 6.05′ which gives an area of 334 ft^2. It was run as a culvert, since it will presumably have a concrete slab bottom as per LA DOTD requirements. However, if it is decided to use this alternate, any changes made to the P3S structure can be reanalyzed if necessary.


CROSS SECTION OF EXISTING BRIDGE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1
SCALE: NOT DRAWN TO SCALE
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
HIGH WATER MARK
FROM RESIDENT:
ELEV. ~ 68.90 FT
Lowest point in the roadway
Elev. 64.48 FT
EXISTING GRAVEL ROAD
CL ROAD
ELEV. 66.86 FT
CL ROAD
ELEV. 66.98 FT
AVERAGE EXISTING
GRADE = 66.93 FT
Existing 52 FT (L) x 25 FT (W)
4 span timber bridge with gravel deck
75
70
65
60
55
65.66
65.28
65.03
65.15
66.25
66.92
66.00
64.81
64.49
64.50
64.62
36+00
37+00
38+00
39+00
40+00

Little Creek at Tarver Road
S.P. No. 713-42-0000 Richland Parish



Stage - Discharge Curve

WSPRO Calculations
for the
Existing 52.0 ft Timber Bridge

```
*
T1        S.P. No. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE
*
*         Q2     Q5     Q10    Q25    Q50     Q100
Q         660    1000   1250   1600   1850    2100
SK        .0005  .0005  .0005  .0005  .0005   .0005
*
XT   TEMP 5000
GR        3449,69.00  3449,66.90  3508,65.29
GR        3606,63.09  3655,64.14  3693,64.17
GR        3734,62.04  3767,61.41  3799,59.19
GR        3831,60.92  3836,62.20  3852,64.14
GR        3856,64.27  3954,62.34  4053,63.71
GR        4149,64.04  4149,69.00
*
XS   EXIT 4948  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA              3767       3831
*
XS   FULL 5000 *  *  *   .0005
*
BR   BRDG 5000  65.69 *  *  .0005
GR        3773,65.69  3773,61.80  3783,60.48
GR        3786,58.80  3793,58.40  3799,59.00
GR        3807,59.62  3812,59.66  3819,59.36
GR        3824,60.57  3825,60.95  3825,65.69
GR        3773,65.69
N         0.085
CD        2  20.00  2  66.93
AB        61.80   60.95
*
XS   APPR 5072  *  *  *   .0005
*
EX
ER
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
         Run Date & Time:  4/13/2005  10:23 am     Version V200104
           Input File: SR-EBR-E       Output File: SR-EBR-E.LST
   *-------------------------------------------------------------*
T1        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE
Q         660    1000   1250   1600   1850    2100

 ***   Processing Flow Data; Placing Information into Sequence  1   ***

SK        .0005  .0005  .0005  .0005  .0005   .0005
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                   EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

              *-----------------------------------------------*
              *      Starting To Process Header Record TEMP   *
              *-----------------------------------------------*

   XT   TEMP 5000
   GR        3449,69.00  3449,66.90  3508,65.29
   GR        3606,63.09  3655,64.14  3693,64.17
   GR        3734,62.04  3767,61.41  3799,59.19
   GR        3831,60.92  3836,62.20  3852,64.14
   GR        3856,64.27  3954,62.34  4053,63.71
   GR        4149,64.04  4149,69.00

    ***   Completed Reading Data Associated With Header Record TEMP    ***
    ***          Storing Template Header Record Data In Memory         ***


    ***              Data Summary For Header Record TEMP               ***
    SRD Location:     5000.    Valley Slope:  *******     Error Code   0

                        X,Y-coordinates (17 pairs)
        X          Y             X          Y             X          Y
   ----------  ----------   ----------  ----------   ----------  ----------
     3449.000      69.000     3449.100      66.900     3508.000      65.290
     3606.000      63.090     3655.000      64.140     3693.000      64.170
     3734.000      62.040     3767.000      61.410     3799.000      59.190
     3831.000      60.920     3836.000      62.200     3852.000      64.140
     3856.000      64.270     3954.000      62.340     4053.000      63.710
     4149.000      64.040     4149.100      69.000
   ----------  ----------   ----------  ----------   ----------  ----------
  +++072 NOTICE:  X-coordinate # 2 increased to eliminate vertical segment.
  +++072 NOTICE:  X-coordinate #17 increased to eliminate vertical segment.

                    Minimum and Maximum X,Y-coordinates
      Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
      Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
      Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
      Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

              *-----------------------------------------------*
              *      Finished Processing Header Record TEMP   *
              *-----------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
               EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

         *-----------------------------------------------*
         *      Starting To Process Header Record EXIT   *
         *-----------------------------------------------*

XS   EXIT 4948  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA              3767       3831

 ***   Completed Reading Data Associated With Header Record EXIT    ***
 ***  Storing X-Section Data In Temporary File As Record Number  1  ***

 ***              Data Summary For Header Record EXIT              ***
 SRD Location:     4948.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      68.974     3449.100      66.874     3508.000      65.264
  3606.000      63.064     3655.000      64.114     3693.000      64.144
  3734.000      62.014     3767.000      61.384     3799.000      59.164
  3831.000      60.894     3836.000      62.174     3852.000      64.114
  3856.000      64.244     3954.000      62.314     4053.000      63.684
  4149.000      64.014     4149.100      68.974
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   68.974 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   68.974 )
  Minimum Y-Elevation:    59.164  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    68.974  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

         *-----------------------------------------------*
         *      Finished Processing Header Record EXIT   *
         *-----------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
               EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

         *-----------------------------------------------*
         *      Starting To Process Header Record FULL   *
         *-----------------------------------------------*

XS   FULL 5000 *  *  *   .0005

 ***   Completed Reading Data Associated With Header Record FULL    ***
 ***   No Roughness Data Input, Propagating From Previous Section   ***
 ***  Storing X-Section Data In Temporary File As Record Number  2  ***

 ***              Data Summary For Header Record FULL              ***
 SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      69.000     3449.100      66.900     3508.000      65.290
  3606.000      63.090     3655.000      64.140     3693.000      64.170
  3734.000      62.040     3767.000      61.410     3799.000      59.190
  3831.000      60.920     3836.000      62.200     3852.000      64.140
  3856.000      64.270     3954.000      62.340     4053.000      63.710
  4149.000      64.040     4149.100      69.000
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
  Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

         *-----------------------------------------------*
         *      Finished Processing Header Record FULL   *
         *-----------------------------------------------*
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                   EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

              *-------------------------------------------------*
              *      Starting To Process Header Record BRDG     *
              *-------------------------------------------------*

   BR   BRDG 5000  65.69 *  *  .0005
   GR        3773,65.69  3773,61.80  3783,60.48
   GR        3786,58.80  3793,58.40  3799,59.00
   GR        3807,59.62  3812,59.66  3819,59.36
   GR        3824,60.57  3825,60.95  3825,65.69
   GR        3773,65.69
   N         0.085
   CD        2  20.00  2  66.93
   AB        61.80   60.95

    ***   Completed Reading Data Associated With Header Record BRDG    ***
    ***   Storing Bridge Data In Temporary File As Record Number  3    ***

    ***              Data Summary For Bridge Record BRDG               ***
    SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
    Valley Slope:  *******    Averaging Conveyance By Geometric Mean.
    Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                        X,Y-coordinates (13 pairs)
        X          Y            X          Y            X          Y
   ----------  ----------   ----------  ----------   ----------  ----------
     3773.000      65.690     3773.100      61.800     3783.000      60.480
     3786.000      58.800     3793.000      58.400     3799.000      59.000
     3807.000      59.620     3812.000      59.660     3819.000      59.360
     3824.000      60.570     3825.000      60.950     3825.100      65.690
     3773.000      65.690
   ----------  ----------   ----------  ----------   ----------  ----------
  +++072 NOTICE:  X-coordinate # 2 increased to eliminate vertical segment.
  +++072 NOTICE:  X-coordinate #12 increased to eliminate vertical segment.

                     Minimum and Maximum X,Y-coordinates
      Minimum X-Station:    3773.000  ( associated Y-Elevation:   65.690 )
      Maximum X-Station:    3825.100  ( associated Y-Elevation:   65.690 )
      Minimum Y-Elevation:    58.400  ( associated X-Station:   3793.000 )
      Maximum Y-Elevation:    65.690  ( associated X-Station:   3773.000 )

                       Roughness Data (  1 SubAreas )
                                Roughness    Horizontal
                       SubArea  Coefficient   Breakpoint
                       -------  -----------  ------------
                          1         .085         ---
                       -------  -----------  ------------
```

```
          Discharge coefficient parameters
       BRType   BRWdth   EMBSS   EMBElv    UserCD
         2       20.000   2.00    66.930 **********

              Pressure flow elevations
                 AVBCEL     PFElev
                *********     65.690

                Abutment Parameters
ABSLPL  ABSLPR   XTOELT    YTOELT    XTOERT    YTOERT
61.800  60.950 ********* ********* ********* *********

          ** No Pier/Pile Data Encountered **


 *--------------------------------------------------*
 *      Finished Processing Header Record BRDG      *
 *--------------------------------------------------*
```

```
**************************  W S P R O  ***************************
   Federal Highway Administration  -  U. S. Geological Survey
          Model for Water-Surface Profile Computations.
         Input Units: English  /  Output Units: English
*-------------------------------------------------------------*
  S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                 STR. NO. P42-32196-91474-1
            EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

        *-------------------------------------------------*
        *      Starting To Process Header Record APPR     *
        *-------------------------------------------------*

XS   APPR 5072  *  *  *   .0005

 ***   Completed Reading Data Associated With Header Record APPR    ***
 ***   No Roughness Data Input, Propagating From Previous Section   ***
 ***  Storing X-Section Data In Temporary File As Record Number  4  ***

 ***              Data Summary For Header Record APPR              ***
 SRD Location:     5072.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
    X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      69.036     3449.100      66.936     3508.000      65.326
  3606.000      63.126     3655.000      64.176     3693.000      64.206
  3734.000      62.076     3767.000      61.446     3799.000      59.226
  3831.000      60.956     3836.000      62.236     3852.000      64.176
  3856.000      64.306     3954.000      62.376     4053.000      63.746
  4149.000      64.076     4149.100      69.036
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.036 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.036 )
  Minimum Y-Elevation:    59.226  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    69.036  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

Bridge datum projection(s):  XREFLT  XREFRT  FDSTLT  FDSTRT
                            ******* ******* ******* *******
        *-------------------------------------------------*
        *      Finished Processing Header Record APPR     *
        *-------------------------------------------------*
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                   EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE
EX

           *=================================================*
           *     Summary of Boundary Condition Information   *
           *=================================================*

             Reach      Water Surface   Friction
       #   Discharge      Elevation      Slope         Flow Regime
      --   ---------    -------------   --------   --------------------
       1      660.00      ********        .0005        Sub-Critical
       2     1000.00      ********        .0005        Sub-Critical
       3     1250.00      ********        .0005        Sub-Critical
       4     1600.00      ********        .0005        Sub-Critical
       5     1850.00      ********        .0005        Sub-Critical
       6     2100.00      ********        .0005        Sub-Critical
      --   ---------    -------------   --------   --------------------

           *=================================================*
           *        Beginning  6 Profile Calculation(s)      *
           *=================================================*
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                   EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                    << Beginning Computations for Profile  1 >>

                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT        64.811   .011    660.000   1093.243 *********  3528.173
  Header Type: XS      64.822 ******       .604   29493.17 *********  4149.016
  SRD:   4948.000      61.678 ******       .109     ******     1.853    ******

  Section: FULL        64.838   .010    660.000   1093.779    52.000  3528.134
  Header Type: FV      64.848   .026       .603   29512.04    52.000  4149.016
  SRD:   5000.000      61.704   .000       .109      .0005     1.853      .001

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR        64.875   .010    660.000   1094.516    72.000  3528.081
  Header Type: AS      64.886   .036       .603   29538.05    72.000  4149.016
  SRD:   5072.000      61.740   .000       .109      .0005     1.852      .001

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

          <<< The Following Data Reflect The "Constricted" Profile >>>
            <<< Beginning Bridge/Culvert Hydraulic Computations >>>


                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG        64.825   .160    660.000    268.259    52.000  3773.022
  Header Type: BR      64.985   .060      2.460   12782.79    52.000  3825.082
  SRD:   5000.000      61.323   .103       .249     ******     1.697     -.002

  Bridge Summary Information - Coordinate Mode
 ----------------------------------------------------------------------------
-
  Flow Class:  1 - Free-surface flow with no embankment overtopping
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                       ------ -------- -------- --------- ---------
                         C     PFELEV    BLEN      XLAB      XRAB
                       ------ -------- -------- --------- ---------
                        .7677   65.690 ******** ********* *********
                       ------ -------- -------- --------- ---------

  No Pier(s)/Pile(s) Present at Bridge
```

```
 ------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     64.838
      Downstream Bridge Section Water Surface Elevation:             64.825
      Bridge DrawDown Distance:                                        .013

 ------------------------------------------------------------------------
-
```

	WSEL EGEL CRWS	VHD HF HO	Q V FR #	AREA K SF	SRDL FLEN ALPHA	LEW REW ERR
Section: APPR	65.121	.008	660.000	1248.746	52.000	3517.114
Header Type: AS	65.129	.070	.529	35190.84	72.853	4149.021
SRD: 5072.000	61.740	.074	.087	.0005	1.739	-.010

** Change in Approach Section Water Surface Elevation: .246 **

Approach Section APPR Flow Contraction Information

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
.916	.612	13761.0	3778.889	3830.948	65.121

<<< End of Bridge Hydraulics Computations >>>

<< Completed Computations of Profile 1 >>

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                   EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                    << Beginning Computations for Profile  2 >>

                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
    Section: EXIT       65.430   .011   1000.000   1485.961 *********  3501.922
    Header Type: XS     65.441 ******       .673   44691.14 *********  4149.029
    SRD:   4948.000     62.195 ******       .099     ******     1.603    ******

    Section: FULL       65.457   .011   1000.000   1486.717    52.000  3501.880
    Header Type: FV     65.469   .026       .673   44723.01    52.000  4149.029
    SRD:   5000.000     62.221   .000       .099      .0005     1.603      .001

           <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

    Section: APPR       65.495   .011   1000.000   1487.716    72.000  3501.823
    Header Type: AS     65.506   .036       .672   44765.10    72.000  4149.029
    SRD:   5072.000     62.257   .000       .099      .0005     1.602      .002

           <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

            <<< The Following Data Reflect The "Constricted" Profile >>>
              <<< Beginning Bridge/Culvert Hydraulic Computations >>>

    ===220 FLOW CLASS 1 ( 4 ) SOLUTION INDICATES POSSIBLE PRESSURE FLOW.
           WS3, WSIU, WS1, PFELV:    65.43      65.84      65.93      65.69

    ===245 ATTEMPTING FLOW CLASS 2 ( 5 ) SOLUTION.

    ===250 INSUFFICIENT HEAD FOR PRESSURE FLOW.
           YU/Z, WSIU, WS:  1.04      65.91      66.03

    ===270 REJECTED FLOW CLASS 2 ( 5 ) SOLUTION.


                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
    Section: BRDG       65.429   .314   1000.000    299.716    52.000  3773.007
    Header Type: BR     65.743   .077      3.336   15173.10    52.000  3825.094
    SRD:   5000.000     61.930   .225       .330     ******     1.815      .000

     Bridge Summary Information - Coordinate Mode
    ------------------------------------------------------------------------
    -
      Flow Class:  1 - Free-surface flow with no embankment overtopping
```

```
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                      ------ -------- -------- --------- ---------
                        C     PFELEV    BLEN      XLAB      XRAB
                      ------ -------- -------- --------- ---------
                       .7424   65.690 ******** ********* *********
                      ------ -------- -------- --------- ---------

  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     65.457
      Downstream Bridge Section Water Surface Elevation:             65.429
      Bridge DrawDown Distance:                                        .028

 ------------------------------------------------------------------------------
-

                      WSEL    VHD       Q         AREA      SRDL      LEW
                      EGEL     HF       V          K        FLEN      REW
                      CRWS     HO      FR #        SF       ALPHA     ERR
                    --------- ------ ---------- ---------- --------- ---------
  Section: APPR       65.933   .007   1000.000   1775.104    52.000  3485.778
  Header Type: AS     65.941   .089       .563   57498.69    77.455  4149.038
  SRD:   5072.000     62.257   .109       .074      .0005     1.485      .001

          ** Change in Approach Section Water Surface Elevation:  .439 **

               Approach Section APPR  Flow Contraction Information
             M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
            -------- -------- --------- --------- --------- --------
                .920     .699   17295.1  3781.481  3833.569   65.933
            -------- -------- --------- --------- --------- --------

                <<< End of Bridge Hydraulics Computations >>>

                  << Completed Computations of Profile  2 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                    EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                     << Beginning Computations for Profile  3 >>

                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT         65.818   .012   1250.000   1739.512 *********  3487.744
  Header Type: XS       65.830 ******       .719   55856.38 *********  4149.037
  SRD:   4948.000       62.523 ******       .096     ******     1.497    ******

  Section: FULL         65.845   .012   1250.000   1740.341    52.000  3487.698
  Header Type: FV       65.857   .026       .718   55894.41    52.000  4149.037
  SRD:   5000.000       62.549   .000       .096      .0005     1.497      .001

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR         65.883   .012   1250.000   1741.415    72.000  3487.638
  Header Type: AS       65.895   .036       .718   55943.72    72.000  4149.037
  SRD:   5072.000       62.585   .000       .095      .0005     1.496      .002

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

          <<< The Following Data Reflect The "Constricted" Profile >>>
            <<< Beginning Bridge/Culvert Hydraulic Computations >>>

 ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
        WS3N, PFelv:     65.84      65.69


                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG         65.690   .254   1266.383    313.301    52.000  3773.000
  Header Type: BR       65.944 ******      4.042   10781.55 *********  3825.100
  SRD:   5000.000       62.316 ******       .411     ******     1.000    ******

  Bridge Summary Information - Coordinate Mode
 ------------------------------------------------------------------------------
-
  Flow Class:  3 - Submerged orifice flow with no embankment overtopping
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                        ------ -------- -------- --------- ---------
                          C     PFELEV    BLEN      XLAB      XRAB
                        ------ -------- -------- --------- ---------
                         .8000   65.690 ******** ********* *********
                        ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     65.845
      Downstream Bridge Section Water Surface Elevation:             65.690
      Bridge DrawDown Distance:                                        .155

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO     FR #         SF       ALPHA     ERR
                  --------- ------ ---------- ---------- --------- ---------
  Section: APPR      66.393   .008  1250.000   2084.059    52.000  3468.950
  Header Type: AS    66.401   .160      .600   72475.01    79.964  4149.047
  SRD:   5072.000    62.585   .109      .071      .0005     1.399      .013

          ** Change in Approach Section Water Surface Elevation:  .511 **

               Approach Section APPR  Flow Contraction Information
           M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
          -------- -------- --------- --------- --------- --------
          ******** ******** ********* ********* *********   66.393
          -------- -------- --------- --------- --------- --------

              <<< End of Bridge Hydraulics Computations >>>

                << Completed Computations of Profile  3 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                    EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                     << Beginning Computations for Profile  4 >>

                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT         66.304   .013   1600.000   2065.732 *********  3469.937
  Header Type: XS       66.318 ******       .775   71551.91 *********  4149.046
  SRD:   4948.000       62.963 ******       .093     ******     1.404    ******

  Section: FULL         66.332   .013   1600.000   2066.537    52.000  3469.893
  Header Type: FV       66.345   .026       .774   71592.38    52.000  4149.046
  SRD:   5000.000       62.989   .000       .093      .0005     1.403      .001

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR         66.369   .013   1600.000   2067.555    72.000  3469.838
  Header Type: AS       66.382   .036       .774   71643.56    72.000  4149.046
  SRD:   5072.000       63.025   .000       .093      .0005     1.403      .002

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

          <<< The Following Data Reflect The "Constricted" Profile >>>
            <<< Beginning Bridge/Culvert Hydraulic Computations >>>

 ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
        WS3N, PFelv:     66.33      65.69


                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG         65.690   .395   1578.422    313.301    52.000  3773.000
  Header Type: BR       66.085 ******      5.038   10781.55 *********  3825.100
  SRD:   5000.000       62.721 ******       .512     ******     1.000    ******

  Bridge Summary Information - Coordinate Mode
 ------------------------------------------------------------------------------
-
  Flow Class:  3 - Submerged orifice flow with no embankment overtopping
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                        ------ -------- -------- --------- ---------
                          C     PFELEV    BLEN      XLAB      XRAB
                        ------ -------- -------- --------- ---------
                         .8000   65.690 ******** ********* *********
                        ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     66.332
      Downstream Bridge Section Water Surface Elevation:             65.690
      Bridge DrawDown Distance:                                        .642

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO     FR #         SF       ALPHA     ERR
                  --------- ------ ---------- ---------- --------- ---------
  Section: APPR      67.134   .008  1600.000   2597.398    52.000  3449.091
  Header Type: AS    67.142   .195      .616  100402.60    82.342  4149.062
  SRD:   5072.000    63.025   .109      .064      .0005     1.302     -.013

          ** Change in Approach Section Water Surface Elevation:  .765 **

               Approach Section APPR  Flow Contraction Information
           M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
          -------- -------- --------- --------- --------- --------
          ******** ******** ********* ********* *********   67.134
          -------- -------- --------- --------- --------- --------

              <<< End of Bridge Hydraulics Computations >>>

                << Completed Computations of Profile  4 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                    EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                     << Beginning Computations for Profile  5 >>

                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT         66.620   .014   1850.000   2282.112 *********  3458.379
  Header Type: XS       66.634 ******       .811   82714.47 *********  4149.053
  SRD:   4948.000       63.060 ******       .092     ******     1.359    ******

  Section: FULL         66.648   .014   1850.000   2283.026    52.000  3458.330
  Header Type: FV       66.662   .026       .810   82762.80    52.000  4149.053
  SRD:   5000.000       63.086   .000       .092      .0005     1.359      .001

          <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR         66.685   .014   1850.000   2284.167    72.000  3458.270
  Header Type: AS       66.699   .036       .810   82823.14    72.000  4149.053
  SRD:   5072.000       63.122   .000       .092      .0005     1.359      .002

          <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

           <<< The Following Data Reflect The "Constricted" Profile >>>
             <<< Beginning Bridge/Culvert Hydraulic Computations >>>

 ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
        WS3N, PFelv:     66.65      65.69


                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG         65.690   .538   1843.311    313.301    52.000  3773.000
  Header Type: BR       66.228 ******      5.884   10781.55 *********  3825.100
  SRD:   5000.000       63.065 ******       .598     ******     1.000    ******

  Bridge Summary Information - Coordinate Mode
 ------------------------------------------------------------------------------
-
  Flow Class:  3 - Submerged orifice flow with no embankment overtopping
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                        ------ -------- -------- --------- ---------
                          C     PFELEV    BLEN      XLAB      XRAB
                        ------ -------- -------- --------- ---------
                         .8000   65.690 ******** ********* *********
                        ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     66.648
      Downstream Bridge Section Water Surface Elevation:             65.690
      Bridge DrawDown Distance:                                        .958

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO     FR #         SF       ALPHA     ERR
                  --------- ------ ---------- ---------- --------- ---------
  Section: APPR      67.693   .007  1850.000   2988.056    52.000  3449.064
  Header Type: AS    67.700   .212      .619  124965.10    83.626  4149.073
  SRD:   5072.000    63.122   .109      .059      .0005     1.242     -.004

          ** Change in Approach Section Water Surface Elevation: 1.007 **

               Approach Section APPR  Flow Contraction Information
             M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
            -------- -------- --------- --------- --------- --------
            ******** ******** ********* ********* *********   67.693
            -------- -------- --------- --------- --------- --------

                <<< End of Bridge Hydraulics Computations >>>

                  << Completed Computations of Profile  5 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                         STR. NO. P42-32196-91474-1
                    EXISTING 4-SPAN, 52 FEET TIMBER BRIDGE

                     << Beginning Computations for Profile  6 >>

                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT         66.914   .015   2100.000   2486.448 *********  3449.098
  Header Type: XS       66.929 ******       .845   93846.28 *********  4149.059
  SRD:   4948.000       63.444 ******       .091     ******     1.324    ******

  Section: FULL         66.941   .015   2100.000   2487.323    52.000  3449.098
  Header Type: FV       66.956   .026       .844   93897.27    52.000  4149.059
  SRD:   5000.000       63.470   .000       .091      .0005     1.324      .001

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR         66.979   .015   2100.000   2488.382    72.000  3449.098
  Header Type: AS       66.993   .036       .844   93958.96    72.000  4149.059
  SRD:   5072.000       63.506   .000       .091      .0005     1.324      .002

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

          <<< The Following Data Reflect The "Constricted" Profile >>>
            <<< Beginning Bridge/Culvert Hydraulic Computations >>>

 ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
        WS3N, PFelv:     66.94      65.69


                        WSEL    VHD       Q         AREA      SRDL      LEW
                        EGEL     HF       V          K        FLEN      REW
                        CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG         65.690   .697   2098.123    313.301    52.000  3773.000
  Header Type: BR       66.387 ******      6.697   10781.55 *********  3825.100
  SRD:   5000.000       63.359 ******       .681     ******     1.000    ******

  Bridge Summary Information - Coordinate Mode
 ------------------------------------------------------------------------------
-
  Flow Class:  3 - Submerged orifice flow with no embankment overtopping
  Bridge Type: 2 - Sloping embankments & vertical abutments w/o wingwalls

                        ------ -------- -------- --------- ---------
                          C     PFELEV    BLEN      XLAB      XRAB
                        ------ -------- -------- --------- ---------
                         .8000   65.690 ******** ********* *********
                        ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     66.941
      Downstream Bridge Section Water Surface Elevation:             65.690
      Bridge DrawDown Distance:                                       1.251

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO      FR #        SF       ALPHA     ERR
                   --------- ------ ---------- ---------- --------- ---------
  Section: APPR       68.250   .007   2100.000   3378.585    52.000  3449.037
  Header Type: AS     68.258   .228       .622  151730.70    84.700  4149.084
  SRD:   5072.000     63.506   .109       .055      .0005     1.199     -.001

          ** Change in Approach Section Water Surface Elevation: 1.272 **

               Approach Section APPR  Flow Contraction Information
              M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
             -------- -------- --------- --------- --------- --------
             ******** ******** ********* ********* *********   68.250
             -------- -------- --------- --------- --------- --------

                 <<< End of Bridge Hydraulics Computations >>>

                   << Completed Computations of Profile  6 >>

   ER

    ******************  Normal end of WSPRO execution.  *****************
    ***************  Elapsed Time:   0 Minutes  1 Seconds  **************
```

WSPRO Calculations
for the
Proposed 4 span (80 ft)
Slab Span Bridge

```
*
T1        S.P. No. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE
*
*         Q5     Q100
Q         1000   2100
SK        .0005  .0005
*
XT   TEMP 5000
GR        3449,69.00  3449,66.90  3508,65.29
GR        3606,63.09  3655,64.14  3693,64.17
GR        3734,62.04  3767,61.41  3799,59.19
GR        3831,60.92  3836,62.20  3852,64.14
GR        3856,64.27  3954,62.34  4053,63.71
GR        4149,64.04  4149,69.00
*
XS   EXIT 4920  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA             3767       3831
*
XS   FULL 5000 *  *  *   .0005
*
BR   BRDG 5000  65.26 *  *  .0005
GR        3761.17,63.93  3777.76,58.40
GR        3822.24,58.40  3838.83,63.93
BC        65.26
BL        80    3800   3800
N         0.085
CD        3  20.00  3  66.93
AB        3.0
*
XS   APPR 5100  *  *  *   .0005
*
EX
ER
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
         Run Date & Time:  5/12/2005  2:25 pm     Version V200104
           Input File: SR-PBR-E       Output File: SR-PBR-E.LST
   *-------------------------------------------------------------*
T1        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE
Q         1000   2100

 ***   Processing Flow Data; Placing Information into Sequence  1   ***

SK        .0005  .0005
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                 PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

              *-----------------------------------------------*
              *      Starting To Process Header Record TEMP   *
              *-----------------------------------------------*

   XT   TEMP 5000
   GR        3449,69.00  3449,66.90  3508,65.29
   GR        3606,63.09  3655,64.14  3693,64.17
   GR        3734,62.04  3767,61.41  3799,59.19
   GR        3831,60.92  3836,62.20  3852,64.14
   GR        3856,64.27  3954,62.34  4053,63.71
   GR        4149,64.04  4149,69.00

    ***   Completed Reading Data Associated With Header Record TEMP    ***
    ***          Storing Template Header Record Data In Memory         ***


    ***              Data Summary For Header Record TEMP               ***
    SRD Location:     5000.    Valley Slope:  *******     Error Code   0

                        X,Y-coordinates (17 pairs)
        X          Y             X          Y             X          Y
   ----------  ----------   ----------  ----------   ----------  ----------
     3449.000      69.000     3449.100      66.900     3508.000      65.290
     3606.000      63.090     3655.000      64.140     3693.000      64.170
     3734.000      62.040     3767.000      61.410     3799.000      59.190
     3831.000      60.920     3836.000      62.200     3852.000      64.140
     3856.000      64.270     3954.000      62.340     4053.000      63.710
     4149.000      64.040     4149.100      69.000
   ----------  ----------   ----------  ----------   ----------  ----------
  +++072 NOTICE:  X-coordinate # 2 increased to eliminate vertical segment.
  +++072 NOTICE:  X-coordinate #17 increased to eliminate vertical segment.

                     Minimum and Maximum X,Y-coordinates
      Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
      Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
      Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
      Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

              *-----------------------------------------------*
              *      Finished Processing Header Record TEMP   *
              *-----------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
              PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

          *-------------------------------------------------*
          *      Starting To Process Header Record EXIT     *
          *-------------------------------------------------*

XS   EXIT 4920  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA              3767       3831

 ***   Completed Reading Data Associated With Header Record EXIT    ***
 ***  Storing X-Section Data In Temporary File As Record Number  1  ***

 ***              Data Summary For Header Record EXIT              ***
 SRD Location:     4920.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      68.960     3449.100      66.860     3508.000      65.250
  3606.000      63.050     3655.000      64.100     3693.000      64.130
  3734.000      62.000     3767.000      61.370     3799.000      59.150
  3831.000      60.880     3836.000      62.160     3852.000      64.100
  3856.000      64.230     3954.000      62.300     4053.000      63.670
  4149.000      64.000     4149.100      68.960
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   68.960 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   68.960 )
  Minimum Y-Elevation:    59.150  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    68.960  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                           Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

          *-------------------------------------------------*
          *      Finished Processing Header Record EXIT     *
          *-------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
             PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

          *-------------------------------------------------*
          *      Starting To Process Header Record FULL     *
          *-------------------------------------------------*

XS   FULL 5000 *  *  *   .0005

 ***   Completed Reading Data Associated With Header Record FULL    ***
 ***   No Roughness Data Input, Propagating From Previous Section   ***
 ***  Storing X-Section Data In Temporary File As Record Number  2  ***

 ***              Data Summary For Header Record FULL              ***
 SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      69.000     3449.100      66.900     3508.000      65.290
  3606.000      63.090     3655.000      64.140     3693.000      64.170
  3734.000      62.040     3767.000      61.410     3799.000      59.190
  3831.000      60.920     3836.000      62.200     3852.000      64.140
  3856.000      64.270     3954.000      62.340     4053.000      63.710
  4149.000      64.040     4149.100      69.000
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
  Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

          *-------------------------------------------------*
          *      Finished Processing Header Record FULL     *
          *-------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
             PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

          *-------------------------------------------------*
          *      Starting To Process Header Record BRDG     *
          *-------------------------------------------------*

BR   BRDG 5000  65.26 *  *  .0005
GR        3761.17,63.93  3777.76,58.40
GR        3822.24,58.40  3838.83,63.93
BC        65.26
BL        80    3800   3800
N         0.085
CD        3  20.00  3  66.93
AB        3.0

 ***   Completed Reading Data Associated With Header Record BRDG    ***
 ***   Storing Bridge Data In Temporary File As Record Number  3    ***

 ***              Data Summary For Bridge Record BRDG              ***
 SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:  *******    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates ( 5 pairs)
    X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3760.000      65.260     3780.795      58.400     3819.205      58.400
  3840.000      65.260     3760.000      65.260
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3760.000  ( associated Y-Elevation:   65.260 )
  Maximum X-Station:    3840.000  ( associated Y-Elevation:   65.260 )
  Minimum Y-Elevation:    58.400  ( associated X-Station:   3819.205 )
  Maximum Y-Elevation:    65.260  ( associated X-Station:   3760.000 )

                   Roughness Data (  1 SubAreas )
                           Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .085         ---
                  -------  -----------  ------------

                   Discharge coefficient parameters
                BRType   BRWdth   EMBSS   EMBElv    UserCD
                  3       20.000   3.00    66.930 **********

                      Pressure flow elevations
                         AVBCEL     PFElev
                         65.260     65.260
```

```
                  Abutment Parameters
   ABSLPL  ABSLPR   XTOELT    YTOELT    XTOERT    YTOERT
    3.000   3.000  3780.795    58.400  3819.205    58.400

     Bridge Length and Bottom Chord component input data
BRLEN   LOCOPT   XCONLT    XCONRT    BCELEV   BCSLP   BCXSTA
80.000    0     3800.000  3800.000    65.260   .0000  3800.000

            ** No Pier/Pile Data Encountered **


    *-------------------------------------------------*
    *      Finished Processing Header Record BRDG     *
    *-------------------------------------------------*
```

```
**************************  W S P R O  ***************************
   Federal Highway Administration  -  U. S. Geological Survey
          Model for Water-Surface Profile Computations.
         Input Units: English  /  Output Units: English
*-------------------------------------------------------------*
  S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                STR. NO. P42-32196-91474-1
          PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

        *-------------------------------------------------*
        *      Starting To Process Header Record APPR     *
        *-------------------------------------------------*

XS   APPR 5100  *  *  *   .0005

 ***   Completed Reading Data Associated With Header Record APPR    ***
 ***   No Roughness Data Input, Propagating From Previous Section   ***
 ***  Storing X-Section Data In Temporary File As Record Number  4  ***

 ***              Data Summary For Header Record APPR              ***
 SRD Location:     5100.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
    X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      69.050     3449.100      66.950     3508.000      65.340
  3606.000      63.140     3655.000      64.190     3693.000      64.220
  3734.000      62.090     3767.000      61.460     3799.000      59.240
  3831.000      60.970     3836.000      62.250     3852.000      64.190
  3856.000      64.320     3954.000      62.390     4053.000      63.760
  4149.000      64.090     4149.100      69.050
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.050 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.050 )
  Minimum Y-Elevation:    59.240  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    69.050  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

Bridge datum projection(s):  XREFLT  XREFRT  FDSTLT  FDSTRT
                            ******* ******* ******* *******
        *-------------------------------------------------*
        *      Finished Processing Header Record APPR     *
        *-------------------------------------------------*
```

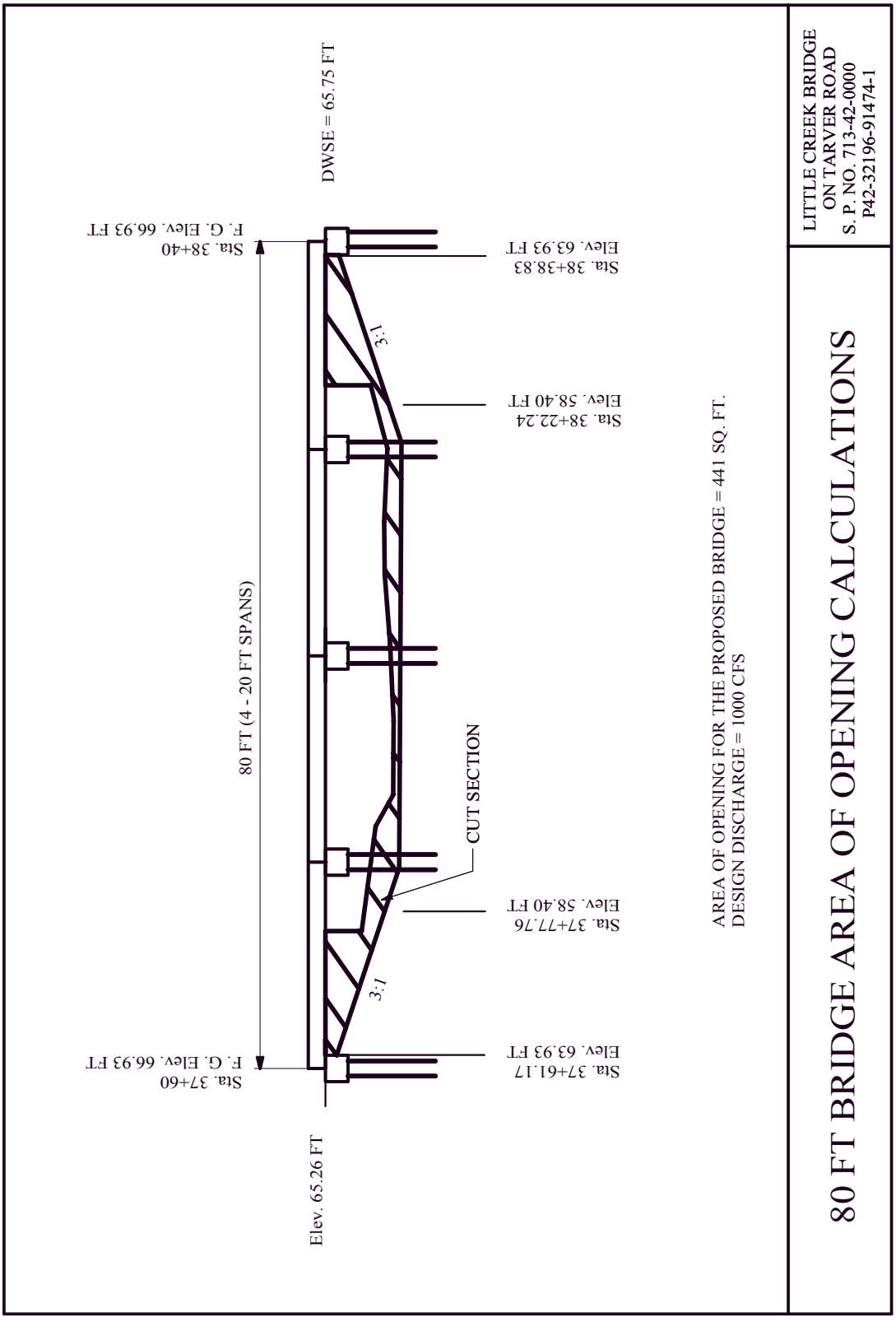
```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                       STR. NO. P42-32196-91474-1
                 PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE
EX

           *=================================================*
           *     Summary of Boundary Condition Information   *
           *=================================================*

             Reach      Water Surface   Friction
       #   Discharge      Elevation      Slope         Flow Regime
      --   ---------    -------------   --------   --------------------
       1     1000.00      ********        .0005        Sub-Critical
       2     2100.00      ********        .0005        Sub-Critical
      --   ---------    -------------   --------   --------------------

           *=================================================*
           *        Beginning  2 Profile Calculation(s)      *
           *=================================================*
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

                    << Beginning Computations for Profile  1 >>

                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
    Section: EXIT       65.416   .011   1000.000   1485.965 *********  3501.922
    Header Type: XS     65.427 ******       .673   44691.34 *********  4149.029
    SRD:   4920.000     62.181 ******       .099     ******     1.603    ******

    Section: FULL       65.458   .011   1000.000   1487.107    80.000  3501.858
    Header Type: FV     65.469   .040       .672   44739.42    80.000  4149.029
    SRD:   5000.000     62.221   .000       .099      .0005     1.602      .002

           <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

    Section: APPR       65.510   .011   1000.000   1488.451   100.000  3501.782
    Header Type: AS     65.521   .050       .672   44796.08   100.000  4149.029
    SRD:   5100.000     62.271   .000       .099      .0005     1.602      .002

           <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

            <<< The Following Data Reflect The "Constricted" Profile >>>
              <<< Beginning Bridge/Culvert Hydraulic Computations >>>

    ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
           WS3N, PFelv:     65.46      65.26


                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
    Section: BRDG       65.260   .096   1008.243    406.146    80.000  3760.000
    Header Type: BR     65.356 ******      2.482   13092.69 *********  3840.000
    SRD:   5000.000     60.984 ******       .275     ******     1.000    ******

     Bridge Summary Information - Component Mode
    ---------------------------------------------------------------------------
    -
     Flow Class:  3 - Submerged orifice flow with no embankment overtopping
     Bridge Type: 3 - Sloping embankments & sloping spillthrough abutments

                       ------ -------- -------- --------- ---------
                         C     PFELEV    BLEN      XLAB      XRAB
                       ------ -------- -------- --------- ---------
                        .8000   65.260   80.000  3780.795  3819.205
                       ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     65.458
      Downstream Bridge Section Water Surface Elevation:             65.260
      Bridge DrawDown Distance:                                        .198

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO     FR #         SF       ALPHA     ERR
                  --------- ------ ---------- ---------- --------- ---------
  Section: APPR      65.753   .009   1000.000   1646.539    80.000  3492.907
  Header Type: AS    65.761   .154       .607   51651.63   104.099  4149.034
  SRD:   5100.000    62.271   .000       .084      .0005     1.532      .008

          ** Change in Approach Section Water Surface Elevation:  .243 **

               Approach Section APPR  Flow Contraction Information
           M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
          -------- -------- --------- --------- --------- --------
          ******** ******** ********* ********* *********   65.753
          -------- -------- --------- --------- --------- --------

              <<< End of Bridge Hydraulics Computations >>>

                << Completed Computations of Profile  1 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
                PROPOSED 4-SPAN, 80 FEET SLAB SPAN BRIDGE

                    << Beginning Computations for Profile  2 >>

                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: EXIT        66.900   .015   2100.000   2486.452 *********  3449.098
  Header Type: XS      66.915 ******       .845   93846.56 *********  4149.059
  SRD:   4920.000      63.430 ******       .091     ******     1.324    ******

  Section: FULL        66.942   .015   2100.000   2487.628    80.000  3449.098
  Header Type: FV      66.956   .040       .844   93915.03    80.000  4149.059
  SRD:   5000.000      63.470   .000       .091      .0005     1.324      .002

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

  Section: APPR        66.994   .015   2100.000   2488.959   100.000  3449.098
  Header Type: AS      67.008   .050       .844   93992.63   100.000  4149.059
  SRD:   5100.000      63.520   .000       .091      .0005     1.324      .002

         <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

          <<< The Following Data Reflect The "Constricted" Profile >>>
            <<< Beginning Bridge/Culvert Hydraulic Computations >>>

 ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
        WS3N, PFelv:     66.94      65.26


                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
  Section: BRDG        65.260   .415   2098.896    406.146    80.000  3760.000
  Header Type: BR      65.675 ******      5.168   13092.69 *********  3840.000
  SRD:   5000.000      62.450 ******       .572     ******     1.000    ******

  Bridge Summary Information - Component Mode
 ------------------------------------------------------------------------------
-
  Flow Class:  3 - Submerged orifice flow with no embankment overtopping
  Bridge Type: 3 - Sloping embankments & sloping spillthrough abutments

                       ------ -------- -------- --------- ---------
                         C     PFELEV    BLEN      XLAB      XRAB
                       ------ -------- -------- --------- ---------
                        .8000   65.260   80.000  3780.795  3819.205
                       ------ -------- -------- --------- ---------
```

```
  No Pier(s)/Pile(s) Present at Bridge

 ------------------------------------------------------------------------------
-

      Unconstricted Full Valley Section Water Surface Elevation:     66.942
      Downstream Bridge Section Water Surface Elevation:             65.260
      Bridge DrawDown Distance:                                       1.682

 ------------------------------------------------------------------------------
-

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO     FR #         SF       ALPHA     ERR
                  --------- ------ ---------- ---------- --------- ---------
  Section: APPR      67.864   .009  2100.000   3098.288    80.000  3449.057
  Header Type: AS    67.873   .283      .678  132300.80   111.239  4149.076
  SRD:   5100.000    63.520   .000      .063      .0005     1.228     -.001

          ** Change in Approach Section Water Surface Elevation:  .870 **

               Approach Section APPR  Flow Contraction Information
             M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
            -------- -------- --------- --------- --------- --------
            ******** ******** ********* ********* *********   67.864
            -------- -------- --------- --------- --------- --------

                <<< End of Bridge Hydraulics Computations >>>

                  << Completed Computations of Profile  2 >>

   ER

    ******************  Normal end of WSPRO execution.  *****************
    ***************  Elapsed Time:   0 Minutes  1 Seconds  **************
```


LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1
80 FT BRIDGE AREA OF OPENING CALCULATIONS
DWSE = 65.75 FT
Sta. 38+40
F. G. Elev. 66.93 FT
Sta. 38+38.83
Elev. 63.93 FT
3:1
Sta. 38+22.24
Elev. 58.40 FT
80 FT (4 - 20 FT SPANS)
CUT SECTION
Sta. 37+77.76
Elev. 58.40 FT
3:1
Sta. 37+61.17
Elev. 63.93 FT
Sta. 37+60
F. G. Elev. 66.93 FT
Elev. 65.26 FT
AREA OF OPENING FOR THE PROPOSED BRIDGE = 441 SQ. FT.
DESIGN DISCHARGE = 1000 CFS

This page left blank.

WSPRO Calculations
for the
Proposed Precast 3 Sided Structure
2 – 28′ x 7′

```
*
T1        S.P. No. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 sf eq area)
*
*         Q5       Q100
Q         1000     2100
WS        65.495   65.495
*         (water surface elevation from existing approach unconstricted)
*
CV   BOXCV 5000   3800  50  58.40  58.45  2
*         (slope for culvert rounded up to 0.001)
CG        112   72.6  331.2
*         (the height and span set to 6.05 ft and 27.6 ft.)
*         (this gives the same area of opening for the arch box)
*
EX
ER
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
         Run Date & Time:  4/23/2005  4:38 pm     Version V200104
           Input File: SR-P3S28       Output File: SR-P3S28.LST
   *-------------------------------------------------------------*
T1        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 SF EQ AREA)
Q         1000     2100

 ***   Processing Flow Data; Placing Information into Sequence  1   ***

WS        65.495   65.495
```

```
    ************************  W S P R O  ***************************
       Federal Highway Administration  -  U. S. Geological Survey
              Model for Water-Surface Profile Computations.
             Input Units: English  /  Output Units: English
    *-------------------------------------------------------------*
      S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                      STR. NO. P42-32196-91474-1
     PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 SF EQ AREA)

          *-----------------------------------------------------*
          *      Starting To Process Header Record BOXCV        *
          *-----------------------------------------------------*

CV   BOXCV 5000   3800  50  58.40  58.45  2
CG        112   72.6  331.2

 ***   Completed Reading Data Associated With Header Record BOXCV   ***
 ***      Notice - Program Assuming All Culvert Input Complete      ***
  ***   Storing Culvert Data In Temporary File As Record Number  1    ***

 ***              Data Summary For Header Record BOXCV              ***
 SRD Location:     5000.       Culvert Code:  112       Error Code   0

 Culvert Information:

     Shape:  Box        Material:  Concrete
     Inlet Code: 2   Length:   50.000
     Rise:    72.600   Span:   331.200   # Barrel(s):  2
     Roughness:   .0120   Horizontal Stationing:  3800.000
     Entrance Loss Coefficient:   .50   Alpha:  1.0000
     Invert Elevations -> Upstream:     58.450
                          Downstream:   58.400

          *-----------------------------------------------------*
          *      Finished Processing Header Record BOXCV        *
          *-----------------------------------------------------*
```

```
**************************  W S P R O  ***************************
   Federal Highway Administration  -  U. S. Geological Survey
          Model for Water-Surface Profile Computations.
         Input Units: English  /  Output Units: English
*-------------------------------------------------------------*
  S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                  STR. NO. P42-32196-91474-1
 PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 SF EQ AREA)
EX

      *=================================================*
      *     Summary of Boundary Condition Information    *
      *=================================================*

        Reach      Water Surface   Friction
 #   Discharge      Elevation      Slope         Flow Regime
--   ---------    -------------   --------   --------------------
 1     1000.00        65.495       ******        Sub-Critical
 2     2100.00        65.495       ******        Sub-Critical
--   ---------    -------------   --------   --------------------

      *=================================================*
      *        Beginning  2 Profile Calculation(s)      *
      *=================================================*
```

```
    ************************  W S P R O  ***************************
       Federal Highway Administration  -  U. S. Geological Survey
              Model for Water-Surface Profile Computations.
             Input Units: English  /  Output Units: English
    *-------------------------------------------------------------*
      S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                     STR. NO. P42-32196-91474-1
     PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 SF EQ AREA)

                  << Beginning Computations for Profile  1 >>
                     WSEL     TWD      Q/BL       AIN      OTFULL
                     HWic      Dc     VELIN       AOUT      Ac
                     HWoc      Dn     VELOUT     CVSLPE     An
                  --------- ------ ---------- ---------- ---------
Section: BOXCV       65.713  7.095    500.000    166.980     1.004
Header Type: CV       3.694  2.167      2.994    166.980    59.819
SRD:  *********       7.263  2.692      2.994      .0010    74.299
                  --------- ------ ---------- ---------- ---------
                  << Completed Computations of Profile  1 >>
```

```
    ************************  W S P R O  ***************************
       Federal Highway Administration  -  U. S. Geological Survey
              Model for Water-Surface Profile Computations.
             Input Units: English  /  Output Units: English
    *-------------------------------------------------------------*
      S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                     STR. NO. P42-32196-91474-1
     PROPOSED P3S STRUCTURE, 2 – 28’SPAN, 7’RISE (167 SF EQ AREA)

                  << Beginning Computations for Profile  2 >>
                     WSEL     TWD      Q/BL       AIN      OTFULL
                     HWic      Dc     VELIN       AOUT      Ac
                     HWoc      Dn     VELOUT     CVSLPE     An
                  --------- ------ ---------- ---------- ---------
Section: BOXCV       66.456  7.095   1050.000    166.980     1.033
Header Type: CV       6.031  3.555      6.288    166.980    98.131
SRD:  *********       8.006  4.367      6.288      .0010   120.519
                  --------- ------ ---------- ---------- ---------
                  << Completed Computations of Profile  2 >>

 ER

  ******************  Normal end of WSPRO execution.  *****************
  ***************  Elapsed Time:   0 Minutes  1 Seconds  **************
```

Culvert Calculations

(HYDR1120 Output)

```
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT      HYDR1120-071498
HYDRAULICS SECTION
DESIGNER: Name                          DATE: 04-19-2005
REMARKS :   Richland Parish - Little Creek Bridge over Tarver Road

                STATE PROJECT NUMBER   713-42-0000

         REINFORCED CONCRETE PIPE ARCH (INLET TYPE: 0-PROJECTING )
*********************************************************************
         STATION                                    Lit_Creek
         NUMBER OF PIPES                                4
         ROUND EQUIVALENT DIAMETER (IN.)               96
         DESIGN DISCHARGE (CFS)                    1000.00
         TAILWATER (FT.)                              8.02
         LENGTH (FT.)                                50.00
         SLOPE (FT./FT.)                            .00100
*********************************************************************

         HEADWATER (OUTLET)                           8.44  FT.
         OUTLET VELOCITY                              4.85  F.P.S.
         DEPTH OF SCOUR FOR TYPE A SOIL               2.70  FT.

*********************************************************************
```

$\Delta H = 0.42$ ft

```
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT      HYDR1120-071498
HYDRAULICS SECTION
DESIGNER: Name                          DATE: 04-19-2005
REMARKS :   Richland Parish - Little Creek Bridge over Tarver Road

                STATE PROJECT NUMBER   713-42-0000

           CORRUGATED METAL PIPE ARCH ( INLET CODE = 0 )
*********************************************************************
         STATION                                    Lit_Creek
         NUMBER OF PIPES                                4
         ROUND EQUIVALENT DIAMETER (IN.)              108
         CORRUGATION                                3" X 1"
         DESIGN DISCHARGE (CFS)                    1000.00
         TAILWATER (FT.)                              8.02
         LENGTH (FT.)                                50.00
         SLOPE (FT./FT.)                            .00100
*********************************************************************

         HEADWATER (OUTLET)                           8.58  FT.
         OUTLET VELOCITY                              4.13  F.P.S.
         DEPTH OF SCOUR FOR TYPE A SOIL               2.51  FT.

*********************************************************************
```

$\Delta H = 0.56$ ft

```
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT      HYDR1120-071498
HYDRAULICS SECTION
DESIGNER: Name                          DATE: 04-19-2005
REMARKS :   Richland Parish - Little Creek Bridge over Tarver Road

                 STATE PROJECT NUMBER   713-42-0000

         REINFORCED CONCRETE BOX ( SQUARE-EDGE STRAIGHT HEADWALLS )
*********************************************************************
         STATION                                    Lit_Creek
         NUMBER OF BOXES                                4
         SPAN (FEET)                                    8
         HEIGHT (FEET)                                  7
         DESIGN DISCHARGE (CFS)                   1000.00
         TAILWATER (FT.)                             8.02
         LENGTH (FT.)                               50.00
         SLOPE (FT./FT.)                           .00100
*********************************************************************

         HEADWATER (OUTLET)                          8.46  FT.
         OUTLET VELOCITY                             4.46  F.P.S.
         DEPTH OF SCOUR FOR TYPE A SOIL              2.62  FT.

*********************************************************************
```

$\Delta H = 0.44ft$

This page left blank.

C. Recommendation

After careful consideration of the different alternates, the following structural alternates are recommended for replacing the existing structure over Little Creek on Tarver Road:

One 80 ft (4 – 20 ft spans) Long Reinforced Concrete Bridge
with 3:1 Spill through Abutments
Proposed Finished Grade at Stream Crossing: 66.93 ft

or

2 – 28′ x 7′
Precast 3 Sided Structure
Proposed Finished Grade at Stream Crossing: 66.93 ft

Considering the project feasibility, area of opening, effective width of the creek, and backwater created by the proposed structure, and the design discharge of 1000 cfs for the 5-year frequency, the four span, 80 ft long concrete bridge at the existing grade is recommended. The 60 ft long bridge is not recommended because of the amount of fill that would be required. A table comparison of the hydraulic performance for each alternate and a Hydraulic Data Table for the preferred alternate follows. A profile view for each alternate is also included.

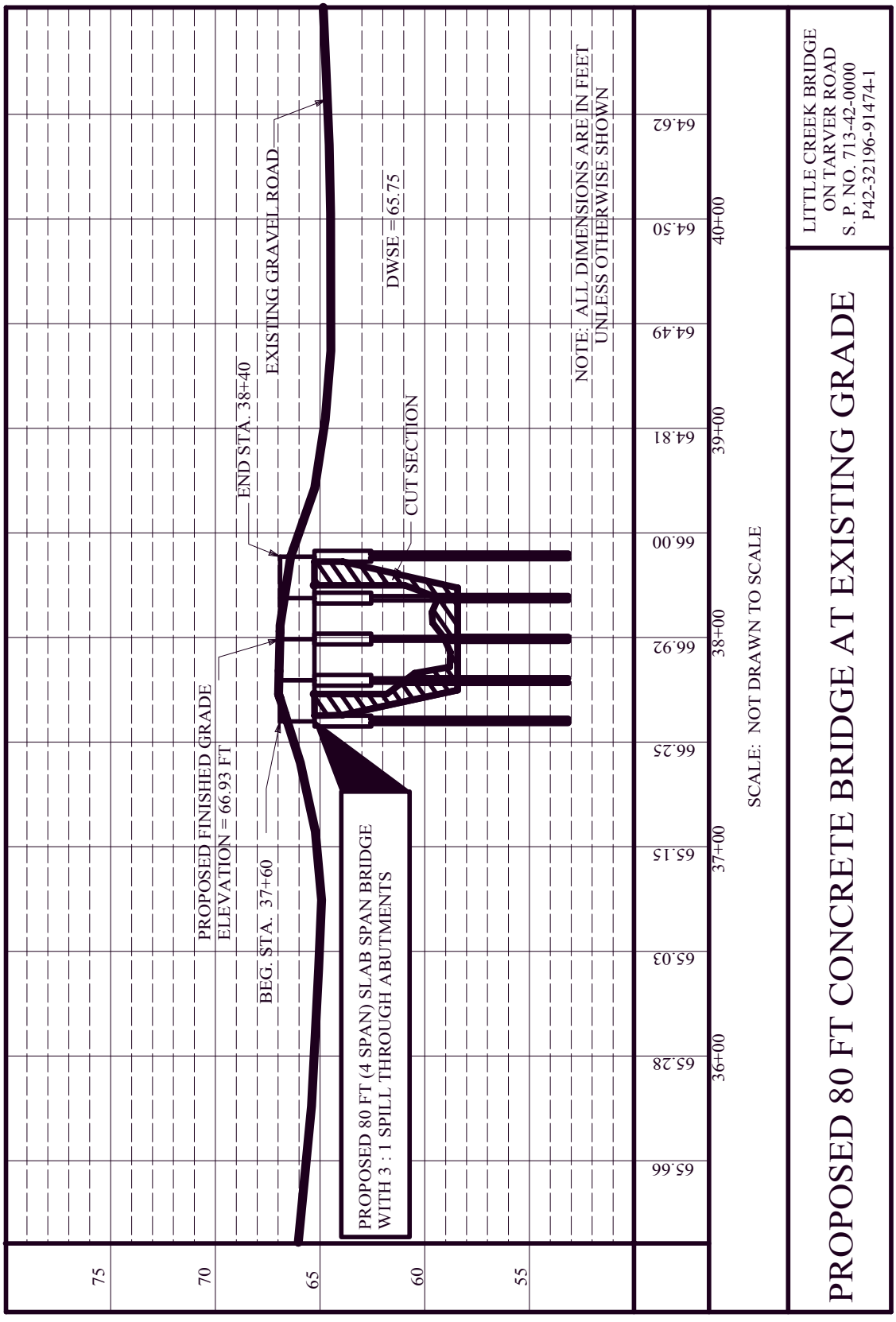
Off-System Bridge Rehabilitation & Replacement Program

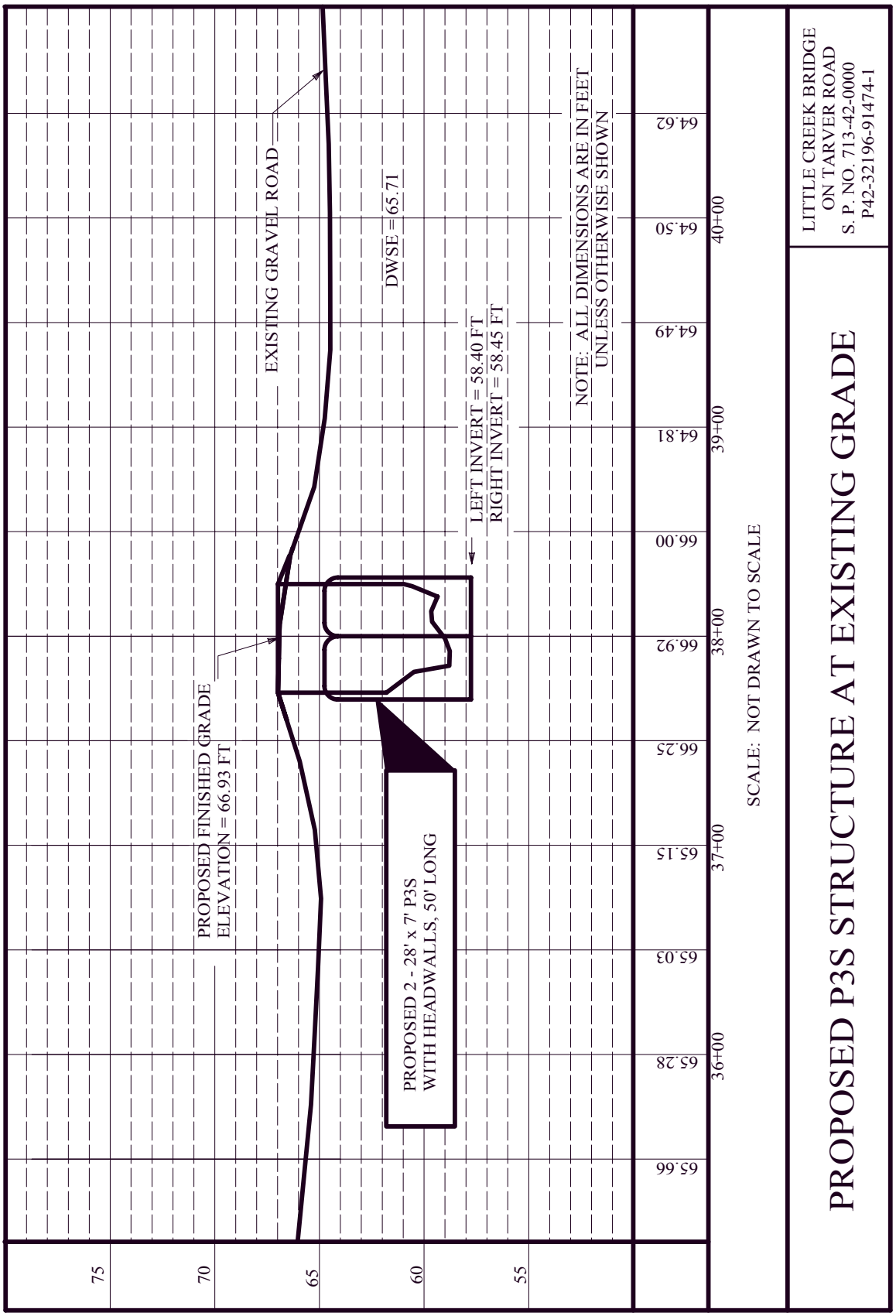
COMPARISON TABLE OF STRUCTURAL ALTERNATES TO EXISTING STRUCTURE

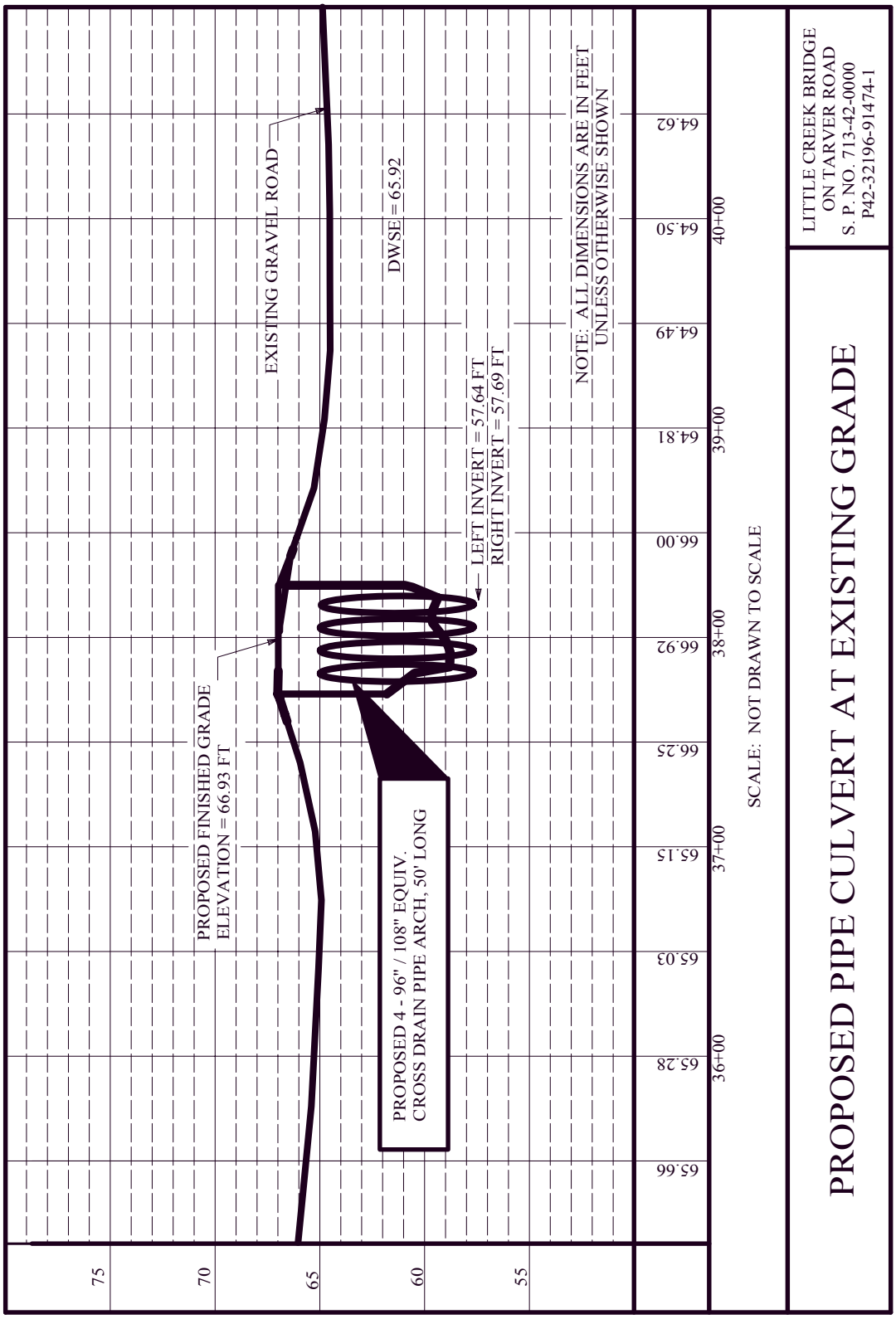
	EXISTING STRUCT.	BRIDGE ALT.	P3S ALT.	RCP / PP ALT.	CMP ALT.	RCB ALT.
SIZE, TYPE & NO.	52′ Timber Bridge	4-span, 80′ slab span bridge	2 - 28’ x 7’	4 – 96” equiv.	4 – 108” equiv.	4 - 8’ x 7’
DESIGN FREQUENCY	5 year	5 year	5 year	5 year	5 year	5 year
DESIGN DISCHARGE (cfs)	1000	1000	1000	1000	1000	1000
FINISHED GRADE ELEVATION (ft)	66.93	66.93	66.93	66.93	66.93	66.93
LOW ROADWAY ELEVATION (ft)	64.48	64.48	64.48	64.48	64.48	64.48
DESIGN WATER SURFACE ELEVATION * (ft)	65.93	65.75	65.71	65.92	66.06	65.94
OUTLET VELOCITY (fps)	2.48	2.46	2.99	4.85	4.13	4.46
DEPTH OF SCOUR (ft) SOIL TYPE (Culverts Only)				1.62 Soil Type C	1.51 Soil Type C	1.57 Soil Type C
AREA OF OPENING (ft^2)	300	406	334	201	255	224
DIFFERENTIAL HEAD (ft)	0.439	0.243	0.21	0.42	0.56	0.44

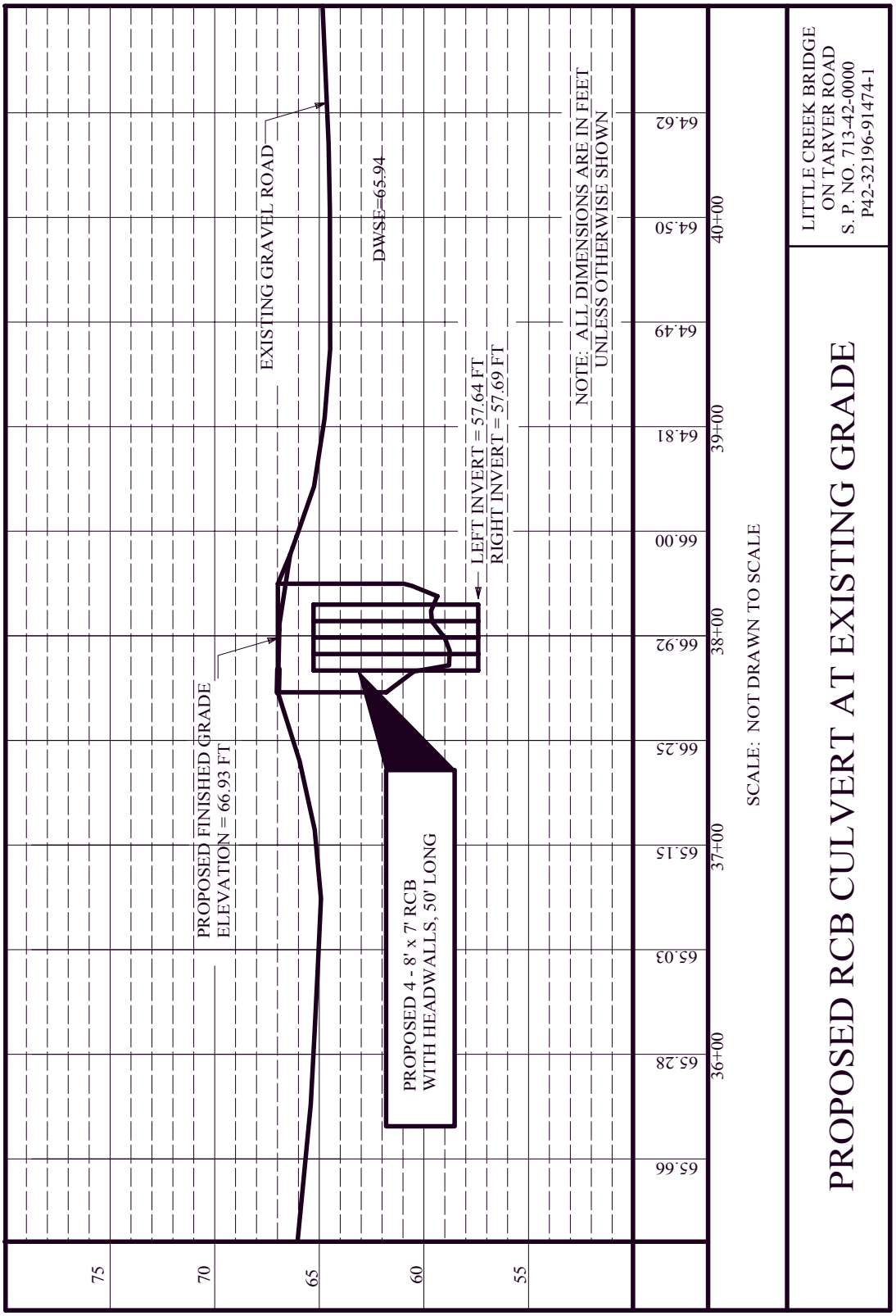
***** Includes the differential head, does not reflect roadway overtopping

2005


PROPOSED 80 FT CONCRETE BRIDGE AT EXISTING GRADE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1
SCALE: NOT DRAWN TO SCALE
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
PROPOSED 80 FT (4 SPAN) SLAB SPAN BRIDGE
WITH 3 : 1 SPILL THROUGH ABUTMENTS
PROPOSED FINISHED GRADE
ELEVATION = 66.93 FT
BEG. STA. 37+60
END STA. 38+40
EXISTING GRAVEL ROAD
CUT SECTION
DWSE = 65.75
75
70
65
60
55
65.66
65.28
65.03
65.15
66.25
66.92
66.00
64.81
64.49
64.50
64.62
36+00
37+00
38+00
39+00
40+00


PROPOSED P3S STRUCTURE AT EXISTING GRADE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1
SCALE: NOT DRAWN TO SCALE
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
LEFT INVERT = 58.40 FT
RIGHT INVERT = 58.45 FT
DWSE = 65.71
EXISTING GRAVEL ROAD
PROPOSED FINISHED GRADE
ELEVATION = 66.93 FT
PROPOSED 2 - 28' x 7' P3S
WITH HEADWALLS, 50' LONG
75
70
65
60
55
65.66
65.28
65.03
65.15
66.25
66.92
66.00
64.81
64.49
64.50
64.62
36+00
37+00
38+00
39+00
40+00


75
70
65
60
55
EXISTING GRAVEL ROAD
PROPOSED FINISHED GRADE
ELEVATION = 66.93 FT
DWSE = 65.92
LEFT INVERT = 57.64 FT
RIGHT INVERT = 57.69 FT
PROPOSED 4 - 96" / 108" EQUIV.
CROSS DRAIN PIPE ARCH, 50' LONG
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
64.62
64.50
64.49
64.81
66.00
66.92
66.25
65.15
65.03
65.28
65.66
36+00
37+00
38+00
39+00
40+00
SCALE: NOT DRAWN TO SCALE
PROPOSED PIPE CULVERT AT EXISTING GRADE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1


EXISTING GRAVEL ROAD
PROPOSED FINISHED GRADE
ELEVATION = 66.93 FT
DWSE=65.94
LEFT INVERT = 57.64 FT
RIGHT INVERT = 57.69 FT
PROPOSED 4 - 8' x 7' RCB
WITH HEADWALLS, 50' LONG
NOTE: ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN
75
70
65
60
55
65.66
65.28
65.03
65.15
66.25
66.92
66.00
64.81
64.49
64.50
64.62
36+00
37+00
38+00
39+00
40+00
SCALE: NOT DRAWN TO SCALE
PROPOSED RCB CULVERT AT EXISTING GRADE
LITTLE CREEK BRIDGE
ON TARVER ROAD
S. P. NO. 713-42-0000
P42-32196-91474-1

Off-System Bridge Rehabilitation & Replacement Program
Bridge Hydraulic Data Form

STATE PROJECT NO.: 713-42-0000

PARISH: RICHLAND

STRUCTURE NO.: P42-32196-91474-1

PREPARED BY: J. K.

DATE: 2005

STREAM NAME: LITTLE CREEK

BEGINNING STATION: 37+60

FINISH GRADE ELEV. (ft): 66.93

BRIDGE LENGTH (ft): 80

LOW ROADWAY ELEVATION (ft): 64.48

NOTE: THE FOLLOWING HYDRAULIC DATA TABLE IS TO BE PLACED ON THE PLANS.

HYDRAULIC DATA TABLE

Drainage Area (mi^2): 19.64					
Basin Slope (ft/mi): 3.02				PREDICTED SCOUR	
Flood Frequency (years)	Design Year (5)	Design Year (5)	100	Flood Frequency (years)	
Discharge (ft^3/s)	1000	1000	2100	Discharge (ft^3/s)	
Structure	Existing Bridge	Proposed Structure	Proposed Structure	Contraction Scour Depth (ft)	
Size & Type	52 ft bridge	80 ft bridge	80 ft bridge		
Design Water Surface Elev. (ft/MSL)	65.93*	65.75*	67.86*	Maximum Local Scour Depth (ft)	
Average Velocity (ft/s)	2.48	2.46	5.17		
Area of Opening (ft^2)	300	406	406	Abutment Scour Depth (ft)	
Backwater (ft)	0.439	0.243	0.870	Bridge Scour Elevation (ft)	

REMARKS: * Includes backwater; does not reflect roadway overtopping

SCOUR: To be calculated after the Plan-in-Hand

EXISTING BRIDGE: 4-span timber bridge, 52 feet total length

DETOUR BRIDGE: not required

2005

This page left blank.

SAMPLE

SCOUR SUBMITTAL

The following is a sample scour submittal for the sample hydraulic report. The intent of providing this is for general format only. **This sample is not for setting policy. (For policy see the first portion of the guidelines.)** The methods, assumptions, and design criteria used in the calculations were considered appropriate for this particular bridge site. Each bridge site is unique and variations in the WSPRO model and scour analyses may be appropriate and acceptable as long as they follow sound hydraulic reasoning.

This page left blank.

I. SCOUR ANALYSIS

The plan-in-hand party has decided that the bridge alternate will be the replacement structure. In view of this, the scour has been determined for the proposed 80 ft (4-span) bridge according to "HEC 18 – Evaluating Scour, fourth edition" (May 2001). The calculations and an updated Hydraulic Data Table follow the WSPRO run.

Since the water overtops the roadway at a frequency less than 5 years, and based on HEC-18, it was decided that the scour should be determined for the 5-year frequency and not the 100-year or 500-year frequency. For the 5-year discharge, clear-water was the governing factor for the contraction scour.

It is recommended that flexible revetment be placed on the abutments; therefore, the calculation of abutment scour was not necessary.

The contraction scour was determined to be 9.72 ft and the pier scour 2.58 ft. The total scour estimation based on the calculations is 12.30 ft. There was not any evidence of scour problems at the site, and the discharge and velocity are low. It is felt that the 12.30 ft of scour is too high an estimation; therefore, it is recommended that the piles be designed for the minimum total scour depth of 5.0 ft.

```
*
T1        S.P. No. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE
*
*         Q5
Q         1000
SK        .0005
*
XT   TEMP 5000
GR        3449,69.00  3449,66.90  3508,65.29
GR        3606,63.09  3655,64.14  3693,64.17
GR        3734,62.04  3767,61.41  3799,59.19
GR        3831,60.92  3836,62.20  3852,64.14
GR        3856,64.27  3954,62.34  4053,63.71
GR        4149,64.04  4149,69.00
*
XS   EXIT 4920  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA              3767       3831
*
XS   FULL 5000 *  *  *   .0005
*
BR   BRDG 5000  65.26 *  *  .0005
GR        3761.17,63.93  3777.76,58.40
GR        3822.24,58.40  3838.83,63.93
BC        65.26
BL        80    3800   3800
N         0.085
CD        3  20.00  3  66.93
AB        3.0
*
*         XR   ROAD 5000   20.00   1
*         GR        3445,68.02  3478,66.36  3543,65.72  3609,65.23
*         GR        3674,64.92  3707,65.22  3740,65.94  3773,66.98
*         GR        3806,66.90  3839,66.40  3871,65.25  3904,64.75
*         GR        3937,64.48  4035,64.56  4101,64.85  4134,64.95
*
XS   APPR 5100  *  *  *   .0005
*
HP 2 BRDG 65.250  1  65.250  1000
HP 1 BRDG 65.250  1  65.250
*
HP 1 APPR 65.753  1  65.753
*
EX
ER
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
         Run Date & Time:  9/27/2005  5:05 pm     Version V200104
           Input File: SA-PBR-E       Output File: SA-PBR-E.LST
   *-------------------------------------------------------------*
T1        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
T2        STR. NO. P42-32196-91474-1
T3        SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE
Q         1000

 ***   Processing Flow Data; Placing Information into Sequence  1   ***

SK        .0005
```

```
     ************************  W S P R O  ***************************
        Federal Highway Administration  -  U. S. Geological Survey
               Model for Water-Surface Profile Computations.
              Input Units: English  /  Output Units: English
     *-------------------------------------------------------------*
       S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                      STR. NO. P42-32196-91474-1
     SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

           *-----------------------------------------------------*
           *      Starting To Process Header Record TEMP         *
           *-----------------------------------------------------*

   XT   TEMP 5000
   GR        3449,69.00  3449,66.90  3508,65.29
   GR        3606,63.09  3655,64.14  3693,64.17
   GR        3734,62.04  3767,61.41  3799,59.19
   GR        3831,60.92  3836,62.20  3852,64.14
   GR        3856,64.27  3954,62.34  4053,63.71
   GR        4149,64.04  4149,69.00

    ***   Completed Reading Data Associated With Header Record TEMP    ***
    ***          Storing Template Header Record Data In Memory         ***


    ***              Data Summary For Header Record TEMP               ***
    SRD Location:     5000.    Valley Slope:  *******     Error Code   0

                        X,Y-coordinates (17 pairs)
        X          Y             X          Y             X          Y
   ----------  ----------   ----------  ----------   ----------  ----------
     3449.000      69.000     3449.100      66.900     3508.000      65.290
     3606.000      63.090     3655.000      64.140     3693.000      64.170
     3734.000      62.040     3767.000      61.410     3799.000      59.190
     3831.000      60.920     3836.000      62.200     3852.000      64.140
     3856.000      64.270     3954.000      62.340     4053.000      63.710
     4149.000      64.040     4149.100      69.000
   ----------  ----------   ----------  ----------   ----------  ----------
  +++072 NOTICE:  X-coordinate # 2 increased to eliminate vertical segment.
  +++072 NOTICE:  X-coordinate #17 increased to eliminate vertical segment.

                    Minimum and Maximum X,Y-coordinates
      Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
      Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
      Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
      Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

           *-----------------------------------------------------*
           *      Finished Processing Header Record TEMP         *
           *-----------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                     STR. NO. P42-32196-91474-1
   SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

         *-----------------------------------------------*
         *      Starting To Process Header Record EXIT   *
         *-----------------------------------------------*

XS   EXIT 4920  *  *  *   .0005
GT
N         0.100      0.085       0.100
SA              3767       3831

 ***   Completed Reading Data Associated With Header Record EXIT    ***
 ***  Storing X-Section Data In Temporary File As Record Number  1  ***

 ***              Data Summary For Header Record EXIT              ***
 SRD Location:     4920.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      68.960     3449.100      66.860     3508.000      65.250
  3606.000      63.050     3655.000      64.100     3693.000      64.130
  3734.000      62.000     3767.000      61.370     3799.000      59.150
  3831.000      60.880     3836.000      62.160     3852.000      64.100
  3856.000      64.230     3954.000      62.300     4053.000      63.670
  4149.000      64.000     4149.100      68.960
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   68.960 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   68.960 )
  Minimum Y-Elevation:    59.150  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    68.960  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                           Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

         *-------------------------------------------------*
         *      Finished Processing Header Record EXIT     *
         *-------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
   SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

         *-------------------------------------------------*
         *      Starting To Process Header Record FULL     *
         *-------------------------------------------------*

XS   FULL 5000 *  *  *   .0005

 ***   Completed Reading Data Associated With Header Record FULL    ***
 ***   No Roughness Data Input, Propagating From Previous Section   ***
 ***  Storing X-Section Data In Temporary File As Record Number  2  ***

 ***              Data Summary For Header Record FULL               ***
 SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates (17 pairs)
     X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3449.000      69.000     3449.100      66.900     3508.000      65.290
  3606.000      63.090     3655.000      64.140     3693.000      64.170
  3734.000      62.040     3767.000      61.410     3799.000      59.190
  3831.000      60.920     3836.000      62.200     3852.000      64.140
  3856.000      64.270     3954.000      62.340     4053.000      63.710
  4149.000      64.040     4149.100      69.000
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.000 )
  Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.000 )
  Minimum Y-Elevation:    59.190  ( associated X-Station:   3799.000 )
  Maximum Y-Elevation:    69.000  ( associated X-Station:   3449.000 )

                   Roughness Data (  3 SubAreas )
                            Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .100         ---
                               ---        3767.000
                     2         .085         ---
                               ---        3831.000
                     3         .100         ---
                  -------  -----------  ------------

         *-------------------------------------------------*
         *      Finished Processing Header Record FULL     *
         *-------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
   SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

         *-------------------------------------------------*
         *      Starting To Process Header Record BRDG     *
         *-------------------------------------------------*

BR   BRDG 5000  65.26 *  *  .0005
GR        3761.17,63.93  3777.76,58.40
GR        3822.24,58.40  3838.83,63.93
BC        65.26
BL        80    3800   3800
N         0.085
CD        3  20.00  3  66.93
AB        3.0

 ***   Completed Reading Data Associated With Header Record BRDG    ***
 ***   Storing Bridge Data In Temporary File As Record Number  3    ***

 ***              Data Summary For Bridge Record BRDG              ***
 SRD Location:     5000.   Cross-Section Skew:    .0   Error Code   0
 Valley Slope:  *******    Averaging Conveyance By Geometric Mean.
 Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                    X,Y-coordinates ( 5 pairs)
    X          Y             X          Y             X          Y
----------  ----------   ----------  ----------   ----------  ----------
  3760.000      65.260     3780.795      58.400     3819.205      58.400
  3840.000      65.260     3760.000      65.260
----------  ----------   ----------  ----------   ----------  ----------

                 Minimum and Maximum X,Y-coordinates
  Minimum X-Station:    3760.000  ( associated Y-Elevation:   65.260 )
  Maximum X-Station:    3840.000  ( associated Y-Elevation:   65.260 )
  Minimum Y-Elevation:    58.400  ( associated X-Station:   3819.205 )
  Maximum Y-Elevation:    65.260  ( associated X-Station:   3760.000 )

                   Roughness Data (  1 SubAreas )
                           Roughness    Horizontal
                  SubArea  Coefficient   Breakpoint
                  -------  -----------  ------------
                     1         .085         ---
                  -------  -----------  ------------

                   Discharge coefficient parameters
                BRType   BRWdth   EMBSS   EMBElv    UserCD
                  3       20.000   3.00    66.930 **********

                      Pressure flow elevations
                         AVBCEL     PFElev
                         65.260     65.260
```

```
                  Abutment Parameters
   ABSLPL  ABSLPR   XTOELT    YTOELT    XTOERT    YTOERT
    3.000   3.000  3780.795    58.400  3819.205    58.400

     Bridge Length and Bottom Chord component input data
BRLEN   LOCOPT   XCONLT    XCONRT    BCELEV   BCSLP   BCXSTA
80.000    0     3800.000  3800.000    65.260   .0000  3800.000

            ** No Pier/Pile Data Encountered **


    *-------------------------------------------------*
    *      Finished Processing Header Record BRDG     *
    *-------------------------------------------------*
```

```
     ************************  W S P R O  ***************************
        Federal Highway Administration  -  U. S. Geological Survey
               Model for Water-Surface Profile Computations.
              Input Units: English  /  Output Units: English
     *-------------------------------------------------------------*
       S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                      STR. NO. P42-32196-91474-1
     SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

           *-----------------------------------------------*
           *      Starting To Process Header Record APPR   *
           *-----------------------------------------------*

   XS   APPR 5100  *  *  *   .0005

    ***   Completed Reading Data Associated With Header Record APPR    ***
    ***   No Roughness Data Input, Propagating From Previous Section   ***
    ***  Storing X-Section Data In Temporary File As Record Number  4  ***

    ***              Data Summary For Header Record APPR              ***
    SRD Location:     5100.   Cross-Section Skew:    .0   Error Code   0
    Valley Slope:   .00050    Averaging Conveyance By Geometric Mean.
    Energy Loss Coefficients ->   Expansion:   .50   Contraction:   .00

                        X,Y-coordinates (17 pairs)
        X          Y             X          Y             X          Y
   ----------  ----------   ----------  ----------   ----------  ----------
     3449.000      69.050     3449.100      66.950     3508.000      65.340
     3606.000      63.140     3655.000      64.190     3693.000      64.220
     3734.000      62.090     3767.000      61.460     3799.000      59.240
     3831.000      60.970     3836.000      62.250     3852.000      64.190
     3856.000      64.320     3954.000      62.390     4053.000      63.760
     4149.000      64.090     4149.100      69.050
   ----------  ----------   ----------  ----------   ----------  ----------

                    Minimum and Maximum X,Y-coordinates
      Minimum X-Station:    3449.000  ( associated Y-Elevation:   69.050 )
      Maximum X-Station:    4149.100  ( associated Y-Elevation:   69.050 )
      Minimum Y-Elevation:    59.240  ( associated X-Station:   3799.000 )
      Maximum Y-Elevation:    69.050  ( associated X-Station:   3449.000 )

                       Roughness Data (  3 SubAreas )
                                Roughness    Horizontal
                      SubArea  Coefficient   Breakpoint
                      -------  -----------  ------------
                         1         .100         ---
                                   ---        3767.000
                         2         .085         ---
                                   ---        3831.000
                         3         .100         ---
                      -------  -----------  ------------

   Bridge datum projection(s):  XREFLT  XREFRT  FDSTLT  FDSTRT
                               ******* ******* ******* *******
           *-------------------------------------------------*
           *      Finished Processing Header Record APPR     *
           *-------------------------------------------------*
```

```
   ************************  W S P R O  ***************************
      Federal Highway Administration  -  U. S. Geological Survey
             Model for Water-Surface Profile Computations.
            Input Units: English  /  Output Units: English
   *-------------------------------------------------------------*
     S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                    STR. NO. P42-32196-91474-1
   SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE
HP 2 BRDG 65.250  1  65.250  1000
HP 1 BRDG 65.250  1  65.250
HP 1 APPR 65.753  1  65.753
EX

        *=================================================*
        *     Summary of Boundary Condition Information    *
        *=================================================*

          Reach      Water Surface   Friction
    #   Discharge      Elevation      Slope         Flow Regime
   --   ---------    -------------   --------   --------------------
    1     1000.00      ********        .0005        Sub-Critical
   --   ---------    -------------   --------   --------------------

        *=================================================*
        *        Beginning  1 Profile Calculation(s)      *
        *=================================================*
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
      SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

                    << Beginning Computations for Profile  1 >>

                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
     Section: EXIT       65.416   .011   1000.000   1485.965 *********  3501.922
     Header Type: XS     65.427 ******       .673   44691.34 *********  4149.029
     SRD:   4920.000     62.181 ******       .099     ******     1.603    ******

     Section: FULL       65.458   .011   1000.000   1487.107    80.000  3501.858
     Header Type: FV     65.469   .040       .672   44739.42    80.000  4149.029
     SRD:   5000.000     62.221   .000       .099      .0005     1.602      .002

            <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

     Section: APPR       65.510   .011   1000.000   1488.451   100.000  3501.782
     Header Type: AS     65.521   .050       .672   44796.08   100.000  4149.029
     SRD:   5100.000     62.271   .000       .099      .0005     1.602      .002

            <<< The Preceding Data Reflect The "Unconstricted" Profile >>>

             <<< The Following Data Reflect The "Constricted" Profile >>>
               <<< Beginning Bridge/Culvert Hydraulic Computations >>>

    ===255 ATTEMPTING FLOW CLASS 3 OR 6 SOLUTION.
           WS3N, PFelv:     65.46      65.26


                       WSEL    VHD       Q         AREA      SRDL      LEW
                       EGEL     HF       V          K        FLEN      REW
                       CRWS     HO      FR #        SF       ALPHA     ERR
                     --------- ------ ---------- ---------- --------- ---------
     Section: BRDG       65.260   .096   1008.243    406.146    80.000  3760.000
     Header Type: BR     65.356 ******      2.482   13092.69 *********  3840.000
     SRD:   5000.000     60.984 ******       .275     ******     1.000    ******

     Bridge Summary Information - Component Mode
    ----------------------------------------------------------------------------
     Flow Class:  3 - Submerged orifice flow with no embankment overtopping
     Bridge Type: 3 - Sloping embankments & sloping spillthrough abutments

                       ------ -------- -------- --------- ---------
                         C     PFELEV    BLEN      XLAB      XRAB
                       ------ -------- -------- --------- ---------
                        .8000   65.260   80.000  3780.795  3819.205
                       ------ -------- -------- --------- ---------
```

```
 No Pier(s)/Pile(s) Present at Bridge

-------------------------------------------------------------------------------

     Unconstricted Full Valley Section Water Surface Elevation:     65.458
     Downstream Bridge Section Water Surface Elevation:             65.260
     Bridge DrawDown Distance:                                        .198

-------------------------------------------------------------------------------

                     WSEL    VHD       Q         AREA      SRDL      LEW
                     EGEL     HF       V           K        FLEN      REW
                     CRWS     HO      FR #        SF       ALPHA     ERR
                   --------- ------ ---------- ---------- --------- ---------
 Section: APPR       65.753   .009   1000.000   1646.539    80.000  3492.907
 Header Type: AS     65.761   .154       .607   51651.63   104.099  4149.034
 SRD:   5100.000     62.271   .000       .084      .0005     1.532      .008

         ** Change in Approach Section Water Surface Elevation:  .243 **

              Approach Section APPR  Flow Contraction Information
             M( G )   M( K )     KQ       XLKQ      XRKQ     OTEL
            -------- -------- --------- --------- --------- --------
            ******** ******** ********* ********* *********   65.753
            -------- -------- --------- --------- --------- --------

                <<< End of Bridge Hydraulics Computations >>>

                  << Completed Computations of Profile  1 >>
```

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
      SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

     ***    Beginning Velocity Distribution For Header Record BRDG     ***
            SRD Location:   5000.000       Header Record Number  3

          Water Surface Elevation:     65.250              Element # 1
          Flow:    1000.000   Velocity:  2.47  Hydraulic Depth:   5.071
          Cross-Section Area:    405.35         Conveyance:    20540.26
             Bank Stations ->  Left:   3760.030   Right:   3839.970

  X STA.      3760.0     3774.7     3778.9     3782.0     3784.7     3787.4
    A( I )             35.5       22.9       20.9       18.3       18.5
    V( I )             1.41       2.18       2.39       2.73       2.71
    D( I )             2.42       5.53       6.65       6.85       6.85

  X STA.      3787.4     3789.9     3792.5     3795.0     3797.5     3800.0
    A( I )             17.6       17.5       17.3       17.1       17.1
    V( I )             2.84       2.85       2.89       2.93       2.93
    D( I )             6.85       6.85       6.85       6.85       6.85

  X STA.      3800.0     3802.5     3805.0     3807.5     3810.1     3812.6
    A( I )             17.1       17.1       17.3       17.5       17.6
    V( I )             2.93       2.93       2.89       2.85       2.84
    D( I )             6.85       6.85       6.85       6.85       6.85

  X STA.      3812.6     3815.3     3818.0     3821.1     3825.3     3840.0
    A( I )             18.5       18.3       20.9       22.9       35.5
    V( I )             2.71       2.73       2.39       2.18       1.41
    D( I )             6.85       6.85       6.65       5.53       2.42

          Water Surface Elevation:     65.260              Element # 2
          Flow:    1000.000   Velocity:  2.46  Hydraulic Depth:   5.077
          Cross-Section Area:    406.15         Conveyance:    13092.69
             Bank Stations ->  Left:   3760.000   Right:   3840.000

  X STA.      3760.0     3774.5     3778.8     3781.9     3784.6     3787.3
    A( I )             34.8       23.5       20.4       18.9       18.1
    V( I )             1.44       2.13       2.46       2.64       2.76
    D( I )             2.40       5.50       6.65       6.86       6.86

  X STA.      3787.3     3789.9     3792.4     3795.0     3797.5     3800.0
    A( I )             17.7       17.7       17.4       17.2       17.2
    V( I )             2.82       2.83       2.87       2.90       2.90
    D( I )             6.86       6.86       6.86       6.86       6.86

  X STA.      3800.0     3802.5     3805.0     3807.6     3810.1     3812.7
    A( I )             17.2       17.2       17.4       17.7       17.7
    V( I )             2.90       2.90       2.87       2.83       2.82
    D( I )             6.86       6.86       6.86       6.86       6.86
```

X STA.	3812.7	3815.4	3818.1	3821.2	3825.5	3840.0
A(I)		18.1	18.9	20.4	23.5	34.8
V(I)		2.76	2.64	2.46	2.13	1.44
D(I)		6.86	6.86	6.65	5.50	2.40

```
      ************************  W S P R O  ***************************
         Federal Highway Administration  -  U. S. Geological Survey
                Model for Water-Surface Profile Computations.
               Input Units: English  /  Output Units: English
      *-------------------------------------------------------------*
        S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                        STR. NO. P42-32196-91474-1
      SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

    ***    Compute Cross-Section Properties For Header Record BRDG    ***
            SRD Location:   5000.000       Header Record Number  3

 Water     S  Cross      Cross                    Bank Station
 Surface   A  Section    Section  Top   Wetted  ------------  Hydrlic  Critical
 Elevation #  Conveyance Area(s) Width   Pmtr    Left  Right   Depth     Flow
 --------- -- ---------- ------- ------ ------- ------ ------ ------- ---------
             1   20540.26    405.   79.9   82.14                 5.071   5179.50
    65.250       20540.26    405.   79.9   82.14 3760.0 3840.0   5.071   5179.50
            Velocity Head Correction Factor (alpha): 1.000

             1   13092.69    406.  160.0  162.20                 2.538   3671.91
    65.260       13092.69    406.  160.0  162.20 3760.0 3840.0   2.538   3671.91
            Velocity Head Correction Factor (alpha): 1.000
 --------- -- ---------- ------- ------ ------- ------ ------ ------- ---------
```

```
     ************************  W S P R O  ***************************
        Federal Highway Administration  -  U. S. Geological Survey
               Model for Water-Surface Profile Computations.
              Input Units: English  /  Output Units: English
     *-------------------------------------------------------------*
       S.P. NO. 713-42-0000  RICHLAND PARISH LITTLE CREEK BRIDGE
                      STR. NO. P42-32196-91474-1
     SCOUR CALCULATIONS FOR PROPOSED 4-SPAN, 80 FT SLAB SPAN BRIDGE

    ***    Compute Cross-Section Properties For Header Record APPR    ***
            SRD Location:   5100.000       Header Record Number  4

 Water     S  Cross      Cross                    Bank Station
 Surface   A  Section    Section  Top   Wetted  ------------  Hydrlic  Critical
 Elevation #  Conveyance Area(s) Width   Pmtr    Left  Right   Depth     Flow
 --------- -- ---------- ------- ------ ------- ------ ------ ------- ---------
            1   13011.37    550.  274.1  274.21                2.008   4424.78
            2   19297.76    354.   64.0   64.12                5.525   4716.99
            3   19355.45    743.  318.0  319.97                2.336   6442.66
    65.753      51664.58   1647.  656.1  658.31 3492.9 4149.0   2.510  11962.73
            Velocity Head Correction Factor (alpha): 1.532

            1   24349.89    843.  310.7  310.81                2.712   7875.70
            2   25463.06    418.   64.0   64.12                6.525   6053.81
            3   34981.97   1061.  318.1  320.97                3.336  10995.17
    66.753      84794.92   2321.  692.7  695.91 3456.3 4149.1   3.351  20734.21
            Velocity Head Correction Factor (alpha): 1.352

            1   40772.79   1160.  317.9  318.82                3.648  12571.96
            2   32293.36    482.   64.0   64.12                7.525   7497.40
            3   54042.68   1379.  318.1  321.97                4.335  16293.04
    67.753     127108.80   3021.  700.0  704.92 3449.1 4149.1   4.315  32005.15
            Velocity Head Correction Factor (alpha): 1.238

            1   60927.72   1478.  318.0  319.82                4.648  18079.54
            2   39757.65    546.   64.0   64.12                8.525   9040.40
            3   76220.74   1697.  318.1  322.97                5.335  22243.29
    68.753     176906.10   3721.  700.1  706.92 3449.0 4149.1   5.315  44974.84
            Velocity Head Correction Factor (alpha): 1.171

            1   67512.50   1572.  318.0  320.12                4.944  19839.57
            2   42092.77    565.   64.0   64.12                8.823   9516.90
            3   83372.13   1792.  318.1  323.27                5.632  24126.13
    69.050     192977.40   3929.  700.1  707.52 3449.0 4149.1   5.611  49084.92
            Velocity Head Correction Factor (alpha): 1.157
 --------- -- ---------- ------- ------ ------- ------ ------ ------- ---------
   ER

    ******************  Normal end of WSPRO execution.  *****************
    **************  Elapsed Time:   0 Minutes  1 Seconds  **************
```

Scour Calculations

CONTRACTION SCOUR

Determine if it is live-bed or clear-water scour.

$$V_C = 11.17\ y^{1/6}\ D_{50}^{1/3}$$

Where:

$$y = \text{depth of flow} = \frac{A_{ch\text{-}appr}}{Topw_{appr}} = \frac{354}{64} = 5.53\ \text{ft}$$

$$D_{50} = 0.0002\ \text{m},\ \text{(assumed a reasonable value)}$$

$$Vc = 11.17\ (5.53)^{1/6}\ (0.0002\ \text{m} * 3.28\ \text{ft/m})^{1/3} = 1.29\ \text{ft/s}$$

The average velocity in the channel equals:

$$V = \frac{Q_1}{A_{ch}}$$

Where:

$$Q_1 = Q_{total}\left(\frac{K_1}{K_{total}}\right) = 1000\left(\frac{19297.76}{51664.58}\right) = 373.52\ \text{ft}^3/\text{s}$$

$$A_{ch} = 354$$

$$V = \frac{373.5}{354} = 1.06\ \text{ft/s}$$

Vc > V; therefore, the flow condition will be clear-water.

CONTRACTION SCOUR CONTD.

Clear-Water Contraction Scour:

$y_s = y_2 - y_0$:

$$y_2 = \left[\frac{0.0077 (Q)^2}{(D_m)^{2/3} (W_{contracted})^2} \right]^{3/7}$$

Where :

$D_m = 1.25 \times D_{50} = 1.25 \left(0.0002 \text{ m} * 3.28 \text{ ft/m}\right) = 0.00082 \text{ ft}$

$Q = 1000 \text{ ft}^3/\text{s}$, (discharge through the bridge)

$W = 44.48 - 3 \left(1.33\right) = 40.49 \text{ ft}$

$$y_2 = \left[\frac{0.0077 (1000)^2}{(0.00082)^{2/3} (40.49)^2} \right]^{3/7} = 14.78 \text{ ft}$$

$$y_0 = \frac{A_{BR}}{TOPW_{BR}} = \frac{405}{79.9} = 5.06 \text{ ft}$$

$y_s = y_2 - y_0$

$= 14.78 \text{ ft} - 5.06 \text{ ft}$

$y_s = 9.72 \text{ ft}$

PIER SCOUR

$$\frac{y_S}{y_1} = 2.0\ K_1 K_2 K_3 K_4 \left(a/y_1\right)^{0.65} F_{r_1}^{\ 0.43}$$

Where:

for a round-nose pier, alighned with the flow,

sand-bed material:

$K_1 = K_2 = K_4 = 1.0$

for plane-bed condition

$K_3 = 1.1$

$V = 2.93$ ft/s

$y_1 = 6.85$ ft

$$F_{r_1} = \frac{V}{\left(g\, y_1\right)^{0.5}} = \frac{(2.93)}{\left[(32.2)(6.85)\right]^{0.5}} = 0.197$$

$$\frac{y_S}{6.85} = 2.0\ (1)\ (1)\ (1.1)\ (1)\ (1.33/6.85)^{0.65}\ (0.197)^{0.43}$$

$$y_S = 2.58 \text{ ft}$$

TOTAL SCOUR:

$$9.72 \text{ ft} + 2.58 \text{ ft} = 12.30 \text{ ft}$$

Off-System Bridge Rehabilitation & Replacement Program
Bridge Hydraulic Data Form

STATE PROJECT NO.: 713-42-0000

PARISH: RICHLAND

STRUCTURE NO.: P42-32196-91474-1

PREPARED BY: J. K.

DATE: 2005

STREAM NAME: LITTLE CREEK

BEGINNING STATION: 37+60

FINISH GRADE ELEV. (ft): 66.93

BRIDGE LENGTH (ft): 80

LOW ROADWAY ELEVATION (ft): 64.48

NOTE: THE FOLLOWING HYDRAULIC DATA TABLE IS TO BE PLACED ON THE PLANS.

HYDRAULIC DATA TABLE

Drainage Area (mi^2): 19.64					
Basin Slope (ft/mi): 3.02				PREDICTED SCOUR	
Flood Frequency (years)	Design Year (5)	Design Year (5)	100	Flood Frequency (years)	5
Discharge (ft^3/s)	1000	1000	2100	Discharge (ft^3/s)	1000
Structure	Existing Bridge	Proposed Structure	Proposed Structure	Contraction Scour Depth (ft)	9.72**
Size & Type	52 ft bridge	80 ft bridge	80 ft bridge		
Design Water Surface Elev. (ft/MSL)	65.93*	65.75*	67.86*	Maximum Pier Scour Depth (ft)	2.58**
Average Velocity (ft/s)	2.48	2.46	5.17		
Area of Opening (ft^2)	300	406	406	Abutment Scour Depth (ft)	protected
Backwater (ft)	0.439	0.243	0.870	Bridge Scour Elevation (ft)	53.40

REMARKS: * Includes backwater; does not reflect roadway overtopping
Flexible revetment is recommended to 5 ft outside the fascia of the structure on the upstream and downstream sides

SCOUR: ** Since there is no evidence of past scour at the site and the velocity is low, a minimum total scour depth of 5 ft is recommended.

EXISTING BRIDGE: 4-span timber bridge, 52 feet total length

DETOUR BRIDGE: not required

2005